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Understanding sleep problems in children with epilepsy: Associations with quality of life, Attention-Deficit Hyperactivity Disorder and maternal emotional symptoms

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ABSTRACT

Purpose: This study aimed to (1) compare sleep problems between children and adolescents with epilepsy and non-epileptic controls, and (2) examine whether there is an association between sleep problems and quality of life, Attention-Deficit Hyperactivity Disorder (ADHD) and mothers' emotional symptoms.

Method: Fifty-three patients from a cohort of epilepsy (aged 7–18 years) and 28 controls with minor medical problems (aged 7–18 years) were included. Parents completed Children's Sleep Habits Questionnaire (CSHQ) and Kinder Lebensqualitätsfragebogen: Children's Quality of Life Questionnaire-revised (KINDL-R) for patients and controls.Turgay DSM-IV Disruptive Behavior Disorders Rating Scale (T-DSM-IV-S) parent and teacher forms were used to assess ADHD symptoms for patients. Mothers of the patients completed Beck Depression Inventory and State-Trait Anxiety Inventory (STAI). Neurology clinic charts were reviewed for the epilepsy-related variables.

Results: Children with epilepsy had a higher CSHQ Total score than the control group. Those with a CSHQ score >56 (which indicates moderate to severe sleep problems) had lower scores on KINDL-R. Parent-rated T-DSM-IV-S Total and Hyperactivity–Impulsivity scores, STAI trait and Beck scores were found to be higher in those with a CSHQ score >56. Significant positive correlations were found between CSHQ Total score and T-DSM-IV-S, STAI trait and Beck scores. Binary logistic regression analysis revealed that T-DSM-IV-S Total, Inattention and Hyperactivity–Impulsivity scores were significantly associated with a higher CSHQ Total score. None of the epilepsy-related variables were found to be related with the CSHQ Total score.

Conclusion: Among children with epilepsy, sleep problems lead to a poor quality of life. The link between sleep problems and psychiatric symptoms must be conceptualized as a bilateral relationship. ADHD appears to be the strongest predictor of sleep problems.

1. Introduction

Sleep problems are one of the most common comorbidities in epilepsy [1]. The available research indicates that children with epilepsy have a higher frequency of sleep problems than both their healthy siblings and healthy control subjects [2,3]. Multiple types of sleep problems, mainly based on parent-rated tools, have been reported including difficulty on initiating and maintaining sleep, sleep-disordered breathing, parasomnias and excessive daytime sleepiness [4].

Sleep problems not only predispose children to mood, cognitive, and behavioral impairments, but also have a significant impact on physical health. For those having sleep problems, health related quality of life may also be expected to be impaired. While the association between sleep problems and health related quality of life (HRQOL) in the general population of children is well described, there are limited studies on children with epilepsy. In a previous study on 55 children with epilepsy, higher total scores on

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Sleep Behavior Questionnaire (SBQ) were found to be correlated with poorer overall quality of life scores and physical, social and cognitive functioning subscores [5].

The factors associated with sleep problems in children with epilepsy have not been completely clarified. The available research mainly focused on the epilepsy-related factors, e.g. the type of seizures and use of antiepileptic drug (AED) polytherapy, as associated factors of sleep problems [6]. Familial factors have also been studied in a few studies. There is evidence that parental sleep habits and household routines in the night are associated with sleep problems [4]. However, the association between parental emotional symptoms and the problematic sleep in the child has not been previously shown.

There is a high rate of psychiatric disorders in children with epilepsy. Amongst these, attention-deficit hyperactivity disorder (ADHD) deserves special attention since prevalence rates as high as 28–70% have been reported depending on the diagnostic criterion used [7]. Sleep problems are commonly encountered in the general population of children with ADHD [8]. In case of children with epilepsy, the association between sleep problems and attention difficulties has also been previously shown [5,9]. However, studies using DSM-based ADHD rating scales including an assessment of ADHD symptom dimensions are largely lacking.

Both ADHD and sleep problems have a neuro-developmental origin and a chronic course [10,11]. Mothers' attitudes and parental practices, which are unavoidably affected by their emotional well-being, have a strong impact on both of these conditions [11–13]. In case of pediatric epilepsy, where most of the psycho-social risks are elevated, ADHD and sleep problems may be even more disabling for the child and mother [5,14]. This study aimed to (1) compare sleep problems between children and adolescents with epilepsy and non-epileptic controls, and (2) examine whether there is an association between sleep problems and quality of life, ADHD and mothers' emotional symptoms.

2. Methods

2.1. Sample and design

This study is the second part of a cross-sectional, case-control cohort survey of children and adolescents with epilepsy who were seen at the Pediatric Neurology Clinic of Acıbadem University Hospital in Istanbul. The first investigation on the sample has focused on the associated factors of self-concept and was titled as "Self-Concept in Children and Adolescents with Epilepsy: The role of family functioning, mothers' emotional symptoms and ADHD" (http://dx.doi.org/10.1016/j.braindev.2016.02.015). The inclusion criteria of the present study were as follows: (1) Age of 7–18 years, (2) Diagnosis of epilepsy of at least a duration of 6 months, (3) Normal intelligence based on either a WISC-R full scale IQ score above 80 or the average/above average academic functioning documented with the last year's final school grades (At least three from a possible of five), (4) Not having a previously diagnosed sleep disorder and/or being on medications to promote sleep.

For the control group, children and adolescents who were seen in the general pediatrics clinic of the same hospital during the study duration were recruited. The following inclusion criteria were used: (1) Age of 7–18 years, (2) Attendance at the general pediatrics clinic with minor medical complaints, e.g. mild infections, gastroenteritis, anemia, (3) Normal intelligence based on either a WISC-R full scale IQ score above 80 or the average/above average academic functioning documented with the last year's final school grades (At least three from a possible of five). (4) Not having a previously diagnosed sleep disorder and/or being on medications to promote sleep. They were also never admitted to the pediatric neurology or child psychiatry clinic. For both the epilepsy and control groups, the children with developmental delay, motor and visual handicaps and other chronic diseases were excluded. In the present study, individual age-sex matching was not performed between the epilepsy and control groups. The control group was frequency matched to the epilepsy group by age (<13 or ≥ 13 years of age). The distribution of being ≥ 13 years of age was determined as the matching factor. In the epilepsy group, the frequency of those ≥ 13 years of age was found as 39.6%. This frequency was used as the matching factor for the recruitment of the control group. In the control group, the frequency of those ≥ 13 years of age was 39.2%.

The parents of the whole sample were informed about the study procedure in detail and informed consent was obtained. The study protocol was approved by the Acıbadem University School of Medicine Ethics Committee. The study duration, a total of 12 months, was between 1st January and 31st December 2012.

2.2. Measurements

2.2.1. The Children's Sleep Habits Questionnaire

The Children's Sleep Habits Questionnaire (CSHQ) is a retrospective, 45-item parent questionnaire that has been used in a number of studies to examine sleep behavior in young children [15]. The CSHQ includes items relating to a number of key sleep domains that encompass the major presenting clinical sleep complaints in this age group: bedtime behavior and sleep onset; sleep duration; anxiety around sleep; behavior occurring during sleep and night wakings; sleep-disordered breathing; parasomnias; and morning waking/daytime sleepiness. Parents are asked to recall sleep behaviors occurring over a "typical" recent week. Items are rated on a three-point scale: "usually" if the sleep behavior occurred five to seven times/week; "sometimes" for two to four times/week; and "rarely" for zero to one time/week. Some items were reversed in order to consistently make a higher score indicative of more disturbed sleep. A total CSHQ score of 41 has been reported to be a sensitive cutoff for clinically significant sleep problems [15]. The Turkish translation of the scale was conducted by Perdahlı et al. [16]. In the present study, based on the approach of a previous study using the scale [17], CSHQ scores of 56 and above were defined as moderate to severe sleep problems.

2.2.2. KINDL-R

The Kinder Lebensqualitätsfragebogen: Children's Quality of Life Questionnaire (KINDL-R) assesses QOL of children and adolescents in six different domains: physical and emotional well-being, self-esteem, family, friends, and everyday functioning (school) [18]. The KINDL-R offers 24 items referring to the past week with 5-point Likert-scales ("Never" to "All the time"), with 11 items being reverse-coded. The scores range from 0 to 100, where higher scores indicate higher levels of HRQOL. In the present study, KINDL-R parent questionnaire for 8–16 years was used. The validity and reliability of the Turkish version of the KINDL-R was demonstrated by Eser et al. [19].

2.2.3. State-Trait Anxiety Inventory

State-Trait Anxiety Inventory (STAI) is a 20-item self report rating scale for measuring state and trait anxiety [20]. The State Anxiety Scale requires the participant to describe how they feel right now and measures the temporary condition of "state anxiety" (anxiety in a specific situation). The Trait Anxiety Scale measures the general and long-standing "trait anxiety" of the individual (anxiety as a general trait). The items are rated on a scale of 1–4. Total scores range from 20 to 80. The Turkish version of STAI [21] was used in this study.

2.2.4. Beck Depression Inventory

Beck Depression Inventory (BDI) is a scale developed by Beck in 1961 for assessing the depression risk and severity of depressive symptoms [22]. It can be administered to both psychiatric patients and the general population. It is a self-report scale and consists of 21 Likert-type items each scored between 0 and 3. The total score can be obtained simply by adding the scores for all items. The validity and reliability of the Turkish version of the BDI was demonstrated by Hisli [23].

2.2.5. Turgay DSM-IV Disruptive Behavior Disorders Rating Scale parent and teacher forms

Turgay DSM-IV Disruptive Behavior Disorders Rating Scale parent and teacher forms (T-DSM-IV-S) was developed by Turgay [24] and translated by Ercan et al. [25] into Turkish. The T-DSM-IV-S is based on DSM-IV diagnostic criteria and assesses hyperactivity–impulsivity, inattention, opposition-defiance and conduct disorder. Symptoms are scored on a 4-point Likert scale (0 = not at all; 1 = just a little; 2 = quite a bit; and 3 = very much). The subscale scores on the T-DSM-IV-S were calculated by summing the scores on the items of each subscale. In the present study, hyperactivity–impulsivity (9 items), inattention (9 items) and ADHD total (18 items) scores of the scale were used.

2.2.6. Epilepsy-related factors

- In addition to a direct interview with the parents, neurology clinic charts were reviewed for age at diagnosis, epilepsy duration, seizure types and the presence of AED mono/polytherapy.
- Epilepsy severity

  Epilepsy severity was calculated by a method similar to the approaches of previous studies by Hermann et al. [26], Austin et al. [27] and Rodenburg et al. [28]. The scoring strategy used in the present study was initially determined [27]. Epilepsy severity was computed by assigning scores from 0 to 3, based on seizure type, seizure frequency, and the presence of mono/polytherapy. Seizure type was scored 3 for generalized tonic–clonic seizures, 2 for partial seizures, and 1 for absence seizures. A score of 3 was assigned if the child had weekly or daily seizures, 2 if seizures happened monthly, and 1 if the child had seizures once a year. Absence of a medication regimen was scored 1, the presence of monotherapy was scored 2, and the presence of polytherapy was scored 3. Scores for seizure type, seizure frequency, and the presence of mono- or polytherapy were then summed. Children scoring between 1 and 5 were considered to have low epilepsy severity, and children with scores $\geq$6 were considered to have high epilepsy severity.

2.2.7. Sample size

For the power calculation, the mean difference on the CSHQ total scores of the epilepsy and control groups was considered a relevant difference. This estimate was used as an effect-size parameter in the power calculation. This estimate was based on a result obtained in a previous study on children with epilepsy [4]. In the mentioned study by Larsson et al. [4], the mean CSHQ total scores of the epilepsy and control groups were 41.10 (SD: 6.69) and 48.25 (SD: 8.91), respectively. The mean difference between groups, which was significant at the level of 0.05, was 7.15. In the present study, it was estimated that at least 26 subjects in each groups would be required to detect a significant mean difference of 7.15 between epilepsy and control groups at the 90% power level with an α error of 5%.

Table 1
The comparison of Children's Sleep Habits Questionnaire (CSHQ) scores between children with epilepsy and controls.

CSHQ	Epilepsy, N = 53 Mean (SD)	Control, N = 28 Mean (SD)	p
Total score	52.59 (6.33)	43.21 (2.85)	0.000
Bedtime resistance	10.86 (4.01)	8.92 (0.81)	0.014
Sleep onset delay	6.73 (1.15)	5.78 (0.83)	0.000
Sleep anxiety	5.53 (1.70)	4.50 (0.69)	0.003
Night wakings	3.73 (0.99)	3.25 (0.44)	0.017
Daytime sleepiness	14.03 (2.74)	10.00 (1.38)	0.000
Parasomnias	8.88 (2.03)	6.92 (0.76)	0.000
Sleep disordered breathing	3.84 (1.48)	3.25 (0.44)	0.042

3. Results

Fifty-three children and adolescents with epilepsy and 28 controls completed the study requirements and included in the study. The mean age of the epilepsy and control groups were 11.78 (SD: 2.58) and 12.14 (SD: 1.16) years respectively (p = 0.411). The frequency of male gender was 54.7% (n = 29) in the epilepsy and 60.7% (n = 17) in the control group (p = 0.604). In the epilepsy group, the frequencies of seizure types were; 45.3% (n = 24) for partial seizures, 30.2% (n = 16) for generalized tonic clonic seizures and 24.5% (n = 13) for absence seizures. The majority of the patients had seizures once a year (n = 40, 75.5%) and 13 patients (24.5%) had monthly seizures while none of the patients had weekly or daily seizures. 77% (n = 41) of the patients were on AED monotherapy. The number of subjects on specific AEDs were as follows: Valproate (VPA): 31, leviretacetam (LEV): 12, oxcarbazepine (OXC): 5, and others: 5. Mean epilepsy severity score of our sample was 5.60 (SD: 1.55). Sixty percent (n = 32) of the children had low epilepsy severity, and (n = 21) 39% had high epilepsy severity.

Among the epilepsy group, 35 (66.1%) had a CSHQ total score of 56 and above, while 18 (33.9%) had a CSHQ total score of 42–55. The comparison of CSHQ scores between children with epilepsy and controls is shown in Table 1. As seen in the table, the total score and subscores of the CSHQ are higher in the epilepsy group when compared with the controls ($p < 0.05$).

The KINDL-R total score was found to be lower (poorer) in children with epilepsy (Mean = 87.98, SD = 11.00) when compared to the controls (Mean = 92.57, SD = 7.28) (p = 0.025). Table 2 shows the KINDL-R scores in the epilepsy group, and in those with or without a CSHQ >56. In addition to the Total score (p = 0.002); the scores of Physical Well-Being (p = 0.001), Emotional Well-Being (p = 0.010) and Self-esteem (0.032) were lower in those with a CSHQ >56.

Psychiatric scale scores in children with a CSHQ <56 and >56 are shown in Table 3. As seen in the table, parent rated T-DSM-IV-S

Table 2
KINDL-R scores among the total epilepsy group, those with CSHQ score <56 and >56.

KINDL-R	Total group N:53 Mean (SD)	CSHQ <56 N:35 Mean (SD)	CSHQ >56 N:18 Mean (SD)	p
Total score	87.98 (11.00)	91.26 (11.13)	81.77 (7.77)	0.002
Physical well-being	13.67 (3.57)	14.85 (3.22)	11.44 (3.20)	0.001
Emotional well-being	15.13 (3.05)	15.91 (3.03)	13.66 (2.56)	0.010
Self-esteem	13.73 (3.72)	14.52 (3.37)	12.22 (3.97)	0.032
Family	16.42 (2.56)	16.88 (2.92)	15.55 (1.38)	0.075
Social	15.25 (2.87)	15.41 (3.11)	14.94 (2.41)	0.582
School	13.75 (2.44)	13.41 (2.65)	14.38 (1.88)	0.172
Disease	22.30 (4.77)	23.02 (4.92)	20.94 (4.27)	0.136

CSHQ >56: moderate to severe sleep problems.

Table 3
Psychiatric scale scores in children with a CSHQ score <56 and >56.

Scale scores	CSHQ <56 *N*:35 Mean (SD)	CSHQ >56 *N*:18 Mean (SD)	*p*
Parent T-DSM-IV-S total	7.03 (6.18)	12.00 (7.43)	0.015
Parent T-DSM-IV-S IA	4.03 (4.09)	5.11 (3.42)	0.348
Parent T-DSM-IV-S HA-IMP	2.37 (2.47)	6.44 (4.07)	0.001
Teacher T-DSM-IV-S total	11.58 (7.61)	11.41 (6.13)	0.938
Teacher T-DSM-IV-S IA	6.22 (4.58)	5.52 (3.08)	0.578
Teacher T-DSM-IV-S HA-IMP	4.64 (4.57)	5.11 (2.71)	0.699
Beck total[a]	8.51 (6.31)	14.55 (12.06)	0.022
STAI state[a]	44.58 (6.11)	44.11 (7.51)	0.806
STAI trait[a]	47.38 (6.61)	52.44 (6.41)	0.011

CSHQ >56: moderate to severe sleep problems, IA: inattentiveness, HA-IMP: hyperactivity–impulsivity.
[a] Mothers' scales.

total ($p = 0.015$) and T-DSM-IV-S Hyperactivity–Impulsivity (0.001) scores were higher in those with a CSHQ >56. Regarding the mothers' scales, the scores of Beck and STAI Trait were found to be higher in those with a CSHQ >56. Regarding epilepsy-related variables, epilepsy severity was not found to be significantly different between those with a CSHQ <56 (65.7% = low, 34.3% = high) and CSHQ >56 (50% = low, 50% = high) ($p = 0.297$). When compared between those with a CSHQ <56 and CSHQ >56; the frequency of seizures in the past year (1.15 vs. 1.18, $p = 0.790$), epilepsy duration (24.84 vs. 24.62 months, $p = 0.978$) and the age at diagnosis (age in years: 9.07 vs. 8.00, $p = 0.136$) were not found to be different. The frequency of AED polytherapy (27% vs. 20%, $p = 0.615$), and the distribution of specific AEDs (VPA: 58.8%, LEV: 23.5%, OXC: 8.8% and others: 11.4% vs. VPA: 61.1%, LEV: 22.2%, OXC: 11.1% and others: 5.6%, $p = 0.995$) were also not different between those with a CSHQ <56 and CSHQ >56. Finally, epilepsy types were not found to be different between those with a CSHQ <56 and CSHQ >56 (CSHQ <56: partial seizures: 48.6%, generalized seizures: 25.7%, absence seizures: 25.7%; CSHQ >56: partial seizures: 38.9%, generalized seizures: 38.9%, absence seizures: 22.2% ($p = 0.627$)).

To examine the association between sleep problems and study variables, a Pearson correlation analysis was performed. As seen in Table 4, significant correlations were found between the total score of CSHQ and the parent-rated Total ($p < 0.005$), Inattention ($p < 0.05$) and Hyperactivity–Impulsivity ($p < 0.005$) scores of T-DSM-IV-S; mothers' STAI Trait ($p < 0.05$) and mothers' Beck ($p < 0.005$) scores. Regarding epilepsy-related variables, there were no significant correlations between CSHQ total score and epilepsy severity ($r = -0.43$, $p = 0.772$), and epilepsy duration ($r = -0.002$, $p = 0.988$).

Among the variables in Table 4, those with significant correlations were entered into a binary regression model to evaluate which of these factors predicted a CSHQ total score >56. As seen in Table 5, parent-rated Total ($p = 0.026$), Inattention ($p = 0.041$) and Hyperactivity–Impulsivity ($p = 0.014$) scores of T-DSM-IV-S were found as predictors of a CSHQ total score >56.

Table 5
Binary regression analyses for the factors associated with a CSHQ score >56.

Factors associated with a CSHQ >56	*p*	Odd's ratio	A 95.0% C.I.	
			Lower	Upper
STAI trait	0.347	1.082	0.918	1.274
Beck	0.269	1.101	0.928	1.307
Parent T-DSM-IV-S total	0.026	0.053	0.004	0.701
Parent T-DSM-IV-S HA-IMP	0.014	43.413	2.145	878.806
Parent T-DSM-IV-S IA	0.041	14.457	1.111	188.108

CSHQ >56: moderate to severe sleep problems. IA: inattentiveness, HA-IMP: hyperactivity–impulsivity.

4. Discussion

In this study on Turkish children with epilepsy, sleep problems are found to be more common in the epilepsy group than healthy controls. The total score and all of the subscores of CSHQ were higher in the epilepsy group. Almost one-third of our sample were found to have a total CSHQ score indicating significant sleep problems. These findings, which are in accordance with the previous studies from Western countries [1–6], underline the fact that children with epilepsy needs an overall evaluation regarding sleep problems. Given the preponderance of low epilepsy severity in our sample, sleep problems may be interpreted as a general and frequent problem in childhood epilepsy. It has been previously shown that even in children with mild epilepsy, sleep problems occur frequently [9].

Sleep problems have a broad negative impact in a child's life. Those with difficulty initiating and maintaining sleep often feel exhausted and drowsy in the day. This circle of sleeplessness and sleepiness may affect the overall functioning of the child including academic performance, physical health and peer relations [13]. In the present study, those children with higher total CSHQ scores had poorer scores on total, physical well-being, emotional well-being and self-esteem scores of KINDL-R. A previous study on 55 children with epilepsy used Sleep Behavior Questionnaire (SBQ) and showed that higher total sleep scores were correlated with lower overall quality of life and lower scores on physical function, cognitive function, social function and behavior [5].

There seems to be a bidirectional relationship between sleep problems and ADHD symptoms, especially hyperactivity and impulsivity [29,30]. Children with ADHD frequently have chronic difficulties at initiating and sustaining sleep, which may be among

Table 4
Correlations between CSHQ scores and psychiatric scale scores.

CSHQ	Parent T-DSM-IV-S total	Parent T-DSM-IV-S IA	Parent T-DSM-IV-S HA-IMP	Teacher T-DSM-IV-total	Teacher T-DSM-IV-S IA	Teacher T-DSM-IV-HA-IMP	STAI State	STAI Trait	Beck
Total score	0.491[b]	0.285[a]	0.620[b]	0.099	0.041	0.089	0.092	0.310[a]	0.412[b]
Bedtime resistance	0.054	0.076	0.040	0.029	0.023	0.024	0.056	0.147	0.109
Sleep onset delay	0.292[a]	0.243	0.294[a]	0.211	0.221	0.120	0.003	0.071	0.039
Sleep anxiety	0.284[a]	0.177	0.355[a]	0.243	0.130	0.249	0.036	0.246	0.202
Night wakings	0.345[a]	0.185	0.405[b]	0.026	0.052	0.014	0.094	0.197	0.269
Daytime sleepiness	0.378[b]	0.290[a]	0.392[b]	0.093	0.079	0.061	0.146	0.162	0.421[b]
Parasomnias	0.176	0.034	0.324[a]	0.099	0.112	0.062	0.027	0.060	0.219
Sleep disordered breathing	0.016	0.096	0.118	0.134	0.266	0.059	0.281[a]	0.020	0.026

[a] $p < 0.05$.
[b] $p < 0.01$.
IA: inattentiveness, HA-IMP: hyperactivity–impulsivity.

the intrinsic features of the disorder [30]. The term "delayed sleep phase disorder (DSPD)" has been used to define the circadian sleep disturbances of children with ADHD [31]. DSPD is a problem in which the circadian clock is entrained in the 24-hour rhythm but at a delayed phase angle [32]. Recent studies have shown that almost 30% of children with ADHD suffer from DSPD [33]. Bedtime resistance, sleep anxiety, parasomnias and sleep-disordered breathing are also common in children with ADHD [8]. All of these deviations from normal sleep can result in sleepiness in the daytime. Daytime sleepiness is strongly associated with more attention problems and more impulsivity/hyperactivity [34]. In the present study, children with a higher CSHQ total score had higher ADHD total, inattention and hyperactivity–impulsivity scores. Previous studies, using more general psychiatric tools, have shown similar findings. One study with a relatively small sample size of 14 children used Conners Parent Rating Scale-Revised (CPRS-R:L) and found that attention deficit and hyperactivity symptoms were more frequent in the ones with significant sleep problems [35]. Wirell et al. [5] showed that children with epilepsy with greater sleep disruption had higher attention problem scores on Child Behavior Checklist (CBCL). Given the already high risk of sleep problems in children with epilepsy, those with ADHD comorbidity should be screened for sleep problems regularly. When early diagnosed, these problems can often be easily alleviated with appropriate behavioral approaches and possible changes in medication regimens.

A number of previous studies have shown that mothers of children with epilepsy, as being the main caregiver, commonly have emotional symptoms including depression and anxiety [36]. The chronic burden of living with epilepsy, unpredictable nature of seizures and the associated social stigma all predispose to a higher frequency of anxiety and depression symptoms in the mother. With the fear of having unexpected seizures, mothers usually develop a tendency to stay with their children almost all day and night. In the study by Larson et al. [4], parent–child room sharing and co-sleeping in the night were shown to be more common in children with epilepsy than normal controls. In that study, where more than two-thirds of the parents were reported to feel concerned about night seizures, room sharing and co-sleeping in the night were found to be linked with child's sleep problems. In the present study, mothers' depression and trait anxiety levels were found to be associated with a higher score on CSHQ. Mothers' emotional symptoms may be conceptualized as a key indicator for an overall poor quality of life in the child which also extends to poor sleep hygiene and sleep problems.

The literature on the link between epilepsy-related variables and sleep problems is mixed. Wirell et al. [5] have found that children with refractory epilepsy had significantly higher scores on Sleep Behavior Questionnaire (SBQ). In a study from Brazil, refractory epilepsy and polytherapy were found to be related with sleep problems [6]. More recently, Larson et al. [4] have shown that increased epilepsy severity and AED polythereapy were associated with sleep problems. In contrast with these findings, Maganti et al. [37] did not find an association between day-time sleepiness and epilepsy syndrome, AEDs used and the presence of seizure freedom. In the present study, none of the epilepsy-related variables including epilepsy severity, seizure frequency, epilepsy type, age of seizure onset, epilepsy duration and the presence of polytherapy were found to be different between those with a higher and lower CSHQ total score. The frequency of sleep problems was also not different between different AEDs used.

In the present study, the lack of individual age–sex matching between epilepsy and control groups must be considered as the most important limitation. The comparison of our sample with epilepsy with a group of age–sex matched children would reveal different findings on CSHQ and KINDL-R scores. Therefore, our comparison findings between epilepsy and control groups should be interpreted with caution. In order to partly overcome this limitation, the same age distribution criteria (7–18 years) were used for both groups. In addition, frequency matching, which was based on the frequency of being $\geq$13 years of age, was used to recruit the control group [38]. According to our results, no significant difference was found regarding the mean age and sex distribution of the epilepsy and control groups. This similarity between the study groups, despite being coincidental, partially alleviates the major weakness of our sample selection.

The other major limitations of the study are the small sample size, cross-sectional design and the diagnosis of sleep disorders based on questionnaires. The confirmation of our findings by other methods, such as PSG or actigraphy, would increase the reliability. Another major limitation of the study is that the circadian rhythmicity aspect of the sleep was not studied. In addition to these, majority of our sample were a group of children with epilepsy of low severity. A sample of children with high epilepsy severity would reveal additional findings. Although parent and teacher-rated tools have a high reliability on ADHD diagnosis, a structured psychiatric interview would yield the possible DSM-IV diagnosis of the children. This same limitation is also present for the evaluation of mothers' emotional symptoms based on self-report questionnaires. Regarding sleep-related variables, the investigation of room sharing and co-sleeping may be helpful to define the sleep problems more accurately.

5. Conclusion

Due to the main target of controlling seizures, sleep problems are often underdiagnosed and undertreated in children with epilepsy. However, efficient sleep is associated with an overall better quality of life and improved psycho-social functioning. During the pediatric visits of children with epilepsy, sleep habits and sleep complaints should be assessed. For the children with chronic insomnia, circadian rhythmicity should be studied, e.g. measuring (salivary) dim light melatonin onset [39]. Because of the association with sleep problems, consideration should be given to screening for ADHD and maternal emotional symptoms, using validated screening instruments. For those with insomnia symptoms due to DSPD, adequately timed and dosed melatonin use may be helpful [40]. Since the relationship between sleep problems and psycho-social factors is complex and multi-dimensional, a thorough evaluation and family-based interventions are needed for an effective management. Future studies with larger sample size are needed to clarify the complex relationship of sleep problems, ADHD and epilepsy.

Conflict of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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