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Cross-Sectional Study of Headache in Flemish Children and Adolescents

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Abstract

Background: Although headache is common in pediatrics, data for the Flemish population are missing. We explored headache-prevalence, and its association with communication-technology (CT) and physical activity (PA) in Flemish children and adolescents. **Methods:** A cross-sectional exploratory school-based questionnaire study was designed. Flemish boys and girls (5–18 years) completed a symptom-questionnaire. *Primary outcomes:* sociodemographic background, headache-prevalence, headache-characteristics, CT-use and PA characteristics (self-report). *Secondary outcomes*: associations between headache-characteristics, age, gender, and CT-use and PA-characteristics. **Results:** Four hundred twenty-four questionnaires were analysed: 5–7-years: n = 58; 8–11-years: n = 84; 12–15-years: n = 137; 16–18-years: n = 145. Fifty-five percent suffered from headache. Prevalence increased with age. More 16–18-year girls versus boys had headache. CT-use was the main headache-provocateur. Headache prevalence was significantly higher in a frequently physical active population. **Conclusion:** Our results suggest presence of headache in Flemish children and adolescents. PA-level associates with headache prevalence. However, children and adolescents with headache did not report more CT-use compared to controls.

Keywords

headache, child, adolescent

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Introduction

Headache is common in the pediatric population.[1,2] Globally, it ranks sixth in the leading causes of disability in children and adolescents.[3] In 6 to 18-year-olds, its overall mean prevalence amounts to 58%, the one-year prevalence to 5%.[1–5] Prevalence however varies from 5.9% to 82%, depending on the age and diagnostic-criteria.[6–11] Headache occurs in 3–8% of three-year-olds, by the age of five 20% reports headache, which increases to 37–52% in seven-year-olds. Between seven and 15 years, headache prevalence amounts between 57% to 82%. An early onset probably reflects an increased biological predisposition to develop headache.[2,12]

The most reported childhood and adolescent headaches are migraine and tension-type headache (TTH).[1,2,13–15] These primary headaches are characterized by a high rate of transitions with increasing age.[8] Approximately one in four patients with migraine switches to TTH and vice versa.[1] An initial childhood migraine diagnosis however, can be predictive for persistent adult headache.[16] A longitudinal prospective study revealed that headaches do not disappear in 15%, and even worsened in 6% of patients diagnosed with childhood headaches.[17,18] Such headaches can become chronic during adulthood, causing impaired individual and parental quality of life, and burden the health care systems.[4,18–20] Participation and performance at school, home, and community can be seriously compromised by headache.[21–23] The individual and economic burden is further reinforced by associations between childhood and adolescent chronic headache, (over)using non-prescription analgesics, and behavioral and mood disorders.[24,25]

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Therefore, factors that provoke, maintain, and aggravate headache should be determined as soon as possible.[25] Early recognition, treatment of comorbid conditions, and lifestyle adjustments could prevent headache progressing towards chronicity.[21] Sleep disturbances, which relate to the frequency and duration of migraine attacks, can affect an entire family since they include sleep anxiety, parasomnias, co-sleeping with parents, and bedtime resistance.[26] According to the Nord-Trøndelag Health Study (HUNT), negative lifestyle factors such as low physical activity, obesity, and smoking are associated with an increased prevalence of migraine, TTH, and non-classifiable headaches in 13 to 18-year-olds.[27]

Unfortunately, those studies concerning the impact of lifestyle factors on the onset, exacerbation, and persistence of headache are often limited to a mainly adolescent population, and do not consider other lifestyle factors.[18,27] Yet, a higher number of such negative lifestyle factors is related to higher headache-frequency in adolescents, which in turn is associated with chronification.[27,28]

In particular screen-time exposure (eg television, smartphones, laptops, computers), and the associated lower physical activity level, should be screened in adolescents and children. Increased screen-time exposure is related to a higher headache prevalence in primary school children.[29–32] Intense light and visual stimuli have been associated with development of migraine.[33] Such association supports investigating a potential link between screen-time exposure and pediatric headache development. Further, screen-time exposure is often reported by patients and families as triggers or exacerbating factor for headaches.

Recent work by Raucci et al (2021) advices regular physical activity as preventive lifestyle modification in pediatric headache.[34] Focussing especially on aerobic activity in children seems important. Such aerobic training program has already demonstrated to reduce the frequency of migraine in adults.[35] Although there are no specific data in children with migraine, recommendations to perform personalized physical activity should be considered as precious guidance in pediatric headache as well.[36]

The personal burden of childhood and adolescent headache is further accentuated by its impact on each domain of the World Health Organizations (WHO) 'International Classification of Functioning, Disability and Health'.[37] Yet, headache disorders attract low health-care priority.[20]

The Global Burden of Disease Study (2010) therefore emphasized the importance of population-based studies of headache disorders, as they are essential to map the problem, and give guidance to policy makers.[38,39] Currently, only one (older) study maps prevalence of pain in Flemish children and adolescents. These authors explore the general prevalence of pain in 10.650 schoolchildren. Focus of the research was to examine pain severity in relation to various domains of school functioning and, the potentially protective role of perceived teacher support of child/adolescent autonomy and competence. Pain was reported to impact a child's quality of life. Higher pain grades were associated with poorer outcomes across all indices of school functioning (ie school absenteeism, school-related pressure and satisfaction, and bullying experiences).[22] These findings, together with the previously reported worse quality of life of children with headache, necessitate exploring prevalence of headache and its association with modifiable lifestyle factors characteristics in Flanders.[22,40]

The goal of the current study was therefore to fill this gap by exploring headache prevalence, and its relation with communication technology (CT) and physical activity in Flemish children and adolescents.

Materials and methods

Design

Cross-sectional exploratory school-based questionnaire design to gather information on headache prevalence, and its association with CT and physical activity in Flemish children and adolescents.

Eligibility and Ethics

Children and adolescents between 5 and 18 years were randomly selected by convenience sampling at different schools. School principals in Flanders (provinces of Antwerp, Limburg, Vlaams-Brabant) were contacted via email to participate between January 2018 and March 2018. The mail contained detailed information concerning the study, an example questionnaire, and an informed consent for the school. If the school granted approval, the questionnaires were distributed to the parents or legal guardian (< 14 years), and teachers (> 14 years). Parents or legal guardians and children/adolescents had to read and sign an additional informed consent before officially being enrolled in the study. Questionnaires were completed at school (> 14 years), and at home (< 14 years). *Inclusion criteria*: school going native Dutch-speaking children and adolescents between 5 and 18 years. *Exclusion criteria*: pregnancy, serious pathology (medical comorbidities), comorbid headache (otitis media, meningitis, sinusitis), dental braces, history of neck/head trauma, and overuse of analgesic medication (NSAID's, opioids, acetylsalicylic acid, triptans, simple analgesics for > 10 days/month > 3 months).

The current study is part a larger project which is registered as an observational study at ClinicalTrials.gov (NCT02887638). The Medisch Ethische ToetsingsCommissie of Zuyderland (NL. 55720.09615) and the Comité Medische Ethiek of the Ziekenhuis Oost-Limburg (B371201423025) granted approval to execute the experimental protocol.

All participants (school, parents, guardians, adolescents > 14 year) signed the written informed consent in which information was given concerning confidentiality of data conform the Belgian law of December eighth 1992. All procedures involving human participants were in accordance with the ethical standards of the institutional research committees and with the 1964 Helsinki Declaration, and the later amendments.

Outcomes, Measurements and Instruments

The construct of the questionnaire in the current study was based on three essential requirements: 1) each question is fully comprehensible to the age-category for whom it is

intended, 2) each question adds comprehensive information, and 3) the time to explain (teacher/parent/guardian) and complete the questionnaire is limited (30 min).[39]

The content of the questionnaire was based on the Vragenlijst Lichamelijke Klachten-Kinderen (VLK-K) and standard pediatric headache-anamnesis. The VLK-K is a valid and reliable symptom-questionnaire.[40] The VLK-K questions 40 possible complaints. For each of these complaints, five questions must be answered: intensity/frequency during the last two weeks, duration, influence on functioning, search for medical help, and the physical cause. Each complaint is assessed on the intensity/frequency question on a four-point scale (0 = not at all, 1 = a little, 2 = a lot, and 3 = very much). The other four questions are answered for complaints with a score of 1, 2 or 3 on the intensity/frequency question. The duration of the complaint is scored on a four-point scale (1 = less than a week, 2 = one to three weeks, 3 = three weeks to three months, 4 = longer than three months). The children then indicate whether a complaint has an influence on their functioning (yes/no). The influence on functioning is explained by the test leader as eg staying away from school, no longer being able to exercise hobbies, etc The children check whether they visited a doctor for a particular complaint, and whether this complaint was discussed during the visit.[41]

Additionally, questions on the prevalence and characteristics (type, setting, frequency, duration) of CT–use, and level of physical activity were included. The Flemish Physical Actvity Questionnaire (12 to 18 years old) and questions from the European ToyBox (children) were used to assess the latter.[42–44]

Primary outcomes. 1. Sociodemographic characteristics. Age, gender, level of education of the mother, and the living situation. *2. Headache characteristics*. Prevalence of headache (yes = 1, no = 0) during the last three months, mean headache intensity per episode (Faces Pain Scale–Revised, converted to 0 to 100 mm conform the Visual Analogue Scale),[45–47] mean duration of an episode (< 30 min, 30–60 min, 1–2 h, 2–4 h, no spontaneous headache-resolution), frequency (not weekly, 1/w, 1–2/w, 2–3/w, 3–4/w, > 4/w, daily), time of day (morning, afternoon, evening, night), and headache provocation(s). *3. CT-use characteristics.* Prevalence of CT-use (yes = 1, no = 0), specifications of CT (laptop, desktop, tablet, smartphone, television), setting (home, school), mean daily duration of CT-use at home and in school (< 30 min, 30–60 min, 1–2 h, 2–4 h, no use), frequency (≤ 1/w, 1–2/w, 2–3/w, 3–4/w, > 4/w, daily, no use), and duration (< 30 min, 30–60 min, 1–2 h, 2–4 h, > 4 h), and *4. Physical activity* characteristics. Mean duration of the physical activity (< 30 min, 30–60 min, 1–2 h, 2–4 h, no activity), and frequency (1/w, 2/w, > 2/w). All primary outcomes were gathered via self-report questionnaires and expressed as percentages (%).

Secondary outcomes. Associations between headache-characteristics, and age, gender, CT-use and physical activity characteristics.

Procedure

Parents and teachers used guidelines to complete the questionnaires together with the children and adolescents in an exam-free period. Instructions were to use a quiet, ventilated, and temperature-controlled room. Questions had to be completed in a chronological order, and answered under supervision of the parent/legal guardian if participants were < 14 years. Participants > 14 years completed the questionnaire individually at school.

Statistics

Analysis was done via SAS JMP Pro 14 software (SAS Institute Inc.). Two-tailed tests at 5% level of significance were reported. Sample size (N = 445) (power 80%, $\alpha = 0.05$) was estimated a priori (G*Power 3.1.9.4, Kiel Germany) based on the prevalence (%) of headache in children and youth in Europe.[48]

Four age-categories were composed: 5–7 years, 8–11 years, 12–15 years, and 16–18 years.[49] All data were proportionally analysed per age-category. Proportions were compared using Chi-squared tests (contingency tables for categorical variables). Odds ratios (OR) or Chi-squares (X^2) were provided with a 95% confidence interval (CI). Corrections were made for the explanatory variables: wearing glasses (0 = no, 1 = yes) and body mass index (BMI) (0 = BMI ≤ 24.9 kg/m^2, 1 = BMI ≥ 25 kg/m^2). The Cg was matched for age.

Objective 1. Headache-prevalence in Flemish children and adolescents.

1. *Sociodemographic characteristics*. Group characteristics (age, gender, level of education of the mother, living situation) were proportionally presented and compared between age-categories. Socioeconomic characteristics (living situation, studies mother, studies participant) were compared between children and adolescents with (Headache-group, HAg), and children and adolescents without (Control-group, Cg) headache.
2. *Headache characteristics* were proportionally presented and compared between the age-categories.

Objective 2. Association between headache (characteristics and prevalence), and CT-use and physical activity characteristics in Flemish children and adolescents (Appendix 1).

1. *CT-use characteristics* (type, location, duration, frequency) were proportionally presented and compared between the HAg and Cg.
2. *Physical activity characteristics* (duration, frequency) were proportionally presented and compared between the HAg and Cg.
3. *Possible associations* (X^2) were analysed between age,[6–11] gender,[50–53] CT-use[29–32] and physical activity[34–36] characteristics, and the frequency and duration of headaches.

The prevalence of headache was a dependent variable. Age, gender, CT-use, and physical activity characteristics were independent variables (Appendix 1).

Further, characteristics of physical activity (duration, frequency) were proportionally presented and compared between the HAg and Cg.

Results

Response-Rate

A total of 876 questionnaires were distributed (November 2017 to March 2018): 176 questionnaires at kindergartens, 250 at primary schools, and 450 at secondary schools. Four hundred ninety-nine questionnaires were collected. The response-rate in the kindergartens was 10%, primary schools 28%, and secondary schools 62%. Seventy-five questionnaires were excluded for: incompleteness (n = 8), chronic medication-use (n = 5), serious pathology (n = 9), history of trauma to the head/face/spinal cord (n = 36), and headache due to sinusitis or otitis media (n = 17). Finally, 424 completed questionnaires were included (5–7 years: n = 58; 8–11 years: n = 84; 12–15 years: n = 137; 16–18 years: n = 145) (Figure 1).

Sociodemographic Characteristics

Fifty-five percent (n = 233) of the participants (N = 424) suffered from headache in the past three months. The prevalence increased significantly ($p < .001$) with age, ie 21% of the children between 5–8 years, 32% of the children between 8–11 years (OR = 1.78, 95% CI 0.26–1.11, $p.147$), 59% of the children and adolescents between 12–15 years (OR = 3.2, 95% CI 1.81–5.66, $p < .001$), and 78% of the adolescents between 16–18 years (OR = 2.39, 95% CI 1.42–4.02, $p.001$) reported headache.

Between 12–15 years (OR = 2.71, 95% CI 1.33–5.52, $p.005$), and between 16–18 years (OR = 2.74, 95% CI 1.22–6.17, $p.001$) significantly more girls had headache compared to boys. Such differences were not observed in the other age-categories (5–7 years, $p.134$; 8–11 years, $p.092$). All participants used CT (Table 1).

Next, each age-category was split into HAg and Cg to compare socioeconomic characteristics (Table 2).

Age-category 5–7 years. All participants in the HAg attended kindergarten compared to 65.2% in the Cg ($p.03$). The remaining 34.8% of children in the Cg frequented primary school.

Age-category 12–15 years. In the HAg significantly ($p.006$) more mothers (27.2%) had a background in vocational education and less mothers obtained a bachelor degree (35.8%) compared to in the Cg (8.9%, 55.4%, respectively). Most participants in the HAg (43.2%) attended general studies in secondary school ($p.004$) compared to 21.4% in the Cg.

Age-categories 8–11 years and 16–18 years. No significant differences were observed concerning socioeconomic background between the HAg and Cg.

Headache Characteristics

Table 3 provides a detailed summary of the headache characteristics. A mainly evening-headache was reported by 74% of the participants. Average duration of a headache episode was less than 30 min in 30% of the participants. Five percent of the participant reported headache was daily present, and in 19% of the participants headache episodes did not resolve spontaneously. Proportionally, participants in the highest age-categories 12–15 years and 16–18 years had the largest percentages of non-resolved headaches (22% and 19%, receptively). These headaches were significantly more prevalent if age increased ($p.01$).

The mean score on the Visual Analogue Scale (VAS) was > 50 mm (derive from the Dutch Faces Pain Scale-Revised) in 36% of the participants. VAS-scores differed not significantly ($p.08$) between age-categories.

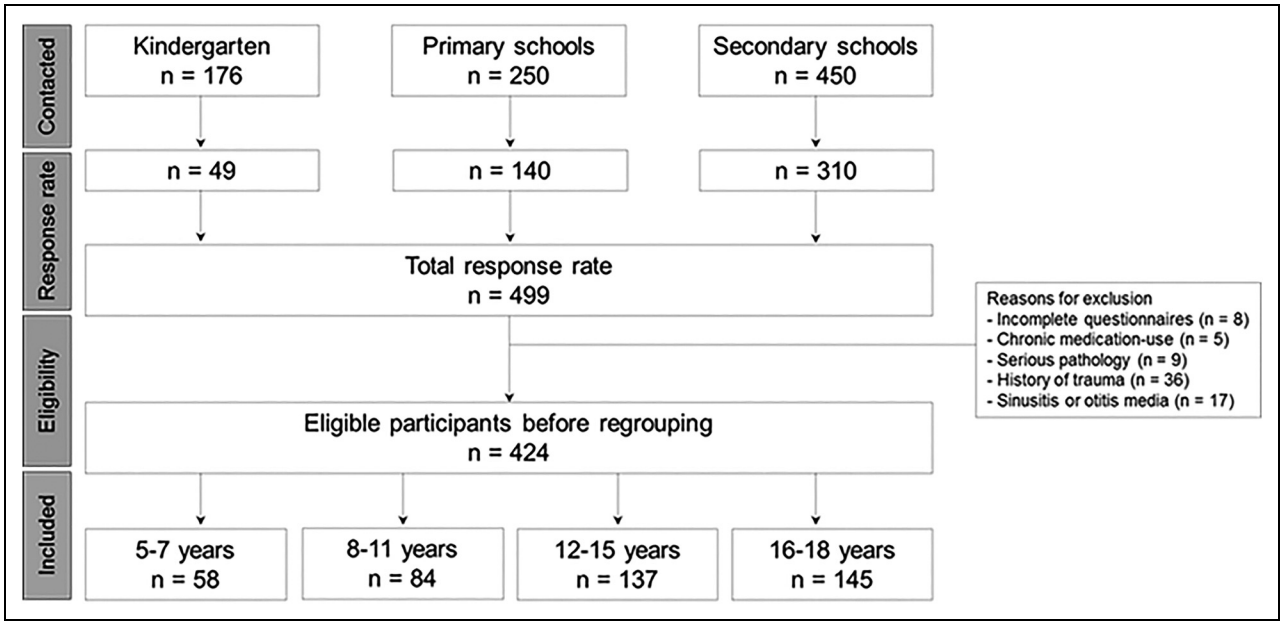


Figure 1. Summary of the selection process (n, number of participants).

Headache Provocation

Of the participants with headache, 42% in the youngest age-category (n = 5/12), 37% in the 8–11 years (n = 10/27), 90% in the 12–15 years (n = 73/81), and 80% in the oldest age-category (n = 91/113) could describe which activity or situation provoked headache (Figure 2). Significantly less participants between 5–11 years were able to define which activity or situation provoked their headache compared to participants between 12–18 years (OR = 2.49, 95% CI 1.17–5.29, *p*.017). Headache-related absence from school for at least one day was reported by 19.3% (45/233) of the participants with headache (5–7 years: n = 1, 8–11 years: n = 4, 12–15 years: n = 18, 16–18 years: n = 22).

CT-use characteristics (Appendix 2)

Each participant used CT *at home*. Tablets were the most reported type of CT in the 5–7 and 8–11 years age-categories, and smartphones and laptops in the 12–15 and 16–18 years age-categories. Watching television was highly prevalent in each age-category. Duration of CT-use at home increased significantly ($p < .001$) with age (between 5–7 and 16–18 years: OR = 2.54, 95% CI 1.36–4.75, *p*.004).

Eighty-nine percent of the participants used CT *at school*. The percentage increased significantly ($p < .001$) from 60% in the youngest age-category to 99% in the oldest (between 5–7 and 8–11 years: OR = 6.33, 95% CI 2.58–15.23, $p < .001$; between 8–11 and 12–15 years: OR = 0.99, 95% CI 0.39–2.5, *p*.985; between 12–15 and 16–18 years: OR = 7.55, 95% CI 1.67–34.1, *p*.009). The desktop-computer was the most common CT-type at school, no smartphone use at school was reported by participants under the age of 12.

No associations between headache prevalence and CT-use were seen in the younger age-categories. From the ages of 12 to 15 years, more participants (61%) who used CT and reported headache were seen. By the age of 16–18 years, significantly (X^2 45.31, 95% CI 47.04–79.24%, $p < .001$) more participants using CT and reporting headache were seen (84%).

Next, each age-category was split into a HAg and Cg to compare CT-use characteristics (Table 4).

Age-category 5–7 years. No significant differences in distribution of the mean duration of CT-use per session at school and at home were seen *between the HAg and Cg*.

Mean duration of CT-use per session was significantly longer in the school- versus home-setting *within the HAg* (*p*.01) *and Cg* ($p < .001$).

Age-category 8–11 years. Most participants in the HAg (88.9%) reported a mean duration of 1–2 h per CT-session, compared to 80.7% of participants in the Cg reporting a mean duration of 2–4 h ($p < .001$).

Within both groups mean duration of CT-use per session was longer in the school- versus home-setting ($p < .001$).

Age-category 12–15 years. Most participants in the HAg (38.3%) reported a mean duration of 2–4 h per session CT-use at home, in the Cg most participants (44.6%) reported a mean duration of 1–2 h per session (*p*.01).

Within both groups mean duration of CT-use per session was significantly longer in the school- versus home-setting ($p < .001$).

Age-category 16–18 years. In the HAg, 30.1% of the participants reported a mean duration of 30–60 min per CT-session at home, compared to 3.1% in the Cg. Further, in the Cg 40.6% of participants reported a mean duration of CT-use of 2–4 h per session at home, compared to 28.3% in the HAg (*p*.01).

Within both groups mean duration of CT-use per session was significantly longer in the school- versus home-setting ($p < .001$).

Factors associated with headache: age, gender, CT-use and physical activity characteristics (Appendix 1)

Higher headache prevalence was significantly associated with older age (Figure 3). Further, headache prevalence was significantly higher in a frequently physical active compared to a less frequently physical active pediatric population. Interestingly, most participants without headache were highly physical active (Figure 4).

Each age-category was split into a HAg and Cg to compare the level of physical activity (Table 5).

Age-category 5–7 years. No significant differences in the distribution of the level of physical activity were seen *between the HAg and Cg*.

Age-category 8–11 years. Duration per session physical activity was generally longer in the HAg compared to the Cg ($p < .001$).

Age-categories 12–15 years and 16–18 years. Participants in the HAg were significantly less frequent physical active compared to participants in the Cg (12–15 years $p < .001$; 16–18 years *p*.001).

Discussion

This explorative study is the first step to explore the prevalence of headache, and its associations with CT-use and physical activity characteristics in Flemish children and adolescents. Our results suggest that headache is prevalent in Flemish children and adolescents, CT-use is reported as an important headache-provocateur, and the level of physical activity an associated factor.

Headache: Health Issue at Flemish Children and Adolescents?

Sociodemographic Characteristics. Headache prevalence amounted to 55% in our study. Further, prevalence was higher in adolescents aged 16–18 years (78%) compared to children aged 5–7 years (21%). These findings are consistent with previous research.[2,23] Next to such age-related increase, a sex-related difference was remarked in our study. Prevalence of headache does not differ significantly between boys and girls before puberty. Yet, from the ages of 12 to 18 significantly more girls compared to boys reported headache. Since prevalence of CT-use and level of physical activity were similar in boys and girls, other factors such as eg hormonal fluctuations

Table 1. Comparison of the Socioeconomic Background and Participants Characteristics Between all Age-categories.

Age-category	5–7 years (n = 58)	8–11 years (n = 84)	12–15 years (n = 137)	16–18 years (n = 145)
Gender, n (%) (F/M)	27 (47) /31 (53)	38 (45)/46 (55)	52 (38)/85 (62)	52 (36)/93 (64)
CT, n (%) (Y/N)	58 (100)/0	84 (100)/0	137 (100)/0	145 (100)/0
Headache, n (%)				
Yes*	12 (21)	27 (32)	81 (59)	113 (78)
F/M	6 (50) / 6 (50)	15 (56) / 12 (44)	58 (72) / 23 (28)‡	79 (70) / 34 (30)‡
No	46 (79)	57 (68)	56 (41)	32 (22)
Diagnosis (if known), %				
TTH	33.3	70.4	40	29.7
Migraine	8	3.7	18.5	17.2
Cervicogenic	0	0	4.9	0
Studies, n (%)				
Kindergarten	42 (72)	N/A	N/A	N/A
Primary school	16 (28)	84 (100)	26 (19)	N/A
Secondary school				
General	N/A	N/A	47 (34)	119 (82)
Technical	N/A	N/A	44 (32)	25 (17)
Vocational	N/A	N/A	20 (15)	1 (1)
Living situation, n (%)				
Both parents	57 (98)	78 (93)	99 (72)	126 (87)
Co-parenting	1 (2)	2 (2)	19 (14)	9 (6)
Mother	N/A	4 (5)	15 (11)	9 (6)
Father	N/A	N/A	1 (1)	1 (1)
Guardian	N/A	N/A	1 (1)	N/A
Boarding school	N/A	N/A	1 (1)	N/A
Level of education mother, n (%)**				
Vocational	12 (20.7)	10 (11.9)	27 (19.7)	30 (20.7)
Evening school	3 (5.2)	0	0	0
Bachelor	29 (50)	54 (64.3)	60 (43.8)	65 (44.8)
Master	14 (24.1)	15 (17.9)	19 (13.9)	30 (20.7)
High school	0	5 (6)	23 (16.8)	11 (7.6)
Self-employed	0	0	6 (4.4)	7 (4.8)
Unemployed	0	0	2 (1.5)	2 (1.4)

n, number of participants; F, Female; M, Male; Y = Yes; N = No; N/A, Not Applicable; CT, Communication Technology; $p < .05$, level of significance; *, $p < .001$ (X^2), prevalence increased significantly with increasing age; ‡, $p.001$ (X^2), significantly more girls compared to boys have headache between the ages of 12–15 and 16–18; **, $p.009$ (X^2), significantly more headache was observed in the age-category 12–15 years if the mother attended vocational education (27.2% vs 8.9%).

during puberty might be involved. Such fluctuations have been associated with the start of a variety of pain disorders, including headache.[50,51] The onset of migraine for instance may occur shortly around the time of menarche, probably triggered by oestrogen withdrawal.[52,53]

In the current analysis an association was also found between lower maternal education level and higher headache prevalence in 12–15 year-olds. This finding is relevant since the parental educational level seems a socioeconomic determinant of psychological and self-perceived health.[54] However, because of the cross-sectional design of the study, associations between headache and sociodemographic variables could only be noted, and not interpreted in terms of causation.[55]

Headache Characteristics. We used the Dutch Faces Pain Scale-Revised to measure headache intensity.[45,46] This scale shows a close linear relationship with the 100 mm VAS from the age of four.[46] Scores from 45 to 75 mm are indicative of moderate pain, scores between 75 and 100 mm of severe pain.[47] The mean headache intensity reported by 36% of the participants in our study was > 50 mm, implying that headache has a moderate to severe intensity. Such pain intensity in children and adolescents is known to be associated with poor outcomes on school functioning.[22] In our study headache-related absence from school for at least one day was reported by 19.3% of the children and adolescents with headache.

Further, it is alarming that headache did not resolve in 19%, and was daily present in 5% of the participants. Such daily headaches have a general prevalence ranging from 0.9 to 7.8% in children and adolescents, and are one of the main reasons to consult a headache clinic in Western countries.[56] Chronic daily headache is often referred to as a multifaceted syndrome in which associations exist between headache, psychosocial stressors, and psychiatric disorders.[56,57] Such complex syndromes are persistent and debilitating.[58]

The prevalence, intensity and persistent character of headache in the current study suggests that headaches could indeed be a health issue in Flemish children and adolescents.

Table 2. Comparison of the Socioeconomic Background Between the HAg and Cg.

Age-category 5–7 years	HAg (12/58)	Cg (46/58)	p
Living situation, n (%)			.73
Both parents	12 (100)	40 (87)	
Co-parenting	0	2 (4.3)	
Mother	0	4 (8.7)	
Level of education mother, n (%)			.41
Vocational	3 (25)	9 (19.6)	
Evening school	0	3 (6.5)	
Bachelor	8 (66.7)	21 (45.7)	
Master	1 (8.3)	13 (28.3)	
Studies child, n (%)			.03
Kindergarten	12 (100)	30 (65.2)	
Primary school	0	16 (34.8)	
Age-category 8–11 years	**HAg (27/84)**	**Cg (57/84)**	**p**
Living situation, n (%)			.28
Both parents	27 (100)	51 (89.5)	
Co-parenting	0	2 (3.5)	
Mother	0	4 (7)	
Level of education mother, n (%)			.67
Vocational	4 (14.8)	6 (10.5)	
High school	2 (7.4)	3 (5.3)	
Bachelor	15 (55.6)	39 (68.4)	
Master	6 (22.2)	9 (15.8)	
Studies child, n (%)			1
Primary school	27 (100)	57 (100)	
Age-category 12–15 years	**HAg (81/137)**	**Cg (56/137)**	**p**
Living situation, n (%)			.72
Both parents	59 (72.8)	40 (71.4)	
Co-parenting	10 (12.3)	9 (16.1)	
Mother	11 (13.6)	6 (10.7)	
Guardian	1 (1.2)	0	
Boarding school	0	1 (1.8)	
Level of education mother, n (%)			.006
Vocational	22 (27.2)	5 (8.9)	
High school	11 (13.6)	12 (21.4)	
Bachelor	29 (35.8)	31 (55.4)	
Master	11 (13.6)	8 (14.3)	
Self-employed	6 (7.4)	0	
Unemployed	2 (2.5)	0	
Studies child, n (%)			.004
Primary school	8 (9.9)	18 (32.1)	
Secondary school	73 (90.1)	38 (67.9)	
General	35 (43.2)	12 (21.4)	
Technical	27 (33.3)	17 (30.4)	
Vocational	11 (13.6)	9 (16.1)	
Age-category 16–18 years	**HAg (113/145)**	**Cg (32/145)**	**p**
Living situation, n (%)			.62
Both parents	98 (86.7)	27 (84.4)	
Co-parenting	6 (5.3)	3 (9.4)	
Mother	9 (8)	2 (6.3)	
Level of education mother, n (%)			.94
Vocational	25 (22.1)	5 (15.6)	
High school	9 (8)	2 (6.3)	
Bachelor	48 (42.5)	17 (53.1)	
Master	23 (20.4)	7 (21.9)	
Self-employed	6 (5.3)	1 (3.1)	
Unemployed	2 (1.8)	0	
Studies child, n (%)			.09
Secondary school			
General	91 (80.5)	28 (87.5)	
Technical	22 (19.5)	3 (9.4)	
Vocational	0	1 (3.1)	

n, number of participants; Bold, $p < .05$, level of significance; p-values were deducted from contingency tables (X^2).

Table 3. Details of Headache Characteristics Per Age-category.

Age-category	5–7 years (n = 12)	8–11 years (n = 27)	12–15 years (n = 81)	16–18 years (n = 113)	Total (n = 233)
Frequency, n (%)					
Not weekly	8 (67)	17 (63)	37 (46)	53 (47)	116 (50)
1/w	3 (25)	7 (26)	21 (26)	24 (21)	54 (23)
1–2/w	1 (8)	2 (7)	10 (12)	17 (15)	30 (13)
2–3/w	0 (0)	1 (4)	2 (3)	10 (9)	13 (6)
3–4/w	0 (0)	0 (0)	1 (1)	3 (3)	4 (2)
> 4/w	0 (0)	0 (0)	2 (3)	3 (3)	5 (2)
Daily	0 (0)	0 (0)	8 (10)	3 (3)	11 (5)
Duration, n (%)					
< 30 min	4 (33)	9 (33)	28 (35)	29 (26)	70 (30)
30–60 min	1 (8)	5 (19)	20 (25)	30 (27)	56 (24)
1–2 h	5 (42)	5 (19)	7 (9)	13 (12)	30 (12)
2–4 h	1 (8)	0 (0)	8 (10)	19 (17)	28 (11)
No spontaneous resolution*	1 (8)	4 (15)	18 (22)	22 (19)	45 (19)
Time of day, n (%)					
Morning	2 (17)	4 (15)	32 (40)	32 (48)	70 (30)
Afternoon	4 (33)	13 (48)	32 (40)	52 (46)	101 (43)
Evening	7 (58)	17 (63)	61 (75)	87 (77)	172 (74)
Night	0 (0)	2 (7)	7 (9)	5 (4)	14 (6)
Intensity, n (%)					
≤ 50 (VAS)	11 (92)	19 (70)	54 (66)	66 (58)	159 (68)
> 50 (VAS)	1 (8)	8 (30)	27 (33)	47 (42)	74 (32)

n, number of participants; w, week; min, minute; h, hour; VAS, 100 mm Visual Analogue Scale, derived from the Faces Pain Scale-Revised; $p < .05$, level of significance; *, $p.01$ (X^2), prevalence increased significantly with an increasing age.

CT-use and Physical Activity Characteristics Associated with Headache Prevalence? Controversial Results

CT-use Characteristics. Children and adolescents use CT such as smartphones, desktops, laptops, and tablets to complete many

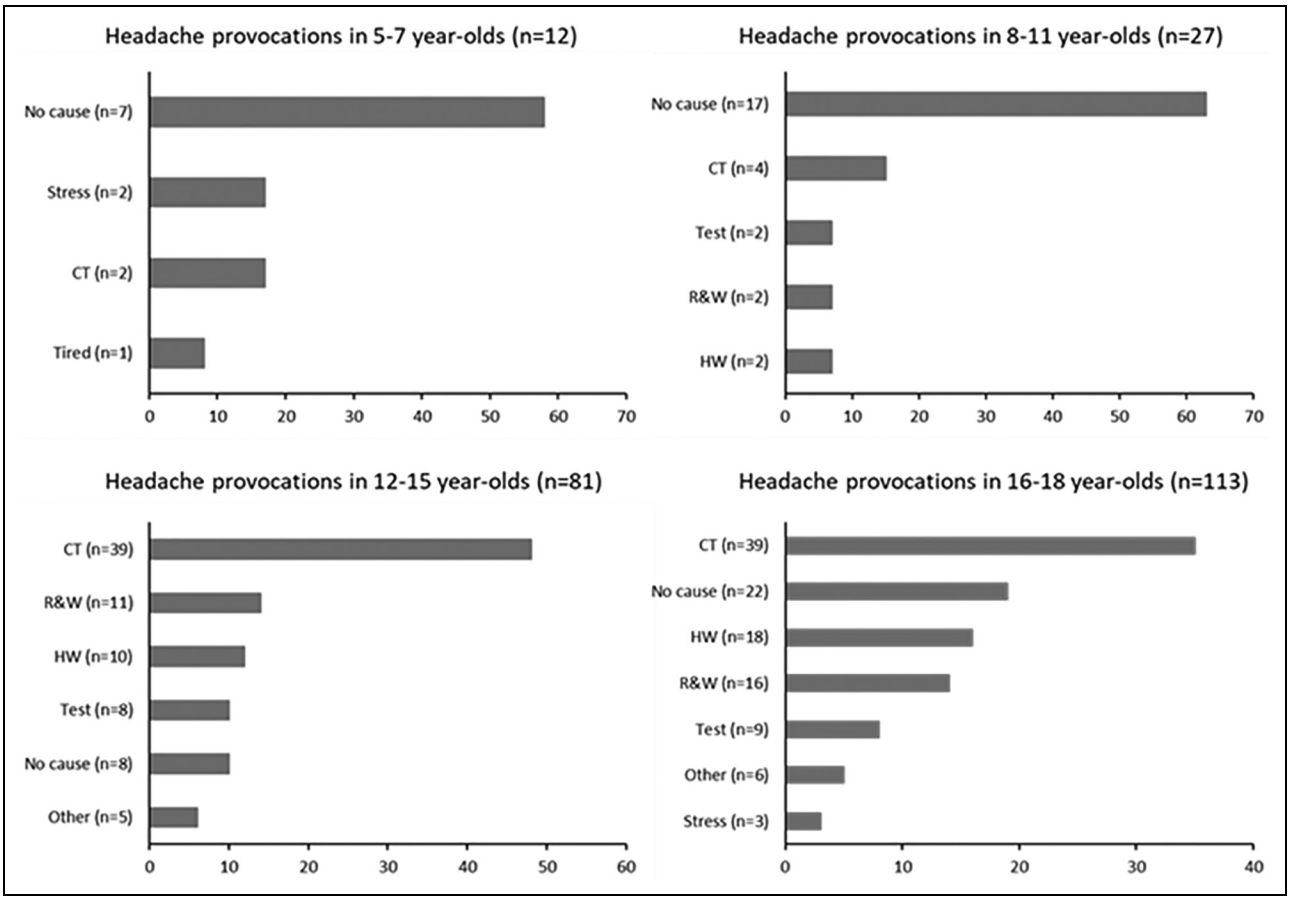


Figure 2. Visualization of headache provocative activities in each age-category (x-axis, proportions (%); n, number of participants; CT, Communication Technology; Test, school test which required home study; R&W, reading and writing; Other: bending, domestic work, swimming, class-room temperature, following course in general; HW, Homework).

daily activities including playing, school work, and socializing with peers. CT-use of participants in our study amounts between 89% and 100% in school- and home-settings, respectively, and was appointed to be the main provocateur for a headache episode in each age-category. According to Brattberg (2004), pain reported in childhood and early adolescents (eg headache) can persist into the late 20s.[59] International guidelines advise no more than 2 h of recreational screen-time per day on weekdays for children and adolescents.[60] However, 23% of our participants reported a daily CT-use of 2–4 h. More participants in the eldest age-categories (12–15 years 29%, 16–18 years 31%) reported a daily CT-use of 2–4 h compared to the youngest (5–7 years 7%, 8–11 years 8%) (OR = 6.21, 95% CI 2.12–18.18, $p < .001$). According to previous work, odds of reporting headache are higher if the time using a screen interface increases.[27]

In our study, duration of CT-use at home exceeded the duration of CT-use at school (OR 1–2 h CT-use at home vs school: 13.83, 95% CI 7.82–24.49, $p < .001$) (OR 2–4 h CT-use at home vs school: 10.05, 95% CI 5.41–18.63, $p < .001$). Such difference in screen behavior at home might be imposed by the multi-functionality of the devices, which can for instance be used as electronic babysitters, behavioral management (reward – calm down) or educational tools.[61]

Interestingly, CT-use was identified as the main provocateur for headache in each age-category. Yet, the frequency and duration of such CT-use did not associate with headache characteristics. It could be hypothesized that headache might be triggered by the specific posture (or type of CT-device), and not exclusively the duration or frequency of using such device. An increased forward head posture was previously already observed in children with headache.[14] Further, a study of sitting posture in 3520 children in the Czech Republic revealed that children with poor posture reported headache and pain in the cervical and lumbar spine more frequently.[62]

Although neuro-musculoskeletal disorders are known consequences of increased CT-use, its application in school curricula is still growing.[63] Despite the limited evidence of added value in school, and the associated neuro-musculoskeletal complaints, screen-based technologies continue to be an integral part of the learning environment, with daily CT-exposure starting as early as the age of six.[64,65] It should be noted that neuro-musculoskeletal pain (which often accompanies headache) experienced in childhood is a predictor for continued pain into early adulthood.[59] Such complaints may interfere in children's daily activities, and over time evolve towards chronicity resulting in sleep

Table 4. Comparison of CT-Characteristics Between the HAg and Cg.

Age category 5–7 years	HAg (12/58)	Cg (46/58)	p
Duration per session **at school**, n (%)			.18
< 30 min	2 (16.7)	1 (2.2)	
30–60 min	1 (8.3)	4 (8.7)	
1–2 h	2 (16.7)	5 (10.9)	
2–4 h	7 (58.3)	29 (63)	
> 4 h	0	7 (15.2)	
Duration per session at home, n (%)			.56
< 30 min	3 (25)	11 (23.9)	
30–60 min	7 (58.3)	19 (41.1)	
1–2 h	1 (8.3)	13 (28.3)	
2–4 h	1 (8.3)	3 (6.5)	
p[1]: Difference at school versus at home	.01	<.001	
Age-category 8–11 years	**HAg (27/84)**	**Cg (57/84)**	**p**
Duration per session at school, n (%)			<.001
< 30 min	1 (3.7)	1 (1.8)	
30–60 min	2 (7.4)	6 (10.5)	
1–2 h	24 (88.9)	1 (1.8)	
2–4 h	0	46 (80.7)	
> 4 h	0	3 (5.3)	
Duration per session at home, n (%)			
< 30 min	1 (3.7)	7 (12.3)	.52
30–60 min	17 (63)	27 (47.7)	
1–2 h	7 (25.9)	17 (29.8)	
2–4 h	2 (7.4)	6 (10.5)	
p[1]: Difference at school versus at home	<.001	<.001	
Age-category 12–15 years	**HAg (81/137)**	**Cg (56/137)**	**p**
Duration per session at school, n (%)			.11
< 30 min	1 (1.2)	0	
30–60 min	0	0	
1–2 h	0	2 (3.6)	
2–4 h	80 (98.8)	53 (94.6)	
> 4 h	0	1 (1.8)	
Duration per session at home, n (%)			**.01**
< 30 min	7 (8.6)	1 (1.8)	
30–60 min	23 (28.4)	19 (33.9)	
1–2 h	20 (24.7)	25 (44.6)	
2–4 h	31 (38.3)	11 (19.6)	
p[1]: Difference at school versus at home	<.001	<.001	
Age-category 16–18 years	**HAg (113/145)**	**Cg (32/145)**	**p**
Duration per session at school, n (%)			1
< 30 min	0	0	
30–60 min	2 (1.8)	0	
1–2 h	0	0	
2–4 h	111 (98.2)	32 (100)	
Duration per session at home, n (%)			
< 30 min	4 (3.5)	3 (9.3)	.01
30–60 min	34 (30.1)	1 (3.1)	
1–2 h	43 (38.1)	15 (46.9)	
2–4 h	32 (28.3)	13 (40.6)	
p[1]: Difference at school versus at home	<.001	<.001	

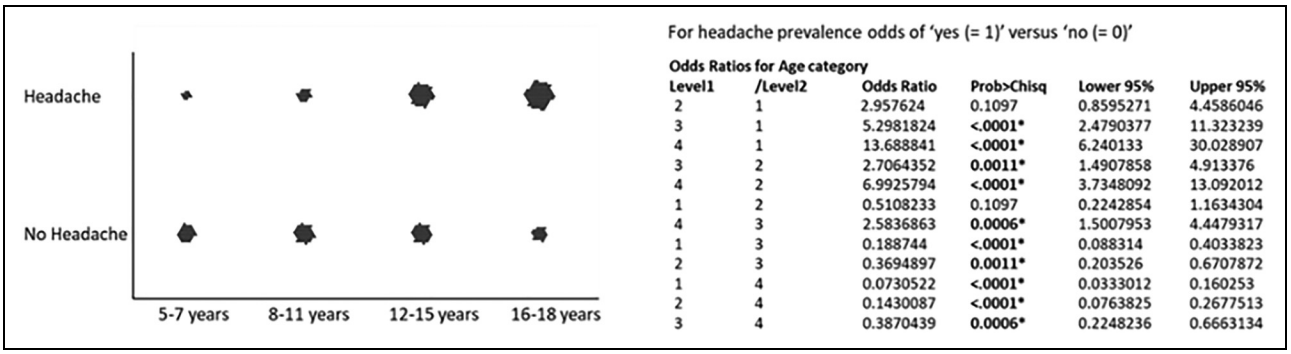
n, number of participants; Bold, $p < .05$, level of significance; [1], Between home and school for both groups (HAg, Cg) separately; p-values were deducted from contingency tables (X^2).

disturbances, depression, social isolation, and reduced quality of life.[65–67]

It should be noted that CT-use was not systematically higher in children and adolescents with, versus children and adolescents without headache. Such finding should be interpreted within the context of childhood and adolescent headaches being a multifaceted problem.[4] Recent work by Torres-Ferrus et al (2019) identified associations between poor sleeping habits, smoking, skipping breakfast, caffeine overuse, smoking, low level of physical activity, worse scores on psychosocial factors, and higher headache prevalence.[68] Based on these findings it seems relevant to compose a patient profile consisting of lifestyle and psychosocial risk factors for headache.

Physical Activity Characteristics. Physical activity is an important health indicator in children and adolescents.[69] Although physical activity levels did not consistently differ between children and adolescents with, versus children and adolescents without headache, a significantly higher headache prevalence was observed if participants were highly physical active. Reflection is needed concerning these unexpected results.

An association between low physical activity and recurrent headaches was a finding of the HUNT-study in 12 to 19 year-olds.[27] A bidirectional hypothesis could explain such relationship. A low activity level might lead to headache, conversely patients might avoid exercises to prevent a headache attack.[70–71] In Flanders, only 6% of the 6–9 year-olds and 17% of the 10–12 year-olds met the national requirements of sufficient physical activity based on a national health survey.[72] In our study, achieving this national norm was significantly associated with less CT-use (< 2–4 h) in 12–15 year-olds (p.001) and 16–18 year-olds (p.01). It is generally accepted that a reduced physical activity level contributes to obesity, which is a risk factor to develop chronic daily headache.[65–73] Obesity is already linked with frequency of migraine attacks. Its pro-inflammatory and pro-thrombotic state might relate to the neurovascular inflammation in migraine.[74–77]

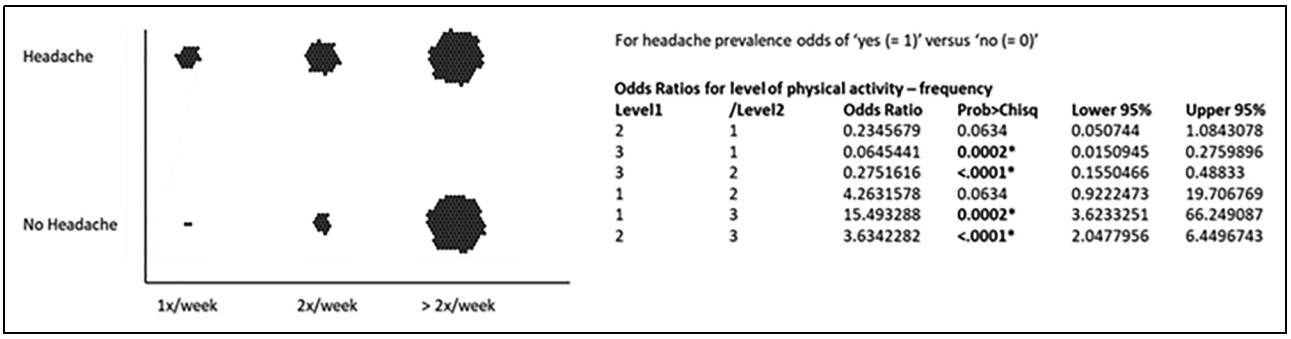


For headache prevalence odds of 'yes (= 1)' versus 'no (= 0)'

Odds Ratios for Age category

Level1	/Level2	Odds Ratio	Prob>Chisq	Lower 95%	Upper 95%
2	1	2.957624	0.1097	0.8595271	4.4586046
3	1	5.2981824	<.0001*	2.4790377	11.323239
4	1	13.688841	<.0001*	6.240133	30.028907
3	2	2.7064352	0.0011*	1.4907858	4.913376
4	2	6.9925794	<.0001*	3.7348092	13.092012
1	2	0.5108233	0.1097	0.2242854	1.1634304
4	3	2.5836863	0.0006*	1.5007953	4.4479317
1	3	0.188744	<.0001*	0.088314	0.4033823
2	3	0.3694897	0.0011*	0.203526	0.6707872
1	4	0.0730522	<.0001*	0.0333012	0.160253
2	4	0.1430087	<.0001*	0.0763825	0.2677513
3	4	0.3870439	0.0006*	0.2248236	0.6663134

Figure 3. Association between headache prevalence and age category (OR = Odds Ratio; * $p < .05$).



For headache prevalence odds of 'yes (= 1)' versus 'no (= 0)'

Odds Ratios for level of physical activity – frequency

Level1	/Level2	Odds Ratio	Prob>Chisq	Lower 95%	Upper 95%
2	1	0.2345679	0.0634	0.050744	1.0843078
3	1	0.0645441	0.0002*	0.0150945	0.2759896
3	2	0.2751616	<.0001*	0.1550466	0.48833
1	2	4.2631578	0.0634	0.9222473	19.706769
1	3	15.493288	0.0002*	3.6233251	66.249087
2	3	3.6342282	<.0001*	2.0477956	6.4496743

Figure 4. Association between headache prevalence and level of physical activity (frequency) (OR = Odds Ratio; * $p < .05$).

Yet, although exercise is often recommended in the treatment of migraine, strenuous physical activity is also reported as a trigger.[78] It seems essential to compose a patient-tailored activity program since maximal aerobic exercise can trigger migraine attacks. However, it does not always provoke such an attack, even in those who report exercise to be a migraine trigger.[79]

Suggestions and Limitations

This cross-sectional study was the first to explore the prevalence of headache, CT-use and physical activity in Flemish children and adolescents. However, to generalize results more data should be gathered on children and adolescents from different Flemish regions.

Several variables were selected based on a priori hypotheses and entered in the regression model, leading to several hypotheses being tested. The models were downsized by selecting the best model fit (based on parameter estimates and the Bayesian information criterion). More research in this field of pediatric pain is needed to correctly interpret results. Statistical correct interpretations (ie erroneously rejecting the null hypothesis) depend on repeatedly performing studies, no probability can be assigned to a singular, observed result.[80] The results of the current study must be interpreted in the context of an explorative study. Therefore, Bonferroni corrections were not applied.

We were interested in gender, age, and level of physical activity as independent variables, rather than defining such variables as confounders. Potential influential variables were anticipated on through the study-protocol (eg quiet and temperature-controlled room, not interfering with exams), eligibility criteria, and statistical model building. Yet, although beyond the scope of the current study, more research is needed on the influence of among others the sociodemographic status of the child/adolescent and his/her family on headache-characteristics.

The most serious limitation was the low and unacceptable response-rate in kindergartens (10%) and primary schools (28%).[81] Absences on the day of data collection might have contributed to a small extent. In addition, studies in these younger age groups are difficult to conduct because written parental consent (passive non-response-rate) is required. Such non-participation increases risk of overestimation due to interest bias.[81] Therefore, results from the current study should be interpreted within the context of an explorative study.

Long-term follow-up studies are required to analyse the development and evolution of headache from child- to adulthood, and to identify its prognostic factors.

We failed to correctly map television time in our study population. More research should focus on realistically measuring such outcome.

In the current study self-reports were used to define presence of headache. The subjective nature of this modus operandi should be taken into account (such as under- or over-reporting subjective symptoms). It is recommended to define headache through valid diagnostic criteria such as the criteria of the International classification of Headache Disorders (ICHD).[82]

Table 5. Summary of Physical Activity Characteristics in the HAg and Cg.

Age-category 5–7 years	HAg (12/58)	Cg (46/58)	p
Duration per session physical activity, n (%)			.26
< 30 min	2 (16.7)	1 (2.2)	
30–60 min	5 (41.7)	24 (52.2)	
1–2 h	4 (33.3)	17 (37)	
2–4 h	1 (8.3)	4 (8.7)	
Frequency physical activity, n (%)			.22
1 time/week	1 (8.3)	1 (2.2)	
2 times/week	0	6 (13)	
> 2 times/week	11 (91.7)	39 (84.8)	
Age-category 8–11 years	**HAg (27/84)**	**Cg (57/84)**	**p**
Duration per session physical activity, n (%)			<.001
< 30 min	0	18 (31.6)	
30–60 min	10 (37)	33 (57.9)	
1–2 h	15 (55.6)	6 (10.5)	
2–4 h	2 (7.4)	0	
Frequency physical activity, n (%)			.16
1 time/week	2 (7.4)	0	
2 times/week	3 (11.1)	8 (14)	
> 2 times/week	22 (81.5)	49 (86)	
Age-category 12–15 years	**HAg (81/137)**	**Cg (56/137)**	**p**
Duration per session physical activity, n (%)			.07
< 30 min	4 (4.9)	7 (12.5)	
30–60 min	40 (49.4)	18 (32.1)	
1–2 h	30 (37)	21 (37.5)	
2–4 h	7 (8.6)	10 (17.9)	
Frequency physical activity, n (%)			<.001
1 time/week	6 (7.4)	1 (1.8)	
2 times/week	31 (38.3)	2 (3.6)	
> 2 times/week	44 (54.3)	53 (94.6)	
Age-category 16–18 years	**HAg (113/145)**	**Cg (32/145)**	**p**
Duration per session physical activity, n (%)			.17
< 30 min	10 (8.8)	0	
30–60 min	29 (25.7)	9 (28.1)	
1–2 h	66 (58.4)	18 (56.3)	
2–4 h	8 (7)	5 (15.6)	
Frequency physical activity, n (%)			.001
1 time/week	23 (20.4)	0	
2 times/week	22 (19.5)	1 (3.1)	
> 2 times/week	68 (60.2)	31 (96.9)	

n, number of participants; Bold, $p < .05$, level of significance; p-values were deducted from contingency tables (X^2).

However, a critical reflection is needed concerning the diagnostic-criteria for pediatric headache. Opinions on such criteria differ between authors. E.g. sensitivity and specificity of the ICHD is only moderate for adolescent migraine, and the International Headache Society symptom-based criteria are highly beneficial in diagnosis of childhood headache, only if used together with a detailed clinical assessment.[8,9] Future studies should consistently apply valid pediatric-specific criteria to diagnose pediatric headache.

In addition, headache prevalence was estimated based on parental reports in the youngest age-category (5–7 years). Since parental reports often underestimate headache-frequency compared to diary-based self-reports, we suggest a visual diary because children communicate better through pictures than verbally. To further nuance the headache characteristic, drawings can be used.[83,84]

The mechanism of physical activity in children and adolescents should be further explored at fundamental level since physical activity might be related to alterations in blood nitric oxide, increase in β-endorphin levels and in well-being.[69,85,86]

Finally, our preliminary findings should promote further assessment concerning the impact of headache on eg the quality of life and school results.

Conclusion

This was the first study to explore headache prevalence and its associations with using communication technology and physical activity in Flemish children and adolescents. Our results suggest that headache is present in Flemish children and adolescents. Headache prevalence increases with age. Between the ages of 12-18 years, more girls than boys suffer from headache. CT-use is reported to be the main headache-provocateur. Further, headache prevalence is higher in frequently physically active children and adolescents. The level of education of the mother was low in 12-15 year olds reporting headache. More research is needed to inventory the magnitude, lifestyle, socio-economic, and psychosocial risk factors, and consequences of these headaches.

Abbreviations

BMI: Body Mass Index
CI: Confidence Interval
CT: Communication Technology
ET: Exercise Therapy
F: Female
HW: Homework
ICHD: International classification of Headache Disorders
M: Male
n: number of participants
N/A: Not Applicable
OR: Odds Ratio
R&W: Reading and Writing
TTH: Tension-Type Headache
VAS: Visual Analogue Scale
VLK-K: Vragenlijst Lichamelijke Klachten - Kinderen
WHO: World Health Organisation
X^2: Chi-square

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Authors' Contributions

SM and MG conceived and planned the experiments. SM carried out the experiments and took the lead in writing the manuscript. MG supervised and provided feedback throughout the entire research and writing phase.

Availability of Data and Material

Additional data available on request from the authors.

Consent to Participate

Eligible participants had to read and sign the informed consent before officially being enrolled. Protection of personal data is legally determined by the Belgian law of December eighth 1992. All test procedures involving human participants were in accordance with the ethical standards of the institutional research committees and with the 1964 Helsinki Declaration and its later amendments.

Declaration of Conflicting Interests

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

Ethics Approval

The current study is part a larger project which is registered as an observational study at ClinicalTrials.gov (NCT02887638). The Medisch Ethische ToetsingsCommissie of Zuyderland (NL. 55720.09615) and the Comité Medische Ethiek of the Ziekenhuis Oost-Limburg (B371201423025) granted approval to execute the experimental protocol.

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Supplemental Material

Supplemental material for this article is available online.

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Appendix 1 – Details on Objective 2. Association between headache (characteristics and prevalence), and CT-use physical activity characteristics in Flemish children and adolescents

Table A1 provides a detailed summary of the interpretation of the independent (age, gender, CT-use, level of physical activity) and depend (headache prevalence, duration, frequency) variables concerning objective 2.

Two models were composed to analyse associations:

Model 1: Headache prevalence = dependent variable, physical activity (frequency, duration), CT-use (frequency, duration), age category, and gender = independent variables (logistic regression)

Model 2a: Headache frequency = dependent variable, physical activity (frequency, duration), CT-use (frequency, duration), age category, and gender = independent variables (ordinal regression)

Model 2b: Headache duration = dependent variable, physical activity (frequency, duration), CT-use (frequency, duration), age category, and gender = independent variables (ordinal regression).

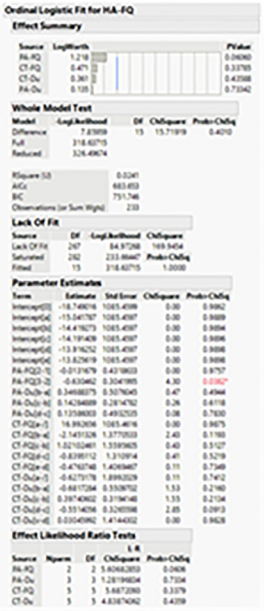
No associations resulted from the statistical models concerning models 2a and 2b (extraction JMP, Pro 16). The best model (BIC − parameter estimates) did not deliver statistically significant results.

Table A1. Detailed Summary of the Interpretation of the Independent (Age, Gender, CT-Use and Physical Activity Characteristics) and Dependent (Headache Characteristics) Variables Concerning Objective 2.

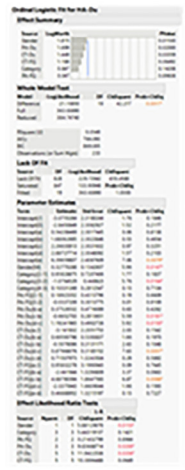
Variable	Interpretation
Demographics	
Age category	1 = 2013–2011
	2 = 2010–2007
	3 = 2006–2003
	4 = 2002–2000
Gender	M
	F
Physical activity characteristics	
Frequency	1 = 1x/week
	2 = 2x/week
	3 = > 2x/week
Duration	a = < 30 min
	b = 30–60 min
	c = 1–2 h
	d = 2–4 h
CT-use characteristics	
Frequency	a = <1x or 1x/week
	b = 1–2x/week
	c = 2–3x/week
	d = 3–4x/week
	e = >4x/week
	f = daily
Duration	a = < 30 min
	b = 30–60 min
	c = 1–2 h
	d = 2–4 h
Headache characteristics	
Frequency	a = <1x or 1/week
	b = 1–2x/week
	c = 2–3x/week
	d = 3–4x/week
	e = >4x/week
	f = daily
	g = not on a weekly base
Duration	a = < 30 min
	b = 30–60 min
	c = 1–2 h
	d = 2–4 h
	e = does not spontaneously disappear

Model 2a: Headache frequency

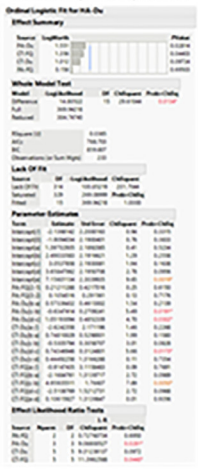
Model 2a: Headache frequency (minus age and gender)



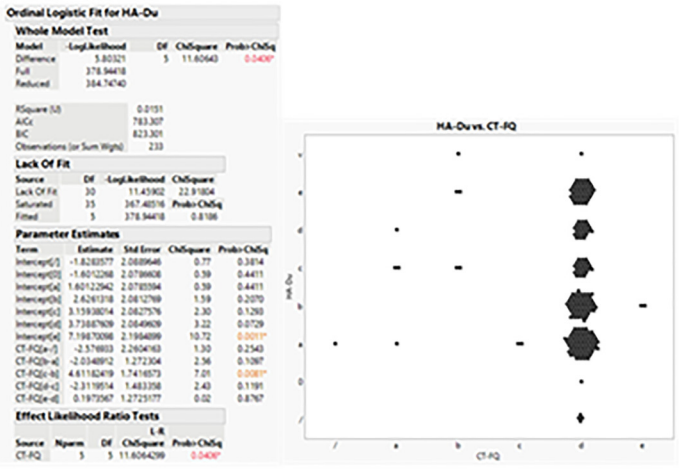
Model 2b: Headache duration



Model 2b: Headache duration (minus age and gender)



Model 2b: Headache duration (best fit – borderline)



Appendix 2 – Details on CT-use per age category

Table A2 provides a detailed summary of CT-use characteristics and of the combined prevalence of using CT and suffering from headache.

Table A2. Summary of the CT-Use Characteristics Per Age-Category.

Age-category	5–7 years (n = 58)	8–11 years (n = 84)	12–15 years (n = 137)	16–18 years (n = 145)	Total (N = 424)
CT home setting, n (%)					
Yes	58 (100)	84 (100)	137 (100)	145 (100)	424 (100)
Desktop	11 (19)	47 (56)	81 (59)	93 (64)	232 (55)
Tablet	44 (76)	75 (89)	105 (77)	83 (57)	307 (72)
Laptop	15 (26)	40 (48)	107 (78)	129 (89)	291 (69)
Smartphone	24 (41)	23 (27)	119 (87)	142 (98)	308 (73)
Television°	57 (98)	84 (100)	132 (96)	137 (94)	410 (97)
Frequency CT-use home, n (%)					
≤ 1/w	5 (9)	4 (5)	1 (1)	0 (0)	10 (2)
1–2/w	5 (9)	8 (10)	1 (1)	2 (1)	16 (4)
2–3/w	7(12)	1 (1)	1 (1)	0 (0)	9 (2)
3–4/w	3(5)	10 (12)	3 (2)	0 (0)	16 (4)
> 4/w	7 (12)	3 (4)	2 (2)	0 (0)	12 (3)
Daily	31 (54)	58 (69)	129 (94)	142 (98)	360 (85)
Daily duration CT-use home, n (%)†					
< 30 min	14 (24)	8 (10)	8 (6)	7 (5)	37 (9)
30–60 min	25 (43)	43 (51)	36 (26)	29 (20)	133 (31)
1–2 h	14 (24)	23 (27)	44 (32)	55 (38)	136 (32)
2–4 h	4 (7)	7 (8)	40 (29)	45 (31)	96 (23)
No use	1 (2)	2 (2)	1 (1)	0 (0)	4 (1)
CT school setting, n (%)					
Yes (%)*	35 (60)	76 (90)	123 (90)	143 (99)	377 (89)
Desktop	21 (36)	75 (89)	104 (76)	131 (90)	331 (78)
Tablet	11 (19)	7 (8)	4 (3)	16 (11)	38 (9)
Laptop	2 (3)	9 (11)	28 (20)	38 (26)	77 (18)
Smartphone	0 (0)	0 (0)	68 (50)	127 (88)	195 (46)
Television	14 (24)	16 (19)	13 (9)	2 (1)	45 (11)
No	23 (40)	8 (10)	14 (10)	2 (1)	47 (11)
Frequency CT-use school, n (%)					
≤ 1/w	20 (34)	47 (56)	40 (29)	14 (10)	121 (29)
1–2/w	10 (17)	11 (13)	21 (15)	15 (10)	57 (13)
2–3/w	1 (2)	3 (4)	10 (7)	17 (12)	31 (7)
3–4/w	0 (0)	1 (1)	5 (4)	10 (7)	16 (4)
> 4/w	2 (3)	0 (0)	3 (2)	10 (7)	15 (4)
Daily	1 (2)	12 (14)	48 (35)	78 (54)	139 (33)
No use	24 (41)	10 (12)	10 (7)	1 (1)	45 (31)
Daily duration CT-use school, n (%)					
< 30 min	17 (29)	21 (25)	55 (40)	66 (46)	159 (38)
30–60 min	13 (22)	47 (56)	57 (42)	61 (42)	178 (42)
1–2 h	1 (2)	0 (0)	6 (4)	7 (5)	14 (3)
2–4h	0 (0)	3 (4)	6 (4)	3 (2)	12 (3)
No use	27 (47)	12 (14)	11 (8)	2 (1)	52 (12)
Prevalence of CT-use and having headache, n (%)					
Headache + CT	12 (21)	27 (32)	83 (61)	122 (84)‡ -	
No Headache + CT	46 (79)	57 (68)	54 (39)	23 (16) -	

n, number of participants; min, minute; h, hour; w, week; CT, Communication Technology; $p < .05$, level of significance; *, $p < .001$ (X^2), prevalence increased significantly with increasing age; †, $p < .0001$ (X^2), duration of CT-use increased significantly with a higher age; °, watching television was not included in the questions concerning duration and frequency of CT-use; %, proportion*100; ‡, $p < .0001$ (nominal logistic regression), significantly more participants using CT with headache.