ALLERGIC RHINITIS AND PEDIATRIC SLEEP DISTURBANCE: FINDINGS FROM A PROSPECTIVE CLINICAL STUDY

RHINITE ALLERGIQUE ET TROUBLES DU SOMMEIL CHEZ L'ENFANT: RÉSULTATS D'UNE ÉTUDE CLINIQUE PROSPECTIVE

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ABSTRACT

Objective: Through this study, we propose to study the impact of allergic rhinitis and its treatment on children's sleep quality.
Methods: We conducted a prospective longitudinal study conducted at the ENT department of the military hospital in Tunis during the period from 2019 to 2021, including children with confirmed allergic rhinitis and aged from 4 to 16 years. The sleep assessment was judged according to Spruyt Gozal's questionnaire and Epworth's sleepiness scale. In children presenting symptoms suggestive of sleep-disordered breathing, respiratory polygraphy was also performed to objectively confirm the diagnosis of obstructive sleep apnea syndrome (OSAS).
Results: One hundred patients were included in our study with an average of 9.09 years. The main symptom was nasal obstruction and a common allergen was mites. Half of patients have excessive daytime sleepiness. The score of Spruyt Gozal showed that 60% of children have respiratory sleep disorders. Among the 60 symptomatic children who underwent respiratory polygraphy, OSAS was confirmed in 40 cases (66.7%). Sleep quality impairment was more pronounced in children with moderate to severe RA with a statistically significant difference ($p<0.05$) and a statistically significant link between elevated sleep quality scores and asthma and obesity.
Conclusion: AR constitutes a significant public health concern in children, notably due to its detrimental effects on sleep quality. Given its potential repercussions on cognitive development, behavior, and quality of life, it is essential that clinicians systematically investigate sleep disturbances in all pediatric patients presenting with AR.
Keys words: Allergic rhinitis; Child, Quality of life; Sleep disorders; Obstructif sleep apnea syndrome.

RÉSUMÉ

Objectif: à travers cette étude, nous proposons d'étudier l'impact de la rhinite allergique et de son traitement sur la qualité du sommeil des enfants.
Méthodes: nous avons mené une étude prospective longitudinale au service d'ORL de l'hôpital militaire de Tunis, entre 2019 et 2021, incluant des enfants âgés de 4 à 16 ans et présentant une rhinite allergique confirmée. L'évaluation du sommeil a été réalisée à l'aide du questionnaire de Spruyt et Gozal ainsi que de l'échelle de somnolence d'Epworth. Chez les enfants présentant des symptômes évocateurs de troubles respiratoires du sommeil, une polygraphie respiratoire a également été réalisée pour confirmer objectivement le diagnostic de syndrome d'apnées obstructives du sommeil (SAOS).
Résultats: cent patients ont été inclus dans notre étude, avec une moyenne d'âge de 9,09 ans. Le symptôme principal était l'obstruction nasale et l'allergène le plus courant était l'acarien. La moitié des patients présentaient une somnolence diurne excessive. Le score de Spruyt Gozal a révélé que 60 % des enfants souffraient de troubles respiratoires du sommeil. Parmi les 60 enfants symptomatiques ayant subi une polygraphie respiratoire, le SAOS a été confirmé dans 40 cas (66,7 %). La détérioration de la qualité du sommeil était plus marquée chez les enfants atteints de RA modérée à sévère, différence qui était statistiquement significative ($p < 0,05$) et qui présentait un lien statistiquement significatif entre les scores élevés de qualité du sommeil et l'asthme ainsi que l'obésité.
Conclusion: La RA constitue un problème de santé publique important chez les enfants, notamment en raison de ses effets néfastes sur la qualité du sommeil. Compte tenu de ses répercussions potentielles sur le développement cognitif, le comportement et la qualité de vie, il est essentiel que les cliniciens examinent systématiquement les troubles du sommeil chez tous les patients pédiatriques présentant une RA.
Mots clés: Rhinite allergique; Enfant, Qualité de vie; Troubles du sommeil; Syndrome d'apnée obstructive du sommeil.

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INTRODUCTION

Sleep is an essential physiological need, playing a pivotal role in the development and well-being of every individual. Any disruption, whether quantitative or qualitative, can have detrimental effects on health and quality of life, particularly in children who are in a period of growth. Thus, it is crucial to identify the causes of these sleep disturbances and to take action to prevent the consequences [1,2]. Allergic rhinitis (AR) is a widespread allergic condition in the pediatric population. Despite its apparent benign nature, AR is considered a debilitating disease due to its impact on children's quality of life. Recent studies focus more on this negative impact on physical and psychosocial aspects, especially sleep. In our region, despite its significance, this impact on sleep quality remains an undervalued and undertreated aspect of AR morbidity [3,4]. Through this study, we evaluated the impact of allergic rhinitis on the quality of sleep, in children before and under treatment.

METHODS

Study Type:

A prospective longitudinal descriptive study gathering children followed at the Military Hospital of Tunis for AR during the period from October 2019 to March 2021.

Study Population

Inclusion Criteria: We included patients aged 4 to 16 years who were diagnosed with allergic rhinitis for the first time at the start of the study with one or more positive allergy test(s). A minimum of two months of well conducted treatment was required.

Exclusion Criteria: Patients with chronic diseases other than comorbidities associated with rhinitis, causing nasal obstruction (juvenile nasosinusoidal polyposis, nasosinusoidal tumor, post-radiotherapy, granulomatous...) and or under treatment at risk of drowsiness (eg neuroleptics, muscle relaxants, …) and or already followed for a sleep disorder (eg narcolepsy or idiopathic hypersomnia) are excluded.

Study Procedure:

Due to the Tunisian pollen season, patient recruitment was carried out in two periods: the first period between October 2019 and March 2020 and the second one between October 2020 and March 2021. For all children, we conducted clinical and paraclinical examinations to confirm or rule out the diagnosis of AR. The severity of AR was assessed according to the ARIA 2016 classification [5]. All patients received medical treatment according to the SFORL 2019 recommendations [6], while explaining hygiene rules and the importance of adherence for children and their guardians. All data were recorded on a predefined information sheet specific to each patient. To assess the impact of AR on sleep quality, children and their guardians (for younger children) completed the validated Arabic version of two questionnaires:

- The Spruyt Gozal Score: Comprising 6 questions evaluating sleep-disordered breathing in children, with a cumulative score > 2.72 considered predictive of sleep-disordered breathing: obstructive sleep apnea syndrome (OSAS), central sleep apnea (CSA), and mixed or complex sleep apnea [7].
- The Epworth Sleepiness Scale adapted for the pediatric population: Assessing daytime sleepiness in children and adolescents. A score > 9 is considered pathological [8].

Additionally, a respiratory polygraphy (sleep ventilatory polygraphy) was performed in children with clinical suspicion of sleep-disordered breathing, particularly those with elevated questionnaire scores and/or symptoms such as habitual snoring or witnessed apneas. The polygraphy included measurements of airflow, respiratory effort, oxygen saturation, and heart rate. An apnea-hypopnea index (AHI) ≥ 1 event/hour was considered abnormal and indicative of OSAS in the pediatric population.

After two months of treatment, we used the same questionnaires to assess the impact of the AR therapeutic arsenal on sleep quality. We defined "good therapeutic control of sleep quality" after two months of AR treatment as children having: a Spruyt Gozal cumulative score < 2.72 after treatment and an Epworth score < 10.

Statistics methods: The collected data were computerized using the statistical software program: SPSS 26. An analytical section involved a bivariate analysis to identify factors influencing sleep quality in children with allergic rhinitis. In this analysis, the dependent variable was dichotomous (influencing sleep quality or not). Thus, in the bivariate analysis, the statistical tests used were the chi-square test or Fisher's exact test for qualitative variables and student's t-test for quantitative variables. The significance threshold was set at 0.05.

RESULTS

One hundred patients aged from 4 to 16 years were included in our study with 58 boys and 42 girls. The average age of the children was 9.09 ± 3.3 years. Nasal obstruction (NO) was the primary symptom, found in all cases, with 75% of cases exhibiting a fluctuating pattern. A history of atopy, mainly asthma, was present in half of the children.

Among non-allergic comorbidities, nocturnal snoring was the most frequently reported symptom, observed in 60% of patients. Based on clinical suspicion of sleep-disordered breathing, respiratory polygraphy was performed in 60 symptomatic children. Obstructive sleep apnea syndrome (OSAS) was objectively confirmed in 40 children (66.7%), while the polygraphic recordings were normal in the remaining 20 cases. The mean Apnea-Hypopnea Index (AHI) among the confirmed cases was 6.1 ± 2.3 events/hour, indicating mild to moderate OSAS.

Dust mites being the most identified allergen. According to the ARIA 2016 classification, 39% of our patients had moderate to severe persistent AR. All patients

received medical treatment based on the SFORL 2019 recommendations.

Sleep quality was assessed using two validated questionnaires: the Epworth Sleepiness Scale and the Spruyt-Gozal score. Sixty children experienced sleep quality disturbances due to respiratory issues, with a Spruyt-Gozal score > 2.72.

Fifty children had excessive daytime sleepiness with an Epworth score >10 (Table 1).

Table 1: Distribution of Children According to the Epworth Sleepiness Scale and the Spruyt Gozal Score before treatment

		Percentage of patients (%)
Epworth Sleepiness Scale	0-9	50
	10-15	30
	>16	20
Spruyt Gozal Score	< 2.72	40
	> 2.72	60

There was a significant correlation between a positive Spruyt-Gozal score (>2.72) and polygraphy-confirmed OSAS ($p < 0.01$), supporting the clinical relevance of the questionnaire. Furthermore, most children with positive polygraphy also had an elevated Epworth score (>10), highlighting the impact of OSAS on daytime functioning.

We studied the severity of AR in children with sleep-disordered breathing, indicated by a Spruyt-Gozal score > 2.72. We observed that sleep-disordered breathing was more prevalent in children with moderate to severe AR, with a statistically significant difference ($p<0.05$).

To analyze factors influencing the Spruyt-Gozal and Epworth scores, a bivariate statistical study was conducted. In our study, asthma and obesity were found to be the two factors significantly affecting the increase in Spruyt-Gozal and Epworth scores among our rhinitic children (Table 2).

Table 2: Multivariate analysis study of factors influencing the Spruyt Gozal score and the Epworth sleepiness scale score

		Spruyt Gozal Score		p value	Epworth Sleepiness Scale		p value
		Score> 2.72	Score< 2.72		>16	<16	
Mean age		7	9	>0.05	7	8	>0.05
Gender	male	25	17	>0.05	20	>0.05	
	female	35	23		30		
asthma		38	12	<0.05	32	18	<0.05
obesity		20	0	<0.05	20	0	<0.05
Sleeping Position: Supine Position		58	42	>0.05	48	52	>0.05
tabaco		20	13	>0.05	18	15	>0.05

Post-treatment sleep quality assessment showed a significant improvement in both sleep quality scores in 50 children. Fifty children with respiratory disturbances had a cumulative score <2.72 and a reduced Epworth score after well-managed treatment and good therapeutic adherence ($p < 0.05$) (Table 3).

Table 3: Distribution of children according to their cumulative Spruyt Gozal and Epworth Scores after two months of treatment

		Percentage of patients (%)
Epworth Sleepiness Scale	0-9	50
	10-15	8
	>16	2
Spruyt Gozal Score	< 2.72	50
	> 2.72	10

For the 10 children who did not show improvement after treatment, further questioning revealed several issues. Three cases involved poor adherence to medical treatment. In five cases, there was associated asthma that was either uncontrolled or partially controlled. Additionally, two cases involved obesity or being overweight.

DISCUSSION

Sleep plays a significant role in mood, cognition, and even vital bodily functions, particularly in growing children. Poor sleep quality can lead to a decrease in quality of life, metabolic syndrome, cardiovascular diseases, and increased mortality [1]. Sleep disorders are common in children, with a prevalence ranging from 11% to 47% [2], OSAS, which can affect up to 4% of children [3]. Currently, several recent studies focus on the association between allergic rhinitis (AR) and sleep disorders in this pediatric population [4]. To assess this association, several specific sleep quality questionnaires have been developed, including the validated Arabic version of the Spruyt-Gozal score [7] and the Epworth Sleepiness Scale [8], which we used in our study. The Spruyt-Gozal score is considered superior to the Pediatric Sleep Questionnaire (PSQ) for identifying various sleep-disordered breathing conditions, such as upper airway resistance syndrome, obesity-related shallow breathing, central sleep apnea, sleep hypoventilation syndrome, mixed apnea, and obstructive sleep apnea [7].

Although the relationship between AR and sleep remains controversial, several studies have demonstrated a significant link between AR and sleep disorders in children. According to the meta-analysis by Liu et al., AR in children leads to disturbances in sleep quality, both nocturnal and diurnal dysfunction [2]. A Portuguese study involving 167 children found that rhinitic children had higher sleep quality scores compared to non-

rhinitic children, with scores being particularly elevated in those with severe and persistent AR [9]. In our study, 60% of rhinitic children had elevated Spruyt-Gozal and Epworth scores, indicating a deterioration in sleep quality. Notably, ventilatory polygraphy performed in symptomatic cases confirmed the presence of OSAS in 66.7% of children, with a mean Apnea-Hypopnea Index (AHI) of 6.1 ± 2.3 events/hour. This reinforces the predictive value of the Spruyt-Gozal score and demonstrates a strong correlation between clinical suspicion and objective confirmation of sleep-disordered breathing. These findings highlight the importance of including objective sleep assessment in children with AR and suggest that symptom-based screening alone may underestimate the prevalence of OSAS.

A statistically significant association has been observed between AR and sleep-disordered breathing. Yen Nguyen-Hoang et al. demonstrated that 65.9% of children with AR develop OSAS, indicating AR as a predictive factor for sleep-disordered breathing [2, 10, 11]. According to Nosetti et al., AR is found in 35% of simple snorers and 6% of children with confirmed OSAS [12]. In our study, 60% of children had an elevated Spruyt-Gozal score >2.72, predictive of OSAS, confirmed by ventilatory polygraphy in 40% of cases.

However, this association between allergic rhinitis (AR) and sleep has been rejected by other authors. Indeed, according to a recent Chinese study involving 1578 children monitored for nocturnal snoring, no statistically significant link was found between AR and the occurrence of sleep-disordered breathing [13].

To evaluate the impact of AR on sleep, it is crucial to consider coexisting factors that influence sleep quality. In the literature, several factors are implicated. Some studies suggest a higher incidence of OSAS in males [13], although gender did not impact sleep quality in our study. Obesity is widely recognized as a risk factor for sleep disorders, particularly OSAS in children, especially those with comorbidities like AR and asthma [13,14]. Adenotonsillar hypertrophy, a common cause of OSAS in children, was associated with elevated Spruyt-Gozal and Epworth scores in our series [1,15] EMBASE, and Cochrane CENTRAL. Inclusion criteria included English-language papers containing original human data, number of subjects ≥7, and age <18 years old. Data was systematically collected on study design, patient demographics, clinical characteristics/ outcomes, and level-of-evidence. Two investigators independently reviewed all articles.\nRESULTS: The initial search yielded 433 abstracts, of which 18 articles were included. Twelve (67%. Asthma is closely linked to impaired sleep quality in children, affecting sleep through various mechanisms. Smoking, both active and passive, has a well-established association with sleep disorders in children [16], although we did not observe a significant link in our study. These factors collectively contribute to the complex relationship between AR and sleep quality in pediatric populations.

Controlled AR significantly enhances children's quality of life, including sleep quality. However, the impact of AR treatments on children's sleep varies depending on the prescribed medication, with limited data available for the pediatric population [17]. While allergen avoidance measures have limited effects on sleep quality, nasal saline irrigation with isotonic or hypertonic solutions is beneficial [18]cytokines, reduced melatonin, and increased IgE. Due to circadian fluctuations of inflammatory mediators, patients often experience worsening symptoms during the night. The following chapter will review the role of antihistamines (oral and nasal. Oral and intranasal antihistamines, although minimally sedating, have a controversial effect on sleep quality due to their limited impact on nasal congestion[18.19]cytokines, reduced melatonin, and increased IgE. Due to circadian fluctuations of inflammatory mediators, patients often experience worsening symptoms during the night. The following chapter will review the role of antihistamines (oral and nasal. Intranasal corticosteroids improve nasal congestion, reducing sleep-disordered breathing severity [20]cytokines, reduced melatonin, and increased IgE. Due to circadian fluctuations of inflammatory mediators, patients often experience worsening symptoms during the night. The following chapter will review the role of antihistamines (oral and nasal. Leukotriene antagonists play a crucial role in managing sleep-disordered breathing in children [21] cytokines, reduced melatonin, and increased IgE. Due to circadian fluctuations of inflammatory mediators, patients often experience worsening symptoms during the night. The following chapter will review the role of antihistamines (oral and nasal. Immunotherapy, targeting the etiology of AR, improves quality of life and sleep, as evidenced by improved nasal symptoms and sleepiness scores in treated patients [22]cytokines, reduced melatonin, and increased IgE. Due to circadian fluctuations of inflammatory mediators, patients often experience worsening symptoms during the night. The following chapter will review the role of antihistamines (oral and nasal.

CONCLUSION

According to our results and a review of the literature, AR is a prevalent allergic condition in children, and its debilitating nature necessitates early diagnosis and treatment tailored to the severity of the symptoms. Sleep is a fundamental need, especially for the pediatric population, and any disruption in its quality can lead to severe psychosocial and vital repercussions. The association between AR and sleep disturbances is common but often underdiagnosed in children, and it should be considered when managing any child with rhinitis.

Informed Consent Statement: informed consent was obtained from each guardian of children for study participation and data publication.

Conflict of interest statement: All other authors declare no conflict of interest

REFERENCES:

1. Lin SY, Melvin TAN, Boss EF, Ishman SL. The association between allergic rhinitis and sleep-disordered breathing in children: a systematic review. Int Forum Allergy Rhinol. 2013 ;3(6) :504-9.
2. Liu J, Zhang X, Zhao Y, Wang Y. The association between allergic rhinitis and sleep: A systematic review and meta-analysis of observational studies. PloS One. 2020;15(2):e0228533.
3. Li Z, Celestin J, Lockey RF. Pediatric Sleep Apnea Syndrome: An Update. J Allergy Clin Immunol Pract. 2016;4(5):852-61.
4. Bosnic-Anticevich S, Smith P, Abramson M, et al. Impact of allergic rhinitis on the day-to-day lives of children: insights from an Australian cross-sectional study. BMJ Open. 2020;10(11):e038870.
5. Elsevier Masson. Rapport SFORL 2019 : rhinites allergiques, Elsevier Masson [Internet]. VG Librairies. [cited on 25 June 2023].
6. Bousquet J, Schünemann HJ, Togias A, et al. Next-generation Allergic Rhinitis and Its Impact on Asthma (ARIA) guidelines for allergic rhinitis based on Grading of Recommendations Assessment, Development and Evaluation (GRADE) and real-world evidence. J Allergy Clin Immunol. 2020;145(1) :70-80.e3.
7. Masoud AI, Mosli RH. Arabic translation and validation of a pediatric sleep questionnaire to assess the prevalence of sleep-disordered breathing among Saudi pre-school children. BMC Pediatr. 2023;23(1):50. Doi: 10.1186/s12887-022-03820-2.
8. Attal BA, Al-Ammar FK, Bezdan M. Validation of the Arabic Version of the Epworth Sleepiness Scale among the Yemeni Medical Students. Sleep Disord. 2020;2020:6760505. doi: 10.1155/2020/6760505.
9. Loekmanwidjaja J, Carneiro ACF, Nishinaka MLT, et al. sleep disorders in children with moderate to severe persistent allergic rhinitis. Braz J Otorhinolaryngol. 2018;84(2):178-4.
10. Nguyen-Hoang Y, Nguyen-Thi-Dieu T, Duong-Quy S. Study of the clinical and functional characteristics of asthmatic children with obstructive sleep apnea. J Asthma Allergy. 2017;10:285-92.
11. Cao Y, Wu S, Zhang L, et al. Association of allergic rhinitis with obstructive sleep apnea: A meta-analysis. Medicine (Baltimore). 2018;97(51):e13783.
12. Nosetti L, Piacentini G, Macchi A, al. Nasal cytology in children with primary snoring and obstructive sleep apnoea syndrome. Int J Pediatr Otorhinolaryngol. 2019;122:133-7.
13. Xu Z, Wu Y, Tai J, et al. Risk factors of obstructive sleep apnea syndrome in children. J Otolaryngol - Head Neck Surg. 2020;49:11. Doi: 10.1186/s40463-020-0404-1. PMID: 3213190.
14. MacLean JE, DeHaan K, Chowdhury T, et al. The scope of sleep problems in Canadian children and adolescents with obesity. Sleep Med. 2018;47:44-50.
15. Dogru M, Evcimik MF, Calim OF. Does adenoid hypertrophy affect disease severity in children with allergic rhinitis? Eur Arch Oto-Rhino-Laryngol Off J Eur Fed Oto-Rhino-Laryngol Soc EUFOS Affil Ger Soc Oto-Rhino-Laryngol - Head Neck Surg. 2017;274(1): 209-13.
16. Cohen-Lévy J, Potenza J, Couloigner V. Syndrome d'apnée obstructive du sommeil de l'enfant : stratégie thérapeutique. Arch Pédiatrie. 2017;24 :S39-47.
17. D'Elia C, Gozal D, Bruni O, et al. Allergic rhinitis and sleep disorders in children - coexistence and reciprocal interactions. J Pediatr (Rio J). 2022;98(5):444-54.
18. Lunn M, Craig T. Rhinitis and sleep. Sleep Med Rev. 2011;15(5):293-9.
19. Chang JL, Goldberg AN, Alt JA, et al. International Consensus Statement on Obstructive Sleep Apnea. Int Forum Allergy Rhinol. 2023;13(7):1061-482.
20. Jung YG, Kim HY, Min JY, et al. Role of Intranasal Topical Steroid in Pediatric Sleep Disordered Breathing and Influence of Allergy, Sinusitis, and Obesity on Treatment Outcome. Clin Exp Otorhinolaryngol. 2011;4(1):27-32.
21. Tsaoussoglou M, Hatzinikolaou S, Baltatzis GE, Lianou L, Maragozidis P, Balatsos NAA, et al. Expression of Leukotriene Biosynthetic Enzymes in Tonsillar Tissue of Children With Obstructive Sleep Apnea: A Prospective Nonrandomized Study. JAMA Otolaryngol Neck Surg. 2014;140(10):944-50.
22. Dhami S, Nurmatov U, Arasi S, Khan T, Asaria M, Zaman H, et al. Allergen immunotherapy for allergic rhinoconjunctivitis: A systematic review and meta-analysis. Allergy. 2017;72(11):1597-631.