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Sleep Characteristics in Egyptian Children with Attention Deficit-Hyperactivity Disorder

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ABSTRACT

Introduction: Sleep problems have been clinically reported in an estimated 25% to 50% of children and adolescents with attention deficit hyperactive disorder (ADHD).

Aim of the Study: To assess subjective and objective sleep disturbances in an Egyptian sample of children who have ADHD.

Subjects and Methods: Twenty five medication-free children with a clinical diagnosis of ADHD (21 boys and 4 girls; age range 5-12 years) were compared with 20 healthy matched controls. All 25 children with ADHD and controls underwent a semi-structured psychiatric interview (Kiddie-SADS) and a behavior assessment by Conners Teacher Rating Scale (CTRS), Conner's Parents Rating Scale (CPRS) and Swanson, Nolan and Pelham Rating Scale (SNAP-IV). The demographic, clinical and psychiatric information of all children were collected from the histories reported by the parents. Patients and control were administered a sleep questionnaire before undergoing nocturnal video-polysemnography (PSG).

Results: Parents reported a wide range of frequently occurring sleep disturbances in their children. Objective sleep measures revealed increase of rapid eye movement (REM) sleep latency and a decrease of REM sleep percentage and decreased duration of sleep in children diagnosed with ADHD ($p<0.01$). No significant correlations between objective sleep measures and clinical symptoms were found.

Conclusion: ADHD is associated with specific sleep alterations. These results stress the need for clinicians to routinely screen for the presence of sleep disorders and found to future evidence-based guidelines on the management of sleep disturbances in children with ADHD.

Key words: Sleep, polysemnography, attention deficit hyperactive disorder, hyperkinetic child.

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INTRODUCTION

Attention deficit/hyperactivity disorder (ADHD) is one of the most prevalent conditions in child psychiatry, estimated to affect 3% - 5% of school-aged children[1,2]. ADHD is characterized by a persistent pattern of inattention, hyperactivity-impulsivity, or both. Onset before the age of 7 and impaired functioning in two or more settings are essential for the diagnosis[3]. Symptoms of ADHD may persist into adulthood in about two thirds of patients[4,5].

Sleep disruption has been reported in patients with ADHD, it is present in about 25% - 50% of children and adolescents with ADHD. Restless and disturbed sleep was initially included in the DSM diagnostic criteria for ADHD, but was later excluded as being a nonspecific symptom[6]. However, the links between sleep disturbances and ADHD have been a topic of ongoing research and clinical interest, because sleep difficulties in children with ADHD present a considerable challenge for parents and for clinicians and may increase daytime ADHD symptoms[7].

Studies assessing subjective sleep disturbances consistently revealed more problems with falling asleep along with longer sleep latencies, more bedtime struggles, nocturnal awakenings, restless sleep, daytime sleepiness and a higher rate of enuresis compared to control children without ADHD, indicating an approximately 5 fold increase in the rate of sleep problems in children with ADHD[6,8].

Polysomnographic (PSG) studies looking at measures of sleep architecture have failed to find consistently significant differences between children with ADHD and controls[9]. Some studies found no differences in PSG measures between children with ADHD and controls[10], whereas other studies have yielded varied and often contradictory findings, such as significant decreases in REM sleep[7,11], significant increases in REM sleep[12] and significant decrease in REM latency[13] in ADHD children versus controls. Also, other investigations of objective sleep parameters have quite consistently shown reduced REM sleep, more nocturnal movements, increased frequency of periodic limb movements (PLMS) and PLMS-

associated arousal as well as elevated daytime somnolence in children with ADHD when compared to controls[10,13].

THE AIM OF THE STUDY

Was to assess subjective and objective sleep disturbances in an Egyptian sample of children with ADHD.

SUBJECTS AND METHODS

Thirty The present study was carried out at Neuropsychiatry Department, Tanta University Hospital and the Neuropsychiatry and Neurosurgery center of Tanta University, Egypt from June 2007 to February 2009. The patients group included 25 children (21 males and 4 females) with ADHD (diagnosed according to DSM-IV (American Psychiatric Association 2000)); all of them were non-medicated; their mean age was 9.08±2.04 years. The control group included 20 healthy children (18 males and 2 females) and their mean age was 10 ±1.62 years.

Both groups were matched as regards age and sex (Table 3), with no significant difference between the 2 group as regards both age and sex ($p>0.05$). The study was explained to the children and their parents and written consents were obtained from parents of those children.

Exclusion criteria for both groups included primary sleep disorders (e.g. obstructive sleep apnea, restless leg syndrome), other major psychiatric disorders (e.g. depression, bipolar disorders, schizophrenia, or anxiety disorders, substance abuse disorders), axis II diagnosis (mental subnormality), pervasive developmental disorders, use of psychotropic medication or any drugs that can affect CNS one month before the start of the study.

Patients with ADHD were subjected to clinical assessment of their ADHD symptoms by using a semi-structured psychiatric interview (Kiddie-SADS)[14,15] and a behavioral assessment by Conners Teacher Rating Scale (CTRS), Conners Parents Rating Scale (CPRS)[16] and Swanson, Nolan and Pelham Rating Scale (SNAP-IV)[17]. Conners Rating Scales (CPRS and CTRS) were completed as the first stage of the initial assessment by parents and teachers. On the basis of the informant's descriptions, the interviewer rated the frequency and severity of the child's behaviors on 4 point scales (0–3). Parents were subsequently asked to rate child behavior using the SNAP-IV Rating Scales (short form)[17]. The SNAP-IV provides measures on 3 separate subscales:

1. Inattention (time spent on a single activity).
2. Activity Level (rating of restlessness, fidgetiness and activity level in structured situations such as meals and car trips).
3. Defiance/antisocial behavior (items concerning temper tantrums, lying, stealing, defiance, disobedience, truancy and destructiveness). The results of clinical evaluation and the scores of the used scales were presented in table (1).

Subjective sleep assessment: All children and their parents underwent a detailed structured interview about their sleep habits and sleep related symptoms. The children's sleep habits questionnaire (CSHQ)[18] was used for assessment of sleep characters of the studied population. It included the following categories:-

1. Bed time resistance (goes to bed at same time, falls asleep in own bed, falls asleep in other's bed, needs parent in room to sleep, struggles at bedtime and afraid of sleeping alone).

2. Sleep onset delay (Falls asleep in 20 minutes).

3. Sleep duration (sleeps too little, sleeps the right amount, sleeps same amount each day).

4. Sleep anxiety (needs parent in room to sleep, afraid of sleeping in the dark, afraid of sleeping alone, trouble sleeping away).

5. Night waking (moves to other's bed in night, awakes once during night and awakes more than once).

6. Parasomnias (include the following items: wets the bed at night, talks during sleep, restless and moves a lot, sleepwalks, grinds teeth during sleep, awakens screaming, sweating, alarmed by scary dream).

7. Sleep disordered breathing (snores loudly, stops breathing, snorts and gasps) and day time sleepiness.

Polysomnographic study: All children were recorded during nocturnal sleep for a minimum of one night by means of video-PSG.

Basic polygraphic parameters for clinical polysomnographic evaluation were obtained. Polysomnography encompassed EEG (C3-A2, C4-A1), horizontal and vertical eye movements, submental and leg electromyogram (left and right anterior tibial muscles) and electrocardiogram. Respiration (oral and nasal air flow, thoracoabdominal respiratory movements and oxygen saturation) was recorded. All sleep recordings were scored in 30-sec epochs, according to Rechtschaffen and Kales criteria[19].

Nine polysomnographic parameters were included in our analysis; sleep-onset latency (time in minutes from getting into bed to polysomnoghraphically defined sleep onset), total sleep duration (time in minutes from sleep onset to final morning awakening of all epochs scored as sleep, i.e., excluding total duration of all epochs scored as wake), sleep efficiency (total sleep time/time in bed×100), REM latency in minutes (time between sleep onset and first epoch of REM sleep), REM percentage, percentage of stage 1, percentage of stage 2, percentage of slow-wave sleep (SWS) and the apnea-hypopnea index (it is calculated by dividing the number of apneas and hypopneas by the number of hours of sleep).

Statistical Analysis:

The collected data was statistically analyzed using Minitab 15 software statistical computer package. The mean and standard deviation was used for presentation of quantitative data. The student (t) test was used for comparison between 2 means. For qualitative data the number and percent distribution was calculated and Chi square and Fisher exact tests were used for comparison between studied groups. The 5% level of significance was adopted for interpretation of tests of significance.

RESULTS

The demographic data and clinical characteristics of the ADHD patients were presented in table (1). According to DSM-IV, clinical types of studied ADHD patients were hyperactive/ impulsive type (68%), mixed inattention and hyperactive/ impulsive (20%) and 12% with only inattention.

Table 1: Demographic and clinical data of the studied ADHD patients.

Age (Mean ± SD)	9.08±2.04
Sex (Males/Females)	21/4
DSM-IV ADHD subtype n (%)	
1- **Hyperactive/impulsive**	17 (68%)
2- **Inattentive**	3 (12%)
3- **Mixed**	5 (20%)
Conners parents rating scale	47.68±8.75
Conners teachers rating scale	43.36±9.23
SNAP-inattention	2.08±0.620
SNAP-hyperactivity-combined	1.63±0.64
SNAP-oppositional	1.640± 0.68

Subjective evaluation of sleep revealed that all children with ADHD had more frequently abnormal sleep parameters (Table 2). Sixty percent of the ADHD patients had one or more sleep complaints, while 30% of the control group had sleep complaints and the difference between the 2 groups was significant (p=0.04). Parents of ADHD patients significantly reported that their children had a delay in sleep onset and time to go to bed (40%) and this was present in only 10% of the control group, the difference between the 2 groups was statistically significant (p=0.02). Also, parents of ADHD patients reported that their children (48%) sleep for shorter duration than the control (5%), the difference between the 2 groups was significant (p=0.002). Most of the ADHD patient (60%) show motor restlessness during sleep and only 15% of the control show motor restlessness and the difference between the 2 groups was significant (p=0.002). The difference between the 2 groups was also significant as regards bruxism. There was no significant difference between the 2 groups as regards other items of the questionnaire (table 2).

Table 2: Subjective sleep variables of the studied groups **.**

	ADHD group Number (%)	Control group Number (%)	
1. Bedtime Resistance	6 (24%)	5 (25%)	0.9
2. Sleep Onset Delay	10 (40%)	2 (10%)	0.02*
3. Sleep Duration Sleeps too little	12 (48%)	1 (5%)	0.002*
4. Sleep Anxiety	1 (4%)	1(5%)	
5. Night Waking	3 (12%)	-	0.11
6. Parasomnias Wets the bed at night	6 (24%)	2 (10%)	0.22
Talks during sleep	8 (32%)	2 (10%)	0.8
Restless and moves a lot Sleepwalks	15(60%)	3 (15%)	0.002*
Grinds teeth during sleep	11 (44%)	3 (15%)	0.03*
Awakens screaming, sweating and alarmed by scary dream	7(28%)	6 (30%)	0.7
7. Sleep Disordered Breathing	-	-	
8. Daytime Sleepiness	-	1 (5%)	
Total number of persons with sleep complaints	15 (60%)	6 (30%)	0.04*

Polysomnographic results:

ADHD children show significantly longer sleep onset latency, decreased sleep duration and efficiency than control group. Also, they had significantly decreased percentage of REM sleep and longer REM latency than the normal children. There was no significant difference between the 2 groups as regards other polysomnographic parameters. No significant correlations between objective sleep measures and clinical symptoms were found (table 3).

The ADHD patients had longer sleep latency (27.88±6.64min.) Than the control group and the difference between the 2 groups was statistically significant (p=0.03). They had significantly (p=0.04) shorter duration of the total sleep time (459.3±98.9 min.) Than control group (508±55.8).

The ADHD patients had a longer REM latency (94.4±17min.) Than the control group (84.7±17.9) but the difference between both groups was non significant (p=0.07). The percentage of REM sleep in patients of ADHD (16.20±3.20) was significantly less than the control group (20.35±5.07), the difference between the 2 groups was significant (p=0.03).

While, the ADHD patients frequently awake during sleep (number of awakening=20.20±7.3), the control group awake for only 14.10±3.60 and the difference between both groups was significant (0.001).

The respiratory function of ADHD patients was not significantly different from the control group. There was no correlation between the type of ADHD and the results of both subject and objective assessment of sleep.

Table 3: Polysomnogaphic data of the studied patients and control subjects.

	ADHD	Control	t	p
Age	9.08±2.04	10±1.62		0,099
Sex (male/female)	21/4	18/2		0.56
Sleep latency (min)	27.88±6.64	23.30±6.94	2.24	0.03*
Total sleep time (min)	459.3±98.9	508±55.8	2.08	0.04*
Sleep efficiency (%)	95±3.56	96±3.73	0.91	0.37
Stage I (%)	10.32±2.06	11±3.70	0.74	0.47
Stage II (%)	55.76±4.92	56.95±4.61	0.84	0.41
Slow wave sleep (%)	7.68±1.89	7.90±2	0.83	0.71
REM latency (min.)	94.4±17	84.7±17.9	1.48	0.07
REM sleep (%)	16.20±3.20	20.35±5.07	3.19	0.03*
Number of awakening	20.20±7.3	14.10±3.60	3.73	0.001*
Apnea-hypopnea index	5.48±6.18	5.50±5.72	0.19	0.82

DISCUSSION

In the present study parents of unmedicated ADHD parents reported that 60% of their children had one or more sleep problems, significantly higher than that of the control group. This finding supports results of previous studies showing increased parental ratings of sleep problems among ADHD children compared to children in the control group. Owens et al, reported quite similar results. In the present study; there was no increase in the day time sleepiness[20,21]. This was in agreement with decreased daytime sleepiness in ADHD children with co-morbid sleep disorders reported before[10,22].

In contrast with this study excessive day time sleepiness in a group of ADHD children was reported[13,20].

The polysomnographic finding of the present study demonstrated that nonmedicated ADHD children had significantly longer sleep latency, shorter total sleep time than the control group. The polysomnographic results are going with some subjective findings in the present study. Sleep onset delay is significantly present in more ADHD patients, who had also significantly longer sleep latency (27.88±6.64min.) Than control (23.30±6.94min.). This is in agreement with Gruber et al.[23]. ADHD seems to be characterized, in some cases, by a sleep onset insomnia characteristic of delayed sleep phase syndrome. On the other hand, the reverse relationship does not seem to hold, as a preliminary study suggests that ADHD symptoms are not common in delayed sleep phase syndrome. It may be that hyperactivity at night in ADHD causes a delayed sleep onset characteristic of Delayed Sleep Phase Syndrome, but that the sleep disruption from a delayed sleep onset is not enough to cause daytime inattention and hyperactivity characteristic of ADHD. The endogenous circadian pacemaker was suggested to be fixed at a later phase than the desired sleep-wake schedule in children with ADHD and sleep-onset insomnia.

The shorter duration of sleep among patients with ADHD than the control (49 minutes shorter), is going with other studies[24]. Also disrupted and short sleep can affect daytime learning and attention in childhood and can lead to ADHD-like symptoms[25]. It has been suggested that disrupted sleep architecture can cause executive dysfunction, impaired vigilance, depression, anxiety and hyperactivity[26,27]. These findings collectively suggest that the impact of decreased sleep duration on neuropsychological functioning in children with ADHD should be investigated further.

The ADHD patients of the present study had significantly decreased percentage of REM sleep (16.20±3.20) than the control (20.35±5.07). The REM latency of the patients was longer than that of the control but the difference was not significant. These findings are in agreement with other studies documenting REM sleep abnormalities in ADHD children[28-31]. These findings may suggest that ADHD children suffer from an intrinsic sleep problem that could be related to the underlying pathophysiology of the disorder. REM sleep has been associated with increased brain-derived neurotrophic factor (BDNF) levels in the dorsal hippocampus[32,33]. BDNF has been suggested to play a role in the pathogenesis of ADHD and two family-based association studies demonstrated an association of BDNF polymorphisms with ADHD[34,35]. The catecholamine systems was also implicated in both the pathophysiology of ADHD and the regulation of sleep and arousal. Variety of anatomical, animal and clinical studies have indicated that dopamine signaling acts not only to stimulate arousal and attention, but is also involved in both the regulation of overall sleep and in mechanisms specifically related to REM sleep[36,37]. Thus, there appears to be a relationship between the mechanisms underlying the pathophysiology of ADHD and the regulation of REM sleep.

CONCLUSION

The present study revealed an association between some sleep parameters and ADHD. The ADHD patients had significantly delayed sleep onset and decreased sleep duration. Also, they had significantly decreased REM sleep and increased number of awakenings.

Recommendations

The present study was limited by its small sample size, so, it is recommended to replicate it with more patients to study the effect of ADHD medication on both clinical ADHD symptoms and sleep parameters as this may help in our understanding of the relationship between the two conditions.

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