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Increased screen time and its association to migraine and tension-type headache: a cross-sectional investigation among Bangladeshi students

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ABSTRACT

Background Increasing prevalence of screens among young people is a notable characteristic of the modern digital era. The study aimed to explore the prevalence and associated factors of migraine headache (MH) and tension-type headache (TTH) among Bangladeshi students continuing online education.

Methods A total of 771 students were selected conveniently and using the quota sampling method. A pretested semistructured and self-administered questionnaire containing the background information, Headache Screening Questionnaire-English Version, Patient Health Questionnaire-9, Speech, Spatial and Qualities of Hearing scale and Insomnia Severity Index was used for data collection. Multivariate logistic regression analysis was conducted to explore the relationship between different headaches and screen use.

Results The prevalence of MH, TTH and mixed headache (both MH and TTH) in the study population was 26.07%, 47.08% and 14.75%, respectively. Longer duration of online study (>12 months, adjusted ORs (AORs): 2.83, 95% CI 0 1.00 to 8.00), history of eye problem (AOR: 1.48, 95% CI 1.01 to 2.17), insomnia (AOR: 1.53, 95% CI 1.01 to 2.33) and moderate-to-severe depression (AOR: 2.35, 95% CI 1.55 to 3.56) were significantly associated with migraine headache. Conversely, longer duration of online study (>12 months, AOR: 2.87, 95% CI 1.40 to 5.86), moderate-to-severe depression (AOR=1.47, 95% CI 1.05 to 2.10) and use of multiple devices (AOR<1) for online study were significantly associated with TTH. In addition, longer duration of screen exposure (for >12 months, AOR: 4.56, 95% CI 0.99 to 20.93), moderate-to-severe depression (AOR: 2.25, 95% CI 1.37 to 3.72) and family history of headache (AOR: 2.66, 95% CI 1.65 to 4.29) were associated with mixed headache.

Conclusion Considering the current prevalence of TTH and MH among students and their relationship with screentime, providing health education on the proper use of electronic devices can be a promising strategy in mitigating the negative consequences.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Migraine headache (MH) may be triggered by the presence of flickering lights emitted by computer screens. Also, prolonged gazing at a digital display can result in digital eye strain and excessive eye fatigue, which can lead to tension-type headache.

WHAT THIS STUDY ADDS

⇒ 86% of the students pursuing online education during COVID-19 developed tension-type headaches, or MHs, or both.

⇒ Longer duration of online study was a significant predictor of tension-type headaches, MHs and both types.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Implementing stringent guidelines regarding screen usage and providing health education can effectively mitigate these negative consequences.

BACKGROUND

The increasing prevalence of screens among young people is a notable characteristic of the modern digital era. The rapid advancement of technologies has led to the use of various screens, including smartphones, tablets, laptops and televisions. In addition, the COVID-19 pandemic triggered increased screen usage (educational and non-educational), as outdoor activities have been limited due to different lockdown measures.[1] The closure of educational institutions led to increased screen time among students, who used digital platforms for homeschooling, socialising and gaming. An increase in screen usage, coupled with its prolonged duration, might result in a lasting escalation of screen time due to the addictive nature of these devices.[2] The presence of screens in young students' daily life has raised concerns regarding its potential impact on health. Numerous studies have demonstrated a correlation between elevated screen time and negative effects on weight, mental health and sleep.[3–5] However, the effect of screen time on headaches is yet to be fully understood. Migraine headaches (MH) may be triggered

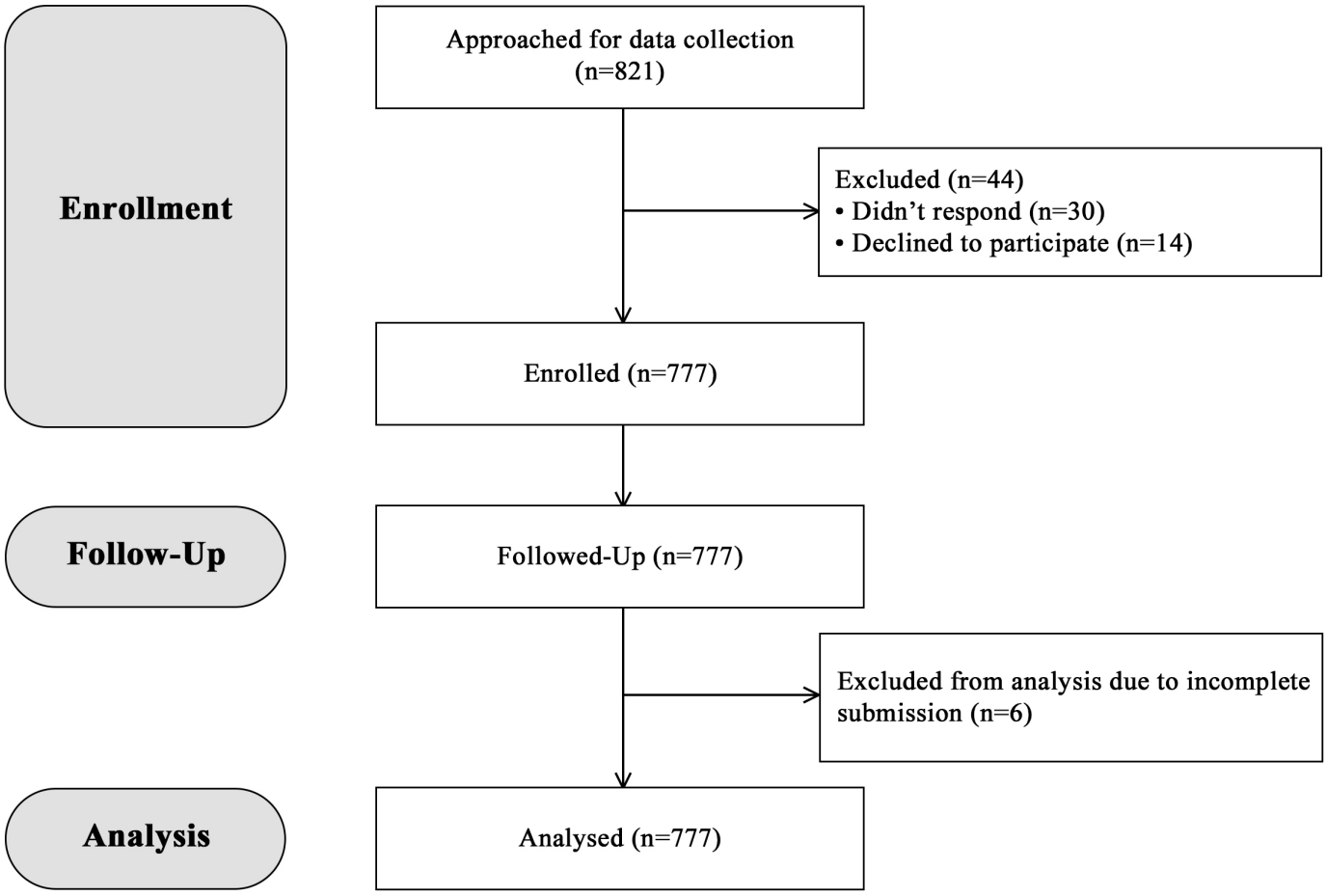

Figure 1 Flow chart of study participants considering the STrengthening the Reporting of OBservational studies in Epidemiology guideline.

by the presence of flickering lights emitted by computer screens.[6–8] Also, prolonged gazing at a digital display can result in digital eye strain and excessive eye fatigue, which can lead to headaches.[9]

Several studies demonstrated a correlation between screen time exposure and headaches. The association between frequent computer use and headache disorders, specifically TTH and MH, has been observed in primary school children.[10–13] A large cross-sectional study of young adults also observed a similar finding.[14] However, these studies were subjected to several potential limitations regarding the design. For example, most of these studies did not employ a validated tool for assessing headaches. Additionally, prior studies failed to address two crucial aspects: the simultaneous presence of various types (MH and TTH) of headaches and the use of multiple screens. To address the gap, this study aims to determine the prevalence of different types of headaches and their relation to screen usage using a validated headache screening tool.

METHOD

Study design and participants

This cross-sectional study was conducted among 771 Bangladeshi students between May 2021 and December 2023 (figure 1). The researchers employed an online survey to ensure social distancing and take appropriate precautions throughout the pandemic. With the help of educational institutions (tuition homes/academies), participants were selected conveniently and using a quota sampling method to ensure equal representation from each of the eight divisions of Bangladesh. Considering the absence of a sampling frame, limited resources and the restrictions and lockdowns due to COVID-19, a convenient sampling technique was used. Moreover, data were collected from tuition homes/academies in Bangladesh that include students from diverse backgrounds in terms of the school's location and residence. This ensured a better representation of the target population. Being a student of postsecondary (11th, 12th grade or above) level, pursuing online education during the COVID-19 pandemic, and residing in Bangladesh during the pandemic were the eligibility criteria for this study. We excluded international students studying in Bangladesh, those with a self-reported history of headaches before online education, students who were engaged in online education before COVID-19 and those who did not consent to enter the study.

Sample size

We initially calculated the sample size (369) considering the sample size formula for single proportions: n=z2 ×

p × (1 − p)/d2; where: z=1.96 for a confidence level of 95%, p=proportion (from Montagni *et al*,[14] 2016 =40%), d=margin of error=0.05. Considering 10% non-response, the final sample size was 369+37=406.

Given the above formula assumes simple random sample and we employed convenient sampling, we approached more than double (821) of the required sample size. Out of 821 participants, 771 (~95%) finally completed the survey and were considered for analysis.

Also, we wanted to employ quota sampling to ensure contribution from each division; 85 participants were expected to participate from each of the 8 divisions. The actual sample size from each division ranged from 88 to 118 (11.4%–15.3% of total sample)

Data collection instrument

A pretested semistructured and self-administered questionnaire containing the background information, Headache Screening Questionnaire-English Version (HSQ-EV),[15] Patient Health Questionnaire-9 (PHQ-9),[16] Speech, Spatial and Qualities of Hearing scale (SSQ12)[17] and Insomnia Severity Index (ISI)[18 19] was used for data collection. After confirming usability and technical functionality, the questionnaire was inputted into Google Forms without randomising items for online distribution. Mandatory items were highlighted with a red asterisk, and a relevant non-response option was present. Respondents could review their answers through the back button and change their responses if necessary. The survey was never displayed again once the user had filled it in to prevent duplicate entries.

Measures

Background information

The questionnaire included sociodemographic data (age, gender, educational status), body mass index (BMI), personal history of diseases and family history of diseases. It also included screen exposure-related variables: daily hours spent on electronic devices for education and entertainment, type of device used (smartphone/tablet, computer, TV), breaks taken during use (enough break: 15 min after 2 hours of use, small break: 10 min break after 2 hours of use, continuous use: 4 hours without a break), duration of online education in months. Moreover, considering the inconsistent use pattern of smartphones/tablets throughout the day, in-built smartphone/tablet software that provides accurate data on smartphone/tablet screen use was used.[20 21] These software of IOS and Android smartphones record data on screentime use, especially, time spent on different applications. With this software, the participants reported their average daily screen use duration specifically in terms of education and entertainment.

Headache (outcome variable)

The 10-item HSQ-EV was used to screen the presence and categorisation of different headache types. It provides an algorithm for the screening of MH and TTH. It showed moderate level of evidence with a sensitivity of 0.69 (95% CI 0.55 to 0.80) and specificity of 0.90 (95% CI 0.77 to 0.96) for MH, and a sensitivity of 0.36 (95% CI 0.21 to 0.54) and specificity of 0.86 (95% CI 0.74 to 0.92) for TTH.[15] Participants with both MH and TH were categorised as having mixed headaches. In each variable, the responses were coded as 0 and 1 representing the presence of specific outcomes and the absence of specific outcomes, respectively (eg, MH (1) vs no MH (0); TTH (1) vs no TTH (0), mixed (1) vs no-mixed (0)).

Depression

The PHQ-9, a 9-item depression screening tool, was used to evaluate depression among the participants. They rated how much each symptom affected them in the past 2 weeks: nothing at all (0), several days (1), more than half the days (2) and nearly every day (3). Final scores were calculated by the cumulative scores in 9 items, and a score of 5 or more, 10 or more and 15 or more indicate mild, moderate and severe depression, respectively.[16] Finally, the participants were recategorised as no-to-mild depression or moderate-to-severe depression.

Hearing impairment

The hearing impairment of the participants was assessed using a 12-item short form of the original 49-item SSQ.[17] The SSQ12 questionnaire consists of four subscales, which include 12 items, each with a possible score of 0–10 points. To determine the subscale and overall scores, the average is calculated using the item scores in each subscale, and a score of ≤8 was considered hearing impairment.[22]

Insomnia

A validated seven-item scale ISI was used to determine insomnia severity for screening purposes. Using a five-point Likert scale (0=none, very satisfied, not at all noticeable, not at all worried, or not at all interfering to 4=very severe, very dissatisfied, very much noticeable, or very much interfering), the ISI total score ranges from 0 to 28, and the total score is interpreted as follows: absence of insomnia (0–7), subthreshold insomnia (8–14), moderate insomnia (15–21) and severe insomnia.[18 19 22–28]

Eye problem

The participants were asked to report any eye problems which was diagnosed by physician. Eye diseases can cause repeated headache; therefore, to minimise bias, we excluded any participants with a history of headache before starting online education.

Survey administration

Trained research assistants contacted prospective participants conveniently and described the research in detail. Once the individuals were ascertained to meet the inclusion criteria and consented to voluntary participation in the study, a link to a web-based survey created by Google Forms was sent via Facebook messenger/email/SMS, making it a closed survey. The survey was not announced or advertised anywhere else, and the survey was never

displayed again once the user had filled it in. The respondents were able to review and change their answers if they wanted to. Of the 777 eligible participants who agreed to participate, 771 completed the entire questionnaire (completion rate: 99.6%); incomplete questionnaires were excluded from the analysis.

Statistical analysis

We used Stata (V.17; StataCorp) for data analysis. A histogram, a normal Q–Q plot and the Kolmogorov-Smirnov test were used to check for normality in continuous data. The mean and SD of continuous variables and the frequencies and proportions of categorical variables were reported. The χ^2 test was used to examine the association between the presence of different headaches with categorical covariates, and an independent sample t-test was conducted to observe any difference in mean values of continuous variables based on the categorical outcome variable (presence of different headaches). Logistic regression models were fitted using all variables considering the literature review and bivariate analysis. We considered each type of headaches: 'MH', 'TTH' and 'Mixed headache (both MH and TTH)' as a separate outcome variable (including mixed headaches). Consequently, we used three logistic regression models to identify the factors associated with each of the outcomes. When defining the models, we considered the groups without the outcomes as reference category (eg, MH vs non-MH, TTH vs non-TTH, and mixed vs non-mixed). It is to be noted that the dependent variables are not mutually exclusive rather there may have overlaps. The lowest values of the Akaike Information Criterion and the Bayesian Information Criterion (BIC) were considered while considering the model selection. The variance inflation factor (VIF) was used to measure the presence of multicollinearity (VIF <5 for all). Lastly, the logistic regression analysis obtained adjusted ORs (AORs) and corresponding 95% CIs. Statistical significance was set at $\alpha<0.05$.

Ethics

The Institutional Review Board of North South University approved the research (approval no: 2022/OR-NSU/IRB/0403), and all participants provided informed consent. Wherever feasible, the 1964 Declaration of Helsinki and later modifications and comparable ethical standards were followed. Data collection was voluntary, and no incentives were offered to participants. Data were only accessible to the research team and were not disclosed anywhere. All the reporting was done according to the Checklist for Reporting Results of Internet E-Surveys guidelines.[20]

RESULT

A total of 771 students took part in this study and the prevalence of TTH, MH and mixed type of headaches were 45.14%, 26.07% and 14.75%, respectively. According to table 1, the mean age of the participants was 18.6±3.04 years, with a mean BMI of 22.54±4.54. Most participants were female (62.82) and belonged to 11th–12th grade (76.84%). Nearly half of the participants (50.58%) reported that they had a family history of headaches, and in terms of personal history, eye problems, clinical insomnia, hearing impairment and moderate-to-severe depression were reported by 56.66%, 27.97%, 66.80% and 49.03%, respectively.

The smartphone/tablet was the most preferred device for educational (64.81%) and entertainment (53.69%) purposes. 66.02% of participants used digital devices for educational purposes for 2–6 hours per day, while 47.35% used these devices less than 2 hours per day for entertainment. The majority (47.74 %) took short breaks while using it for education, but for entertainment, 46.41% reported sufficient breaks during use (table 2).

According to bivariate analysis, gender (MH: p<0.001; mixed headache: p=0.01) and personal history of clinical insomnia (MH: p<0.001; mixed headache: p=0.01) were significantly associated with participants who had MH and who had mixed headache (table 1). Personal history of eye problems (p<0.001) and hearing impairment (p=0.03) were significantly associated with MH only. However, self-reported family history of headache (TTH: p=0.01, MH: p<0.001, mixed headache: p<0.001) and presence of moderate-to-severe depression (TTH: p=0.004, MH: p<0.001, mixed headache: p<0.001) were significantly associated with all three groups (MH, TTH and mixed headache). Regarding online education-related screen time-related factors, duration of online study (p=0.03) and device type (p=0.03) were significantly associated with TTH. In contrast, daily use duration (p=0.04) was significantly associated with MH in terms of entertainment-related use (table 2).

According to multivariate analysis using a logistic regression model (table 3), participants who continued online education for 3–6 months (95% CI 1.081 to 4.977), 6–12 months (95% CI 1.016 to 4.189) and >12 months (95% CI1.403 to 5.862) had 2.32, 2.063 and 2.868 times higher odds of reporting TTH. Also, using multiple devices was significantly associated with a lower chance (adjusted OR less than 1 for all) of reporting TTH compared with those who used only smartphones/tablets. Participants with a family history of headache (AOR 1.397, 95% CI 1.023 to 1.907) also showed higher odds of TTH.

Regarding MH (table 4), after adjusting for potential confounders, males had a 46% lower chance (AOR: 0.54, 95% CI 0.36 to 0.82) of reporting MH. Also, the graduate students (vs students in 11–12th grade) and students with a family history of headaches (vs those without a family history of headache) were associated with higher odds (AOR: 5.12, 95% CI 1.297 to 20.237; AOR: 2.248, 95% CI 1.533 to 3.295) of reporting MH. Regarding personal history of diseases, individuals with a history of eye problems (95% CI 1.013 to 2.171), insomnia (95% CI1.009 to 2.331) and moderate-to-severe depression (95% CI1.553 to 3.559) were 1.48, 1.53 and 2.35 times more likely to

Table 1 Personal characteristics of the participant and their relation to TTH, MH and mixed headache (n=771)

Variable	N	%	TTH		MH		Mixed headache	
			Yes (n=348, 45.14%)	P value*	Yes (n=201, 26.07%)	P value*	Yes (n=114, 14.75%)	P value*
Age (mean±SD)	18.62±3.04		18.63±3.02	0.78¥	18.81±3.02	0.25¥	18.68±3.14	0.80¥
Gender								
Female	485	62.82	229 (47.31)	0.83	155 (32.02)	**<0.001**	84 (17.32)	**0.01**
Male	287	37.18	133 (46.50)		46 (16.08)		30 (10.45)	
Level of study								
11th–12th grade	594	76.84	279 (46.97)	0.92	149 (25.08)	0.05	88 (14.81)	0.16
Undergraduate	131	16.95	61 (46.56)		33 (25.19)		15 (11.45)	
Graduate	48	6.21	23 (50.00)		19 (41.30)		11 (22.92)	
BMI (mean±SD)	22.54±4.54		22.68±4.49	0.42¥	22.16±4.44	0.19¥	22.29±4.20	0.55¥
Personal history of disease								
Eye problem	438	56.66	209 (47.94)	0.59	135 (30.96)	**<0.001**	76 (17.35)	0.20
Clinical insomnia	214	27.97	112 (52.34)	0.08	82 (38.32)	**<0.001**	43 (20.09)	**0.01**
Hearing impairment	515	66.80	235 (45.63)	0.25	147 (28.54)	**0.03**	79 (15.34)	0.54
Moderate-to-severe depression	378	49.03	198 (52.38)	**0.004**	139 (36.77)	**<0.001**	78 (20.63)	**<0.001**
Self-reported family history of headache	391	50.58	201 (51.54)	**0.01**	138 (35.38)	**<0.001**	83 (21.23)	**<0.001**

*p-values derived from χ^2 test (¥ marked p-vlaues are derived from two-independent sample t-test)
p values <0.05 are in bold.
BMI, body mass index; MH, migraine headache; N, total number of participants; TTH, tension-type headache.

develop MH. Regarding screen use, those who continued online education for more than 12 months showed 2.833 times higher odds of reporting MH than those who continued for less than 3 months. For entertainment, 6–12 hours of screen use (AOR: 0.41, 95% CI 0.178 to 0.955) was also associated with a 59% lower chance of reporting MH.

For mixed headache, individuals who had a family history of headache had a twofold higher chance (AOR=2.659, 95% CI 1.65 to 4.285) of reporting mixed headache than those who did not. Using a smartphone/tablet and computer (AOR=0.48, 95% CI 0.239 to 0.965) was associated with a 52% lower risk of mixed headache and MH than those who used only a smartphone/tablet. Participants with moderate-to-severe depression (AOR=2.253, 95% CI 1.365 to 3.719) had a higher risk of reporting mixed headaches than those with no or mild depression (Table 5).

DISCUSSION

This study aimed to assess the prevalence of MH and TTH headaches and their association with screen use characteristics among a large student sample. This study observed that the prevalence of TTH, MH and mixed headache were 47.08%, 26.07% and 14.75%, respectively. An exposure–response relationship was also observed between screen exposure duration and headaches associated with online education use. The study also identified associations between various personal medical conditions (depression, insomnia, eye problems and hearing problems) and different types of headaches based on different patterns of screen usage.

Previous research has investigated the relationship between screen usage and headaches, employing diverse methodologies and diagnostic approaches.[10–14] Our findings also aligned with the existing research where increased screen usage was associated with more frequent headaches. Nevertheless, the diverse range of screen usage patterns, particularly with regard to smartphone/tablet usage, has consistently posed a limitation in many studies.[23] For example, compared with computer and TV usage, daily smartphone/tablet usage is typically more sporadic and inconsistent, posing challenges in accurately self-reporting screen time.[14] This study used screen usage data obtained from the built-in smartphone/tablet software, offering a precise screen usage report. In addition, screen usage patterns may vary based on their intended purposes (entertainment vs education). Therefore, in this study, screen use data were collected separately for entertainment and education purposes and included in the logistic regression models, which helped to reduce the potential influence of confounding factors.

Table 2 Screen use of the study participant and their relation to TTH, MH and mixed headache (n=771)

Variables	N	%	TTH		MH		Mixed headache	
			Yes (n=348)	P value*	Yes (n=201)	P value*	Yes (n=114)	P value*
For online education								
Duration of use								
1–3 months	49	6.34	15 (30.61)	**0.03**	6 (12.24)	0.08	2 (4.08)	0.10
3–6 months	111	14.36	53 (47.75)		25 (22.52)		14 (12.61)	
6–12 months	300	38.81	133 (44.63)		80 (26.85)		45 (15.00)	
>12 months	313	40.49	162 (51.76)		90 (28.75)		53 (16.93)	
Device								
Smartphone/tablet	501	64.81	250 (50.00)	**0.01**	139 (27.80)	0.20	81 (16.17)	0.11
Smartphone/tablet and Computer	209	27.04	90 (43.27)		51 (24.52)		26 (12.44)	
Smartphone/tablet, TV	10	1.29	4 (100)		2 (50.00)		2 (50.00)	
Smartphone/tablet, computer, TV	4	0.52	2 (20.00)		1 (10.00)		1 (10.00)	
Computer	49	6.34	17 (34.69)		8 (16.33)		4 (8.16)	
Daily use								
<2 hours	97	12.58	50 (51.55)	0.49	25 (25.77)	0.15	14 (14.43)	0.30
2–6 hours	509	66.02	229 (45.08)		121 (23.82)		68 (13.36)	
6–12 hours	143	18.55	72 (50.70)		47 (33.10)		28 (19.58)	
> 12 hours	22	2.85	11 (50.00)		7 (31.82)		4 (18.18)	
Use pattern								
Use with enough break	208	26.91	97 (46.63)	0.73	47 (22.60)	0.34	30 (14.42)	0.86
Use with a small break	369	47.74	170 (46.07)		98 (26.56)		57 (15.45)	
Use without break	196	25.36	96 (49.48)		56 (28.87)		24 (13.78	
For entertainment								
Daily use								
<2 hours	366	47.35	166 (45.36)	0.19	97 (26.50)	**0.04**	**55** (15.03)	0.19
2–6 hours	312	40.36	152 (49.03)		85 (27.42)		47 (15.06)	
6–12 hours	72	9.31	30 (41.67)		10 (13.89)		6 (8.33)	
> 12 hours	23	2.98	15 (65.22)		9 (39.13)		6 (26.09)	
Device								
Smartphone/tablet	415	53.69	201 (48.55)	0.27	111 (26.81)	0.56	61 (14.70)	0.55
Smartphone/tablet, computer	107	13.84	56 (52.83)		26 (24.53)		17 (15.89)	
Smartphone/tablet, computer, TV	62	8.02	24 (38.71)		11 (17.74)		6 (9.68)	
Smartphone/tablet, TV	121	15.65	58 (47.98)		38 (31.40)		23 (19.01)	
Computer	38	4.92	14 (36.84)		8 (21.05)		5 (13.16)	
Computer, TV	4	0.52	1 (25.00)		1 (25.00)		0 (0)	
TV	26	3.36	9 (34.62)		6 (23.08)		2 (7.69)	
Use pattern								
Use with enough break	355	46.41	1645 (46.20)	0.18	100 (28.17)	0.39	55 (15.49)	0.91
Use with a small break	276	36.08	125 (45.29)		67 (24.28)		40 (14.49)	
Use without break	134	17.52	73 (54.48)		31 (23.13)		19 (14.18)	

*χ^2 test was used
p values <0.05 are in bold.
MH, migraine headache; N, total number of participants; TTH, tension-type headache.

Table 3 Factors associated with tension-type headache among the study participants (n=771)

Variables	AOR	Upper bound of 95% CI	Lower bound of 95% CI
Baseline characteristics			
Age	0.99	0.901	1.101
Gender			
Female	Reference		
Male	1.093	0.79	1.513
Level of study			
11th–12th grade	Reference		
Undergraduate	0.821	0.467	1.443
Graduate	1.098	0.332	3.626
Family history of headache			
No	Reference		
Yes	1.397*	1.023	1.907
Personal history of the disease			
Eye problem			
No	Reference		
Yes	0.96	0.704	1.309
Insomnia			
No clinically significant insomnia	Reference		
Clinical insomnia	1.005	0.694	1.455
Depression			
No or mild depression	Reference		
Moderate-to-severe depression	1.474*	1.05	2.069
Hearing impairment			
No	Reference		
Yes	0.694*	0.501	0.961
Screen use-related information			
Duration of online education			
<3 months	Reference		
3–6 months	2.32*	1.081	4.977
6–12 months	2.063*	1.016	4.189
>12 months	2.868*	1.403	5.862
Use per day for study			
<2 hours	Reference		
2–6 hours	0.671	0.402	1.12
6–12 hours	0.776	0.419	1.437
>12 hours	0.571	0.2	1.627
Use patterns for online education			
With enough break	Reference		
With small break	1.021	0.696	1.498
Without break	1.044	0.658	1.658
Device used for online education			
Smartphone/tablet	Reference		
Smartphone/tablet and computer	0.559*	0.354	0.882
Smartphone/tablet and TV	–	.	.
Smartphone/tablet, computer and TV	0.098*	0.011	0.861
Computer	0.496*	0.226	1.089
Use per day for entertainment			
<2 hours	Reference		
2–6 hours	1.05	0.736	1.498
6–12 hours	0.624	0.336	1.158
>12 hours	1.598	0.547	4.667
Use patterns for entertainment			
With enough break	Reference		
With small break	0.901	0.623	1.303
Without break	1.264	0.741	2.155
Device used for entertainment			
Smartphone/tablet	Reference		
Smartphone/tablet and computer	1.664	0.965	2.872
Smartphone/tablet and TV	0.951	0.616	1.47
Smartphone/tablet, computer and TV	1.101	0.559	2.169
Computer and TV	0.47	0.042	5.26
Computer	0.988	0.415	2.351
TV	0.648	0.27	1.555

Multivariable logistic regression was used.
*P< 0.05,
**P<0.001.
AOR, adjusted OR; TTH, tension-type headache.

For example, constant screen use patterns are common in education, whereas in entertainment, one may use screen with sufficient intervals (table 2). Therefore, we also found lower odds of MHs in participants who used 6–12 hours of the screen for entertainment, probably due to the non-continuous usage of entertainment. However, >12 hours of use were associated with higher odds of MHs, although statistically not significant. Additionally, the participants were naïve to online education, allowing us to assess the impact of a sudden increase in screen usage exclusively. Moreover, prior studies could not compare MH and TTH[14] whereas this study could differentiate and compare MH and TTH using a validated screening tool

Table 4 Factors associated with migraine headaches among the study participants (n=771)

Variables	AOR	Upper bound of 95% CI	Lower bound of 95% CI
Baseline characteristics			
Age	0.95	0.841	1.064
Gender			
Female	Reference		
Male	0.543*	0.36	0.82
Level of study			
11th–12th grade	Reference		
Undergraduate	1.312	0.677	2.542
Graduate	5.124*	1.297	20.237
Family history of headache			
No	Reference		
Yes	2.248**	1.533	3.295
Personal history of disease			
Eye problem			
No	Reference		
Yes	1.483*	1.013	2.171
Insomnia			
No clinically significant insomnia	Reference		
Clinical insomnia	1.534*	1.009	2.331
Depression			
No or mild depression	Reference		
Moderate-to-severe depression	2.351**	1.553	3.559
Hearing impairment			
No	Reference		
Yes	1.284	0.857	1.924
Screen use-related variables			
Duration of online education			
<3 months	Reference		
3–6 months	2.162	0.723	6.466
6–12 months	2.731	0.974	7.661
>12 months	2.833*	1.003	8.003
Use per day for study			
<2 hours	Reference		
2–6 hours	0.769	0.412	1.436
6–12 hours	1.058	0.508	2.205
>12 hours	1.148	0.348	3.784
Use patterns for online education			
With enough break	Reference		
With small break	1.231	0.767	1.975
Without break	1.204	0.685	2.118
Device used for online education			
Smartphone/tablet	Reference		
Smartphone/tablet and Computer	0.802	0.465	1.383
Smartphone/tablet and TV	0.591	0.061	5.699
Smartphone/tablet, computer and TV	0.384	0.037	3.97
Computer	0.56	0.202	1.558
Use per day for entertainment			
<2 hours	Reference		
2–6 hours	0.984	0.646	1.5
6–12 hours	0.413*	0.178	0.955
>12 hours	1.405	0.443	4.454
Use patterns for entertainment			
With enough break	Reference		
With small break	0.717	0.46	1.118
Without break	0.713	0.375	1.354
Device used for entertainment			
Smartphone/tablet	Reference		
Smartphone/tablet and Computer	1.15	0.588	2.25
Smartphone/tablet and TV	1.269	0.767	2.10
Smartphone/tablet, computer and TV	0.84	0.361	1.954
Computer and TV	0.608	0.045	8.136
Computer	1.304	0.436	3.899
TV	1.216	0.439	3.368

Multivariable logistic regression was used.
*P<0.05.
**P<0.001.
AOR, adjusted OR.

(HSQ-EV scale) which can determine MH and TTH with high specificities (0.95 and 0.86, respectively).[15]

A recent systematic review and meta-analysis including seven articles found a significant relationship between smartphone/tablet use and headache.[24] Likewise, our study also established the detrimental role of smartphones/tablets compared with other devices in headaches. However, the underlying mechanism behind this issue is still unclear. Some studies suggested possible damage to the blood-brain barrier[25–28] or involvement of the dopamine–opiate system[29 30] on exposure to smartphone microwaves. In contrast, others mostly condemned the eye strain caused by screen resolution or viewing distance/angle.[31] However, some prior research identified screen characteristics (eg, screen brightness, frequency of screen band light, flickering, glare) as a possible trigger while some highlighted gradual lowering of migraine cascade threshold on repeated long-term

Table 5 Factors associated with mixed headache among the study participants (n=771)

Variables	AOR	Upper bound of 95% CI	Lower bound of 95% CI
Baseline characteristics			
Age	0.94	0.82	1.078
Gender			
Female	Reference		
Male	0.763	0.468	1.244
Level of study			
11th to 12th grade	Reference		
Undergraduate	0.893	0.404	1.972
Graduate	3.982	0.879	18.037
Family history of headache			
No	Reference		
Yes	2.659**	1.65	4.285
Personal history of disease			
Eye problem			
No	Reference		
Yes	1.301	0.822	2.06
Insomnia			
No clinically significant insomnia	Reference		
Clinical insomnia	1.102	0.671	1.809
Depression			
No or mild depression	Reference		
Moderate-to-severe depression	2.253*	1.365	3.719
Hearing impairment			
No	Reference		
Yes	0.873	0.543	1.404
Screen use-related information			
Duration of online education			
<3 months	Reference		
3–6 months	3.117	0.641	15.158
6–12 months	4.034	0.886	18.362
>12 months	4.562*	0.994	20.929
Use per day for study			
<2 hours	Reference		
2–6 hours	0.723	0.347	1.508
6–12 hours	0.978	0.415	2.303
>12 hours	0.884	0.215	3.633
Use patterns for online education			
With enough break	Reference		
With small break	1.056	0.609	1.833
Without break	0.795	0.401	1.578
Device used for online education			
Smartphone/tablet	Reference		
Smartphone/tablet and computer	0.48*	0.239	0.965
Smartphone/tablet and TV	1.77	0.195	16.032
Smartphone/tablet, computer and TV	0.604	0.058	6.329
Computer	0.355	0.09	1.408
Use per day for entertainment			
<2 hours	Reference		
2–6 hours	0.887	0.539	1.459
6–12 hours	0.482	0.176	1.322
>12 hours	1.639	0.458	5.86
Use patterns for entertainment			
With enough break	Reference		
With small break	0.884	0.524	1.492
Without break	0.915	0.426	1.966
Device used for entertainment			
Smartphone/tablet	Reference		
Smartphone/tablet and computer	1.885	0.838	4.239
Smartphone/tablet and TV	1.339	0.745	2.406
Smartphone/tablet, computer and TV	1.062	0.37	3.047
Computer and TV	–	–	–
Computer	1.997	0.536	7.435
TV	0.625	0.136	2.865

Multivariable logistic regression was used.
*P<0.05.
**P<0.001.
AOR, adjusted OR.

exposure.[32 33] Besides, according to Ranasinghe *et al*,[34] prolonged screen exposure leading to chronic accommodation, stress and fatigue of the eye muscles can lead to headaches.[34] Further research found that postural problems related to screen exposure, such as improper placement of the screen, inappropriate table or chair height, or close distance between eye and screen, resulting in unnecessary stretching or forward bending, often resulting in a muscular sprain, can cause primary headache.[31] Future research can help understand the actual mechanism behind this issue. Specifically, understanding the role of different light bands, screen quality and other device characteristics can significantly add to current knowledge.

Lastly, prior studies identified being female, depression,[35 36] insomnia[37] and eye problems[38] as aggregating factors of different types of headaches. The current study also linked these conditions to MH and TTH using validated and pretested methods. However, depression was the only condition that was consistently present as an aggregating factor in all headache types (TTH, MH and mixed). Therefore, the role of mental healthcare, adequate sleep and ocular care in preventing headaches can be explored in future studies.

The study has certain limitations that should be acknowledged. First, this study included a cross-sectional design, precluding any causality inference. Also, the HSQ-EV tool was used to differentiate between types of headaches as a screening tool rather than a diagnostic tool. Usually, the clinical diagnosis of headache is made by neurologists according to the International Classification of Headache Disorders criteria.[39] However, HSQ has high specificity and high negative predictive value in terms of determining headaches, which makes it a suitable tool for determining migraine and TTH headaches.[40] Furthermore, our study was conducted during COVID-19; therefore, the possibility of secondary headaches cannot be ruled out. In addition, it is necessary to consider the potential impact of using non-probability sampling methods and online data collection. Such methods can influence the generalisability and may result in inaccurate data reporting. In order to mitigate these challenges, researchers recruited a large sample size and employed personalised communication techniques to reach the target participants. Despite limitations, this study generated compelling evidence on-screen use and associated headaches using a validated headache and screentime assessment, considering potential confounders and large nationally representative samples.

This study examined the relationship between screen time and the occurrence of the two most prevalent types of headaches. Longer duration of screen exposure and smartphone usage were found to have a significant association with headaches. Further, longitudinal studies are required to establish the causal relationship of this association. Considering the inevitable proliferation of screen use among students, more efforts directed towards educating students on the proper use of electronic devices can be considered to mitigate the negative consequences.

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