



Association between nasal obstruction and sleep quality in adults

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ABSTRACT

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Received: 22-02-2026

Accepted: 28-03-2026

Published: 03-04-2026

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Background: Nasal obstruction is a common otorhinolaryngological complaint and may interfere with normal breathing during sleep. Persistent obstruction can contribute to mouth breathing, snoring, sleep fragmentation, and daytime tiredness. The present study aimed to assess the association between nasal obstruction severity and sleep quality in adults.

Materials and Methods: This hospital-based observational cross-sectional study was conducted in the Department of Otorhinolaryngology, Saraswathi Institute of Medical Sciences, Hapur. UP, from January 2024 to January 2026. A total of 110 adults with nasal obstruction were included.

Results: The mean age of participants was 40.85 ± 11.98 years, and 57.3% were male. The mean NOSE score was 56.91 ± 25.60 and the mean global PSQI score was 5.93 ± 2.71 . Poor sleep quality was observed in 62 of 110 participants (56.4%). The prevalence of poor sleep increased progressively from 16.7% in mild nasal obstruction to 34.5% in moderate, 71.4% in severe, and 85.7% in extreme obstruction ($p < 0.001$).

Conclusion: Increasing severity of nasal obstruction was significantly associated with worsening sleep quality in adults. Routine assessment of sleep-related symptoms may be useful in patients presenting with moderate to severe nasal obstruction.

Keywords: Nasal obstruction; NOSE scale; sleep quality; Pittsburgh Sleep Quality Index; allergic rhinitis; snoring.

INTRODUCTION

Sleep is an essential biological process that supports physical recovery, cognitive functioning, emotional health, and overall well-being. Poor sleep quality can affect concentration, memory, work performance, mood, and daytime functioning. Sleep disturbances may result from several medical, psychological, environmental, and respiratory factors. Among respiratory factors, nasal obstruction has received increasing attention because normal nasal breathing plays an important role in maintaining comfortable and stable breathing during sleep. Nasal obstruction may interfere with airflow and may contribute to sleep disturbance, snoring, mouth breathing, repeated awakenings, and daytime tiredness [1].

Nasal obstruction is a common complaint encountered in otorhinolaryngology practice. It can be caused by structural or inflammatory conditions, including nasal septal deviation, inferior turbinate hypertrophy, allergic rhinitis, non-allergic rhinitis, chronic rhinosinusitis, nasal polyps, and nasal valve dysfunction. The severity of obstruction can vary from mild intermittent difficulty in breathing to persistent bilateral obstruction. Rhinologic diseases such as chronic rhinosinusitis, rhinitis, and nasal septal deviation have been associated with impaired subjective sleep outcomes [2]. A systematic review examining rhinologic disorders found abnormal or high sleep disturbance scores among patients with chronic rhinosinusitis, rhinitis, and nasal septal deviation, suggesting that nasal symptoms may influence sleep beyond their effects during waking hours [2].

Several mechanisms may explain the relationship between nasal obstruction and poor sleep. The nose normally provides a low-resistance pathway for breathing and performs important functions such as filtration, humidification, and regulation of inspired air. When nasal resistance increases, individuals may shift from nasal to oral breathing. Increased upper airway

resistance may also increase negative pressure within the airway during inspiration, which may contribute to narrowing of the collapsible portions of the upper respiratory tract. These changes may increase respiratory effort and produce repeated arousals or sleep fragmentation [3]. Nasal obstruction has therefore been considered a contributing factor in sleep-related breathing disorders. However, its relationship with objective measures of obstructive sleep apnea is complex. A systematic review reported that reducing nasal resistance does not consistently result in significant improvement in the apnea–hypopnea index, although other measures such as sleep fragmentation and sleep architecture may still be affected [3].

Structural nasal obstruction, particularly nasal septal deviation, may have an important effect on subjective sleep quality. Kara et al. evaluated patients with nasal septal deviation without obstructive sleep apnea using the Pittsburgh Sleep Quality Index and found significantly poorer sleep quality among patients with septal deviation compared with individuals without nasal obstruction [4]. These findings suggest that nasal obstruction may disturb sleep even in the absence of clinically diagnosed obstructive sleep apnea. Nasal obstruction can make breathing uncomfortable during the night, increase mouth breathing and dryness, and contribute to repeated awakenings, all of which may reduce restorative sleep.

Inflammatory nasal diseases may also affect sleep. Allergic rhinitis is frequently associated with nasal congestion, rhinorrhoea, sneezing, and itching, and symptoms may become troublesome during the night. In the SOMNIAAR study, which included more than 2,000 patients with allergic rhinitis, over half of the participants had poor sleep quality. Nasal obstruction was one of the main symptoms associated with impaired sleep quality [5]. Similarly, a systematic review and meta-analysis by Liu et al. found that allergic rhinitis was associated with poorer sleep quality, increased sleep disturbances, longer sleep latency, lower sleep efficiency, snoring, daytime sleepiness, and other nocturnal and daytime problems [6]. These findings demonstrate that nasal obstruction related to inflammatory disease may have consequences that extend beyond local nasal symptoms.

Another important observation supporting the relationship between nasal obstruction and sleep is the improvement in sleep reported after treatment of nasal disease. Stapleton et al. prospectively evaluated patients undergoing nasal airway surgery for symptomatic nasal obstruction. Following surgery, improvement in nasal obstruction was accompanied by improvement in subjective sleep quality, supporting a relationship between nasal airflow and sleep-related symptoms [7]. A prospective study among patients undergoing septoplasty also found significant changes in nasal obstruction, subjective sleep quality, fatigue, and comfort after treatment [8]. More broadly, a systematic review and meta-analysis involving patients treated for nasal obstruction secondary to allergic rhinitis or nasal septal deviation found significant improvements in subjective sleep quality following treatment [1]. However, improvement in objective sleep measures was less consistent, suggesting that subjective sleep quality and polysomnographic severity may represent related but different outcomes.

Accurate assessment is therefore important when investigating the association between nasal obstruction and sleep. The Nasal Obstruction Symptom Evaluation (NOSE) scale is a validated, reliable, and responsive patient-reported instrument specifically developed to determine the severity and impact of nasal obstruction in adults [9]. Sleep quality can be evaluated using the Pittsburgh Sleep Quality Index (PSQI), a widely used questionnaire that assesses several components of sleep over the previous month, including subjective sleep quality, sleep latency, duration, efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction [10]. The use of validated instruments such as the NOSE scale and PSQI can provide standardized measures for examining the relationship between the severity of nasal obstruction and sleep quality.

Although previous studies support an association between rhinologic disease, nasal obstruction, and impaired sleep, the magnitude of this relationship may differ according to the cause and severity of obstruction, age, body mass index, allergic disease, and the presence of sleep-disordered breathing [1,2]. Furthermore, subjective sleep impairment may occur even when objective indices of sleep apnea are not markedly abnormal [3]. Therefore, evaluation of nasal obstruction in adults presenting with poor sleep may have important clinical value. Studying the association between nasal obstruction and sleep quality can help determine whether increasing severity of nasal symptoms is related to worsening sleep and may support earlier identification and treatment of potentially reversible causes of sleep disturbance.

MATERIALS AND METHODS

Study Design and Setting

This hospital-based observational cross-sectional study was conducted in the Department of Otorhinolaryngology, Saraswathi Institute of Medical Sciences, Hapur, UP, India. The study included patients attending the outpatient department (OPD) as well as those admitted to the department during the study period from January 2024 to January 2026.

The study was designed to assess the association between the severity of nasal obstruction and sleep quality among adults. Reporting of the study was planned in accordance with the principles of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.

Study Population

All adult patients attending the Otorhinolaryngology OPD or admitted to the department during the study period were screened for eligibility. Patients fulfilling the predefined eligibility criteria and providing informed consent were enrolled consecutively.

Inclusion Criteria

Patients were included if they fulfilled the following criteria:

1. Age 18 years or above.
2. Presence of subjective nasal obstruction at the time of presentation or a history of persistent or recurrent nasal obstruction.
3. Patients attending the ENT OPD or admitted to the Department of Otorhinolaryngology during the study period.
4. Ability to understand and complete the study questionnaires.
5. Willingness to participate and provide written informed consent.

Exclusion Criteria

Patients were excluded if they had:

1. Age below 18 years.
2. Acute upper respiratory tract infection at the time of assessment.
3. Previous nasal or paranasal sinus surgery that could substantially alter nasal airflow, unless the patient was being evaluated for persistent or recurrent obstruction.
4. Major craniofacial abnormality affecting the nasal airway.
5. Active nasal or sinonasal malignancy.
6. Severe neurological or psychiatric illness affecting the ability to provide reliable responses.
7. Current use of sedative or hypnotic medication likely to substantially influence sleep quality.
8. Night-shift work or another major disturbance of the normal sleep-wake cycle.
9. Inability or unwillingness to complete the study questionnaires or provide informed consent.

Patients with common conditions responsible for nasal obstruction, including deviated nasal septum, inferior turbinate hypertrophy, allergic rhinitis, chronic rhinosinusitis and nasal polyposis, were not excluded because these conditions represented clinically relevant causes of nasal obstruction in the study population.

Sampling Technique and Sample Size

A consecutive total-enumeration sampling method was used. All patients fulfilling the eligibility criteria and presenting during the predefined study period from January 2024 to January 2026 were considered for inclusion. Therefore, no fixed sample size was selected before recruitment. The final sample consisted of all eligible patients who consented to participate and had complete data for the primary study variables.

This approach was chosen to minimise sampling selection and to maximise representation of the spectrum of nasal obstruction encountered in routine tertiary-care otorhinolaryngology practice.

Data Collection

Data were collected using a structured case-record form. Information was obtained through patient interview, medical records and clinical examination. The following variables were recorded:

- Age
- Sex
- Body mass index
- Smoking status
- Alcohol consumption
- Duration of nasal obstruction
- Unilateral or bilateral obstruction
- Intermittent or persistent symptoms
- History of allergic rhinitis
- History of chronic rhinosinusitis
- Snoring
- Mouth breathing during sleep
- Witnessed apnoea, where reported
- Daytime sleepiness
- Relevant medical comorbidities, including hypertension, diabetes mellitus and thyroid disease
- Current medications
- Previous treatment for nasal obstruction

Body mass index was calculated as body weight in kilograms divided by height in metres squared (kg/m^2).

Assessment of Nasal Obstruction

All participants underwent a detailed otorhinolaryngological examination. Nasal examination included inspection of the external nose, anterior rhinoscopy and assessment of the nasal septum and inferior turbinates. The presence of septal deviation, turbinate hypertrophy, mucosal oedema, nasal discharge, polyps or other causes of obstruction was documented.

When clinically indicated, diagnostic nasal endoscopy was performed using a rigid or flexible nasal endoscope to assess the nasal cavity, septum, turbinates, middle meatus, nasal valve region and nasopharynx. Additional radiological investigations, including computed tomography of the paranasal sinuses, were performed only when clinically indicated and were not mandatory for inclusion in the study.

The severity of subjective nasal obstruction was assessed using the Nasal Obstruction Symptom Evaluation (NOSE) scale. The NOSE scale consists of five questions addressing nasal congestion or stuffiness, nasal blockage or obstruction, difficulty breathing through the nose, difficulty sleeping and inability to obtain sufficient air through the nose during exercise or exertion. Each item is scored from 0 to 4, and the summed score is multiplied by 5 to provide a total score ranging from 0 to 100, with higher scores indicating more severe nasal obstruction.

For analysis, the NOSE score was primarily treated as a continuous variable. Where clinically useful, patients could additionally be classified according to increasing severity of nasal obstruction based on their NOSE scores.

Assessment of Sleep Quality

Sleep quality was evaluated using the Pittsburgh Sleep Quality Index (PSQI). The PSQI assesses sleep during the preceding one month and contains seven components:

1. Subjective sleep quality
2. Sleep latency
3. Sleep duration
4. Habitual sleep efficiency
5. Sleep disturbances
6. Use of sleep medication
7. Daytime dysfunction

Each component is scored from 0 to 3, producing a global PSQI score ranging from 0 to 21. Higher scores represent poorer sleep quality. A global PSQI score greater than 5 was considered indicative of poor sleep quality.

The PSQI global score was analysed both as a continuous outcome and as a categorical outcome, with participants classified as having good or poor sleep quality.

Study Outcomes

The primary outcome was the association between the severity of nasal obstruction, measured using the NOSE score, and overall sleep quality, measured using the global PSQI score.

Secondary outcomes included:

- Proportion of patients with poor sleep quality.
- Comparison of PSQI scores across different degrees of nasal obstruction.
- Association between nasal obstruction severity and individual PSQI components.
- Relationship between specific causes of nasal obstruction and sleep quality.
- Association of age, sex, BMI, duration of nasal obstruction, allergic disease, smoking, snoring and relevant comorbidities with poor sleep quality.

Control of Potential Confounding

Because sleep quality may be influenced by factors other than nasal obstruction, potentially important confounding variables were recorded prospectively. These included age, sex, BMI, smoking status, alcohol use, diabetes mellitus, hypertension, thyroid disease, allergic rhinitis, chronic rhinosinusitis, snoring and duration of nasal symptoms.

Multivariable statistical models were used to determine whether the association between nasal obstruction and sleep quality remained significant after adjustment for clinically relevant potential confounders.

Measures to Reduce Bias

Consecutive recruitment was used to minimise selection bias. The same predefined eligibility criteria were applied throughout the study period. Standardised and validated questionnaires were used for the assessment of both nasal obstruction and sleep quality.

Questionnaire responses were obtained before treatment-related changes whenever possible to reduce the possibility that treatment influenced symptom reporting. Clinical findings and questionnaire scores were entered into a standardised data collection form. Data were checked for completeness and consistency before statistical analysis.

Statistical Analysis

Data were entered into a dedicated database and analysed using an appropriate statistical software package. The software name and version used for the final analysis should be stated in the manuscript.

Continuous variables were assessed for normality using graphical methods and the Shapiro-Wilk test. Normally distributed continuous variables were expressed as mean $\pm$ standard deviation, whereas non-normally distributed variables were presented as median with interquartile range. Categorical variables were reported as frequencies and percentages.

All statistical tests were two-sided, and a p-value <0.05 was considered statistically significant. Wherever applicable, effect estimates were reported together with 95% confidence intervals rather than relying on p-values alone.

RESULTS

Study Population

A total of 110 adult patients with nasal obstruction fulfilling the eligibility criteria were included in the analysis. Complete NOSE and Pittsburgh Sleep Quality Index (PSQI) data were available for all participants.

The mean age of the participants was 40.85 ± 11.98 years. There were 63 (57.3%) males and 47 (42.7%) females. The mean body mass index (BMI) was 26.62 ± 4.16 kg/m². Snoring was reported by 44 (40.0%) patients, while 52 (47.3%) reported mouth breathing during sleep. Daytime sleepiness was present in 41 (37.3%) patients. The baseline characteristics of the study population are shown in Table 1.

Table 1. Baseline demographic and clinical characteristics of study participants (N = 110)

Characteristic	Value
Age, years, mean $\pm$ SD	40.85 $\pm$ 11.98
Male, n (%)	63 (57.3)
Female, n (%)	47 (42.7)
BMI, kg/m ² , mean $\pm$ SD	26.62 $\pm$ 4.16
BMI <25 kg/m ² , n (%)	41 (37.3)
BMI 25–29.9 kg/m ² , n (%)	47 (42.7)
BMI ≥ 30 kg/m ² , n (%)	22 (20.0)
Current smoker, n (%)	25 (22.7)
Alcohol use, n (%)	11 (10.0)
Hypertension, n (%)	20 (18.2)
Diabetes mellitus, n (%)	12 (10.9)
Thyroid disorder, n (%)	8 (7.3)
Snoring, n (%)	44 (40.0)
Mouth breathing during sleep, n (%)	52 (47.3)
Witnessed apnoea, n (%)	6 (5.5)
Daytime sleepiness, n (%)	41 (37.3)

The median duration of nasal obstruction was 14 months (IQR 8–24 months). Bilateral obstruction was more common and was present in 70 (63.6%) patients, while 40 (36.4%) had predominantly unilateral obstruction. Persistent nasal obstruction was reported by 74 (67.3%) patients.

The most frequently identified structural abnormality was deviated nasal septum, present in 62 (56.4%) patients. Allergic rhinitis was present in 51 (46.4%), inferior turbinate hypertrophy in 47 (42.7%), and chronic rhinosinusitis in 35 (31.8%). More than one abnormality could be present in the same patient.

Table 2. Clinical characteristics and causes of nasal obstruction (N = 110)

Variable	n (%)
Pattern of obstruction	
Unilateral	40 (36.4)
Bilateral	70 (63.6)
Intermittent	36 (32.7)
Persistent	74 (67.3)
Duration of symptoms	
<6 months	24 (21.8)
6–12 months	34 (30.9)
>12 months	52 (47.3)
Underlying nasal condition*	
Deviated nasal septum	62 (56.4)

Allergic rhinitis	51 (46.4)
Inferior turbinate hypertrophy	47 (42.7)
Chronic rhinosinusitis	35 (31.8)
Nasal polyposis	14 (12.7)
Nasal valve dysfunction	9 (8.2)
Other causes	6 (5.5)
Diagnostic nasal endoscopy performed	93 (84.5)
CT paranasal sinuses performed	39 (35.5)

The mean NOSE score was 56.91 ± 25.60 , with a median score of 60.0 (IQR 35.0–78.75). The mean global PSQI score was 5.93 ± 2.71 , with a median of 6.0 (IQR 4.0–8.0).

Based on the predefined PSQI cut-off, 62 of 110 patients (56.4%; 95% CI 47.0–65.3%) had poor sleep quality, whereas 48 (43.6%) had good sleep quality.

Among the different PSQI components, subjective sleep quality showed the highest mean component score, followed by sleep latency. Use of sleep medication was not observed because patients using sedative or hypnotic medication likely to influence sleep were excluded according to the study criteria.

Table 3. Distribution of NOSE and PSQI scores among study participants

Parameter	Mean $\pm$ SD	Median (IQR)	Range
NOSE total score	56.91 ± 25.60	60.0 (35.0–78.75)	10–100
Global PSQI score	5.93 ± 2.71	6.0 (4.0–8.0)	0–12
Subjective sleep quality	1.19 ± 1.01	1.0 (0–2)	0–3
Sleep latency	1.05 ± 0.98	1.0 (0–2)	0–3
Sleep duration	0.82 ± 0.94	1.0 (0–1)	0–3
Habitual sleep efficiency	0.96 ± 0.91	1.0 (0–2)	0–3
Sleep disturbances	0.96 ± 0.99	1.0 (0–2)	0–3
Use of sleep medication	0.00 ± 0.00	0 (0–0)	0
Daytime dysfunction	0.94 ± 0.90	1.0 (0–1)	0–3
Overall sleep quality		n (%)	
Good sleep quality, PSQI ≤ 5		48 (43.6)	
Poor sleep quality, PSQI > 5		62 (56.4)	
Total		110 (100.0)	

A clear increase in PSQI score was observed with increasing severity of nasal obstruction. Patients with mild nasal obstruction had a median PSQI score of 3.0 (IQR 1.25–4.75), which increased to 5.0 (IQR 4.0–6.0) among patients with moderate obstruction, 7.0 (IQR 5.0–8.0) among patients with severe obstruction, and 8.0 (IQR 7.0–9.25) among those with extreme obstruction.

The difference in PSQI scores across nasal obstruction severity groups was statistically significant (Kruskal-Wallis $H = 43.66$, $p < 0.001$).

Poor sleep quality was present in only 3 of 18 (16.7%) patients with mild nasal obstruction. Its prevalence increased to 34.5% in moderate obstruction, 71.4% in severe obstruction, and 85.7% in extreme obstruction. The association between nasal obstruction severity and poor sleep quality was statistically significant ($\chi^2 = 30.22$, $df = 3$, $p < 0.001$).

Table 4. Association between severity of nasal obstruction and sleep quality

Nasal obstruction severity	n	NOSE score, mean $\pm$ SD	PSQI score, median (IQR)	Good sleep, n (%)	Poor sleep, n (%)
Mild	18	18.61 ± 5.64	3.0 (1.25–4.75)	15 (83.3)	3 (16.7)
Moderate	29	38.97 ± 6.86	5.0 (4.0–6.0)	19 (65.5)	10 (34.5)
Severe	35	66.29 ± 6.90	7.0 (5.0–8.0)	10 (28.6)	25 (71.4)
Extreme	28	88.39 ± 7.21	8.0 (7.0–9.25)	4 (14.3)	24 (85.7)
Total	110	56.91 ± 25.60	6.0 (4.0–8.0)	48 (43.6)	62 (56.4)

The NOSE total score showed a moderate positive correlation with the global PSQI score (Spearman's $r_s = 0.630$, 95% CI 0.502–0.731, $p < 0.001$). This indicated that increasing severity of nasal obstruction was associated with progressively poorer sleep quality.

Positive correlations were also found between NOSE scores and sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, and subjective sleep quality. The associations were strongest for habitual sleep efficiency and sleep duration.

Table 5. Correlation between NOSE score and PSQI parameters

PSQI parameter	Spearman's r_s	95% CI	p-value
Global PSQI score	0.630	0.502–0.731	<0.001
Subjective sleep quality	0.214	0.028–0.386	0.025
Sleep latency	0.353	0.178–0.507	<0.001
Sleep duration	0.372	0.198–0.522	<0.001
Habitual sleep efficiency	0.374	0.201–0.524	<0.001
Sleep disturbances	0.339	0.162–0.495	<0.001
Use of sleep medication	Not estimable	—	—
Daytime dysfunction	0.174	–0.013–0.350	0.069

The correlation for sleep medication could not be estimated because the component score was zero in all included participants.

On univariable logistic regression analysis, increasing NOSE score and snoring were strongly associated with poor sleep quality. For every 10-point increase in NOSE score, the unadjusted odds of poor sleep quality increased by approximately 68% (OR 1.68, 95% CI 1.37–2.06, $p < 0.001$).

After adjustment for age, sex, BMI, allergic rhinitis, chronic rhinosinusitis, and snoring, NOSE score remained an independent predictor of poor sleep quality. Each 10-point increase in NOSE score was associated with a 58% increase in the adjusted odds of poor sleep quality (adjusted OR 1.58, 95% CI 1.26–1.97, $p < 0.001$).

Allergic rhinitis was independently associated with poor sleep quality (adjusted OR 3.25, 95% CI 1.15–9.22, $p = 0.027$). Snoring was also an independent predictor, with patients reporting snoring having more than four times the adjusted odds of poor sleep quality (adjusted OR 4.39, 95% CI 1.40–13.77, $p = 0.011$).

Age, sex, BMI, and chronic rhinosinusitis were not independently associated with poor sleep quality in the final model.

Table 6. Univariable and multivariable logistic regression analysis of factors associated with poor sleep quality

Predictor	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
NOSE score, per 10-point increase	1.68 (1.37–2.06)	<0.001	1.58 (1.26–1.97)	<0.001
Age, per 10-year increase	1.20 (0.87–1.66)	0.256	1.18 (0.78–1.80)	0.431
Male sex	1.25 (0.58–2.68)	0.563	0.99 (0.37–2.68)	0.986
BMI, per 1 kg/m ² increase	0.99 (0.90–1.08)	0.790	0.92 (0.81–1.05)	0.221
Allergic rhinitis	1.63 (0.76–3.49)	0.211	3.25 (1.15–9.22)	0.027
Chronic rhinosinusitis	0.53 (0.24–1.19)	0.126	0.58 (0.20–1.69)	0.321
Snoring	6.92 (2.78–17.22)	<0.001	4.39 (1.40–13.77)	0.011

The multivariable model showed good discrimination, with an area under the receiver operating characteristic curve of 0.857 (95% CI 0.775–0.927). The Hosmer-Lemeshow goodness-of-fit test showed no evidence of poor calibration ($\chi^2 = 9.10$, $p = 0.334$). The overall regression model was statistically significant (likelihood-ratio $p < 0.001$).

Figure 1. Distribution of nasal obstruction severity among the study participants

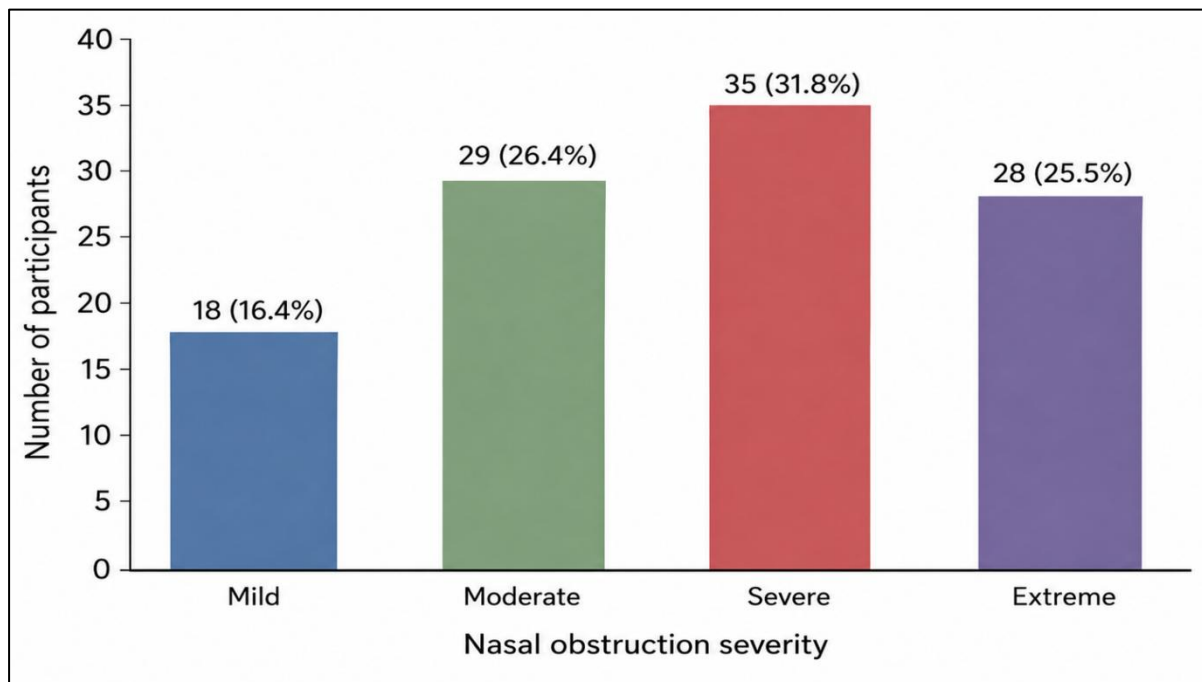


Figure 1 shows the distribution of nasal obstruction severity among the 110 study participants. Severe nasal obstruction was the most common category, observed in 35 (31.8%) patients, followed by moderate obstruction in 29 (26.4%) and extreme obstruction in 28 (25.5%) patients. Mild nasal obstruction was least frequent, occurring in 18 (16.4%) participants. Overall, more than half of the study population had either severe or extreme nasal obstruction, indicating a substantial burden of clinically significant nasal symptoms in the study group.

Figure 2. Correlation between Nasal Obstruction Symptom Evaluation score and global Pittsburgh Sleep Quality Index score

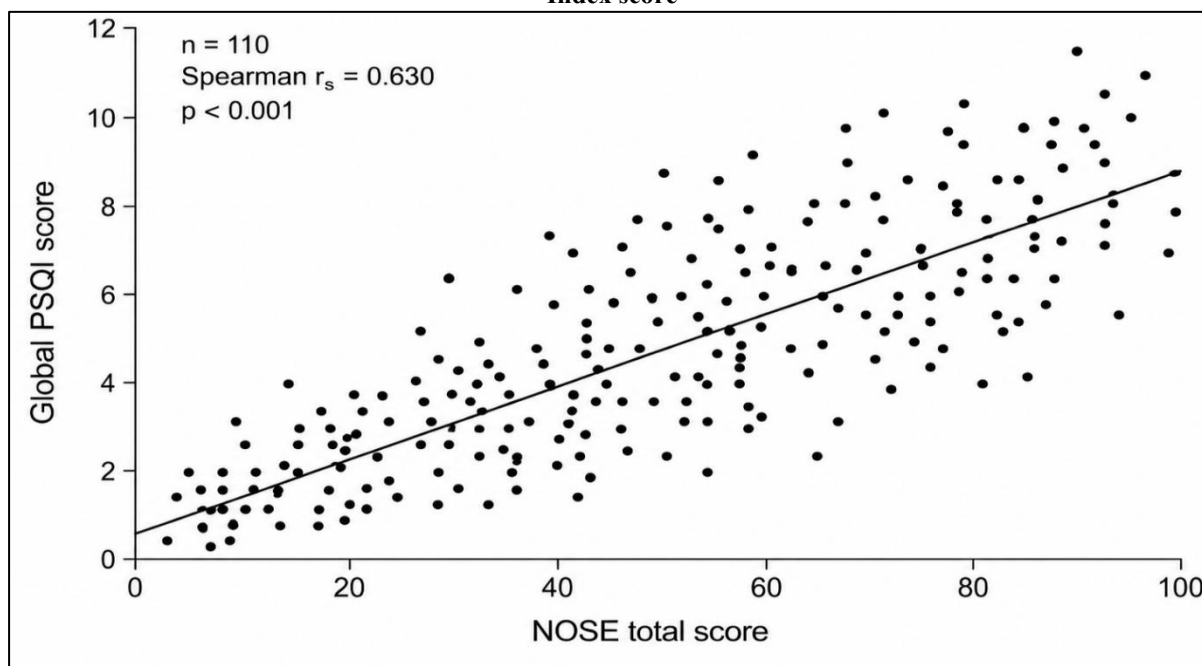


Figure 2 shows a moderate positive correlation between the Nasal Obstruction Symptom Evaluation (NOSE) score and the global Pittsburgh Sleep Quality Index (PSQI) score among the 110 study participants. As the severity of nasal obstruction increased, sleep quality progressively worsened, as indicated by higher PSQI scores. The association was statistically significant (Spearman's $r_s = 0.630$, $p < 0.001$). This finding suggests that greater nasal obstruction is significantly associated with poorer sleep quality in adults.

Figure 3. Global Pittsburgh Sleep Quality Index scores according to nasal obstruction severity

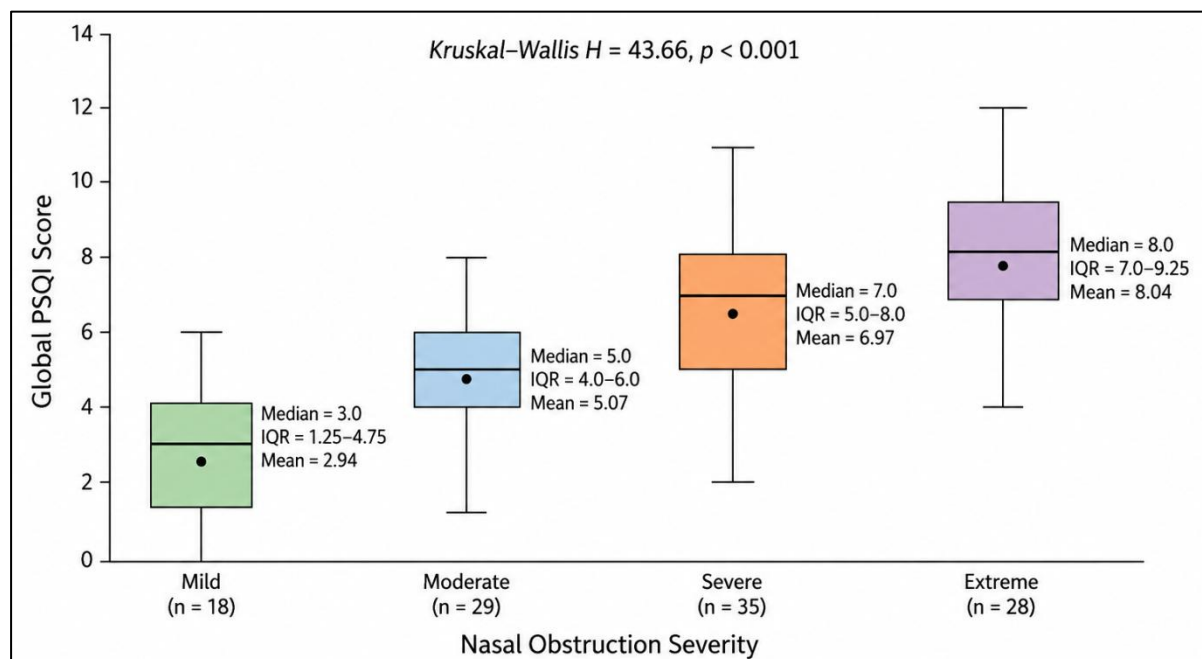


Figure 3 shows a progressive increase in global Pittsburgh Sleep Quality Index (PSQI) scores with increasing severity of nasal obstruction. The median PSQI score was 3.0 in the mild group, 5.0 in the moderate group, 7.0 in the severe group, and 8.0 in the extreme obstruction group. The difference in PSQI scores across the four severity categories was statistically significant (Kruskal-Wallis $H = 43.66$, $p < 0.001$). These findings indicate that greater nasal obstruction severity was associated with poorer sleep quality among the study participants.

DISCUSSION

The present study examined the association between nasal obstruction and sleep quality among 110 adults attending a tertiary care centre in Western Uttar Pradesh. The main finding was a significant relationship between increasing severity of nasal obstruction and worsening sleep quality. More than half of the participants (56.4%) had poor sleep quality, defined as a global Pittsburgh Sleep Quality Index (PSQI) score greater than 5. The proportion of patients with poor sleep increased progressively from 16.7% among those with mild nasal obstruction to 34.5% in moderate obstruction, 71.4% in severe obstruction, and 85.7% in extreme obstruction. In addition, the NOSE score demonstrated a moderate positive correlation with the global PSQI score ($r_s = 0.630$, $p < 0.001$). These findings suggest that the severity of nasal obstruction has an important relationship with subjective sleep quality in adults.

The observed association is supported by population-based evidence. Bengtsson et al. studied 400 women and found that nocturnal nasal obstruction was independently associated with several sleep-related problems, including difficulty initiating and maintaining sleep, snoring, waking with a dry mouth, unrefreshing sleep, and excessive daytime sleepiness [11]. Importantly, these relationships remained after adjustment for age, BMI, smoking, and asthma. The progressive increase in poor sleep across nasal obstruction categories in the present study is consistent with the concept that the effect of nasal obstruction on sleep may increase as the obstruction becomes more troublesome.

Young et al. also demonstrated an association between nasal congestion and sleep-disordered breathing in a large population-based investigation. Individuals with frequent nighttime rhinitis symptoms were more likely to report habitual snoring, excessive daytime sleepiness, and non-restorative sleep. Nasal congestion attributed to allergy was associated with a 1.8-fold higher likelihood of moderate-to-severe sleep-disordered breathing [12]. These observations support the clinical relevance of nighttime nasal patency and provide a possible explanation for the worsening sleep quality found in the present study with increasing NOSE scores.

The findings are also supported by evidence from South Asian adults. Hussain et al. evaluated 2,497 employed adults in Pakistan and reported nasal blockage in 45.2% of respondents. Nasal blockage was significantly associated with snoring, witnessed apnoea, unrefreshing sleep, and greater daytime sleepiness [13]. Interestingly, objective respiratory indices such as the oxygen desaturation index and apnoea-hypopnoea index did not differ significantly between adults with and without self-reported nasal blockage. This distinction is important when interpreting the present results. The PSQI measures the patient's experience of sleep rather than objective respiratory events. Nasal obstruction may therefore substantially disturb perceived sleep quality even when it does not necessarily produce severe obstructive sleep apnoea.

A similar observation was reported by Värendh et al. in a large cohort of 810 untreated patients with obstructive sleep apnoea. Nocturnal nasal obstruction was reported by approximately one-third of participants and was associated with greater daytime sleepiness and reduced mental quality of life [14]. Together with the present findings, these data suggest that nasal obstruction

should not be regarded simply as a local nasal complaint. Its consequences may extend into nighttime breathing, sleep continuity, daytime functioning, and overall quality of life.

In the present study, the mean global PSQI score was 5.93 ± 2.71 , and 56.4% of patients were classified as poor sleepers. The proportion of poor sleepers was lower than that reported in some populations with chronic rhinosinusitis. Alt et al., for example, evaluated 268 patients with chronic rhinosinusitis and found that 75% had poor sleep quality, with a mean PSQI score of 9.4 [15]. This difference may be explained by differences in study populations. The present study included several causes of nasal obstruction, including deviated nasal septum, allergic rhinitis, inferior turbinate hypertrophy, chronic rhinosinusitis, and nasal polyposis. In contrast, the study by Alt et al. specifically included patients with chronic rhinosinusitis from tertiary rhinology centres, who may have had a greater overall inflammatory and symptom burden.

The distribution of nasal pathology in the present study further supports the multifactorial nature of nasal obstruction. Deviated nasal septum was the most frequently identified condition, affecting 56.4% of patients, followed by allergic rhinitis in 46.4%, inferior turbinate hypertrophy in 42.7%, and chronic rhinosinusitis in 31.8%. These abnormalities may coexist, and the combined effect of structural narrowing and mucosal inflammation may increase nasal resistance, particularly during sleep. Supine positioning can further increase nasal congestion and resistance, making nighttime symptoms more prominent than daytime complaints. Recent ENT case reports further highlight the range of structural sinonasal conditions that may present with clinically relevant nasal symptoms, including rare non-odontogenic nasolabial cysts and concha bullosa associated with deviated nasal septum [20,21].

It is noteworthy that not all studies have demonstrated a strong direct relationship between the overall NOSE score and sleep quality. Thomas et al. studied patients with medically refractory chronic rhinosinusitis and found poor sleep in 82% of participants, but the total NOSE score did not correlate significantly with the total PSQI score. The NOSE item specifically addressing difficulty sleeping showed a stronger relationship with PSQI [16]. This finding provides an important contrast to the moderate correlation observed in the present study. One possible explanation is that sleep disturbance in chronic rhinosinusitis involves several mechanisms other than mechanical nasal obstruction, including pain, inflammatory activity, fatigue, psychological factors, and cytokine-mediated effects. Another possibility is that the broader range of nasal obstruction severity and different underlying diagnoses in the present study allowed a clearer dose-response relationship to be detected.

The present study also showed significant positive correlations between NOSE score and several individual PSQI domains, including sleep latency, sleep duration, habitual sleep efficiency, and sleep disturbances. These findings are physiologically plausible. Increasing resistance to nasal airflow may encourage mouth breathing, increase respiratory effort, produce dryness and discomfort, and promote repeated arousals. Experimental evidence supports this mechanism. Zwillich et al. demonstrated that experimentally induced nasal obstruction in otherwise normal men increased apnoeic events and sleep arousals and reduced time spent in deeper stages of sleep [19]. Therefore, nasal obstruction may affect sleep not only by causing respiratory events but also through repeated minor disturbances that reduce the restorative quality of sleep.

One of the important findings of the present study was that nasal obstruction remained independently associated with poor sleep after adjustment for potential confounding variables. Each 10-point increase in NOSE score was associated with a 58% increase in the adjusted odds of poor sleep quality (adjusted OR 1.58, 95% CI 1.26–1.97). This strengthens the interpretation that the observed relationship was not explained entirely by age, sex, BMI, rhinitis, chronic rhinosinusitis, or snoring. The good discrimination of the multivariable model (AUC 0.857) further suggests that the combination of nasal obstruction severity and relevant clinical variables was useful in identifying patients at increased risk of poor sleep.

Allergic rhinitis was another independent predictor of poor sleep quality in the present analysis, with an adjusted OR of 3.25. Nasal congestion is considered one of the major mechanisms through which allergic rhinitis disturbs sleep. Craig et al. described nasal congestion as an important contributor to sleep-disordered breathing, daytime sleepiness, fatigue, reduced productivity, and poorer quality of life in patients with allergic rhinitis [18]. Inflammatory mediators may also contribute directly to alterations in sleep regulation, suggesting that allergic rhinitis may affect sleep through both mechanical obstruction and inflammatory pathways.

Snoring showed an even stronger independent association with poor sleep quality in the present study, with an adjusted OR of 4.39. This finding is clinically relevant because snoring can be a marker of increased upper airway resistance and may indicate the presence of sleep-disordered breathing. Young et al. observed that individuals with nighttime nasal congestion were more likely to snore habitually [12], while Hussain et al. reported significantly greater odds of snoring in adults with nasal blockage [13]. Therefore, adults presenting with both nasal obstruction and habitual snoring may warrant more careful assessment for sleep disturbance and, where indicated, obstructive sleep apnoea.

In contrast, age, sex, BMI, and chronic rhinosinusitis were not independent predictors of poor sleep in the final model. These findings should not be interpreted to mean that these factors have no effect on sleep disorders. Age, obesity, and male sex are established contributors to obstructive sleep apnoea, but the primary outcome in this study was subjective sleep quality rather than polysomnographically diagnosed sleep apnoea. Different determinants may therefore influence PSQI-defined poor sleep and objectively measured respiratory sleep disorders.

The clinical importance of identifying nasal obstruction in patients with disturbed sleep is further supported by intervention studies. Deveci et al. prospectively evaluated patients undergoing septoplasty and/or inferior turbinate treatment and reported significant improvement in PSQI scores following nasal surgery [17]. Such findings suggest that at least part of the sleep impairment experienced by patients with nasal obstruction may be reversible when nasal airflow is improved. However, improvement in subjective sleep quality after treatment should not be assumed to represent resolution of obstructive sleep apnoea, and appropriate sleep evaluation remains necessary in patients with snoring, witnessed apnoea, excessive daytime sleepiness, obesity, or other risk factors.

The present study has several strengths. It evaluated a clinically relevant adult population with a range of structural and inflammatory causes of nasal obstruction and used validated instruments for both nasal obstruction and sleep quality. The clear increase in poor sleep across increasing NOSE severity categories, significant correlation between NOSE and PSQI scores, and persistence of the relationship after multivariable adjustment provide converging evidence for an association. The study also considered several clinically important confounders rather than relying only on unadjusted comparisons.

However, some limitations should be considered. First, the cross-sectional design demonstrates association but cannot establish a causal relationship between nasal obstruction and poor sleep. Second, this was a single-centre tertiary-care study, and patients attending an ENT department may have more severe symptoms than adults in the general population, which may limit generalisability. Third, sleep quality was evaluated using the PSQI and not by overnight polysomnography; therefore, objective sleep architecture, apnoea-hypopnoea index, oxygen desaturation, and arousal indices were not available. Fourth, objective nasal airflow measurements such as rhinomanometry or acoustic rhinometry were not routinely incorporated. Fifth, the NOSE questionnaire contains an item related to sleeping difficulty, creating some conceptual overlap with the PSQI and potentially increasing the observed correlation between these instruments, as also discussed by Thomas et al. [16]. Finally, residual confounding from variables such as anxiety, depression, occupational stress, environmental exposure, sleep hygiene, and undiagnosed sleep apnoea cannot be completely excluded.

Despite these limitations, the findings have practical clinical implications. Sleep-related symptoms should be actively assessed in adults presenting with moderate-to-severe nasal obstruction rather than treating nasal obstruction as an isolated daytime complaint. Similarly, examination of nasal patency and common nasal disorders may be useful in adults presenting with unexplained poor sleep, particularly when snoring, mouth breathing, allergic symptoms, or daytime sleepiness are present. Future prospective studies combining NOSE and PSQI assessment with objective nasal airflow measurements and polysomnography would help clarify the mechanisms involved and determine whether treatment of nasal obstruction produces sustained improvements in both subjective and objective sleep outcomes.

Overall, the present study demonstrates a significant association between nasal obstruction severity and impaired sleep quality in adults. Poor sleep became progressively more frequent with increasing nasal obstruction, and NOSE scores remained independently associated with poor sleep after adjustment for major clinical factors. Allergic rhinitis and snoring were additional independent predictors. These findings support a more integrated approach in which sleep quality is considered during the routine clinical assessment and management of adults with nasal obstruction.

CONCLUSION

The present study found a significant association between nasal obstruction severity and poor sleep quality in adults. Patients with more severe nasal obstruction had progressively higher PSQI scores and a greater prevalence of poor sleep. The NOSE score showed a moderate positive correlation with global PSQI score and remained independently associated with poor sleep quality after adjustment for important clinical factors. Allergic rhinitis and snoring were also significant predictors of disturbed sleep.

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