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Gender Dimorphism in the Impact of Obesity on Chronic Rhinosinusitis Symptoms: An Analysis of SNOT-22 Subitems

Obezitenin Kronik Rinosinüzit Semptomları Üzerindeki Cinsiyet Dimorfizmi: SNOT-22 Alt Kalemlerinin Analizi

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ABSTRACT

Aim: This study aimed to evaluate the effect of obesity on the symptom profile and radiological disease burden in patients with chronic rhinosinusitis (CRS).

Materials and Methods: A total of 123 patients with CRS were retrospectively analyzed. The patients' heights, weights, 22-item Sinonasal Outcome test (SNOT-22) scores, and Lund-Mackay scores were recorded. Patients were grouped into obese (≥30 kg/m^2) and normal (<30 kg/m^2) based on their body mass index (BMI) values. Symptom profiles and radiological disease burden were assessed using SNOT-22 and Lund-Mackay scoring, respectively BMI was correlated with each SNOT-22 question and with the total SNOT-22 score using Spearman's rank correlation, while the Lund-Mackay score was analyzed using Pearson correlation.

Results: Increase in BMI was positively correlated ($p<0.05$) with certain SNOT-22 items; these associations were more pronounced in women with nasal congestion and sleep-related symptoms and in men with postnasal drip. However, no significant differences were found in total SNOT-22 and Lund-Mackay scores between the obese and normal groups.

Conclusion: Obesity may be associated with specific symptom patterns, although it does not significantly increase the total symptom burden. The fact that obesity is associated with obstructive symptoms in women and secretory symptoms in men underscores the need for personalized treatment approaches in this patient group. Large-scale studies are needed to more clearly demonstrate the effect of obesity on CRS symptoms, phenotypes, and radiological findings.

Keywords: Chronic rhinosinusitis, obesity, body mass index, SNOT-22

ÖZ

Amaç: Bu çalışmada, obezitenin kronik rinosinüzitli (KRS) hastalardaki semptom profili ve radyolojik hastalık yükü üzerindeki etkisini değerlendirmek amaçlandı.

Gereç ve Yöntem: Toplam 123 KRS hasta, geriye dönük olarak analiz edildi. Olguların boy, kilo, 22-öğelik Sinonazal Sonuç testi (SNOT-22) testi ve Lund-Mackay skorları not edildi. Hastalar vücut kitle indeksi (VKİ) değerlerine göre obez (≥30 kg/m^2) ve normal (<30 kg/m^2) olarak gruplandırıldı. Semptom profilleri SNOT-22 ile, radyolojik hastalık yükü ise Lund-Mackay skorlaması ile değerlendirildi. VKİ ile SNOT-22'nin her bir sorusu ve toplam SNOT-22 skoru Spearman korelasyon, Lund-Mackay skoru ise Pearson korelasyon analizi ile incelendi.

Bulgular: VKİ artışı bazı SNOT-22 maddeleri ile anlamlı pozitif korelasyon gösterdi; bu ilişkiler kadınlarda burun tıkanıklığı ve uykuya ilişkin semptomlarda, erkeklerde ise geniz akıntısında daha belirgindi. Ancak obez ve normal gruplar karşılaştırıldığında toplam SNOT-22 ve Lund-Mackay skorlarında anlamlı fark saptanmadı.

Sonuç: Obezite, toplam semptom yükünü belirgin olarak artırmamakla birlikte belirli semptom paternleri ile ilişkili olabilir. Kadınlarda obezitenin obstrüktif semptomları, erkeklerde ise sekretuar semptomları ön plana çıkarması, bu hasta grubunda kişiselleştirilmiş tedavi yaklaşımlarının gerekliliğini ortaya koymaktadır. Obezitenin KRS semptomları, fenotipleri ve radyolojik bulguları üzerindeki etkisini daha net ortaya koymak için geniş örneklemli çalışmalara ihtiyaç vardır.

Anahtar Kelimeler: Kronik rinosinüzit, obezite, vücut kitle indeksi, SNOT-22

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INTRODUCTION

Chronic rhinosinusitis (CRS) is characterized by inflammation of the nasal passages and paranasal sinuses. CRS is a common disease that imposes a substantial burden on individuals and society. A multicenter study in Europe reported a CRS prevalence of 10.9%[1]. Similar prevalence studies have been conducted in different countries, with reported rates of 5.5% in Brazil, 8% in China, 8.4% in South Korea, and 11.9% in the United States (US)[2-5].

CRS can be divided into two subtypes based on endoscopic findings: CRS with nasal polyps and CRS without nasal polyps[6]. It can also be classified based on the predominance of type 2 inflammation[7]. Type 2 inflammation is associated with T helper 2 cell cytokines, including interleukin (IL)-4, IL-5, and IL-13[8]. In Western countries, T helper 2-mediated type 2 inflammation is recognized as the predominant inflammatory profile, affecting approximately 50% of patients without nasal polyps and up to 80% of patients with nasal polyps[9].

According to the World Health Organization (WHO), overweight is defined as a body mass index (BMI) of 25 kg/m^2 or greater, and obesity as a BMI of 30 kg/m^2 or greater. Obesity is a rapidly growing pandemic, affecting more than 1 billion people worldwide[10]. Obesity prevalence is also increasing markedly in the Turkish population. The prevalence of overweight and obesity in Türkiye is higher than in Europe and comparable to that in the US. Obesity prevalence among adults in Türkiye was 18.8% in 1990 and increased to 36% in 2010[11].

Obesity is characterized by low-grade inflammation mediated by inflammatory cytokines and adipokines, including IL-6, TNF-α, and IL-1[12,13]. Asthma, an airway inflammatory disease, is well known to be associated with obesity[14]. In addition, higher BMI has been associated with increased prevalence of CRS; obesity is one of the most common comorbidities among patients with CRS[15,16].

Bapat et al.[17] compared obese and non-obese groups in mouse models of atopic dermatitis and allergic asthma. In the obese group, they observed that Th17-dominant inflammation replaced type 2 helper T (Th2) inflammation and that disease symptoms and findings were exacerbated. Furthermore, while biological therapies targeting Th2 cytokines were effective in the non-obese group, they were found to exacerbate disease severity in the obese group.

Although several studies have examined the relationship between obesity and CRS, the number of studies evaluating symptom-specific associations remains limited. In this study, we aimed to investigate the relationship between obesity and the symptom profile of CRS by analyzing each item of the 22-item Sinonasal Outcome test (SNOT-22). To this end, data from patients diagnosed with CRS at our clinic were retrospectively analyzed.

MATERIALS AND METHODS

This retrospective study included patients aged 18-70 years who presented to our clinic between 2021 and 2024, were diagnosed with CRS according to the EPOS 2020 criteria, and who had complete SNOT-22 forms, paranasal sinus computed tomography (CT) scans, and height and weight measurements. Patients with chronic diseases that could cause systemic inflammation, other than obesity, were excluded from the study; a total of 123 patients were included in the analysis. The study was approved by the Tekirdağ Namık Kemal University Non-Interventional Clinical Research Ethics Committee with (decision number 2024.236.07.11, date: 30.07.2024) and was conducted in accordance with the Declaration of Helsinki.

Symptom severity and quality of life were assessed using the SNOT-22; the Turkish-validated version by Hancı et al.[18] was used. Radiological disease burden was assessed using the Lund-Mackay classification on paranasal sinus CT. The BMI of all patients was calculated from height and weight measurements according to the WHO classification; patients with a BMI <30 kg/m^2 were classified as non-obese, and those with a BMI ≥30 kg/m^2 were classified as obese.

Statistical Analysis

An independent-groups t-test or Mann-Whitney U test was used to compare obese and normal groups, depending on the data distribution. The relationships between BMI and SNOT-22 items and between BMI and CT scores were evaluated using Pearson or Spearman's rank correlation analyses. $p<0.05$ was considered statistically significant, and all analyses were performed using IBM SPSS Statistics v29 (IBM Corp., Armonk, NY).

RESULTS

A total of 123 patients, with or without nasal polyps, were included in the study. Of the participants, 81 (65.9%) were male and 42 (34.1%) were female. The mean age was 41.95±13.46 years, with no significant difference in age distribution between male and female patients ($p=0.332$). Eighty-four patients (68.3%) had nasal polyps, while 39 patients (31.7%) did not. BMI ranged from 17 to 42.90, with a mean BMI of 27.12±4.81. The demographic characteristics of patients in the obese and non-obese groups are presented in Table 1.

Comparison of mean SNOT-22 scores between the obese and normal groups showed no significant difference in total SNOT-22 score ($p=0.867$). Similarly, no significant differences were found between the obese and normal-weight groups across the items of the SNOT-22. Lund-Mackay scores obtained from paranasal sinus CT were also similar between the two groups ($p=0.430$).

When examining the relationships between BMI and SNOT-22 items, some items showed weak but statistically significant correlations with BMI. As BMI in female patients increased, nasal congestion severity increased (p=0.033) and cough scores decreased (p=0.009). Furthermore, among female patients, an increase in BMI was positively and significantly correlated with difficulty falling asleep (p=0.011), nighttime awakenings (p<0.001), and inability to get a good night's sleep (p<0.001). Among male patients, BMI was negatively correlated with sneezing (p=0.001) and positively correlated with postnasal drip (p=0.042).

In the analysis of the entire patient group, some items were also significantly related to BMI. The sneezing item showed a negative correlation with BMI (p=0.005), whereas the poor nighttime sleep quality item showed a positive correlation with BMI (p<0.001). The irritability item showed a positive correlation with BMI in female patients (p=0.012), and this relationship remained significant in the analysis of the entire patient group (p=0.038). The correlation values for SNOT-22 items associated with obesity in the female, male, and entire group are shown in Table 2.

DISCUSSION

In this study, we evaluated the effects of obesity on the symptom profile and radiologic disease burden in patients with CRS. The associations between BMI, SNOT-22 scores, and Lund-Mackay scores were analyzed. Our findings demonstrated no significant differences between obese and non-obese groups in total SNOT-22 or Lund-Mackay scores. However, correlation analyses of individual SNOT-22 items revealed that BMI was associated with specific symptoms.

In female patients, an increase in BMI was associated with higher scores for nasal congestion, difficulty falling asleep, nighttime awakenings, and embarrassed; in male patients, a decrease in sneezing scores and an increase in postnasal drip scores were observed. In the entire patient group, the item "lack of a good night's sleep" showed a positive correlation with BMI. These findings suggest that obesity may affect certain symptom patterns, even if it does not significantly alter the total symptom burden.

These differences in symptom severity are consistent with the upper airway pathophysiology of obesity. In obese patients, increased body weight leads to narrowing of the upper airway, increased airway resistance, and a predisposition to nasopharyngeal collapse, resulting in reduced nasal airflow and more pronounced sleep-related symptoms[19]. For this reason, the positive correlations between BMI and measures of nasal blockage and sleep quality are biologically plausible. The negative correlation between sneezing and BMI may be explained by obesity-related alterations in sensory perception and neuromuscular responses[20]. In addition, the association between BMI and the item assessing embarrassed may reflect the negative impact of obesity on quality of life and the increased psychosocial burden experienced by these patients.

Table 1. Demographic characteristics of obese and normal-weight patients

Age (Mean ± SD)	43.53±12.94	41.4±13.66	0.442
Gender, n (%)	Female: 10 (31.2%) Male: 22 (68.8%)	Female: 32 (35.2%) Male: 59 (64.8%)	0.668
BMI (kg/m²) (Mean ± SD)	33.68±3.10	24.8±2.73	<0.01
Nasal polyp, n (%)	Present: 21 (65.6%) Absent: 11 (34.4%)	Present: 63 (69.2%) Absent: 28 (30.8%)	0.706
Lund-Mackay score (mean)	15.13	16.24	0.43

BMI: Body mass index, SD: Standard deviation

Table 2. Correlation coefficients for SNOT-22 items showing a significant relationship with BMI

SNOT-22 item	Female (rs/p)	Male (rs/p)	Total (rs/p)
Nasal blockage	0.329/0.033*	—	—
Sneezing	—	-0.347/0.001*	-0.250/0.005*
Cough	0.397/0.009*	—	—
Post-nasal discharge	—	0.226/0.042*	—
Difficulty falling asleep	0.388/0.011*	—	—
Wake up at night	0.557/<0.001*	—	—
Lack of a good night's sleep	0.505/<0.001*	—	0.181/0.045*
Embarrassed	0.385/0.012*	—	0.187/0.038*

*: p<0.05, SNOT-22: 22-item Sinonasal Outcome test, BMI: Body mass index

The positive correlation between nasal blockage and BMI observed in female patients may reflect obesity-related, sex-specific hormonal and inflammatory mechanisms affecting the nasal mucosa. Estrogen is known to predispose individuals to nasal congestion through increased acetylcholinesterase activity and alterations in vascular tone[21]. In obesity, peripheral adipose tissue exhibits increased aromatase activity, leading to enhanced conversion of androgens to estrogens. The resulting increase in estrogenic activity in obese female patients may further exacerbate pre-existing edematous changes in the sinonasal mucosa, thereby intensifying the sensation of nasal obstruction.

In addition, adipokines, such as leptin, which play a key role in obesity-associated systemic inflammation, are present at higher levels in females than in males. Leptin receptors have been identified in the nasal mucosa, where leptin can induce the release of pro-inflammatory cytokines[22]. This finding suggests that, in female patients in our study, the effect of obesity on nasal obstruction symptoms is mediated primarily by mucosal inflammation and edema rather than by structural narrowing, as evidenced by the absence of a significant change in Lund-Mackay scores. In male patients, the closer association between obesity and postnasal drip suggests that obesity-characterized by a predominance of visceral adiposity-may be linked to a distinct inflammatory pathway or impaired mucociliary clearance.

To the best of our knowledge, no previous study has performed a detailed, item-level analysis of the relationship between BMI and individual SNOT-22 components; in this respect, our study is unique. In a study by Chen et al.[23] that included 325 patients, symptoms were assessed using the visual analog scale. Although obese and overweight patients demonstrated higher scores for certain symptoms, these differences did not reach statistical significance[23]. In the same study, consistent with our findings, no significant association was observed between obesity and Lund-Mackay scores. Bhattacharyya,[15] in a large-scale US population study, reported a strong association between obesity and CRS and emphasized the need for further research to investigate how obesity influences CRS severity. Similarly, EPOS 2020 identified the impact of obesity on CRS as a research priority. In line with this recommendation, our study contributes to the literature by evaluating obesity-related effects at the symptom level, using individual SNOT-22 items.

Study Limitations

Our study has several limitations. The relatively small number of obese patients, compared with the normal-weight group, may have reduced the statistical power for comparisons between groups. In addition, the predominance of male patients and patients with nasal polyps in our cohort limited the feasibility of detailed subgroup analyses. The SNOT-22 is a subjective assessment tool and may be influenced by emotional or behavioral factors, potentially leading to variability in symptom reporting. Furthermore, due to the cross-sectional design of the study, causal relationships between BMI and symptom severity cannot be established.

CONCLUSION

In patients with CRS, obesity does not appear to directly increase the overall disease burden; however, it may modify the clinical expression of the disease in a sex-specific manner. Obesity is predominantly associated with nasal obstruction and sleep-related disturbances in female patients, whereas postnasal drip appears to be more prominent in male patients. These findings suggest that, in the management of obese patients with CRS, personalized treatment strategies that take sex and BMI into account may be more effective than a standardized approach. To fully elucidate the impact of obesity on CRS, future studies should focus on symptom clusters and the underlying sex-specific inflammatory mechanisms.

Ethics

Ethics Committee Approval: The study was approved by the Tekirdağ Namık Kemal University Non-Interventional Clinical Research Ethics Committee with (decision number 2024.236.07.11, date: 30.07.2024) and was conducted in accordance with the Declaration of Helsinki.

Informed Consent: The study is a retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: Ö.K., Concept: Ö.K., M.F.E., Design: M.F.E., Data Collection or Processing: Ö.K., M.F.E., Analysis or Interpretation: Ö.K., Literature Search: M.F.E., Writing: Ö.K., M.F.E.

Conflict of Interest: No conflict of interest was declared by the authors.

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