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Association Between Subjective Symptom Severity and Radiologic Involvement in CRSwNP Patients Using SNOT-22 and Lund-Mackay Scores

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Abstract

Introduction:

Chronic rhinosinusitis with nasal polyps (CRSwNP) is a chronic inflammatory sinonasal disorder associated with persistent symptoms and considerable impairment in quality of life. While both subjective symptom scores and objective radiologic assessments are commonly used in clinical practice, the association between these two measures has not been fully established.

Materials and Methods:

This cross-sectional study included 141 patients with confirmed CRSwNP who were recruited from Qaem Hospital, Mashhad, Iran, during 2024–2025. Symptom burden was evaluated using the validated Persian version of the Sinonasal Outcome Test-22 (SNOT-22), whereas radiologic disease extent was assessed using the Lund-Mackay computed tomography scoring system. The relationship between SNOT-22 and CT scores was examined using Spearman's correlation analysis.

Results:

The mean SNOT-22 score was 51.00 ± 17.86, while the mean Lund-Mackay score was 17.71 ± 4.76. Analysis demonstrated a moderate positive correlation between SNOT-22 and CT scores ($r = 0.347$, $p < 0.001$). Patients with asthma or Samter's triad ($n = 70$) showed significantly higher SNOT-22 and Lund-Mackay scores compared with those without these comorbidities ($p < 0.001$).

Conclusion:

A moderate association was identified between symptom severity reported by patients and radiologic disease severity in CRSwNP. Coexisting asthma or Samter's triad was linked to a greater overall disease burden. These findings highlight the value of integrating subjective symptom scoring with objective radiologic assessment for more comprehensive evaluation and individualized management.

Keywords: CRSwNP, SNOT22, Lund-Mackay CT score, Symptom severity, Radiologic finding

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Introduction

Chronic rhinosinusitis (CRS) is a prevalent disorder affecting nearly 3–6% of the general population (1). The diagnosis is established when cardinal symptoms, including nasal obstruction, anterior or posterior nasal discharge, facial pain or pressure, and/or impaired olfaction, persist for at least 12 weeks and are accompanied by objective evidence of sinonasal inflammation on sinus computed tomography (CT) or nasal endoscopy (2). According to the presence or absence of nasal polyps, CRS is broadly categorized into two phenotypes: chronic rhinosinusitis with nasal polyps (CRSwNP) and chronic rhinosinusitis without nasal polyps (CRSsNP) (3).

CRSwNP represents an important clinical phenotype of CRS and frequently coexists with asthma, allergy, or non-steroidal anti-inflammatory drug–exacerbated respiratory disease (N-ERD) (4). Patients with concomitant asthma often experience a more severe disease course, characterized by higher recurrence rates of nasal polyps, greater dependence on corticosteroid therapy, and increased difficulty in asthma control due to enhanced airway obstruction and eosinophilic inflammation (5). CRSwNP is commonly linked to type 2 inflammatory pathways and is associated with substantial impairment in health-related quality of life (HRQoL) (6,7). Persistent sinonasal symptoms can negatively affect sleep quality, contribute to mood disturbances, and ultimately reduce daily functioning and overall quality of life (8). Consequently, recent research has increasingly focused on developing reliable subjective and objective assessment tools to better evaluate disease burden and its impact on patients' lives.

The 22-item Sinonasal Outcome Test (SNOT-22) is a well-established and extensively validated instrument for measuring subjective symptom burden in patients with CRS (9). In clinical settings, this questionnaire is widely used to quantify symptom severity and evaluate disease impact from the patient's perspective. SNOT-22 covers several domains, including symptom burden, social and emotional well-being, productivity, and sleep-related disturbances associated with CRS. Each item is scored from 0 (no problem) to 5 (worst possible problem), resulting in a cumulative score ranging from 0 to 110 (10). Based on the Consensus-based Standards for the Selection of Health Status Measurement Instruments (COSMIN) checklist, SNOT-22 is regarded as one of the most reliable patient-reported outcome measures (PROMs) for CRS and is recommended for both routine clinical assessment and research applications (11). Although the overall SNOT-22 score reflects the general disease burden, evaluating individual domains provides a more detailed understanding of how CRS affects health-related quality of life (HRQoL) and helps identify the most affected symptom areas. Such detailed assessment may support more personalized therapeutic decision-making and improved clinical outcomes (12).

Accurate diagnosis and management of CRS also require objective evaluation of disease severity. Computed tomography (CT) remains a cornerstone of this assessment, and scoring systems such as the Lund-Mackay Score (LMS) are widely used because of their practicality and reproducibility, even among non-radiologist clinicians (8,9). The LMS measures the degree of sinus opacification on CT imaging and offers a standardized method for quantifying radiologic disease severity. This objective measure serves as an important complement to symptom-based assessment and contributes to clinical decision-making (13).

Despite the routine use of both SNOT-22 and LMS in clinical practice, the association between patient-reported symptom burden and objective radiologic severity in CRSwNP has not yet been fully clarified. Better understanding of this relationship is essential for comprehensive disease evaluation and may improve individualized treatment planning.

To further explore this relationship, the present study aimed to assess the correlation between subjective symptom burden, measured by SNOT-22, and objective radiologic severity, determined by LMS, in patients with CRSwNP.

Materials and Methods

This cross-sectional study was performed at Qaem Hospital, Mashhad, Iran, between 2024 and 2025. A total of 141 adult patients with CRSwNP diagnosed according to EPOS 2020 criteria were enrolled. All eligible patients attending the otolaryngology clinic during the study period who met the predefined inclusion and exclusion criteria were included in the study. As this was an observational study, no

randomization was applied. To reduce potential selection bias, consecutive sampling was used. All participants underwent standardized clinical evaluation under the supervision of a board-certified otolaryngologist.

Inclusion and Exclusion Criteria

Patients aged 18 to 60 years were considered eligible if they had a confirmed diagnosis of CRSwNP according to the EPOS 2020 criteria. Diagnosis was established by the presence of at least two symptoms, including either nasal obstruction/congestion or nasal discharge (anterior or posterior), together with facial pain/pressure and/or olfactory dysfunction, in addition to objective evidence on nasal endoscopy (such as polyps or mucosal edema) or CT findings consistent with sinonasal inflammation (2). Only patients with complete medical records, including a fully completed SNOT-22 questionnaire and an available sinus CT scan, were included in the analysis.

Exclusion criteria were as follows

- Presence of other disorders affecting the paranasal sinuses, such as granulomatosis with polyangiitis, sinonasal tumors, cystic fibrosis, primary ciliary dyskinesia, systemic vasculitis, facial trauma, or congenital craniofacial abnormalities
- History of cocaine use
- Previous nasal or sinus surgery within the preceding 6 months
- Incomplete clinical data, including missing SNOT-22 scores or unavailable CT imaging (9).

Symptom and Imaging Assessment

All participants completed the SNOT-22 questionnaire, a validated 22-item patient-reported outcome measure designed to evaluate the impact of CRS on health-related quality of life. Each item is rated on a scale from 0 (“No problem”) to 5 (“Problem as bad as it can be”), resulting in a total score ranging from 0 to 110 (11).

The validated Persian version of SNOT-22, previously adapted for Iranian populations, was administered under the supervision of an allergist.

Objective disease severity was evaluated using CT scans of the paranasal sinuses. To ensure consistency and reduce interpretation bias, all CT images were reviewed by a single experienced otolaryngologist who was blinded to the patients’ SNOT-22 scores. Radiologic severity was determined using the LMS, in which each of the six paired sinus regions receives a score of 0 (no opacification), 1 (partial opacification), or 2 (complete opacification). The ostiomeatal complex was scored as 0 (patent) or 2 (obstructed), resulting in a total score ranging from 0 to 24 (14).

Ethical Considerations

The study protocol was approved by the Ethics Committee of Mashhad University of Medical Sciences (approval code: R.MUMS.IRH.REC.1404.002). Written informed consent was obtained from all participants before data collection.

Statistical Analysis

Statistical analyses were performed using SPSS version 22 (IBM Corp., Armonk, NY, USA). Descriptive statistics were applied to summarize demographic and clinical characteristics. The association between SNOT-22 scores and LMS was evaluated using Spearman’s rank correlation coefficient. A P-value of <0.05 was considered statistically significant.

Results

A total of 141 patients with confirmed CRSwNP were enrolled in the study. The demographic and clinical characteristics of the study population are presented in Table 1.

The mean age was 42.12 ± 12.56 years, and the sex distribution was nearly equal, including 71 men (50.4%) and 70 women (49.6%).

Table 1. Epidemiologic data of our cohort of patients

Variables		CRSwNP (N=141)		
		Mean ± SD or N (%)	Min	Max
Sex	Age	42.12±12.56	11	77
	Men (%)	71 (50.4%)	-	-
	Female (%)	70 (49.6%)	-	-
	SNOT	51±17.86	13	107
	LMS	17.71±4.76	7	24

The mean SNOT-22 score was 51.00 ± 17.86 (range: 13–107), whereas the mean LMS was 17.71 ± 4.76 (range: 7–24). Based on symptom severity, 104 patients (73.8%) had SNOT-22 scores ≥40, reflecting a substantial symptom burden, while 37 patients (26.2%) had scores below 40. Regarding radiologic severity, 109 patients (77.3%) had LMS values ≥12, whereas 32 patients (22.7%) had scores <12.

Correlation analysis demonstrated a statistically significant positive association between total SNOT-22 scores and LMS (Spearman's r = 0.347, p < 0.001), indicating a moderate relationship between patient-reported symptom severity and radiologic disease extent (Figure 1).

Overall, patients reporting greater symptom burden tended to exhibit more extensive radiologic involvement, although noticeable inter-individual variability remained.

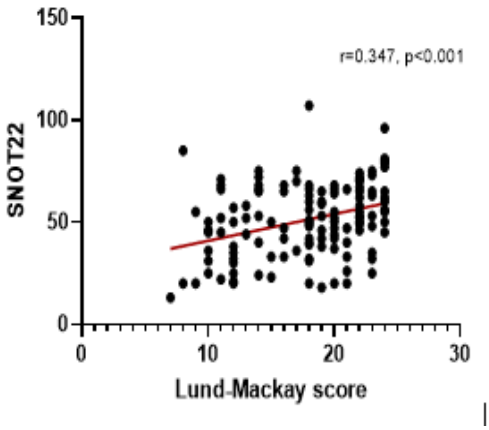

Fig 1. The Correlation Analysis of Lund-Mackay Score and SNOT-22

Further analysis of inflammatory biomarkers revealed a weak yet statistically significant positive association between SNOT-22 scores and peripheral blood eosinophil counts (r = 0.174, p = 0.04). In contrast, no significant relationships were identified between SNOT-22 scores and total serum IgE levels (r = 0.113, p = 0.181) or nasal tissue eosinophilia (r = 0.063, p = 0.455). Regarding radiologic severity, LMS demonstrated a weak but significant positive correlation with total serum IgE levels (r = 0.209, p = 0.013), whereas no statistically significant associations were found between LMS and either blood eosinophil counts or nasal eosinophilia (Table 2).

Table 2. correlation between inflammatory biomarkers and SNOT22/LMS

Variables		Total IgE	Blood eosinophil	Nasal tissue eosinophil
SNOT22	spearman's r	0.11	0.17	0.06
	p-value	0.18	0.04	0.45
LMS	spearman's r	0.20	0.09	0.14
	p-value	0.01	0.28	0.09

Among the study participants, 31.2% had asthma, 18.2% had Samter's triad, and 11.3% had hypothyroidism, while the remainder had no clinically significant systemic comorbidities (Figure 2).

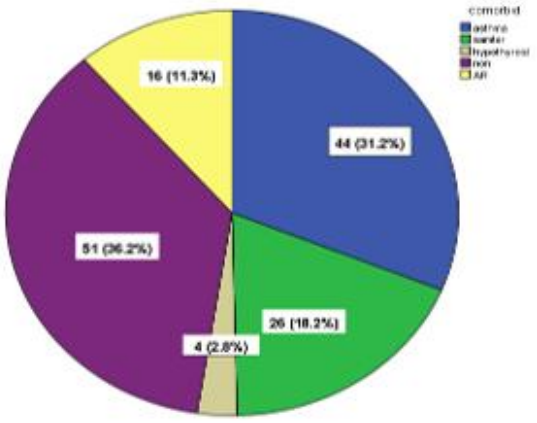

Fig 2. Frequency distribution of comorbidities in patients

Patients with asthma or Samter's triad (n = 70) had significantly higher SNOT-22 scores compared with patients without these comorbidities (56.7 vs. 45.35, p < 0.001). Additionally, 87.1% of patients in this subgroup had SNOT-22 scores ≥40 (p < 0.001). Their mean LMS was also significantly greater than that of patients without these conditions (18.75 vs. 16.67, p < 0.001), indicating that asthma or Samter's triad is associated with both increased symptom burden and more extensive radiologic disease.

No statistically significant differences were observed between male and female patients in either SNOT-22 or LMS scores (SNOT-22: p = 0.475; LMS: p = 0.742), suggesting comparable symptom burden and radiologic disease severity across sexes. Subgroup analyses based on SNOT-22 and LMS severity categories demonstrated a consistently positive direction of correlation across different severity strata. Although statistical significance was attenuated

in smaller subgroups, likely because of limited sample size and reduced score variability, the overall correlation pattern remained consistent.

Taken together, these findings support the value of multidimensional assessment in CRSwNP.

Although a moderate correlation was observed between patient-reported symptoms and radiologic severity, considerable inter-individual variability highlights the importance of combining subjective and objective measures for comprehensive disease evaluation and individualized management.

Discussion

The present study investigated the clinical characteristics of patients with CRSwNP and explored the relationship between subjective symptom burden, assessed by SNOT-22, and objective radiologic severity, measured by the LMS. The study population had a mean age of 42.12 ± 12.56 years (range: 18–77 years) and showed a nearly equal sex distribution, with 50.4% males and 49.6% females. These findings are consistent with previous reports indicating that CRS commonly affects adults during their most productive years (2). Regarding sex distribution, previous studies have reported inconsistent findings. While some investigations, such as Sujana et al. (9), reported male predominance, others particularly those conducted in Western populations—have demonstrated a higher prevalence among females (15). Such variation may be attributable to differences in environmental exposures, occupational risk factors, genetic susceptibility, and health-seeking behaviors across populations (16).

Regarding comorbidities, asthma was present in 31.2% of patients, while 18.2% had Samter's triad, also known as aspirin-exacerbated respiratory disease (AERD). Additionally, 11.3% of patients had hypothyroidism. The coexistence of asthma and CRSwNP has been consistently reported and is commonly associated with a more severe disease course, greater corticosteroid requirements, and increased recurrence rates following treatment (5,17). This relationship is likely explained by shared type 2 inflammatory mechanisms, particularly eosinophilic inflammation, which contributes to both upper and lower airway disease (18).

A moderate positive correlation was identified between SNOT-22 and LMS ($r = 0.347$, $p < 0.001$), indicating that patients with greater symptom burden generally tended to demonstrate more extensive radiologic involvement. This finding is in agreement with previous studies by Sujana W et al., Zhou et al., and Chen T et al. (9,8,19), which similarly reported positive associations between subjective symptom severity and CT-based disease extent. In contrast, studies by Misirovs R et al. (20) and Gregurić T et al. (21) found no significant correlation between these measures. Such discrepancies may reflect the complex and multifactorial nature of CRS, in which radiologic abnormalities do not always correspond directly to patient-reported symptoms.

However, the moderate strength of this correlation highlights the importance of using both subjective and objective tools in CRS assessment (8). For example, patients with minimal radiologic involvement may still report significant symptoms due to factors such as central sensitivity, psychological distress, or comorbid conditions .This moderate correlation may be attributed to factors such as anatomical variability, differences in symptom perception thresholds, and the influence of non-sinonasal contributors like migraine and sleep disorders, which are not always reflected in radiologic findings (22,23).

In additional analyses of inflammatory biomarkers, weak but statistically significant correlations were observed between peripheral blood eosinophil counts and SNOT-22 scores, as well as between total IgE levels and LMS. Although these associations were modest, they further support the contribution of type 2 inflammatory activity to both subjective symptom burden and objective radiologic severity in CRSwNP. The relatively weak magnitude of these correlations suggests that inflammatory biomarkers alone may not fully reflect the complexity of the disease, further emphasizing the importance of a multidimensional assessment approach. In our cohort, 73.8% of patients had SNOT-22 scores ≥40, and 77.3% had LMS values ≥12, indicating a substantial overall disease burden. Notably, 87.1% of patients with Samter's triad and 85.7% of those with asthma had SNOT-22 scores ≥40, representing significantly greater

symptom burden compared with patients without these comorbidities ($p < 0.001$ and $p = 0.018$, respectively). Moreover, patients with asthma or Samter's triad demonstrated higher mean SNOT-22 and LMS scores than those without these conditions.

These findings are consistent with previous studies indicating that asthma-related comorbidities are associated with more severe CRS symptoms and greater radiologic involvement (5,24,25).

Despite the strengths of our study, several limitations should be considered. First, the cross-sectional design does not allow causal relationships to be established. Second, all CT scans were evaluated by a single observer; although this approach ensured consistency in scoring, it may have introduced observer-related bias. In addition, psychological factors, sleep quality, and endoscopic findings were not formally evaluated, all of which could partly account for variability in symptom scores.

All eligible consecutive patients with CRSwNP presenting during the study period were included to minimize selection bias. Although the distribution of SNOT-22 and LMS scores was not perfectly balanced across severity categories, it reflects real-world clinical presentation. Subgroup analyses demonstrated a consistent positive direction of correlation across severity strata.

The reduced statistical significance observed in smaller subgroups is likely related to limited sample size and restricted score variability.

Conclusion

In conclusion, our findings highlight the necessity of a comprehensive, multidimensional evaluation of CRSwNP. Integrating patient-reported outcomes (SNOT-22) with radiologic, endoscopic, or biomarker-based assessments can improve disease stratification, guide personalized treatment, and enhance clinical outcomes. Future longitudinal studies incorporating inflammatory biomarkers and quality-of-life subdomains are warranted to further elucidate the complex relationship between symptom severity and radiologic disease burden.

References

1. Dietz de Loos D, Lourijsen ES, Wildeman MAM, Freling NJM, Wolvers MDJ, Reitsma S, et al. Prevalence of chronic rhinosinusitis in the general population based on sinus radiology and symptomatology. J Allergy Clin Immunol. 2019; 143(3):1207–14. PMID: 30578880.

2. Fokkens WJ, Lund VJ, Hopkins C, et al. European Position Paper on Rhinosinusitis and Nasal Polyps 2020. Rhinology. 2020;58(Suppl 29):1–464.

3. Staudacher AG, Peters AT, Kato A, Stevens WW. Use of endotypes, phenotypes, and inflammatory markers to guide treatment decisions in chronic rhinosinusitis. Ann Allergy Asthma Immunol. 2020;124(4):318–25.

4. Costanzo GA, Ledda AG, Sambugaro G, Murdaca G, Caruso C, Canalis S, et al. A real-life evaluation of SNOT-22 domains in a cohort of CRSwNP patients treated with biologic therapies for 12 months. World Allergy Organ J. 2025;18(3):101041.

5. Laidlaw TM, Mullol J, Woessner KM, Amin N, Mannent LP. Chronic rhinosinusitis with nasal polyps and asthma. J Allergy Clin Immunol Pract. 2021;9(3):1133–41. doi: 10.1016/j. jaip.2020. 09.063.

6. Dennis SK, Lam K, Luong A. A review of classification schemes for chronic rhinosinusitis with nasal polyposis endotypes. Laryngoscope Investig Otolaryngol. 2016;1(5):130–4.

7. Khan A, Vandeplas G, Huynh TMT, et al. The Global Allergy and Asthma European Network (GALEN) rhinosinusitis cohort: a large European cross-sectional study of chronic rhinosinusitis patients with and without nasal polyps. Rhinology. 2019;57(1):32–42.

8. Zhou AS, Prince AA, Maxfield AZ, Corrales CE, Shin JJ. Sinonasal outcome scores and imaging: a concurrent assessment of factors influencing their association. Otolaryngol Head Neck Surg. 2021; 165(1):215–22.

9. Sujana W, Maharani I. The correlation between the CT-scan scoring system and the SNOT-22 score in adult chronic rhinosinusitis. Egypt J Ear Nose Throat Allied Sci. 2022;23(23):1–4.

10. Levy JM, Mace JC, Rudmik L, Soler ZM, Smith TL. Low 22-item sinonasal outcome test scores in chronic rhinosinusitis: why do patients seek treatment? Laryngoscope. 2017;127:22–8.

11. Rudmik L, Soler ZM, Mace JC, DeConde AS, Schlosser RJ, Smith TL. Using preoperative SNOT-22 score to inform patient decision for endoscopic sinus surgery. Laryngoscope. 2015;125:1517–22.

12. DeConde AS, Bodner TE, Mace JC, Smith TL. Response shift in quality of life after endoscopic sinus surgery for chronic rhinosinusitis. JAMA Otolaryngol Head Neck Surg. 2014;140:712–9.

13. Taheri A, Hasani S, Esfeedvajani MS, Saeedi M, Abolghasemi R. Sino-nasal outcome test-22 and Lund–Mackay CT score to select endoscopic sinus

surgery in chronic rhinosinusitis. World J Otorhinolaryngol Head Neck Surg. 2024; 10(3): 200–5.

14. Brooks SG, Trope M, Blasetti M, et al. Preoperative Lund–Mackay computed tomography score is associated with preoperative symptom severity and predicts quality-of-life outcome trajectories after sinus surgery. Int Forum Allergy Rhinol. 2018;8:668–75.

15. Hoehle LP, Phillips KM, Caradonna DS, Gray ST, Sedaghat AR. A contemporary analysis of clinical and demographic factors of chronic rhinosinusitis patients and their association with disease severity. Ir J Med Sci. 2018;187(1):215–21.

16. Shi JB, Fu QL, Zhang H, Cheng L, Wang YJ, Zhu DD, et al. Epidemiology of chronic rhinosinusitis: results from a cross-sectional survey in seven Chinese cities. Allergy. 2015;70(5):533–9.

17. Lin DC, Chandra RK, Tan BK, Zirkle W, Conley DB, Grammer LC, et al. Association between severity of asthma and degree of chronic rhinosinusitis. Am J Rhinol Allergy. 2011;25:205–8. PMID: 21819754.

18. Zhang Y, Derycke L, Holtappels G, et al. Th2 cytokines orchestrate the secretion of MUC5AC and MUC5B in IL-5-positive chronic rhinosinusitis with nasal polyps. Allergy. 2019;74(1):131–40.

19. Chen T, Chidarala S, Young G, Jeong SS, Nguyen SA, Edwards TS, Schlosser RJ. Association of sinonasal computed tomography scores to patient-reported outcome measures: a systematic review and meta-analysis. Otolaryngology–Head and Neck Surgery. 2023 Apr;168(4):628-34

20. Misirovs R, Chan R, Lipworth B. 5-item sino-nasal outcome test and 22-item sino-nasal outcome test relationship with endoscopic and radiologic scores in chronic rhinosinusitis with nasal polyps. Ann Allergy Asthma Immunol. 2024;132(3):363–7.

21. Gregurić T, Trkulja V, Baudoin T, Grgić MV, Šmigovec I, Kalogjera L. Association between computed tomography findings and clinical symptoms in chronic rhinosinusitis with and without nasal polyps. Eur Arch Otorhinolaryngol. 2017; 274:2165–73.

22. Derbarsegian A, Adams SM, Phillips KM, Sedaghat AR. The burden of migraine on quality of life in chronic rhinosinusitis. Laryngoscope. 2023;133(12):3279–84.

23. Mahdavinia M, Schleimer RP, Keshavarzian A. Sleep disruption in chronic rhinosinusitis. Expert Rev Anti Infect Ther. 2017;15(5):457–65.

24. Lehrer EM, Mullol J, Agredo F, Alobid I. Management of chronic rhinosinusitis in asthma patients: is there still a debate? Curr Allergy Asthma Rep. 2014;14:440.

25. Shaw DE, Sousa AR, Fowler SJ, et al. Clinical and inflammatory characteristics of the European U-BIOPRED adult severe asthma cohort. Eur Respir J. 2015;46(5):1308–21.