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DisConnect: Characterisation of Screen Use and Perception of Health Problems in Students from Aveiro, Portugal – A Cross-Sectional Study

Fábio Sousa Gomes[a] José Chen-Xu[b, c] Cristina Conceição[d] Fátima Claro[e] Emídio Abrantes[d] Dulce Seabra[f]

[a]Unidade de Saúde Pública, Unidade Local de Saúde da Região de Leiria, Leiria, Portugal; [b]Unidade de Saúde Pública, Unidade Local de Saúde do Baixo Mondego, Figueira da Foz, Portugal; [c]Comprehensive Health Research Centre (CHRC), Public Health Research Center, Escola Nacional de Saúde Pública, Universidade NOVA de Lisboa, Lisbon, Portugal; [d]Centro de Respostas Integradas de Aveiro, Instituto para os Comportamentos Aditivos e as Dependências, Aveiro, Portugal; [e]Unidade de Cuidados na Comunidade Farol do Mondego, Unidade Local de Saúde do Baixo Mondego, Figueira da Foz, Portugal; [f]Unidade de Saúde Pública, Unidade Local de Saúde da Região de Aveiro, Aveiro, Portugal

Keywords
Digital literacy · Digital health · Public health · Epidemiology · Screen use

Abstract

Introduction: Digitalisation has made technologies an important vehicle for development and learning, especially for children and young people. However, multiple risks of excessive or inappropriate use have been described. This study aimed to characterise the use of screens in young Portuguese students and the association with perceived health problems in the Aveiro municipality. ***Methods:*** A cross-sectional study was conducted between September 2019 and April 2020 on students enrolled in schools in the Aveiro municipality of Portugal through a questionnaire applied to 4th, 6th, and 8th graders. A descriptive analysis characterised the screen use, while logistic regressions were utilised to assess association with perceived health outcomes. ***Results:*** Four of the 989 students who responded to the questionnaire (0.4%) reported not using any screen device. Around 57% of students reported not taking any device to school. Screen time spent during weekdays was associated with higher reduction in physical activity (adjOR = 2.54, p = 0.019). Receiving a device between 0 and 5 years old showed positive association with body pain (adjOR = 1.62, p = 0.034), and using screens at school was associated with more problems at home (adjOR = 2.04, p = 0.01). Screen use during meals and having screens in the bedroom during sleep were consistently associated with a more negative perception of health outcomes. ***Discussion:*** Literature points to a multitude of possible health consequences regarding inadequate or excessive screen use, but most data are based on small samples and a limited number of observations. This is one of the first studies describing screen use among young schoolgoers in Portugal and the first using a big representative sample of Aveiro students. Our study gives some insight on the screen habits of young people in Portugal and demonstrates that some habits can have impact on important aspects such as physical activity, body pain, and family dynamics. ***Conclusion:*** Screen use and screen habits have important consequences in multiple aspects of health. Systematic data collection on screen use and its

karger@karger.com
www.karger.com/pjp

Correspondence to:
José Chen-Xu, josechenx@gmail.com

impact on health, including mental health, among schoolgoers is essential, particularly to understand long-term effects and allow effective prevention strategies.

DisConnect: Caracterização do uso de ecrãs e perceção de problemas de saúde em estudantes de Aveiro, Portugal – um estudo transversal

Palavras Chave
Literacia digital · Saúde digital · Saúde pública · Epidemiologia · Uso de ecrãs

Resumo

Introdução: A digitalização fez das tecnologias um importante veículo de desenvolvimento e aprendizagem, sobretudo para crianças e jovens. Porém, a literatura descreve múltiplos riscos do uso excessivo ou inadequado. Este estudo pretendeu caracterizar o uso de ecrãs numa população de estudantes do município de Aveiro, e estudar associação com problemas de saúde. ***Métodos:*** Estudo transversal, desenvolvido entre setembro de 2019 e abril de 2020, numa amostra de alunos matriculados no 4.°, 6.° e 8.° anos, em escolas do município de Aveiro. A recolha de dados foi realizada através de questionário. A caracterização do uso de ecrãs foi realizada por análise descritiva, enquanto a associação com aspetos de saúde foi estudada por regressão logística. ***Resultados:*** Quatro dos 989 estudantes (0.4%) referiram não usar dispositivos com ecrãs. Cerca de 57% referiram não levar ecrãs para a escola. Maior tempo de ecrã durante a semana demonstrou associação com maior redução de atividade física (adjOR = 2.54, p = 0.019). Receber um primeiro dispositivo até aos 5 anos apresentou associação positiva com dor corporal (adjOR = 1.62, p = 0.034), e o uso de ecrãs na escola apresentou associação com problemas familiares (adjOR = 2.04, p = 0.01). O uso de ecrãs durante refeições e a sua presença no quarto durante o sono, relacionaram-se com uma perceção geral mais negativa das questões de saúde. ***Discussão:*** Os estudos apontam várias consequências de saúde decorrentes do uso excessivo ou inadequado dos ecrãs, mas a maioria baseia-se em amostras pequenas ou num número limitado de observações. Este é um dos primeiros estudos sobre o uso de ecrãs entre estudantes Portugueses, e o primeiro a usar uma amostra de grande dimensão, representativa da população escolar de Aveiro. Fornece informação respeitante a hábitos de uso de ecrãs, e demonstra associação com questões importantes para a saúde, como atividade física, dor corporal e aspetos da dinâmica familiar. ***Conclusão:*** O uso de ecrãs e os hábitos de utilização têm associação com múltiplos aspetos relevantes para a saúde das crianças e jovens em idade escolar. É essencial promover recolha sistemática de dados, e estudar os potenciais impactes na saúde (incluindo saúde mental) para compreender os efeitos a longo prazo e permitir intervenção efetiva.

Introduction

Worldwide, it is estimated that around 5.2 billion people (64%) use the Internet, 5.4 billion (68%) own a phone, and 4.8 billion (59%) use social media [1]. In Portugal, it is estimated that 8.7 million (85%) use the Internet, and 10.1 million (98.2%) have a cellphone. The Portuguese user spends an average of 7 h and 37 min per day connected to the Internet, mainly at the expense of social networks. Around 8.1 million (79%) are active users of social media, with an average daily use of more than 2 h [2].

Young people are the main user group. Around 90% have access to the Internet, with an average use of 3 h per day [3]. Access and use increase with age (38% between 3 and 8 years old, 62% between 6 and 8 years old) [3, 4]. In 2019, 87% used a smartphone every day (compared to just 35% in 2014) and 73% used social media daily [3]. The average age at which younger people start using the Internet is currently under 10 years old [5], which represents an important generational gap in relation to their respective parents, whose initiation occurred on average after the age of 20 [6].

The digitalisation of the world has made technologies an important vehicle for development and learning, especially for children and young people. On the other hand, daily life has become, in many aspects, dependent on screens and the Internet, meaning technologies are important for social integration and personal and professional development [1, 7]. However, in parallel with the recognised benefits, there is an increasing number of studies highlighting possible risks related to excessive or inappropriate use. Exposure to content related to alcohol, tobacco, and sexual activity through the media encourages earlier initiation of these behaviours [7, 8]. Internet has also become

a means of disseminating trends and challenges that can directly compromise health and physical integrity, of which the "Blue Whale Challenge" and "Momo Challenge" are examples [9–11]. Indirectly, the use of screens has been associated with overweight and obesity, postural changes, vision problems, sleep disorders, and also issues related to behaviour, learning, and mental health, especially in children and young people [9–12].

The risk of addiction was already recognised by the World Health Organization (WHO) through the inclusion of Internet Gaming Disorder in the 11th revision of the International Classification of Diseases (ICD-11) [13, 14]. The American Psychiatric Association included Internet addiction and online gaming addiction in the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), listing them as problems requiring further investigation [15].

However, there are no national or local studies in Portugal that allow us to know the prevalence of problems related to the use of screens or the Internet in young people. Therefore, this study aimed to characterise the use of screens and the Internet in young people and the associated health problems in the Aveiro municipality.

Materials and Methods

Study Design

A cross-sectional study was conducted between September 2019 and April 2020 by applying a questionnaire to students enrolled in the 4th, 6th, and 8th school years in the Aveiro municipality of Portugal. The study is reported in adherence to the STROBE statement (online suppl. File 1; for all online suppl. material, see https://doi.org/10.1159/000542198).

Sampling

The municipality of Aveiro has a territorial area of 197.58 km^2 and a population of 78,734 inhabitants [16, 17]. The schools of Aveiro municipality include seven school groups (AE) and one non-grouped school, in a total of 44 educational institutions. The school population, at the date of the assessment carried out for this study, contained 11,375 students, 1,037 teachers, and 585 non-teaching staff. Of the total number of students, 7,336 attended primary school [18]. The sample of this study comprised 992 students, being representative of the school population of the municipality of Aveiro, considering the size of the population equivalent to the enrolled students, a margin error of 5%, a confidence interval of 95%, and a maximum estimated prevalence value of 50% (as it is unknown).

Data Collection

In the absence of information that would allow for a targeted situation diagnosis, a data collection questionnaire was developed to locally characterise the use of screens and the Internet (online suppl. File 2). The questions included in the questionnaire were based on the available national and international bibliography, as well as pre-existing questionnaires validated for the Portuguese population. The questionnaire was subjected to assessment by a multidisciplinary team with experience and knowledge in the area and involved in the construction and application of the previously mentioned questionnaires. A pre-test application of the final questionnaire was carried out for a sample of students.

Study Variables

Several variables were selected, including demographic data relating to gender, age, group of schools belonging to and school year. Additionally, data on screen use were collected, including location of use, frequency, time of use during the week and the weekend, and the purpose of use. Questions related to screen habits were also obtained, including use after waking up or before going to sleep.

As dependent variables, the perception of students regarding the impact of their screen use on time spent with family and friends, physical exercise, sleep hygiene, physical pain, and vision problems. The questionnaire provides greater detail on the variables under study (online suppl. File 2).

Statistical Analysis

A descriptive analysis of the sample was carried out. Categorical variables were presented as absolute and relative values, and continuous variables as mean and standard deviation. For the association analysis, continuous variables, such as age and age at first device, were converted to categories of similar size, recurring to a k-means analysis. These were added to account for differences in student groups.

A bivariate analysis was performed to test the association between the dependent and the independent variables. Finally, multivariate analysis was performed using logistic regression to evaluate the predictive factors that contributed to the existence of health problems. For dichotomous variables with the categories "yes" and "no," the category "no" was used as reference. The variables with a p value <0.20 in the bivariate analysis were selected for the multivariate logistic regression model, resulting in crude and adjusted odds ratio (OR), 95% confidence intervals (CIs), and p values with a significance level of 0.05. The latter was performed using a stepwise methodology.

Table 1. Characterisation of the sample of students surveyed

Variable	Mean (standard deviation)	
Continuous variables		
Age (n = 989)	10.7 (1.6)	
Age at first device (n = 989)	7.1 (2.2)	
Variable	**Categories**	***n*** **(%)**
Categorical variables		
Sex (n = 989)	Female	494 (49.9)
	Male	495 (50.1)
School year (n = 989)	4th Year	450 (45.5)
	6th Year	359 (36.3)
	8th Year	180 (18.2)
School group (n = 989)	Aveiro	476 (48.1)
	Eixo	170 (17.2)
	José Estêvão	293 (29.6)
	Rio Novo do Príncipe	50 (5.1)

This process was repeated for each of the outcomes. All missing values were excluded from the inferential analysis. Data were analysed using IBM SPSS Statistics® version 28.

Results

Characterisation of the Sample

The questionnaire was applied to 992 students in the 4th, 6th, and 8th school years in four AE in the municipality of Aveiro (Aveiro, Eixo, José Estêvão, and Rio Novo do Príncipe). Three questionnaires were invalidated, resulting in a total of 989 valid questionnaires. The number of male and female (50%) students was equivalent. The average age was 11 years. The students were mostly in the 4th year (45.5%), followed by the 6th (36.3%) and the 8th year (18.2%). The majority of students belonged to AE Aveiro (48.1%), followed by AE José Estêvão (29.6%), AE Eixo (17.2%), and AE Rio Novo do Príncipe (5.1%). The sample characterisation can be found in Table 1.

Characterisation of the Use of Screens and the Internet

Only four of the 989 students who responded validly to the questionnaire reported not using any screen device. Of the remaining 985 (99.6%), only three did not have at least one device of their own (Table 2). The most used devices were the cellphone (88%), the tablet (67%), and the laptop (64%) (online suppl. Table S1). More specific details can be found in online supplementary Table S1, and a distribution by school year is present in online supplementary Table S2.

Most children received their first device around 7 years of age (Table 1), and 10% received their first device before the age of 5. Around 57% of students reported not taking any device with them to school (Table 2), although there was significant disparity between school years (online suppl. Table S2). In the 4th year, only 2% of students took devices with them to school, rising to 75% and 83% in the 6th and 8th years, respectively. In general, the use of devices within the classroom was not permitted in the 4th year of schooling, with a tendency towards greater permission in the 6th and 8th years, depending on the teacher or class subject.

Most guardians (90%) somehow controlled students' interaction with screens, regardless of the year of schooling, although with a tendency towards increasing autonomy with advancing age. The "parental control" methodology varied, with controlling the time spent in front of screens coming first for 4th and 6th years and establishing rules/advice coming first for 8th year (online suppl. Table S2).

Only 39% of students reported spending less than 2 h in front of screens on a typical weekday. Around 12% reported spending more than 6 h per day in front of screens (Table 2). Screen viewing time increased as schooling progressed and was significantly higher on weekends (online suppl. Table S2).

The main place where screens were used was the student's home. The type of main activity varied depending on age, with gaming predominating among younger students and social media among older students (online suppl. Table S2).

With regard to food, more than 90% of students ate at the table with their family, regardless of their year of schooling. The majority (91%) did not use screens during meals. However, 49% reported frequently eating or drinking in front of screens, with a variation between 41% in the 4th year and 65% in the 8th year. The most frequently consumed foods were fruit (53%), sweets (51%), bread (44%), and juices (43%), with differences between years of schooling. At the same time, more than 25% of students in each year of schooling reported that their use of screens and the Internet diminished their time for physical activity (online suppl. Table S2).

Regarding the impact of screens on students' daily lives, 18% reported that the use of screens reduces time spent with family, 12% reported that it reduces time spent with friends, and 21% reported that their use of screens often created problems at home. 16% reported that the use of screens interferes with academic success or the completion of school tasks (Table 2), reaching a maximum of 25% in 8th-year students.

Table 2. Characterisation of the screen use among students from Aveiro

Variable	Categories	*n* (%)
Use of screen devices	No	4 (0.4)
	Yes	985 (99.6)
Owns a screen device	No	3 (0.3)
	Yes	982 (99.7)
Takes screens to school	No	557 (56.5)
	Yes	428 (43.5)
Screens at the classroom	No	743 (75.1)
	Yes	8 (0.8)
	Depends	238 (24.1)
Parental control	No control	105 (10.6)
	Some control	591 (59.8)
	Control everything	293 (29.6)
Average daily time spent on screen activity on weekdays	<2	392 (39.5)
	2–4	333 (33.7)
	4–6	146 (14.8)
	6–8	64 (6.5)
	>8	54 (5.5)
Average daily time spent on screen activity on weekends	<2	167 (16.8)
	2–4	325 (32.9)
	4–6	218 (22.0)
	6–8	143 (14.5)
	>8	136 (13.8)
Preferential place of use	Home	827 (84.6)
	School	22 (2.2)
	Other	14 (1.4)
	No specific place	115 (11.8)
Family meals are shared at the table	No	79 (8.0)
	Yes	910 (92.0)
Takes screens to the meal table	No	897 (90.7)
	Yes	92 (9.3)
Eats or drinks while using screen devices	No	500 (51.3)
	Yes	474 (48.7)
Outcomes: perception of the impact of screen use		
Diminished physical activity	No	721 (72.9)
	Yes	268 (27.1)
Diminished family time	No	809 (81.8)
	Yes	180 (18.2)
Diminished time with friends	No	869 (87.9)
	Yes	120 (12.1)
Impact on school tasks or academic success	No	833 (84.2)
	Yes	156 (15.8)
Problems at home	No	779 (78.8)
	Yes	210 (21.2)
Screens in the bedroom while sleeping	No	334 (33.8)
	Yes	655 (66.2)

Table 2 (continued)

Variable	Categories	*n* (%)
Diminished sleep quality	No	680 (68.8)
	Yes	309 (31.2)
Body pain	Yes, in front of screens	52 (5.3)
	Yes, even without screens	32 (3.2)
	Yes, in the past	143 (14.5)
	Never	762 (77.0)
Sight changes	Yes, in front of screens	50 (5.1)
	Yes, even without screens	72 (7.3)
	Yes, in the past	48 (4.9)
	Never	819 (82.8)

As for sleeping habits, students reported sleeping an average of 9 h per night (9.4 h/night in the 4th year; 8.8 h/night in the 6th year; 8.3 h/night in the 8th year). The majority of students (66%) said they had screens in their bedrooms while sleeping, a percentage that increased as they progressed in school. The most frequent device was the cellphone (45%), surpassing the television (36%). 31% of students reported that screens disturbed their sleep. Taking a long time to fall asleep and needing screens to fall asleep were the main disorders identified (Table 2).

Regarding organic problems, 77% of students reported never having felt body pain associated with the use of screens, values that remained stable between years of schooling. Although 83% reported never having suffered from vision changes associated with the use of screens (Table 2), this percentage decreased as the year of schooling progressed, with a gradual increase in the proportion of past or current complaints (online suppl. Table S2).

Some questions were specifically related to signs indicating inappropriate or excessive use of screens (red flags). In this context, 32% stated that they spent most of their free time in front of screens; 29% acknowledged feeling worried or irritable when they needed to be away from screens; 29% stated that it was common for them to receive comments regarding their excessive use of screens; and 10% admitted lying or avoiding talking about their screen use. Around 15% stated that they started using screens immediately after waking up, and 44% stated that they continued using screens until they fell asleep (online suppl. Table S1). The frequency of these phenomena increased with school year.

Association Analysis

Eight different models were created to test the association between students' characteristics or behaviours and their perception of the impact of screen use in different dimensions. The association between independent variables and the perception of impact on physical activity was analysed through bivariate analysis and multivariable logistic regression (Table 3). The bivariate model showed significant positive association with children's age (between 10 and 12 years old) (OR = 1.48, 95% CI: 1.00–2.19, $p = 0.048$) and with the use of screens during meals (OR = 1.66, 95% CI: 1.06–2.60, $p = 0.027$), whereas there was a negative association with having screens in the bedroom (OR = 0.69, 95% CI: 0.51–0.94, $p = 0.019$) and with time spent in front of screens during the weekend, especially in the intermediate groups – the ones that spent between 2 and 4 h (OR = 0.47), between 4 and 6 h (OR = 0.57), and between 6 and 8 h (OR = 0.52). The multivariate model confirmed the association with the same three groups of screen use during the weekend, with two additional significant ones: a positive association with the time spent during weekdays (6–8 h: adjOR = 2.54, 95% CI: 1.17–5.52, $p = 0.019$) and a negative one with the AE José Estevão (adjOR = 0.43, 95% CI: 0.21–0.86, $p = 0.017$).

When analysing the influence of screen use on the time spent with family (online suppl. Table S3), female sex (OR = 0.61, 95% CI: 0.44–0.85, $p = 0.003$), time spent in front of screens during weekdays (2–4, 4–6 and 6–8 h) and weekends (2–4 and 4–6 h) showed a negative association, whereas the use of screens during meals contributed positively to decrease time spent with family. The multivariate analysis further confirmed the associations with sex (adjOR = 0.67), time spent on weekends (2–4 h: adjOR = 0.40; 4–6 h: adjOR = 0.42; 6–8 h: adjOR = 0.71), and usage during meals (adjOR = 0.61).

The impact on time spent with friends was also analysed (online suppl. Table S4), and the variables which showed a negative association were female sex (OR = 0.66), 10–12 age group (OR = 0.50), and eating meals with

Table 3. Association between characteristics and behaviours regarding screens, and the perception of lower physical activity

Variable	OR	95% CI	*p* value	adjOR	95% CI	*p* value
Sex (ref: male)	0.94	0.71–1.25	0.682			
Age, years						
13–15 (ref)	1					
10–12	1.48	1.00–2.19	0.048			
8–9	1.22	0.88–1.67	0.230			
School cluster						
Aveiro (ref)	1			1		
Eixo	0.70	0.38–1.30	0.260	0.61	0.33–1.13	0.114
José Estevão	0.53	0.27–1.04	0.066	**0.43**	0.21–0.86	0.017
Rio Novo do Príncipe	0.62	0.33–1.17	0.143	0.54	0.28–1.03	0.062
Owning a device (≥1)	1.21	0.71–2.07	0.483			
Age of first device, years						
9–14 (ref)	1					
6–8	0.85	0.56–1.29	0.443			
0–5	0.95	0.66–1.35	0.760			
Takes device to school	1.16	0.87–1.53	0.317			
Uses device at school	1.02	0.74–1.41	0.913			
Parental control						
Do not control (ref)	1					
Some level of control	1.43	0.88–2.31	0.148			
Control everything	1.03	0.75–1.42	0.842			
Time spent in front of screens in weekdays, h						
<2 (ref)	1			1		
2–4	1.07	0.55–2.07	0.851	2.15	0.98–4.74	0.058
4–6	1.10	0.56–2.15	0.784	2.04	0.95–4.35	0.066
6–8	1.59	0.78–3.25	0.20	**2.54**	1.17–5.52	0.019
>8	1.54	0.68–3.47	0.298	1.81	0.79–4.19	0.164
Time spent in front of screens during the weekend days, h						
<2 (ref)	1			1		
2–4	0.47	0.29–0.79	0.004	**0.39**	0.21–0.74	0.005
4–6	0.57	0.37–0.88	0.010	**0.47**	0.27–0.80	0.007
6–8	0.52	0.33–0.83	0.006	**0.43**	0.25–0.74	0.003
>8	0.77	0.47–1.26	0.290	0.65	0.38–1.11	0.118
Place where screens are used the most						
Home (ref)	1					
School	0.85	0.56–1.28	0.437			
Unspecified/other	0.52	0.16–1.62	0.257			
Eats meals with family	1.11	0.65–1.87	0.710			
Use screens during meals	1.66	1.06–2.60	0.027	0.68	0.42–1.09	0.110
Screens in the bedroom while sleeping	0.69	0.51–0.94	0.019			

Bold indicates statistically significant vlaues.

family (OR = 0.47), whereas the use of screens during meals had a positive association (OR = 1.90, 95% CI: 1.09–3.30). In the multivariate analysis, the 8–9 age group had a positive association (adjOR = 1.95, 95% CI: 1.19–3.19, $p = 0.008$), as well as taking devices to school (adjOR = 1.94, 95% CI: 1.18–3.20, $p = 0.009$), while having screens in the bedroom showed a negative association (adjOR = 0.63, 95% CI: 0.40–0.99, $p = 0.045$).

The analysis on the perceived impact on school tasks (online suppl. Table S5) showed multiple variables with significant results in the bivariate model, such as lower age groups, taking devices to school, and time spent on screens in both weekdays and weekends. The multivariable model showed that age groups were positively associated with the outcome, with the 10–12 age group having an adjOR of 3.08 (95% CI: 1.85–5.13, $p < 0.001$), and the 8–9 one with an adjOR of 2.04 (95% CI: 1.30–3.19, $p = 0.002$). Negative associations were found with the usage of screens during meals (adjOR = 0.35, 95% CI: 0.21–0.57, $p < 0.001$) and the presence of screens in the bedroom (adjOR = 0.53, 95% CI: 0.33–0.82, $p = 0.005$).

Regarding the perceived worsening of problems at home (online suppl. Table S6), the multivariate regression showed positive significant values with the use of screens at school (adjOR = 2.04, 95% CI: 1.19–3.51, $p = 0.01$), whereas negative values were found in the intermediate groups of time spent during weekends (adjOR between 0.34–0.55) and with the use of screens during meals (adjOR = 0.51, 95% CI: 0.32–0.82, $p = 0.005$).

Associations with sleep issues were also analysed (online suppl. Table S7). In the bivariate model, time spent on weekdays (OR = 0.32–0.47) and weekends (OR = 0.33–0.59) had negative associations, as well as eating meals with family (OR = 0.57) and having a screen in the bedroom (OR = 0.47). Using screens during meals contributed positively to the outcome (OR = 2.30). The multivariate analysis showed negative associations with belonging to the AE Rio Novo do Príncipe (adjOR = 0.45, $p = 0.016$), as well as spending 4–6 h during weekends in front of a screen (adjOR = 0.42, $p < 0.001$), using screens during meals (adjOR = 0.52, $p = 0.006$), and having a screen in the bedroom (adjOR = 0.50, $p < 0.001$).

Association with body pain was analysed through regression models (Table 4). Bivariate models showed a negative association with receiving the first screen device at younger ages (OR = 0.57–0.69) and spending 4–6 h in front of screens during weekend days (OR = 0.51). In the multivariate regression, receiving a device between 0 and 5 years old showed a positive association (adjOR = 1.62, $p = 0.034$), while spending between 2–4 h (adjOR = 0.44, $p = 0.016$) and 4–6 h (adj = 0.31, $p < 0.001$) in front of screens had a negative association with body pain.

When analysing the association with eyesight problems (online suppl. Table S8), being younger than 12 years old had a positive association (OR = 1.92 for 10–12 years old and OR = 1.55 for 8–9 years old), as well as receiving the first device between 6 and 8 years old (OR = 1.65) and using them during meals (OR = 1.70). Having screens at the bedroom while sleeping (OR = 0.57) and spending screen time during the weekend (OR = 0.25–0.51) showed negative associations. Further analysis with the multivariate regression confirmed the negative association with the time spent during the weekend, namely, for 2–4 h (adjOR = 0.27, $p < 0.001$), 4–6 h (adjOR = 0.47, $p = 0.003$), and 6–8 h (adjOR = 0.54, $p = 0.019$).

Discussion

Digital technologies, the Internet, and screen devices have changed our way of life. However, there remains a lack of data that allows an adequate characterisation of the consequences of this widespread use for safety and, even more so, for health. Studies have been multiplying but have limitations, sometimes due to their small samples or methodological flaws, and there is a lack of systematic reviews and meta-analyses. Most countries do not have specific coding for problems related to the use of screens and the Internet, which makes access to uniform and reliable information difficult. The present study provides important data on the use of screens by young Portuguese schoolgoers.

This study showed that screen use during meals was positively associated with several health dimensions, including diminished time with family and friends, neglecting school tasks, and sight problems. Using screens during meals may disrupt healthy eating habits and family interactions, just as described in the literature. It influences eating habits and physical activity, with a consequent association with overweight and obesity [19, 20]. On the other hand, watching screens is mostly a sedentary activity. It is often associated with the consumption of high-calorie foods with low nutritional value [21]. Advertising content viewed while browsing is also a stimulus for this type of consumption [21, 22].

Having screens in the bedroom was consistently associated with negative impact on the time spent with friends, school tasks, and sleep. Evidence also suggests a negative impact on the quantity and quality of sleep [23–25]. While the excessive use of screens can directly reduce sleep time, the presence of devices in the bedroom during sleep, exposure to blue light from screens before falling asleep, and pre-sleep stimulation can also result in changes in melatonin levels, delay the onset of sleep, cause irregular sleep cycles, and lead to nighttime or premature awakenings [22–26].

Receiving devices at a younger age was associated with increasing body pain. Incorrect screen viewing postures can lead to acute musculoskeletal pain [27]. However, chronic

Table 4. Association between characteristics and behaviours regarding screens and the perception of body pain

Variable	OR	95% CI	*p* value	adjOR	95% CI	*p* value
Sex (ref: male)	1.04	0.77–1.40	0.807			
Age, years						
13–15 (ref)	1					
10–12	1.05	0.69–1.61	0.816			
8–9	1.13	0.81–1.58	0.463			
School cluster						
Aveiro (ref)	1					
Eixo	1.09	0.54–2.20	0.808			
José Estevão	1.24	0.58–2.63	0.578			
Rio Novo do Príncipe	0.91	0.44–1.89	0.806			
Owning a device (≥1)	0.82	0.49–1.39	0.465			
Age of first device, years						
9–14 (ref)	1			1		
6–8	0.57	0.37–0.88	0.011	1.13	0.76–1.67	0.552
0–5	0.69	0.48–0.99	0.045	**1.62**	1.04–2.52	0.034
Takes device to school	1.04	0.77–1.41	0.778	1.53	0.78–3.01	0.213
Uses device at school	0.95	0.68–1.34	0.788			
Parental control						
Do not control (ref)	1					
Some level of control	1.13	0.67–1.91	0.641			
Control everything	1.02	0.73–1.42	0.916			
Time spent in front of screens in weekdays, h						
<2 (ref)	1			1		
2–4	0.79	0.41–1.52	0.483	1.74	0.78–3.89	0.174
4–6	1.00	0.52–1.92	0.988	1.54	0.72–3.29	0.265
6–8	0.77	0.37–1.59	0.481	0.98	0.44–2.17	0.958
>8	0.59	0.24–1.44	0.25	0.62	0.25–1.56	0.311
Time spent in front of screens during the weekend days, h						
<2 (ref)	1					
2–4	0.61	0.36–1.04	0.069	**0.44**	0.23–0.86	0.016
4–6	0.51	0.32–0.81	0.005	**0.31**	0.17–0.56	<0.001
6–8	0.95	0.60–1.53	0.844	0.77	0.44–1.33	0.345
>8	0.75	0.44–1.28	0.287	0.71	0.40–1.26	0.242
Place where screens are used the most						
Home (ref)	1					
School	0.86	0.561	0.509			
Unspecified/other	0.86	0.295	0.79			
Eats meals with family	0.94	0.546	0.809			
Use screens during meals	1.45	0.9	0.127	0.71	0.43–1.18	0.186
Screens in the bedroom while sleeping	0.89	0.646	0.456			

Bold indicates statistically significant vlaues.

changes such as persistent cervical pain, headaches, and changes in spinal alignment may appear. Prolonged use favours increased stiffness of the cervical muscles and accentuation of thoracic kyphosis [28], which are more notorious in older adolescents who have been using devices for longer time, as noted in our study.

Several factors contributed to worsening sight: younger age groups, receiving devices between 6 and 8 years old, and

screen use during meals. Excessive brightness increases the risk of computer vision syndrome. This concerns a set of symptoms that usually appear during or after long periods of screen viewing (tiredness, irritation, dryness, blurred vision, double vision, headaches) [29, 30]. These are usually acute, although chronic changes may appear. In children, screens can anticipate the need for optical correction [20, 22, 30].

Use of screens in younger age groups was associated with higher perceived impact on school tasks and time spent with friends. Taking devices to school was also linked to a perception of decreased time with friends. Excessive or inappropriate use of the Internet has been associated with disorders in affective development, deficits in social skills, changes in behaviour, difficulty in acquiring communication and learning skills, and delayed capacity for autonomy [31, 32]. These effects are more frequent when problematic use is established early in life.

The literature highlights objective risks to health and safety arising from excessive or inappropriate use of screens. Although multifactorial, the emergence of these problems is mostly influenced by behavioural determinants, linked to habits and lifestyle. Thus, some caution must be paid for when interpreting these results, as other factors might be present, which might not have been accounted for. Nevertheless, it is known that behavioural determinants are influenced by the level of education and literacy, which makes them vulnerable to intervention in this way. The school environment has been reinforced as particularly conducive to effective intervention strategies in this field [33, 34]. At an international level, UNICEF recommends teaching "digital literacy to children in schools" [35]. At the national level, many priorities highlighted in the National Health Plan and the National School Health Program may be linked to the use of screens (diet and physical activity, sleeping habits, postural education, mental health, and prevention of substance-free addiction) [36, 37].

The Portuguese Society of Neuropediatrics has recently published recommendations for the good use of digital technologies, aligned with the scientific evidence accumulated to date and the experience of paediatric neurologists in Portugal. Among other recommendations, it is mentioned that screen time should be limited depending on age (avoid exposure until the age of 3, less than 30 min per day between the ages of 4 and 6, less than 1 h per day between the ages of 7 and 11, less than 2 h per day between 12 and 15 years old); there should be no use of screens during meals at any age; screens should not be present in the bedroom at night; screens should be avoided at schools up to the age of 6 [38]. Thereby, this study demonstrates the existence of inappropriate use of screens at the local level.

Regarding intervention in this area, initiatives have been growing in number and prominence, both nationally and internationally. However, they are often based on strategies that are not evidence-based or are implemented in an isolated and poorly structured way. Thus, following the results of this study, the project "DisConnect – Promotion of Healthy and Safe Use of Screens" was created by the Public Health Unit of the Primary Healthcare Cluster of Baixo Vouga, ensuring evidence-based intervention of both health professionals and security forces in close collaboration. It is also intended that "DisConnect" migrates to school curricula, requiring the implementation of objective and standardised measures across schools, if possible, through involvement of the government itself.

Limitations

The present study has several limitations. Given its transversal nature, it is not possible to evaluate incidences nor to assess causal associations. The data were collected between September 2019 and April 2020. The first cases of COVID-19 in Portugal were reported in March 2020, demanding the subsequent reorganisation of the public health services and its activities. Additionally, the pandemic context may have influenced the participation of schools in the study, which could lead to selection bias. However, most of the data had already been collected by the time the first cases were detected.

Regarding the questionnaire, a "pre-test" application was carried out. Using the online route allowed data collection to be faster, with simultaneous application in several classes and with delegation of monitoring to teachers, after training. Despite the validation of the instrument, this is fallible, presenting information bias. Some questions may also have induced responses in a certain direction, for example, through social desirability. Because of geographical disparities, these results may not accurately reflect the entire country's population of schoolgoers.

Final Remarks

This study presents data on the use of digital devices and the Internet, based on a big representative sample of students in the Aveiro municipality, presenting one of the first studies in Portugal on this topic. It is increasingly recognised that digital technologies present risks and benefits. While it is important to prevent excessive or inappropriate use, it is equally important that children are familiar with these tools and know how to use them naturally for practical and useful everyday purposes.

Therefore, prohibitive recommendations, focused only on-screen time, are outdated and inappropriate. Current recommendations focus mainly on the need for supervision, the establishment of rules and dialogue, which makes their application more difficult to evaluate objectively and quantitatively. The results of this study are important to highlight the aspects to which health services should pay more attention regarding screen habits and its possible health consequences. This can help drive effective interventions, of which "DisConnect" may be a good example for dissemination and development.

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Statement of Ethics

The study protocol of DisConnect was reviewed and approved by Comissão de Ética da Administração Regional de Saúde do Centro. Written informed consent was obtained from participants and their parent/legal guardian/next of kin to participate in the study.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

Authorship criteria are in accordance with the guidelines established by the ICMJE in the "Statement on Authorship and Contribution." Fábio Sousa Gomes, José Chen-Xu, Cristina Conceição, Fátima Claro, Emídio Abrantes, and Dulce Seabra had a substantial and direct intellectual contribution to the design and preparation of the article; participated in the analysis and interpretation of data; participated in writing the manuscript, reviewing versions, and critically reviewing the content; approved the final version; and agreed that they are responsible for the accuracy and integrity of all work.

Data Availability Statement

All data generated or analysed during this study are included in this article and its supplementary material files. Further enquiries can be directed to the corresponding author.

References

1 Kemp S. Digital 2023: global overview report. DataReportal – Global Digital Insights; 2023 [cited August 24, 2023]. Available from: https://datareportal.com/reports/digital-2023-global-overview-report
2 Kemp S. Digital 2023: Portugal. DataReportal – global digital insights; 2023 [cited August 24, 2023]. Available from: https://datareportal.com/reports/digital-2023-portugal
3 Ponte C, Batista S. EU Kids Online Portugal: usos, competências, riscos e mediações da Internet reportados por crianças e jovens (9-17 anos). Lisboa: Faculdade de Ciências Sociais e Humanas. Universidade Nova de Lisboa; 2019.
4 Ponte C, Simões J, Baptista S, Jorge A. Crescendo entre ecrãs: usos de meios eletrónicos por crianças (3-8 Anos). Lisboa: Entidade Reguladora para a Comunicação Social (ERC); 2017.
5 Carapinha L, Calado V, Neto H. Comportamentos aditivos aos 18 anos: inquérito aos jovens participantes no Dia da Defesa Nacional 2021. Lisboa: Serviço de Intervenção nos Comportamentos Aditivos e nas Dependências (SICAD); 2022.
6 Simões J, Ponte C, Ferreira E, Doretto J, Azevedo C. Crianças e meios digitais móveis em portugal: resultados nacionais do Projeto Net Children Go Mobile. Lisboa: Faculdade de Ciências Sociais e Humanas. Universidade Nova de Lisboa; 2014.
7 Szymkowiak A, Melović B, Dabić M, Jeganathan K, Kundi GS. Information technology and Gen Z: the role of teachers, the Internet, and technology in the education of young people. Technol Soc. 2021;65:101565. https://doi.org/10.1016/j.techsoc.2021.101565
8 Livingstone S, Davidson J, Bryce J, Batool S. Children's online activities, risks and safety: a literature review by the UKCCIS Evidence Group. London: London School of Economics and Political Science (LSE); 2017.
9 Bozzola E, Spina G, Agostiniani R, Barni S, Russo R, Scarpato E, et al. The use of social media in children and adolescents: scoping review on the potential risks. Int J Environ Res Public Health. 2022;19(16):9960. https://doi.org/10.3390/ijerph19169960
10 Shutzman B, Gershy N. Children's excessive digital media use, mental health problems and the protective role of parenting during COVID-19. Comput Hum Behav. 2023;139:107559. https://doi.org/10.1016/j.chb.2022.107559
11 Council on Communications and Media; Brown A. Media use by children younger than 2 years. Pediatrics. 2011;128(5):1040–5. https://doi.org/10.1542/peds.2011-1753
12 Suris JC, Akre C, Piguet C, Ambresin AE, Zimmermann G, Berchtold A. Is Internet use unhealthy? A cross-sectional study of adolescent Internet overuse. Swiss Med Wkly. 2014;144:w14061. https://doi.org/10.4414/smw.2014.14061
13 Darvesh N, Radhakrishnan A, Lachance CC, Nincic V, Sharpe JP, Ghassemi M, et al. Exploring the prevalence of gaming disorder and Internet gaming disorder: a rapid scoping review. Syst Rev. 2020;9(1):68. https://doi.org/10.1186/s13643-020-01329-2
14 World Health Organization. ICD-11 - international classification of Diseases 11th revision. Geneva: World Health Organization; 2021 [cited February 20, 2023]. Available from: https://icd.who.int/en

15 American Psychiatry Association. Section III - measures and models, conditions for additional investigation. In: American Psychiatry Association. Statistic manual of mental disorders. 5th ed. Washington, DC: American Psychiatry Association; 2013. p. 795–8.
16 Portugal Ministério da Saúde. Unidade de Saúde Pública do Agrupamento de Centros de Saúde do Baixo Vouga (ACES BV). In: Plano Local de Saúde do Baixo Vouga 2016-2020: revisão 2019. Aveiro: Unidade de Saúde Pública do Agrupamento de Centros de Saúde do Baixo Vouga (ACES BV); 2019.
17 Instituto Nacional de Estatística. Portal do INE: estatísticas - população. Lisboa: Instituto Nacional de Estatística; 2023 [cited January 6, 2023]. Available from: https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_main
18 Portugal Ministério da Saúde. Agrupamento de Centros de Saúde do Baixo Vouga (ACES BV). In: Programa Nacional de Saúde Escolar: relatório de avaliação 2018/2019. Aveiro: Agrupamento de Centros de Saúde do Baixo Vouga (ACES BV); 2019.
19 Melchior M, Chollet A, Fombonne E, Surkan PJ, Dray-Spira R. Internet and video game use in relation to overweight in young adults. Am J Health Promot. 2014;28(5):321–4. https://doi.org/10.4278/ajhp.121023-ARB-515
20 Bener A, Al-Mahdi HS, Ali AI, Al-Nufal M, Vachhani PJ, Tewfik I. Obesity and low vision as a result of excessive Internet use and television viewing. Int J Food Sci Nutr. 2011;62(1):60–2. https://doi.org/10.3109/09637486.2010.495711
21 Börnhorst C, Wijnhoven TM, Kunešová M, Yngve A, Rito AI, Lissner L, et al. WHO European Childhood Obesity Surveillance Initiative: associations between sleep duration, screen time and food consumption frequencies. BMC Publ Health. 2015;15:442. https://doi.org/10.1186/s12889-015-1793-3
22 Council on Communications and Media. Media use in school-aged children and adolescents. Pediatrics. 2016;138(5):e20162592. https://doi.org/10.1542/peds.2016-2592
23 Hale L, Guan S. Screen time and sleep among school-aged children and adolescents: a systematic literature review. Sleep Med Rev. 2015;21:50–8. https://doi.org/10.1016/j.smrv.2014.07.007
24 Lund L, Sølvhøj IN, Danielsen D, Andersen S. Electronic media use and sleep in children and adolescents in western countries: a systematic review. BMC Publ Health. 2021;21(1):1598. https://doi.org/10.1186/s12889-021-11640-9
25 Paruthi S, Brooks LJ, D'Ambrosio C, Hall WA, Kotagal S, Lloyd RM, et al. Recommended amount of sleep for pediatric populations: a consensus statement of the American Academy of Sleep Medicine. J Clin Sleep Med. 2016;12(6):785–6. https://doi.org/10.5664/jcsm.5866
26 Huang Y, Zhao N. Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey. Psychiatry Res. 2020;288:112954. https://doi.org/10.1016/j.psychres.2020.112954
27 Straker LM, Coleman J, Skoss R, Maslen BA, Burgess-Limerick R, Pollock CM. A comparison of posture and muscle activity during tablet computer, desktop computer and paper use by young children. Ergonomics. 2008;51(4):540–55. https://doi.org/10.1080/00140130701711000
28 Prado CG. Social media and your brain: web-based communication is changing how we think and express ourselves. Westport, CT: Praeger; 2017.
29 Rosenfield M. Computer vision syndrome: a review of ocular causes and potential treatments. Ophthalmic Physiol Opt. 2011;31(5):502–15. https://doi.org/10.1111/j.1475-1313.2011.00834.x
30 Abuallut I, Ajeebi RE, Bahari AY, Abudeyah MA, Alyamani AA, Zurayyir AJ, et al. Prevalence of computer vision syndrome among school-age children during the COVID-19 pandemic, Saudi Arabia: a cross-sectional survey. Children. 2022;9(11):1718. https://doi.org/10.3390/children9111718
31 Cerniglia L, Zoratto F, Cimino S, Laviola G, Ammaniti M, Adriani W. Internet addiction in adolescence: neurobiological, psychosocial and clinical issues. Neurosci Biobehav Rev. 2017;76(Pt A):174–84. https://doi.org/10.1016/j.neubiorev.2016.12.024
32 Calado VJ. Internet e outros comportamentos aditivos: dossier temático. Lisboa: Serviço de Intervenção nos Comportamentos Aditivos e nas Dependências (SICAD); 2019.
33 United Nations Children's Fund. Engaging children and young people on UNICEF's Strategic Plan 2022-2025. New York, NY: United Nations Children's Fund; 2021.
34 United Nations Children's Fund. The state of the world's children 2017: children in a digital world. New York, NY: United Nations Children's Fund; 2017.
35 United Nations Children's Fund. Harnessing the power of technology and digital innovation for children. New York, NY: United Nations Children's Fund; 2021.
36 Portugal Ministério da Saúde; Direção-Geral da Saúde. Plano Nacional de Saúde 2030: Saúde Sustentável: de tod@s para tod@s. Lisboa: Direção-Geral da Saúde; 2023.
37 Portugal Ministério da Saúde; Direção-Geral da Saúde. Programa Nacional de Saúde Escolar. Lisboa: Direção-Geral da Saúde; 2015.
38 Santos TP, Sampaio M. Sociedade Portuguesa de Neuropediatria. In: Recomendações da Sociedade Portuguesa de Neuropediatria para a utilização de ecrãs e tecnologia digital em idade pediátrica. Lisboa: Sociedade Portuguesa de Neuropediatria; 2024.