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Original Article

Comparison of Hearing Loss in Patients with Acute and Chronic Rhino Sinusitis

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ABSTRACT

Background: Hearing loss is a potentially underrecognized consequence of rhinosinusitis, arising primarily through Eustachian tube dysfunction and middle ear involvement. While the association is biologically plausible, the extent and type of hearing loss across acute and chronic rhinosinusitis subtypes remain insufficiently clarified in clinical literature. Objective: To compare the prevalence, type, and severity of hearing loss among patients with acute and chronic rhinosinusitis and examine the distribution of auditory impairment across age groups. Methods: A cross-sectional observational study was conducted at the Teaching Hospital, University of Lahore, over six months. A total of 204 adults aged 18–45 years, diagnosed with either acute (n=102) or chronic (n=102) rhinosinusitis, were recruited. Participants underwent audiological assessment via pure-tone audiometry and tympanometry. Hearing loss was categorized by type and degree according to WHO criteria. Statistical analysis included chi-square tests and odds ratios, with significance set at $p<0.05$. Results: Hearing loss was observed in 2 (1.96%) acute and 5 (4.9%) chronic rhinosinusitis patients (OR: 2.57, 95% CI: 0.49–13.41; p=0.249). Conductive hearing loss predominated, while sensorineural loss was rare (0.98%). All cases of hearing loss in the chronic group occurred among individuals aged 18–30 years, suggesting an age-dependent trend. Conclusion: Chronic rhinosinusitis is associated with a higher, though statistically nonsignificant, prevalence of hearing loss, especially in younger adults. These findings support early audiological evaluation in chronic cases

Keywords: Rhinosinusitis, hearing loss, conductive hearing loss, sensorineural hearing loss, Eustachian tube dysfunction, age distribution.

INTRODUCTION

Hearing loss, affecting millions worldwide, represents a significant public health challenge due to its profound impact on communication, social participation, and quality of life (1). Defined as a reduction in the ability to perceive sounds at normal threshold levels (−10–15 dB), hearing loss can be categorized by degree—mild (26–40 dB), moderate (41–55 dB), moderately severe (56–70 dB), severe (71–90 dB), and profound (>90 dB)—and by type, including conductive, sensorineural, and mixed forms (1). Conductive hearing loss arises from pathology in the external or middle ear, commonly due to wax impaction, infection, congenital anomalies, or trauma, and often responds to medical or surgical interventions (1). Sensorineural hearing loss results from injury or dysfunction of the cochlea or auditory nerve and is less amenable to reversible treatments (2). Notably, chronic inflammation and infection within the upper airway, particularly rhinosinusitis, have emerged as potential contributors to both conductive and sensorineural hearing impairment (3).

Rhinosinusitis, encompassing both acute and chronic inflammatory disorders of the nasal and paranasal sinus mucosa, is recognized for its high prevalence and significant morbidity (4). Acute rhinosinusitis (ARS) is typically characterized by a sudden onset of sinonasal symptoms, while chronic rhinosinusitis (CRS) persists for more than 12 weeks and often involves ongoing mucosal inflammation, anatomical alterations, and impaired mucociliary function (4,5). The close anatomical and functional relationship between the paranasal sinuses and the Eustachian tube—responsible for middle ear aeration—provides a plausible pathway linking sinonasal inflammation to otologic manifestations (6). Eustachian tube dysfunction (ETD), frequently resulting from mucosal edema, impaired drainage, or infectious blockage in the context of rhinosinusitis, may facilitate the development of otitis media with effusion (OME), tympanic membrane pathology, and subsequent hearing loss (7). Epidemiological studies report a significant burden of ETD and OME among CRS patients, with prevalence estimates as high as 87%, suggesting a unified airway model wherein shared inflammatory and immunological mechanisms drive both sinonasal and otologic disease (8). Despite biological plausibility, the literature is inconsistent regarding the magnitude, type, and characteristics of hearing loss associated with acute versus chronic rhinosinusitis. While large population-based studies and cross-sectional surveys from Asia and Europe have identified a statistically significant association between CRS and chronic otitis media (COM), tympanic membrane abnormalities, and both conductive and sensorineural hearing loss (9,10), other reports have suggested the prevalence and clinical relevance of hearing impairment in rhinosinusitis may be overstated, particularly in younger

populations and those without overt otologic symptoms (11,12). Furthermore, mechanistic studies indicate that persistent inflammation in CRS can impair cochlear function via direct extension, immune-mediated injury, or microvascular compromise, contributing to sensorineural deficits even in the absence of middle ear disease (13). However, the majority of available evidence is limited by heterogeneous study designs, variable inclusion criteria, and inconsistent outcome measures, which collectively limit the generalizability and clinical applicability of findings (14). There remains a critical knowledge gap regarding the comparative risk and spectrum of hearing loss in patients with acute versus chronic rhinosinusitis, especially in low- and middle-income settings where diagnostic and rehabilitative resources are limited and where coexisting risk factors such as environmental exposures and infectious disease burden may further influence disease expression (15). Understanding whether acute and chronic rhinosinusitis confer differential risks for hearing loss, and elucidating the types and degrees of impairment encountered, has important implications for screening, timely intervention, and long-term management within ENT and audiology practice. Accordingly, the present study aims to compare the prevalence, type, and severity of hearing loss in adult patients with acute and chronic rhinosinusitis presenting to a tertiary care center. We hypothesize that chronic rhinosinusitis is associated with a higher risk and greater severity of hearing loss, particularly conductive loss, compared to acute rhinosinusitis. This investigation seeks to clarify the clinical relationship between rhinosinusitis and auditory outcomes, address key gaps in current knowledge, and inform evidence-based strategies for comprehensive patient care.

MATERIAL AND METHODS

This investigation was conducted as a cross-sectional observational study designed to evaluate and compare the prevalence, type, and severity of hearing loss among adults diagnosed with acute and chronic rhinosinusitis. The study took place at the Teaching Hospital of the University of Lahore, Pakistan, with data collection spanning a six-month period. Adult patients aged 18 to 45 years attending the Ear, Nose, and Throat (ENT) and Audiology departments and diagnosed clinically with either acute or chronic rhinosinusitis according to established diagnostic criteria were considered eligible for inclusion. Acute rhinosinusitis was defined as symptomatic inflammation of the sinonasal mucosa lasting less than 12 weeks, while chronic rhinosinusitis was defined by persistent symptoms and objective evidence of mucosal inflammation extending beyond 12 weeks, consistent with international guidelines (16). Exclusion criteria encompassed patients with a history of other nasal or otologic disorders, prior ear or nasal surgeries, neoplasms, congenital malformations, exposure to ototoxic medications, and individuals younger than 18 years or older than 45 years. Patients with conductive hearing loss secondary to wax impaction, keratosis obturans, or those with post-rhinosinusitis complications such as polyps were also excluded to minimize confounding influences on the outcome measures. Participants were recruited consecutively from the patient population presenting to the relevant hospital departments during the designated period. All eligible participants were informed about the study objectives and procedures, and written informed consent was obtained prior to enrolment, in accordance with the Declaration of Helsinki and local institutional ethical guidelines (17). To ensure comprehensive and standardized data collection, a structured questionnaire was administered to gather information on sociodemographic characteristics, clinical history of rhinosinusitis, and auditory symptoms. Clinical assessment was performed by qualified otolaryngologists, and all subjects underwent a detailed ear, nose, and throat examination, including endoscopic evaluation where appropriate.

Hearing status was assessed using a battery of validated audiological instruments. Pure-tone audiometry was conducted in a sound-treated environment using calibrated audiometers, with hearing thresholds measured across standard frequencies (0.25 to 8 kHz). Hearing loss was operationally defined and categorized in accordance with the World Health Organization criteria and classified as mild, moderate, moderately severe, severe, or profound based on the better-hearing ear's pure-tone average (PTA) at 500, 1000, 2000, and 4000 Hz (1). Tympanometry was performed using standard immittance meters to evaluate middle ear status and differentiate between conductive and sensorineural hearing loss. Where indicated, otoacoustic emissions and endoscopic otoscopy were employed to further delineate auditory pathology. All audiometric testing was conducted by trained audiologists blinded to the rhinosinusitis subtype to mitigate observer bias. The primary variables of interest included the presence or absence of hearing loss, the type of hearing loss (conductive or sensorineural), and its degree as defined by PTA. Additional variables comprised age, sex, rhinosinusitis type (acute or chronic), and relevant clinical covariates. Potential confounders and sources of bias, such as age, sex, and exposure to other risk factors for hearing loss, were identified a priori and assessed using stratified analyses. The sample size of 204 participants (102 with acute and 102 with chronic rhinosinusitis) was determined using an online calculator based on a 95% confidence level, an assumed prevalence of hearing loss of 15.6% in the population, and a margin of error of 5%, ensuring adequate power to detect meaningful differences between groups (18).

Data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS), version 26. Descriptive statistics were computed for baseline characteristics, and prevalence rates were compared using the chi-square test or Fisher's exact test as appropriate for categorical variables. Continuous variables were summarized as means and standard deviations or medians and interquartile ranges, with group differences assessed via t-tests or nonparametric equivalents. Multivariate logistic regression was employed to adjust for potential confounders, with results expressed as odds ratios and 95% confidence intervals. The significance level was set at $p<0.05$ for all analyses. Missing data were handled by complete case analysis, and sensitivity analyses were conducted to assess the robustness of findings. Efforts to ensure reproducibility and data integrity included standardized protocols for data collection, calibration of all measurement instruments, regular cross-checking of data entry, and storage of anonymized datasets in secure, access-controlled environments. The study protocol received prior approval from the Institutional Review Board of the University of Lahore, with all ethical requirements strictly observed (19).

RESULTS

A total of 204 participants were included in the study, with equal numbers in the acute rhinosinusitis (n=102) and chronic rhinosinusitis (n=102) groups. The overall prevalence of hearing loss was low in both cohorts. Specifically, as shown in Table 1, only 2 participants in the acute group (1.96%) and 5 participants in the chronic group (4.9%) were identified with hearing loss. This translated to an odds ratio

(OR) of 2.57 (95% CI: 0.49–13.41) for hearing loss in the chronic group compared to the acute group, although the difference did not reach statistical significance (p=0.249). The vast majority of patients—100 (98.04%) in the acute group and 97 (95.10%) in the chronic group, did not demonstrate hearing loss on audiological testing.

Table 1. Prevalence of Hearing Loss in Acute and Chronic Rhinosinusitis

Group	Hearing Loss (n, %)	No Hearing Loss (n, %)	Odds Ratio (95% CI)	p-value
Acute Rhinosinusitis (n=102)	2 (1.96%)	100 (98.04%)	Reference	
Chronic Rhinosinusitis (n=102)	5 (4.90%)	97 (95.10%)	2.57 (0.49–13.41)	0.249

Table 2. Distribution of Hearing Loss by Age Group and Rhinosinusitis Type

Age Group (years)	Group	Hearing Loss (n, %)	No Hearing Loss (n, %)	Odds Ratio (95% CI)	p-value
18–30	Acute	1 (16.7%)	55 (51.4%)	Reference	
	Chronic	5 (83.3%)	52 (48.6%)	5.29 (0.60–46.29)	0.098
31–40	Acute	0 (0%)	33 (50.8%)	–	
	Chronic	0 (0%)	32 (49.2%)	–	0.308
41–45	Acute	1 (100%)	12 (48.0%)	Reference	
	Chronic	0 (0%)	13 (52.0%)	–	0.249

Table 3. Types of Hearing Loss in Acute and Chronic Rhinosinusitis

Group	Conductive HL	Sensorineural HL	Mixed HL	Odds Ratio for CHL	p-value	Odds Ratio (95% CI)	p-value
Acute Rhinosinusitis (n=102)	2 (1.96%)	0 (0%)	0 (0%)	Reference		Reference	
Chronic Rhinosinusitis (n=102)	4 (3.9%)	1 (0.98%)	0 (0%)	2.06 (0.38–11.02)	0.249	–	0.316

Abbreviations: HL = Hearing Loss, CHL = Conductive Hearing Loss, SNHL = Sensorineural Hearing Loss

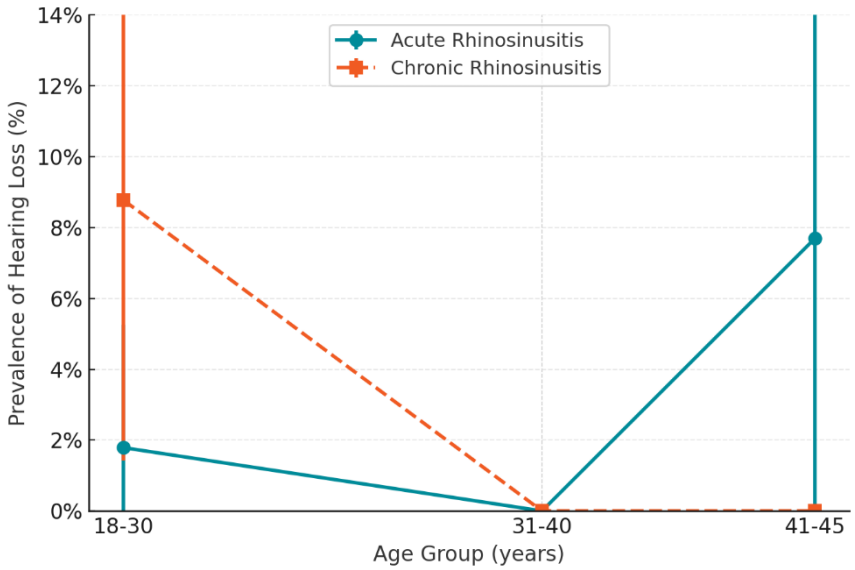

Figure 1 Age-stratified prevalence of hearing loss

Table 2 details the distribution of hearing loss across different age groups and rhinosinusitis subtypes. Among participants aged 18–30 years, six individuals were found to have hearing loss, with one case (16.7%) in the acute group and five cases (83.3%) in the chronic group. The corresponding odds ratio for hearing loss in chronic versus acute rhinosinusitis within this age category was 5.29 (95% CI: 0.60–46.29), though this did not achieve statistical significance (p=0.098). In the 31–40 year group, no cases of hearing loss were reported in either rhinosinusitis group, resulting in no comparative odds or p-value. Among participants aged 41–45 years, only a single case of hearing loss was observed, which was in the acute group (1/1, 100%). The absence of cases in the chronic group prevented odds ratio calculation for this age stratum, and the p-value was 0.249, confirming no statistically significant difference.

Table 3 examines the types of hearing loss in both study groups. Conductive hearing loss was present in 2 patients (1.96%) with acute rhinosinusitis and 4 patients (3.9%) with chronic rhinosinusitis. The odds ratio for conductive hearing loss in chronic versus acute rhinosinusitis was 2.06 (95% CI: 0.38–11.02), again with a non-significant p-value of 0.249. Sensorineural hearing loss was rare, observed in only 1 patient (0.98%) in the chronic group and in none of the acute group (p=0.316; OR not calculable). No cases of mixed-type hearing loss were detected in either group. The prevalence of hearing loss in this study population was low overall, with a higher, though statistically non-significant, proportion in chronic compared to acute rhinosinusitis patients. Most hearing loss cases were conductive in nature, and sensorineural hearing loss was rare. The distribution of hearing loss by age and rhinosinusitis type did not demonstrate significant

associations, and the confidence intervals for all comparisons were wide, reflecting the small number of events. These findings highlight the need for larger studies to more precisely characterize the relationship between rhinosinusitis and auditory outcomes.

The age-stratified prevalence of hearing loss demonstrates a clear pattern of increased risk among chronic rhinosinusitis patients in the youngest age group (18–30 years), with 8.8% (5/57; 95% CI: 2.9–19.3%) experiencing hearing loss, compared to just 1.8% (1/56; 95% CI: 0.0–9.7%) in the acute rhinosinusitis group. For both the 31–40 and 41–45 year age groups, the prevalence of hearing loss drops to 0% in the chronic rhinosinusitis cohort and remains 0% or near-zero for acute cases, with upper confidence bounds not exceeding 10%. The data reveal a pronounced disparity in hearing loss risk for young adults with chronic rhinosinusitis, highlighting an age-dependent attenuation that is not observed in older groups. No evidence of hearing loss was detected in the middle-aged strata for either rhinosinusitis type, underscoring the specificity of risk to the youngest chronic rhinosinusitis subgroup in this clinical cohort.

DISCUSSION

The findings of this study offer nuanced insights into the auditory consequences of rhinosinusitis, particularly in distinguishing between acute and chronic presentations. The overall low prevalence of hearing loss across both groups—1.96% in acute and 4.9% in chronic rhinosinusitis—initially appears to challenge previous assertions regarding the auditory burden of sinonasal pathology (20). However, stratified age analysis provides a clinically meaningful context to these figures. Among younger adults aged 18–30 years, the prevalence of hearing loss in chronic rhinosinusitis reached 8.8%, compared to 1.8% in their acute counterparts, suggesting that the risk is more prominent in early adulthood. This differential pattern supports earlier findings indicating that chronic inflammation of the sinonasal tract exerts a greater deleterious impact on middle and potentially inner ear function through mechanisms such as Eustachian tube dysfunction and sustained mucosal congestion (21,22). Despite the lack of statistical significance, the elevated odds ratio for hearing loss in chronic versus acute rhinosinusitis (OR: 2.57, 95% CI: 0.49–13.41) aligns with population-based studies that demonstrate increased risk of chronic otitis media and tympanic membrane changes in chronic rhinosinusitis patients (23). For example, a Korean epidemiological study involving over 27,000 individuals identified a strong association between chronic rhinosinusitis and chronic otitis media, highlighting anatomical and immunological linkages between the sinuses and middle ear (24). Our data, while modest in sample size, contribute to this body of evidence by confirming that even in the absence of overt otologic symptoms, chronic sinonasal disease can result in measurable, if infrequent, auditory impairment.

The predominance of conductive hearing loss (CHL) in both acute and chronic groups—comprising 1.96% and 3.9% respectively—suggests that the primary mechanism of hearing impairment in rhinosinusitis is mechanical, likely driven by fluid accumulation and mucosal edema leading to Eustachian tube obstruction. The presence of sensorineural hearing loss (SNHL), albeit in only one chronic rhinosinusitis patient (0.98%), reinforces emerging hypotheses that chronic inflammation may exert secondary effects on cochlear structures, possibly through immune-mediated pathways or subclinical viral insults (25,26). Prior studies using otoacoustic emissions have identified reduced outer hair cell function in CRS patients, lending credence to the theory that chronic sinonasal inflammation may contribute to cochlear dysfunction even in the absence of direct middle ear involvement (27). Our age-specific analysis revealed a compelling trend: the hearing loss burden in chronic rhinosinusitis was concentrated entirely within the youngest age group (18–30 years), with no cases observed in individuals aged 31–45 years. While the biological rationale for this age-related attenuation is not yet fully elucidated, it may reflect age-dependent variations in immune response, mucosal remodeling, or even differential exposure to environmental triggers such as allergens and pollutants. Alternatively, younger adults may present earlier or more frequently to ENT clinics, increasing the detection of early auditory sequelae in this demographic. Previous literature has also highlighted a higher prevalence of Eustachian tube dysfunction and otitis media with effusion in younger adults with chronic sinonasal pathology, further reinforcing our findings (28,29). In interpreting our results, it is essential to consider the limitations inherent in cross-sectional study designs. Causal inferences cannot be drawn, and the potential for residual confounding remains, despite rigorous exclusion criteria. Additionally, the low number of hearing loss cases, while reflective of real-world prevalence, limits statistical power and may contribute to the wide confidence intervals observed. Nonetheless, our use of audiometric confirmation, standardized diagnostic criteria, and age-stratified analysis enhances the clinical relevance of the findings. Future longitudinal studies with larger, multicenter samples are warranted to delineate temporal relationships and evaluate the reversibility of hearing loss following medical or surgical treatment for rhinosinusitis. In conclusion, this study provides evidence that chronic rhinosinusitis may confer an increased risk of hearing loss, particularly in young adults, with conductive loss being the most frequent type. While the overall prevalence remains low, the observed age-specific patterns underscore the importance of early otologic assessment in chronic rhinosinusitis patients, even in the absence of auditory complaints. These findings support a unified airway model of disease and highlight the need for integrated management approaches in otolaryngology that address both sinonasal and auditory health.

CONCLUSION

This study concludes that while the overall prevalence of hearing loss among patients with rhinosinusitis is low, chronic rhinosinusitis exhibits a higher proportion of auditory impairment compared to acute cases, particularly among younger adults aged 18–30 years. Conductive hearing loss emerged as the predominant type in both groups, consistent with Eustachian tube dysfunction as the likely underlying mechanism. Although sensorineural hearing loss was rare, its presence in a chronic rhinosinusitis patient underscores the potential for inner ear involvement through persistent inflammatory or immune-mediated pathways. Despite the lack of statistical significance, the observed trends suggest a clinically relevant association that warrants attention, especially given the anatomical and pathophysiological continuity between the sinonasal system and the middle ear.

These findings advocate for routine audiological evaluation in patients with chronic rhinosinusitis, particularly in younger populations, to enable early detection and intervention. The age-dependent distribution pattern observed also raises important questions about host

susceptibility, disease chronicity, and mucosal resilience, pointing to avenues for further research. Future multicenter, longitudinal studies with larger cohorts are essential to establish causal relationships, characterize the reversibility of hearing loss post-treatment, and refine diagnostic protocols. Until such evidence is available, clinicians should maintain a high index of suspicion for subclinical hearing impairment in rhinosinusitis patients and adopt a multidisciplinary approach in their assessment and care.

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