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## A population-based follow-up study of headache from age 7 to 22 years

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**Abstract** To study changes in headache prevalence during childhood, adolescence and early adulthood, we performed a prospective long-term follow-up study on an unselected child population. Seven-year-old children, resident in a Finnish city and starting primary school, were followed for 15 years. Data were collected at the ages of 7, 13, 14, and 22 years. Number of children participating in all four stages was 1205. Number of participants answering questions concerning the prevalence of headache in different ages varied between 918–1204. Face-to-face interviews and structured questionnaires were employed. After the start of compulsory school, the prevalence of overall headache rose from the preschool level of 27.1% to 63.6% at age 14 years to 66.2% at age 22 years. At preschool age, the prevalence of migraine was 4.3% in girls and 3.6% in boys. In girls, the highest prevalence rate

(15.2%) occurred at the age of 13 years, and was higher than the peak prevalence in boys (6.5%). After the onset of puberty, a temporary decrease of migraine prevalence was found in girls, and a permanent one in boys. The overall prevalence of headache remained virtually unchanged during and after puberty. Headache and migraine are relatively prevalent at preschool age but entering puberty represents a substantially increased risk of headache without a great variation throughout puberty and in young adulthood. Preschool headaches do not necessarily persist and may disappear during and after puberty. From the preventive viewpoint, the target children are those who either continue to have headache or who develop headache during school years.

**Key words** Childhood headache • Migraine • Long-term follow-up • Population study

### Introduction

The presence of headache is often difficult to assess in young children. The true nature of symptoms may remain undetermined for years. The mean age of headache onset in children varies from 4.8 years [1] to 7.5 years [2]. The prevalence rate of headache usually increases with age [3, 4]. There are some ages when the increase is particularly

clear. Anttila et al. [5] recently demonstrated that beginning school is a time when occasional headache increases in particular. During the first school year, the prevalence of headache will even up again [5]. In puberty, the prevalence rate remains unchanged or may even decrease [6, 7].

Only a few studies on the long-term outcome of headache have been published to date. Bille [8] followed 73 persons presenting with pronounced migraine in childhood for 40 years. In his study, 23% of those suffering

from migraine in childhood were migraine-free by age 25 years, boys significantly more often than girls. However, around the age of 50 years, more than half of those with childhood migraine still had migraine attacks [8]. In their 8-year follow-up study, Guidetti and Galli [9] concluded that headache of juvenile onset changes its characteristics over time, and there is a high tendency of headache to remit (mostly in males) or to improve [9].

In order to study the epidemiology of headache it is necessary to collect subjects from an unselected population. These studies are few and most of them are cross-sectional. Therefore we decided to undertake a long-term follow-up study of the occurrence and variability in time of headache in an unselected child population. The main emphasis of the study was on the changes in headache prevalence during childhood, adolescence and early adulthood. The present study is part of a larger project investigating the occurrence and variety by age of psychosomatic symptoms in children and adolescents.

### Study population and methods

The original study population included 2367 seven-year-old children resident in the Finnish city of Tampere (total population approximately 160 000) and starting primary school in 1974. Of them, however, 35 were assessed to be mentally disabled, 33 had a non-Finnish native language, and 12 were absent from school for a severe long-term illness. In addition, 216 children were ruled out because they had started their school attendance about 2.5 months prior to the initiation of the study, and the same study design could not have been applied for them as for the other study subjects. There were no cases of refusal. The final number of subjects entering the study was then 2071. A routine initial physical examination, performed by ordinary school doctors, included a structured interview with the children and one or both of their parents. Among the 2071 children, there were 640 (30.9%) headache sufferers, including 56 (2.7%) with migraine. The children were re-examined for headache or changes in the occurrence of headache at the ages of 13, 14 and 22 years. The same children were examined at the ages of 7, 13 and 14 by one author (MS) and at age 22 years by another author (HA), primarily unaware of each other. When a fortunate coincidence was recognized, the two databases were linked.

The present study population consisted of the 1205 subjects who participated in all four cross-sectional studies during the 15-year period and whose follow-up data were used in the study (from 1974 to 1989). The remaining 866 children could not be traced. By far the most important reason for dropouts was a strong relocation movement from and to the city of Tampere. At the ages of 7, 13, 14, and 22, the numbers of children answering the questions concerning headache were 1185, 1204, 1164 and 918 respectively.

### Measures

At the ages of 7, 13 and 14 years the data were collected in face-to-face interviews between the school doctor and the child and one or both of the parents, using a structured questionnaire for headache. The prevalence of *overall headache* was inquired with the following questions:

a) Have you during the preceding six months had headaches which have disturbed your school attendance, home work, leisure activities or daily living? (options: never, once, 2–11 times, approximately once a month, two or more times a month, approximately once a week, two or more times a week but not daily, daily).

b) Have you previously (earlier than six months ago) had recurrent headache which ceased later? (options: yes or no).

At age 22 years, the data were collected using self-administered questionnaires. The prevalence of migraine was studied using criteria developed by Vahlquist [10] throughout the years 1974–1989. These criteria are recurrent, paroxysmal headache attacks separated by symptom-free intervals, with at least two of the following factors: nausea, unilateral location, visual scotoma or related phenomena, and family history of headache.

### Statistical analyses

Direct associations between variables were studied using cross tabulation. A  $p$  value of  $< 0.05$  was used as the cutoff point of significance. McNemar test of symmetry was used in the analysis of the changes in frequencies of headache over time. The chi-square test was used in the analysis of association between headache and migraine occurrence in different ages. BMDP 90 statistical software was used for statistical computation [11].

### Results

Table 1 shows the prevalence rates of overall headache and migraine in the study population at the ages of 7 to 22 years. When the subjects were 7 years old, there were no significant gender differences between the occurrences of overall headache (26.6% in boys vs. 27.6% in girls); the occurrence of migraine was slightly higher in boys than in girls (4.3% vs. 3.6%). The proportion of headache sufferers among 13-year-olds was more than twice that of 7-year-olds; the prevalence among girls was higher than that of boys (66.8% vs. 60.1%). This increase was exclusively related to a higher prevalence rate of migraine in girls than in boys (15.2% vs. 6.5%). After the onset of puberty, a temporary decrease of migraine prevalence was found in girls, and a permanent one in boys. The overall prevalence of headache for boys and girls together remained virtually unchanged during and after puberty (63.4% to 66.2%).

**Table 1** Prevalence rates of overall headache and migraine in the study population at ages 7–22 years

	7 years		13 years		14 years		22 years	
	M	F	M	F	M	F	M	F
Subjects, n	609	576	617	587	592	572	429	489
Headache, n (%)	162 (26.6)	159 (27.6)	371 (60.1)	392 (66.8)	341 (57.6)	399 (69.8)	222 (51.7)	386 (78.9)
Migraine, n (%)	26 (4.3)	21 (3.6)	40 (6.5)	89 (15.2)	15 (2.5)	42 (7.3)	14 (3.3)	54 (11.0)

Table 2 shows the distribution of the headache frequency in study subjects at different ages. Quite a few children suffered from headache more often than once a month and the percentages (1.0%–1.6%) did not significantly differ at different ages. If the subjects having headaches once or more than once per month are counted together, the prevalence rates of “frequent” headache (at least once a month) are 5.9%, 10.7%, 10.5% and 11.0% at the ages of 7, 13, 14 and 22 years respectively. Most of those who suffered from headache had headache attacks less frequently than once a month at all ages (range 21.3%–55.2%), and the once-a-month frequency varied between 4.5% and 9.8%. The frequency distribution was even in all frequency classes from ages 13 to 22 years.

Twenty-seven percent (65 of 241) of the children with headache at the age of 7 were headache-free at the age of 22. Thirty-six percent (241 of 661) of the preschool-aged children without headache were headache-free also in young adulthood. On the other hand, headache at the preschool age predicted more frequent headache in adulthood ( $p < 0.001$ ). Seventeen percent (41 of 241) of children with headache, but only 3.6% (24 of 661) of those without headache at the age of 7 years suffered from migraine in adulthood. The difference between groups was statistically significant ( $p < 0.001$ ).

## Discussion

The present study was based on a prospective follow-up of an unselected child population. The original data collection

was carried out using face-to-face interviews by experienced school doctors and examinations with structured questionnaires. The applied study design enabled us to gain reliable and valuable information on the occurrence of headache and migraine in a long period. The marked dropout rate was mainly caused by two factors. One is a considerable relocation to and from the city of Tampere which has many young people, who are either students or military service enlistees. In addition, and most importantly, many study subjects got married and changed their family name. Consequently, they were not traceable because we did not get their unique social security number. Another reason for a high dropout rate may be the fact that the study subjects who had been followed by one of the authors (MS) up to age 14 years were quite coincidentally re-examined by another author (HA). It is quite obvious that we lost many patients for follow-up because of difficulties in identifying the changed family names in association with the linkage of the two databases.

In accordance with previous reports [8, 12], headache in the present study occurred as often in girls as it did in boys at preschool age. The occurrence of headache disturbing everyday life in more than one-fourth of children aged 7 years might sound alarming. However, the data were derived from the 6 months preceding the start of school. It is possible that the approaching start of school contributed to the relatively high prevalence of headache at preschool age. Start of school contributes to an increase in the occurrence of occasional headache which will later stabilize during the first school year [5], only to increase again during later school years.

**Table 2** Distribution of frequency of headache in the study population at different ages

	Subjects, n (%)							
	7 years (n = 1185)		13 years (n = 1204)		14 years (n = 1164)		22 years (n = 918)	
Never	864	(72.9)	441	(36.6)	424	(36.4)	310	(33.8)
< 1 per month	252	(21.3)	634	(52.7)	618	(53.1)	507	(55.2)
1 per month	53	(4.5)	110	(9.1)	110	(9.5)	90	(9.8)
> 1 per month	16	(1.4)	19	(1.6)	12	(1.0)	11	(1.2)

The onset of puberty appears to be a turning point in the occurrence of headache. Previously it has been reported that during and after the teen years, there is first some decrease in the prevalence, which then begins to steadily rise, especially in girls [13–15]. Since prepuberty, there is a female predominance of headache up to and over adulthood [16]. In girls and women, menstruation is a common triggering or aggravating factor of migraine [17, 18]. Hormonal factors at menarche, menstruation, pregnancy and menopause are believed to trigger or change the prevalence of migraine [19]. A fall in estrogen levels occurring at menstruation is believed to trigger menstrual migraine, whereas sustained high estrogen levels during pregnancy frequently cause headache relief [20, 21]. In the present study, 13 years was the age of very high prevalence of both overall headache and especially migraine. In the Finnish school population, the mean age of menarche is 13.1 years [22]. We did not examine the onset of menarche in the present study, but coincidence of a high prevalence of migraine headache and onset of menarche is clear. The high prevalence rates in this age group have also been reported previously by Raieli et al. [23]. The Finnish school system itself might be a contributor to the high prevalence of headache at the age of 13 years. At this age, school children move to junior high school. Because of the individual courses instead of stable classroom, there is a weakening in class spirit, loss of class teacher and, finally, large school building complexes with

much higher number of pupils than previously. So, both social and environmental factors could be potential causes of stress and subsequent headache [24, 25].

Not unexpectedly, the higher prevalence of headache and migraine, which can be seen in women compared to men, can be found already during puberty and in young adulthood. Our study showed that the preschool occurrence of headache and migraine predicts their occurrence later in young adulthood to some extent. In our study, 27% of preschool-aged children with headache were headache-free at the age of 22 years. The figure is similar to that of Bille [8]. However, many preschool-aged children who suffer from migraine and other headaches continue to have attacks later. From the viewpoint of prevention, it is important to detect factors that predict the risk of persistence of existing migraine or incidence of new cases of migraine.

Headache and migraine are relatively prevalent at preschool age, but entering puberty represents a substantially increased risk of headache without great variation throughout puberty and in young adulthood. Preschool headache and migraine does not necessarily persist but may disappear during or after puberty. From the preventive viewpoint, the target children are those who either continue to have headache or who develop headache during school years. Risk factors for persistent or incident headache should be further analysed to enable preventive work. This kind of research is underway.

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