


# Headache in Children and Adolescents: The Association between Screen Time and Headache within a Clinical Headache Population

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## Abstract

**Background** More than half of children and adolescents have experienced headache within the last 3 months. Several risk factors for headache have been identified, including obesity and lack of sleep. The association between screen time and headache in children and adolescents is sparsely investigated. The aim of this study was to assess this association and evaluate if it varied according to headache diagnosis.

**Method** This cross-sectional study was performed at the tertiary pediatric outpatient clinic for headache at Herlev University Hospital. A total of 139 participants who answered a questionnaire on lifestyle factors and their daily living were included. Diagnoses of migraine and tension-type headache (TTH) were made according to the International Classification of Headache Disorders-3. Children with both migraine and TTH were allocated to a mixed headache group. We differentiated between total, leisure, and school-related screen time.

**Results** The mean age was  $13.20 \pm 3.38$  years and 53.2% were girls. Note that 25.2% were diagnosed with migraine without aura, 23.0% migraine with aura, 28.1% TTH, 15.8% mixed headache, and 7.9% had an unclassified headache diagnosis at the time of inclusion. There was no statistically significant difference in screen time across the five headache groups. An association between screen time and headache frequency was found in children with migraine with aura.

**Conclusion** In this study, we investigated the association between screen time and headache in children and adolescents. More screen time was associated with more frequent headaches in children with migraine with aura. Future prospective studies are needed to determine the causality of this association.

## Keywords

- ▶ headache
- ▶ migraine
- ▶ tension-type headache
- ▶ risk factor
- ▶ screen time

## Introduction

Headache is a common complaint across the world. In Europe, lifetime prevalence of headache is 91.3%.<sup>1</sup> Of children and adolescents, 58.4% have experienced at least one headache episode within a 3-month period.<sup>2</sup> Migraine with and without aura and tension-type headache (TTH) are the most prevalent primary headache diagnoses in children.<sup>3</sup> Of

all children and adolescents, 7.7 to 9.1% are diagnosed with migraine and 31% suffer from TTH.<sup>4,5</sup>

## Risk Factors for Headache in Children and Adolescents

Numerous risk factors for migraine in children have been identified including obesity, alimentation, and lack of sleep.<sup>6</sup> Several studies have found an association between obesity and migraine in both adults and children, where a body mass

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index over 30 increases the risk of having migraine compared with those of normal weight. Although this association has been acknowledged, its nature is still discussed.<sup>7–10</sup> Regarding alimentation, studies show that 12 to 44% of both children and adults with migraine are triggered by a particular food or drink.<sup>11–14</sup> The most common food triggers are chocolate, cheese, and citrus fruit.<sup>14,15</sup> Although an association between certain foods and migraine has been established, it is still discussed whether it should be seen as a trigger or a premonitory symptom.<sup>16</sup> Caffeine, smoking, and alcohol are also well-known to induce headaches in adolescents.<sup>17–19</sup> Sleep is thought to have great impact on headaches as well as health in general. Studies show that children with migraine or TTH on average tend to sleep less and have a longer sleep latency compared with healthy controls.<sup>20,21</sup>

Despite numerous well-studied risk factors, screen time's effect on headache is yet to be fully understood.

No clear definition of screen time, or which devices it includes, is found in existing studies and literature, but the common denominator is time spent on screen-based electronics.<sup>22–25</sup> According to a large study including 2,000 young Americans in 2010, the average 8- to 10-year-old spent nearly 5.5 hours a day in front of a screen, 11- to 14-year-olds spent >8 hours a day while 15- to 18-year-olds spent >6 hours daily.<sup>26</sup> American Academy of Pediatrics (AAP) recommends that the child's total entertainment screen time is limited to a maximum of 2 hours per day.<sup>27</sup> Both the World Health Organization and AAP do not recommend any screen time at all for children under the age of 2 years.<sup>27,28</sup>

Several studies have shown that increased screen time has a negative effect on weight, mental health, and sleep.<sup>23,29,30</sup> The number of studies on screen time and headache is sparse, but the existing studies have shown an association in healthy children, adolescents, and young adults, where headache became more frequent with increased screen time.<sup>25,31–33</sup> A cross-sectional study on young adults, 18 years and older, found an association between increased screen time and migraine. When divided into migraine with and without aura, the significant association between screen time and migraine with aura disappeared.<sup>22</sup>

Two potential hypotheses have been raised to explain how screen time may interact with the migraine pathophysiology: (1) The luminosity or frequency of screen band light may directly trigger a migraine attack, and (2) increasing screen time exposure may reduce the threshold for migraine cascade that is induced by other factors.<sup>22</sup>

Overall, the evidence on how screen time affects headache in both adults and children is scarce. To provide more knowledge on the probable correlation between screen time and headache in children, we have performed a cross-sectional study on a clinical headache population of children and adolescents. The hypotheses were that (1) there is an exposure–response relationship between the number of hours spent in front of a screen and the frequency of headache, and (2) the association of screen time and headache frequency varies depending on the headache diagnosis.

## Methods

The study was located at the tertiary pediatric outpatient clinic (POC) for headache at Herlev University Hospital, Denmark.

### Inclusion of Participants

From April 2019 till April 2021, all patients aged 5 to 18 years in the POC were asked to participate in the project. All questionnaires were in Danish, therefore children who had never attended a Danish institution or school were excluded to avoid a language barrier.

### The Questionnaire

The structured questionnaire “You and your daily life” (“Dig og din hverdag”) consists of general questions about the child, for example, date of birth, gender, and school level, followed by questions on their headache, diet, smoking, alcohol, drugs, exercise, screen time (see definition below), sleep, stress, vision, hearing, dental status, and family.

### Definition of Screen Time

In this study, screen time is defined as time spent in front of a screen, for example, television, computer, tablet, smartphone, and/or video game console. A distinction between “school-related screen time” and “leisure screen time” has been made. “School-related screen time” is defined as screen time in relation to school classes and homework, while “leisure screen time” is defined as screen time for personal entertainment.

### Classification of Headache

To compare the different headache diagnoses, medical journals of the participants were examined. Classification of the headaches was done by experienced neuropediatricians as part of the care pathway at the POC. Classification was done according to the International Classification of Headache Disorders (ICHD)-3.<sup>34</sup> Depending on the diagnosis, the participants were grouped in five categories: migraine without aura, migraine with aura, TTH, mixed headache, and unclassified headache. The unclassified headache group consisted of children in whom the headache was not classified yet. Children with both migraine and TTH were allocated to the mixed headache group.

### Statistical Methods

Descriptive statistics were calculated for the sample, according to headache diagnosis. Chi-square, one-way analysis of variance, and Kruskal–Wallis test were used to assess differences between headache diagnoses. Mann–Whitney's test was used to assess the differences between those who had headache at least once a week, versus less than once a week, in relation to screen time (total, leisure, and school-related) and physical activity. When relevant, adjustment for confounders such as age, gender, physical activity, and healthy eating was made. The confounders were included based on existing literature.<sup>14–31</sup> The statistical analyses were performed using SPSS statistics software (version 26; IBM Corp.,

**Table 1** Sample characteristics, headache frequency, dietary habits, time spent on physical exercise, and screen time (school-related, leisure screen time, and total screen time) stratified by headache diagnosis (N = 139)

Characteristics	Migraine without aura N = 35	Migraine with aura N = 32	Tension-type headache N = 39	Mixed headache N = 22	Unclassified headache N = 11	p
Gender						
Boys (%)	57.14	68.75	17.95	40.91	63.64	< 0.001 <sup>a</sup>
Age (mean ± SD)	12.41 ± 3.73	12.28 ± 3.04	14.57 ± 2.88	13.65 ± 3.32	12.57 ± 3.78	<b>0.019<sup>b</sup></b>
Headache frequency						< 0.001 <sup>a</sup>
Daily (%)	8.58	–	61.54	45.45	27.27	
Weekly (%)	11.43	53.13	30.77	36.36	36.36	
Monthly (%)	65.71	40.63	7.69	13.64	27.27	
Less than monthly (%)	14.29	6.25	–	4.55	9.09	
Healthy eating						0.395 <sup>a</sup>
Yes (%)	85.71	84.38	87.18	68.18	81.82	
No (%)	14.29	15.63	12.82	31.82	18.18	
Weekly exercise						
0 h (%)	37.14	25.00	38.46	40.91	36.36	
1–5 h (%)	20.00	46.88	48.72	31.82	27.27	
5–10 h (%)	40.00	21.88	7.69	22.73	36.36	
More than 10 h (%)	2.86	6.25	5.13	4.55	–	
Average (mean ± SD)	3.31 ± 3.28	3.53 ± 3.09	2.54 ± 3.28	2.86 ± 3.14	3.00 ± 3.26	0.549 <sup>c</sup>
School-related screen time						
0–2 h daily (%)	45.71	37.50	41.03	36.36	54.55	
2–4 h daily (%)	28.57	28.13	23.08	9.10	27.27	
4–6 h daily (%)	8.57	18.75	23.08	27.27	10.00	
6–8 h daily (%)	14.29	15.63	12.82	22.73	18.18	
More than 8 h (%)	2.86	–	–	4.55	–	
Average (mean ± SD)	3.40 ± 2.52	3.56 ± 2.36	3.51 ± 2.22	4.45 ± 2.54	2.82 ± 1.99	0.363 <sup>c</sup>
Leisure screen time						
0–2 h daily (%)	31.43	37.50	30.77	22.73	54.55	
2–4 h daily (%)	40.00	37.50	51.28	50.00	36.36	
4–6 h daily (%)	28.57	18.75	17.95	22.73	9.09	
6–8 h daily (%)	–	3.13	–	–	–	
More than 8 h (%)	–	3.13	–	4.55	–	
Average (mean ± SD)	3.43 ± 1.48	3.53 ± 1.98	3.31 ± 1.32	3.77 ± 1.77	2.55 ± 1.37	0.333 <sup>b</sup>
Total screen time						
0–4 h daily (%)	31.43	25.00	17.95	4.55	45.45	
4–8 h daily (%)	40.00	43.75	56.41	54.55	45.45	
8–12 h daily (%)	20.00	21.88	25.64	31.82	9.09	
More than 12 h daily (%)	8.57	9.38	–	9.10	–	
Average (mean ± SD)	6.83 ± 3.48	7.09 ± 3.81	6.82 ± 2.46	8.23 ± 3.25	5.36 ± 2.92	0.178 <sup>b</sup>

Abbreviations: ANOVA, analysis of variance; SD, standard deviation.

Note: Significant estimates ( $p < 0.05$ ) in bold.

<sup>a</sup>Tested by chi-square.

<sup>b</sup>Tested by ANOVA one-way.

<sup>c</sup>Tested by Kruskal–Wallis test.

Armonk, New York, United States). The level of significance was set at 0.05.

### Ethics Statement

The project was approved by the Danish Scientific Ethical Committee (reference number: H-19003374) and Danish Data Protection Agency (reference number: VD-2019-222).

### Results

A total of 139 participants (65 boys and 74 girls) were included in this study. The mean age of the participants was  $13.20 \pm 3.38$  years and their mean total screen time was  $6.99 \pm 3.22$  hours per day, of which the mean leisure screen time accounted for  $3.40 \pm 1.61$  hours.

Sample characteristics, including headache frequency, dietary habits, time spent on physical exercise, and screen time (school-related, leisure screen time, and total screen time), was stratified by headache diagnosis (►Table 1). It shows that there was a significant difference in gender, age, and headache frequency between the headache groups, whereas no difference was found in screen time, dietary habits, and physical activity. Even after adjusting for possible confounders (age, gender, physical activity, and dietary habits) no significant difference in screen time (total, leisure, school-related) was found. ►Fig. 1 illustrates the differences in screen time across the five groups.

Participants with migraine with aura and headache at least once a week had a significantly higher total screen time than those with headache less than once a week ( $p=0.04$ ) (►Table 2). No significant association between total screen time and headache frequency was found in the other headache groups (►Table 2).

To examine the association of headache frequency and screen time across headache diagnoses, we compared lifestyle factors (exercise hours, dietary habits) and screen time among those with a headache frequency of less than once a week and those with a frequency of at least once a week. No statistically significant differences in screen time or lifestyle factors were found between the two frequency groups, even after correction of the possible confounders (exercise, age, gender, dietary habits).

### Discussion

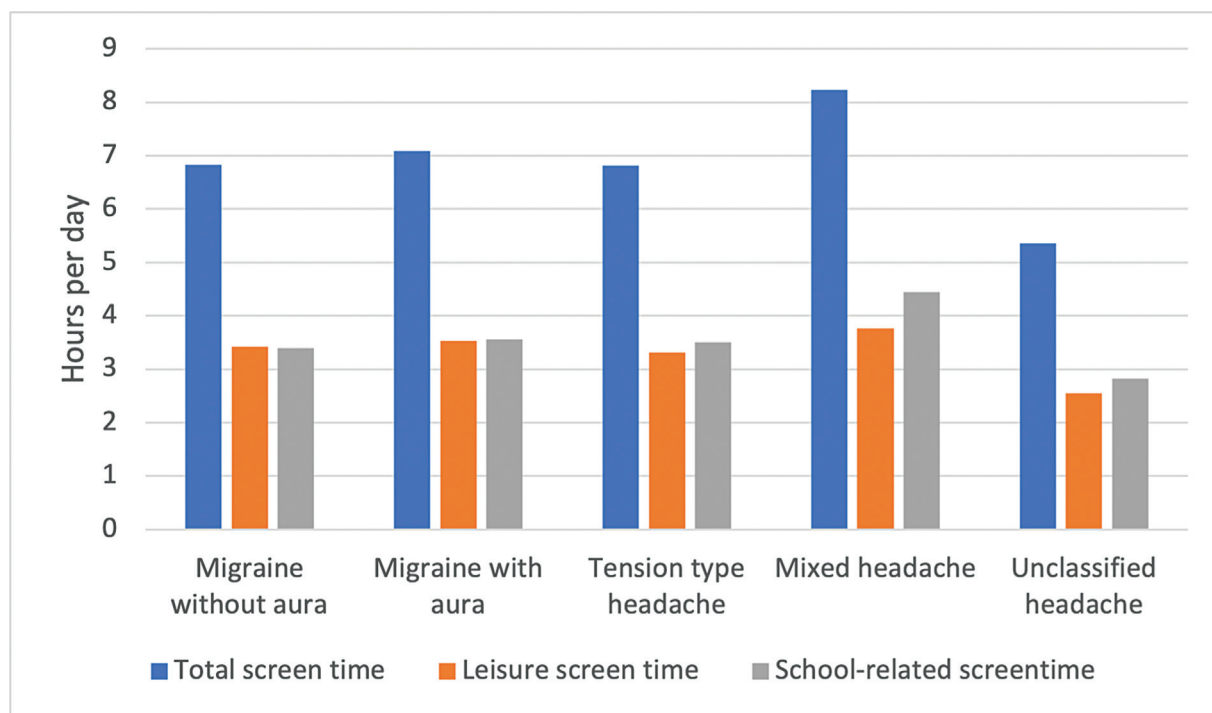
In this clinical cross-sectional study, we wanted to elucidate the association between screen time and headache in children. An exposure–response relationship between the number of hours spent in front of a screen and frequency of headache was found in children with migraine with aura. Children with more frequent headaches had higher total screen time than those with less frequent headaches.

#### Headache Diagnosis

This study found no significant differences in total, leisure, or school-related screen time across the five headache diagnoses (migraine without aura, migraine with aura, TTH, mixed headache, and unclassified), even after adjusting for headache frequency and possible confounders.

#### Headache Frequency

Total screen time and headache frequency was found to be associated in children with migraine with aura only. In the migraine with aura group, it was found that children with more frequent headaches had over 2.5 hours more total



**Fig. 1** Mean screen time in hours per day (total, leisure, and school-related screen time) within the five headache diagnoses.

**Table 2** Bivariate analyses between screen time, physical activity, and headache frequency within the five headache groups

Headache frequency	Migraine without aura		Migraine with aura		TTH		Mixed headache		Unclassified		p
	At least once a week	Less than once a week	At least once a week	Less than once a week	At least once a week	Less than once a week	At least once a week	Less than once a week	At least once a week	Less than once a week	
Total screen time (h/d)	7.43 ± 3.55	6.68 ± 3.51	8.35 ± 3.89	5.67 ± 3.27	6.72 ± 2.52	8.00 ± 1.00	8.56 ± 3.38	6.75 ± 2.36	5.57 ± 2.57	5.00 ± 2.00	0.648
Leisure screen time (h/d)	3.71 ± 1.25	3.36 ± 1.55	4.12 ± 2.21	2.87 ± 1.51	3.33 ± 1.31	3.00 ± 1.73	3.89 ± 1.91	3.25 ± 0.96	2.14 ± 1.35	3.25 ± 1.26	0.230
School-related screen time (h/d)	3.71 ± 2.81	3.32 ± 2.50	4.24 ± 2.25	2.80 ± 2.31	3.39 ± 2.26	5.00 ± 1.00	4.67 ± 2.59	3.50 ± 2.38	3.43 ± 2.23	1.75 ± 0.96	0.315
Physical exercise (h/wk)	4.86 ± 3.08	2.93 ± 3.27	2.88 ± 2.21	4.27 ± 3.81	2.61 ± 3.39	1.67 ± 1.53	2.17 ± 2.46	6.00 ± 4.32	3.14 ± 2.91	2.76 ± 4.27	0.788

Abbreviation: TTH, tension-type headache. Note: Tested by Mann–Whitney. The values presented are means and standard deviation (mean ± SD). Significant estimates ( $p < 0.05$ ) in bold.

screen time, than those with less frequent headaches. The school-related and leisure screen time were not associated with headache frequency in any of the headache diagnosis groups.

**Comparison with Other Studies**

Our findings are in line with the existing research,<sup>22,24,25,31–33</sup> where increased screen time is associated with more frequent headaches. Two studies have found an increased screen time in the children with migraine compared with healthy controls.<sup>22,24</sup> No differences in screen time was found between patients with migraine with aura and patients with migraine without aura, but participants with migraine without aura had a statistically significant higher screen time than healthy controls.<sup>22</sup>

In this study, we only found an association between screen time and headache frequency in patients with migraine with aura.

The definition of the duration of screen time in this study was different from the study of Attygalle et al.<sup>24</sup> They distinguished between “an hour or less” and “more than one hour” of screen time, while this study includes 1-hour intervals of screen time from 0 to “more than 8 hours.” This provides a more accurate estimate of the association.

As described, two potential hypotheses on how screen time might interact with the migraine pathophysiology has been raised.<sup>22</sup> Although this might explain why previous studies have found that migraine patients have a higher screen time than healthy controls, this cannot explain our finding that total screen time was associated with frequent headaches in patients with migraine with aura, but not in those without aura. Further studies are needed to examine this further.

**Strengths and Limitations**

This study has several strengths. The diagnoses in this study were verified by neuropsychiatrists using the ICHD-3, which contributes to correct classification of headaches.

Approximately 25% of the time children and adolescents use more than one media (TV, computer, smartphone, etc.) concurrently. This phenomenon has been defined as, “Media multitasking.”<sup>35</sup> An overestimation of screen time can thereby occur in studies, where screen time is summed per device. One study suggested that the association between screen time and headache might be more related to duration than the type of screen time.<sup>31</sup> In this study, the overestimation of screen time was avoided by asking the participants of their total screen time and using this number instead of summing all their screen time per device.

Limitations of this study include the cross-sectional design, which precludes any inference about causality. It is therefore not possible to determine whether the migraine with aura group with frequent headaches had more total screen time because they had frequent headaches or if they had more frequent headaches due to more total screen time. Furthermore, the used questionnaire has not been validated and the self-reported screen time might introduce recall



bias. Finally, younger children could be influenced by their parents, when answering the questionnaire.

## Conclusion

In this study, we have investigated the association between screen time and headache in children and adolescents within a clinical headache population. More screen time was associated with more frequent headaches in children with migraine with aura. Future prospective studies are needed to determine the causality of this association.

### Conflict of Interest

None declared.

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