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Evaluation of sleep-disordered breathing in children and adolescents referred to the sleep ward of Qazvin children's hospital during 2014-2019

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Abstract

Background: Polysomnography is a gold standard method for examination of information obtained from physiological changes in the body related to sleep. The aim of this study was to diagnose respiratory disorders in children and adolescents with sleep disorders by the use of polysomnography.

Methods: The sample of this cross-sectional retrospective study included 112 children and adolescents aged 0-18 years who were referred to the sleep ward of Qazvin children's hospital due to sleep disorders. After recording the participants' comprehensive demographic and medical history, questionnaires regarding their sleep history were filled in by their parents. Then the results of polysomnography and severity of obstructive sleep apnea (OSA) were identified. SPSS 21 software and frequency tables were used to determine the prevalence of the variables.

Results: The most common sleep disorder was restless sleep (68; 60.71%). One hundred and four (92.85%) patients had sleep apnea. Also, 66 (58.92%) patients with severe OSA, 19 (16.96%) patients with moderate OSA, 14 (12.5%) patients with mild OSA and 5 (4.46%) patients with central sleep apnea were observed. Eighty eight (78.57%) children had less than normal sleep efficiency (less than 90%) and 34 (30.35%) had normal and desirable sleep efficiency. Total adenotonsillectomy, medical therapy for OSA and non-invasive ventilation (NIV) were recommended for 46 (41.7%), 27 (24.10%) and 20 (17.85%) patients, respectively.

Conclusion: Symptoms of respiratory disorders during sleep were seen in our results, especially in children with a history of adenotonsillectomy. Based on the severity of symptoms, medication was prescribed for children. Referral of children suspected of sleep disorder to a physician is essential for control and treatment of this disease.

Key Words: Adolescents, Children, Polysomnography, Sleep-Disordered Breathing.

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1- INTRODUCTION

Sleep is an important regulator of growth, metabolism, tissue repair, cell division, endocrine dissection, and immunological function of the body. Any acute sleep disturbance and subsequent quantitative or qualitative disturbances in children can impair the functioning of the immune system, cardiovascular, endocrine, respiratory and nervous systems; with the continuation of chronic sleep disturbance, the child's physical development, academic, behavioral and cognitive performance are affected (1-4). Depression, anxiety, learning and psychological problems and increasing the chance of accidents are among the complications of insomnia (5-7). Therefore, sleep disorders in children can impair the quality of life of children and families (8, 9). Sleep disordered breathing (SDB) is defined as upper airway dysfunction syndrome during sleep. It is characterized by snoring or increased respiratory effort due to increased upper airway resistance. Its phenotypic spectrum includes primary snoring, airway resistance syndrome, obstructive sleep apnea (OSA), and hypoventilation (10). SDB prevalence in >2.5 years old children is observed with the rate of 42% (8). Also in children with ages ranging from 2 to 16 years, the prevalence of SDB was detected with the rate of 9.7% (9). The peak prevalence of OSA, in the pediatric population, is among 2-8 year-old children with a rate of 1-5%. Adenotonsillar hypertrophy is the main cause of OSA in the early age (10-12). Various epidemiological studies show that more than 20% of children experience sleep problems (12). According to reports, 10-75% of children around the world have sleep disorders, ranging from a simple resistance to falling asleep, maintaining sleep, recurrent parasomnia awakenings to subsequent and dangerous events such as respiratory illnesses, especially OSA (13, 14). Daily symptoms of sleep disorders are much milder and include behavioral hyperactivity, difficulty concentrating and learning, morning headaches, daytime sleepiness, and failure to thrive (FTT) (1, 15).

Parsapour et al., in Iran, showed that among 120 children (aged 1 to 15 years old), 88.8% had shown snoring. Also, 90.0% of them had no family history of insomnia. Finally, 107 children were confirmed with sleep disorder (16). Ozgoli et al., in Iran, reported that the mean age of children with sleep disorders was 64.27±9.3 months and the prevalence of sleep disorders was 36.25%. Sleep disorders were significantly associated with age, height, body mass index (BMI), children's place of residence, father's occupation, mother's illness, father's drug use, and parents' marital status (17). In another study in Iran, Javadi et al. reported that from among 579 children aged 3-6 years old, the prevalence of awakening during the night, SDB and snoring was 13.9%, 1.2% and 2.7%, respectively (1). In a study conducted by Liu et al., in China, 8.3% of teens snorted loudly at least once a week and 1.2% snored almost every night (18).

Respiratory sleep disorders can lead to intermittent hypoxia, hypercapnia, intrathoracic pressure fluctuations, and sleep apnea. These physiological changes activated inflammatory responses, oxidative stress responses, resulting in cell damage, dysfunction, and even death. Given the irreversible side effects of untreated sleep apnea in children, as well as the low sensitivity and specificity of history and physical examination to diagnose OSA, American academy of pediatrics (AAP) recommends a gold standard for diagnosing OSA during research; performing a nocturnal polysomnography in the laboratory. It is the most commonly used test in the diagnosis of OSA. It can be used for

diagnosing other sleep disorders, too (1, 17, 18).

Sleep disorders are one of the most important problems in children, while many parents are unaware of them. Symptoms of these disorders are also unknown to many families. Simultaneous monitoring and recording of physiological parameters of the body during sleep are recorded by polysomnography. This procedure is performed in a rare number of medical centers in Iran and will provide symptoms of sleep disorders and appropriate treatment to physicians and parents. Therefore, due to the need for timely diagnosis and treatment of OSA in children referred with sleep disorders, the aim of this study was to diagnose SDB in children and adolescents referred to the sleep ward of children's hospital in Qazvin.

2- MATERIALS AND METHODS

The participants of this descriptive-retrospective cross-sectional study included 121 children and adolescents in the age range of 0-18 years who referred to the sleep center of Quds hospital in Qazvin from 2014-2019 to study sleep disorders, and for them polysomnography (DevilbiSS, USA and Resmed, Germany) were recommended (ethics code IR.QUMS.REC.1399.075). Parents of the above children were advised to bathe their children before attending the sleep center and to adjust their sleep and wake programs so that they sleep the night before the polysomnography. Children were taught not to sleep during the day. They were also advised to have a light dinner and to be in the hospital's sleeping ward 4 hours before the test. With the presence of the child and parents in the sleep ward and before performing polysomnography, a file was created for the above clients and with complete information of the child, the main problem during sleep, previous medical treatment history, family history, medical history and type of nutrition, diagnosis and treatment measures performed, referring to physician, causes of referral as well as clinical examination findings such as vital signs, weight, height, body mass index (BMI), and their growth status (normal or abnormal growth) were recorded in the file. Moreover, according to the age of the children referred, questionnaires were filled in by their parents regarding their sleep history such as normal child's sleep time, average 24-hour sleep duration, average duration of daily naps, sleep disorders and sleep habits. After recording all the required formation in terms of the child's sleep history and clinical examinations, necessary explanations and preparations were provided on how to perform the test. The test room was also prepared with a bed suitable for the child's age, and standard space with access to the bathroom/toilet; and the decoration of the test room was tried to be similar to the child's bedroom at home. The room temperature was set and absolute silence ruled over it, and after that, polysomnography was performed. At this part, gold electrodes and sensors included electroencephalography (EEG) electrodes of at least 8 strands, electrooculography (EMG) of the chin and limbs of at least 6 strands, electrocardiogram (ECG) electrodes of at least two strands, and a sensor of hoof and sensor. Two types of heat and pressure, arterial blood oxygen saturation sensor, abdominal and chest motion sensors to monitor respiratory effort, audio-visual snoring recording and body position sensors based on the latest recommendations of the American Academy of Sleep Medicine (AASM) were connected by a specialist nurse. The patients then went to bed at home, according to their usual hours of sleep. After turning off the light, the test started and continued for each case for an average of 400 minutes (6-7 hours) and ended in the morning with the light on (19, 20). The analysis of the recorded data was performed by the polysomnography device

by the sleep fellowship physician of the center, manually and according to AASM standards. Information on respiratory diseases and their severity, apnea-hypopnea index during sleep (number per hour) and number of respiratory events (obstructive apnea, central apnea, mixed apnea and hypopnea) were examined (21, 15). Apnea refers to a drop; equal or more than 90% of nasopharyngeal airflow relative to baseline. In the obstructive type, apnea is accompanied by continued respiratory effort of the chest and abdominal muscles. There is no respiratory effort in the central type, but in the mix apnea, the first part is central respiratory arrest and the second part is obstructive (18).

The apnoea–hypopnoea index (AHI) refers to the number of apneas and hypopneas that occur during sleep, and are used to assess the severity of sleep apnea. The number of apneas / hypopneas per hour is used to assess the severity of OSA: Less than 1 per hour, 1-4 per hour, 5-10 per hour and more than 10 per hour are classified as normal, mild, moderate and severe AHI, respectively (22).

The information was entered into the statistical package for the social sciences (SPSS) 2021 software, and then the frequency distribution table was used to obtain the frequency and prevalence of variables.

3-RESULTS

Nine of the above children were excluded from the investigation for various reasons, such as incomplete information in the case file. Statistical values of respiratory disorders were presented as frequencies. Among the remaining 112 children in the study, 73 (65.17%) were boys and 39 (34.82%) were girls. The age range of the studied children was from 3 months to 16 years, with a mean age of 5.82 years. Among them, 12 (10.71%) patients were under 2 years old, 59 (52.67%) patients in the period of 2-6 years, 39 (34.82%) patients in the age range of 7-12 years, and 2 (1.78%) patients were over 12 years old. The prevalence of respiratory disorders identified in this study is presented in **Table 1**.

Simultaneous monitoring and recording of physiological parameters of the body during nighttime sleep were conducted in this study by polysomnography. Changes in different body parameters and different stages of sleep are shown in **Table 2**.

Only 8 (7.14%) of the children studied did not have any respiratory apnea. 102 (91.7%) had lower than normal blood oxygen levels and 10 (8.92%) had good oxygen levels. Also, 88 (78.57%) of the subjects had less than normal sleep efficiency (less than 90%) and 34 (30.35%) had normal and desirable sleep efficiency. Seventy five (66.96%) of the children also had short-term arousal sleep disorders, 5 of them (4.46%) had a history of adenotonsillectomy due to respiratory disorders following adenotonsillar hypertrophy.

Based on the results obtained from polysomnography, considering the main and first clinical diagnosis, the severity of symptoms, the presence of risk factors, comorbidities, clinical findings and a history of previous adenotonsillectomy in patients, medical treatment including total adenotonsillectomy, previous medical therapy for OSA and non-invasive ventilation (NIV) were recommended for 46 (41.7%), 27 (24.10%) and 20 (17.85%) of patients, respectively.

4- DISCUSSION

Children with respiratory problems and other diseases which are associated with serious sleep disorders are generally recommended for polysomnography (18, 19). From among 112 children and adolescents in this study, 65.17% were boys and 34.82% were girls.

Table-1: Distribution of respiratory disorders in children and adolescents with SDB

Respiratory disorders	Frequency	Prevalence (%)
Restless sleep	68	60.71
Snoring	56	50
Mouth breathing	46	36.60
Night sweating	27	24.10
Witness apnea	26	23.21
Frequent waking during night	14	12.50
Cyanosis and daytime sleepiness	13	11.60
Enuresis	12	10.71
Sleep walking	7	6.52
breath pause	4	3.57
Night terror	4	3.57
Night mare	4	3.57
Sleep talking	4	3.57
Daytime fatigue	4	3.57
Low weight gain	3	2.67
frequent body movement	3	2.67
Dry mouth	3	2.67
Limb jerk during sleep	3	2.67
Fragmented sleep	2	1.78
Behavioral and school performance impairment	2	1.78
Fear of falling asleep	1	0.89
Abnormal behavior	1	0.89
Morning headache	1	0.89
Headache	1	0.89
Head drop	1	0.89
Feeling uncomfortable in the legs at night	1	0.89
Unusual sleep habits	1	0.89
Nasal speech, amnesia to events	1	0.89
Productive cough	1	0.89
Chronic sinusitis	1	0.89
Whooping cough	1	0.89
Stridor	1	0.89

Table-2: Polysomnography results in children and adolescents with SDB

Respiratory disorders	Frequency	Prevalence (%)
Sleep apnea.	104	92.85
OSA / Hypopnea	99	88.39
OSA	66	58.92
Moderate OSA	19	16.96
Mild OSA	14	12.5
Central sleep apnea	5	4.46

The most common respiratory disorder identified in this study was restless sleep (68 patients; 71.60%), also less frequent respiratory disorders were fear of falling asleep, abnormal behavior, morning headache, headache, head drop, feeling uncomfortable in the legs at night, unusual sleep habit, nasal speech amnesia to events, productive cough, chronic sinusitis, whooping cough and stridor (each one 1 patient; 0.89%). In 2010, a study was conducted in Brazil on the 330 children who referred to the clinical laboratory, and were examined for sleep disorders using the sleep disorders scale for children. SDB (55%) was more common in children. The prevalence of sleep hyperhidrosis (SHY) was 27%. Sleep disorders were more common in boys of lower socioeconomic status (23). Parents of many children, especially those with lower economic and social status, were unaware of their children's sleep disorders and therefore did not see a doctor for evaluation and treatment of these disorders. Due to the fact that sometimes the lack of timely diagnosis and treatment of these disorders in childhood can cause serious and even irreversible complications for the child during life, it is necessary to provide sufficient information and education about the symptoms and complications of the disorder to parents. In this study, as in our study, the prevalence of sleep disorders was higher in boys. This may be due to hormones and different sleep mechanisms in boys in comparison to girls (21-23). In a study performed in 2020 in India by Narasimhan et al., 450 children were surveyed. Sleep Disturbance Scale for Children (SDSC) was used to collect information on sleep disorders. A percentage of 72.2% of children slept 9-11 hours a day. Sleep problems were present in 34% of the participants. A history of sleep problems in infancy, the absence of siblings, and the presence of parents at bedtime were identified as risk factors for childhood sleep disorders (24).

In another study performed in 2021, 283 children (12-83 months) from eight countries were studied by Vasileva et al. in Australia. In children with sleep disorders, the concomitant prevalence of mental disorders with sleep disorders was generally 20.1%. Also, a number of children with sleep disorders had hyperactivity (4.3%), anxiety disorder (8.5%) and depression (1.1%) at the same time. Vasileva's study showed that a significant number of young children have mental disorders that require age-appropriate treatments (25).

Risk factors for sleep disorders include obesity, the severity of OSA before surgery, age (higher risk in children over 7 years old), underlying asthma or allergic rhinitis. Ethnicity and genetic diseases (such as autism and chromosomal disorders) and neuromuscular diseases are also among the factors contributing to higher risks and can affect the prevalence and type of disorders in other parts of the world (24-26). Other factors include sleep disorders such as stress and anxiety, disturbed thoughts, depression and addiction. Usually people with this problem do not have qualified sleep or have difficulty sleeping; this can cause them to feel tired or bored during the day, and if left untreated, it can negatively affect their academic performance, employment, and relationships (26, 27). In the polysomnographic survey in our study, 92.85% had sleep apnea and OSA/hypopnea was observed in 88.39% of patients. OSA occurs in 2-5.7% of children between the ages of 2 and 8 years, when enlargement of the adenoids and/or tonsils is common. It also occurs during adolescence, the most common cause of which is obesity. OSA should be recognized as a public health problem. Due to the increasing prevalence of this secondary disease following the increase in the rate of obesity in children, this disorder has an important impact on the development of the child from a behavioral

and neurodevelopmental perspective. This is especially important in children with secondary medical conditions. Therefore, it is very important to apply appropriate approaches for early diagnosis and treatment of OSA in children, with a multidisciplinary team including otorhinolaryngologist, respiratory medicine, pediatrics and clinical nutrition services (27-29).

Furthermore, in the present study, 58.92% of patients were diagnosed with severe OSA, 16.96% with moderate OSA, 12.5% with mild OSA and 4.46% with central sleep apnea. In 2003, de Carlos Villafranca et al. in Austria examined the common symptoms of sleep disorders in children with a mean age of 7.8 years with a polysomnographic diagnosis of OSA. In this study, 42%, 28.9% and 22.1% of children had mild, moderate, and severe OSA, respectively. In our study, children without apnea included 7.14% of children and the rest of them had apnea. In line with our results, de Carlos Villafranca et al. found that only 7.9% of children were without apnea and the rest of the children in the study had apnea (30). Most pediatric sleep specialists begin treatment with a diagnosis of moderate to severe OSA, but there are differing views on mild OSA. Regarding treatment recommendations in these children, it should be noted that the treatment decisions in them should not be guided, separately, from the results of polysomnography, but the overall clinical picture should be considered. Therefore, the severity of symptoms, examination findings, the presence of risk factors and the extent of comorbidities should be thoroughly evaluated before developing and implementing an individual treatment plan (12, 13). In the medical history of the studied children, 5 (4.46%) patients had a history of adenotonsillectomy due to respiratory disorders following adenotonsillar hypertrophy, which indicates that despite the fact, that adenotonsillectomy in children with OSA causes OSA improves in most of these children, but in a significant number of people who have surgery, OSA can persist. Unlike adults with OSA, adenotonsillectomy is the first-line treatment for OSA in children with adenotonsillar hypertrophy. Adenotonsillectomy has been shown to improve OSA in children with OSA; however, in a significant percentage of children after surgery, OSA may persist. For this reason, children who continue to have OSA after adenotonsillectomy, as well as those who have smaller or superior airway lymph adenoid tissues or prefer to have surgery, should not be operated on; NIV therapy is then recommended (NIV). It has been shown to be an effective treatment. In low-risk populations, the percentage of children with residual OSA is approximately 20-25%, while in high-risk populations it increases significantly. Therefore, clinicians should pay attention to this issue and re-evaluate those children who are at risk of surviving OSA after adenotonsillectomy. Trial therapy and the use of a variety of anti-inflammatory drugs such as leukotriene receptor antagonists (Montelukast and steroids) are used to treat children with mild OSA. Sleep hygiene, weight loss and lifestyle modification can also be effective in therapeutic success (12-15).

Therapeutic recommendations in our study included adenotonsillectomy for 46 patients, OSA Medical therapy for 27 patients, and NIV therapy for 20 patients. Sleep deprivation can have a negative effect on a child's energy, mood, concentration and health. In some cases, sleep disorders can also be a sign of a medical problem or other mental illnesses. These sleep problems may eventually go away with treatment for the underlying cause. When sleep disorders are not caused by another illness, it is important to receive diagnosis and treatment as soon as sleep

disorders are suspected. The negative effects of sleep disorders, if left untreated, can lead to more health consequences. These disorders can also affect your performance in the workplace, causing stress in personal relationships and disrupting your child's ability to perform daily tasks. Therefore, prescribing appropriate treatments and correct diagnostic methods is necessary (29, 30).

According to what has been said, sleep disorders in children are a serious problem that in addition to sleep affect other aspects of life and development of the child; so their identification and treatment in children is important. However, due to reasons such as insufficient knowledge about children's sleep disorders and its complications, most physicians only and mainly depend on the usual drug treatments. Considering the limited number of the centers of children's sleep disorders and the patients' financial or distance problems in referring to them, adequate training and comprehensive information in this regard should be given to the colleagues in general medicine and pediatricians.

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