

## Sleep Profile in Children with Attention Deficit Hyperactivity Disorder

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## Abstract

**Background:** Attention Deficit Hyperactivity Disorder (ADHD) is a common neurological disorder affecting 5- 8% of school- age children and symptoms continue to mature in about 60% of cases, about 4% of adults.

**Objectives:** To identify sleep problems and their diagnostic characteristics that may help to better understand ADHD and to assess the severity of symptoms and their relationship to ADHD.

**Methodology:** A case- control study was carried out on 60 children divided into: 30 children with ADHD diagnosed according to the DSM of Mental Disorders (5th ed.), in addition, 30 normal children as controls. The study was conducted at the Institute of Postgraduate Childhood Studies and Center of Psychiatry at Ain Shams University in the period from April 2016 to October 2017. Complete psychological history and examination were done for each child who met the inclusion criteria. Physical, neurological and psychological examination were performed using: DSM 5, Conner scale, Child Sleep habits questionnaire and sleep laboratory at the Center for Psychiatry Ain Shams University.

**Results:** The findings revealed that 18 (60%) of cases suffered from insomnia: (27.7%), primary insomnia (22.2%), primary, intermediate and final insomnia (16.6%), primary and late insomnia (11.1%), moderate insomnia and hyper hypnosis (5.5%). There is increased instability in sleep and latency in children with ADHD. There are statistically significant differences between cases and control groups as regards longer latency, lack of sleep, slightly lower phases 3 and 4 duration, longer duration of dreaming sleep (accompanied by eye movement) and longer response time, increased vigilance, height of the periodic leg movement.

**Conclusion:** There is a high co- occurrence of sleep problems among children with ADHD that minimally 65.62% of ADHD cases have at least one sleep disturbance type.

## دراسة أنماط النوم لدى الأطفال المصابين باضطراب نقص الانتباه وفرط الحركة

**المقدمة:** اضطراب نقص الانتباه/ فرط النشاط هي مرض عصبي شائع تؤثر على 5- 8% من الأطفال في سن المدرسة وتستمر الأعراض إلى مرحلة البلوغ في حوالي 60% في المئة من الحالات، أي حوالي 4% من البالغين.

**الهدف:** معرفة مشاكل النوم وخصائصها التشخيصية التي قد تساعد في فهم اضطراب نقص الانتباه/ فرط النشاط بشكل أفضل وتقدير شدة الأعراض وعلاقتها بمتلازمة نقص الانتباه/ فرط النشاط.

**المنهجية:** أجريت دراسة (المجموعة المرضية والمجموعة الضابطة) على عينة من 60 طفل مقسمة إلى مجموعتين متساويتين، الأولى بها 30 طفل مصابين بمتلازمة نقص الانتباه/ فرط النشاط وتم تشخيص حالاتهم وفقاً لمعايير) الدليل التشخيصي والإحصائي للاضطرابات النفسية الطبعة الخامسة)، والثانية بها 30 طفل طبيعي في معهد الدراسات العليا للطب النفسي ومركز الطب النفسي في جامعة عين شمس الفترة من إبريل 2016 إلى ديسمبر 2017. تم الحصول على التاريخ النفسي الكامل والفحص لكل طفل تتوافر فيه معايير الاشتغال، تم الفحص البدني والعصبي وكذلك الفحص النفسي باستخدام المقابلة السريرية المصممة بناء على المعايير التشخيصية الدليل التشخيصي والإحصائي للاضطرابات النفسية الطبعة الخامسة، والتقييم باستخدام مقياس كورنر لتقييم شدة أعراض متلازمة نقص الانتباه/ فرط النشاط والعلاقة بنتائج فحص النوم، ودراسة النوم يتم في معمل النوم في مركز الطب النفسي جامع عين شمس، واستبيان عادات النوم لدى الأطفال.

**النتائج:** في الأطفال المصابين باضطراب فرط الحركة ونقص الانتباه، كشفت النتائج أن من أصل 30 مريضاً، 18 (60%) كانوا من الأرق. (27,7%)، والأرق الأولى (22,2%)، والأرق الأولى والمتوسط والأخير (16,6%)، والأرق الأولى والأخير (11,1%)، ثلثها حالة واحدة فقط تعاني من (5,5%) وحالة واحدة مع الأرق الأوسط وفرط التنويم (5,5%)، وهناك زيادة عدم الاستقرار في مدة النوم والكمون في الأطفال المصابين بفرط الحركة ونقص الانتباه ADHD، وهناك فروق ذات دلالة إحصائية بين الحالات ومجموعات السيطرة مع الأخذ بعين الاعتبار جميع العناصر الشخصية للنوم (كمون أطول لوقت النوم، قصور في النوم أكثر، أقل قليلاً في المرحلتين 3 و 4، مدة أطول للنوم الحالم (المصاحب بحركة العينين)، زيادة أوقات اليقظة، ارتفاع مؤشر حركة الساق الدورية) في مجموعة الحالات مقارنة بالمجموعة الضابطة.

**التوصيات:** تضمين الدراسات المستقبلية عدد أكبر من المرضى، وإجراء أبحاث مسحية على مستوى المجتمع ككل وربط نتائج الدراسة الإكلينيكية بنتائج الاختبارات المعملية والتصويرية والدراسات الخاصة بالتخطيط الكهربائي للمخ.

**Introduction:**

Attention deficit hyperactivity disorder (ADHD) is a developmental condition of inattention and distractibility, with or without accompanying hyperactivity. There are 3 basic forms of ADHD described in the Diagnostic and Statistical Manual, Fifth Edition (DSM-V) of the American Psychiatric Association: inattentive; hyperactive- impulsive; and combined type.<sup>(1)</sup>

ADHD has a persistent pattern of inattention and/or hyperactivity impulsivity that interferes with functioning or development. Six or more of the symptoms have persisted for at least six months to a degree that is inconsistent with developmental level and that negatively impacts directly on social and academic/ occupational activities.<sup>(2)</sup>

**Aim of The Study:**

The study aimed at investigating the sleep profile in children with ADHD (non- medicated) either drug naive or haven't received medication for at least 1 month, and to estimate the severity of ADHD symptoms and their correlation with the sleep profile in children.

**Hypothesis:**

The presence of sleep problems among children with ADHD with directly proportionate relation between the severity of ADHD symptoms and sleep changes.

**Methodology**

**Study Design:**

A case- control study.

**Place:**

The sample will be recruited from patients attending the outpatient clinics in two areas: The Childhood Special Needs Center clinics a Ain Shams University that work 6 days a week (From Saturday till Thursday) and from The Institute of Psychiatry's child psychiatry clinics, Faculty of medicine, Ain Shams University Hospitals that work 4 days a week (from 9 am till 2 pm), during the period from January 2015 to December 2017.

**Subjects:**

Sixty children will be recruited in this study; divided into 2 groups: patients group and controls group:

⊠ Case Group: Thirty patients will be selected from the patients attending the outpatient clinics, diagnosed with ADHD according to the DSM-V criteria (after history taking, clinical and psychiatric examination).

1. Inclusion Criteria:

- a. Patients fulfilling the criteria of ADHD according to the DSM-V criteria.
- b. Age ranges between (6- 12) years.
- c. Both males and females patients.

2. Exclusion Criteria:

- a. Patients with co- morbid major psychiatric illnesses (e.g. Psychosis, Mood disorders- Conduct disorders- mental retardation) to exclude the effect of these illnesses or their medications.

- b. History of non psychiatric diseases that can affect sleep or attention or hyperactivity parameters like (cerebrovascular diseases, epilepsy, endocrinal diseases and learning disorder etc.).

⊠ Control Group: Thirty apparently healthy volunteer children with no history of any psychiatric, neurological disorder matched with patients for age, sex and social standard will be included in the study.

Cases were subjected to: Full psychiatric history and examination to patient fulfilling the inclusion criteria, physical and neurological examination as well as psychiatric examination using the following tools:

1. Structured Clinical Interview based on the diagnostic criteria of DSM-V.<sup>(2)</sup>
2. Conners' Rating Scale<sup>(3)</sup> (Conners et.al., 1998) to assess the severity of ADHD patients and correlate it to sleep profile results: the Conners' parent scale. It is an 80 item questionnaire. It scores the parents' report of their child's behavior during the past month on a 4- point response scoring. The main use of this questionnaire is to assess the severity of ADHD.
3. Children's Sleep Habits Questionnaire (CSHQ),<sup>(4)</sup> the Arabic translated version is used,<sup>(5)</sup> It is a 33 item questionnaire. It scores the sleep habits of school aged children as reported by the parents during the past week. It assesses 8 parameters about sleep habits: bed time resistance, sleep latency, total sleep time, sleep disruption, awakenings, sleep phenomenon, respiratory disturbance during sleep and day time sleepiness. Then after completing the questionnaires the cases and controls will be given a date for another day for having the polysomnogram procedure. It will be done in the sleep lab at The Institute of Psychiatry, Faculty of Medicine, Ain Shams University Hospitals.
4. The Polysomnography (PSG) also called a sleep study. It is a test used to diagnose sleep disorders. Poly- somnography records.

**Statistical analysis:**

Data were collected, tabulated and statistically analyzed using SPSS version 12.

Ethical considerations were taken.

**Results:**

Table (1) Clinical picture of insomnia in ADHD cases

Insomnia Picture	Cases (N= 30)	%
No Insomnia	12	40
Initial Insomnia	4	13.3
Middle Insomnia	2	6.7
Initial And Middle Insomnia	5	16.7
Initial And Late Insomnia	2	6.7
Initial, Middle And Late Insomnia	3	10
Initial, Middle Insomnia And Hypersomnolence	1	3.3
Middle Insomnia And Hypersomnolence	1	3.3

Table (1) shows clinical picture of insomnia in ADHD cases, there was no insomnia in (40%), initial insomnia in (13.3%), middle insomnia in (6.7%), initial and middle insomnia in (16.7%), initial and late insomnia in

(6.7%), initial and middle and late insomnia in (10%), initial and middle insomnia and hypersomnolence in (3.3%), and middle insomnia and hypersomnolence in (3.3%).

Table (2) Comparing between the sleep profile in case and control groups

	Cases (N= 30) (Mean ± SD)	Control (N= 30) (Mean ± SD)	T- Test	P- Value
Sleep Latency	26.5 ±7.1	16.5 ±3.0	22.53	0.000**
Sleep Efficiency	80.7 ± 7.8	91.9 ± 1.5	84.5	0.000**
Stage I	2.53 ± 1.2	0.86 ±0.25	10.98	0.000**
Stage II	50.1±0.40	49.8±0.36	924.3	0.000**
Stage III	10.7±2.41	12.04±0.81	46.18	0.000**
Stage IV	11.5±1.76	12.6±0.71	64.83	0.000**
SWS	23.2±0.72	24.7±1.0	157.8	0.000**
REM	24.3 ± 1.43	24.7 ±0.42	176.7	0.000**
Sws Latency	33.2 ± 4.3	33.2 ± 2.93	70.9	0.000**
Rem Latency	57.7± 5.2	73.7± 12.4	61.2	0.000**
Arousal	4.04± 3.9	0.3±0.32	5.03	0.000**
PLMI	0.14±0.2	0.04±0.04	4.81	0.000**

Table (2) shows that there is statistically significant difference between cases and control groups as regard all items of sleep profile (p= 0.00).

Table (3) Shows that Conner's scale is not correlated with any of sleep profiles

Conner's Scale	R Value	P Value
Sleep Latency	0.111	0.559
Sleep Efficiency	0.019	0.920
Stage I	0.148	0.435
Stage II	- 0.042	0.827
Stage III	0.068	0.719
Stage IV	- 0.207	0.272
SWS	- 0.191	0.312
REM	0.083	0.664
Sws Latency	- 0.087	0.648
Rem Latency	- 0.125	0.512
Arousal	0.085	0.657
PLMI	0.142	0.454

Table (3) Correlation of conner's scale with sleep profile

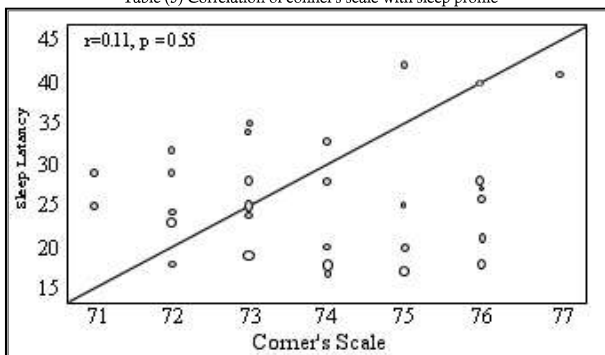


Figure (1) Correlation of CONNER'S scale with Sleep latency

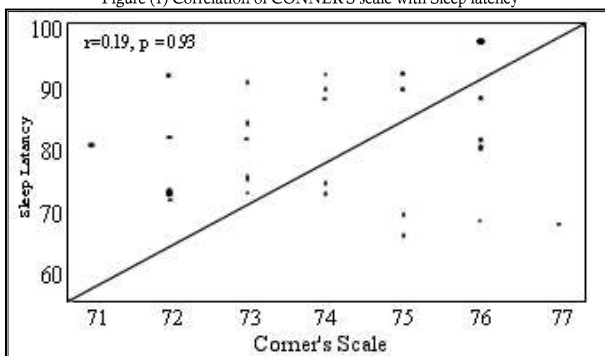


Figure (2) Correlation of Conner's scale with Sleep efficiency.

**Discussion:**

The current study investigated the pattern of insomnia in cases of children with ADHD, findings revealed that out of 30 patients, 18 (60%) suffered from insomnia; among which the majority reported combined initial and middle insomnia (27.7%), initial insomnia (22.2%), combined initial, middle and late insomnia (16.6%), initial and late insomnia (11.1%), followed by only one case suffering from initial, middle and hypersomnolence (5.5%) and one case with middle insomnia and hypersomnolence (5.5%). And this can be interpreted by studies showing affection of the frontal and prefrontal cortices that can cause both inattention and sleep disturbance symptoms.<sup>(6)</sup>

Agreeing with these results, a study found increased instability in sleep duration and latency in ADHD children,<sup>(7)</sup> additionally, a study's findings showed that there is a strong association between ADHD and insomnia especially initial insomnia<sup>(8)</sup> and middle insomnia.<sup>(9)</sup> Also, Corkum and colleagues (1998)<sup>(10)</sup> reported difficulty in initiating and maintaining sleep in children with ADHD, in approximately 25- 50% of sampled patients. Spruy and Gozal, (2011)<sup>(11)</sup> found that children with ADHD had shorter sleep duration with more interrupted sleep than in controls. This is explained by a neurobiological connection between ADHD and sleep wake dysregulation<sup>(12)</sup> Also, ADHD patients had initial insomnia sleeping after midnight.<sup>(13)</sup>

On the contrary, Cohen- Zion and Ancoli- Israel (2004)<sup>(14)</sup> revealed that parental answers highly suggested sleep problems in their children with ADHD that objective sleep investigations didn't confirm when applied. This can be explained by cultural variation and methodological limitations.

The current study's results revealed that the mean of severity of ADHD symptoms according to Conner's scale was 73.8, yet without significantly correlation with any of the sleep profile items. A study revealed that the severer the ADHD symptoms the more REM disturbances were recorded in children.<sup>(15)</sup>

Contrary to those results, researches showed an effect of insomnia on causing more frequent attention shifting and attention seeking behaviours due to sleep deprivation.<sup>(16)</sup>

The findings of the current research demonstrated that there was a statistically significant difference between cases and control groups considering all items of sleep profile (P= 0.00). Similarly, various studies found shorter duration of sleep, longer sleep latency and late insomnia in children with ADHD than those in the control groups.<sup>(17)</sup>

Longer sleep latency was reported in the current study to be longer in cases than in the control (mean of 26.5 versus 16.5 respectively), with statistically significant difference (P= 0.000), this goes with another research that stated longer sleep latency in ADHD cases (26 minutes) being double that in control<sup>(17)</sup> also found that patients had delayed sleep onset and delayed awakening than their healthy siblings. This can be explained by the intake of stimulants as such treatment group showed longer sleep latency.<sup>(18)</sup>

In the current there was more sleep insufficiency in cases than in control with statistically significant difference ( $P= 0.000$ ), likewise, parents of ADHD cases reported fatigue on waking up, day time sleepiness and lack of deep sleep in children with ADHD, Vaidyanathan<sup>(19)</sup> which was explained by the change in the sleep structure.

The current study revealed that cases with ADHD had slightly shorter stage 3 and 4 durations and nearly equal SWS latency than in the control group with statistically significant difference ( $P= 0.000$ ). Contrarily, Ringli and colleagues (2013)<sup>(20)</sup> found slow wave sleep prolongation more in cases than in controls with less mature topographic distribution reflecting the neuroanatomical delay in patients. Also, Bernal Lafuente and colleagues (2004)<sup>(21)</sup> found increased slow wave sleep and stage 3 in ADHD cases which might be explained by alteration in dopamine and adrenaline transmission.

The current study revealed that cases with ADHD had slightly longer REM duration and shorter REM latency than in the control group with statistically significant difference ( $P= 0.000$ ). Agreeing with the current study's data, Kirov and colleagues (2004)<sup>(22)</sup> showed a significant increase in the duration of the absolute REM sleep, and a shorter REM latency which can cause increased frequency of sleep- wake cycles and may also contribute to an increased duration of the absolute REM sleep. And this can be explained by the disturbance in monoamines and cortical inhibitory control in ADHD. Though various studies reflected on contradicting findings on the REM sleep in ADHD (Spruyt and Gozal, 2011)<sup>(23)</sup> found differences in eye movements in REM sleep in ADHD cases.

The study showed increased arousal in cases group compared to the control (mean of 4.04 versus 0.3 respectively) with linear correlation (positive correlation) with Conner's scale scores with statistically significant difference ( $P= 0.000$ ). Studies showed motor restlessness in ha

If the sampled ADHD children with higher interrupted sleep, confusional arousals than in those without ADHD.<sup>(24)</sup>

The current study found that cases reported higher index of periodic leg movement than controls did (mean of 0.14 versus 0.4 respectively) with statistically significant difference ( $P= 0.000$ ), which agrees with studies that reported the existence of PLM in 26% of ADHD children compared 1.2% in children with sleep problems risks.<sup>(25)</sup>

Also, Chervin RD et.al.<sup>(26)</sup> stated the strong co- occurrence of PLM in ADHD with high arousal associated, and Picchiatti and colleagues<sup>(27)</sup> reported higher PLMD and decreased sleep duration by 40 minutes than in controls. Also, a meta- analysis study by Sadeh and colleagues<sup>(28)</sup> revealed that children with ADHD are more prone to PLM than controls and highlighted factors like age, gender, inclusion of adaptation night, and co- morbidity play a moderating role. The association between ADHD and PLMD is explained by sharing common dopamine deficit where children treated by levodopa or dopamine agonist pergolide scored improved symptoms of both.<sup>(29)</sup> This can be explained by the common symptoms shared in PLMS and ADHD due to having dopamine production and metabolism deficiency.<sup>(30)</sup>

**(Sleep Profile in Children With Attention ...)**

### **Conclusion:**

There is a high co- occurrence of sleep problems among children with ADHD that minimally 65.62% of ADHD cases have at least one sleep disturbance type. The findings of the current research demonstrated that there was a statistically significant difference between cases and control groups considering all items of sleep profile. There was more sleep insufficiency in cases than in control with statistically significant difference. Cases with ADHD had slightly longer REM duration and shorter REM latency than in the control group with statistically. The study showed increased arousal in cases group compared to the control also higher index of periodic leg movement than controls.

### **Recommendations:**

1. For children with ADHD, management of insomnia by sleep hygiene techniques and behavioral modifications can reduce daytime sleepiness, inattention and irritability.
2. Future studies should include a larger number of participants to be able to generalize the findings and linking the results of the clinical study with the results of laboratory and imaging tests and studies of electrical brain planning.

### **Limitations:**

The research recruited limited number of participants that limits its generalization. The study didn't discuss the relationship between medication types and doses given and their impact on the sleep study and habit.

### **Conflict of Interest:**

The authors declare no conflict of interest.

### **Acknowledgement:**

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