

Sleep impairment in allergic rhinitis, rhinosinusitis, and nasal polyposis[☆]Timothy J. Craig, DO^{a,*}, Berrylin J. Ferguson, MD^b, John H. Krouse, MD^c^a*Pennsylvania State University College of Medicine, Hershey, PA, USA*^b*University of Pittsburgh Medical Center, PA, USA*^c*Wayne State University, Detroit, MI, USA*

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Abstract

Sleep impairment is a significant problem for patients with inflammatory disorders of the upper respiratory tract, such as allergic rhinitis, rhinosinusitis, and nasal polyposis. Nasal congestion, one of the most common and bothersome symptoms of these conditions, is associated with sleep-disordered breathing and is thought to be a key cause of sleep impairment. This review examines sleep impairment associated with allergic rhinitis, rhinosinusitis, and nasal polyposis. It explores the adverse effects of disturbed sleep on patients' quality of life and how these inflammatory nasal conditions can be reduced by therapies that address the underlying problems affecting sleep. Treatment with intranasal corticosteroids has been shown to reduce nasal congestion in inflammatory disorders of the upper respiratory tract. Data on sleep-related end points from clinical trials of intranasal corticosteroids indicate that this reduction is associated with improved sleep, reduced daytime fatigue, and improved quality of life. Further research using measures of sleep as primary end points is warranted, based on the potential of these agents to improve sleep and quality of life in patients with allergic rhinitis, acute rhinosinusitis, and nasal polyposis. Such trials will help to identify the most effective therapies for sleep impairment in these 3 nasal conditions.

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1. Introduction

Sleep impairment is a significant problem for patients with inflammatory disorders of the upper respiratory tract. In a

recent survey of individuals with allergic rhinitis, 68% of respondents with perennial allergic rhinitis (PAR) and 48% with seasonal allergic rhinitis (SAR) reported that their condition interfered with sleep [1]. Sleep impairment is also reported by patients with rhinosinusitis and nasal polyposis [2,3]. Sleep disturbance can be caused by symptoms of these conditions, particularly nasal congestion, and underlying disease processes, such as the release of inflammatory mediators.

Nasal congestion is a prominent and troublesome symptom of inflammatory disorders of the upper respiratory tract. It is a major symptom of allergic rhinitis, along with rhinorrhea, sneezing, and pruritus of the eyes, nose, and throat, particularly in patients with PAR [4]. The symptoms of rhinosinusitis and nasal polyposis are similar; nasal congestion/obstruction is a key feature, accompanied by nasal discharge or postnasal drip, facial pain/pressure, and reduction or loss of smell [5]. In chronic rhinosinusitis, nasal obstruction/congestion is typically the most common major symptom [6]. Typical sleep-related problems seen with these 3 conditions include sleep-disordered breathing, sleep apnea, and snoring, all of which are associated with nasal congestion/obstruction [7–10].

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Inflammatory disorders of the upper respiratory tract are prevalent in the general population. The sleep impairment associated with these conditions, therefore, is likely to be a common problem. Allergic rhinitis, for example, is thought to affect up to 40% of the population [11], and its prevalence is increasing [12]. Estimates suggest that it affects 20 to 40 million people in the United States, including up to 40% of children [13]; its prevalence in Europe is estimated at 23% [14]. Rhinosinusitis is also highly prevalent, affecting approximately 15% of adults in the United States annually [15,16]. In Germany, acute sinusitis was diagnosed 6.3 million times and chronic sinusitis 2.6 million times from July 2000 to June 2001 [16]. The prevalence of nasal polyposis is lower, but it still affects a substantial percentage of the population: European studies have found that nasal polyps are present in 2.1% to 4.3% of individuals [17–19].

The socioeconomic burden of these 3 disorders is significant. It is estimated that more than \$6 billion was spent on prescription medications for allergic rhinitis in 2000 [20]. The socioeconomic costs of these disorders include the costs of treatment and the secondary cost of poor productivity, which results from the impact of symptoms on patients’ lives and the use of inappropriate therapies. Patients’ quality of life is significantly affected by allergic rhinitis, rhinosinusitis, and nasal polyposis, which has been shown using generic health-related quality-of-life questionnaires, such as the Medical Outcomes Study Short Form Health Survey, and disease-specific measures, such as the Rhinoconjunctivitis Quality of Life Questionnaire (RQLQ) [5,21–28]. These effects may, in part, be a consequence of sleep impairment. Nasal polyposis has been associated with a poorer quality of life for patients than for healthy subjects or patients with PAR, possibly owing to the worse nasal congestion/obstruction experienced by patients with nasal polyposis [3].

Treatments that improve the symptoms of allergic rhinitis, rhinosinusitis, and nasal polyposis, particularly those that relieve nasal congestion, have been shown to improve patients’ sleep and quality of life, but the data are limited and further research is warranted. This review examines the sleep impairment associated with these 3 conditions. It also explores the adverse effects of disturbed sleep on the quality of life of patients with these inflammatory nasal conditions and how these effects can be reduced by therapies addressing the underlying problems affecting sleep.

2. Evidence of sleep impairment in allergic rhinitis, rhinosinusitis, and nasal polyposis

Inflammatory disorders of the upper respiratory tract are associated with sleep problems, daytime somnolence, and fatigue. The symptoms of allergic rhinitis, in particular nasal congestion, adversely affect sleep [29,30], and the degree of sleep impairment is used in the Allergic Rhinitis and its

Table 1
Allergic Rhinitis and its Impact on Asthma guidelines for the classification of allergic rhinitis [11]

Symptoms	
Intermittent	Present <4 days per week or <4 weeks
Persistent	Present 4 days per week and >4 weeks
Severity	
Mild	No impairment of sleep, daily activities, leisure or sport, or school or work performance No troublesome symptoms
Moderate-severe	One of more of the following are present Impairment of sleep Impairment of daily activities, leisure, or sport Impairment of school or work Troublesome symptoms

Impact on Asthma guidelines to classify allergic rhinitis severity (Table 1) [11]. Sleep disturbances associated with allergic rhinitis include sleep-disordered breathing (ranging from snoring to obstructive sleep apnea and/or hypopnea) and microarousals [31–33], although one study has suggested that allergic rhinitis is not a major risk factor for obstructive sleep apnea syndrome (OSAS) [34]. Individuals with frequent nighttime symptoms of rhinitis have been shown to be more likely to have chronic excessive daytime sleepiness (EDS) or chronic nonrestorative sleep than those who rarely or never have such symptoms [35]. Studies in children have demonstrated that allergic rhinitis and allergic sensitization are associated with snoring [36–38]. In a study in patients with bronchial asthma, the presence of concomitant allergic rhinitis was independently related to difficulties in inducing sleep and daytime sleepiness [39].

Although sleep impairment has been less well studied in patients with nasal polyposis and rhinosinusitis, these conditions are associated with sleep disturbances and fatigue [2,3,6]. In a population-based case-control study, patients with nasal polyposis had a 2-fold higher risk of sleep disturbance than controls, and snoring was reported by a significantly greater proportion of those with polyposis than those without the condition ($P < .001$) [40]. A study of general medical outpatients found an increased prevalence of rhinosinusitis symptoms in patients with unexplained chronic fatigue than in those without [41]. Thus, sleep impairment is a substantial issue for patients with inflammatory disorders of the upper respiratory tract.

3. Mechanisms of sleep impairment

Identifying the mechanisms involved in sleep impairment in allergic rhinitis, rhinosinusitis, and nasal polyposis is important in determining how to alleviate this problem. For example, the daytime fatigue experienced by patients with allergic rhinitis could be attributed to sleep impairment resulting from nasal congestion and other symptoms [42,43] or to the effects of the disease itself [44]. Current evidence suggests that symptoms (particularly nasal congestion) and underlying pathophysiological changes of the disease

Table 2
Objective measures of nasal congestion

Measure	Parameter evaluated
Peak nasal inspiratory flow	Nasal airflow
Rhinomanometry	Airway resistance/conductance
Acoustic rhinometry	Nasal cavity volume and area

contribute to reduced sleep quality in these inflammatory conditions [15,16,29,40–42].

Nasal congestion is a common and bothersome symptom of allergic rhinitis, rhinosinusitis, and nasal polypsis. It occurs when the cavernous tissues of the nasal turbinates swell as a result of dilation of the capacitance vessels [45,46]. Nasal congestion reduces the internal nasal diameter, increases airway resistance to nasal airflow, and causes nasal obstruction [45]. In addition to subjective clinical assessments of the severity of nasal congestion, the degree of congestion (nasal patency) can be evaluated objectively by measures of nasal airflow (such as peak nasal inspiratory flow), by assessment of airways resistance/conductance (rhinomanometry), by and acoustic rhinometry, which assesses the volume and area of the nasal cavity by analyzing reflected sound waves (Table 2) [47–49].

Nasal congestion is often worse at night and first thing in the morning. Although congestion tends to increase when an individual lies down [50], the normal overnight decline in serum cortisol levels is likely to contribute to nighttime worsening. In patients with asthma, lower cortisol levels are associated with greater airway obstruction, particularly at night [51]. A large study in patients with allergic rhinitis confirmed that nasal congestion worsened overnight and peaked at approximately 6 AM, showing a clear, large-amplitude, circadian variation (Fig. 1) [52]. This might explain why patients with nasal congestion due to inflammatory nasal conditions often complain that they have difficulty sleeping at night and feel fatigued during the day.

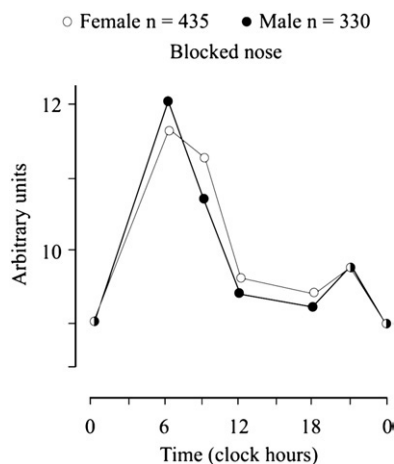


Fig. 1. Circadian rhythms in nasal congestion [52]. Peak-to-trough differences were statistically significant ($P < .008$).

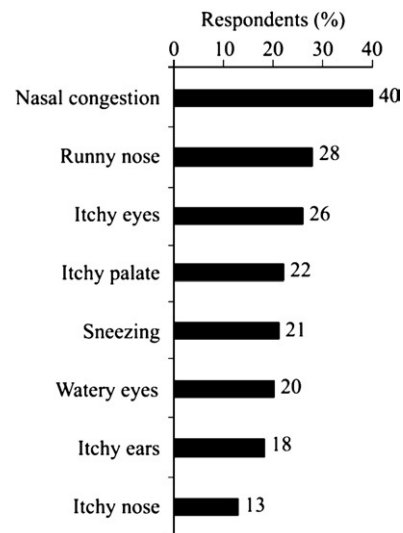


Fig. 2. Severity of nasal congestion in allergic rhinitis (AR) expressed as proportion of all survey respondents who rated the symptom severe (9 or 10 on 10-point scale, with 1 = not severe at all and 10 = extremely severe) [53].

Results from an Internet survey of 2355 individuals with allergic rhinitis or parents of children with allergic rhinitis supported these findings. Of the 85% of respondents (or their children) who experienced nasal congestion, 40% considered nasal congestion to be severe, a greater proportion than for any other symptom of allergic rhinitis (Fig. 2). Approximately half stated that congestion was the most bothersome symptom [53], that nasal congestion woke them up during the night, and that it made it difficult to fall asleep (Fig. 3). Furthermore, 20% of adults reported that their partner's or spouse's sleep was affected by their nasal congestion. These effects were more pronounced for those experiencing more severe congestion. The survey illustrated

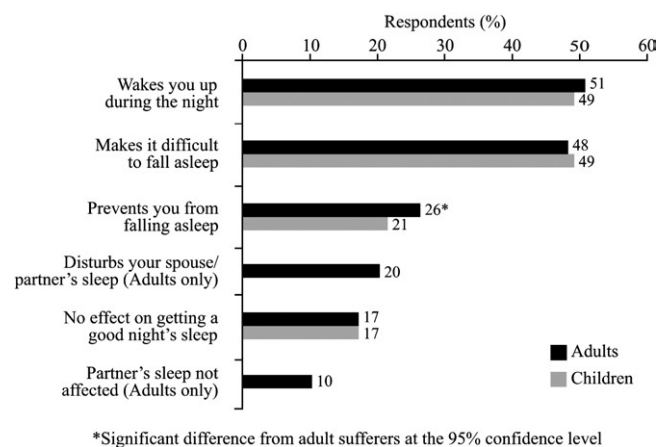


Fig. 3. Effects of nasal congestion on sleep in individuals with allergic rhinitis [53]. Results expressed as a proportion of survey respondents. Data were collected in response to the question: In what ways has nasal congestion affected you/your child at nighttime?

that nasal congestion had a negative effect on emotions and the ability to perform daily activities. These effects may, in part, be a consequence of the effects of nasal congestion on sleep.

Studies of treatments for nasal congestion associated with allergic rhinitis have suggested that it is largely responsible for the disturbed sleep and daytime fatigue associated with this condition [43]. Early studies using objective assessments of sleep indicated that nasal congestion in patients with allergic rhinitis is associated with an increase in the number of microarousals [33] and episodes of apnea [31]. When developing the Nocturnal Rhinoconjunctivitis Quality of Life Questionnaire (NRQLQ), Juniper et al [54] found that a stuffy nose and sinus congestion were among the symptoms troublesome to patients with allergic rhinoconjunctivitis who experienced sleep disturbance associated with nocturnal symptoms. Nasal occlusion in healthy subjects resulted in an increase in sleep apnea and transient arousals [7,8], and the congestion with rhinitis and other upper respiratory tract disorders can cause or worsen sleep disturbances, including obstructive sleep apnea [45]. In patients with allergic rhinitis, greater nasal congestion was associated with obstructive sleep apnea [47]. Canova et al [55] found that patients with OSAS had a greater risk of PAR than those with chronic obstructive pulmonary disorder. A population-based study (N = 4927) investigating the role of acute and chronic nasal congestion in sleep-disordered breathing identified subjects with a history of nasal congestion and sleep problems. Those with frequent nocturnal symptoms of rhinitis were more likely to report habitual snoring, chronic nonrestorative sleep, and excessive daytime fatigue than those who rarely or never had symptoms. Subjects with nasal congestion due to allergic rhinitis were 1.8 times more likely to have moderate to severe sleep-disordered breathing than subjects with allergic rhinitis without nasal congestion [35]. The role of congestion as a risk factor for habitual snoring was confirmed in a population-based cohort study (N = 4916) [9]. The switch to oronasal breathing that occurs as a result of nasal congestion may be the key factor behind this association, compromising the airway and leading to sleep-disordered breathing [10]. A review by Chen and Kushida [56] recommends that nasal obstruction be addressed in patients with a sleep-related breathing disorder as an adjunct to other surgical and nonsurgical treatment.

Other symptoms such as sneezing, rhinorrhea, and nasal pruritus may contribute to reduced sleep quality and sleep disturbance in allergic rhinitis [57]. Juniper et al [54] concluded that rhinorrhea was troublesome to patients with allergic rhinitis and interfered with sleep. In a survey of children with sleep disturbances, respiratory symptoms were found to be risk factors for disorders of initiating and maintaining sleep, snoring, and EDS. Wheezing was a risk factor for disorders of initiating and maintaining sleep, and cough and sputum production were risk factors for snoring and EDS [58].

The inflammatory mediators, such as histamine and cytokines released during allergic reactions, may directly affect the central nervous system, which contributes to disturbed sleep and fatigue or sleepiness during the day [59–61]. Histamine is involved in the regulation of the sleep-wake cycle and arousal [59]. Higher levels of the cytokines interleukin (IL)-1 β , IL-4, and IL-10 in allergic patients than in healthy subjects have been shown to correlate with increased latency to rapid eye movement (REM) sleep, decreased time in REM sleep, and decreased latency to sleep onset [61]. Because the restorative function of REM sleep is important, its disruption may contribute to daytime fatigue, difficulty concentrating, and poorer performance in individuals with allergic rhinitis [61]. Inflammatory cells and mediators show circadian variation, with levels peaking during the early morning hours [62]. This could explain the higher level of allergic rhinitis symptoms upon waking and why overnight sleep is particularly affected. Because inflammatory mediators are a key component of the disease process in rhinosinusitis and nasal polyposis [16], they probably play a role in sleep impairment.

4. Sleep impairment and quality of life

The effects of sleep impairment on quality of life have been studied in patients with allergic rhinitis and in the general population. Findings in these settings are likely to be applicable to the sleep impairment of patients with rhinosinusitis and nasal polyposis.

Individuals with allergic rhinitis have impaired cognitive function and reduced work productivity and performance [63–65]. Allergic rhinitis can affect children's learning ability and performance at school [66,67] and cause somnolence and inability to concentrate in children [68]. These effects may be a direct result of allergic symptoms but are likely to be exacerbated by sleep impairment [29,67,69]. Sleep-disordered breathing and sleep disturbance are known to be directly associated with decreased quality of life in the general population [70], whereas experimentally induced sleep fragmentation in healthy subjects is associated with impaired mental flexibility and attention, increased daytime sleepiness, and impaired mood [71,72]. Adolescents with allergic rhinitis have difficulty getting a good night's sleep and experience problems doing their school work [73], and children with rhinitis and snoring have poorer school performance than controls [74]. A survey of individuals with allergic rhinitis or urticaria in 5 European countries found that a substantial proportion reported problems with getting enough sleep to feel rested in the morning or found it difficult to sleep without snoring [75]. Of those who reported these difficulties, 29% to 79% and 28% to 56%, depending on country, characterized these problems as disruptive or extremely disruptive, respectively [75]. Daytime fatigue, difficulty concentrating, and impaired psychomotor performance are commonly reported by individuals with allergic

Table 3

Disease-specific quality-of-life questionnaires and general measures of sleep quality

Measure
Disease-specific questionnaires
RQLQ ^a [78,79]
NRQLQ ^a [54]
RSOM-31 ^a [80]
SNOT-20 ^a [81]
Chronic Sinusitis Survey [82]
Rhinosinusitis Disability Index ^a [83]
General sleep measures
Epworth Sleepiness Scale [84]
Sleep Quality Index [85]
Calgary Sleep Apnea Quality of Life Index [86]
University of Pennsylvania Functional Outcomes of Sleep Questionnaire [87]

^a Includes an evaluation of sleep parameters.

rhinitis [27,64,76] and may reduce their ability to perform physical and social tasks of daily living [27]. An Internet-based survey of 1322 people with self-reported rhinitis found that both PAR and SAR interfered with sleep (68% and 51% of respondents, respectively) and daily routine (58% and 48%, respectively) [1]. Sleep disturbance seen in patients with symptomatic allergic rhinitis is associated with reduced psychological well-being [77].

Studies of subjective and objective measurements of sleep impairment and its impact on patients' quality of life have emphasized the significance of this problem for patients with inflammatory nasal conditions. Most studies of the impact of allergic rhinitis, rhinosinusitis, and nasal polyposis on sleep have used subjective measures, such as questionnaires (Table 3) or daily scoring of symptoms, sleep problems, daytime sleepiness, and fatigue. Disease-specific quality-of-life measures, such as the RQLQ, include a domain that measures the effects of disease and/or treatment on sleep [78,79]. These questionnaires focus on the problems for which patients seek help and so are more sensitive to changes in patients' quality of life than generic health-status questionnaires [23]. The NRQLQ assesses the functional impairments most problematic for patients with nocturnal symptoms [54], including sleep problems, symptoms during sleep time and on waking in the morning, and problems during waking hours. Disease-specific health-related quality-of-life instruments used in rhinosinusitis and nasal polyposis include the Rhinosinusitis Outcome Measure-31 (RSOM-31) [80]; the Sino-Nasal Outcome Test-20 (SNOT-20) [81], which is a modified version of the RSOM-31; the Chronic Sinusitis Survey [82]; and the Rhinosinusitis Disability Index [83]. In patients with rhinosinusitis, sleep is the most severely affected domain in the RSOM-31 [80]. General questionnaires that assess daytime sleepiness and sleep quality include the Epworth Sleepiness Scale [84], the Pittsburgh Sleep Quality Index [85], the Calgary Sleep Apnea Quality of Life Index [86], and the University of Pennsylvania Functional Outcomes of Sleep Questionnaire [87]. Poor

sensitivity may limit their use in assessing the mild-to-moderate sleep disturbance in inflammatory disorders of the upper respiratory tract.

Only a few studies have objectively assessed sleep (using polysomnography) in allergic rhinitis [9,31,33,35,44,61,88,89]. In one study, 25 patients with SAR and 25 healthy volunteers underwent 2 consecutive nights of polysomnography before and during the pollen season [44]. There were statistically significant differences between the 2 groups in sleep parameters, including increases in the apnea index (number of apneas per hour), hypopnea index (number of hypopneas per hour), apnea-hypopnea index, snoring time, amount of REM sleep, and sleep latency. The changes were not clinically relevant because values remained within normal limits. The study found a statistically significant increase in daytime sleepiness (assessed subjectively using the Epworth sleepiness scale) in patients with SAR compared with healthy subjects, suggesting a poor correlation between subjective and objective measures of sleep disturbance.

5. Effects of therapy

Treatments that alleviate nasal congestion may reduce sleep impairment and daytime sleepiness and thereby improve patients' quality of life. Not all treatments for allergic rhinitis, rhinosinusitis, and nasal polyposis are effective in this respect.

Sedating antihistamines are contraindicated in those experiencing daytime sedation, fatigue, and functional impairment and should be avoided in most people with allergic rhinitis, rhinosinusitis, and nasal polyposis. Non-sedating oral antihistamines are widely used to treat allergic rhinitis and relieve nasal symptoms such as rhinorrhea, sneezing, and pruritus but have less effect on nasal congestion [30], although some studies have shown an improvement in sleep and quality of life after therapy with an oral or topical antihistamine [90,91]. Oral decongestants reduce nasal congestion but may have adverse effects on sleep because of their stimulatory effects and their association with systemic side effects, such as tachycardia and urinary retention [30]. Topical decongestants appear to improve sleep in patients with nasal obstruction [92], but because of the risk of rhinitis medicamentosa ("rebound" congestion), they should not be used for long periods [30]. The anticholinergic agent ipratropium bromide is not considered effective in relieving nasal congestion [30]; however, limited data suggest that sleep and quality of life may be improved after treatment [93]. Leukotriene receptor antagonists [94,95] or a combination of an antihistamine and a leukotriene receptor antagonist [96] has shown some efficacy in improving sleep and quality of life in patients with allergic rhinitis or sleep-disordered breathing. Intranasal corticosteroids, which relieve congestion and other nasal symptoms of allergic rhinitis, are considered first-line therapy when nasal obstruction is a major symptom [30].

In nasal polyposis, surgery, oral steroids, and a combination of oral and intranasal steroids have been shown to improve symptoms and patients' quality of life [24,97]. Regrowth of nasal polyps after surgery is not infrequent, and thus, surgery is likely to provide only transient benefits [98], so medical treatment with intranasal corticosteroids may be preferable when possible. Topical steroids and surgical treatment improve symptoms, including nasal congestion, and quality of life in patients with chronic rhinosinusitis [16,99].

Intranasal corticosteroids relieve nasal symptoms, including nasal congestion, of allergic rhinitis, rhinosinusitis, and nasal polyposis [5,16,100,101]. All intranasal corticosteroids reduce nasal congestion of allergic rhinitis. For example, mometasone furoate nasal spray (MFNS) has been demonstrated to be effective against nasal congestion in rhinosinusitis, nasal polyposis, SAR, and PAR [102–109]. The improvement in nasal congestion seen with MFNS treatment was accompanied by increased nasal airflow, as assessed objectively by peak nasal inspiratory flow in allergic rhinitis patients [110,111] and adults with bilateral nasal polyposis [106].

Alleviation of nasal congestion using intranasal corticosteroids may have beneficial effects on sleep, daytime sleepiness, and quality of life in patients with inflammatory nasal conditions. Three small studies in adults and children with PAR found that intranasal budesonide reduces nasal congestion, subjective daytime somnolence, and fatigue and improves sleep quality and patients' quality of life [88,112,113]. Kamenov et al [114] found that treatment with intranasal budesonide improves quality of life (including concentration and performance at school) in school-aged children with rhinitis or rhinosinusitis. Another intranasal corticosteroid, flunisolide, improved subjectively assessed nasal congestion and sleep problems in patients with PAR compared with placebo, although daytime fatigue and sleepiness did not show significant improvement [43]. Berlin et al [115] found that flunisolide was superior to azelastine nasal spray in improving nasal congestion, sleep, and daytime sleepiness in patients with PAR. In another study involving patients with PAR, intranasal fluticasone significantly improved subjective assessments of sleep compared with placebo and decreased daytime sleepiness and fatigue by more than 10% (although this was not statistically significant) [89]. Fluticasone propionate nasal spray improved nasal symptoms, quality of life, and verbal memory in children with SAR [116]. Further, intranasal fluticasone improved allergic rhinitis associated with OSAS; treatment resulted in a significantly lower frequency of apnea/hypopnea and subjective improvements in nasal congestion and daytime alertness, although snoring noise and sleep quality were unchanged compared with placebo [117].

Data indicate that other intranasal corticosteroids improve quality of life in patients with allergic rhinitis. Milgrom et al [93] showed that beclomethasone dipropionate controlled nasal congestion and improved quality of life in children with either perennial allergic or nonallergic

rhinitis, reducing the negative effects of rhinorrhea on mood, concentration on school work, and sleep. Two recent studies in patients with allergic rhinitis found that intranasal triamcinolone acetonide relieved nasal congestion and improved health-related quality of life (including sleep), as assessed using the RQLQ [118], the NRQLQ, and the Pittsburgh Sleep Quality Index [119].

Mometasone furoate nasal spray has been shown to improve sleep and quality of life in patients with rhinosinusitis and nasal polyposis. In patients with acute rhinosinusitis, treatment with MFNS 200 μ g, BID, significantly improved quality of life (assessed using SNOT-20) compared with placebo [120]. The greatest difference in improvement between active treatment and placebo was in the SNOT item representing night waking (0.6 points). In a large, multicenter, randomized, double-blind trial of MFNS 200 μ g, QD, in adults with mild-to-moderate nasal polyposis, significantly more MFNS-treated patients than placebo recipients showed improvements in breathing ($P < .001$), sleep disturbances ($P = .001$), and daily activities ($P = .001$) [105].

These findings suggest that treating nasal symptoms of allergic rhinitis, rhinosinusitis, and nasal polyposis, particularly nasal congestion, can alleviate sleep disturbances and improve patients' quality of life. The evidence for this hypothesis is based largely on subjective assessments from studies in which sleep-related outcomes were secondary end points. It has not been definitively shown that reducing nasal congestion with an intranasal corticosteroid is associated with improvement in daytime somnolence or fatigue, snoring, or objective measures of sleep. Thus, there is a need for large, well-designed clinical studies that assess intranasal corticosteroids in patients with inflammatory nasal disorders and impaired sleep quality, daytime fatigue or sleepiness, and impaired daytime functioning.

6. Conclusions

Sleep impairment associated with allergic rhinitis, rhinosinusitis, and nasal polyposis has a significant impact on patients' quality of life. Nasal congestion, one of the most common and bothersome symptoms of these conditions, is thought to be a major cause of sleep impairment and sleep-disordered breathing. Recent research has suggested that poor sleep associated with nasal congestion is an important therapeutic target.

Treatment with intranasal corticosteroids has been shown to significantly reduce nasal congestion in allergic rhinitis and to benefit patients with rhinosinusitis and nasal polyposis. Data from clinical trials of intranasal corticosteroids indicate that this reduction in nasal congestion is generally associated with improved sleep, reduced daytime fatigue, and improved quality of life.

Further research is warranted on the potential of intranasal corticosteroids to improve sleep quality, and

consequently quality of life, in patients with inflammatory disorders of the upper respiratory tract. Such trials should use sleep-related measures as primary end points and include both subjective and objective assessment of sleep parameters. The most effective therapies for addressing the detrimental effects of sleep impairment in these conditions can then be identified.

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