

Primary Headaches and Sleep Disturbances: A Cause or a Consequence?

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Aims: To evaluate the possible relationship between sleep disturbances and primary headaches. **Methods:** This prospective study was carried out in a random group of patients with active primary headaches (case group) and a control group. Patients with active primary headaches were further stratified into two groups: patients with migraine and patients with tension-type headache (TTH). Participants were questioned using the following standardized tests: Insomnia Severity Index (ISI), Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), Berlin Sleep Apnea Questionnaire (BSAQ), and a custom-made headache questionnaire. The results of the questionnaires were compared among patients with TTH, patients with migraine, and age- and sex-matched controls. **Results:** Of the 143 participants, 22.4% had TTH, 30.8% were diagnosed with migraine, and 46.9% did not have a diagnosed headache disorder. Patients with TTH were more likely to have insomnia (ISI score > 7) than patients with migraine (75% vs 50%, respectively) or controls (75% vs 37.3%, respectively) ($P = .002$). Frequency of poor sleep quality (global PSQI score ≥ 6) was significantly highest in the TTH group (87.5%), while the migraine and control groups had better sleep quality (47.7% and 43.3%, respectively) ($P = .0001$). TTH patients were more likely to have insufficient sleep (sleep efficiency < 85%) (53.1%) than those with migraine (25%) or the control group (29.9%) ($P = .025$). **Conclusion:** Patients who suffered from TTH were more likely to have insomnia than patients with migraine or controls. Nearly all patients with TTH had poor sleep quality, which was also observed in approximately half of the individuals in the migraine and control groups. Three-quarters of patients in the TTH group and more than half in the migraine group indicated inadequate sleep as a trigger factor for headache. *J Oral Facial Pain Headache 2020;34:61–66. doi: 10.11607/ofph.2405*

Keywords: headache, insomnia, migraine, poor sleep quality, tension-type headache

Headaches and sleep have a complex relationship.¹ Tension-type headache (TTH) and migraine are the most commonly diagnosed headache-related diseases, and they both have huge social and economic impacts on society.² Migraine was recognized to be the sixth highest cause of disability worldwide and is responsible for diminished productivity and decreased quality of life.³ Most people with a primary headache disorder feel their attacks are provoked by one or more precipitants, the most common of which are stress and sleep.⁴ Nevertheless, physicians should be aware of the fact that the relationship between headaches and sleep disorders is bidirectional: lots of patients complain that the headache leads them to sleep disruption, while others think that poor sleep leads to increased frequency, severity, and chronicity of headache.^{5,6} This two-way association may be linked to the brain structures—such as the thalamus, hypothalamus, and brainstem nuclei (including the locus coeruleus and raphe nucleus)—that are shared by both sleep and headaches.⁷ Inadequate sleep may also be related to an exaggerated sense of pain and increased frequency of headache episodes and supports the theory that the intensity of sleep disorders increases in proportion to the frequency of headache attacks.² Excessive daytime sleepiness and snoring have been also linked to chronic headaches.⁸ Recent data in a study sample

of participants with TTH suggest that depression and quality of sleep are related to the frequency of headache attacks and to the psychologic concerns caused by pain experiences.⁹ However, information regarding the impact of sleep disturbances on the course of TTH and migraine in a population-based setting is limited. The definition “sleep disturbances” covers sleep-related diseases, such as insomnia and obstructive sleep apnea, and also other sleep disturbances; eg, poor sleep quality.¹⁰ Many researchers have focused more on the rates of insomnia, and few of them have evaluated the impact of headaches on sleep quality.¹¹ Nevertheless, poor sleep quality includes different components (eg, sleep disruption, early morning awakening, and difficulty in falling asleep) that could explain the incompatibility found in data assessing its importance in headache-related disorders.¹² Therefore, these studies suggest that the management of patients with TTH and migraine should include means to target depression, the emotional burden of the headache, quality of sleep, and pain.¹³ Thus, earlier evaluation and appropriate management of sleep disorders might help with better control of headaches, improving their outcomes and likely preventing chronification.¹⁴

This study therefore sought to evaluate the possible relationship between sleep disturbances and primary headaches, with the specific aims of (1) determining the frequency and type of sleep disturbances in patients with primary headaches and comparing them to a control group; (2) evaluating the quality of sleep among patients with primary headaches and comparing them to a control group; and (3) assessing the influence of sleep-related symptoms on the course of headache.

Materials and Methods

Study Design

The study protocol was approved by the Bioethics Center of the Lithuanian University of Health Sciences (2017-09-12 No. BEC-MF-08). Written informed consent was obtained from all participants. The study was carried out in a random group of 76 patients with active primary headaches (case group) and a control group of 67 random volunteers. The 76 patients with active primary headaches were further stratified into two groups: patients with migraine (44) and patients with TTH (32). Criteria for inclusion in the study group were active primary headache; age of 18 to 65 years; diagnosis of primary headache made based on the International Criteria for Headache Disorders, 3rd edition; and consent to participate in the research. Active primary headache was described as having at least one episode

of headache during the last month. Participants in the case group were asked to fill out the questionnaire in the outpatient department during their routine visits to a neurologist at the Neurology Department, Kaunas Clinics, Hospital of Lithuanian University of Health Sciences. Controls were randomly selected volunteers matched by age and sex who did not have a diagnosed primary headache or any episodes of headache in the last month and who gave consent to participate in the research. The study did not include patients who had epilepsy, meningitis, encephalitis, head trauma, multiple sclerosis, trigeminal neuralgia, or oncologic disease, or those who were pregnant, employed in shift work, or had traveled through time zones lately. Patients who were diagnosed with both types of primary headache (TTH and migraine) at the same time were also excluded.

Questionnaire

Patients were questioned using the following standardized tests: Insomnia Severity Index (ISI), Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), Berlin Sleep Apnea Questionnaire (BSAQ), and a custom-made headache questionnaire. The results of the questionnaires were compared among the patients with TTH, the patients with migraine, and the age- and sex-matched controls.

Participants with ISI scores of ≥ 8 were classified as having insomnia. The ISI consists of 7 questions assessing the severity of problems at the beginning of sleep, staying asleep, waking up too early, satisfaction with sleep, interference with daytime functioning, noticeability of impairment, and concern caused by the sleep problems. Each question is scored from 0 to 4 points, and a total score can be from 0 to 28 points. The ISI total score categories are: no clinically significant insomnia (0–7 points); subthreshold insomnia (8–14 points); moderate severity insomnia (15–21 points); and severe insomnia (22–28 points). A score of > 7 points shows that insomnia can be suspected. Poor sleep quality was defined as a global PSQI score of ≥ 6 . Short sleep time was defined as ≤ 6 hours per day. Normal sleep efficiency was defined as $> 85\%$. An ESS score > 10 suggests excessive daytime sleepiness (EDS). An ESS score ≥ 16 suggests a high level of EDS.⁹ The Berlin Questionnaire (BSAQ), which includes questions about snoring, daytime somnolence, body mass index (BMI), and hypertension, is a brief and validated screening tool that identifies individuals in the community who are at high risk for OSA.⁵ The BSAQ is scored as high or low risk for obstructive sleep apnea (OSA). The custom-made questionnaire included different questions that allowed the assessment of demographic and headache type-related characteristics of headaches, such as age, gender, BMI, the intensity of pain on a

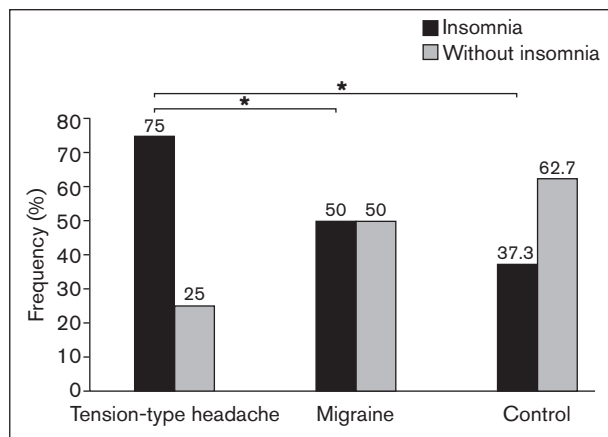


Fig 1 Frequency of insomnia among participants (n = 143). * $P = .002$

1–10 scale, days per month affected, other symptoms appearing together with the headaches, duration of a single episode, ability to work and maintain one's daily routine during an episode, etc; as well as information about the diseases in the exclusion criteria.

Statistical Analyses

The results were analyzed using SPSS 24.0 software package and Microsoft Office Excel 2013. The Shapiro-Wilk test was used to evaluate the normality of the distribution. For comparison of two samples of ordinal variables, nonparametric Mann-Whitney U test was used. Frequencies of different qualitative features were compared using chi-square test. Descriptive statistics are represented by percentages for qualitative variables. Median (minimum to maximum) values were used to describe the results of the nonparametric tests. P values of less than .05 were determined as significant.

Results

Survey

Among the 143 participants, 32 (22.4%) had active TTH, 44 (30.8%) had active migraine, and 67 (46.9%) were controls. The mean age of the patients was 33.09 (11.2) years, and 67 (88%) were women and 9 (12%) were men (Table 1).

Characteristics of Primary Headache Groups

The number of days with headaches per month was significantly higher among the patients with TTH than among migraineurs (median = 9.5 [2 to 30] vs 5 [1 to 22] days, respectively) ($P = .028$). A significant difference in the severity of pain as measured by visual analog scale (VAS) was also found. The median pain severity score in the group of patients with migraine attacks was 8 (5 to 10) and in the TTH patient group was 6.5 (4 to 9) ($P < .001$).

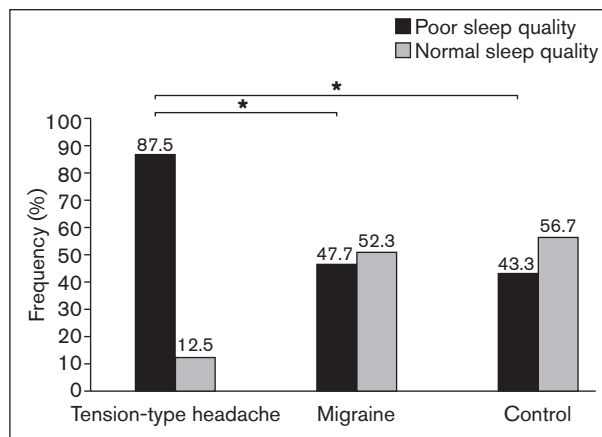


Fig 2 Frequency of poor subjective sleep quality among participants (n = 143). * $P = .0001$.

Table 1 Demographic Characteristics of the Participants

	Tension-type headache, n (%)	Migraine, n (%)	Control group, n (%)
Men	4 (12.5)	5 (11.4)	11 (16.4)
Women	28 (87.5)	39 (88.6)	56 (83.6)
Total	32 (100)	44 (100)	67 (100)
Mean (standard deviation) age, y	30 (10)	35 (11)	34 (11)

Headaches and Insomnia

Based on these results, the incidence of suspected insomnia according to the ISI was different among the groups ($P = .002$). Pairwise comparisons showed that patients with TTH (n = 24 [75%]) were more likely to have insomnia than patients with migraine (n = 22 [50%]) or controls (n = 25 [37.3%]) ($P < .05$) (Fig 1).

The age of migraineurs with insomnia was significantly different from migraineurs with no history of insomnia; younger people were more likely to suffer from insomnia (median 26.5 [19 to 54] years vs 37.5 [21 to 56] years, respectively; $P = .014$). In the TTH and control groups, no differences in the ages of the individuals with and without insomnia were found.

Sleep Quality and Efficiency

Among the patients with TTH, 28 (87.5%) were classified as having poor subjective sleep quality according to the PSQI, while those with migraine and the control group had better sleep quality (n = 21 [47.7%] and n = 29 [43.3%], respectively). Pairwise comparisons showed that poor sleep quality was different between the groups ($P = .0001$) and that the frequency of poor sleep quality was significantly highest in the TTH group (87.5% vs 47.7% [migraine] and 87.5% vs 43.3% [control]; $P < .05$) (Fig 2).

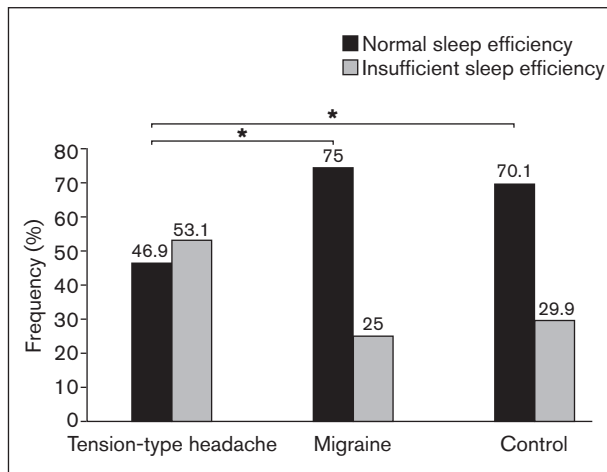


Fig 3 Sleep efficiency among groups (n = 143). *P = .025.

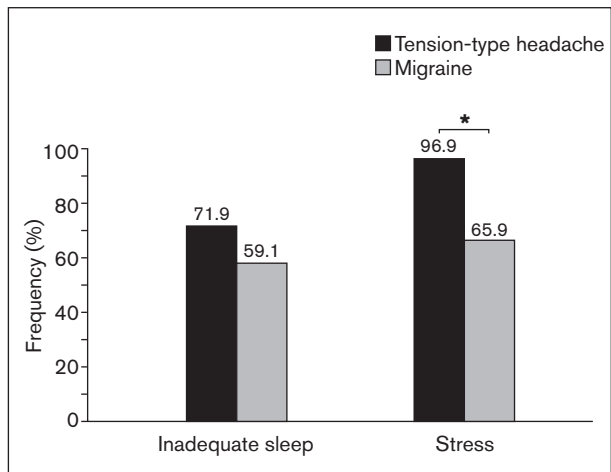


Fig 4 Trigger factors for headache (n = 76). *P = .01.

Eight (25%) participants in the TTH group, 7 (15.9%) in the migraine group, and 14 (20.9%) in the control group suffered from short-duration sleep. The results showed that there was no significant difference in the rates of short sleep time among all three groups ($P = .614$).

The analysis of sleep efficiency according to the PSQI revealed that there was a significant difference among the groups ($P = .025$). TTH patients (n = 17 [53.1%]) were more likely to have insufficient sleep than those with migraine (n = 11 [25%]) or the control group (n = 20 [29.9%]) ($P < .05$) (Fig 3).

Twenty-three participants (71.9%) in the TTH group and 26 (59.1%) in the migraine group indicated inadequate sleep as a trigger factor for headache; however, there was no significant difference between the groups ($P = .25$). Stress was a significantly more frequent trigger in TTH patients than in migraineurs (n = 31 [96.9%] vs n = 29 [65.9%], respectively; $P = .01$) (Fig 4).

Sleepiness and Apnea

The results of the ESS showed that there was no significant difference in the rates of EDS among all three groups ($P = .503$). Among the individuals with TTH, 3.1% had EDS and 21.9% had a high level of EDS, while in the migraine group these proportions were 9.1% and 20.5%, respectively. Among controls, 6.0% had EDS and 11.9% had a high level of EDS.

The results of the BSAQ showed that there was no significant difference in the rates of high or low risk for OSA among all three groups ($P = .244$). There were 6 people (18.8%) in the TTH group who had a high risk for OSA, 6 (13.6%) in the migraine group, and 5 (7.5%) in the control group.

Discussion

The main findings of this study were as follows: (1) The prevalence of insomnia was significantly higher among patients who suffered from TTH than among patients with migraine or individuals without headache; (2) TTH patients were more likely to have poor sleep quality than those with migraine or the control group; and (3) Inadequate sleep was a common trigger factor for headache among patients with primary headache.

A significant association between insomnia and TTH has been found in previous studies. For example, a population-based study in Norway revealed that the prevalence of insomnia is 1.8 times higher in individuals with TTH than in those without headache.¹⁵ When comparing these findings to results of the study performed by Kim et al,¹⁶ the prevalence of insomnia in groups with TTH and without headache are distinctly higher (TTH = 75% vs 12.9%, respectively; and without headache = 37.3% vs 5.8%, respectively). One of the reasons that could explain this discrepancy is the fact that the present sample size was 18 times smaller. Furthermore, 25% to 71% of patients with TTH and 47% to 73% of patients with migraine suggested insufficient sleep as a trigger cause for a headache episode,¹⁷ while in another study it was 79% and 58%, respectively.¹⁸

Kelman and Rains performed research where they found that 50% of patients suffering from migraine identified intermittent episodes of insomnia.¹⁹ The present study revealed the same percentage of subjects with migraine were affected: 38% reported sleeping up to 6 hours per night, and 50% reported that inadequate sleep provoked their migraine attacks. Another study revealed that insomnia

appeared to be more frequent among participants with TTH than among those suffering from migraine,²⁰ which is consistent with the present study, in which 75% of subjects with TTH were affected by insomnia. Indeed, insomnia is thought to be a significant risk factor for the increasing incidence of headache, especially in TTH and migraine.²¹ Caspersen et al revealed a poor sleep quality in patients with TTH and found that the hours of sleep per night did not differ greatly between patients with a headache disorder and healthy controls.²² The large cohort study revealed a greater risk ratio (adjusted hazard ratio = 3.51, 95% CI 3.27 to 3.78) of developing migraine in people with sleep disorders.²³ What is more, headache sufferers are at greater risk of progressing to sleep disturbances (odds ratio = 2.4, 95% CI 1.9 to 3.0) than headache-free subjects, regardless of the specific headache type.²⁴ Patients with TTH who experience sleeping problems also appear to have increased sensitivity to pain.²⁵ Bezov et al discovered that inadequate sleep changes central sensitization.²⁶ Insufficient sleep could also lead to an exaggerated sense of pain by enhancing the frequency of headaches, supporting the theory that the intensity of sleep disorders increases in proportion to the frequency of headache attacks.¹⁷

Finally, current data advise that the management of patients with TTH and migraine must include means to target depression (eg, psychotherapy and medications), psychologic anxiety of the headache, quality of sleep (eg, sleep hygiene, strategies and efforts of the patient to handle personal issues), and pain (eg, medications and other interventions). Physicians should be aware of the fact that medications, although quite widely available, are not always enough to manage the symptoms of headaches adequately.

Although the data were collected, more detailed information regarding subjects' medications and mental disorders were not analyzed. Moreover, instrumental sleep diagnostics such as actigraphy and polysomnography, which would be a more objective method than questionnaires, were not performed. In fact, this study did not answer the question of whether headaches are a cause or a consequence of sleep disorders or vice versa. In order to answer this particular question, a group of subjects newly diagnosed with sleep disorders and their potential to develop a certain type of headache would need to be observed. A prospective cohort study would be the study design of choice in this case.

The present study design is unique for using many different questionnaires that helped to evaluate many different aspects of sleep disorders. There are studies analyzing associations between headaches and the rates of insomnia, but only few have focused

more on the sleep quality itself. The present research suggests that management of patients with TTH and migraine must include means to target not only pain but also quality of sleep. This type of study is the first in Lithuania and is unique for its great relevance to the stresses of present-day society in everyday life.

Conclusions

Patients who suffer from TTH were more likely to have insomnia than patients with migraine or the control group. The rates of EDS and OSA did not differ greatly between the groups. However, one-fifth of the patients with TTH tended to have a high level of EDS and a high risk for OSA.

Nearly all patients with TTH had poor sleep quality, which was also observed in approximately half of the individuals in the migraine and control groups. TTH patients were more likely to have insufficient sleep than those with migraine or controls.

Three-quarters of patients in the TTH group and more than half in the migraine group indicated inadequate sleep as a trigger factor for headache. This advocates for a combined therapeutic approach targeted at pain, emotional status, and sleep-related aspects.

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