Original Research

Obstructive Sleep Apnea Syndrome in Children Referred to a Sleep Clinic

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Abstract

Background and Objective: Failure in diagnosis and treatment of sleep apnea in children lead to physical and mental growth retardation, cardiopulmonary, and/or behavioral disorders. This study was aimed to evaluate polysomnographic (PSG) and clinical findings of sleep apnea in children referred to a sleep clinic in Qazvin, Iran.

Materials and Methods: This cross-sectional study was conducted among 50 children and adolescents < 18 years old in Qazvin. All children referred to a pediatric sleep clinic during the years 2008-2009 were enrolled in this study, consecutively. These children were referred for suspected obstructive sleep apnea (OSA). BEARS and Children's Sleep Habits Questionnaire were completed by parents. Subjects underwent overnight full PSG. Data were analyzed using descriptive statistics and chi-square test.

Results: A total of 50 subjects participated in this study. A mean age was 7.8 ± 5.2 years. 40 (80%) subjects were male. The most common cause for referral was snoring (18 patients, 36%). Daily hyperactivity and insomnia were reported in 20 (40%) and 16 (32%) subjects, respectively. 12 (24%) children had normal sleep pattern, 30 (60%) OSA and 8 (16%) other sleep disorders. No significant associations were seen between PSG results and body mass index or sex.

Conclusion: The majority of children referred to the sleep clinic had sleep apnea which indicates that many cases of the disease remain unknown. It is necessary to increase the knowledge of the public and medical staff about signs and symptoms of sleep breathing disorders to screen the patients and referral to sleep clinics.

Keywords: Sleep apnea; Children; Polysomnography

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Introduction

Sleep apnea is an interruption of breathing during sleep and it has three types including obstructive, central, and mixed apnea. Obstructive sleep apnea (OSA) is defined as stoppage of oro-nasal airflow for at least two breaths. It is associated with continued or increased inspiratory efforts. Central apnea is a cessation of oronasal breathing in the absence of respiratory efforts; it lasts at least for two breaths with arousal or reduced oxygen saturation (3%) or awaking (1). OSA occurs in 2-4% of all children, with a peak of 3-7 years of age and correlates with the maximum size of

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the adenoids and tonsils before maturation (2). Other risk factors of OSA include obesity, genetic syndromes (facial hypoplasia, small nasopharyngeal airway in Down Syndrome or Pierre Robin Syndrome), allergies, asthma, sinusitis, surgery on the nasopharyngeal region, sickle cell anemia, medications (sedative and narcotics), and autonomic dysfunction (3, 4). However, all healthy children should be evaluated for possible OSA (4).

The most common diurnal clinical symptoms of OSA are chronic mouth breathing and hyponasal speech. Most of these children have adenoid face. Other diurnal symptoms in the children are severe daytime sleepiness, chronic rhinorrhea, dysphagia, difficulty in swallowing, hyperactivity, learning problems, and inability to concentrate (1, 5). Common nocturnal symptoms during night sleep are loud snoring, difficult breathing, breath pauses, or apnea (6-8). They have restlessness, sweating, nocturnal enuresis, and chronic cough without appropriate response to interventions. Consequences of non-treatment among children with OSA are impaired school performance, learning and behavioral problems, and aggression. OSA in severe cases leads to pulmonary hypertension and cor pulmonale. Growth retardation without any known underlying causes can also be considered due to OSA (7, 9). Despite defining some signs and symptoms, no pathognomonic finding exists for OSA (10). The most important diagnostic techniques are careful history taking and complete physical examination, as well as audio-video recording during sleep (2). Polysomnography (PSG) is the gold standard diagnostic test (11). Treatment of OSA in children includes total adenotonsillectomy, non-invasive ventilation (by continuous positive airway pressure or bilevel positive airway pressure), oxygen therapy, systemic or nasal steroids, weight loss, uvulopalatopharyngoplasty, oral appliances, tracheostomy, and glottoplasty (2, 3, 6, 12). The treatment of any associated disorder that increases impaired breathing during sleep (such as gastroesophageal reflux, allergic rhinitis, or nasal congestion) is also effective in OSA (2). Diagnosis of OSA is one of the major medical challenges. Although snoring is one of the main characteristic findings of this disorder, this point is not usually considered. Many parents consider the snore during sleep in their children as a normal event especially in those who are obese and ignore any consult with their physician. Therefore, late diagnosis of OSA in the children will be associated with complications such as failure to thrive, impaired school performance, cor pulmonale, proteinuria, and enuresis. Regarding complications of undiagnosed OSA in children and limited available data in the region, this study was designed to evaluate the signs and symptoms of sleep apnea in children referred to a sleep clinic in Qazvin, Iran.

Materials and Methods

This cross-sectional study was conducted in children and adolescents < 18-year-old in Qazvin, a city in North-West of Iran. Participants were referred to a sleep clinic because of any suspected sleep disorder.

Two questionnaires including Persian version of which contains five major sleep domains of Bedtime problems, Excessive daytime sleepiness, Awakenings during the night, Regularity, and duration of sleep and Snoring (BEARS) and

Children's Sleep Habits Questionnaire (CSHQ) were completed by parents (13, 14). The BEARS questionnaire provides a comprehensive screen for major sleep disorders affecting children in the age range of 2-18 years old (15). The Persian versions of these questionnaires have been used in previous studies. The Cronbach's alpha values in the previous studies conducted in the Persian language were more than 0.8 for all domains of BEARS questionnaire and 0.8 for CSHQ (13, 16, 17).

The parents were asked about daily symptoms of their kids, and their response was classified into five categories:

- Never
- Sometime (1-2 night or days/week)
- Often (3-5 nights or days/week)
- Always (6-7 nights or days/week)
- I do not know.

Interval between going to bed until sleeping was also asked for the children and the results were recorded. Weight was measured barefoot with the least clothing using a standardized instrument. Height was measured using a wall mounted "height measuring tape" in centimeters with the child standing barefoot and completely upright, heels back, head touching the wall, and a straight plate on the head. Body mass index (BMI) was also calculated. Children were classified according to their BMI and with regard to standard National Center for Health Statistics charts for age and sex. BMI < 3^{rd} percentile was defined as underweight. BMI between the 5^{th} and 85^{th} percentile was defined as normal. BMI from the 85 to 95^{th} percentile was defined as overweight and BMI ≥ 95^{th} percentile was defined as obese, respectively. In infants younger than 24 months, weight < 3^{rd} percentile, between the 3^{rd} and 95^{th} percentile and above the 95^{th} percentile for age and sex were considered as underweight, normal weight and obese, respectively (16).

Then, PSG was performed according to pediatric PSG guidelines (18). The patients were instructed to avoid nap, tea or coffee, to continue the usual medication, to eat light dinner between 7:30 and 8 pm. They attended 2 hours before PSG to the lab. They slept in a comfortable room with suitable temperature (24° C) between 10:30 pm and 6 am. Subjects underwent overnight full PSG with an international 10-20-electrode placement (C3/A2, O2/A1), electrooccullograms, and electromyograms (chin and legs). Respiratory recordings included nasal airflow, thoracic and abdominal effort bands (strain gauge), and O2 saturation using pulse oximetry. All sleep data were recorded and collected on a computerized 16-channel PSG system (Compumedics, Australia). The sleep studies were scored by a sleep physician according to American Academy of Sleep Medicine 2007 guideline. The sleep indices considered were sleep onset latency, non-rapid eye movement (NREM) including N1, N2, N3 sleep stages, rapid eye movement (REM) sleep, waking after sleep onset (WASO), total sleep time (TST), total wake time, sleep efficiency (SE), and arousal index (AI). Respiratory events were scored as obstructive, central, mixed apneas, and hypopneas (19). Sleep apnea-hypopnea index (AHI) equal or more than one was considered abnormal. AHI as an indicator of disease was classified as; mild (1-5 times/hour), moderate (5-15 times/ hour), and severe (over 15 times). AI more than 10 times/hour was defined as abnormal (20, 21).

Data were described as mean ±

standard deviation (SD) or proportion (percent) where appropriate. Data were analyzed using one-sample t-test, chi-square test, and Pearson's correlation coefficient with SPSS software (Version 16; SPSS Inc., Chicago, IL., USA). The level of significance in all tests was set at $P < 0.050$.

Results

A total of 50 participants completed the questionnaires. Out of them, 40 (80%) were male. The mean (± SD) age was 7.8 ± 5.2 years. Most of the subjects were in the 3-6 years age range with a frequency of 28% (14 subjects). Mean weight ± SD was 29.1 ± 1.9 kg. Mean height ± SD was 121.48 ± 28.70 cm. Mean BMI ± SD was 17.34 ± 4.39 kg/m^2. Eight subjects were underweight, 12 subjects were overweight, and 2 subjects were obese.

The patients had been referred to the sleep clinic because of snoring in 18 (36%), viewing of breath pauses during sleep by parents in 6 (12%), night terror in 6 (12%), hypersomnia in 4 (8%), and poor sleep in 4 (8%) subjects. Other reasons for referral included frequent waking during night, physicians' suspicion to apnea, sleep attacks during the day, refractory enuresis, crying at night and cataplexy; each one was observed in 2 (4%) of the participants.

The common accompanying diseases among the patients were asthma 20 (40%), difficult breathing through the nose 18 (36%), sinusitis 16 (32%), cough or chronic bronchitis, and gastroesophageal reflux 12 (24%). Cerebral palsy, Down syndrome, or craniofacial abnormalities were found in only 10 (20%) subjects.

Common sleep problems in children reported by parents are shown in table 1. The interval between going to bed until sleeping was more than 20 min in 16 subjects. Diurnal hyperactivity was reported in 20 participants.

In PSG, NREM sleep in the N1, N2, and N3 stages were 5.85% ± 4.52% (0.9-20%), 47.04 ± 8.67 (10-54.8%), and 20.9% ± 6.6% (6.2-30.5%), respectively. Mean REM duration was 24.4% ± 9.6%. AI was from 5 to 46 per hour and the means AI was 21.2 ± 1.2. Mean WASO was 6.86 ± 4.27.

AHI in the subjects was from 0 to 45.4/hour. The mean AHI was 16.88 ± 1.63/hour. SO_2 was variable among the subjects from 91.5% to 97.1%, and the mean SO_2 was 94.85% ± 1.92%. Out of 50 subjects, 12 had normal sleep patterns. 30 subjects had OSA, out of which 4, 10, and 16 were classified as having mild, moderate, and severe OSA, respectively. Six participants had narcolepsy and two had nocturnal epilepsy.

There was no significant difference in PSG results according to sex and BMI classification (Tables 2 and 3).

Table 1. Parents' answer about common sleep problems in children referred to the sleep clinic

Question	Some time	Often	Always	Don't know	Never
Does your child have a regular daily sleep schedule?	14 (28)	24 (48)	2 (4)	0	10 (20)
Does your child resist and oppose to go to bed?	14 (28)	4 (8)	8 (16)	0	24 (48)
Does your child have trouble falling asleep?	10 (20)	4 (8)	8 (16)	0	28 (56)
Does your child have frequent awakenings during the nights?	10 (20)	12 (24)	10 (20)	4 (8)	14 (28)
Does your child have trouble getting up in the morning?	14 (28)	10 (20)	14 (28)	0	12 (24)
Does your child have snoring or any respiratory difficulties during nights?	10 (20)	0	12 (24)	4 (8)	24 (48)

Data are presented as number (percent).

Table 2. Association of sleep disorders (based on PSG) and BMI classification

Diagnosis	Underweight	Normal	Overweight	Obese	Total
	N (%)	N (%)	N (%)	N (%)	N (%)
OSA	4 (50)	16 (57.1)	8 (66.7)	2 (100)	30 (60)
Normal	4 (50)	6 (21.4)	2 (16.7)	0 (0)	12 (24)
Other sleep disorders	0 (0)	6 (21.4)	2 (16.7)	0 (0)	8 (16)
Total	8 (100)	28 (100)	12 (100)	2 (100)	50 (100)

P > 0.05. OSA: Obstructive sleep apnea, PSG: Polysomnographic, BMI: Body mass index

Table 3. Association of sleep disorders (based on PSG) and sex of patients

Diagnosis	Male	Female	Total
	N (%)	N (%)	N (%)
OSA	22 (55)	8 (80)	30 (60)
Normal	10 (25)	2 (20)	12 (24)
Other sleep disorders	8 (20)	0 (0)	8 (16)
Total	40 (100)	10 (100)	50 (100)

P > 0.05. OSA: Obstructive sleep apnea

Matrix of correlation between the evaluated parameters from PSG is shown in table 4. There was negative significant correlation between age with N1 (R = −0.591 and P = 0.001) and total AHI (R = −0.371, P = 0.045). Negative significant correlation was between BMI with TST (R = −0.602, P = 0.001), SE (R = −0.413, P = 0.012), N2 (R = −0.421, P = 0.016), and REM (R = −0.358, P = 0.033), but there was no significant correlation with other parameters.

Negative and significant correlation was observed between SE with N1 (R = −0.568, P = 0.001), but positive and significant correlation with REM (R = 0.608, P = 0.001).

Discussion

The challenge for pediatricians is to diagnose clinical presentations of OSA in a cost-effective, reliable, and accurate manner before recommending PSG. In the current study, more than half of the children were referred because of sleep problems. These children had frequent short time awakening during the night.

The frequency of OSA in this study was high. It should be considered that children with OSA may remain undiagnosed and never refer to sleep clinic. There were no significant differences between age and severity of OSA events in this study.

The association of OSA and BMI was not significant in the present data. It may be due to a wide range of age and a limited number of subjects. The correlation between obesity and OSA in adults has been well demonstrated, but data in children are limited (22, 23). Most of the children with moderate to severe OSA may have failure to thrive (4, 20). Markus et al. indicate that children with OSA have growth retardation because it increases work of breathing during sleep time, reduces insulin-like growth factor 1, induces loss of appetite, dysphagia, hypoxia, and acidosis during the night (7). Zeng et al. (24) in another study found that OSA in children results in decreased secretion of growth hormone. OSA among the obese children is estimated to be about 13-36% (10). The prevalence of OSA with AHI more than 5 times/hour was 32.6% in Chinese obese children (25). In a study by Chay et al. (4) in Singapore among 3671 cases suspected of OSA underwent PSG, 146 participants had BMI more than 18 kg/m^2. They estimated the prevalence of OSA in school-aged obese children to be 0.7%. Overall, the prevalence of OSA in obese children is very variable. Therefore, a conclusion in this area is very difficult.

A major problem in participants of this study was a history of frequently upper respiratory tract infection.

Table 4. Matrix of correlation between the evaluated parameters from PSG

Parameters	Age	BMI	SE	TST	N1	N2	N3	R	AHI total back	AHI total left	AHI total right	AHI total prone
Age												
Correlation	1	0.421*	0.196	0.131	-0.591**	-0.281	-0.143	0.166	-0.371*	-0.486**	-0.396*	-0.139
P value		0.027	0.183	0.531	0.001	0.132	0.367	0.351	0.045	0.003	0.017	0.355
BMI												
Correlation		1	-0.413*	-0.602**	0.135	-0.421*	-0.016	-0.358*	0.195	-0.065	-0.010	-0.135
P value			0.012	0.001	0.472	0.016	0.774	0.033	0.371	0.626	0.955	0.637
SE												
Correlation			1	0.782**	-0.549**	0.332	0.111	0.524**	-0.076	-0.034	-0.159	0.260
P value				< 0.001	0.001	0.171	0.521	0.001	0.682	0.786	0.345	0.205
TST												
Correlation				1	-0.568**	0.397*	-0.092	0.608**	-0.316	-0.177	-0.198	-0.058
P value					0.001	0.048	0.689	0.001	0.060	0.307	0.219	0.734
N1												
Correlation					1	0.210	-0.395*	-0.459**	0.258	0.486**	0.178	0.089
P value						0.317	0.022	0.007	0.129	0.002	0.319	0.632
N2												
Correlation						1	-0.401*	0.083	-0.025	0.090	0.139	-0.141
P value							0.017	0.529	0.897	0.625	0.417	0.397
N3												
Correlation							1	-0.141	0.040	-0.126	0.096	0.292
P value								0.539	0.828	0.461	0.552	0.076
REM												
Correlation								1	-0.131	-0.110	-0.231	-0.127
P value									0.439	0.532	0.274	0.385
AHI total back												
Correlation									1	0.615**	0.369*	0.303
P value										0.003	0.034	0.101
AHI total left												
Correlation										1	0.310	0.294
P value											0.059	0.093
AHI total right												
Correlation											1	0.195
P value												0.302
AHI total prone												
Correlation												1
P value												

*Correlation is significant at the 0.05 level (two-tailed), **Correlation is significant at the 0.01 level (two-tailed). BMI: Body mass index, REM: Rapid eye movement, AHI: Apnea-hypopnea index, PSG: Polysomnographic, SE: Sleep efficiency, TST: Total sleep time

In Palombini et al. study, the most common problems in patients suspected with OSA were cerebral palsy, Down syndrome, and craniofacial abnormalities (23). Such abnormalities were observed in only 10 participants of this study. It may be due to child neglect in cases of chronic neurologic, developmental and genetic abnormalities.

In this study, snoring was the most common cause of referral to the sleep clinic. Not all children with OSA have snoring and not all children with snoring have OSA. It has been suggested that family physicians should ask about signs and symptoms of OSA as a routine examination in children regardless of the presence or absence of snoring (26).

The current study results were also consistent with study of Helfaer et al. (27) and Carroll (28). In this study, when parents were asked about the signs of OSA in their children, more than half reported snoring while sleeping.

According to a study conducted by Guilleminault et al., (29) mothers reported episodes of interrupted breathing during sleep, mouth breathing, sweating, and disturbed sleep, or sleeping in unusual conditions. The prevalence was more of morning headaches and difficulties to waking up in the morning.

In the current study, respiratory problem during sleep (68%), nightmares (60%), night sweating (56%), daytime sleepiness (52%), and stopped breathing (24%) were reported. The history and physical findings compared to PSG had specificity ranging from 39% to 71%, and sensitivity ranging from 35% to 79% (30). The accurate diagnosis of sleep behavioral disorders in the pediatric population is accomplished by integration of PSG findings with clinical evaluation (31).

PSG is an expensive method which requires at least one night stay in a sleep clinic, but it is essential, especially in children suspected to have sleep breathing disorders. Although all referred children to the sleep clinic were recruited in this study, overall judgment about the value of referral is limited due to small sample size.

Conclusion

The majority of children referred to the sleep clinic had sleep apnea which indicates that many cases of the disease remain unknown. It is necessary to increase the knowledge of the public and medical staff about signs and symptoms of sleep breathing disorders to screen and refer the patients to sleep clinics (20).

Conflict of Interests

Authors have no conflict of interests.

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