

Sleep disorders and sleep habits in children and adolescents with headache

Zaburzenia snu i nawyki związane ze snem u dzieci i młodzieży z bólami głowy

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ABSTRACT

Purpose: The purpose of the study was to investigate the sleep habits and sleep disorders in children and adolescents with headache. **Methods:** Three hundred children and adolescents with headache and 284 children without headache were investigated using a questionnaires developed by the authors. **Results:** In Our study we observed difference is all the more important as some phenomena like bed co-sleeping (27.7%) and watching TV (20.3%) during falling asleep and sleep disorders awakenings from night sleep (43.7%), sleep talking (48.3%), snoring (27.3%), bruxizm (23.3%), nightmares (16.7%), sleep terror (9.0%) are observed statistically more frequently in children with headache. **Conclusions:** Sleep habits described by parents in the children with headache are significantly different than those in healthy. Sleep disorders are very common in the group of children with headache. There is a need of additional research to find correlation between the different types, frequency of headache and sleep habits and disorders.

Key words: sleep, sleep habits, sleep disorders, headache, migraine, children, adolescents

STRESZCZENIE

Cel: Celem badania było określenie nawyków związanych ze snem i zaburzeń snu występujących u dzieci i młodzieży z bólami głowy. **Materiał i metody:** Badaniu kwestionariuszowemu zostało poddana grupa 300 dzieci i młodzieży z bólami głowy oraz 284 dzieci bez bólów głowy. **Wyniki:** W badaniu obserwowano znamienne statystycznie różnice pomiędzy grupą badaną i kontrolną w odniesieniu do wielu parametrów. Najważniejsze wśród nawyków związanych ze snem to: spanie we wspólnym łóżku (27,7%), oglądanie TV podczas zasypiania (20,3%). Zaburzenia snu takie jak wybudzenia ze snu nocnego (43,7%), mówienie przez sen (48,3%), chrapanie (27,3%), bruksizm (23,3%), koszmary senne (16,7%) oraz lęki nocne (9,0%), obserwowano istotnie statystycznie częściej w grupie dzieci z bólami głowy. **Wnioski:** Opisywane przez rodziców nawyki związane ze snem, w grupie dzieci z bólami głowy, różnią się w sposób istotny statystycznie od opisywanych u dzieci bez bólów głowy. Zaburzenia snu są bardzo częste w grupie dzieci z bólami głowy. Konieczne są dalsze badania, mające na celu znalezienie korelacji pomiędzy typami bólów głowy i ich częstotliwością a nawykami związanymi ze snem i zaburzeniami snu.

Słowa kluczowe: sen, zaburzenia snu, nawyki związane ze snem, bóle głowy, migrena, dzieci, młodzież

The concomitance of sleep and headaches has been known for centuries, but the details of that concomitance were mysterious [1, 2]. It is known by clinical experience that various kinds of sleep disorders are more frequent in group of children with headache than in the general population of children [1]. Sleep disorders are very common in the population of children [3]. The relationship between them seems to have clinical and nosological connections [2]. The etiology of sleep disorders is complex and depends on varied factors connected with health, environment, family and social influences. Also the psychological problems connected with family life have crucial influence on sleep. The general state of health seems to have very significant influence on sleep. Sleep habits which impact the quality of sleep can consequently interfere with the daily functioning of the patients [1, 4–7]. Disruptions of night sleep have impact

on school attendance and performance, daily activities, and emotional status [8, 9]. Also headaches have a significant impact on the lives of children and adolescents, resulting in school absence, decreased extracurricular activities, and poor school achievements [5, 6, 10]. Those patients more frequently suffered from parasomnias, difficulties at sleep onset, awakenings and daytime somnolence [1]. All of them can cause serious consequences as: worse quality of day activity connected with problems with attention, aggression, emotional liability, hyperactivity, increase of frequency and severity of headache and can produce cognitive dysfunction [6, 10]. Bruni et al observed that bedtime problems are connected not only with fear of falling asleep, but also to a smaller degree with poor sleep hygiene [1]. Peculiar sleep habits are observed in children with headaches and it is known that they are different from those

observed in general population of children [10]. Bruni et al evaluated the impact of education on sleep hygiene (e.g., conformity of bedtime and waking time, regularity of sleep schedule on weekdays and weekends, and restriction of beverages and foods that disrupt sleep) on headache, especially on migraine [1, 8]. Children who received sleep hygiene education had rarer migraine attacks. The instability of the level of serotonin in both conditions may be a connecting link between headache and sleep disorders [1]. Recent studies in patients with primary headache have led to identification of potential central generators which are also important for the regulation of sleep [2]. Sometimes it is difficult to separate those neurological symptoms because the anatomical and physiological basis is similar [1, 11]. Fragmentation of sleep is observed more frequently in migraine and tension headache than in the general population of children. That induces worse quality of life by daytime somnolence, problems with concentration, memory etc. which superimpose on headaches [1]. The cognition of the anatomy and the physiology of both disorders allows for effective therapeutic management, especially in children and adolescents [2]. In particular, headache beginning in the morning and chronic headache can be intensified by sleep disorders, or caused by them. It is curious enough that the therapy of sleep problems may relieve a patient from headache [7]. There are only several professional publications which concern the epidemiology of sleep disturbances in children and adolescents with headache [1, 6]. Bruni et al noticed more sleep disturbances i.e. co-sleeping, parasomnias, sleep breathing disorders and napping in the study group than in the control group. They observed more night awakenings and daytime sleepiness in children with headaches [1]. Also Miller et al observed patients with coexisting migraine and sleep disturbances [8]. Behavioral disturbances and mood disorders were most frequent in children with headache, especially those suffering from migraines but also depended on the severity, duration and frequency of pain [4, 12, 13]. Likewise Luc et al affirmed that the prevalence of sleep disorders as excessive daytime sleepiness, narcolepsy, and insomnia was significantly higher in children with headaches [6]. There are only several professional publications discussing the epidemiology of sleep disorders in children and adolescents with headache. The purpose of the study was to investigate the sleep habits and sleep disorders in children and adolescents with headache.

METHODS

From May 2005 to October 2006, 1500 children and adolescents from Poznan area were investigated using a specially developed questionnaire. The first part of the survey was conducted in the Chair and Department of Developmental Neurology, Poznan University of Medical Sciences. All patients admitted to the Department were examined using the questionnaire. There were 300 children and adolescent who matched the criterion of migraine headache or tension type headache according to the International Classification of Headache Disorders, 2nd edition (ICHD-2), qualified to the study group [14]. The full medical history of those children was provided and all children in the investigated group were examined by neuropsychiatrists during hospitalization. The test results of the study group were compared to the data of control group (CG), composed of healthy children.

There were 284 children from schools and kindergartens without headache qualified to the CG.

The first questionnaire used in the survey was a sleep questionnaire developed by the authors, filled in by the parents of all children in the HG and the CG. Most of the questions referring to children's sleep were answered by ticking the correct yes/no box. The questionnaire included points relating to the child's sleeping habits (e.g. co-sleeping, daytime naps); sleep disorders (e.g. sleepwalking, sleep talking, bruxism, leg movements, snoring, breathing pauses, etc); frequent nighttime awakenings, daytime sleepiness, family sleep disorder history and demographic data. (Sample of sleep-related questions – Appendix A)

The second questionnaire was a headache questionnaire filled in by the parents of all children in the HG. This questionnaire consisted of points relating to the characteristic of the headache, frequency and additional symptoms. Data from this questionnaire were additionally used to verify the ICHD-2 criteria to migraine and tension type headache. Each questionnaire was accompanied with a cover letter describing the study. The parents were assisted with the questionnaire by the investigators. The investigators were all trained to ask questions and record answers to ensure the quality of responses.

Before conducting the study, both sleep and headache questionnaires were pilot tested on a sample of 100 patients of the Department of Developmental Neurology. The study was approved by the Institutional Review Board at the Poznan University of Medical Sciences and the local Chief Education Officer of Poznan.

The chi2 test was used for statistical analysis purposes in the majority of cases. Sleep duration time was calculated as arithmetic difference between the reported bedtime and rise time. The sleep duration time and time of falling asleep were analyzed using the Mann-Whitney test. The statistical significance was set at $p < .05$.

RESULTS

Participants. There were 160 girls (53.3%) and 140 boys (46.7%), from 1 to 18 years of age in the study group. The control group consisted of 147 (52.7%) and 132 (47.3%), respectively. The mean age in the study group was 12.6 +/- 4.0 years and in CG 8.6 +/- 4.4 years. There were four categories created, depending on the age: preschool (1-6 years old) – 7.3% in the HG vs. 31.0% in the CG, primary school (7-12 years old) – 42.3% in the HG vs. 52.8% in the CG, middle school (13-15 years old) – 18.3% in the HG vs. 8.5% in the CG and secondary school (15-18 years old) – 32.0% in the HG vs. 7.7% in the CG. Sixty four children (21.3%) from the HG have migraine headache according to ICHD-2 diagnostic criteria. The characteristic of the study group was shown in table 1.

Table 1. Group Characteristic

	the HG	the CG
Whole Group	300	284
Mean age	12.6	8.6
Age standard deviation	4.0	4.4
Girls	53.3% (n=160)	52.7% (n=147)
Boys	46.7% (n=140)	47.3% (n=132)
Preschool	7.3% (n=22)	31.0% (n=88)

Primary school	42.3% (n=127)	52.8% (n=150)
Middle school	18.3% (n=55)	8,5% (n=24)
Secondary school	32.0% (n=96)	7.7% (n=22)

Total duration of the night sleep. The average of the total night sleep duration was about 9.7 h +/- 1.3 h in HD group and 10.0 h +/- 1.8 h in the CG. The night sleep duration decreased in the older children from 10.6 h in the preschool group to 8.8 h in the secondary school group (in the CG from 10.0 h to 8.4 h). In particular, the age groups differences between the HG and the CG were not significant.

The comparison of the mean time of sleep duration in the individual groups of children was shown in Table 2.

Table 2. The average of total sleep duration (in hours)

	HG		CG	
	Average	SD	Average	SD
Whole Group	9.7	1.3	10.0	1.8
Preschool (1-6 y)	10.6	0.7	10.4	1.2
Primary school (7-12 y)	10.2	0.9	10.1	0.9
Middle school (13-15 y)	9.7	1.0	9.8	0.6
Secondary school (16-18 y)	8.8	1.3	8.4	1.6

Falling asleep. In the study group, the mean time of falling asleep in the whole group was 25.5 minutes and it ranged from 1 minute to 120 minutes. The mean time of falling asleep was the longest in the preschool group – 34.1 minutes, decreasing as the age increased, and the shortest in the secondary school group – 23.2 minutes. The differences between the time of falling asleep of children in the HG group and the CG were not significant in the whole groups or in the particular age dependent group.

In the study group, 44.8% of children needed over 20 minutes to fall asleep, with 76.2% in the preschool group and only 40.9% in the primary school group. In the CG, only 30.1% of children were falling asleep longer than 20 minutes and it was statistically significant at p=.0005. The differences between the HG and the CG in the preschool, primary school and secondary school group were also significant (44.8% vs.30.1%, p= .0005 for the whole group; 76.2% vs. 27.2%, p< .0000 for preschool; 45.7% vs. 23.3%, p= .0487 for middle school; 42.0% vs. 10.5%, p= .0096 for preschool). The percentage of HG children in the primary school group who needed over 20 minutes to fall asleep was lower than in the other age group (40.9%) and there were no significant differences in children from the CG (35.9%). The time of falling asleep in each age group was shown in Table 3.

Table 3. Time of Falling Asleep

	HG		CG	
	Average [min]	Falling asleep >20 min. [%]	Average [min]	Falling asleep >20 min. [%]
Whole Group	25.5	44.8**	20.0	30.1**
Preschool (1-6 y)	34.1	76.2**	19.4	27.2**

Primary school (7-12 y)	26.0	40.9	18.3	35.9
Middle school (13-15 y)	24.5	45.7*	15.0	23.3*
Secondary school (16-18 y)	23.2	42.0*	19.3	10.5*

Significant results are indicated in bold type; *p<.05; **p<.005

Sleep habits. In our study, 27.7% children of the HG slept together with another person in the bed; in the CG it was only 18.7%. The difference was significant at p= .0101. Co-sleeping was more frequent in case of younger children, particularly in the preschool group 50.0%, and was decreasing in the secondary school group to 13.5%. The differences in the CG and the HG in the particular age category were significant in the preschool (50.0% vs.18.2%; p= .0019) and primary school group (34.6% vs.19.3%; p= .0039). About 57.7% of children slept in the same room with other family members, in the CG only 58.1%, the difference was not significant. In the individual age groups, significant differences between healthy and HG children were observed in the primary school group. It was observed in 70.9%, in comparison to 48.0% of the CG group in the same age (p= .0001).

In the HG, 11.7% of children had physical contact with parents when falling asleep, while 19.7% in the CG, the difference was significant (p= .0073). There were no significant differences between the HG and the CG in the particular age groups. Watching TV and listening to the music when falling asleep were more frequent in the HG than in the CG and those differences were also significant (20.3% vs. 8.1%; p< .0000 for TV and 26.7% vs. 15.1%; p= .0006 for music). In the individual age groups, significant differences between healthy and HG children were in the primary school group. Watching TV was observed in 17.3%, in comparison to 4.7% of the CG group in the same age (p= .0006).

Parents reading, soft toys and light during falling asleep were observed to occur more frequently in the CG. Approximately 20% of parents of the HG read aloud to children before putting them to sleep, while 32.4% in the CG; the difference was significant (p= .0006). Twenty eight percent of children from the HG had a soft toy in bed when falling asleep, in the CG – 43.7% (p= .0002). The light was on during falling asleep in 16.7% of children from the HG and 27.1% from the CG (p= .0022). All the differences were significant.

The sleep habits in each age groups were shown in Table 4.

Sleep disorders. The most frequent sleep disorders reported in the study group as parasomnia symptoms were: sleep talking 48.3% (38.7% in the CG); bruxism 23.3% (16.5% in the CG); leg movement 20.3% (18.0% in the CG); nightmares 16.7% (7.4% in the CG) and sleep breathing disorder symptoms like snoring 27.3% in the HG group (19.0% in the CG) and breathing pauses 5.7% (1.4% in the CG). Differences concerning sleep talking, bruxism, sleep terror, nightmares, snoring, and breathing pauses were significant (48.3% vs. 38.7%; p= .0194 for sleep talking; 23.3% vs. 16.5%; p= .0406 for bruxism; 9.0% vs. 4.6%; p= .0345 for sleep terror, 16.7% vs. 7.4%; p= .0006 for nightmares; 23.7% vs. 19.0%; p= .0174 for snoring and 5.7% vs. 1.4%; p= .0057 for

Table 4. Prevalence of Sleep Habits by Age

[%]	Preschool		Primary school		Middle school		Secondary school		Total	
	the HG	the CG	the HG	the CG	the HG	the CG	the HG	the CG	the HG	the CG
Bed co-sleeping	50.0**	18.2**	34.6**	19.3**	27.3	29.2	13.5	4.5	27.7*	18.7*
Room co-sleeping	72.7	79.5	70.9**	48.0**	54.5	54.2	38.5	45.5	57.7	58.1
Physical contact	40.9	39.8	17.3	12.7	3.6	8.3	2.1	0.0	11.7*	19.7*
Watching TV	22.7	10.2	17.3**	4.7**	18.2	8.3	25.0	22.7	20.3**	8.1**
Listening to the music	13.6	12.5	11.8	13.3	25.5	12.5	50.0	40.9	26.7**	15.1**
Parents reading	36.4	46.6	31.5	32.0	9.1	0.0	7.3	13.6	20.0**	32.4**
Soft toys	36.4	48.9	47.2	50.7	12.7	8.3	12.5	13.6	29.0**	43.7**
Light	40.9	39.8	22.8	27.3	9.1	4.2	7.3	0.0	16.7**	27.1**

Significant results are indicated in bold type; * $p < .05$; ** $p < .005$

Table 5. Prevalence of Sleep Disorder Symptoms by Age

[%]	Preschool		Primary school		Middle school		Secondary school		Total	
	the HG	the CG	the HG	the CG	the HG	the CG	the HG	the CG	the HG	the CG
Snoring	31.8	21.6	36.2*	21.3*	25.5	16.7	15.6	13.6	27.3*	19.0*
Breathing pauses	18.2**	0.0**	7.1	2.7	1.8	0.0	3.1	0.0	5.7*	1.4*
Sleep talking	50.0	33.0	46.5	44.7	56.4	41.7	45.8	31.8	48.3*	38.7*
Bruxism	31.8	21.6	31.5*	18.7*	21.8	8.3	11.5	4.5	23.3*	16.5*
Leg movement	31.8	22.7	20.5	16.0	23.6	20.8	15.6	22.7	20.3	18.0
Enuresis	36.4*	9.2*	8.7	7.3	5.5	8.3	1.0	0.0	7.7	6.3
Sleep terror	22.7*	8.0*	11.8	6.0	7.3	4.2	3.1	4.5	9.0*	4.6*
Sleepwalking	0.0	2.3	7.9	6.0	10.9	4.2	5.2*	9.1*	7.0	3.9
Nightmares	9.1	8.0	22.0**	8.7**	10.9	0.0	14.6	22.7	16.7**	7.4**
Awakening	81.8*	55.7*	44.9**	22.3**	38.2	16.7	35.4	22.7	43.7**	31.7**

Significant results are indicated in bold type; * $p < .05$; ** $p < .005$

Table 6. Daytime Consequences of Sleep Problems by Age

[%]	Preschool		Primary school		Middle school		Secondary school		Total	
	the HG	the CG	the HG	the CG	the HG	the CG	the HG	The CG	the HG	the CG
Day naps	59.1	42.0	18.9**	6.0**	34.5*	12.5*	43.8	36.4	32.7**	20.1**
Well rested	77.3	90.9	64.6	72.7	50.9*	75.0*	38.5	50.0	54.7**	76.8**
Well rested (weekend)	90.9	96.9	83.5*	92.0*	72.7	79.2	75.0	72.7	79.3**	90.8**
School problems	0.0	0.0	27.6**	4.0**	32.7	25.0	19.8	13.6	24.0**	5.3**

Significant results are indicated in bold type; * $p < .05$; ** $p < .005$

breathing pauses). The differences concerning breathing pauses (18.2% vs. 0.0%; $p < .0000$), enuresis (36.4% vs. 9.2%; $p = .0012$), sleep terror (22.7% vs. 8.0%; $p = .0468$) were significant in the preschool group also and those concerning snoring (36.2% vs. 21.3%; $p = .0061$), bruxism (31.5% vs. 18.7%; $p = .0134$) and nightmares (22.0% vs. 8.7%; $p = .0018$) were significant in the primary school group. In the secondary school group only the differences concerning sleepwalking were significant (5.2% vs. 9.1%; $p = .0066$). Awakenings from night sleep were observed in 43.7% children of the HG and 31.7% children of the CG; those differences were statistically significant ($p = .0029$). Other significant differences in the prevalence of awakenings from night sleep were observed in the preschool group, (81.8% vs. 55.7%; $p =$

.0246) and primary school group (44.9% vs. 22.3%; $p < .0000$).

The prevalence of sleep disorder symptoms in different age group were shown in Table 5.

In our study, 32.7% children of the HG had day naps; in the CG only 20.1%. It was a significant difference at $p = .0006$. The day naps were more frequent in case of younger children, particularly in the preschool group 59.1%, and were decreasing in the primary school group to 18.9%. The differences between the CG and the HG in the individual age categories were significant in the primary school group (18.9% vs. 6.0%; $p = .0010$) and middle school group (34.5% vs. 12.5%; $p = .0444$).

In the HG, 54.7% of children were well rested after a night's sleep on the school days, while only 76.8% in the CG, it was a

significant difference ($p < .0000$). To compare, on weekends it was 79.3% vs. 90.8% $p = .0001$.

About 24.0% of children of the HG had school problems, while only 5.3% in the CG, it was a significant difference ($p < .0000$). In the individual age groups the significant differences between healthy and HG children were in the primary school group. It was observed in 27.6%, in comparison to 4.0% of the CG group in the same age ($p < .0000$). We didn't observe significant differences in any parameters between children with migraine and children with tension type headache.

DISCUSSION

Sleep disorders are not often described, particularly in children, even though they are estimated to occur in 25%–30% of the population [15–17]. In the individual age groups a high prevalence of sleep problems was reported in the preschool children, ranging from 25 to 50% [18]. Due to the frequency of sleep disorders in children the subject should be thoroughly researched [19].

The prevalence of primary headaches was estimated as 10% of the population of children [20].

Parents of children with headache report many different problems that their children have with the night sleep. The reported problems became a direct reason of this study. Bruni at all proves in actigraphic monitoring studies that the time of falling asleep in children with headaches in periods without pain attacks is significantly longer [21]. We did not observe significant differences in the time of falling asleep (measured in minutes) between the HG and the CG, neither in the whole groups nor in the individual age groups. In the HG group significantly more children (44.8% vs. 30.1% in the CG) needed over 20 minutes to fall asleep, it was especially noticeable in the preschool group (respectively 76.2% vs. 27.2%). The relation applied both to children with headache and tension type headache. The information is important because when the time of falling asleep is longer than 20 minutes, it is considered to be a parasomnia risk factor [22, 23].

In our study the sleep habits in children with headache were considerably different than sleep habits in the control group. There have been peculiar sleep habits observed in children with headaches and it is known that they are different from those occurring in the general population of children [10]. Bed co-sleeping of young children and parents is a common practice in many countries all around the world [8, 24]. There are many differences between the individual countries, for example a high rate (59%) is reported in Japan and only about 15% in the USA [25, 26]. In China bed sharing was reported at the level of 18.2% [27, 28]. In Switzerland, a high prevalence was reported for four year old children, estimated at 38% [29]. In our study, 18.7% children of the CG slept together with another person in the bed. The rate is similar to the one reported for China [27]. In children with migraine Miller observed co-sleeping in 25% of children [8]. In our study, bed co-sleeping observed in children with headache was at a similar level 27.7%. There were no differences between children with migraine and tension type headache. It was a significant difference. Co-sleeping was more frequent in case of younger children, particularly in the preschool group 50.0%, and was decreasing in the secondary school group, down to 13.5%. The differences in the CG and the HG in the individual age categories were significant in the preschool and primary school groups. The differences are a mine of very important information

and suggest that co-sleeping in the HG is not a choice of lifestyle but rather a reaction to certain circumstances. High rate of co-sleeping in the HG was a reaction to children's health problems. Liu at all observed that children who shared beds with their parents were reported to have more sleep anxiety than children who slept alone [27]. The ability to identify differential vulnerabilities of the child and parent from risks and benefits of co-sleeping may help professionals to guide parents in making informed choices which are in their family's best interest [24].

About 58% of children slept in the same room with other family members. There was no significant difference between the CG and the HG. Room co-sleeping is rather a choice of lifestyle or a consequence of socioeconomic conditions than a reaction to health problems. In the primary school group 71% of children with headache were sharing room with another person from the family. There was a significant difference between the healthy and HG children. The observation was considered to be interesting and the phenomenon seemed not to be related with the cultural and socioeconomic condition.

Unfavorable sleep habits, e.g. listening to the music or watching TV, were significantly more frequently observed in the HG. Watching TV when falling asleep is associated with sleep onset delay and anxiety [30]. Statistically significant more frequent prevalence of the mentioned habits in children of the HG may be a condition causing more frequent occurrence of sleep problems in this group of children. It is recommended that negative effects of such habits are emphasized to the parents [30].

The sleep habits which impact the quality of sleep can consequently interfere with the daily functioning of the patients [1, 4–7]. **It is particularly important in case of school age children.** Disruptions in the night sleep have significant impact on school attendance and performance, daily activities and emotional status [8]. One of the basic method of treating sleep disorders in children is parents' education and implementation of the correct sleeping habits [31–33]. Discussing sleep patterns with parents provides opportunity to learn more about the child and family and allows to evaluate the behavioral and family interventions [23]. It also makes it possible to educate the parents on the sleep hygiene and methods of preventing more serious sleep problems [34].

Some epidemiological studies pay attention to a co-occurrence of sleep disturbances and various types of headache [21]. Sleep disturbances are significantly more frequent in children with headaches [35]. Those patients more frequently suffered from parasomnias, difficulties at sleep onset, awakenings, and daytime somnolence [1].

There are only few professional publications which concern the epidemiology of sleep disturbances in children and adolescents with headache [1, 6]. Bruni et al noticed more sleep disturbances i.e. parasomnias, sleep breathing disorders, night awakenings and napping in the study group than in the control group [1]. Also Miller et al observed patients with coexisting migraine and sleep disturbances [8]. They came to a conclusion that even though the direction of the relationship between headaches and sleep was not obvious, interventions change of the sleep habits might release headache and also effective therapy of headaches in children had positive impact on sleep [8, 12, 36, 37].

Sleep disorders in children are complex and approximately 30% of children have sleep problem in at least one domain [38].

Parasomnias constitute a specific group of sleep disorders, which can be described as undesirable physical phenomena occa-

sionally or sporadically occurring during sleep [39, 40]. The phenomena are quite often described, in particular in children, and they are estimated to occur in 25% of population [15, 16]. Some parasomnias, i.e. sleep talking occur in children so often that they can be considered physiological phenomena rather than disorders [3, 16]. Some stressors may predict the occurrence of parasomnias in this age group [41, 42].

On a Turkish sample bruxism, nocturnal enuresis and sleep talking were the most common parasomnias among both girls and boys [41]. Some research suggest that parasomnia symptoms are more frequent in children with primary headache, especially with migraine [8]. In our study the prevalence of parasomnia symptoms like sleep talking, bruxism, sleep terror and nightmares in children with headache was significantly higher than the one observed in the CG.

In a study on migraine children Miller describes a prevalence of bruxism at a high level of 29% [8]. We observed differences in the prevalence of bruxism, children with headache more often had bruxism 23.3% (in CG – 16.5%). Some data suggest that children with bruxism have a higher arousal index [43]. It may be associated with higher risk of somatic complaints or problems, as well as behavior and attention problems [43].

Children who experience nightmares have significantly higher levels of anxiety than children who do not experience nightmares [44]. In our study we observed more frequent prevalence of nightmares in the group of children with headaches, what can be connected with higher levels of anxiety in this group of children.

In our study prevalence of sleep breathing disorder symptoms (frequent snoring and breathing pauses) in children with headache was also significantly higher. Sleep-disordered breathing may affect up to 3% of children, is associated with sleep fragmentation and imposes significant clinical morbidity, primarily involving cardiovascular and neurobehavioral functions [45]. Habitual snoring varies from country to country and has been observed to occur in 6% to 27% [45]. The parental reports from questionnaire-based assessments of snoring can be used as surrogate predictors of sleep disorder breathing in children [42]. In children with migraine headache Miller noticed snoring in 23% of children [8]. In our study we observed snoring in 19% of healthy children and 27.3% of children with headache. That can be a cause of increased sleep fragmentation and increased frequency of awakenings observed in children with headache. Numerous studies show that approx. 20-30% children wake up at night [46]. In our study night awakenings were observed in 43.7% of children from the HG and 31.7% of children from the CG. The prevalence of night awaking was decreasing as the age of children increased. The prevalence of sleep disorder symptoms like: snoring, sleep talking, bruxism, sleep terror, nightmares, breathing pauses and awaking from night sleep was higher in the HG group than in the CG and it may have consequences on the functioning of children from that group during the day.

The impact of sleep deprivation on cognitive functions is not well established especially for children and adolescents [47]. Some studies suggest that higher cognitive functions in children are impaired after a single night of restricted sleep [48]. In this study children demonstrated deficits in abstract thinking, verbal processing and creativity after one night of sleep restriction. The deficits were observed on 50% restrictions of total sleep time during one night even when the routine performance was relatively maintained [48].

Some effects of sleep disturbances in the group of children with headache may have influence on problems during day activity – planning, over activity or impulsivity especially at school [49, 50]. In our study school problems were observed more frequently in the HG (24.0%) than in the CG (5.3%), in particular in the primary school group. It was observed in 27.6%, in comparison to 4.0% of the CG in the primary school group. The observed difference is all the more important as some phenomena like bed and room co-sleeping, watching TV during falling asleep and sleep disorders snoring, bruxism, nightmares, awakenings from night sleep are observed statistically more frequently in that age group.

Several limitations in the study merit discussion. The first limitation of the study was a relatively small number of participants. The individual groups were too small, especially the group of children with migraine. We are continuing to collect additional data to create a larger sample of children. The second limitation was the differences in age distribution. The mean age in the HG was 12.6 +/- 4.0 and 8.6 +/- 4.4 in the CG. This difference was significant and might have influence on some results. There were too few children in the middle and secondary school group of the control group. This limitation will be overcome when a larger group is created in the further course of the study.

However the relationship between migraine headaches and sleep has been found in adults, research with pediatric populations remains limited [8]. Interventions with children with headache and sleep problems remain an important area for future investigation.

Some findings suggest that pediatricians and neurologists may want to include sleep history questions as part of the standard examination in children with headache [8]. It is at present a common knowledge that in many cases the diagnosis and treatment of children sleep disorders at the GP (General Practitioner) level is unpractical or even impossible, requiring interdisciplinary approach in specialist sleep clinics [51, 52]. Only such interdisciplinary approach and a team of pediatricians, psychiatrists, neurologists, psychologists and laryngologists can ensure professional diagnosis and treatments of sleep disorders in children [19, 51, 52].

It is necessary to conduct additional research on a larger group of patients with headache to correlate the prevalence of sleep disorder symptoms with the type of primary headache (migraine and tension type headache) and other symptoms.

Appendix A.
Exemplary sleep-related questions from the questionnaire (English translation)

Number of persons sleeping with the child in the same bed (No.)
Number of persons sleeping with the child in the same room (No.)

What is the average time needed by your child to fall asleep (in minutes)?
At what hour does your child usually go to sleep on working days?
At what hour does your child usually wake up on working days?
At what hour does your child usually go to sleep on weekends?
At what hour does your child usually wake up on weekends?

Does your child have physical contact with parents when falling asleep? (yes/no)
Does your child watch TV when falling asleep? (yes/no)
Does your child listen to the music when falling asleep? (yes/no)
Do you read books to your child when she/he is falling asleep? (yes/no)
Does your child need soft toys when she/he is falling asleep? (yes/no)
Does your child need a light when she/he is falling asleep? (yes/no)

Have you observed your child to snore while asleep? (yes/no)
Have you observed your child to stop breathing for a few seconds while asleep? (yes/no)
Have you observed your child to talk while asleep? (yes/no)

Have you observed your child to have enuresis while asleep? (yes/no)
Have you observed your child to grind her/his teeth while asleep? (yes/no)
Have you observed your child to walk while asleep? (yes/no)
Have you observed your child to awake from a night's sleep? (yes/no)
Have you observed your child to have nightmares while asleep? (yes/no)
Have you observed your child to have night terrors while asleep? (yes/no)
How often does your child awake from a night's sleep?

Does your child have day naps? (yes/no)
How many naps does your child have during a day? (No.)
How long are your child's naps? (in minutes)
Does your child have school problems? (yes/no)

Are there any family members who snore while asleep? (yes [who: father, mother, siblings]/no)
Are there any family members who stop breathing for a few seconds while asleep? (yes [who: father, mother, siblings]/no)
Are there any family members who talk while asleep? (yes [who: father, mother, siblings]/no)
Are there any family members who have enuresis while asleep? (yes [who: father, mother, siblings]/no)
Are there any family members who grind her/his teeth while asleep? (yes [who: father, mother, siblings]/no)
Are there any family members who walk while asleep? (yes [who: father, mother, siblings]/no)
Are there any family members who have nightmares while asleep? (yes [who: father, mother, siblings]/no)
Are there any family members who have sleep terrors while asleep? (yes [who: father, mother, siblings]/no)

REFERENCES

1. 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.
2. Dodick D.W., Eross E.J., Parish J.M. et al.: Clinical, anatomical, and physiologic relationship between sleep and headache. *Headache*, 2003;43, 282.
3. ICSD, American Academy of Sleep Medicine. International classification of sleep disorders, 2th ed.: Diagnostic and coding manual. 2005, Westchester, Illinois: American Academy of Sleep Medicine.
4. Bursztein C., Steinberg T., Sadeh A.: Sleep, sleepiness, and behavior problems in children with headache. *J. Child Neurol.*, 2006;21, 1012.
5. Fallone G., Owens J.A., Deane J.: Sleepiness in children and adolescents: clinical implications. *Sleep Med. Rev.*, 2002;6, 287.
6. Luc M.E., Gupta A., Birnberg J.M. et al.: Characterization of symptoms of sleep disorders in children with headache. *Pediatr. Neurol.*, 2006;34, 7.
7. Rains J.C., Poceta J.S.: Headache and sleep disorders: review and clinical implications for headache management. *Headache*, 2006;46, 1344.
8. Miller V.A., Palermo T.M., Powers S.W. et al.: Migraine headaches and sleep disturbances in children. *Headache*, 2003;43, 362.
9. Prusiński A.: Bezsenność i inne zaburzenia snu. PZWL, Warszawa 2007, 160.
10. Neveux T., Cnattingius S., Olsson U. et al.: Sleep habits and sleep problems among a community sample of schoolchildren. *Acta Paediatr.*, 2001;90, 1450.
11. Paiva T., Batista A., Martins P. et al.: The relationship between headaches and sleep disturbances. *Headache*, 1995;35, 590.
12. Heng K., Wirrell E.: Sleep disturbance in children with migraine. *J. Child Neurol.*, 2006;21, 761.
13. Kelman L., Rains J.C.: Headache and sleep: examination of sleep patterns and complaints in a large clinical sample of migraineurs. *Headache*, 2005;45, 904.
14. Society H.C.C.o.t.I.H.: The International Classification of Headache Disorders: 2nd edition. *Cephalalgia*, 2004;24 Suppl. 1, 9.
15. Prusiński A.: Parasomnia. *Sen*, 2001;1, 33.
16. Hublin C., Kaprio J., Genetic aspects and genetic epidemiology of parasomnias. *Sleep Med. Rev.*, 2003;7, 413.
17. Lee-Chiong T.L. (ed.): *Sleep: A Comprehensive Handbook*. John Wiley & Sons, Inc.: Hoboken, New Jersey 2006, 1136.
18. Anders T.F., Eiben L.A.: Pediatric sleep disorders: a review of the past 10 years. *J. Am. Acad. Child Adolesc. Psychiatry*, 1997;36, 9.
19. Stores G.: Practitioner review: assessment and treatment of sleep disorders in children and adolescents. *J. Child Psychol. Psychiatry*, 1996;37, 907.

20. Abu-Arefeh I., Russell G.: Prevalence of headache and migraine in school-children. *BMJ*, 1994;309, 765.
21. Bruni O., Russo P.M., Violani C. et al.: Sleep and migraine: an actigraphic study. *Cephalalgia*, 2004;24, 134.
22. Mehlenbeck R., Spirito A., Owens J. et al.: The clinical presentation of childhood partial arousal parasomnias. *Sleep Med.*, 2000;1, 307.
23. Żarowski M., Steinborn B.: Zaburzenia zasypiania i ciągłości snu u dzieci. *Przewodnik Lekarzy*, 2004;11/12, 22.
24. Owens J.: Sleep in children: Cross-cultural perspectives. *Sleep and Biological Rhythms*, 2004;2, 165.
25. Latz S., Wolf A.W., Lozoff B.: Cosleeping in context: sleep practices and problems in young children in Japan and the United States. *Arch. Pediatr. Adolesc. Med.*, 1999;153, 339.
26. Montgomery-Downs H.E., Gozal D.: Sleep habits and risk factors for sleep-disordered breathing in infants and young toddlers in Louisville, Kentucky. *Sleep Med.*, 2006;7, 211.
27. Liu X., Liu L., Wang R.: Bed sharing, sleep habits, and sleep problems among Chinese school-aged children. *Sleep*, 2003;26, 839.
28. Claudill W., Plath D.: Who sleeps by whom? Parent-child involvement in urban Japanese families. *Psychiatry*, 1966;29, 344.
29. Jenni O.G., Fuhrer H.Z., Iglowstein I. et al.: A longitudinal study of bed sharing and sleep problems among Swiss children in the first 10 years of life. *Pediatrics*, 2005;115, 233.
30. Owens J., Maxim R., McGuinn M. et al.: Television-viewing habits and sleep disturbance in school children. *Pediatrics*, 1999;104, e27.
31. Quine L.: Sleep problems in primary school children: comparison between mainstream and special school children. *Child Care Health Dev.*, 2001;27, 201.
32. Akerstedt T., Billiard M., Bonnet M. et al.: Awakening from sleep. *Sleep Med. Rev.*, 2002;6, 267.
33. Owens L.J., France K.G., Wiggs L.: Behavioural and cognitive-behavioural interventions for sleep disorders in infants and children: A review. *Sleep Med. Rev.*, 1999;3, 281.
34. Stein M.A., Mendelsohn J., Obermeyer W.H. et al.: Sleep and behavior problems in school-aged children. *Pediatrics*, 2001;107, E60.
35. Guidetti V., Galli F., Fabrizi P. et al.: Headache and psychiatric comorbidity: clinical aspects and outcome in an 8-year follow-up study. *Cephalalgia*, 1998;18, 455.
36. Smeyers P.: Headaches in childhood: association with sleep disorders and psychological implications. *Rev. Neurol.*, 1999;28, 150.
37. Zucconi M., Bruni O.: Sleep disorders in children with neurologic diseases. *Semin. Pediatr. Neurol.*, 2001;8, 258.
38. Spruyt K., Cluydts R., Verleye G.B.: Pediatric sleep disorders: exploratory modulation of their relationships. *Sleep*, 2004;27, 495.
39. ICSD, The International Classification of Sleep Disorders: Diagnostic and Coding Manual. Minnesota: Rochester 1990.
40. Garcia-Borreguero D., Larrosa O., de la Llave Y.: Circadian aspects in the pathophysiology of the restless legs syndrome. *Sleep Med.*, 2002;3, S17.
41. Agargun M.Y., Cilli A.S., Sener S. et al.: The prevalence of parasomnias in preadolescent school-aged children: a Turkish sample. *Sleep*, 2004;27, 701.
42. Montgomery-Downs H.E., O'Brien L.M., Holbrook C.R. et al.: Snoring and sleep-disordered breathing in young children: subjective and objective correlates. *Sleep*, 2004;27, 87.
43. Herrera M., Valencia I., Grant M. et al.: Bruxism in children: effect on sleep architecture and daytime cognitive performance and behavior. *Sleep*, 2006;29, 1143.
44. Mindell J.A., Barrett K.M.: Nightmares and anxiety in elementary-aged children: is there a relationship. *Child Care Health Dev.*, 2002;28, 317.
45. Ali N.J., Pitson D.J., Stradling J.R.: Snoring, sleep disturbance, and behaviour in 4-5 year olds. *Arch. Dis. Child*, 1993;68, 360.
46. Mindell J.A., Kuhn B., Lewin D.S. et al.: Behavioral treatment of bedtime problems and night wakings in infants and young children. *Sleep*, 2006;29, 1263.
47. Walsh J., Lindblom S.: Psychophysiology of Sleep Deprivation and Disruption in Humans, in *The Evaluation and Treatment of Sleep Disorders*, P. MR and O. WC, Editors. American Psychological Association: Washington, 1997, D. C. 73.
48. Randazzo A.C., Muehlbach M.J., Schweitzer P.K. et al.: Cognitive function following acute sleep restriction in children ages 10-14. *Sleep*, 1998;21, 861.
49. Beebe D.W., Gozal D.: Obstructive sleep apnea and the prefrontal cortex: towards a comprehensive model linking nocturnal upper airway obstruction to daytime cognitive and behavioral deficits. *J. Sleep Res.*, 2002;11, 1.
50. Borod J.C.: *The neuropsychology of emotion. Series in Affective Science*, 2000: Oxford University Press.
51. Owens J., Mindell J.A.: Clinical sleep services for children: clinical and administrative considerations. *Sleep Med.*, 2002;3, 291.
52. Wiggs L.D.: Paediatric sleep disorders: the need for multidisciplinary sleep clinics. *Int. J. Pediatr. Otorhinolaryngol.*, 2003;67, S115.

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