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RESEARCH ARTICLE

OBSTRUCTIVE SLEEP APNEA DURING CHILDHOOD IN TERTIARY CARE CENTER IN SAUDI ARABIA

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Abstract

Background: Obstructive sleep apnea (OSA) is a common disorder with the prevalence of 1-5%. OSA in there is a paucity of data regarding OSA in children in our region. This is particularly important as OSA is associated with neurocognitive deficits and cardiovascular complication. The aim of this study is to evaluate the prevalence of OSA among children referred to specialized centre in Saudi Arabia.

Methods: A retrospective chart review study involving children ≤ 18 years, identified from pediatric tertiary care centre who had an overnight polysomnography (PSG). OSA was diagnosed if the obstructive apnea-hypopnea index (OAHI) was higher than 1 event per hour.

Results: There were 12 participants included. The mean age was 8 years (standard deviation [SD] ± 1.7). Of these, 6/12 (50%) had OSA. Compared with the non-OSA group, the OSA group had a lower sleep SpO₂ during REM sleep ($p = 0.008$).

Conclusion: Children with clinical symptoms should be referred for OSA diagnosis. A history of snoring may be useful indicators to facilitate a PSG, especially in resource-limited settings.

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Introduction:-

Sleep-disordered breathing (SDB) is a spectrum of breathing disorders ranging from habitual snoring to obstructive sleep apnea (OSA) and nocturnal hypoventilation¹. Apnea in sleep medicine is defined as the cessation of breathing for at least 10 seconds during sleep. Hypopnea is defined as a reduction of the amplitude of breathing by at least 30% and is associated with 3% oxygen desaturation. The number of apneas and hypopneas are counted as a function of their occurrence per hour to calculate the apnea-hypopnea index (AHI) (American Academy of Sleep Medicine)².

Obstructive sleep apnea (OSA) is defined by the American Thoracic Society (ATS) as a disorder of breathing during sleep characterized by partial and/or complete upper airway obstruction that disrupts gas exchange during sleep³. Among children, many cutoffs have been suggested, however AHI of more than one is considered symptomatic of OSA, which requires intervention. Studies have reported that the expression of OSA among children can be variable and depend on the examination setting⁴. Other factors include whether the testing tools was a screening questionnaire or polysomnography (PSG) and the characteristics of the included population. Studies using a screening questionnaire have found that snoring, one of the major symptoms of OSA was reported by 5-20% of children and probably the most characteristic symptom in OSA^{5, 6}. Other symptoms include sleeping in the prone position, salivation at night, pauses in breathing during sleep, sleeping with a hyperextended neck, sweating while asleep, nocturia or bedwetting, hyperactivity, and inattention during the daytime. However, Questionnaire alone

should not be used alone to diagnose OSA as neither single nor combined symptoms that have satisfactory results in predicting OSA in children⁷⁻¹⁰. In pediatric population polysomnography (PSG) is the current gold standard for diagnosis of SDB¹¹. The aim of this study is to emphasize the importance of diagnosis of OSA in children and to discuss the complication of OSA if left untreated¹².

Method:-

This study was a retrospective chart review for patients who attended the sleep laboratory for an overnight PSG for evaluation of suspected OSA. Only patients less than 18 years were identified and included in the study. The body mass index (BMI) was calculated as weight (kg) divided by the height squared (m²) which was measured at the time of PSG. Twelve patients were identified using clinical history, physical examination, and sleep questionnaire like the Pittsburgh Sleep Quality Index (PSQI). The main presentation was snoring. The PSQI is a validated measure of self-reported sleep quality. It comprises 19 items in 7 component scales that assess sleep quality over the past month. The component scores of these scales are summed to yield a global PSQI score with a range of 0-21, with higher scores indicating worse sleep quality¹³.

PSG was performed and scored manually based on the American Academy of Sleep Medicine (AASM) guidelines². Patients underwent a standard overnight PSG using Alice 6 (Philips, USA) Diagnostic sleep system with electro-oculogram, electroencephalogram - EEG, electromyogram, EMG, nasal air flow, chest belt for thoracic and abdominal movements, pulse oximetry, snoring microphone, leg movements, analysis data acquisition and analysis systems. Video and audio recordings were obtained as well as body position.

The severity of OSA was determined by the obstructive apnea-hypopnea index (OAHI), the number of obstructive, mixed apneas, and obstructive hypopneas per hour during sleep. OSA was diagnosed if the OAHI was greater than 1 event per hour with severity range. Severity range is defined as mild, moderate, and severe if < 5 events/h, ≥ 5–10 events/h, and > 10 events/h, respectively according to pediatric rules.

Patients' demographics and polysomnographic data were presented as mean (standard deviation, SD) for continuous variables and number (percentage) for categorical variables. Comparisons between OSA and non-OSA groups were conducted using Student's t test where appropriate for continuous variables, and Fisher's exact test for categorical variables.

Result:-

From May 2018 to March 2019, a total number of 12 children (5 females) were identified for baseline assessment. The mean age (±SD) was 8 (±2) year. The data for these patients are summarized in table 1. Children known to have psychiatric disorders or other chronic comorbidities in addition to those on sedative drugs were excluded.

Overall, 6 out of 12 patients had evidence of OSA. Of those, 1 was mild, 2 were moderate, and 3 had severe OSA. There were no children who had an underlying significant CSA. By using univariate regression analysis, only the age was significant in OSA prediction (P = 0.02); however, there was no significant prediction in the multivariable regression model. The correlation between overnight oximetry and PSG showed that the desaturations index correlated with the OAHI (r = 0.64, P < 0.001). Other findings include that the minimum sleep SpO₂ during REM sleep was significantly lower in the OSA group (p = 0.008). PSG data for these patients are summarized in table 2.

Discussion:-

The principal finding of this study was that OSA is highly prevalent, occurring in half of this population. This probably was due to very selected patients. Indeed, OSA is estimated at 1–5% in the school-aged children¹⁴ and the prevalence of habitual snoring occurs in 5–12% of children. Due to the complexity of studying young children, which is related to equipment, presence of sleep technicians, challenges in behaviour and appropriate medical care, younger children will need to have a PSG completed in a specialized pediatric facility.

While in adults, OSA frequently results from obesity, anatomical factors like adenoid and tonsillar hypertrophy, play a major role in pediatric OSA¹⁵. However, at present, the rate of childhood obesity is increasing significantly and is also a significant contributor to OSA. While non-obese children who have OSA, and who concurrently exhibit adeno-tonsillar hypertrophy (but without craniofacial abnormalities) can improve with surgical resection of their adenoids and/or tonsils, which is not the case with obese children¹⁶⁻¹⁸. One study has found that adenoid and tonsillar

hypertrophy is associated with obesity, thus increasing the risk for OSA¹⁹. OSA is more common among boys and obese children²⁰. First-degree relatives of children with OSA is considered a risk factor for development of OSA²¹. Other risk factors such as retrognathia, macroglossia should be considered in pediatric OSA²². Children with other genetic diseases had higher prevalence of OSA²³⁻²⁵.

OSA is associated with poor quality sleep, thus these children remain in a state of partial sleep deprivation. Hence, they are at risk of developing the multiple complications of sleep deprivation including the production of the appetitive neurohormone ghrelin^{26, 27}. These children may also show ADHD-like symptoms of inattention and hyperactivity, as well as nocturnal enuresis²⁸. A growing amount of evidence supports the conclusion that sleep deprivation has cumulative effects and interferes with normal cognitive functioning^{29, 30}. It also affects academic performance, mostly mathematics^{6, 31}.

As in adults, children with OSA also develop cardiovascular complications, particularly endothelial dysfunction³²⁻³⁴. While endothelial dysfunction initially leads to functional, and later, anatomical complications of the vasculature, its early effects on the pulmonary vasculature and cardiac anatomy cannot be ignored³⁴. A meta-analysis of cardiographic studies among children with OSA showed several important symptoms including significant increases in pulmonary arterial pressure, thickening of the interventricular septum, and dilation of the right ventricle³⁵⁻³⁷.

Other important adverse effects of OSA are metabolic abnormalities. OSA is associated with an increase in plasma levels of insulin and glucose in the fasting state³⁸. OSA in obese children is associated with inflammation including elevation of inflammatory cytokines, increased leptin, and decreased adiponectin³⁹. These cardiovascular and metabolic abnormalities may interfere with healthy development, thus posing a direct cost to public healthcare systems. A meta-analysis done by Galland et al included 16 studies which showed that OSA was significantly associated with poor academic performance for language of arts, mathematics, science, and with unsatisfactory learning problems⁴⁰.

This study had several limitations. This was a retrospective study, and the children in question was a referred cohort with reported snoring and was referred primarily to exclude OSA providing us with a highly selected, relatively small cohort.

In summary, OSA is not uncommon among children, and its broad consequences to personal health and wellbeing indicate that the condition deserves careful screening in children. Those identified in screening should be tested using polysomnography in a sleep clinic to determine the severity of OSA. After diagnosis, an individualized treatment should be carefully developed. In general, if anatomical factors are primary contributors to the condition, they should be corrected surgically, weight and dietary habits should be encouraged, and continuous positive airway pressure (CPAP) therapy should be advised.

Table 1:- Baseline characteristics.

Characteristic	All subjects	Non-OSA	OSA	p value
Number (%)	12	6	6	
Age, mean (SD) (years)	7.46 (1.7)	7.51 (1.6)	7.39 (1.9)	NS
Male gender, n (%)	7 (58)	4 (55)	3 (55)	NS
BMI, mean (SD)	21 (3)	20 (3.5)	22 (3.2)	NS
Snoring, n (%)	10	4 (66)	6 (100)	0.03

p value is calculated using Student's t test for continuous variables, and Fisher's exact test for categorical variables, NS not significant.

BMI body mass index (calculated as weight in kilograms divided by height in meters squared)

Table 2:- PSG data.

Measurement, mean (SD)	Non-OSA	OSA	p value
TST (min)	411 (35)	403 (36)	NS
Sleep efficiency (%)	86 (10)	83.8 (11)	NS
Sleep latency (min)	32 (40)	29 (31)	NS
REM latency	102 (42)	95 (33)	NS

N1 % TST	4.3 (3.2)	4.6 (4.1)	NS
N2 % TST	50 (11.1)	52.1 (12.5)	NS
N3 % TST	27.1 (9.8)	24.1 (10.5)	NS
REM % TST	18.6 (8.1)	19.2 (6.1)	NS
Maximum respiratory rate (breaths/min)	22 (3)	24 (4)	NS
Maximum heart rate (beats/min)	115 (12)	123 (15)	NS
Obstructive AHI (no./hour)	0.4 (0.3)	10.2 (9)	0.001
Central AHI (no./hour)	1.1 (1.4)	1.4 (1.3)	NS
Total sleep SpO2 min (%)	88 (4)	82 (7)	NS
REM sleep SpO2 min (%)	90 (5)	78 (12)	0.01

TST total sleep time, REM rapid eye movement, AHI Apnea-Hypopnea Index

p value is calculated using Student's t test for continuous variables, and Fisher's exact test for categorical variables, NS not significant.

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