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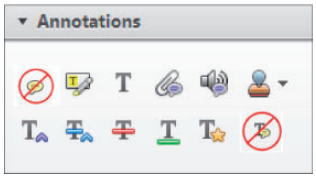

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Screen time exposure and reporting of headaches in young adults: A cross-sectional study*

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Abstract

Objective: The objective of this article is to investigate whether excessive screen time exposure is associated with non-migraine headache and migraine in young adults.

Background: Increased levels of television time have been associated with increased risk of headache. However, time spent using newer electronic devices with a screen (smartphone, tablet) has not been examined yet.

Methods: We conducted a cross-sectional study among 4927 participants of the French i-Share cohort. Demographic characteristics, screen time exposure (computers, tablets, smartphones and television) as well as headache/migraine symptoms were recorded in a standardized questionnaire. Multinomial logistic regression models were used to evaluate the association between screen time exposure and headache status.

Results: Participants had a mean age of 20.8 years and 75.5% were female. The multivariable model showed that students in the highest screen time exposure quintile had an increased risk for migraine. The odds ratio (OR) (95% confidence interval (CI)) was 1.37 (1.14 to 1.66) for migraine when compared with students without headache and with low screen time exposure. This association was somewhat stronger for migraine without aura (OR = 1.50, 95% CI 1.19 to 1.89). We found no significant association between screen time exposure and non-migraine headache.

Conclusion: High levels of screen time exposure are associated with migraine in young adults. No significant association was found with non-migraine headache.

Keywords

Screen time, cell phones, computers, headache, tablets, television, students, migraine disorders

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Introduction

The use of electronic media that have a screen as interface, i.e. television (TV), smartphones, computers and tablets, is very common, especially among young people. According to a national survey on the diffusion of new technology devices, French people between the ages of 18 and 24 years are high consumers of the Internet, spending on average 27 hours per week online (1). Moreover, they usually spend about two hours a day watching TV (2). As for mobile devices, around 16% of French young adults use a tablet every day and 79% also own a smartphone (3). Further, students of higher education institutions have high screen time exposure, due to increasing use of computers for their academic work (4).

In addition to having a high amount of screen time exposure, university students also report a high prevalence of headache and particularly migraine (5,6), especially in the faculty of medicine (7–9). Previous studies have observed associations between screen time exposure and headaches (10–13). For example, in primary school children, frequent computer use was

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associated with both tension-type headache and migraine (10). Similarly, computer use and TV watching were associated with headache in two studies of Nordic adolescents (11,12). This had led to speculation that the high amount of screen time exposure among students of higher education institutions may be correlated with the high prevalence of headache and migraine observed in this population.

We aimed to assess the associations between screen time exposure and risk of different types of headache in university students.

Methods

Study population

Study participants were part of the ongoing Internet-based Students Health Research Enterprise (i-Share) project, a prospective population-based cohort study of students of French-speaking universities and higher education institutions. The i-Share project was initiated by the Universities of Bordeaux and Versailles Saint-Quentin (France).

To be eligible to participate, a student had to be officially registered at a University or higher education institute, be at least 18 years of age, able to read and understand French, and provide informed consent for participation.

Data for this study come mainly from participants from Bordeaux, where active recruitment started in February 2013. Students were informed about the purpose and aims of the study by flyers, information stands at registrations, during lectures, and via social media and newsletters (www.i-Share.fr). Furthermore, a group of trained students informed their peers about the study and collected contact information to initiate the online recruitment process. Enrollment followed a two-step process: First, a formal pre-registration on the i-Share online portal was required. In the second step, the student finalized the registration process and completed self-administered online questionnaires. Only students who completely filled out the baseline questionnaire were eligible for our analyses. The baseline questionnaire asked information on the participant's health status, personal and family medical histories, socio-demographic characteristics, and lifestyle habits. We used data available as of April 1, 2015.

Measures

Screen time exposure. Screen time exposure was assessed by self-report of the average time spent on a screen across five different activities: 1) working on a computer/tablet, 2) playing video games on a computer/tablet, 3) surfing the Internet on a computer/tablet, 4) watching TV or videos (movies, serials, TV programs) on a computer/tablet, and 5) using a smartphone. Six different time categories could be checked ranging from never to more than eight hours. To summarize the time spent in front of electronic screens, an unweighted scoring system was applied using an arbitrary six-point scale (never = 0, less than 30 minutes = 1, from 30 minutes to two hours = 2, from two to four hours = 3, from four to eight hours = 4, more than eight hours = 5). The score was categorized in quartiles that were labeled "very low," "low," "high" and "very high."

Outcomes: assessment of headache

On the baseline questionnaire, participants were asked: "Have you ever had headache attacks of several hours in the last 12 months?" Participants who did not report headaches during the last 12 months were included in the "no headache" category. Participants who reported headaches were asked further details about their headache symptoms: unilateral location, pulsating quality of pain, inhibition of daily activities, aggravation by routine physical activity, nausea or vomiting, and sensitivity to light or sound. Participants who reported headaches and who reported at least two symptoms of the four first symptoms listed above and at least one symptom of the two last ones were included in the "migraine category"; the other participants were included in the "non-migraine headache" category. Participants who reported headache were further asked whether they had visual, sensory or motor disturbances before the migraine attack.

To establish migraine classification, we used the "probable migraine" category of the International Classification of Headache Disorders, third edition (beta version) (14).

We defined two outcome measures. The first outcome classified individuals as either "no headache," "non-migraine headache" or "migraine"; the second outcome further dichotomized migraine into "migraine with aura" and "migraine without aura," resulting in four possible categories (no headache, non-migraine headache, migraine with aura, and migraine without aura).

To validate the self-reported migraine variables, we invited 400 i-Share participants who had indicated having had a headache in the 12 months before the baseline questionnaire to fill out the French version of the ID migraine™ questionnaire (15,16). Of the 400 students, seven could not be contacted as their email addresses were invalid. Of the remaining 393 students, 139 completed the ID Migraine™ questionnaire. Using information from these 139 students, we examined the number of students who were classified as having migraine and non-migraine headache based on the baseline i-Share questionnaire and the ID Migraine™

questionnaire. On the baseline i-Share questionnaire, 88 were classified as having migraine and 51 were classified as having non-migraine headache. Compared to the migraine classification of the i-Share questionnaire, only eight participants were not classified as having migraine by the ID Migraine™ questionnaire, resulting in a positive predictive value of 90.9%. In contrast, 33 participants classified as non-migraine headache by the i-Share questionnaire were classified as having "migraine" by the ID Migraine™ questionnaire (negative predictive value 35.3%), underscoring that the ID Migraine™ questionnaire was developed to identify migraine, not to disprove it.

Statistical method

We compared the characteristics of students with respect to their self-reported screen time exposure categories. We used multinomial logistic regression models to calculate odds ratios (ORs) and 95% confidence intervals (CIs) of the association between screen time exposure and headache status. Calculated ORs had two reference categories, one for the exposure (very low screen time exposure) and one for the outcome (no headache) categories. Our main analysis was performed with headache status composed of the three categories "no headache," "non-migraine headache" and "migraine." We also ran secondary analyses taking information on migraine aura into account.

We ran multivariable models adjusting for: gender (male, female), body mass index (BMI) (quartiles, missing indicator variable), sports practice (yes, no), extracurricular activities (yes, no), paid employment as a student (yes, no), daily consumption of fast and junk food (yes, no), self-reported physician-diagnosed depression (yes, no), parents' marital status (divorced, not divorced), family economic condition in childhood (comfortable, about right, difficult), age (18, 19, 20, 21 years or more), study level (first, second, third, fourth or higher year of university), parents' headache status (no headache, one parent has headaches, both parents have headaches), alcohol consumption (never, several times per year, once a month, once a week or less, more than twice a week), cannabis consumption (yes, no), current tobacco consumption (yes, no), consumption of other drugs (yes, no), and sleep quality (good, quite good, neither good nor bad, bad).

Variables were chosen based on the literature on screen time exposure and headache/migraine (4,10–13,15–17). Selected variables were classified into three groups: confounding variables, i.e. variables that are causes of both the exposure and the outcome (gender, body mass index (BMI), sports practice, extracurricular activities, paid employment as a student, daily consumption of fast and junk food, self-reported physician-diagnosed depression, parents' marital status, family economic condition in childhood, sleep quality); intermediate variables, i.e. variables considered as a consequence of the exposure and also as a cause of the outcome (sleep quality); and variables that could be conceptually classified as confounding or intermediate variables (age, study level, parents' headache status, alcohol consumption, cannabis consumption, current tobacco consumption, consumption of other drugs) (18). We performed four multivariable analyses in addition to the unadjusted analysis: 1) adjusting for the confounding variables, 2) adjusting for the intermediate variables, 3) adjusting for the "potential confounding or intermediate" variables, and 4) adjusting for the confounding variables plus the potential confounding or intermediate variables. Concerning the variable about sleep quality, we included it both in the confounder and in the intermediate model. As the results of the association between screen time and migraine did not change, we did not further consider it in the analyses.

For the main analysis and the secondary analyses, we stratified the association between screen time exposure and headache status by gender. In addition, we performed a formal test for effect modification by contrasting a main model to a model including an interaction term between gender and screen time using the likelihood ratio test.

All p values were two tailed and we considered $p < 0.05$ to be statistically significant. Since our aim was to test a priori hypotheses, we did not adjust for multiple testing. We performed all analyses using statistical software (SAS version 9.3; SAS Institute Inc, Cary, NC, USA).

Results

In our sample of 4927 participants, 2773 (56.3%) reported not having a headache, 710 (14.4%) reported a non-migraine headache, 791 (16.1%) reported migraine without aura, and 653 (13.3%) reported migraine with aura. Table 1 summarizes the association between personal characteristics of the sample and screen time exposure. When compared with other participants, students reporting very high screen time exposure were more likely to be male, to be older, to have higher BMI, and to consume cannabis. They were also more likely to report non-migraine headache or migraine.

When stratifying the association between screen time exposure and headache status by gender for confounding variables, the results remained essentially unchanged. The associations between screen time exposure and headache status are summarized in Table 2. We did not find any significant association between screen time exposure and non-migraine headache. In contrast, we found a significant association between increasing

Table 1. Characteristics of the study population according to screen time exposure categories. i-Share cohort ($n = 4927$).

	Screen time exposure							
	Very low ($n = 1170$)		Low ($n = 1101$)		High ($n = 1307$)		Very high ($n = 1349$)	
	n	%	*n*	%	*n*	%	*n*	%
Headache status								
No headache	700	59.8	633	57.5	714	54.6	726	53.8
Non-migraine headache	160	13.7	161	14.6	195	14.9	194	14.4
Migraine without aura	163	13.9	170	15.4	213	16.3	245	18.2
Migraine with aura	147	12.6	137	12.4	185	14.2	184	13.6
Gender								
Male	252	21.5	254	23.1	303	23.2	393	29.1
Female	918	78.5	847	76.9	1004	76.8	956	70.9
BMI								
First quartile	308	26.3	275	25.0	282	21.6	303	22.5
Second quartile	305	26.1	240	21.8	330	25.2	292	21.6
Third quartile	271	23.2	275	25.0	302	23.1	316	23.4
Fourth quartile	225	19.2	250	22.7	331	25.3	355	26.3
Missing indicator variable	61	5.2	61	5.5	62	4.7	83	6.2
Sports practice								
No	563	48.1	543	49.3	645	49.3	691	51.2
Yes	607	51.9	558	50.7	662	50.7	658	48.8
Extracurricular activities								
No	814	69.6	765	69.5	872	66.7	902	66.9
Yes	356	30.4	336	30.5	435	33.3	447	33.1
Paid employment as a student								
No	747	63.8	732	66.5	817	62.5	832	61.7
Yes	423	36.2	369	33.5	490	37.5	517	38.3
Daily consumption of fast and junk food								
No	1081	92.4	1024	93.0	1192	91.2	1187	88.0
Yes	89	7.6	77	7.0	115	8.8	162	12.0
Self-reported physician-diagnosed depression								
No	1029	87.9	973	88.4	1140	87.2	1163	86.2
Yes	141	12.1	128	11.6	167	12.8	186	13.8
Parents' marital status								
Not divorced	816	69.7	762	69.2	889	68.0	913	67.7
Divorced	354	30.3	339	30.8	418	32.0	436	32.3
Family economic condition in childhood								
Comfortable	603	51.5	590	53.6	679	52.0	699	51.8
About right	446	38.1	401	36.4	507	38.8	508	37.7
Difficult	121	10.3	110	10.0	121	9.3	142	10.5
Age								
18 years	410	35.0	387	35.1	383	29.3	314	23.3
19 years	234	20.0	194	17.6	252	19.3	210	15.6
20 years	150	12.8	153	13.9	176	13.5	220	16.3
21 years or more	376	32.1	367	33.3	496	37.9	605	44.8
Study level								
First year	594	50.8	557	50.6	572	43.8	485	36.0

(continued)

Table 1. Continued.

	Screen time exposure							
	Very low ($n = 1170$)		Low ($n = 1101$)		High ($n = 1307$)		Very high ($n = 1349$)	
	n	%	*n*	%	*n*	%	*n*	%
Second year	208	17.8	185	16.8	250	19.1	289	21.4
Third year	125	10.7	136	12.4	195	14.9	209	15.5
Fourth or more higher year of post-secondary education	243	20.8	223	20.3	290	22.2	366	27.1
Parents' headache status								
No headache	785	67.1	738	67.0	833	63.7	874	64.8
One parent has headaches	357	30.5	339	30.8	441	33.7	431	31.9
Both parents have headaches	28	2.4	24	2.2	33	2.5	44	3.3
Alcohol consumption								
Never	129	11.0	118	10.7	111	8.5	105	7.8
Several times per year	258	22.1	241	21.9	249	19.1	241	17.9
Once a month	187	16.0	186	16.9	235	18.0	231	17.1
Once a week or less	353	30.2	370	33.6	447	34.2	452	33.5
More than twice a week	243	20.8	186	16.9	265	20.3	320	23.7
Cannabis consumption								
No	565	48.3	478	43.4	578	44.2	540	40.0
Yes	605	51.7	623	56.6	729	55.8	809	60.0
Current tobacco consumption								
Yes	362	30.9	379	34.4	448	34.3	483	35.8
No	808	69.1	722	65.6	859	65.7	866	64.2
Consumption of other drugs								
No	971	83.0	929	84.4	1053	80.6	1071	79.4
Yes	199	17.0	172	15.6	254	19.4	278	20.6
Sleep quality								
Good	231	19.7	201	18.3	218	16.7	206	15.3
Quite good	412	35.2	413	37.5	488	37.3	492	36.5
Neither good nor bad	306	26.2	253	23.0	300	23.0	332	24.6
Bad	221	18.9	234	21.3	301	23.0	319	23.6
Total	1170	100.0	1101	100.0	1307	100.0	1349	100.0

Numbers may not add to 100% due to rounding of values.
BMI: body mass index.

screen time exposure and migraine. For the "confounding" model, students with the highest screen time exposure (very high) reported an OR (95% CI) of 1.21 (0.96 to 1.54) for non-migraine headache and an OR of 1.37 (1.14 to 1.66) for migraine when compared to students with very low screen time exposure who did not report headache. These associations did not change after adjustments for intermediate variables or for variables that could be confounders or intermediates. We also observed a steady increase in the odds of reporting migraine as screen time exposure increased.

When taking into account migraine aura status, we found a statistically significant association between screen time exposure and migraine without aura (OR = 1.50 95% CI 1.19 to 1.89) but not for migraine with aura (OR = 1.23 95% CI 0.96 to 1.58) (Table 2). These results remained unchanged after further adjustments for potential confounding or intermediate variables.

Finally, there was no indication that the association between screen time exposure and headache status was modified by gender (p for interaction = 0.56).

Discussion

In this large sample of university students, we found an association between high screen time exposure and

Table 2. Association between screen time exposure and headache status. i-Share cohort ($n = 4927$).

	Headache status using three modalities		Headache status using four modalities	
	Non-migraine headache ($n = 710$) OR (95% CI)	Migraine ($n = 1444$) OR (95% CI)	Migraine without aura ($n = 791$) OR (95% CI)	Migraine with aura ($n = 653$) OR (95% CI)
Univariate				
Very low	1.00	1.00	1.00	1.00
Low	1.12 (0.88–1.43)	1.10 (0.91–1.33)	1.16 (0.91–1.47)	1.04 (0.80–1.35)
High	1.21 (0.96–1.54)	1.28 (1.07–1.54)	1.29 (1.03–1.63)	1.27 (1.00–1.62)
Very high	1.18 (0.93–1.49)	1.34 (1.12–1.61)	1.46 (1.17–1.83)	1.22 (0.96–1.55)
Confounding				
Very low	1.00	1.00	1.00	1.00
Low	1.14 (0.89–1.46)	1.12 (0.92–1.37)	1.18 (0.92–1.51)	1.06 (0.81–1.38)
High	1.23 (0.97–1.56)	1.28 (1.06–1.54)	1.30 (1.02v1.64)	1.26 (0.98–1.61)
Very high	1.21 (0.96–1.54)	1.37 (1.14–1.66)	1.50 (1.19–1.89)	1.23 (0.96–1.58)

Results for multinomial logistic regression models with the headache status as dependent variable. The first outcome is composed of three categories and the second one is composed of four categories including migraine with or without aura, and screen time exposure levels represent the main independent variable. The reference screen time exposure group is the "very low" category and the reference for both dependent variables is the "no headache" category. Results for the "non-migraine headache" are from the two models.
OR: odds ratio; CI: confidence interval.

migraine. This association was mainly driven by the migraine without aura group and was not observed for non-migraine headache. The findings persisted after adjustment for a large number of covariates.

Comparison with other studies

Our findings are in line with previous research in a population of children and adolescents (10,17,19), which observed a relationship between screen time exposure and migraine among individuals who use digital devices every day. Additionally, the association between screen time exposure and migraine was stronger for migraine without aura (17). Among adolescent boys, high screen time exposure significantly increased the risk of recurrent headaches. Among adolescent girls, computer use and TV viewing, but not computer gaming, were associated with an increased risk of recurrent headaches (19). In our study we found no difference by gender.

A few studies have assessed the prevalence of migraine according to screen time exposure in college students (5), students of medicine (7,9), and in students from developing countries (6,8). However, these studies reported only information about screen time exposure from a computer and/or a TV screen. Given the prevalence of smartphone and tablet use among young adults (3), not including these devices when calculating screen time may underestimate university students' screen time exposure.

Two potential scenarios can be hypothesized to explain how screen time may interact with the migraine pathophysiology. First, the luminosity or frequency of screen band light may directly trigger a migraine attack; second, increasing screen time exposure may reduce the threshold for the migraine cascade that is then induced by other factors (20–22). However, our data cannot provide direct insights into potential biological mechanisms.

Strengths and limitations

Strengths of our study include the large number of participants with headache or migraine, the standardized assessment of screen time exposure, migraine, and other covariates, and the homogenous nature of our cohort that may reduce confounding.

Several limitations have to be considered when interpreting our results. First, all information was self-reported, which may result in misclassification. However, we have no reason to believe that there is differential reporting of information based on screen time exposure or headache status. Additionally, it has been shown that the use of standardized questionnaires to assess migraine in large population-based studies has good validity (16). Second, most participants of the i-Share cohort were students from the Universities of Bordeaux, Versailles and Nice and generalizability to other settings may be limited. Third, residual confounding may be present as our study is observational. Fourth, we did not have information on screen time exposure conditions like distance between participants and the screens, screen size, or luminosity during viewing. Indeed optimal viewing could be associated with a decreased prevalence of headaches, since headaches can

be caused by computer-related vision problems (23). Fifth, our study reported screen time exposure per device but did not take into account the possibility of contemporary multi-screen viewing, i.e. the fact that students can use different digital devices at the same time. Simply summing screen time exposure per device may overestimate screen time exposure. Last, we did not ask specific questions addressing playing video games on a TV screen, which may cause an underestimate of screen time exposure.

Potential implications, next steps

Our results suggest that screen time exposure is associated with migraine. Patients with migraine should be asked about their screen time exposure and whether screen time may be related to their migraine attacks. However, whether reduction of screen time exposure can help to reduce migraine attack frequency needs to be tested in further studies. The assessment of this association could provide a way for students to reduce concentration and performance problems caused by migraine headaches.

Conclusions

Increasing levels of screen time exposure are associated with increased reporting of migraine among post-secondary students. This association was driven mainly by migraine without aura. We did not observe associations between screen time exposure and non-migraine headache.

Public health relevance

- Associations between screen time exposure and headache have been suggested but data are sparse among young adults and scarce on the use of modern mobile devices.
- This large study among students found that increasing levels of screen time exposure are associated with migraine, particularly migraine without aura. There was no association with non-migraine headache.
- Future studies are warranted to investigate whether reduction of screen time exposure results in reduced migraine attack frequency.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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