Original Article

Sleep, Sleepiness, and Behavior Problems in Children With Headache

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ABSTRACT

The purpose of this study was to assess sleep, daytime sleepiness, and behavior problems in children suffering from headaches and in controls, with a special focus on the role of gender. A clinical group of 28 children with persistent headache complaints and a control group of 108 healthy children were included. Sleep was assessed by actigraphy and diaries. Behavior problems were assessed by parental reports. In comparison with the control group, the sleep quality of the clinical group was poorer and they complained more about excessive daytime sleepiness. Children suffering from headache showed higher levels of internalizing behavior problems. Gender was found to be a moderating factor for the relationships between headache and sleep. Compared with control girls, girls suffering from headaches had poorer sleep quality, whereas the opposite was true for the boys. The results highlight the importance of assessing sleep, daytime sleepiness, and psychologic adjustment in children complaining about headaches as an integral part of their routine assessment. (*J Child Neurol* 2006;21:1012–1019; DOI 10.2310/7010.2006.00239).

Sleep problems and headaches are among the most prevalent complaints presented to pediatricians and other child care professionals. Complaints about headaches are very prevalent during childhood.[1–10] Depending on the definition of headache complaints, the prevalence reported in large-scale studies ranges between 10% and more than 50%.[5,9–12] Gender differences have been reported in prevalence rates, with higher reported rates in girls after puberty onset.[9,13,14] Interestingly, it has been reported that, over the years, a dramatic increase occurred in the reported prevalence of headaches in children.[15] This change calls for better understanding of its underlying mechanisms.

When discussing headaches, it is important to emphasize that our focus is on primary headaches that exclude those related to a known organic source, such as tumor, elevated intracranial pressure, or head trauma. Primary headaches typically include two types: migraine and tension type.[6,16–18] In children, migraines are reported at a rate of 2.7% at the age of 7 years and gradually escalate to 6.4% in boys and 14.8% in girls at the age of 14 years.[17] The prevalence of sleep problems in children is estimated within the range of 15% to 30%.[19–23] In addition to the reported and monitored sleep problems, as children approach adolescence, there is a significant increase in their complaints about insufficient sleep and daytime sleepiness and fatigue.[24–27]

The links between sleep disorders and headaches have been known for over a century from clinical work and research studies.[6] Although a clear link between sleep and headaches has been established in adults, the clinical research in children has been very limited.[28–31] Children who suffer from headache have a high rate of sleep difficulties, such as insufficient sleep, cosleeping with parents, difficulties falling asleep, anxiety related to sleep, restless sleep, night waking, nightmares, and fatigue during the day.[28,29] Furthermore, headaches have been linked to specific sleep disorders, such as somnambulism[32] and snoring.[33] In longitudinal research of the first 6 years of life, it has also been reported that sleep problems in early childhood predict headaches at school entry age.[34]

Bruni et al found no differences in the duration, frequency, or intensity of headaches in children with and without reported sleep difficulties.[29] However, they did find a higher rate of sleep difficulties (8.13% vs 2.35% in the control group) in children suffering from headaches. These included shorter sleep, difficulty falling asleep, night wakings, and reported fatigue during the day. In addition, a recent study conducted in children aged 2 to 12 years found a correlation between the frequency, timing, length, and intensity of a migraine attack and sleep-related problems.[28] Furthermore, in this study, migraines were found to be associated with less sleep, fear of falling asleep, and bedtime refusal in children.

In addition to the links between sleep problems and headaches in childhood, it is important to emphasize the potential adverse effects of each of these problems on the child's functioning and well-being. Sleep disorders have been linked to compromised neurobehavioral functioning, increased rates of behavior problems, and psychopathology.[35–41] Similarly, headaches have been associated with psychopathology in children.[42–46] Interestingly, gender-related differences were found for the association between headaches and psychopathology.[47] Girls suffering from internalizing disorders, such as anxiety and depression, showed higher rates of headaches compared with girls with no psychopathology; whereas in boys, headaches were linked to conduct (externalizing) disorders. It is also important to emphasize that both sleep disorders and headaches have been repeatedly associated with stress in children.[8,25,48–53]

Gender appears to be a key factor in headaches, sleep, and behavior problems. The prevalence of headaches appears to be significantly higher in girls, and the course of the disorders appears to diverge, with boys having higher recovery rates than girls.[4,14,54–57] It has been suggested that maturational and sex differences in hormonal activity might play a role in the onset and evolution of headaches in children.[56] Furthermore, boys and girls appear to differ in their perception of and coping with pain.[58–66] In the behavioral domain, gender differences have been repeatedly demonstrated with regard to behavior problems and childhood psychopathology.[67] It appears that during early childhood, there are no notable gender differences in the prevalence of behavior problems. During the preschool and elementary school years, boys appear to present with more behavior problems than girls (mostly externalizing disorders), with a shift toward predominance of psychopathology in girls (mostly internalizing disorders) starting in adolescence. Gender appears to play a role in the evolution of sleep patterns.[25,68–72] Although the literature on sleep, gender, and development is less consistent, there appear to be differentiated developmental trajectories for boys and girls in the evolution of sleep patterns.

In summary, headaches and sleep problems are very prominent health care issues in children. Links between primary headaches and sleep problems have been documented in the literature, as have associations between these two domains and behavior problems and child psychopathology. Gender appears to play a major role in the developmental trajectories in these domains. In the present study, we assessed sleep and behavior problems in children referred because of persistent headache complaints and in healthy controls.

METHOD

Participants

Twenty-eight children (17 girls and 11 boys), in the age range of 7 and 14 years, were recruited from the Outpatient Neurology Clinic in Schneider Children's Medical Center, Petah-Tikva, Israel. These children were referred to the clinic because of reported persistent headaches. They were all assessed by a child neurologist who used the International Headache Society criteria for headache diagnosis.[18,73] Specific diagnoses included migraine (in 15 children), tension-type headache (7), and mixed (6). The children and their parents signed an informed consent form explaining the purpose of the study and their rights to decline participation or withdraw at any point in time, without compromising the clinical services they were receiving.

The control group consisted of 108 children with no reported chronic health problems. These children were recruited from regular schools and participated in a study on normal development of sleep patterns in school-aged children.

The demographic variables of the two groups were compared, with no significant differences on any of the variables (Table 1). Most children in both samples came from middle- or upper-class families and were living with their two biologic parents.

Table 1. Demographic Variables of the Children With Headache and Controls: Range, Mean ± SD, or Percentage of the Sample

Sleep Variables	*Control*	*Headache*	*Range*
Child's age (yr)	10.28 ± 1.62	10.39 ± 2.02	7–14
Mother's age (yr)	40.01 ± 4.66	38.53 ± 5.12	28–53
Father's age (yr)	42.94 ± 5.87	41.59 ± 5.70	24–68
Mother's education (yr)	14.60 ± 2.93	13.68 ± 2.76	8–24
Father's education (yr)	14.28 ± 3.64	14.58 ± 2.87	8–25
No. of children in family	3.15 ± 3.84	3.25 ± 1.71	1–8
No. of rooms at home	5.03 ± 1.20	5.04 ± 1.20	2–8
Birth order of child (% of firstborns)	38.14	46.43	
Sex (% of boys)	39.29	50	
Parents employed full time (%)			
Fathers	87.93	81.48	
Mothers	46.55	42.86	
Two biologic parents in family (%)	92.31	96.43	

Procedure

The study was approved by the Helsinki Committee of Schneider Children's Medical Center and by the Ethics Committee of the Psychology Department at Tel Aviv University. In the hospital, children and their parents were approached as they arrived for a clinical interview with a child neurologist and were offered participation in the study. After signing the informed consent forms, children and their parents were given a set of questionnaires and an actigraph. The children were asked to attach the actigraph to their nondominant wrist from bedtime to morning rise time for a period of 5 days and to complete the daily sleep logs. The children received a small gift and an actigraph chart describing their sleep. In the control group, the children and their parents completed a similar protocol coordinated through the school setting. All monitoring occurred during regular school days.

Measures

The measures included assessment of sleep by objective and subjective instruments and assessment of headaches and behavior problems.

Actigraphy

Activity monitoring (actigraphy) was used to assess sleep-wake patterns. Actigraphy has been established as a reliable and valid method for the naturalistic study of sleep in infants, children, and adults.[74,75] Recent studies have also demonstrated good reliability of these actigraphic measures.[25,36,76]

The children were asked to attach the miniature actigraph (a wristwatch-like device, Mini Motionlogger, Ambulatory Monitoring Inc., Ardley, NY) to their nondominant wrist in the evening when preparing for sleep and to remove it in the morning. Sleep assessment was performed for five continuous nights during the week. The actigraphs collected data in 1-minute epochs and in amplifier setting 18, which is the standard mode for sleep-wake scoring. Actigraphic files were analyzed with the *Actigraphic Scoring Analysis* program for an IBM-compatible personal computer that provides validated sleep-wake measures.[77]

Actigraphic sleep measures included (1) sleep onset time; (2) morning rise time; (3) the total time from sleep onset to morning awakening; (4) sleep time excluding all periods of wakefulness; (5) percentage of true sleep time (measure 4) from the total sleep period (measure 3); (6) the number of night wakings; and (7) the percentage of motionless sleep. In parallel to the actigraphic monitoring, the children completed a daily log on which they reported their subjective perception of sleep and reported if they suffered from headache during each specific monitored day.

Sleep Habit Questionnaire

The sleep habit questionnaire was developed and used mainly to assess daytime sleepiness and excessive daytime sleepiness.[25] This 20-item Likert-type scale is completed by the child and provides one scale of excessive daytime sleepiness.

Child Behavior Problems

The Child Behavior Checklist was used to assess behavior problems as perceived by parents.[78] It is a widely used instrument for assessing behavior problems with well-established psychometric properties. The Hebrew version of this instrument has been translated and validated in Israel.[79]

RESULTS

Data analysis consisted of three stages: (1) comparison between the clinical and the control samples on sleep measures, (2) comparison of sleep on nights with and without headaches within the clinical group, and (3) comparison of the clinical and control samples on the behavioral measures.

Comparison Between Clinical and Control Groups: Sleep and Sleepiness

Actigraphic sleep measures were averaged across the nights of monitoring. To test for group differences considering possible effects and interactions with gender, we used multivariate analysis of variance (ANOVA) with group (headache/control) and gender as independent variables, age as a covariate, and the six sleep measures derived from the actigraph device as dependent variables.

The analysis revealed differences in the sleep quality measures of children in the headache group compared with those in the control group (Table 2 and Figure 1). In comparison with the controls, children with headache had reduced percentages of motionless sleep, $F(1,131) = 4.46$, $P < .05$, and an earlier morning rise time, $F(1,131) = 8.24$, $P < .005$.

Significant group by gender interaction, $F(1,131) = 12.79$, $P < .05$, was found for some of the measures. Specifically, boys with headaches fell asleep earlier than boys with no headaches, whereas girls with headaches fell asleep later than girls with no headaches.

Another significant interaction between sample and gender was seen in the total sleep time, $F(1,131) = 10.51$, $P < .05$, and true sleep time, $F(1,131) = 8.13$, $P < .05$ (see Figure 1). In comparison with the control group, boys suffering from headaches slept more and spent more time in true sleep, whereas girls suffering from headaches slept less and spent less time in true sleep than girls in the control group.

In addition to the group differences on morning rise time, in the clinical group, an earlier rise time was significantly correlated with an increased subjective rating of the severity of the headache problem, $r(26) = .48$, $P < .05$.

On the excessive daytime sleepiness scale of the sleep habit questionnaire, the children in the clinical group rated themselves significantly higher than those in the control group, $F = 5.82$, $P < .05$. The specific statistically distinct items were "I sleep during daytime" ($F = 8.11$, $P < .01$), "I have difficulty getting up in the morning" ($F = 4.49$, $P < .05$), and "I suffer from chronic tiredness" ($F = 4.78$, $P < .05$), on which the clinical group received higher scores.

Table 2. Actigraphic Sleep Measures of Children With Headache and Controls: Means, Standard Deviations, and *F* Values

Sleep Measures	*F(1,131)*	*Control*	*Headache*
Sleep onset time (h)	2.27	22.29 ± 0.74	22.48 ± 0.98
Morning rise time (h)	4.46*	6.86 ± 0.35	7.18 ± 0.56
Sleep period (min)	1.33	514.4 ± 39.5	521.9 ± 41.3
True sleep time (min)	0.02	479.1 ± 39.7	485.3 ± 41.8
Sleep percentage	1.62	93.15 ± 3.84	93.91 ± 3.85
Night wakings (*n*)	1.77	1.98 ± 1.36	1.73 ± 1.3
Motionless sleep (%)	8.24**	68.52 ± 8.42	64.32 ± 11.11

*$P < .05$; **$P < .005$.

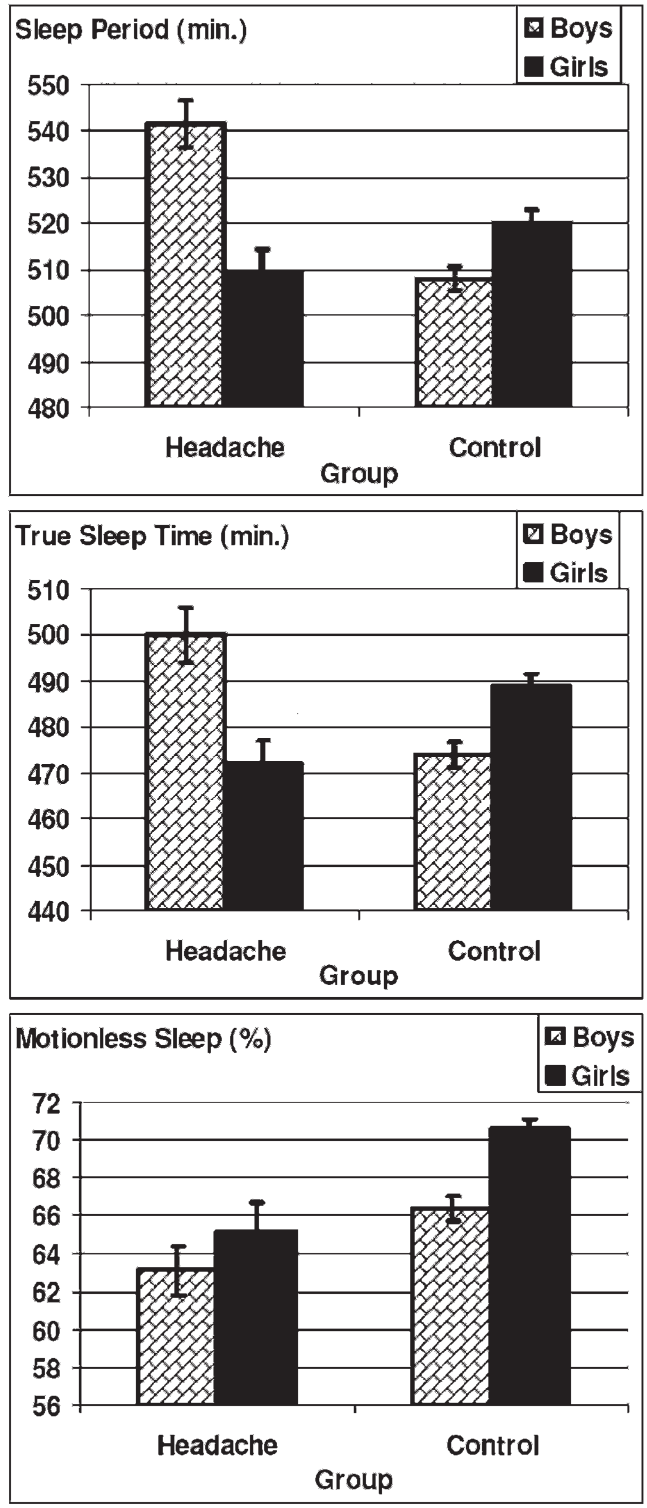

Figure 1. Comparison of actigraphic sleep measures between children suffering from headache and controls. Each panel represents a specific sleep measure (mean ± standard error).

Analysis of Sleep on Days With or Without Reported Headaches

From the 163 days documented in the clinical group, 66 days (40.5%) were reported as days with headache complaints. One child reported no headache on all days of the study and was excluded from this analysis. To assess the daily impact of reported headaches, we calculated separate means for the sleep measures on the monitored nights with or without reported headache for each child in the clinical sample. We performed ANOVA for repeated measures with type (with or without reported headache) as the repeated measure and gender as the second independent variable. The analyses (Figure 2) revealed significant gender by type interactions on four actigraphic sleep measures, including quiet sleep, $F(1,21) = 8.39$, $P < .01$; sleep percentage, $F(1,21) = 4.54$, $P < .05$; and night wakings, $F(1,21) = 4.60$, $P < .05$. It appears that in comparison with nights with no reported pain, boys slept more poorly on nights with reported headaches, as manifested in a decreased sleep percentage and quiet sleep percentage and an increased number of night wakings. In contrast, in comparison with nights with no reported pain, girls slept better on nights with reported headaches, as reflected in an increased sleep percentage and a quiet sleep percentage and a reduced number of night wakings.

Comparison Between Clinical and Control Groups: Behavior Problems

Multivariate ANOVA with group, age, and gender was used to compare the clinical and control groups on the behavior problem scales on the Child Behavior Checklist (Figure 3). The Child Behavior Checklist's headache item was removed from the analyses because of its specificity in defining the clinical group. Significant group, $F(9,118) = 7.49$, $P < .0001$, and gender, $F(9,118) = 2.53$, $P < .05$, differences were found on the multivariate ANOVA. Discrete ANOVA analyses for each of the subscales revealed significant differences on the total Child Behavior Checklist score, $F(1,126) = 8.26$, $P < .005$; the Internalizing factor, $F(1,126) = 19.45$, $P < .0001$; and the Attention $F(1,126) = 5.35$, $P < .05$), Withdrawal, $F(1,126) = 5.33$, $P < .05$, Somatic, $F(1,126) = 63.36$, $P < .0001$, and Anxiety-Depression, $F(1,126) = 5.67$, $P < .05$, subscales.

The number of reported episodes of headache during the day and night (based on the daily reports) was associated with an increased level of reported behavior problems. Children who reported more headache episodes were rated as having more attention problems, $r(27) = .64$, $P < .0005$); social problems, $r(27) = .57$; $P < .005$; social withdrawal, $r(27) = .50$; $P < .001$); and delinquency problems. $r(27) = .41$, $P < .05$.

DISCUSSION

The goal of the study was to assess sleep patterns and behavior problems associated with reported, persistent headaches in children. Special attention was given to the potential moderating role of gender.

Before addressing the findings, the limitations of this study should be emphasized. Although the distinction between different types of headaches is important, the subgroups were too small to enable powerful statistical analysis; therefore, the subgroups of migraine, tension-type headache, and mixed headache were treated as one clinical group.

Our data suggest that children with reported headaches have distinct sleep patterns and behavior problems. In comparison with their controls, children with headaches spent less time in quiet, motionless sleep and woke up significantly earlier in the morning. Furthermore, increased severity of the headache problem was significantly associated with an earlier morning rise time. These findings suggesting disruptions to normal sleep patterns in children with headaches are consistent with earlier findings based on parental reports[28,29]; however, they diverge

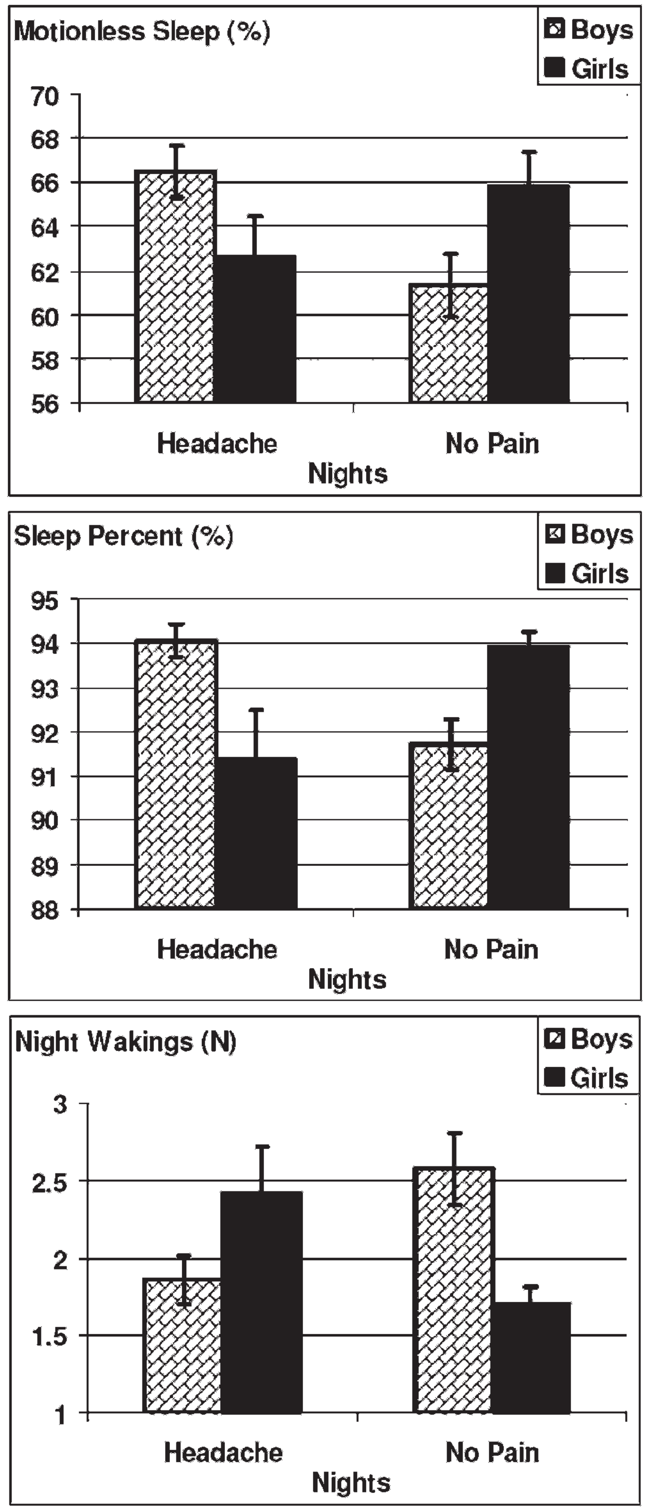

Figure 2. Comparison of actigraphic sleep measures on nights with and without reported headache. Each panel represents a specific sleep measure (mean ± standard error).

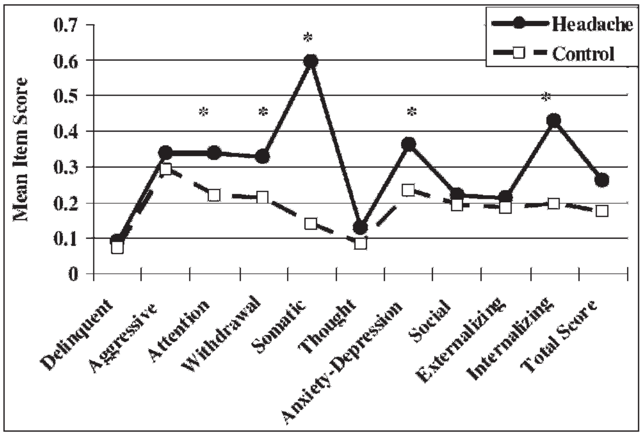

Figure 3. Comparison of differences between children with headache and controls on the Child Behavior Checklist scales. Scores represent the mean score on items of each specific scale. *Statistically significant group differences.

from previous findings of an earlier actigraphic study that found no indication for sleep disruptions in children with migraine.[31]

These difference are in line with the reports about daytime sleepiness, which were found to be significantly higher in the clinical group. These findings support earlier reports about increased sleepiness in children who suffer from headache.[29,80,81]

Gender appears to play a major role in moderating the links between headaches and migraine. In comparison with their controls, boys with headaches spent significantly less time in sleep, whereas the opposite trend was seen in girls. This finding is further supported by the findings from the comparison, within the clinical group, between nights with and without reported headaches. On nights with reported headaches, boys slept significantly better than on nights with no headaches, as manifested in their increased percentages of sleep and quiet sleep and reduced number of night wakings, whereas the opposite picture is seen in girls. To our knowledge, these are unique findings, obtained with objectives measures in children suffering from recurrent headaches, and require further validation. Our interpretation is that girls and boys can differ in their coping strategies with stress in general and with headaches in particular. It has been demonstrated that coping strategies play a moderating role in the links between stress and sleep.[82–84] For instance, it was found that sleep was curtailed during periods of increased stress in individuals who tend to use an emotion-focused coping style, whereas individuals who refrain from emotion-focused coping and prefer disengagement tend to extend sleep during stressful periods.[82] It has been suggested that sleep can serve as an escape from stress to those who refrain from emotion-focused coping or prefer disengagement. Furthermore, it has been repeatedly reported that boys tend to use more emotion-focused coping than girls.[85,86] Therefore, it is possible that boys with headaches extend their sleep as a mechanism for coping with the headaches or the emotional stresses that led to or resulted from the headaches. It is important to note here that emotion-focused coping has been found to be a less efficient coping strategy with pain in children[87] and could possibly partially account for the more negative outcome course seen in girls suffering from headaches in comparison with boys. These unique findings require further validation and assessment of the underlying mechanisms.

The comparison of reported behavior problems between the clinical and control samples revealed significantly more problems in children with headaches. Domains with increased problem behaviors included attention, withdrawal, somatic, anxiety-depression, and the internalizing factor. The most striking difference was found in the somatic domain, which indicates that children with headaches tend to have many more somatic complaints that are not specifically related to headaches. These findings are consistent with other recent studies suggesting that internalizing (with or without externalizing) problems are more prevalent in children suffering from headaches.[44–46] This consistent finding should alert clinicians to the common underlying internalizing psychopathology associated with headaches and the need to identify and offer psychologic help to these children, who are often referred to medical services only. This is particularly important in light of the repeated studies suggesting that internalizing disorders are underreported and underdiagnosed.[88,89]

From a clinical perspective, it is important to remember that insufficient sleep or primary sleep disorders can lead to headache complaints in children. Therefore, clinical assessment of headache complaints should include consideration of sleep patterns and underlying sleep disorders or insufficient sleep. It is important to emphasize that behavioral intervention aimed at improving the sleep hygiene of children and adolescents suffering from migraine has been effective in reducing the frequency and duration of their symptoms.[30] Similar findings have been reported following the treatment of underlying sleep disorders in adult patients suffering from chronic headache.[90] Brief behavioral interventions for sleep disorders in children have been found to be very effective.[91–93] Therefore, such interventions should be considered when a child presents with headache complaints associated with significant sleep difficulties.

An additional clinical issue that should be considered in children with headache is the possibility that these children have increased sleep needs. This possibility should be considered because these children report increased daytime sleepiness, although they do not sleep significantly less than their normal controls. This issue should be further explored scientifically but could be tested clinically by short trials of sleep extension.[94]

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References

1. Virtanen R, Aromaa M, Rautava P, et al: Changes in headache prevalence between pre-school and pre-pubertal ages. *Cephalalgia* 2002;22:179–185.
2. Ozge A, Bugdayci R, Sasmaz T, et al: The sensitivity and specificity of the case definition criteria in diagnosis of headache: A school-based epidemiological study of 5562 children in Mersin. *Cephalalgia* 2003;23:138–145.
3. Laurell K, Larsson B, Eeg-Olofsson O: Prevalence of headache in Swedish schoolchildren, with a focus on tension-type headache. *Cephalalgia* 2004;24:380–388.
4. Zwart JA, Dyb G, Holmen TL, et al: The prevalence of migraine and tension-type headaches among adolescents in Norway. The

Nord-Trondelag Health Study (Head-HUNT-Youth), a large population-based epidemiological study. *Cephalalgia* 2004;24: 373–379.

5. Stewart WF, Linet MS, Celentano DD, et al: Age-specific and sex-specific incidence rates of migraine with and without visual aura. *Am J Epidemiol* 1991;134:1111–1120.
6. Jennum P, Jensen R: Sleep and headache. *Sleep Med Rev* 2002;6: 471–479.
7. Abuarefeh I, Russell G: Prevalence of headache and migraine in schoolchildren. *BMJ* 1994;309:765–769.
8. Carlsson J: Prevalence of headache in schoolchildren: Relation to family and school factors. *Acta Paediatr* 1996;85:692–696.
9. Sillanpaa M: Prevalence of headache in prepuberty. *Headache* 1983;23:10–14.
10. Sillanpaa M: Changes in the prevalence of migraine and other headaches during the first seven school years. *Headache* 1983;23: 15–19.
11. Deubner DC: An epidemiologic study of migraine and headache in 10-20 year olds. *Headache* 1977;17:173–180.
12. Linet MS, Stewart WF, Celentano DD, et al: An epidemiologic study of headache among adolescents and young adults. *JAMA* 1989;261:2211–2216.
13. Lewis DW, Ashwal S, Dahl G, et al: Practice parameter: Evaluation of children and adolescents with recurrent headaches: Report of the Quality Standards Subcommittee of the American Academy of Neurology and the Practice Committee of the Child Neurology Society. *Neurology* 2002;59: 490–498.
14. Wober-Bingol C, Wober C, Karwautz A, et al: Clinical features of migraine: A cross-sectional study in patients aged three to sixty-nine. *Cephalalgia* 2004;24:12–17.
15. Sillanpaa M, Anttila P: Increasing prevalence of headache in 7-year-old schoolchildren. *Headache* 1996;36:466–470.
16. Moldofsky H: Sleep and pain. *Sleep Med Rev* 2001;5:387–398.
17. Rossi LN, Cortinovis I, Menegazzo L, et al: Classification criteria and distinction between migraine and tension-type headache in children. *Dev Med Child Neurol* 2001;43:45–51.
18. Headache Classification Committee of the International Headache Society: Classification and diagnostic criteria for headache disorders, cranial neuralgias and facial pain. *Cephalalgia* 1988;8(Suppl 7):1–96.
19. Ohayon MM, Roberts RE, Zulley J, et al: Prevalence and patterns of problematic sleep among older adolescents. *J Am Acad Child Adolesc Psychiatry* 2000;39:1549–1556.
20. Blader JC, Koplewicz HS, Abikoff H, Foley C: Sleep problems of elementary school children. A community survey. *Arch Pediatr Adolesc Med* 1997;151:473–480.
21. Kerr S, Jowett S: Sleep problems in pre-school children: A review of the literature. *Child Care Health Dev* 1994;20:379–391.
22. Sadeh A, Gruber R: Sleep disorders, in Ollendick T (ed): *Comprehensive Clinical Psychology*. Oxford, UK, Pergamon/ Elsevier Science, 1998, 629–653.
23. Owens JA, Spirito A, McGuinn M, Nobile C: Sleep habits and sleep disturbance in elementary school-aged children. *J Dev Behav Pediatr* 2000;21:27–36.
24. Carskadon MA: Patterns of sleep and sleepiness in adolescents. *Pediatrician* 1990;17:5–12.
25. Sadeh A, Raviv A, Gruber R: Sleep patterns and sleep disruptions in school-age children. *Dev Psychol* 2000;36:291–301.
26. Gau SF, Soong WT: The transition of sleep-wake patterns in early adolescence. *Sleep* 2003;26:449–454.
27. Wolfson AR: Sleeping patterns of children and adolescents: Developmental trends, disruptions, and adaptations. *Child Adolesc Psychiatr Clin North Am* 1996;5:549–568.
28. Miller VA, Palermo TM, Powers SW, et al: Migraine headaches and sleep disturbances in children. *Headache* 2003;43:362–368.
29. Bruni O, Fabrizi P, Ottaviano S, et al: Prevalence of sleep disorders in childhood and adolescence with headache: A case-control study. *Cephalalgia* 1997;17:492–498.
30. Bruni O, Galli F, Guidetti V: Sleep hygiene and migraine in children and adolescents. *Cephalalgia* 1999;19:57–59.
31. Bruni O, Russo PM, Violani C, Guidetti V: Sleep and migraine: An actigraphic study. *Cephalalgia* 2004;24:134–139.
32. Barabas G, Ferrari M, Matthews WS: Childhood migraine and somnambulism. *Neurology* 1983;33:948–949.
33. Smeyers P: Headaches in childhood: Association with sleep disorders and psychological implications. *Rev Neurol* 1999; 28(Suppl 2):S150–S155.
34. Aromaa M, Rautava P, Helenius H: Factors of early life as predictors of headache in children at school entry. *Headache* 1998;38:23–30.
35. Owens J, Opipari L, Nobile C, Spirito A: Sleep and daytime behavior in children with obstructive sleep apnea and behavioral sleep disorders. *Pediatrics* 1998;102:1178–1184.
36. Sadeh A, Gruber R, Raviv A: Sleep, neurobehavioral functioning and behavior problems in school-age children. *Child Dev* 2002;73: 405–417.
37. Dahl RE: The regulation of sleep and arousal: Development and psychopathology. *Dev Psychopathol* 1996;8:3–27.
38. Bates JE, Viken RJ, Alexander DB, et al: Sleep and adjustment in preschool children: Sleep diary reports by mothers relate to behavior reports by teachers. *Child Dev* 2002;73:62–75.
39. Aronen ET, Paavonen EJ, Fjallberg M, et al: Sleep and psychiatric symptoms in school-age children. *J Am Acad Child Adolesc Psychiatry* 2000;39:502–508.
40. O'Brien LM, Ivanenko A, Crabtree VM, et al: Sleep disturbances in children with attention deficit hyperactivity disorder. *Pediatr Res* 2003;54:237–243.
41. Chervin RD, Dillon JE, Bassetti C, et al: Symptoms of sleep disorders, inattention, and hyperactivity in children. *Sleep* 1997; 20:1185–1192.
42. McCauley E, Carlson GA, Calderon R: The role of somatic complaints in the diagnosis of depression in children and adolescents. *J Am Acad Child Adolesc Psychiatry* 1991;30:631–635.
43. Pine DS, Cohen P, Brook J: The association between major depression and headache: Results of a longitudinal epidemiologic study in youth. *J Child Adolesc Psychopharmacol* 1996;6: 153–164.
44. Just U, Oelkers R, Bender S, et al: Emotional and behavioural problems in children and adolescents with primary headache. *Cephalalgia* 2003;23:206–213.
45. Anttila P, Sourander A, Metsahonkala L, et al: Psychiatric symptoms in children with primary headache. *J Am Acad Child Adolesc Psychiatry* 2004;43:412–419.
46. Virtanen R, Aromaa M, Koskenvuo M, et al: Externalizing problem behaviors and headache: A follow-up study of adolescent Finnish twins. *Pediatrics* 2004;114:981–987.
47. Egger HL, Angold A, Costello EJ: Headaches and psychopathology in children and adolescents. *J Am Acad Child Adolesc Psychiatry* 1998;37:951–958.
48. Sadeh A: Stress, trauma, and sleep in children. *Child Adolesc Psychiatr Clin North Am* 1996;5:685–700.
49. Sarioglu B, Erhan E, Serdaroglu G, et al: Tension-type headache in children: A clinical evaluation. *Pediatr Int* 2003;45:186–189.
50. Reynolds LK, O'Koon JH, Papademetriou E, et al: Stress and somatic complaints in low-income urban adolescents. *J Youth Adolesc* 2001;30:499–514.

51. Waldie KE: Childhood headache, stress in adolescence, and primary headache in young adulthood: A longitudinal cohort study. *Headache* 2001;41:1–10.
52. Metsahonkala L, Sillanpaa M, Tuominen J: Social environment and headache in 8- to 9-year-old children: A follow-up study. *Headache* 1998;38:222–228.
53. Fisher BE, Rinehart S: Stress, arousal, psychopathology and temperament: A multidimensional approach to sleep disturbance in children. *Pers Individ Dif* 1990;11:431–438.
54. Guidetti V, Galli F: Evolution of headache in childhood and adolescence: An 8-year follow-up. *Cephalalgia* 1998;18:449–454.
55. El-Metwally A, Salminen JJ, Auvinen A, et al: Prognosis of non-specific musculoskeletal pain in preadolescents: A prospective 4-year follow-up study till adolescence. *Pain* 2004;110:550–559.
56. Silberstein SD: Sex hormones and headache. *Rev Neurol* 2000; 156:30–41.
57. Rhee H: Prevalence and predictors of headaches in US adolescents. *Headache* 2000;40:528–538.
58. Leonardsson-Hellgren M, Gustavsson UM, Lindblad U: Headache and associations with lifestyle among pupils in senior level elementary school. *Scand J Prim Health Care* 2001;19:107–111.
59. Passchier J, Orlebeke JF: Headaches and stress in schoolchildren—An epidemiological study. *Cephalalgia* 1985;5:167–176.
60. Fowlerkerry S, Lander J: Assessment of sex-differences in children's and adolescents' self-reported pain from venipuncture. *J Pediatr Psychol* 1991;16:783–793.
61. Spirito A, Stark LJ, Gil KM, Tyc VL: Coping with everyday and disease-related stressors by chronically ill children and adolescents. *J Am Acad Child Adolesc Psychiatry* 1995;34:283–290.
62. Unruh AM: Gender variations in clinical pain experience. *Pain* 1996;65:123–167.
63. Holden EW, Rawlins C, Gladstein J: Children's coping with recurrent headache. *J Clin Psychol Med Settings* 1998;5:147–158.
64. Piira T, Taplin JE, Goodenough B, von Baeyer CL: Cognitive-behavioural predictors of children's tolerance of laboratory-induced pain: Implications for clinical assessment and future directions. *Behav Res Ther* 2002;40:571–584.
65. Merlijn V, Hunfeld JAM, van der Wouden JC, et al: Psychosocial factors associated with chronic pain in adolescents. *Pain* 2003; 101:33–43.
66. Sallfors C, Hallberg LRM, Fasth A: Gender and age differences in pain, coping and health status among children with chronic arthritis. *Clin Exp Rheumatol* 2003;21:785–793.
67. Crick NR, Zahn-Waxler C: The development of psychopathology in females and males: Current progress and future challenges. *Dev Psychopathol* 2003;15:719–742.
68. Acebo C, Millman RP, Rosenberg C, et al: Sleep, breathing, and cephalometrics in older children and young adults. Part I—Normative values. *Chest* 1996;109:664–672.
69. Gau SF, Soong WT: Sleep problems of junior high school students in Taipei. *Sleep* 1995;18:667–673.
70. Saarenpaa-Heikkila OA, Rintahaka PJ, Laippala PJ, Koivikko MJ: Sleep habits and disorders in Finnish schoolchildren. *J Sleep Res* 1995;4:173–182.
71. Coble PA, Kupfer DJ, Taska LS, Kane J: EEG sleep of normal healthy children. Part I: Findings using standard measurement methods. *Sleep* 1984;7:289–303.
72. Carskadon MA, Keenan S, Dement WC: Nighttime sleep and daytime sleep tendency in preadolescents, in Guilleminault C (ed): *Sleep and Its Disorders in Children*. New York, Raven Press, 1987, 43–52.
73. Winner P, Martinez W, Mate L, Bello L: Classification of pediatric migraine: Proposed revisions to the IHS criteria. *Headache* 1995; 35:407–410.
74. Sadeh A, Acebo C: The role of actigraphy in sleep medicine. *Sleep Med Rev* 2002;6:113–124.
75. Sadeh A, Hauri PJ, Kripke DF, Lavie P: The role of actigraphy in the evaluation of sleep disorders. *Sleep* 1995;18:288–302.
76. Acebo C, Sadeh A, Seifer R, et al: Estimating sleep patterns with activity monitoring in children and adolescents: How many nights are necessary for reliable measures? *Sleep* 1999;22:95–103.
77. Sadeh A, Sharkey KM, Carskadon MA: Activity-based sleep-wake identification: An empirical test of methodological issues. *Sleep* 1994;17:201–207.
78. Achenbach TM, Edelbrock CS: *Manual for the Child Behavior Checklist and Revised Child Behavior Profile*. Burlington, VT, Department of Psychiatry, University of Vermont, 1983.
79. Zilber N, Auerbach J, Lerner Y: Israeli norms for the Achenbach Child Behavior Checklist: Comparison of clinically-referred and non-referred children. *Isr J Psychiatry Relat Sci* 1994;31:5–12.
80. Neveus T, Cnattingius S, Olsson U, Hetta J: Sleep habits and sleep problems among a community sample of schoolchildren. *Acta Paediatr* 2001;90:1450–1455.
81. Palermo TM, Kiska R: Subjective sleep disturbances in adolescents with chronic pain: Relationship to daily functioning and quality of life. *J Pain* 2005;6:201–207.
82. Sadeh A, Keinan G, Daon K: Effects of stress on sleep: The moderating role of coping style. *Health Psychol* 2004;23: 542–545.
83. Hicks RA, Marical CM, Conti PA: Coping with a major stressor: Differences between habitual short- and longer-sleepers. *Percept Mot Skills* 1991;72:631–636.
84. Morin CM, Rodrigue S, Ivers H: Role of stress, arousal, and coping skills in primary insomnia. *Psychosom Med* 2003;65:259–267.
85. Renk K, Creasey G: The relationship of gender, gender identity, and coping strategies in late adolescents. *J Adolesc* 2003;26:159–168.
86. Matud MP: Gender differences in stress and coping styles. *Pers Individ Dif* 2004;37:1401–1415.
87. Reid GJ, Gilbert CA, McGrath PJ: The Pain Coping Questionnaire: Preliminary validation. *Pain* 1998;76:83–96.
88. Wren FJ, Scholle SH, Heo J, Comer DM: Pediatric mood and anxiety syndromes in primary care: Who gets identified? *Int J Psychiatr Med* 2003;33:1–16.
89. Clarke-Stewart KA, Allhusen VD, McDowell DJ, et al: Identifying psychological problems in young children: How do mothers compare with child psychiatrists? *J Appl Dev Psychol* 2003;23: 589–624.
90. Paiva T, Farinha A, Martins A, et al: Chronic headaches and sleep disorders. *Arch Intern Med* 1997;157:1701–1705.
91. Sadeh A: Cognitive-behavioral treatment for childhood sleep disorders. *Clin Psychol Rev* 2005;25:612–628.
92. Mindell JA: Empirically supported treatments in pediatric psychology: Bedtime refusal and night wakings in young children. *J Pediatr Psychol* 1999;24:465–481.
93. Kuhn BR, Elliott AJ: Treatment efficacy in behavioral pediatric sleep medicine. *J Psychosom Res* 2003;54:587–597.
94. Sadeh A, Gruber R, Raviv A: The effects of sleep restriction and extension on school-age children: What a difference an hour makes. *Child Dev* 2003;74:444–455.