

Prevalence of Headache and its Association With Sleep Disorders in Children

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An association between headache and sleep disturbances has been reported in previous studies, but there is a lack of research examining this relationship in a community sample of children in order to reveal the magnitude of the problem. Among 32 District Educational Directorates in Istanbul, nine school districts and within each district eight schools were randomly selected. A questionnaire consisting of sociodemographic variables and evaluating headache and sleep disturbances was sent to students' homes to be completed by their parents. The prevalence of headache was 31.4% (95% confidence interval: 29.5-33.4%). Migraine prevalence was 3.3%, whereas nonmigraine headache prevalence was 28.1%. The prevalence of headache was similar between males and females (29.6% vs 33.3%, $P > 0.05$). The frequency of headache increased with age for both sexes. Snoring, parasomnias, sweating during sleep, and daytime sleepiness were more common among children with migraine compared with nonmigraine and no headache groups. Headaches are common among schoolchildren. Because children with migraine headaches have a high prevalence of sleep disturbances, they should always be evaluated for the presence of sleep problems. © 2007 by Elsevier Inc. All rights reserved.

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Introduction

Both headache and sleep disorders are common problems in children [1,2]. Although it is common thinking

that headache and sleep problems are related, there has been little research in this area. A few studies examined this relationship in children and found a high frequency of sleep disturbances involving sleep quality, night awakening, nocturnal symptoms, and daytime sleepiness in children with headache [3,4]. However, those studies were performed in children from pediatric neurology and headache clinics so they represented a select group. To our knowledge, this is the first population-based study which examines this particular relationship in children.

The aim of the present study was (1) to determine headache (migraine and nonmigraine headache) prevalence among school-aged children, and (2) to determine the association between headache and sleep disturbances among these children.

Study Design

This study was part of the Sleep Disordered Breathing in School Children Project [5], and it was approved by the Regional Director of Education, which serves as the Institute of Human Subject Protection Committee for the schools in Istanbul. Multistage, randomized sampling was used for data collection. The city of Istanbul has a population of approximately 12 million people and there are 32 school districts. Nine districts out of 32 were selected randomly. All schools were listed and among them, 72 were selected by systematic sampling. Classes were also randomly chosen from every school. The questionnaire and a personally addressed letter asking for consent were mailed to the parents. Data collection was performed between March and May 2002. Among the 2746 students, 2228 returned fully completed questionnaires (81.1%).

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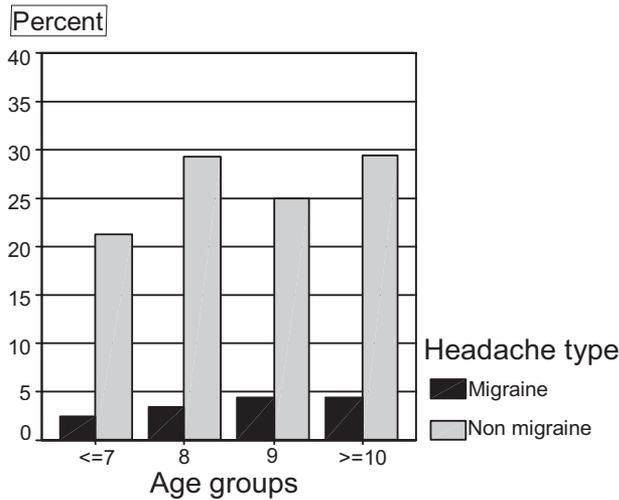


Figure 1. Headache types according to age groups among males.

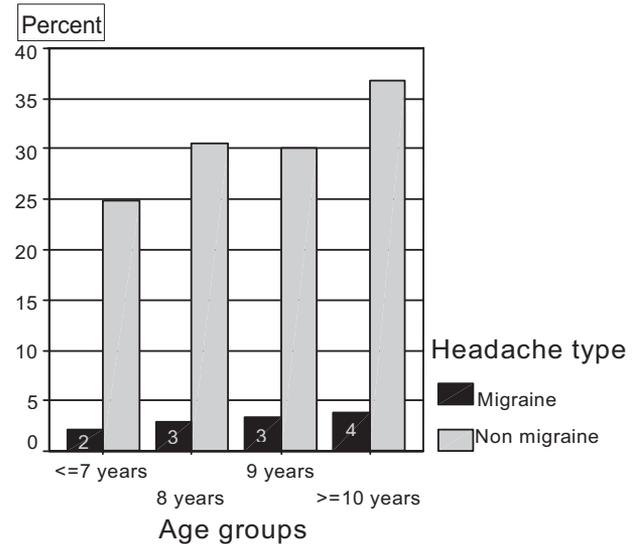


Figure 2. Headache types according to age groups among females.

The Questionnaire

The questions about the demographic data included the name, date of birth, sex, home address, home phone number, school name, and class name of the student. The 55-item questionnaire consisted of two parts: questions related to headache and sleep disorders. The questions about headache consisted of time of onset; frequency (every day, more than once a week, once a week, once a month, other); duration—minutes (less than 1 hour), hours (1 hour or more), and days; severity (mild, moderate, severe); limitation in daily activities; aggravating factors (exercise, stress, tiredness); unilateral headache; associated symptoms (nausea, vomiting, photophobia, and phonophobia); medication history; and family history. Headache was classified according to the International Headache Society (IHS) 2004 criteria [6]. Headache lasting hours (1 hour or more) was considered as migraine. We did not specify headache lasting between 1-2 hours and headache lasting more than 2 hours each, as we thought getting headache duration details, more than 1 hour long, would be difficult to obtain through a questionnaire. At least two or more of the following criteria had to be present for migraine diagnosis: unilateral location, pulsating quality, moderate to severe in intensity, and aggravation by physical activity. In addition, during the headache either (1) nausea and/or vomiting, or (2) photophobia and phonophobia had to be present. Headache was categorized as moderate to severe if the headache was limiting daily activities or if parents or child rated headache as moderate or severe. The presence of aura was not questioned in this study, and therefore a distinction between migraine with or without aura was not made. Headaches not fulfilling these criteria were considered nonmigraine type headache but not specified further.

Questions related to sleep disorders included parasomnias (bedtime struggle, teeth grinding, sleep vocalizations,

sleepwalking, nightmares), sweating during sleep, excessive daytime sleepiness, and snoring. Parents reported snoring on a four-point scale: 0 (never), 1 (occasionally), 2 (often), and 3 (always). Habitual snoring was considered present if parents reported snoring as either often or always. Excessive daytime sleepiness was considered to be present if at least one of the following criteria was met: 1—falling asleep during class; 2—falling asleep at theater/concert/visiting friends/relatives; 3—falling asleep during a conversation. The frequency of each parasomnia and sweating during sleep was evaluated separately (i—every 2-3 months; ii—1-3 times a month; iii—more than 3 times

Table 1. Headache characteristics in migraine and nonmigraine groups

	Migraine (%) (n = 74)	Nonmigraine (%) (n = 626)	P Value
Frequency			
Everyday/More than once a week	30.6	15.6	<0.001
Once a week	33.3	24.4	
Once a month	29.2	39.0	
Few a year	6.9	21.0	
Duration			
less than 1 hour	0	59.6	<0.001
1 hour or more	82.2	37.3	
days	17.8	3.1	
Limitation in activities*	60.3	14.9	<0.001
Accompanying symptoms			
Nausea and/or vomiting	75.0	17.5	<0.001
Photophobia and phonophobia	57.5	11.6	<0.001
Headache triggers			
Stress	72.6	63.0	>0.05
Exercise	40.8	16.7	<0.001
Tiredness	77.8	69.8	>0.05
Unilateral pain	62.5	38.1	<0.001

* Limitation in physical activities while the child is experiencing headache.

Table 2. Sleep characteristics in children with and without headache*

Presence and Type of Headache	Snoring	Bedtime Struggle	Teeth Grinding	Sleep Vocalizations
Nonmigraine headache OR (95% CI) [†]	1.39 (1.14-1.68)	1.94 (1.59-2.37)	1.78 (1.43-2.22)	1.87 (1.53-2.29)
<i>P</i> value	0.01	<i>P</i> < 0.001	<i>P</i> < 0.001	<i>P</i> < 0.001
Migraine headache OR (95% CI) [†]	1.97 (1.23-3.16)	3.19 (1.81-5.61)	2.80 (1.70-4.61)	3.58 (2.17-5.88)
<i>P</i> value	0.005	<i>P</i> < 0.001	<i>P</i> < 0.001	<i>P</i> < 0.001

* *P* values are adjusted for age and sex.

[†] Odds ratios are calculated using the nonheadache group as the reference category.

Abbreviations:

CI = Confidence interval

OR = Odds ratio

a month; iv—almost every day); however, it was categorized as present even if it was present occasionally, i.e. every 2-3 months. All the forms were evaluated by the same pediatric neurologist for the diagnosis of headache and its types (U.I.).

Statistical Analysis

Statistical analyses were performed using SPSS for Windows Release 11.0. Pearson chi-square test and the chi-square for trend analysis were used for the comparison of categorical variables. The strength of association was described by odds ratios and 95% confidence intervals. Sleep characteristics were analyzed among children with and without headache after adjusting for age and sex. *P* < 0.05 was accepted as the level of statistical significance.

Results

Seventy-two schools from nine school districts were surveyed. Of the 2746 children participating in the study, 2395 (87.2%) returned the questionnaire and among them 2228 (81.1%) were fully completed. Females and males were almost equally represented in the study (49.1% and 50.9%, respectively). The age of the students ranged from 6 to 13 years with a mean and a standard deviation of 8.4 ± 1.4 years.

Headache

The prevalence of headache was 31.4% (95% confidence interval [CI]: 29.5-33.4%). Among the 2228 participants, 74 (3.3%) fulfilled the migraine criteria, whereas 626 (28.1%) had nonmigraine headache. The rate of headache was 33.3% among females and 29.6% among males; the difference was not statistically significant. The rate of headache increased with age for both sexes. Among females the rates for ≤7 and ≥10 years of age were 27.0% and 40.6%, respectively (*P* = 0.001, chi square for trend). For males the corresponding rates were 23.8% and 34%, respectively (*P* = 0.017, chi-square for trend).

The prevalence of migraine was similar for both sexes, 3.0% for the females and 3.6% for the males. There was a slight increase in the rate of migraine with age; among females the rate was 2.2% for 7-year-olds and 3.8% for 10-year-olds, among males it was 2.4% for 7-year-olds and 4.5% for 10-year-olds. Yet the difference was not statistically significant. Headache type according to age groups by sex is presented in Figures 1 and 2.

The rate of family history of headache among migraine and nonmigraine headache groups were 87.3% and 65.6%, respectively (*P* < 0.001). 77.5% of students experiencing migraine and 63.8% with nonmigraine headache were using pain relief medications (*P* = 0.02). Table 1 summarizes the characteristics of headache among migraine and nonmigraine groups.

Association of Headache With Sleep Disorders

The rates of all sleep disturbances were significantly higher among the migraine group, with a trend towards a lower frequency among nonmigraine and nonheadache groups. Table 2 presents the odds ratios of headache types for the presence of several sleep characteristics while controlling for age and sex. The odds ratio of habitual snoring for the nonmigraine headache group was 1.39, whereas it was 1.97 for the migraine group. The odds ratios of daytime sleepiness for the nonmigraine and migraine group were 1.78 and 2.17, respectively. When snoring was controlled, odds ratios of daytime sleepiness for nonmigraine and migraine headaches were 1.68 (95% CI: 1.33-2.12) and 2.00 (95% CI: 1.19-3.38), respectively.

As medications can have adverse consequences on sleep, headache patients taking any medications were compared with headache patients taking no medications. There was no statistically significant difference in the frequency of sleep disturbances among headache sufferers who used medications vs those who did not use any medications (*P* > 0.05).

Table 2. Sleep characteristics in children with and without headache*

Sleep Walking	Nightmares	Sweating During Sleep	Excessive Daytime Sleepiness
1.28 (0.80-2.06)	1.93 (1.55-2.41)	2.20 (1.81-2.66)	1.78 (1.41-2.25)
$P > 0.05$	$P < 0.001$	$P < 0.001$	$P < 0.001$
2.77 (1.20-6.39)	7.11 (4.07-12.41)	4.01 (2.41-6.68)	2.17 (1.28-3.65)
0.02	$P < 0.001$	$P < 0.001$	0.004

Discussion

There are a few reports which reveal an association between headache and sleep disorders in children; however, these studies were performed on a limited number of children within selected populations [3,4,7]. This report is the first population-based study among children that examines this relationship.

The association between headache and sleep disorders can have different aspects. One may cause the other, or they may share a common intrinsic etiology. Both headache and sleep disorders have been thought to be caused by neurotransmitter changes or circadian rhythm disorders [8]. Serotonin secreted from dorsal raphe nucleus is associated with migraine and sleep cycle [9,10]. It has been demonstrated that the suprachiasmatic nucleus of the hypothalamus regulates the release of serotonin from dorsal raphe. Serotonin decreases rapid eye movement sleep, and its decline in systemic circulation has been associated with migraine [11].

Headache

The prevalence of migraine ranges from 3.0% to 10.6% according to different studies [12-18]. Migraine prevalence was 3.3% in the present study, which is comparable but lower than most of the previous studies. It should be noted that the diagnostic criteria used as well as the age group studied might result in different rates for headache types. Two recent studies reported the prevalence of pediatric migraine in the Middle East. The first one performed in Iran, which evaluated a random sample of 1868 teenaged females (aged 11-18 years) reported an overall prevalence rate of 6.1% for migraine [17]. The second study evaluated 1400 randomly selected Saudi children in grades 1 through 9. Overall headache prevalence was 49.8%, and the prevalence of migraine was 7.1% [18]. A meta-analysis of prevalence studies suggests that migraine is most common in North and South America, followed by Europe, and lowest in Africa and Asia [19]. A recent population-based study performed in

schoolchildren in Turkey aged 8-16 years revealed a current headache prevalence of 31.3%, which was similar to our findings. Yet in the mentioned study, the reported migraine prevalence was 10.4% [20]. The reason for the differences between the prevalence rates of migraine could be explained by the criteria used for the diagnosis of migraine. The previous study used the revised IHS criteria for the diagnosis which had an increased sensitivity for the diagnostic rate of migraine [21]. The variations between the two studies could also have resulted from the age difference in the survey (younger in our study) as well as the difference between the two geographic locations. Istanbul is located in northwestern Turkey and Mersin is in southern Turkey.

Migraine prevalence increases with age. The present study determined an increasing trend in the headache prevalence as children got older. There was a statistically significant difference between the <7-year-olds and >10-year-olds among both sexes, but this difference did not reach statistical significance for migraine. According to Stewart et al. [22], the incidence of migraine without aura in females peaked between the ages of 14 and 17 years. In schoolchildren, the prevalence of migraine increases with age, with male preponderance in children aged less than 12 years and female preponderance thereafter [19]. In the present study, migraine prevalence was slightly higher in males compared with females. However, the age range was between 6 and 13 and only partially included the adolescence period. So we may not have observed the usual peak of migraine observed in adolescent females.

The rate of family history of headache was 87.3% in this study, which is consistent with previous studies disclosing a similar headache frequency among family members [23,24].

Association of Headache With Sleep Disorders

All of the sleep problems we studied among school-aged children were more frequent among migraine sufferers compared with nonmigraine and no headache groups.

There was a trend between the three groups; the prevalence of all the sleep disorders was the highest among the migraine group.

The first sleep disorder studied was snoring. The odds ratio of habitual snoring for the nonmigraine headache group was 1.39, whereas it was 1.97 for the migraine group. According to Miller et al. [3] the rate of snoring among children with migraine is 23%. Torok et al. [25] studied snoring in 11- to 15-year-old schoolchildren and found that headache was more common in children who snored frequently. Bruni et al. [4] found a 2.9% rate of snoring in children with migraine headache. There is a well-known association between cluster headaches and obstructive sleep apnea as well [26,27]. Hypoxemia during rapid eye movement sleep is thought to result in cluster headache. Snoring can be responsible for an increased rate of headache with a similar mechanism.

Migraine headaches were also associated with parasomnias. Bedtime struggle, teeth grinding, sleep vocalizations, nightmares, and sleep walking rates were highest among the migraine group, followed by the nonmigraine and no headache groups (Table 2). Our results are concordant with previous studies which revealed a high correlation between parasomnias and migraines. Bruni et al. [4] found that the rate of night sweating, sleep talking, bruxism, and nightmares was higher among migraine patients compared with tension headaches and control groups. However, sleepwalking, bedwetting, and sleep terrors were not higher in the migraine group. Barabas et al. [28] found a high frequency of somnambulism in children suffering from migraine. In the present study, sleepwalking had a borderline statistical significance, although all other parasomnias were highly associated with migraine headaches. The frequency of parasomnias in the general population is lower compared with children with neurologic problems [29].

Headache was also associated with excessive daytime sleepiness. Increased sleepiness was determined to be associated with headaches in previous studies performed in children [3,4,7]. Although it is difficult to evaluate whether it is the cause or the result of headache, it is more likely to be the consequence of sleep disorders. Excessive sleepiness can be found in children with sleep-disordered breathing [30]. In the present study, when snoring was controlled, headache type still continued to increase daytime sleepiness.

Limitations

One of the drawbacks of this study is that it is based on parental reports. Because the data were collected via questionnaires, history taking and physical examination are lacking. However, parental information has proved to be an effective method for diagnosing sleep disorders [31]. Sasmaz et al. [32] reported that 74% of parents are aware of their children's headache, and migraine type of headache is one of the factors that affect the awareness level of

parents. It is also known that physical and neurologic examinations rarely affect migraine diagnoses in the general population [33]. This study is the first population-based study which examines the particular association between headache and sleep problems in a large sample.

Another possible limitation is the question of headache duration. The headache duration was not specified more than hours in the questionnaire, so headaches lasting between 1-2 hours were considered as migraine, theoretically. IHS criteria suggest that migraine can last 1 hour in children, although headache lasting less than 2 hours requires prospective diary studies [6].

Although an association between headache and sleep disorders was demonstrated in this cross-sectional study, a causal relationship cannot be determined without a follow-up study looking at the treatment effect.

Bruni et al. [34] demonstrated a reduction in the frequency and duration of migraine in the group of children who received sleep hygiene education compared with those who received no education. The findings reported herein also suggest that physicians taking care of children with headache should ask questions about sleep behaviors as part of the standard headache assessment. Such evaluations are important because children may not raise concerns about sleep-related problems.

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