Original Article

Association Between Allergic Rhinitis and Sleep Disorders in Pediatric and Adult Populations in Pakistan

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ABSTRACT

Background: Allergic rhinitis (AR) is a prevalent chronic inflammatory condition of the upper airways that heavily impacts the quality of sleep because of nasal obstruction, inflammation of the nasal mucosa, and alteration in the upper airway flow. As the burden of AR rises in the Pakistani population, there remains a scarcity of information regarding disturbed sleep in the pediatric and adult AR patient groups according to the patient's age. **Objectives**: To identify the intensity and factors of sleep disorders in pediatric and adult patients who suffer from physician-verified AR in Pakistan. **Methods**: This was a cross-sectional study involving 124 participants: 62 children and adults each with AR according to ARIA guidelines. Sleep problems were assessed using standardized scales: the Pittsburgh Sleep Quality Index (PSQI), the Epworth Sleepiness Scale (ESS), and the Insomnia Severity Index (ISI). Sleep breathing problems were screened by the Pediatric Sleep Questionnaire in the pediatric group and symptom reports in the adult group. Comparisons of groups were done using the χ^2 test, the t-test, and the odds ratio at the 95% confidence level. **Results**: Sleep problems existed in high proportions in both the pediatric and adult groups: 80.6% in the pediatric group and 85.5% in the adult group. Difficulty in initiating sleep existed predominantly in the adult group (59.7% vs. 45.2%), although OSA existed predominantly in the pediatric group (12.9% vs. 3.2%).In both groups, the average value of the PSQI score exceeded the cut-off value of 8.5. In addition, both groups experienced excessive daytime somnolence and disrupted sleep. **Conclusion**: The co-occurrence of disturbed sleep is evident across the spectrum of AR in Pakistan, especially within the pediatric population, who are at risk of OSA. The incorporation of the management of disturbed sleep in the treatment of AR could be beneficial.

Keywords: allergic rhinitis, sleep disorders, obstructive sleep apnea, pediatric patients, Pakistan, PSQI

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INTRODUCTION

Allergic rhinitis (AR) has been reported to be one of the most common chronic inflammatory diseases of the upper airways that affects both children and adults globally. Occasional attacks of AR can also occur in developing nations like Pakistan due to increasing levels of environmental exposure to allergic stimuli (1-3). The AR symptoms of nasal obstruction, runny nose, congestion, sneezing fits, and itchy eyes greatly affect the patient's quality of disturbed sleep due to mucosal inflammation and parasympathetic stimulation during the night (4). According to various studies from across the world, AR compromises the quality of continuous and efficient sleep and also diminishes work

performance. The pathophysiological factors of mucosal inflammation and arousals from intense parasympathetic stimulation during the night also confer a predisposition of AR to insomnia and disturbed sleep schedules of patients (5).

Children are especially at risk owing to the smaller upper airway diameter, enlarged tonsillar and adenoidal mass, and poor neuromuscular adaptation. The meta-data suggests an increased rate of habitual snoring and OSA in pediatric AR than in non-AR controls, while the intensity of AR has been found to be directly linked with the risk of OSA (6). However, there are scarce observations from the South Asia region regarding this condition. Only a few studies from Pakistan revealed a high magnitude of sleeping disturbances in patients suffering from moderate to severe AR but did not consider inter-age group differences and the disparity between pediatric and adult patients suffering from AR (6). The scarcity of inter-age group data regarding the impact of AR on sleeping patterns in Pakistan remains an unexplored area. This region has its own unique sets of allergens, along with scarce accessibility to the diagnosis of sleeping disorder patients, revealed through national-level surveys (7-8).

Knowing the effect of AR on the quality of sleep across different ages has clinical significance because disrupted patient sleep aggravates symptoms of AR, increases fatigue symptoms during the day, affects cognitive function, and leads to reduced productivity at school or work. There also seems to be a two-way relationship in which the condition aggravates the quality of sleep, and the latter adds to the symptoms of AR and the inflammatory burden because of the condition. The early identification and treatment of disrupted patient sleep can lead to improved symptoms of AR, reduced symptoms of fatigue during the day, and improved quality of patient life. The lack of enough information specific to the region and the need for region-specific guidelines prompted the study to evaluate the difference in the prevalence and type of disrupted sleep experienced by pediatric and adult patients of physician-verified AR in Pakistan. The study also aimed to evaluate the difference in the relationship of the intensity of AR to disrupted patient sleep across the two groups of patients (8-12).

MATERIAL AND METHODS

This observational study recruiting pediatric and adult participants with physician-diagnosed AR was conducted at the outpatient clinic of an otolaryngology department in Pakistan. Participants were recruited without interruption to minimize the risk of sampling bias. The study participants consisted of pediatric as well as adult patients aged above 18 years who had been proven to be suffering from AR according to ARIA criteria and demonstrated clinical findings of the nasal passages. The participants had to be suffering from moderate to severe AR and could not be suffering from AR infections, craniofacial dysfunctions, neuromuscular conditions involving respiratory functions, or proven pre-existing sleeping disorders not linked to AR, as well as the intake of sedatives.

Informed consent was taken from all consenting adults and from parents/caretakers of minors, and from assenting minors when needed. Sleep questionnaire completion was standardized and validated: global sleep quality from the PSQI, daytime sleepiness from the ESS, and insomnia from the ISI. Sleep breathing disorders were screened using developmentally appropriate instruments: the PSQ Sleep-Related Breathing Disorder scale in minors and symptom-based inquiry in adults. The PSQI cut-offs were used: <5: good global sleep quality, 5+: poor global sleep quality. The cut-offs used were ESS: <10: no excessive daytime sleepiness and >10: excessive daytime sleepiness. The ISI had built-in

cutoffs according to standard definitions of insomnia. A diagnosis of OSA was made if there was positive PSQ in the child and consistent symptoms in the adult (12-14).

Information about demographics, duration of AR, ARIA grade of severity, and type of AR (intermittent vs. house dust allergies only/persistent due to additional allergies) was collected through structured questionnaire forms. The data was collected through uniform protocols of trained research personnel and verified through interviews. Covariate information that might affect the results, namely the classification of Body Mass Index, exposure to smoke in the household environment, asthmatic illnesses, and recurrent tonsillitis episodes, was also recorded. The sample size calculation took into account strength to compare groups regarding the parameter of sleep problems. Statistical processing was done using conventional software. Some statistical tests used were the independent samples t-test and the Mann-Whitney U test when comparing continuous variables to determine their distribution and significance. For categorical variables, the χ^2 test was used to compare the differences. In particular, the odds ratios at the level of the 95% CI were used to establish the strength of particular relationships of interest, namely the probability of OSA across the various ages. In regard to missing data points, the method of pairwise deletions was employed. Additionally, statistical significance was placed at the level of $p<0.05$. This study had approval from an institutional review board to ensure the integrity of the study results through the standardization of the data processing steps.

RESULTS

A total of 124 participants were recruited, of whom 62 were pediatric and 62 were adult patients with physician-verified AR. The relevant characteristics of the study groups are presented in Table 1. The adult group was substantially older than the pediatric group (mean age: 34.7 ± 9.6 years vs. 9.4 ± 3.2 years; $p < 0.001$). There were no differences regarding sex proportions, AR duration of at least one year, ARIA grades of severity, and intermittent/persistent courses (all $p > 0.05$). The characteristics of the participants' demographics and AR are shown in Table 1: There was no difference in the clinical characteristics at baseline, except for the difference in the participants' ages. The adults were significantly older than the children (mean difference of 34.7 ± 9.6 years vs. 9.4 ± 3.2 years; t=-19.8; $p<0.001$). The distribution of sex was also equivalent (males: 58.1% of the children vs. 56.5% of the adults; p=0.86). Two-thirds of the participants in both groups had at least one-year duration of their AR (66.1% of the children vs. 72.6% of the adults; p=0.43). The ARIA severity and the persistence of the AR were also equivalent (56.5% of the children had moderate AR vs. 51.6% of the adults; severe AR: 38.5% of the children vs. 48.4% of the adults). The persistence of AR was also equivalent (66.1% of the children vs. 71.0% of the adults; p=0.55). In general, the information suggests that the characteristics of the participants' AR are equivalent, apart from their ages, hence the appropriateness. The high burden of sleep disorder reported can be seen in table 2. The prevalence of insomnia was higher in adults (59.7%) than in children (45.2%) ($p = 0.11$), OR 1.78 (95% CI: 0.88–3.61). Hypersomnia affected 32.3% of children and 38.7% of adults ($p = 0.45$). The risk of hypersomnia was OR 1.32. OSA affected 12.9% of the pediatric group and only 3.2% of the adult group ($\chi^2 = 3.92$). OSA was about four times higher in the pediatric group (OR: 4.48; 95% CI: 0.90–22.3). The four groups together had an effect of at least one SED condition: insomnia, hypersomnia, and OSA. The findings showed that the adjusted difference of at least one SED affected 80.6% of the pediatric group and 85.5% of the adult group ($p = 0$.

Table 3 presents the symptoms of disturbed sleep that contribute to the functional impact of AR. Symptoms of fatigue at waking were found to be extremely frequent: 75.8% of pediatric patients and 83.9% of adults, while excessive daytime somnolence impacted

approximately equal proportions of each group (50.0% vs. 54.8%; p=0.59). Habitual snoring was also reported at a high level of frequency in the pediatric group (53.2%) and adult group (48.4%), reflecting their shared propensity to obstruction of the upper airway. Poor quality of sleep (PSQI>5) was noted in the pediatric group at 61.3% and in the adult group at 64.5% (p=0.71). This suggests the importance of minimizing the impact of AR-induced disturbed sleep across the patient's lifetime. Restless/sleep-disturbed episodes were reported at the same level of frequency (58.1% vs. 62.9%), while morning headaches occurred in approximately one-third of the patients in each group (30.6% vs. 35.5%).

Table 1. Demographic and Allergic Rhinitis Characteristics of Pediatric and Adult Patients (N = 124)

Variable	Pediatric AR (n = 62)	Adult AR (n = 62)	Statistic	p-value
Age, years (mean ± SD)	9.4 ± 3.2	34.7 ± 9.6	t = −19.8	<0.001
Male sex, n (%)	36 (58.1%)	35 (56.5%)	χ^2 = 0.03	0.86
Duration of AR ≥ 1 year, n (%)	41 (66.1%)	45 (72.6%)	χ^2 = 0.61	0.43
ARIA severity				
– Moderate AR, n (%)	38 (61.3%)	32 (51.6%)	χ^2 = 1.14	0.28
– Severe AR, n (%)	24 (38.7%)	30 (48.4%)		
Pattern of AR				
– Intermittent, n (%)	21 (33.9%)	18 (29.0%)	χ^2 = 0.35	0.55
– Persistent, n (%)	41 (66.1%)	44 (71.0%)		

Table 2. Prevalence of Sleep Disorders among Pediatric and Adult AR Patients

Sleep Disorder	Pediatric AR (n = 62)	Adult AR (n = 62)	χ^2	p-value	Effect Size (OR, 95% CI)
Insomnia	28 (45.2%)	37 (59.7%)	2.62	0.11	1.78 (0.88–3.61)
Hypersomnia	20 (32.3%)	24 (38.7%)	0.56	0.45	1.32 (0.63–2.75)
Obstructive sleep apnea	8 (12.9%)	2 (3.2%)	3.92	0.048	4.48 (0.90–22.3)
Any sleep disorder*	50 (80.6%)	53 (85.5%)	0.54	0.46	1.41 (0.57–3.50)

Table 3. Sleep-Related Symptoms in Pediatric and Adult AR Patients

Symptom / Complaint	Pediatric AR (n = 62)	Adult AR (n = 62)	χ^2	p-value
Tired on waking	47 (75.8%)	52 (83.9%)	1.25	0.26
Daytime sleepiness	31 (50.0%)	34 (54.8%)	0.29	0.59
Habitual snoring	33 (53.2%)	30 (48.4%)	0.29	0.59
Poor sleep quality (PSQI > 5)	38 (61.3%)	40 (64.5%)	0.14	0.71
Restless / disturbed sleep	36 (58.1%)	39 (62.9%)	0.31	0.58
Morning headache	19 (30.6%)	22 (35.5%)	0.33	0.57

Table 4. Sleep Scale Scores in Pediatric and Adult AR Patients

Sleep Scale	Pediatric AR (mean ± SD)	Adult AR (mean ± SD)	t-statistic	p-value
Insomnia Severity Index (ISI)	11.4 ± 5.1	13.2 ± 5.5	−1.89	0.06
Epworth Sleepiness Scale (ESS)	9.6 ± 4.2	10.8 ± 4.5	−1.51	0.13
Pittsburgh Sleep Quality Index	8.5 ± 3.0	9.2 ± 3.1	−1.28	0.20

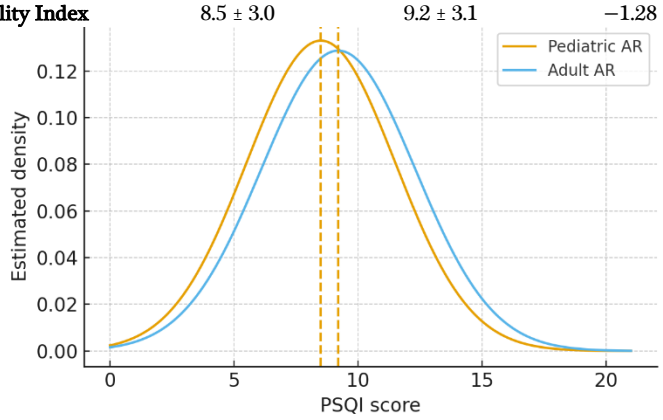

Figure 1 PSQI distributions showing similarly elevated sleep-quality impairment

The scores from the quantitative Sleep questionnaire also appear in Table 4 and reflect the extent of impaired sleep in both groups. The ISI revealed that the insomnia symptoms were severe in the children (11.4 ± 5.1) and adults (13.2 ± 5.5), though there was a trend of

increased insomnia in the adults, which did not reach statistical significance (p = 0.06). The ESS revealed mild to moderate levels of daytime sleepiness in the pediatric group (9.6 ± 4.2) and adults (10.8 ± 4.5). This trend was not statistically significant (p = 0.13). The PSQI revealed poor quality of sleep in the pediatric group (8.5 ± 3.0) and adults (9.2 ± 3.1). In this case, the difference was also not statistically significant (p = 0.20). The scales above indicate the extent of impaired insomnia and increased OSA risk in the pediatric group when compared to the adult group.

Figure 1 regarding distribution of the PSQI in pediatric and adult patients with allergic rhinitis suggests the existence of considerable overlap across the two groups. This suggests that the impact of poor sleep quality remains relatively consistent across the two groups. The distribution of the PSQI peaks at a mean of 8.5 in the pediatric group against a slightly higher mean of approximately 9.2 in the adult group. In both instances, the value is considerably higher than the clinical cut point of 5 points to indicate poor quality of sleep. The smoothed densities of the two groups' PSQI distribution appear to be of equal width. This suggests that the standard deviation of the impact of poor quality of sleep in the two groups is the same. The distribution of the PSQI across the two groups of patients suggests that the right shift observed in the adult group is remarkably small compared to the magnitude of the poor quality of sleep experienced.

DISCUSSION

The results confirm the endemic level of disturbed sleep in the Pakistani pediatric and adult patient group diagnosed with allergic rhinitis and support the existing global consensus regarding the significant effect of AR on the quality of sleep. The statistical overlap of the value of over four-fifths of the patient pool experiencing at least one of the six described sleeping disturbances supports the global observations establishing the disturbed quality of sleep as an integral morbidity of AR due to constant nasal obstruction, the release of inflammatory mediators, and congestion caused by increased airway resistance during the altered state of sleep. The observed high levels of the PSQI questionnaire scales and ESS and ISI scales of both pediatric and adult patients support the complex impact of AR-induced disturbed sleep and confirm the observations of the trends described by the studies of both Léger et al. and the identification of poor sleep efficiency, prolonged latency of sleep onset, and disturbances of the daytime disturbed state described as predominant characteristics of the patient pool of the same AR group. The significance of this research lies within establishing the first age-adjusted data of the extent of the symptoms of disrupted disturbed sleep within the region of Pakistan itself due to the regional level of airborne pollen levels and the persistence of the relative underestimation of the level of disrupted disturbed sleep symptoms in the medical practice of the region (14-21).

One of the key findings from this study that must be noted is the large difference observed in the prevalence of OSA in pediatric AR patients compared to adults. This has been found to be consistent with meta-analyses that confirm the increased risk of SRBDs in the pediatric population due to anatomical factors such as the propensity for the development of large tonsils and a reduced airway opening. The four larger odds of OSA development also confirm previous observations made in Go et al. and D'Elia et al. regarding the coexistence of SRBDs and pediatric AR. The similarity in levels of insomnia and hypersomnia observed suggests that though OSA has been developing physiology as its cause, the symptoms of AR appear consistent across the affected population, whether pediatric or adult (16).

The similarity in the levels of daytime episodes of somnolence, disrupted sleep, and headache in the mornings in children and adults draws attention to the systemic effect of impaired sleep caused by AR. The observed symptoms of impaired sleep that affect cognitive functions and productivity in this study confirm the results of previous research involving both pediatric and adult patients. The findings emphasize the necessity of developing care paths that incorporate the level of impaired sleep into the treatment of AR in Pakistan, as this approach is currently rare (17-21).

The mutually amplifying relationship between poor sleep and symptoms of AR puts these results into context. Poor sleep exacerbates inflammation of the nasal passages, mucosal hypersensitivity, and the intensity of symptoms experienced during the day, thus establishing a vicious cycle of this condition. The consistent levels of PSQI observed in both groups over time indicate the chronic nature of disturbed sleep patterns and might contribute to complications from this condition if it remains unmanaged. Although the study did not measure the objective level of disrupted sleep through tools such as polysomnography, the incorporation of standardized scales helps establish the level of morbidity due to poor sleep quality in AR patients from the region of Pakistan (21-24).

This study contributes fresh data to the regional literature regarding the comparative study of various ages, although some limitations of the study must be appreciated. The study had limitations because it did not consider the cause-effect relationship due to its cross-sectional nature and might not accurately measure the OSA through the questionnaire method compared to the quantitative approach. Although this study explored some possible confounding factors, the regression analysis did not comprehensively explore them, which might affect the study's results concerning the impact of various factors related to sleep quality (24).

CONCLUSION

The findings from this study indicate the high level of disrupted sleep experienced by pediatric as well as adult allergic rhinitis patients in Pakistan. Even though insomnia and hypersomnia were found to be prevalent in the group of participants without restrictions of age, the occurrence of OSA was found to be considerably high in the pediatric group. The various facets of sleep being negatively affected in the participants bring out the significance of analyzing the level of sleep problems being experienced in the case of allergic rhinitis sufferers. A high level of awareness regarding this problem can bring about an improvement in the condition of the affected people in the nations of the Asia-Pacific region.

DECLARATIONS

Ethical Approval

This study was approved by the Institutional Review Board of University of Lahore

Informed Consent

Written informed consent was obtained from all participants included in the study.

Conflict of Interest

The authors declare no conflict of interest.

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Authors' Contributions

Concept: AK; Design: SR; Data Collection: MN; Analysis: BU; Drafting: AK.

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Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Acknowledgments
Not applicable.
Study Registration
Not applicable.

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