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Original Article

## Specific Headache Factors Predict Sleep Disturbances Among Youth With Migraine



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### ABSTRACT

**BACKGROUND:** There is a paucity of pediatric data addressing the complex relationship between primary headaches and sleep disturbances. Our study objective was to explore headache-related factors that predict sleep disturbance and to compare sleep complaints with other forms of headache-related disability among youth with migraines. **METHODS:** A prospective cohort study was conducted in patients 10–18 years old with migraine or probable migraine and without daily sleep complaints. The patients completed a 90-day internet-based headache diary. On headache days, patients rated headache intensity, answered Pediatric Migraine Disability Assessment-based questions modified for daily scoring, and reported sleep disturbances that resulted as a direct effect of proximate headaches. **RESULTS:** Fifty-two patients generated 4680 diary entries, 984 patients (21%) involved headaches. Headache intensity ( $P = 0.009$ ) and timing of headache onset ( $P < 0.001$ ) were predictive of sleep disturbances. Three Pediatric Migraine Disability Assessment-based items were also associated with sleep disturbances: partial school-day absence ( $P = 0.04$ ), recreational activities prevented ( $P < 0.001$ ), and decreased functioning during recreational activities ( $P < 0.001$ ). Sleep disturbances correlated positively and significantly with daily headache disability scores ( $r_{pb} = 0.35$ ;  $P < 0.01$ ). **CONCLUSION:** We conclude that specific headache factors predict sleep disturbances among youth with primary headaches.

**Keywords:** PedMIDAS, MIDAS, migraine, pediatric, adolescent, diary, disability

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### Introduction

Migraine is a common form of primary headache that often begins during the early school-age years.<sup>1,2</sup> The prevalence of migraine in children is estimated at 10%, with higher rates occurring among older teenagers.<sup>2–4</sup> Migraine headaches can lead to impairments in a child's daily activities and school performance and can adversely impact quality of life.<sup>5,6</sup> The Pediatric Migraine Disability Assessment (PedMIDAS) is the only validated measure of

headache-related disability in children.<sup>5</sup> The PedMIDAS uses six questions to assess three functional disability domains: school attendance and function, participation in activities at home, and participation and function in recreational/leisure activities.

Sleep disturbance is a common comorbidity of primary headaches. However, there is a paucity of research exploring the specific interactions between headaches and sleep in children and adolescents. The few studies available support the notion that youth with primary headaches have more sleep complaints than healthy controls.<sup>7–12</sup> The prevalent sleep disturbances include difficulty falling asleep, increased nightly waking, decreased sleep duration, and excessive daytime sleepiness. Aside from the potential influence that sleep deprivation can have as a headache trigger, poor sleep quality and shortened sleep duration can cause a lowered

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sense of well being, impair daytime functioning, and impact school performance and attendance in school-age children.<sup>13–16</sup> Additionally, inadequate sleep can have detrimental effects on the patient's ability to cope with the pain of headache.<sup>16</sup> Sleep quality is an important indicator of quality of life.<sup>17</sup>

The relationship between primary headaches and sleep disturbances is complex. Sleep impairments and headaches can interact in a bidirectional manner: altered sleep patterns can trigger headaches, whereas the presence of headache can disrupt nightly sleep. Furthermore, migraines can occur during nocturnal sleep, particularly during periods of rapid-eye-movement sleep and on morning arousals.<sup>18,19</sup> In a study of migraine patients aged 6–18 years, 24% reported that at least one quarter of their headaches began at night and woke them from sleep; 4% of the patients reported exclusively nocturnal headaches.<sup>11</sup> Conversely, sleep itself can be an effective method of terminating a migraine episode.<sup>20</sup> It is possible that common genetic, pathophysiologic, and/or behavioral factors exist that predispose some patients to both primary headaches and sleep disturbances, but these factors have not yet been identified.

Most studies addressing the associations between primary headaches and sleep disruptions in children and adolescents have done so using cross-sectional study designs which limit conclusions about the direction of the effects.<sup>7,8,10–12,16</sup> Longitudinal study designs are better suited to examine how headaches affect sleep and how sleep affects headaches. Bruni et al.<sup>21</sup> randomly assigned migraineurs, 5–14 years of age, to two groups: one group received recommendations about sleep hygiene, and the other group did not. After 6 months of follow-up, the sleep-hygiene group reported lower mean headache duration than the control group, suggesting that better sleep quality led to altered migraine patterns. Although this study represents an indirect measure of the effects that sleep disturbances can have on migraines, it supports the direction of the relationship (i.e., sleep disturbance can exacerbate migraine). We are not aware of a longitudinal pediatric study that has examined the specific migraine characteristics that can impact sleep. When sleep disruption results from a proximate headache episode, the sleep disruption could be considered a form of headache-related disability, similar to missing school or missing recreational activities because of headache. We hypothesize that certain headache features will be predictive of sleep disturbances and that these sleep disturbances will correlate with other measures of headache-related disability: functioning during school and school attendance, functioning during leisure activities and participation in leisure activities, and participation in home activities.

The aim of the present study was to identify specific headache factors related to sleep disturbances on headache days among youth with migraine or probable migraine. Headache days with sleep disturbances were compared with headache days without sleep disturbances using an internet-based headache diary. Sleep disruptions due to proximate headaches were also compared with headache-related disability (PedMIDAS elements) reported in the corresponding diary entry.

## Methods

### Overview

We conducted a longitudinal study of 52 patients with migraine or probable migraine over an 11-month recruitment period from December 2011 to October 2012. Each patient completed a 90-day internet headache diary. On headache days, they answered diary questions which addressed headache intensity, headache disability, and whether abortive medicines were taken. They also completed a comment section where they were asked to describe additional headache features, the timing of each headache, and whether the headache disrupted sleep. Several study details including the internet diary description, the patient population, and diary compliance have been described previously.<sup>22</sup>

### Ethics

This study was approved by the Institutional Review Board at Nationwide Children's Hospital. Written informed consent (parents and patients 18 years of age) and assent (patients <18 years) were obtained from all patients.

### Patient population

Patients ranged in age from 10–18 years, and all had clinical evaluations consistent with episodic migraine (with or without aura) or probable migraine based on International Headache Society criteria.<sup>23</sup> We included patients with 1–15 headaches monthly. Migraine patients who also had episodic tension-type headaches were not excluded provided that their migraines occurred  $\geq 1$  day per month, and the frequency of all combined headaches remained  $\leq 15$  days per month. Patients with chronic sleep disturbances, excessive daytime sleepiness, diagnosed sleep disorder, or use of any sleep aid(s) were excluded. We also excluded patients with chronic musculoskeletal pain, depression, or suspected medication-overuse headache. The sample size was chosen empirically (goal of  $n = 50$ ) to include adequate variations in patient age, headache frequency, and migraine disability.

### Internet headache diary

Daily diary entries included 11 questions and a comment section. The first question asked "Did you have a headache today?" Questions 2–7 mirrored PedMIDAS questions,<sup>5</sup> but were modified to address disability for each daily diary entry. Questions 2–4 addressed missing the entire school day (Q2), leaving school early or arriving late (Q3), and functioning at less than half ability in school (Q4) because of a headache. Question 5 asked if activities at home such as homework or chores were affected by headache. Questions 6 and 7 addressed missed participation in social or recreational/leisure activities (Q6) and functioning at less than half ability during these activities because of headache (Q7). Patients could not choose more than one form of disability for school or for social activities on a given headache day. For example, if Q2 ("missed school") was selected, then Q3 and Q4 were automatically blocked. Question 8 provided a headache intensity rating scale that ranged from 1–10. Questions 9–11 addressed medicine compliance and the use of abortive medicine(s). The 400-character comment section allowed headache description beyond the diary questions. At the time of recruitment participants were instructed to describe additional headache features, timing of their headache(s) for that day, and whether the headache delayed or disrupted normal nighttime sleep (as defined in the following section).

### Study protocol

We encouraged parents to remind their children to log on to the internet diary each day but to let the child complete each entry. Study investigators had an administrative log-in feature that allowed daily monitoring of diary compliance and review of each entry upon submission. A reminder e-mail was sent to both parent and patient when

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