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Prevalence and Management of Obstructive Sleep Apnea in Children in Saudi Arabia: A Systematic Review

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Abstract

***Background*:** Obstructive sleep apnea (OSA) is a prevalent and potentially serious condition in children, with significant implications for health and development. Limited data exists on the prevalence and management of OSA in Saudi Arabian children. ***Objective*:** To study the prevalence and management of OSA in children residing in Saudi Arabia. ***Methods*:** An extensive search of PubMed, Web of Science, Scopus, and Science Direct was performed to locate relevant material. Rayyan QRCI was used to select the eligible articles. ***Results*:** Our data includes eight articles with 2619 children, 1254 (47.8%) of whom were males. The prevalence of OSA in Saudi children ranged from 6.6% in school children to 50% in children with SCD, with a total prevalence of 208 (9.9%). Adenotonsillectomy (AT) successfully and effectively managed OSA and lifestyle modifications improved the outcomes of AT. Anti-inflammatory therapy with a combination of nasal steroids and anti-leukotriene significantly lowers the adenectomy rate. Some orthodontic evaluation and orofacial morphology were significantly associated with a higher incidence of OSA. ***Conclusion*:** The prevalence of OSA in Saudi children is generally low but rising among children with SCD. AT and lifestyle modifications can reduce the severity and symptoms of sleep apnea in Saudi children with OSA. Anti-inflammatory and steroid therapy was reported to decrease the rate of implementing AT. Certain craniofacial traits were more common, but not consistently, in a subset of juvenile OSA patients. Effective care necessitates a comprehensive approach that includes early detection, surgical and non-surgical procedures, and addressing underlying risk factors like obesity and allergies. By addressing current hurdles and utilizing future research, Saudi Arabia's healthcare system may enhance the quality of life for children with OSA.

Keywords: Obstructive sleep apnea, children, Saudi Arabia, prevalence, management, systematic review.

INTRODUCTION

OSA is a significant public health concern that affects children worldwide, leading to various physiological and psychological complications. It is characterized by recurrent episodes of upper airway obstruction during sleep, resulting in disrupted sleep patterns, daytime fatigue, impaired cognitive functioning, and various associated health issues [1].

The prevalence of OSA in children varies significantly across different regions and populations. In Saudi Arabia, studies have reported a concerning trend in the incidence of OSA. For instance, a systematic review published in 2021 indicated that the prevalence of OSA in children ranged from 1% to 6%, with variances attributed to age, gender, environmental factors, and comorbid conditions such as obesity. The rising rates of childhood obesity, exacerbated by lifestyle changes including sedentary behavior and dietary shifts, contribute to the increasing prevalence of OSA [2].

A particular concern in Saudi Arabia is the cultural context of sleep practices and family dynamics. The traditional practice of co-sleeping, which is commonplace in many Saudi families, may inadvertently increase the risk of children developing OSA, as the presence of allergens or exposure to second-hand smoke in a shared sleeping environment could exacerbate underlying respiratory issues [3].

Moreover, the lack of public awareness and educational programs about OSA may lead to underdiagnosis. Many parents may not recognize the symptoms associated with OSA, which can include loud snoring, periods of apnea, restless sleep, and excessive daytime sleepiness. As a result, the true prevalence of OSA in children may be significantly underestimated in clinical settings [3].

Several risk factors predispose children to OSA, including obesity, adenotonsillar hypertrophy, and familial history of sleep apnea. In Saudi Arabia, the rising childhood obesity epidemic presents a notable risk factor—approximately 20%-30% of Saudi children are classified as underweight or overweight, suggesting that lifestyle changes are imperative to combat this health crisis. Hypertrophy of the tonsils and adenoids is another common anatomical predisposition leading to OSA.

In addition to these physical attributes, factors such as high socioeconomic status have been correlated with increased likelihood of OSA. Children from affluent families may have greater exposure to environmental allergens (from dust, pets, or smoke) in well-insulated homes. Furthermore, the psychological ramifications of OSA, such as stress and anxiety, can lead to disrupted sleep architecture, exacerbating the condition further [1, 4].

To accurately diagnose OSA, a comprehensive clinical evaluation is crucial. In Saudi Arabia, pediatricians and sleep specialists emphasize detailed patient histories, physical examinations, and, when necessary, polysomnography—an overnight sleep study that characterizes various sleep phases and detects disturbances related to breathing. Given the scarcity of sleep centers and availability of resources in some regions, the referral process may be cumbersome, leading to delays in diagnosis and treatment [5].

The use of clinical screening tools, such as the Pediatric Sleep Questionnaire (PSQ), has gained traction in Saudi pediatric practices to effectively identify at-risk children and facilitate timely intervention. Nevertheless, increasing awareness among parents and healthcare practitioners is essential to enhance early diagnosis and management, with a focus on providing education about the signs and symptoms of OSA [2].

Management of OSA in children involves a multifaceted approach that addresses both medical and lifestyle factors. Treatment protocols often begin with behavioral interventions aimed at addressing modifiable risk factors. For overweight children, weight loss remains paramount. Encouraging physical activity, promoting healthy dietary habits, and providing parental counseling can lead to significant improvements in sleep apnea symptoms [6].

Surgical management, particularly adenoidectomy and tonsillectomy, is frequently recommended for children with adenotonsillar hypertrophy. Studies conducted in the region have shown that these surgical interventions can effectively alleviate upper airway obstruction, leading to improved sleep quality, behavior, cognitive function, and overall health outcomes [4].

Continuous Positive Airway Pressure (CPAP) therapy is another treatment option for children with moderate to severe OSA. However, adherence to CPAP remains a critical challenge in pediatric patients, often due to discomfort, social stigma, and lack of understanding about the importance of consistent use. Family support and education about the benefits of CPAP can help mitigate adherence issues [6].

Emerging therapies, including pharmaceutical interventions and positional therapy, are also being studied in the Saudi context. Comprehensive management plans often involve collaboration between pediatricians, otolaryngologists, dietitians, and sleep specialists to provide holistic care tailored to the child's specific needs [1].

OSA in children is a growing public health concern with significant implications for physical, cognitive, and emotional development. While there is increasing awareness of OSA in adults, knowledge about its prevalence and management in children remains limited, particularly in specific populations like Saudi Arabia. This study is significant as it will provide crucial data on the extent of OSA in Saudi children and the current practices in its management, informing targeted interventions and policies. The lack of comprehensive data on the prevalence and management of OSA in Saudi children creates a knowledge gap hindering effective prevention, early detection, and treatment strategies. Existing studies may have limited scope, methodological variations, or focus on specific age groups. A systematic review is necessary to synthesize available evidence, identify knowledge gaps, and inform future research and clinical practice. There is a dearth of evidence on the true prevalence of OSA in the pediatric population of Saudi Arabia. Furthermore, the current management practices for OSA in children in this region are not well documented. This lack of knowledge hinders the development of effective prevention, early detection, and treatment strategies for this significant health issue. This study aims to systematically review the available literature to determine the prevalence and management of OSA in children in Saudi Arabia.

Study Objectives:

1. To systematically identify and appraise studies investigating the prevalence of OSA in Saudi children.
2. To synthesize the findings to estimate the overall prevalence of OSA in Saudi children.

3. To identify risk factors associated with OSA in Saudi children.
4. To assess the current diagnostic and management practices for OSA in Saudi children.
5. To evaluate the effectiveness of different management strategies for OSA in Saudi children.
6. To identify gaps in knowledge and recommend directions for future research.

METHODS

We conducted this systematic review in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [7] criteria. A computerized search was conducted on databases such as PubMed, Web of Science, SCOPUS, and Science Direct to discover English-language research on the prevalence and management strategies for OSA among children in Saudi Arabia. Relevant keywords were used in the search method in these scenarios: "Obstructive sleep apnea," "OSA," "Sleep-disordered breathing," "Children," "Pediatric," "Prevalence," "Management," and "Saudi Arabia.". Two reviewers separately searched through the search outcomes, chose relevant papers, collected data, and utilized the appropriate assessment procedures to establish how strong the included study was.

Eligibility Criteria:

Inclusion Criteria

- **Study Population:** Children and adolescents residing in Saudi Arabia.
- **Study Design:** Cross-sectional, cohort, case-control, or randomized controlled trials (RCTs).
- **Outcome Measures:** Prevalence of OSA and management strategies employed.
- **Language:** Studies in English.

Exclusion Criteria

- **Study Population:** Adults, individuals from countries other than Saudi Arabia.
- **Study Design:** Case reports, case series, reviews, editorials, or commentaries.
- **Outcome Measures:** Studies without data on OSA prevalence or management.
- **Language:** Studies published in languages other than English.
- **Quality:** Studies with a critical methodological flaw that significantly compromises the validity of the results.

Data Extraction

Rayyan (QCRI) was utilized to check the search results and ensure accuracy [8]. The inclusion and exclusion criteria were employed to establish the relevance of the search results' titles and abstracts. The study team thoroughly reviewed papers that met the inclusion criteria. Consensus was employed to resolve disputes. Key study data will be recorded using an established data extraction form, including titles, authors, publication year, study location, gender distribution, participant demographics, OSA diagnostic tools, population type, intervention/ management, prevalence of OSA, and main outcomes. To investigate the probability of bias, a neutral evaluation instrument was developed.

Data Synthesis Strategy

Summaries of the research outcomes and aspects were generated using information from relevant studies in order to provide a qualitative assessment. The optimum technique to ensure the use of the data from the included studies was determined upon after gathering the information for the systematic review was completed.

Risk of Bias Assessment

The study's quality was assessed using the critical assessment criteria for studies reporting prevalence data developed by the Joanna Briggs Institute (JBI) [9]. This tool contained nine questions. A one was provided for a favorable response, and a zero for a negative, ambiguous, or irrelevant response. The following scores will be classified as poor, moderate, or high quality: less than 4, between 5 and 7, and greater than 8. Researchers rated the quality of the studies separately, and disagreements were resolved through discussion.

RESULTS

Systematic Search Outcomes

Following the removal of 502 duplicates, a systematic search yielded 866 study papers. After 364 studies' titles and abstracts were reviewed, 212 papers were rejected. Out of the 152 reports that needed to be obtained, just two articles were not found. 150 articles passed the full-text screening procedure; 98 were rejected owing to inaccurate study results, 42 were due to improper population type, and 2 were editor's letters. Eight of the research publications included in this systematic review met the eligibility criteria. Figure 1 depicts an overview of the approach used to choose the research.

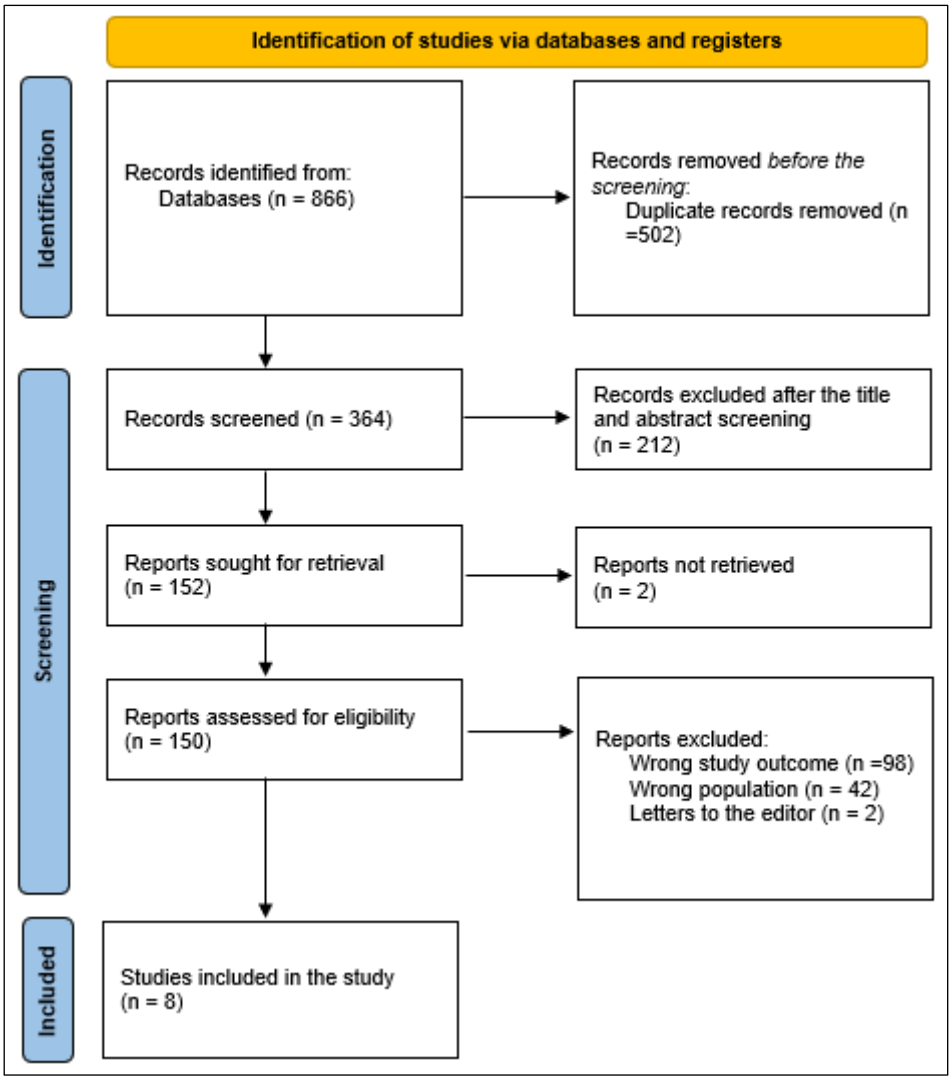

Figure 1: A PRISMA diagram is used to summarize the study decisions

Sociodemographic of the comprised participants and studies

Table 1 displays the sociodemographic information from the research articles. Our data includes eight articles with 2619 children, 1254 (47.8%) of whom were males [10-19]. Four studies were cross-sectional [11, 15, 16, 17], two were case-controls [12, 14], one was prospective cohort [10], and one was retrospective cohort [13]. Two studies were conducted in Jeddah [10, 16], two in Riyadh [15, 16], one in Abha [11], one in Jazan [12], one in Dammam [14], and one in Al-Kharj [17].

Clinical Outcomes

OSA Prevalence

Three studies investigated the prevalence of OSA in Saudi children and it ranged from 6.6% in school children [17] to 50% in children with SCD [15], with a total prevalence of 208 (9.9%) Table (2).

Management Strategies

Table (3) presents the management approaches for children with OSA. We found five studies discussing the management of OSA among Saudi children. Two of them reported that AT successfully and effectively managed OSA and lifestyle modifications improved the outcomes of AT [10, 12]. Anti-inflammatory therapy with a combination of nasal steroids and anti-leukotriene significantly lowers the adenectomy rate [13]. Two studies reported that orthodontic evaluation and orofacial morphology such as deviations in an overbite, deeper palatal vault, a steeper mandibular plane angle, and less space between the upper and lower arches are significantly associated with a higher incidence of OSA. This requires orthodontic assessment in the detection of pediatric OSA [11, 14].

Table 1: Sociodemographic parameters of the involved populations

Study	Study design	Country	Participants	Mean age	Females (%)
Eldin *et al.*, 2023 [10]	Prospective cohort	Jeddah	224	8.3 ± 2	127 (56.7%)
Zakirulla *et al.*, 2022 [11]	Cross-sectional	Abha	150	3 - 12	78 (52%)
Jazan *et al.*, 2021 [12]	Case-control	Jazan	74	9.8 ± 2.9	40 (54%)
Eldegeir *et al.*, 2023 [13]	Retrospective cohort	Dammam	60	NM	36 (60%)
AlHammad *et al.*, 2015 [14]	Case-control	Riyadh	30	4.3 ± 1.57	30 (50%)
Al-Otaibi *et al.*, 2017 [15]	Cross-sectional	Riyadh	65	2 - 14	26 (50%)
Abulhamail *et al.*, 2022 [16]	Cross-sectional	Jeddah	150	2 - 18	78 (53%)
Alwadei *et al.*, 2023 [17]	Cross-sectional	Al-Kharj	1866	9.67 ± 1.78	839 (45%)

Table 2: Prevalence of OSA

Study ID	The diagnostic tool of OSA	Population type	Prevalence of OSA (%)	Main outcomes	JBI
Al-Otaibi *et al.*, 2017 [15]	PSG	Children with SCD	52 (50%)	In kids with SCD, OSA is highly prevalent. Routine OSA evaluation should be a part of these patients' appropriate care in order to enhance general health and guard against any problems from OSA.	Moderate
Abulhamail *et al.*, 2022 [16]	PSQ	Children with SCD	33 (22%)	Among children with sickle cell illness, OSAS is a very common condition.	High
Alwadei *et al.*, 2023 [17]	PSQ	School children	123 (6.6%)	NM	Moderate

***NM=Not-mentioned**

PSQ= Pediatric Sleep Questionnaire, PSG= Polysomnography

Table 3: Management strategies of the comprised participants

Study ID	The diagnostic tool of OSA	Management	Prevalence of tonsillar hypertrophy (%)	Prevalence of adenoid hypertrophy (%)	Main outcomes	JBI
Eldin *et al.*, 2023 [10]	PSQ and otorhinolaryngologic assessment	Lifestyle modification and AT	212 (94.6%)	212 (94.6%)	In children with minor OSA and minimal cognitive dysfunction, lifestyle management is a good treatment strategy and is necessary prior to surgery to enhance the results of AT.	Moderate
Zakirulla *et al.*, 2022 [11]	Clinical	Orthodontic evaluation	NM	NM	Deviations in overbite and overjet as well as posterior cross bite appear to be significantly linked to OSA. These occlusal characteristics highlight the value of an orthodontic assessment in the detection of pediatric OSA.	High
Jazan *et al.*, 2021 [12]	PSG	AT	NM	NM	The surgery cured OSA and markedly improved monosymptomatic	Moderate

Study ID	The diagnostic tool of OSA	Management	Prevalence of tonsillar hypertrophy (%)	Prevalence of adenoid hypertrophy (%)	Main outcomes	JBI
					primary nocturnal enuresis.	
Eldegeir *et al.*, 2023 [13]	Sleep-Related Breathing Disorder Scale	Nasal steroids and anti-leukotriene	NM	60 (100%)	In children with OSA due to adenoid hypertrophy, anti-inflammatory therapy with a combination of nasal steroids and anti-leukotriene significantly lowers the adenectomy rate.	Moderate
AlHammad *et al.*, 2015 [14]	Clinical	Orthodontic evaluation	NM	NM	In comparison to control children, OSA children exhibit a comparatively distinct orofacial morphology. In comparison to the control, OSA participants had a deeper palatal vault, a steeper mandibular plane angle, and less space between the upper and lower arches.	Moderate

***NM=Not-mentioned**
PSQ= Pediatric Sleep Questionnaire, PSG= Polysomnography

DISCUSSION

This review included a few studies with our special population, Saudi children with OSA, we found that the prevalence ranged from 6.6% in school children [17] to 50% in children with SCD [15], with a total prevalence of 208 (9.9%). Our findings were lower than Andersen *et al.*, who reported that the prevalence of persistent OSA in children ranged between 15 and 76%, depending on the diagnosis of OSA [18]. Another systematic review by Magnusdottir & Hill reported that the prevalence of OSA among preschoolers may have increased during the last decade [19].

We that AT successfully and effectively managed OSA and lifestyle modifications improved the outcomes of AT [10, 12]. Galluzzi *et al.*, found that AT effectively reduces the severity of sleep apneas in otherwise healthy children with severe OSA, as evidenced by a considerable reduction in objective polysomnographic indices. However, a disproportionately large number of children with severe OSA experience chronic apneas following surgery [20]. Almutairi *et al.*, also demonstrated that AT reduces central apnea occurrences in OSA patients, but not in those with comorbidities [21].

This study found that anti-inflammatory therapy with a combination of nasal steroids and anti-leukotriene significantly lowers the adenectomy rate [13]. Children with OSA have nasal and oropharyngeal inflammation, which may contribute to the pathophysiology of breathing difficulties during sleep [22]. Children with OSA have elevated local and systemic inflammatory markers, as well as pro-inflammatory cytokines, which encourage lymphoid tissue development [23]. Anti-inflammatory medications, particularly topical nasal spray corticosteroids, are thought to play a role in reversing adenotonsillar hypertrophy [24, 25]. Furthermore, these drugs have shown efficacy against allergic rhinitis, a prevalent co-morbidity in children with OSA [26].

Two studies in this review reported that orthodontic evaluation and orofacial morphology such as deviations in an overbite, deeper palatal vault, a steeper mandibular plane angle, and less space between the upper and lower arches are significantly associated with a higher incidence of OSA. This requires orthodontic assessment in the detection of pediatric OSA [11, 14]. Fagundes *et al.*, reported that because of the extremely low to moderate level of certainty, these data cannot

indicate either a relationship or a lack thereof between craniofacial morphology and pediatric OSA [27]. The primary characteristics of craniofacial morphology were evaluated using skeletal, soft, and dental studies. In terms of dental examination, children with OSA had shorter inter-canine widths [28]. Overall, there is little understanding of the clinical and physiological phenotypes of OSA [29]. The available research implies that lateral pharyngeal wall thickness and blood pressure are potential OSA characteristics in children and adolescents [30]. To further understand the significance of craniofacial morphology in pediatric OSA, more research on the clinical characteristics associated with the disease is required.

To better understand the incidence of OSA in preschoolers, additional well-conducted longitudinal studies using objective measurements with sufficient power to determine prevalence in each age group are required. To further understand the frequency of OSA in young children, objective sleep testing in the general population is needed. This requires a reliable home sleep apnea test device with established accuracy when compared to PSG in youngsters. Multi-night testing should increase the accuracy and comprehension of night-to-night variations in OSA. Standard pediatric-specific diagnostic criteria, obvious gender, age, and knowledge of concurrent diseases such as body weight, tonsillar size (Mallampati-score) [31], Friedman-palate position [32], facial frameworks, and malocclusions [33] are all necessary.

CONCLUSION

The prevalence of OSA in Saudi children is generally low but rising among children with SCD. AT and lifestyle modifications can reduce the severity and symptoms of sleep apnea in Saudi children with OSA. Anti-inflammatory and steroid therapy was reported to decrease the rate of implementing AT. Certain craniofacial traits were more common, but not consistently, in a subset of juvenile OSA patients. Effective care necessitates a comprehensive approach that includes early detection, surgical and non-surgical procedures, and addressing underlying risk factors like obesity and allergies. By addressing current hurdles and utilizing future research, Saudi Arabia's healthcare system may enhance the quality of life for children with OSA.

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