

Nasal Symptoms Among Allergic Rhinitis Patients Could Contribute to Sexual Dysfunction

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Background: Allergic rhinitis (AR) is a prevalent chronic inflammatory airway disease with a range of symptoms that can significantly impact quality of life. This study aimed to explore the relationship between the severity of nasal symptoms and sexual function in AR patients.

Methods: A case-control study involving 1034 AR patients and 422 healthy controls was conducted. Nasal symptoms were assessed using Visual Analog Scale (VAS) scores, while sexual function was evaluated using the International Index of Erectile Function (IIEF) for males and the Female Sexual Function Index (FSFI) for females.

Results: In female AR patients, total FSFI scores, as well as scores for subjective arousal, orgasmic function, and intercourse satisfaction, were significantly decreased compared to controls. Nasal obstruction scores were significantly correlated with sexual desire, subjective arousal, orgasmic function, intercourse satisfaction, and total FSFI scores ($r=-0.3176$, $r=-0.2106$, $r=-0.6129$, $r=-0.3430$, $r=-0.5233$). Dysosmia scores also correlated with subjective arousal, orgasmic function, intercourse satisfaction, and total FSFI scores ($r=-0.4331$, $r=-0.3123$, $r=-0.5259$, $r=-0.5436$). Overall disease severity correlated significantly with subjective arousal, orgasmic function, intercourse satisfaction and total scores ($r=-0.2908$, $r=-0.3703$, $r=-0.3739$, $r=-0.4225$). Among male AR patients, lower total IIEF scores were observed, with reductions in erectile function, sexual desire, and overall satisfaction. Nasal obstruction scores were negatively correlated with erectile function, orgasmic function, sexual desire, and total IIEF scores ($r=-0.8544$, $r=-0.3869$, $r=-0.2772$, $r=-0.6855$). Furthermore, rhinorrhea scores showed significant correlations with overall satisfaction and total IIEF scores ($r=-0.3711$, $r=-0.2680$), and dysosmia scores were significantly associated with erectile function, orgasmic function, sexual desire, and total IIEF scores ($r=-0.5048$, $r=-0.2904$, $r=-0.5607$, $r=-0.4733$). Overall disease severity correlated significantly with erectile function, orgasmic function, sexual desire and total scores ($r=-0.5385$, $r=-0.2034$, $r=-0.3257$, $r=-0.4833$).

Conclusion: This study underscores the negative correlations between nasal symptoms and sexual function in AR patients, suggesting that AR may contribute to sexual dysfunction.

Keywords: allergic rhinitis, sexual function, nasal symptom, IIEF, FSFI

Introduction

Allergic rhinitis (AR) is one of the most prevalent chronic airway inflammatory diseases worldwide with diverse symptoms like nasal obstruction, rhinorrhea, sneezing, itchy nose, and dysosmia.^{1,2} AR is commonly linked with a range of comorbid conditions, such as asthma, sinusitis, and conjunctivitis, leading to a substantial and adverse health burden on individuals and impacting the quality of life across age groups, including adults, children, and adolescents.^{3,4} The burden of symptoms and comorbidities of AR can further lead to fatigue and mood changes, impairment of cognitive function, depression, and anxiety, thus negatively impacting quality of life.⁵ To date, there has been a limited body of research examining the impact of allergic rhinitis (AR) on the sexual function of both men and women. It is possible that

the importance of sexual function in AR patients has been underestimated. Therefore, it is crucial to emphasize the significance of sexual activity as an integral component of overall quality of life. One study documented impaired sexual activity in AR patients, as assessed by the Female Sexual Function Index (FSFI) and the International Index of Erectile Function (IIEF), with notable improvements in sexual function following treatment.⁶ These findings are consistent with another study, suggesting that AR may independently increase the risk of developing erectile dysfunction (ED), with this risk likely escalating in proportion to the severity of AR.⁷

Several tools have been developed to assess the impact of allergic rhinitis (AR) on the quality of life. The present study aims to evaluate the sexual functioning of both male and female AR patients using commonly employed subjective questionnaires. A higher score on the International Index of Erectile Function (IIEF) for men and the Female Sexual Function Index (FSFI) for women suggests better sexual function.^{8,9} However, there has been limited exploration of the influence of AR symptoms on sexual function. In the present study, we examined common symptoms such as nasal obstruction, rhinorrhea, sneezing, itchy nose, and dysosmia in AR patients. To assess the severity of these AR symptoms, we relied on patients' self-reports using the Visual Analogue Scale (VAS).¹⁰ To gain a more comprehensive understanding of the sexual function of AR patients, we concentrate on exploring the relationship between AR symptoms and various aspects of sexual function. Our study was to investigate the correlation between the severity of nasal symptoms and sexual function in both male and female AR patients.

Materials and Methods

Study Design

This study complies with the Declaration of Helsinki. A total of 1034 patients with AR were enrolled at the Department of Otolaryngology, The Second Hospital of Shandong University, from June 2019 to January 2023. AR was defined by the patient's case history, significant nasal symptoms (sneezing, rhinorrhea, itchy nose, and nasal congestion) signs, and a positive atopic status. Patients meeting the criteria for AR were evaluated using a skin-prick test (SPT) for common inhalant allergens.¹¹ The control group comprised 422 randomly selected healthy volunteers, consisting of 199 women and 223 men, aged between 23 and 45 years, all of whom had no prior history of any diseases, including allergic conditions. Controls were confirmed to be allergy-free based on negative results from skin prick tests (SPT). Exclusion criteria for the control group included the presence of chronic diseases like diabetes mellitus or chronic renal failure, active psychiatric disorders such as depression, other metabolic and neurological conditions that are known to cause peripheral neuropathy, or individuals who had been taking medication for sexual dysfunction in the recent past. For the study, individuals with allergic rhinitis (AR) who also had asthma and atopic dermatitis were not included in the analysis. Informed written consent was obtained from all participants, and medical records were used to gather information on age, gender, height, and weight. Approval for this study was obtained from the institutional review board (IRB) of the Second Hospital of Shandong University, China. The review Board protocol number is KYLL-2021(KJ)P-0242.

Skin-Prick Tests

Skin-prick tests (SPT) were performed for the following 16 common aeroallergens: *Dermatophagoides pteronyssinus* (*D. pteronyssinus*), *Dermatophagoides farina* (*D. farina*), giant ragweed, dog dander, *Alternaria alternata*, *Aspergillus fumigatus*, *Penicillium*, *Humulus scandens*, cat dander, *Alnus incana*, *Platanus orientalis*, *Triticum sativum*, *Robinia pseudoacacia*, *Artemisia vulgaris*, cockroach and *Taraxacum*. For these tests, standardized allergen extracts and control solutions were sourced from ALK-Abello Co. (Horsholm, Denmark). The procedure included using positive histamine and negative saline controls for each case. A positive response was defined as the presence of a weal (raised bump) that was at least 3mm larger in diameter than that of the negative control. The test reactions were measured 15 minutes after the skin-prick test was administered. Participants who exhibited one or more positive reactions were classified as atopic.

Evaluate the Nasal Symptom

To assess nasal symptoms, which encompassed nasal obstruction, rhinorrhea, sneezing, itchy nose, and dysosmia, a Visual Analogue Scale (VAS) score was employed. Five VAS symptom domains were added together, scores ranged

from 0 to 50, with a mean score relating to overall disease severity ranged from 0 to 10.¹² This scale consisted of a 10 cm continuum, with the leftmost end marked as “0” signifying normal, and the rightmost end marked as “10”, indicating the highest level of severity. A score of “0” on this scale represented the absence of symptoms, while a score of “10” represented the most severe manifestation of these symptoms. Participants were instructed to indicate the severity of their symptoms by marking the appropriate position on the VAS scale based on their subjective perception. The researchers then measured the distance between the “0” point (representing no symptoms) and the location marked by the participants and recorded this numerical value as an objective measure of symptom severity.¹³

Sexual Function Assessing

To assess sexual activity within the preceding four weeks, two specific questionnaires, the International Index of Erectile Function (IIEF) and the Female Sexual Function Index (FSFI), were subjected. The IIEF is a comprehensive self-administered questionnaire containing 15 questions, widely recognized for evaluating male sexual function across various dimensions. These dimensions encompass erectile function, orgasmic function, intercourse satisfaction, sexual desire, and overall satisfaction.⁸ The total IIEF score ranges from 5 to 75. A higher score is indicative of better male sexual function. On the other hand, the FSFI is a 30-item questionnaire designed to assess female sexual function across six distinct domains. These domains include desire, subjective arousal, lubrication, orgasm, satisfaction, and pain.⁹ The total FSFI score has a theoretical range between 4 and 95. The Chinese versions both of the FSFI and IIEF have been validated for reliability and validity.^{14,15} Both questionnaires, IIEF and FSFI, were administered to participants and completed in approximately 15 minutes by both the control group and AR patients. Higher scores on the IIEF indicated better sexual function for men, while higher scores on the FSFI suggested better sexual function for women.

Statistical Analysis

All data were subjected to analysis using SPSS software (version 18.0, SPSS, Chicago, IL). Data were expressed as median (25th-75th percentile). The disparity between the VAS scores for nasal symptoms was stratified and compared using the Mann–Whitney two-tailed test. To assess the correlation between sexual function scores and nasal symptoms, Spearman correlation analysis was employed. A p-value of less than 0.05 was deemed statistically significant.

Results

Demographic Characteristics and AR Severity of Study Participants

In the present study, a total of 1034 AR patients, aged 20 to 45 years, and 422 healthy individuals were included as participants. The demographic characteristics of the study participants are presented in Table 1. Regarding gender, there were no statistically significant differences observed in the median age between female patients and controls, with median ages of 30.0 (26.0–36.0) for female patients and 31.0 (28.0–38.0) for female controls. Similarly, for male

Table 1 Patients' Characteristics

	AR Patients (Female)	AR Patients (Male)	Controls (Female)	Controls (Male)	P value
Number (n)	466	568	199	223	NS
Age	30 (26, 36)	32 (26, 39)	31 (28, 38)	34 (28, 39)	NS
Nasal obstruction	5.8 (4.5–7.0)	6.5 (5.5–7.5)	0	0	<i>p</i> <0.0001
Rhinorrhea	6.0 (4.5–7.0)	6.1 (5.5–7.5)	0	0	<i>p</i> <0.0001
Sneezing	5.0 (4.0–6.0)	5.5 (5.0–6.5)	0	0	<i>p</i> <0.0001
Itchy nose	5.0 (4.0–6.0)	5.5 (4.5–7.0)	0	0	<i>p</i> <0.0001
Dysosmia	5.4 (4.3–6.9)	5.5 (5.0–7.2)	0	0	<i>p</i> <0.0001
Overall disease severity	5.5 (5.0–6.1)	6.1 (5.6–6.6)	0	0	<i>p</i> <0.0001

Notes: The difference between the VAS scores of nasal symptom in male AR patient group and female AR patients were also stratified and compared using the Mann–Whitney 2-tailed test. A *p* value of less than 0.05 was considered statistically significant.

participants, there were no significant differences in median age between male AR patients (32.0; 26.0–39.0) and male controls (34.0; 28.0–39.0). However, it's worth noting that higher VAS scores were observed in the male AR patient group in comparison to the female AR patients. Specifically, male AR patients exhibited higher VAS scores for nasal obstruction (6.5; 5.5–7.5), rhinorrhea (6.1; 5.5–7.5), sneezing (5.5; 5.0–6.5), itchy nose (5.5; 4.5–7.0), dysosmia (5.5; 5.0–7.2) and overall disease severity (6.1; 5.6–6.6) when compared to their female counterparts.

Sexual Function Assessment and the Correlation Between the Severity of Nasal Symptoms and Sexual Function

Female patients with allergic rhinitis (AR) demonstrated significantly lower total Female Sexual Function Index (FSFI) scores (63.0; 56.0–71.0) compared to the control group (72.0; 51.0–82.0), indicating a notable degree of sexual dysfunction. Specifically, female AR patients showed significant decreases in the domains of subjective arousal, orgasmic function, and intercourse satisfaction (13.0; 7.2–17.0; 11.0; 8.0–13.0; 11.0; 9.0–13.0) in comparison to the control group (15.0; 10.0–17.0; 12.0; 8.0–14.0; 12.0; 9.0–14.0). However, no significant differences were observed between the two groups in terms of sexual desire, lubrication, and pain (Table 2). Notably, there were correlations between nasal obstruction and various aspects of sexual function, including sexual desire ($r=-0.3176$; $p<0.0001$), subjective arousal ($r=-0.2106$; $p<0.0001$), orgasmic function ($r=-0.6129$; $p<0.0001$), intercourse satisfaction ($r=-0.3430$; $p<0.0001$), and total scores ($r=-0.5233$; $p<0.0001$). Additionally, the dysosmia score of AR patients showed significant correlations with subjective arousal ($r=-0.4331$; $p<0.0001$), orgasmic function ($r=-0.3123$; $p<0.0001$), intercourse satisfaction ($r=-0.5259$; $p<0.0001$), and total scores ($r=-0.5436$; $p<0.0001$). Overall disease severity of AR patients correlated significantly with subjective arousal ($r=-0.2908$; $p<0.0001$), orgasmic function ($r=-0.3703$; $p<0.0001$), intercourse satisfaction ($r=-0.3739$; $p<0.0001$) and total scores ($r=-0.4225$; $p<0.0001$). (Table 3)

Table 2 Sexual Function Scores Obtained From the Female Sexual Function Index (FSFI) Applied to the Female Patients and Controls

	Theoretical Score, Range	AR	Controls	P value
Sexual desire	2–10	6.0 (4.0–8.0)	6.0 (5.0–9.0)	$p=0.0554$
Subjective arousal	0–20	13.0 (7.2–17.0)	15.0 (10.0–17.0)	$p=0.013$
Lubrication	0–20	14.0 (11.0–17.0)	15.0 (11.0–18.0)	$p=0.2056$
Orgasmic function	0–15	11.0 (8.0–13.0)	12.0 (8.0–14.0)	$p=0.0004$
Intercourse satisfaction	2–15	11.0 (9.0–13.0)	12.0 (9.0–14.0)	$p=0.0085$
Pain	0–15	11.0 (8.2–13.0)	11.0 (10.0–13.0)	$p=0.1484$
Total	4–95	63.0 (56.0–71.0)	72.0 (51.0–82.0)	$p<0.0001$

Notes: Data were expressed as median (25th–75th percentile). The difference between the FSFI scores in female AR patient and control were also stratified and compared using the Mann–Whitney 2-tailed test. A p value of less than 0.05 was considered statistically significant.

Table 3 The Relationship Between Female Sexual Function Scores and Nasal Symptom

	Nasal Obstruction	Rhinorrhea	Sneeze	Itchy Nose	Dysosmia	Total VAS
Sexual desire	$r=-0.3176^{***}$	$r=-0.0196$	$r=-0.0849$	$r=-0.0122$	$r=-0.1499$	$r=-0.1317$
Subjective arousal	$r=-0.2106^{***}$	$r=-0.0369$	$r=-0.0402$	$r=-0.0658$	$r=-0.4331^{***}$	$r=-0.2908^{***}$
Lubrication	$r=-0.1925$	$r=-0.0063$	$r=-0.0078$	$r=-0.0167$	$r=-0.1508$	$r=-0.1155$
Orgasmic function	$r=-0.6129^{***}$	$r=-0.0367$	$r=-0.0735$	$r=-0.0287$	$r=-0.3123^{***}$	$r=-0.3703^{***}$
Intercourse satisfaction	$r=-0.3430^{***}$	$r=-0.0297$	$r=-0.0406$	$r=-0.0536$	$r=-0.5259^{***}$	$r=-0.3739^{***}$
Pain	$r=-0.0549$	$r=-0.0072$	$r=-0.0857$	$r=-0.0438$	$r=-0.0956$	$r=-0.0642$
Total	$r=-0.5233^{***}$	$r=-0.0282$	$r=-0.0382$	$r=-0.0252$	$r=-0.5436^{***}$	$r=-0.4225^{***}$

Notes: Spearman correlation analysis was used to evaluate the correlation between sexual function scores and nasal symptoms. A p value of less than 0.05 was considered statistically significant while symbol “***” means the p value is less than 0.001.

Table 4 Sexual Function Scores Obtained From the International Index of Erectile Function (IIEF) Applied to Male

	Theoretical Score	AR	Controls	P value
Erectile function	1–30	18.0 (14.0–21.0)	20.0 (13.0–25.0)	$p < 0.0001$
Intercourse satisfaction	0–15	9.0 (6.0–13.0)	10.0 (6.0–12.0)	$p = 0.4971$
Orgasmic function	0–10	6.0 (4.0–9.0)	6.0 (4.0–8.0)	$p = 0.0893$
Sexual desire	2–10	5.0 (3.0–7.0)	7.0 (5.0–9.0)	$p < 0.0001$
Overall satisfaction	2–10	6.0 (4.0–8.0)	8.0 (4.0–9.0)	$p < 0.0001$
Total	5–75	44.0 (38.0–50.0)	49.0 (33.0–64.0)	$p = 0.0122$

Notes: Data were expressed as median (25th–75th percentile). The difference between the IIEF scores in male AR patient and control were also stratified and compared using the Mann–Whitney 2-tailed test. A p value of less than 0.05 was considered statistically significant.

Table 5 The Relationship Between Sexual Function Scores and Nasal Symptom of Male AR Patients

	Nasal Obstruction	Rhinorrhea	Sneezing	Itchy nose	Dysosmia	Total VAS
Erectile function	$r = -0.8544^{***}$	$r = -0.0366$	$r = -0.0879$	$r = -0.0205$	$r = -0.5048^{***}$	$r = -0.5385^{***}$
Intercourse satisfaction	$r = -0.0609$	$r = -0.0265$	$r = -0.0225$	$r = -0.0528$	$r = 0.0505$	$r = -0.0004$
Orgasmic function	$r = -0.3869^{***}$	$r = -0.0556$	$r = -0.0203$	$r = 0.0496$	$r = -0.2904^{***}$	$r = -0.2034^{***}$
Sexual desire	$r = -0.2772^{***}$	$r = -0.0593$	$r = -0.0126$	$r = -0.0125$	$r = -0.5607^{***}$	$r = -0.3257^{***}$
Overall satisfaction	$r = -0.0621$	$r = -0.3711^{***}$	$r = 0.0823$	$r = -0.0663$	$r = -0.0489$	$r = -0.1378$
Total	$r = -0.6855^{***}$	$r = -0.2680^{***}$	$r = 0.0302$	$r = -0.0222$	$r = -0.4733^{***}$	$r = -0.4833^{***}$

Notes: Spearman correlation analysis was used to evaluate the correlation between sexual function scores and nasal symptoms. A p value of less than 0.05 was considered statistically significant. 0.05, while symbol “***” means the p value is less than 0.001.

The Total International Index of Erectile Function (IIEF) scores were significantly higher in the control group (49.0; 33.0–64.0) in comparison to male AR patients (44.0; 38.0–50.0). When we compared male AR patients to the control group, we observed decreases in three domain scores: erectile function, sexual desire, and overall satisfaction (18.0; 14.0–21.0; 5.0; 3.0–7.0; 6.0; 4.0–8.0), as opposed to the control group (20.0; 13.0–25.0; 7.0; 5.0–9.0; 8.0; 4.0–9.0). However, there were no significant differences in the scores for intercourse satisfaction and orgasmic function between the two groups (Table 4). Furthermore, nasal obstruction scores in patients negatively correlated with four domain scores: erectile function ($r = -0.8544$; $p < 0.0001$), orgasmic function ($r = -0.3869$; $p < 0.0001$), sexual desire ($r = -0.2772$; $p < 0.0001$), and total scores ($r = -0.6855$; $p < 0.0001$). Rhinorrhea scores in AR patients showed significant correlations with the overall satisfaction score ($r = -0.3711$) and the total score ($r = -0.2680$). Notably, there were significant correlations between dysosmia scores and the scores for erectile function ($r = -0.5048$; $p < 0.0001$), orgasmic function ($r = -0.2904$; $p < 0.0001$), sexual desire ($r = -0.5607$; $p < 0.0001$), and total score ($r = -0.4733$; $p < 0.0001$). Overall disease severity of AR patients correlated significantly with erectile function ($r = -0.5385$; $p < 0.0001$), orgasmic function ($r = -0.2034$; $p < 0.0001$), sexual desire ($r = -0.3257$; $p < 0.0001$) and total scores ($r = -0.4833$; $p < 0.0001$), as detailed in Table 5.

Discussions

There many toolsets are recommended in assessing the severity of AR and its impact on quality of life of the patients by various international guidelines. With the global shift towards patient-centred clinical care, subjective scoring as such as VAS scores play a more important role in treatment of chronic diseases. In this study, VAS was adopted as a tool for evaluating symptoms in patients suffering from AR. The VAS scoring method is simple and easy to implement, allowing for a quantitative assessment of the severity of AR that are validated and accepted internationally. Furthermore, VAS as determined by the patients was recommended by Chinese guideline for diagnosis and treatment of allergic rhinitis. (2022, revision).¹⁶

AR is known to negatively affect the quality of life; however, its impact on sexual function remains underexplored. Understanding the link between AR symptoms and sexual health using standardized assessment tools is crucial. AR has been associated with comorbidities like nasal polyps (NPs), chronic rhinosinusitis (CRS), and asthma, which can further

affect overall well-being. Past studies have shown that conditions such as NPs, CRS, and asthma are linked to reduced quality of life, often accompanied by sexual dysfunction. For instance, a large-scale case-control study with 17,891 participants identified a noteworthy relationship between CRS and the risk of developing erectile dysfunction (ED), with CRS patients generally scoring lower across multiple domains of the International Index of Erectile Function (IIEF), except for sexual desire.^{17,18} These results align with earlier research that used the Rhinosinusitis Disability Index (RSDI) to compare sexual function in CRS patients. Interestingly, post-surgical intervention in CRS patients resulted in notable improvements in both sexual function and sleep quality. Similarly, patients with nasal polyps have been found to have a higher occurrence of ED. Postoperative assessments utilizing the IIEF-EF scale also demonstrated significant enhancements in erectile function after polyp removal, highlighting the potential benefits of surgical intervention.¹⁹ Allergic rhinitis and asthma are closely related from an epidemiological standpoint. Numerous studies have shown a strong association between rhinitis and the subsequent development of asthma, indicating that rhinitis often serves as a precursor to asthma.²⁰ According to data from an asthma quality-of-life survey, 58% of individuals reported experiencing sexual dysfunction, placing sexual limitations as the 15th most common out of 19 identified limitations. Furthermore, there was a positive correlation between the severity of sexual dysfunction and the intensity of asthma symptoms.²¹

To account for gender differences in sexual function, we stratified the study population into female and male groups. Our findings revealed that female patients with AR had significantly lower total FSFI scores compared to the control group, indicating various levels of sexual dysfunction. Specifically, female AR patients exhibited notable declines in subjective arousal, orgasmic function, and intercourse satisfaction. These results are consistent with a 2005 study from Turkey, where FSFI scores of women with Allergic Rhinoconjunctivitis (ARC) were significantly lower than those of the control group during symptomatic periods. In that study, statistical differences between women with ARC before treatment and controls were primarily seen in the domains of lubrication and pain, while other domains showed no significant changes.⁶ In the treatment group, women reported substantial reductions in asthma-related symptoms during sexual activity and an overall improvement in their quality of life. This aligns with another study in which 25.8% of women with asthma reported impaired sexual function compared to controls, with lower scores observed in sexual arousal, lubrication, orgasm, sexual satisfaction, and pain, except for sexual desire.^{22,23}

In our study, the total IIEF scores were significantly higher in the control group compared to male patients with AR. Specifically, erectile function, sexual desire, and overall satisfaction were markedly lower in male AR patients than in the control group. These findings are in line with previous research, which showed that a higher proportion of AR patients (1.32%) developed ED during a 5.82-year follow-up period in a nationwide population-based study in Taiwan. The study indicated that the risk of developing ED was greater among those with more frequent clinical visits for AR and prolonged use of AR medications compared to controls, suggesting that AR may be an independent risk factor for ED.⁷ Additionally, a retrospective analysis found that patients with ED were more likely to have co-existing rhinologic diseases compared to healthy individuals, which supports our current observations.²⁴ Another retrospective cohort study, using data from Taiwan's National Health Insurance Research Database, examined 14,039 cases of chronic rhinosinusitis (CRS) and 140,387 matched controls. This study revealed that both CRS with and without nasal polyps (NP) were associated with a higher risk of ED, although no significant differences were found between the two types of CRS in relation to ED.²⁵

To better understand the impact of AR on sexual function, we analyzed the relationship between nasal symptoms and sexual function. Our findings showed that, in both male and female AR patients, nasal congestion, dysosmia and overall disease severity had the most significant effect on various aspects of sexual function. The correlation between overall nasal symptoms and sexual function, aiding in our holistic understanding of the effects of AR on sexual function. These results contributing to further understanding of the broader effects of AR on patients' quality of life. In male patients, rhinorrhea scores were notably correlated with overall satisfaction and total sexual function scores, emphasizing the complex connection between nasal symptoms and sexual health. Although the pathophysiology of AR and CRS differs, we can draw parallels in the subjective assessment of sexual function between these conditions. Early research suggests that nasal function plays a crucial role in sexual health. For example, one study demonstrated that sexual function in CRS patients improved following surgical intervention, with these improvements closely linked to better outcomes in nasal

symptoms, including nasal congestion, drainage, changes in smell, and relief from facial pain or pressure.²⁶ A case-control study by Zojaji et al involving 100 male patients with CRS found a significant negative correlation between the severity of nasal obstruction and sexual function. As nasal obstruction became more severe, sexual function scores showed a marked decrease.¹⁸ Additionally, a strong correlation was found between improvements in four nasal symptoms, sneezing, nasal obstruction, nasal itching, and watery discharge, and corresponding enhancements in sexual function scores in allergic patients treated with oral desloratadine.⁶ Chronic inflammation and hypoxia in patients with AR may plausibly contribute to the development of cardiovascular complications, including ED.²⁷

Our findings align with existing data that suggest a connection between olfactory function and sexual function in both men and women. Specifically, the olfactory threshold is directly associated with sexual desire, as measured by the IIEF scale, in young adult men, although this relationship may not extend to elderly men.²⁸ One study has even suggested that heightened olfactory sensitivity positively influences the sex life of young, healthy individuals.²⁹ These observations are consistent with earlier findings that reported sexual impairments in individuals diagnosed with smell disorders and those experiencing subjective smell impairment.^{30,31} Additionally, a previous study revealed that patients with both ED and rhinologic diseases had the poorest olfactory sensitivity. ED patients with rhinologic conditions also reported greater nasal discomfort and more severe erectile dysfunction compared to those without rhinologic diseases.²⁴ This may be attributed to the impact of olfactory sensitivity on the enjoyment and quality of sexual experiences and activities.

Certain limitations in our present study should be considered and addressed in the future. Firstly, the participants were recruited from the Otolaryngology department, and some of the exclusion criteria were based on subjective questionnaires completed by the participants, which may be less accurate. Secondly, we did not collect data on factors such as body mass index, comorbidities, and smoking, which could potentially interact with sexual dysfunction. Lastly, sexual dysfunction is a symptom of various conditions stemming from organic or psychological causes. In this study, we primarily focused on the subjective assessment of sexual function through questionnaires completed by patients and controls. Therefore, future studies should explore additional related risk factors to further assess the sexual function of AR patients.

Conclusion

To the best of our knowledge, the significance of sexual dysfunction as a comorbidity of allergic rhinitis (AR) has been underappreciated in existing literature. Our study emphasizes the critical yet often overlooked association between AR-related nasal symptoms and sexual function, shedding light on negative correlations between the two. Both male and female AR patients face an increased risk of experiencing sexual dysfunction, which warrants greater attention in clinical practice. Among the various symptoms, nasal congestion and dysosmia were found to exert the most profound and multifaceted effects on sexual function. These findings underscore the need for comprehensive management approaches that address not only AR's respiratory manifestations but also its broader impacts on quality of life.

Data Sharing Statement

The data that support the findings of this study are available from the corresponding author.

Ethics Statement

Approval was obtained from the institutional review board of The Second Hospital of Shandong University. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

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Disclosure

The authors report no conflicts of interest in this work.

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