

The Impact of a Sleep Hygiene Intervention on Sleep Habits in Children with Attention Deficit/Hyperactivity Disorder

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Abstract

Background

Attention Deficit/Hyperactivity Disorder (ADHD) is one of the most common neurodevelopmental disorders of childhood. Up to 50% of these children suffer from at least one comorbid sleep disorder. Considering the deleterious effects of sleep problems on all aspects of children's life, this study was designed to investigate the impact of a sleep hygiene intervention on sleep habits in children with ADHD and comorbid sleep disorders.

Materials and Methods

This randomized controlled trial, was conducted on 62 children aged 7 to 13 years with diagnosis of ADHD and comorbid sleep disorders. Children's Sleep Habits Questionnaire (CSHQ) was completed by children's mothers and then the participants allocated randomly into experimental (n=28) and control (n=28) groups. Mothers of the children in experimental group received a sleep hygiene educational intervention which was delivered through a training session and a booklet followed by two telephone calls and educational text messages. Participants in the control group received usual clinical care. The post-test was performed two months after intervention.

Results

56 children (case and control groups) completed the survey (mean age 8.62 ± 1.57 years). Data analysis showed that, compared with control children, experimental children had a significant-reduction in mean scores of Bedtime resistance ($P < 0.05$), Sleep onset delay ($P < 0.05$), Sleep duration ($P < 0.05$), Sleep anxiety ($P < 0.05$), Daytime sleepiness ($P < 0.05$) and total score of CSHQ ($P < 0.05$), after controlling pre-test.

Conclusion

The sleep hygiene intervention improved sleep problems in a sample of children with ADHD by parent report. The findings of this study support the design, implementation and evaluation of educational programs on good sleep-hygiene practices for children and adolescents.

Key Words: Attention deficit-hyperactivity disorder (ADHD), Children, Sleep Hygiene, Training.

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1- INTRODUCTION

Attention Deficit/Hyperactivity Disorder (ADHD) is one of the most common psychiatric disorders of childhood (1, 2). According to the diagnostic and statistical manual of mental disorders, fourth edition-text revised (DSM-IV-TR), ADHD has described as a neurodevelopmental disorder (NDD) by age-inappropriate level of inattention, impulsivity and hyperactivity (3).

The worldwide prevalence of ADHD in children and adolescents is approximated at about 5.3% (4). ADHD could cause impairment in many aspects of children's lives, including their academic performance, social and emotional functioning (5), and quality of life (6). In addition, the problems of children with ADHD have a significant impact on family function (7). Besides, ADHD is associated with developmental and cognitive dysfunctions and numerous health hazards (8). Sleep is a complex neurologic function that requires a normal central nervous system, therefore, sleep difficulties are even more common in children suffering from neurodevelopmental disabilities (NDDs) (9), including ADHD (10). Sleep problems are prevalent among children with ADHD (11, 12), by 2-3 times (13) and sometimes up to 5 times more likely than healthy children (14). So that, up to 50% of parents of these children report difficulties with their children's sleep (15). The majority of these problems are typically behavioral in nature (12, 16).

The mechanisms causing sleep problems in children with ADHD are intricate and appear multifactorial (15). ADHD and sleep problems are regulated by the central nervous system (CNS), hence there is a strong neurobiological overlap (15, 17) and their relationship is likely bidirectional (15, 18). The main sleep problems reported in children with ADHD include difficulties in initiating sleep, Maintaining Sleep, tiredness on waking and daytime

sleepiness (11, 12, 15). Insufficient or inefficient sleep has deleterious potential subsequences on children's cognitive development, mood regulation, attention, and behavior, as well as health and overall quality of life (9, 19). Moreover, these children suffer from more behavioral, emotional, and social problems and have more difficulties with school attendance (11). Furthermore, studies have documented secondary effects on health and well-being of parents and family functioning (19, 20). Even more, ADHD severity deteriorate in the presence of sleep problems (12, 21).

A number of treatment strategies to manage sleep disorders in children exist, including behavioral interventions (behavior management techniques and sleep hygiene) and medications (19, 22). With considering the efficiency of behavioral strategies in long term, the first line of treatment for sleep difficulties in both typically developing children and those with NDDs is to improve their sleep hygiene (9, 23). Sleep hygiene encompasses a set of behaviors, environmental conditions, and other sleep-related factors that can be used as a stand-alone treatment or component of multimodal treatment for patients suffering from sleep disorders (24). The sleep promotion activities can be classified into four categories: environmental factors, scheduling, sleep practices and physiologic factors (9, 20, 24).

Although, the mechanisms that sleep hygiene promotes sleep are not completely recognized yet, it is obvious that without proper sleep-promoting strategies, sleep patterns often deviate from developmentally appropriate norms (25). Therefore, behavioral interventions and sleep hygiene should be part of a multi-sectional management program in every ADHD treatment package (22, 26) and have been recommended as a preventive or therapeutic strategy for sleep problems

(20). According to the above discussion, this study aimed to investigate the efficacy of a training program in good sleep hygiene practices on the sleep habits in children with ADHD and comorbid sleep disorders.

2- MATERIALS AND METHODS

2-1. Participants and design

This study was a clinical trial (IRCT2016100830212N1) with a pretest-posttest control group design, and random assignment. The study population included 62 children aged 7 to 13 years with the diagnosis of ADHD and comorbid sleep disorders and their mothers, with 95% confidence interval (CI) and the power of a hypothesis test was 95%. Participants were selected by the convenience sampling from patients who had referred to Ali-Asghar Children's Hospital, and Tehran Institute of Psychiatry (between July 2015 and October 2015), Tehran- Iran. Eligible patients (n=62) were randomly allocated to two matched groups, experimental (n=31) and control (n=31).

The inclusion criteria included age of 7 to 13 years, having ADHD diagnosis based on the DSM-VI-TR criteria, and having at least one sleep disorder formally confirmed by a child psychiatrist. Furthermore, all the participants continued their medical treatment process normally. The exclusion criteria consisted of suffering from an acute or chronic medical illness or mental disorder, and using medications for sleep disorders.

2-2. Ethical considerations

This study was approved by Research Ethics Committee of Faculty of Medical Sciences, Tarbiat Modares University Tehran, Iran (IR.TMU.REC.1394.63). After explaining the procedure of the study, written informed consent was also obtained from all mothers of the participants.

2-3. Data Collection

The data collection tools included:

- A demographic checklist and
- Children Sleep Habits Questionnaire (CSHQ).

This questionnaire is a retrospective parent-report sleep screening instrument designed for school-aged children. The questionnaire includes 35 items which grouped into eight subscales including: 1) Bedtime resistance, 2) Sleep onset delay, 3) Sleep duration, 4) Sleep anxiety, 5) Night waking, 6) Parasomnias, 7) Sleep-disordered breathing, 8) Daytime sleepiness.

Items were rated on a three-point Likert-scale: "rarely (0-1 times a week): 1 score", "sometimes (2-4 times a week): 2 score", and "usually (5-7 times a week): 3 score", with higher scores indicative of greater sleep disturbance. Total sleep disturbance score included all items of the eight subscales, but consisted of only 33 items because two of the items on the Bedtime resistance and Sleep anxiety subscales were identical (27). Validity evidence for this scale has been reported by Shoghy et al. and reliability of this test was calculated at 0.97 using Cronbach's alpha in their study (28).

2-4. Educational program

At the baseline, the pretest was performed on both the experimental and control group. Then the educational intervention was conducted for the mothers of children in the experimental group. The intervention plan, based on the study predetermined objectives, included:

2-4-1. Training session

The therapy session was held for 135 minutes and included key information on: **a)** nature of sleep and normal sleep patterns; **b)** the importance of sleep in children and age appropriate amounts of sleep; **c)** common sleep disorders among

children with ADHD; **d**) the concept of "sleep hygiene" and its categories; **e**) self-settling techniques; **f**) sleep diary (**Table.1**). Then the mothers were trained about the step-by-step implementation of sleep hygiene strategies known to be effective in typically developing children, and how to use visual schedules accompany with their children before bedtime, during the next eight weeks.

4-2-2. Educational package

The educational package contained: **a**) an instructional booklet about sleep health, provided based on text books, articles, guidelines and other related resources under supervision of a pediatric psychiatrist, tailored to the needs of participants and according to the study objectives, in 12 chapters with two attachments for both mothers and children, **b**) visual schedules or to-do-lists and stickers (a visual schedule is a set of pictures that shows what happens during a particular period of time and can help break down a task that has many steps. This helps some children feel less anxious and be more flexible), and **c**) Incentive awards for the children.

4-2-3. Telephone calls

Two follow up telephone calls were made at the third and fifth weeks after intervention to reinforce the suggested techniques, assessment the participant's progress to establish a good sleep hygiene program for their children, and troubleshoot any problems to use the

instructional booklet and finding alternative applicable strategies for mothers (i.e. dietary recommendations before bedtime or sequencing bedtime routines), whenever it was needed.

4-2-4. Weekly educational cell phone text messages

The messages contents were designed based on the study purposes by the research team. Children in the control group received usual clinical care. The post-test was performed two months after the intervention. Mothers in both the experimental and control groups completed the CSHQ again at the clinic. For those who were unable to return to clinic we used e-mailed questionnaires.

2-5. Statistical Analysis

Data were analyzed using SPSS software (Version 19.0). According to the study design, which was pretest-posttest with control group, analysis of covariance (ANCOVA) was performed to compare the control group versus experimental group two months after intervention at a statistical significance level of $\alpha=0.05$. The assumptions underlying the ANCOVA were met. The normality assumption was checked by Kolmogorov-Smirnov test. The assumption of homogeneity of variance was tested using Levene's test of equality of variances. Furthermore, the assumptions of homogeneity of regression slopes and linearity of regression were tested and confirmed.

Table-1: Training sessions of Sleep Hygiene

Categories	Subsets
Environmental factors	Ambient light, humidity, bedroom ventilation, temperature, noise level, bedroom decoration, bedding and family atmosphere.
Scheduling	Regular sleep/wake schedule.
Sleep practices	Establishing a perfect bedtime routine.
Physiologic factors	Exercise, diet and timing of meals, caffeine use, relaxation techniques, sunlight exposure and taking a bath.

3- RESULTS

Three members of the experimental group and three members of the control group were excluded for various reasons, including absenteeism from the educational session, and no participation in posttest. Finally, 28 patients in the experimental group and 28 patients in the control group completed the survey. The mean age of the participants was 8.71 ± 1.56 years (ranged 7-13), and 78.6% were boys and 21.4% girls. The Chi-square test results showed that no statistically significant differences between the experimental and control groups in terms of demographic variables (**Table.2**). In other words, two groups were matched perfectly in basic characteristics.

The means and standard deviation (SD) of pretest and posttest scores in both groups are presented in **Table.3**. The impact of sleep hygiene education program on the Children Sleep Habits Questionnaire subscales in the experimental and control children was compared, after controlling the pretest. In this study, the independent variable was the training condition—whether the participants received the sleep

hygiene training or some without training, and the dependent variable was their CSHQ scores after receiving the training. The covariate variable was the participants CSHQ scores in the pretest. The ANCOVA results are shown in **Tables.4, 5**.

The analysis showed statistically significant differences between the scores of pretest in the experimental and control groups regarding several subscales including Bedtime resistance ($F= 51.485$, $P= 0.001$), Sleep onset latency ($F= 8.988$, $P= 0.004$), Sleep duration ($F= 7.438$, $P= 0.009$), Sleep anxiety ($F= 33.487$, $P= 0.001$), Daytime sleepiness ($F= 5.030$, $P= 0.029$) and CSHQ total score ($F= 28.917$, $P= 0.001$) after controlling pretest. This means that the intervention had effectively improved the children's sleep problems in the experimental group (**Figure.1**).

However, the findings did not indicate significant differences in the posttest scores of other subscales (Sleep waking, Parasomnias, Sleep breathing disorder) in the experimental group, comparing with the control group ($P > 0.05$).

Table-2: Demographic characteristics of children in experimental and control groups

Characteristics	Experimental group	Control group	P-value
Children			
Age	8.64 ± 1.44	8.79 ± 1.70	0.922
Gender			
Male	21 (75)	23 (82.1)	0.515
Female	7 (25)	5 (17.9)	
Medication use	18 (64.3)	20 (71.4)	0.567
Mothers			
Academic status			
Completed high school	16 (57.1)	19 (67.8)	0.675
College or postgraduate degree	12 (42.9)	9 (32.2)	
Occupation status			
Employed	7 (25)	9 (32.2)	0.759
Housewife	21 (75)	19 (67.8)	
Family			
Siblings with ADHD	8 (28.6)	6 (21.4)	0.537
Economic status			

Poor	6 (21.4)	4 (14.3)	0.766
Average	14 (50)	16 (57.1)	
Good	8 (28.6)	8 (28.6)	

*Data are presented as mean± standard deviation (SD), or Number (%).

Table-3: Mean and standard deviation of CSHQ subscales scores in experimental and control groups

Variables	Experimental group		Control group	
	Pretest	Post-test	Pretest	Post-test
Bedtime resistance	14.29±2.96	11.36±2.18	13.36±2.24	13.57±2.28
Sleep onset latency	2.64±0.48	2.36±0.55	2.71±0.53	2.75±0.44
Sleep duration	6.04±1.47	5.50±1.20	5.43±1.39	5.50±1.23
Sleep anxiety	8.89±2.20	7.21±1.57	7.46±2.20	7.54±1.95
Sleep waking	4.79±1.50	4.57±1.13	4.68±1.46	4.68±1.18
Parasomnias	10.14±1.20	10.11±1.03	9.18±1.49	9.39±1.28
Sleep breathing disorder	3.46±0.63	3.50±0.63	3.43±0.63	3.39±0.56
Daytime sleepiness	15.36±2.88	14.64±2.76	15.32±3.33	15.39±3.11
Total score of CSHQ	61.36±7.23	55.89±5.87	57.93±6.59	58.46±6.28

*Data are presented as mean± standard deviation (SD).

Table-4: Analysis of covariance results on the variables of CSHQ subscales in experimental and control groups after controlling the pretest

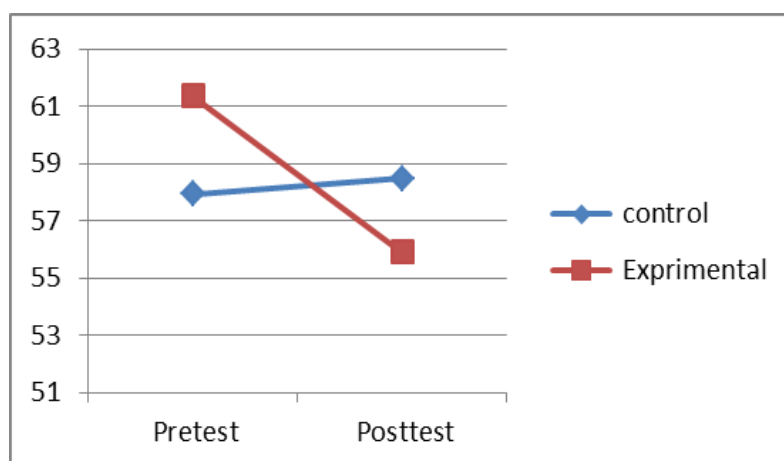
Variables	SS	df	SM	F	P-value	Eta-squared
Bedtime resistance						
(Pretest)	158.382	1	158.382	75.689	0.001	0.588
Group	107.735	1	107.735	51.485	0.001	0.493
Sleep onset latency						
(Pretest)	3.053	1	3.053	15.231	0.001	0.223
Group	1.802	1	1.802	8.988	0.004	0.145
Sleep duration						
(Pretest)	60.867	1	60.867	168.608	0.001	0.761
Group	2.685	1	2.685	7.438	0.009	0.123
Sleep anxiety						
(Pretest)	130.355	1	130.355	195.579	0.001	0.787
Group	22.319	1	22.319	33.487	0.001	0.387
Sleep waking						
(Pretest)	57.331	1	57.331	194.364	0.001	0.768
Group	0.461	1	0.461	1.563	0.217	0.029
Parasomnias						
(Pretest)	54.443	1	54.443	152.446	0.001	0.722
Group	0.001	1	0.001	0.357	0.994	0.001
Sleep breathing disorder						
(Pretest)	11.419	1	11.419	73.280	0.001	0.580
Group	0.092	1	0.092	0.593	0.445	0.011
Daytime sleepiness						
(Pretest)	379.284	1	379.284	379.284	0.001	0.809
Group	8.525	1	8.525	8.525	0.029	0.087

* Abbreviations: df: Degree of Freedom; SM: Sum of Means; SS: Sum of Squares.

Table-5: Analysis of covariance results on the variable of CSHQ total outcome in experimental and control groups after controlling the pretest ^a

Variables	SS	Df	SM	F	P-value	Eta-squared
Total score of CSHQ						
(Pretest)	1376.78	1	1376.78	117.531	0.001	0.689
Group	338.736	1	338.736	28.917	0.001	0.353
Error	620.854	53	11.714			
Total	2090.21	55				

^a Abbreviations: df: Degree of Freedom; SM: Sum of Means; SS: Sum of Squares.

**Fig.1:** Results of groups in the pretest and posttest of CSHQ total scores

4- DISCUSSION

Given the high prevalence of sleep disorders in children with ADHD, this study was aimed to evaluate the impact of sleep hygiene education on the sleep habits of children aged 7 to 13 years with the diagnosis of attention deficit/ hyperactivity disorder and comorbid sleep disorders. The results showed that intervention was effective on improving sleep problems in children with ADHD. The efficacy of behavioral interventions and sleep hygiene educational programs on sleep disorders has been investigated and confirmed in various studies. The results of Mindell et al. study emphasis on the association between good sleep hygiene practices and better sleep (22). LeBourgeois et al. showed that compared with American children, Italian children had better sleep hygiene, and consequently, had higher

sleep quality (29). Papadopoulos et al. in a study entitled "The impact of a brief behavioral sleep intervention in school-aged children with ADHD and comorbid Autism Spectrum disorder" confirmed the efficiency of a behavioral sleep intervention on sleep disorders in children with ADHD and comorbid Autism Spectrum disorder (30). Paavonen et al. assessed the effectiveness of a brief behavioral sleep intervention for adolescents and found that three weeks post-intervention self-reported sleep duration, sleep quality and sleep latency were improved (31). A study performed by Tan et al. to examine the efficiency of a sleep hygiene intervention for youth aged 10-18 years with problematic sleep indicated that 20 weeks after intervention, sleep quality was improved according to Pittsburgh Sleep Quality Index (PSQI) and

Sleep Disturbances Scale for Children (SDSC) (32). Hiscock et al. in a study entitled "Impact of a behavioral sleep intervention on symptoms and sleep in children with ADHD, and parental mental health: Randomised controlled trial" revealed that compared with control children, experimental children had fewer moderate-severe sleep problems after three months (56% vs. 30%) and six months (46% vs. 34%) post-intervention (33).

Although, the above-mentioned studies have been done in different ways and in diverse populations, the results were almost identical, which correspond with the findings of the current study in a population of Iranian children with ADHD. Due to the extensive and significant impacts of sleep disorders in children, the development of empirically supported treatment strategies and clinical guidelines for the management of sleep problems in children is necessary (19). Behavioral and sleep hygiene interventions have been used successfully for the treatment of a wide range of sleep disorders and are the treatment of choice for many of the most common pediatric sleep problems (34). Therefore, since the majority of sleep issues in children with ADHD are typically behavioral in nature (12, 16), and the fact that the first step to manage these problems should be behavioral interventions, so through the current study to target the sleep problems of children in experimental group, we attempted to train and enable mothers to play an active role to improve sleep patterns, sleep habits and sleep related behaviors of their children. Thus, with increasing maternal knowledge about sleep process, sleep importance, consequences of pediatric sleep problems and acquiring skills for implementing good sleep habits practices as a part of behavioral strategies for managing sleep problems, they reported improvement in their children's sleep problems according to the Children

Sleep Habits Questionnaire. So that, two months after the intervention, compared with control children, intervention children had a significant reduction in the mean scores of five subscales of CSHQ including Bedtime resistance, Sleep onset delay, Sleep duration, Sleep anxiety, Daytime sleepiness and total score of CSHQ, after controlling pretest.

In explaining the study results, it is to be noted that five subscales of Children Sleep Habits Questionnaire (CSHQ), which the educational program could affect them, categorized in the scope of extrinsic sleep disorders (dependent on external factors) (35); hence, the intervention through promoting sleep hygiene practices (doing behaviors that facilitate sleep and avoid behaviors interfering with sleep) could succeed in modifying these problems. Lack of the intervention effectiveness in improving Sleep breathing disorder subscale could be due to this reason that this subscale is categorized in the scope of intrinsic (dependent on internal and pathophysiologic factors) sleep disorders (35). Thus, modifying the external agents, does not necessarily have a substantial role on the disorder process.

Likewise, about the parasomnia subscale, since the problems, which classified entitled this category, occur because of impairments in sleep stages (owing to internal reasons) (35); therefore, manipulating the external factors that affect children's sleep would not have significant impact. Moreover, since two effective factors, Sleep breathing disorder and parasomnia, in children's sleep waking do not have significant reduction post-intervention, this could explain why the sleep waking did not improve in posttest.

4-1. Limitations of the study

We measured sleep by parent report which may have biased results toward more favorable responses, because they could not be blinded.

5- CONCLUSION

In summary, our findings showed that a sleep hygiene educational intervention could be effective in improving sleep habits in children with ADHD. These findings suggest that clinical management of sleep issues can procure benefits for the considerable number of children with ADHD who have behavioral sleep disorders. The results of this study support the planning, implementation and evaluation of educational programs on good sleep hygiene practices for children.

6- CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

7- ACKNOWLEDGMENTS

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