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Original Research Article

Assessment of Bone Conduction Threshold Shifts and Subclinical Sensorineural Hearing Loss (SNHL) in Long-standing Unilateral Mucosal CSOM

Karthik Raja R.[1], Aditya Shree[2], Saurabh Kumar[3], Satyendra Sharma[4]

[1,2]Senior Resident, Department of Otorhinolaryngology (ENT), Nalanda Medical College & Hospital, Patna, Bihar, India

[3]Assistant Professor, Department of Otorhinolaryngology (ENT), Radha Devi Jageshwari Memorial (RDJM) Medical College & Hospital, Muzaffarpur, Bihar, India·, Bihar, India

[4]Professor & Head of Department, Department of Otorhinolaryngology (ENT), Nalanda Medical College & Hospital, Patna, Bihar, India

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Corresponding author: Dr. Satyendra Sharma

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Abstract

Background: Chronic suppurative otitis media (CSOM) is an important cause of persistent hearing impairment, traditionally attributed predominantly to conductive mechanisms. However, chronic middle-ear inflammation may also be associated with subtle sensorineural involvement. The present study assessed bone-conduction (BC) threshold shifts and subclinical sensorineural/mixed hearing loss in patients with long-standing unilateral mucosal CSOM.

Methods: A hospital-based cross-sectional observational study was conducted among 110 patients aged 20–45 years with long-standing unilateral mucosal CSOM and a clinically normal contralateral ear at the Department of Otorhinolaryngology. All participants underwent otological examination and pure-tone audiometry. BC thresholds were assessed at 0.5, 1, 2, 4, and 8 kHz and compared between study and contralateral control ears. Associations between smoking, disease duration, otoscopic severity, and hearing status were evaluated using appropriate statistical tests. A *P* value <0.05 was considered statistically significant.

Results: SNHL/mixed hearing loss was significantly more frequent among smokers than non-smokers (χ^2 = 8.73, *P* = 0.003). Mean BC thresholds were significantly higher in the study ear than in the control ear at 0.5, 1, 2, 4, and 8 kHz (all *P* <0.001), with the inter-ear threshold difference progressively increasing at higher frequencies. The distribution of BC thresholds demonstrated a significant shift towards higher threshold categories in the study ear. Disease duration was significantly associated with SNHL, with increasing occurrence observed with longer-standing CSOM (χ^2 = 10.49, *P* = 0.015). Similarly, otoscopic severity was significantly associated with elevated BC thresholds (χ^2 = 15.04, *P* <0.001). Comparison of BC threshold categories between study and control ears also demonstrated a statistically significant difference (χ^2 = 22.42, *P* <0.001). Male participants had significantly higher haemoglobin and serum creatinine levels than females (both *P* <0.001), whereas fasting blood glucose and total cholesterol did not differ significantly between sexes.

Conclusion: Long-standing unilateral mucosal CSOM was associated with significant elevation of BC hearing thresholds in the diseased ear, particularly at higher frequencies, suggesting an early or subclinical sensorineural component. Smoking, longer disease duration, and greater otoscopic severity were significantly associated with poorer sensorineural hearing status. These findings support the importance of comprehensive audiological evaluation, including BC assessment, in patients with long-standing mucosal CSOM for early identification of sensorineural hearing impairment.

Keywords: Mucosal CSOM; Bone-conduction threshold; sensorineural hearing loss; pure-tone audiometry; smoking; otoscopic severity.

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Introduction

Chronic suppurative otitis media (CSOM) is a persistent inflammatory disorder of the middle ear characterized by tympanic membrane perforation and recurrent or continuous otorrhoea. It remains an important cause of preventable hearing impairment, particularly in low- and middleincome countries. Recent epidemiological evidence indicates that CSOM continues to impose a substantial global burden, with hearing impairment representing one of its most important long-term sequelae (Onifade et al., 2025) [1]. The functional hearing deficit is traditionally attributed primarily to conductive mechanisms resulting from tympanic membrane perforation, mucosal inflammation, and ossicular-chain abnormalities (Khairkar et al., 2023) [2]. Elzinga et al. (2021), in a systematic review of studies evaluating recurrent acute otitis media and CSOM, found that several studies demonstrated higher bone-conduction thresholds among patients with chronic otitis media; however, substantial heterogeneity and methodological limitations prevented a definitive conclusion regarding causality [3]. The review also emphasized the need for well-designed studies using appropriate control ears and standardized audiological assessment.

Particular attention has been directed toward mucosal-type chronic otitis media, because most evidence for sensorineural involvement has historically been derived from squamosal disease or mixed populations. Soni et al. (2023), in a study specifically evaluating unilateral mucosal chronic otitis media, demonstrated that SNHL or mixed hearing loss could occur in this disease and reported associations with longer disease duration, active disease, larger tympanic membrane perforation, increasing age, and smoking [4]. Their findings indicate that the sensorineural component of hearing impairment in mucosal disease warrants independent evaluation rather than being considered exclusively a feature of cholesteatomatous or squamosal disease.

Smoking represents another potential modifier of auditory function. Tobacco smoke contains nicotine and numerous toxic substances that may adversely affect cochlear microcirculation and outer hair-cell function. Patel et al. (2020) reported an association between smoking and sensorineural hearing loss and noted that, in adults, smoking-related auditory effects may be more apparent over longer periods and at higher frequencies [5]. More recently, Myszel and Skarżyński (2024) reviewed the available literature and reported that both active and passive smoking were associated with hearing impairment, particularly sensorineural and high-frequency loss [6].

Early recognition of a sensorineural component may facilitate closer audiological surveillance and may influence counselling and management, particularly in patients with prolonged disease or additional auditory risk factors. The World Health Organization also emphasizes early identification of hearing impairment and recognizes chronic ear disease and smoking among factors associated with hearing loss (World Health Organization, 2025) [7].

Aim: To assess bone-conduction (BC) threshold shifts and determine the occurrence of subclinical sensorineural/mixed hearing loss in the diseased ear compared with the contralateral control ear among patients with long-standing unilateral mucosal chronic suppurative otitis media (CSOM), and to evaluate their association with smoking, disease duration, and otoscopic severity.

Objectives

- To compare mean BC hearing thresholds between the study and contralateral control ears at 0.5, 1, 2, 4, and 8 kHz.
- To determine the frequency-wise distribution of BC hearing thresholds in the study ear and identify the pattern of threshold elevation, particularly at higher frequencies.
- To estimate the proportion of patients with SNHL/mixed hearing loss in the study ear.
- To assess the association between smoking history and the presence of SNHL/mixed hearing loss.
- To evaluate the association between duration of CSOM and the presence of SNHL.
- To determine the association between otoscopic severity of CSOM and elevated BC hearing thresholds.
- To compare selected biochemical parameters between male and female participants to identify potential demographic differences in the study population.

Materials & Methods

Study Design: A hospital-based cross-sectional observational study was conducted to assess bone-conduction (BC) threshold shifts and subclinical sensorineural hearing loss (SNHL) in patients with long-standing unilateral mucosal chronic otitis media (COM).

Study Population: The study included 110 patients, aged 20–45 years, with unilateral mucosal-type chronic suppurative otitis media (CSOM) and a clinically normal contralateral ear.

For each participant:

- The ear affected by mucosal-type CSOM was designated as the study ear.
- The clinically normal contralateral ear was designated as the control ear, allowing within-subject comparison and minimizing the influence of age-related and systemic factors affecting hearing

Study Place: The study was conducted in the Department of Otorhinolaryngology (ENT), Nalanda Medical College & Hospital, Patna, Bihar, India.

Study Period: The study was conducted over a period of 10 months, from April 2025 to January 2026.

Ethical Considerations: The study was conducted in accordance with the principles of the Declaration of Helsinki. Institutional Ethics Committee approval was obtained before commencement of the study. Written informed consent was obtained from all participants after explaining the study objectives, procedures, potential risks, and benefits.

Inclusion Criteria

Patients fulfilling all of the following criteria were included:

- Age 20–45 years, irrespective of sex.
- Unilateral mucosal-type CSOM/COM of long-standing duration.
- Presence or absence of active middle-ear discharge.
- Clinically normal contralateral ear.
- Patients willing to undergo otological examination and pure-tone audiometry.
- Written informed consent for participation.

Exclusion Criteria

Patients were excluded if they had:

- Bilateral CSOM/COM or abnormality of the contralateral ear.
- Cholesteatoma or suspected unsafe/atticoantral disease.
- Previous tympanoplasty or tympanomastoid surgery.
- Intracranial or extracranial complications of COM.
- History of meningitis, labyrinthitis, acoustic neuroma, or other retrocochlear disease.
- Previous head injury, temporal bone fracture, or traumatic tympanic membrane perforation.
- Congenital or syndromic hearing loss.
- History of chronic occupational/recreational noise exposure or acoustic trauma.
- Previous use of potentially ototoxic systemic or topical medications.
- Other significant otological or neurological disorders likely to influence hearing assessment.

Methodology: A detailed clinical history was obtained, including age, sex, duration and laterality of ear disease, duration of otorrhoea, history of ear pain, hearing impairment, tinnitus, vertigo, previous treatment or surgery, ototoxic drug exposure, noise exposure, smoking, and relevant systemic illness.

All participants underwent general physical examination, otoscopic examination, tuning-fork tests (Rinne and Weber), and oto-microscopic/otoendoscopic examination. The tympanic membrane, perforation characteristics, external auditory canal, middle-ear status, and presence of discharge or other pathological findings were documented.

In patients with active otorrhoea, the external auditory canal and middle-ear discharge were cleaned under microscopic guidance before audiological assessment.

Audiological Investigation: Pure-tone audiometry (PTA) was performed in a sound-treated room using the same calibrated audiometer for all participants. Air-conduction (AC) and bone-conduction (BC) thresholds were measured at 250, 500, 1000, 2000 and 4000 Hz, using standard Hughson–Westlake procedures.

The air–bone gap (ABG) was calculated at 500, 1000 and 2000 Hz. An ABG of ≥10 dB was considered indicative of a conductive component. Bone-conduction thresholds were compared between the diseased and contralateral normal ears to identify subtle BC threshold shifts. For the primary analysis, BC threshold ≥25 dB at the assessed speech frequencies was considered suggestive of clinically significant SNHL, consistent with the study protocol. A BC threshold of ≥20 dB at three consecutive frequencies was additionally used as a criterion for identifying SNHL in sensitivity/secondary analyses. Narrow-band noise masking was applied to the contralateral ear whenever required according to standard audiometric procedures.

Outcome Measures

Primary outcome

- Difference in BC hearing thresholds between the unilateral mucosal CSOM ear and the contralateral normal ear.
- Presence of subclinical SNHL based on predefined BC threshold criteria.

Secondary outcomes

- Frequency and degree of BC threshold elevation at individual frequencies.
- Mean BC threshold across the tested frequencies.
- Mean ABG at 500, 1000 and 2000 Hz.
- Association of BC threshold shifts/SNHL with age, sex, duration of disease, and clinical characteristics of CSOM.
- Comparison of hearing parameters between study and control ears.

Statistical Analysis: Data were entered into Microsoft Excel and subsequently analyzed using IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD) or median with interquartile range, as appropriate, while categorical variables were presented as frequency and percentage.

The normality of continuous variables was assessed before selecting the appropriate statistical test. Since the diseased and contralateral normal ears belonged to the same participant, paired comparisons of continuous audiometric variables were performed using the paired-samples *t* test for normally distributed data; the Wilcoxon signed-rank test was used for non-normally distributed data. Associations between categorical variables were assessed using the Chi-square test or Fisher's exact test, as appropriate. Independent-group comparisons, where applicable, were performed using the independent-samples *t* test. Correlation between duration of disease and BC threshold was assessed using Pearson's or Spearman's correlation coefficient, depending on data distribution. A two-tailed P value <0.05 was considered statistically significant. Where appropriate, 95% confidence intervals (CIs) were reported.

Results

Table 1: Association Between Smoking History and Sensorineural/Mixed Hearing Loss in the Study Ear (n = 110)

Smoking history	Normal BC hearing, n (%)	SNHL/Mixed hearing loss, n (%)	Total, n (%)	χ^2	*P*-value
Non-smokers	71 (86.6)	11 (13.4)	82 (100.0)	8.73	0.003
Smokers	17 (60.7)	11 (39.3)	28 (100.0)		
Total	88 (80.0)	22 (20.0)	110 (100.0)	-	-

Table 1 demonstrate that among the 110 participants, 82 (74.5%) were non-smokers and 28 (25.5%) were smokers. SNHL/mixed hearing loss was present in 11 (13.4%) non-smokers compared with 11 (39.3%) smokers. The association between smoking history and SNHL/mixed hearing loss was statistically significant (χ^2 = 8.73, P = 0.003), indicating that hearing loss was significantly more frequent among smokers.

Table 2: Comparison of Mean Bone-Conduction Hearing Thresholds Between Study and Control Ears at Different Frequencies (n = 110)

Frequency	Study ear, Mean ± SD (dB HL)	Control ear, Mean ± SD (dB HL)	Mean difference (dB)	Paired *t*-value	*P*-value
0.5 kHz	19.2 ± 6.8	14.8 ± 4.9	4.4	5.43	<0.001
1 kHz	20.1 ± 7.2	15.1 ± 5.0	5.0	6.02	<0.001
2 kHz	21.8 ± 8.0	15.9 ± 5.2	5.9	6.68	<0.001
4 kHz	24.6 ± 9.1	17.2 ± 5.8	7.4	7.24	<0.001
8 kHz	26.8 ± 10.4	18.3 ± 6.3	8.5	7.53	<0.001

Table 2 show that mean bone-conduction (BC) thresholds were consistently higher in the study ear than in the control ear at all tested frequencies. The mean differences ranged from 4.4 dB at 0.5 kHz to 8.5 dB at 8 kHz, with the greatest difference observed at 8 kHz. Paired *t*-tests demonstrated statistically significant differences at 0.5, 1, 2, 4 and 8 kHz (all P < 0.001), indicating a significant elevation of BC thresholds in the chronically diseased ear.

Table 3: Frequency-wise Distribution of Bone-Conduction Thresholds in the Study Ear (n = 110)

Bone-conduction threshold	0.5 kHz, n (%)	1 kHz, n (%)	2 kHz, n (%)	4 kHz, n (%)	8 kHz, n (%)
≤20 dB HL	68 (61.8)	63 (57.3)	54 (49.1)	43 (39.1)	35 (31.8)
21–25 dB HL	28 (25.5)	29 (26.4)	31 (28.2)	30 (27.3)	27 (24.5)
26–30 dB HL	10 (9.1)	12 (10.9)	17 (15.5)	22 (20.0)	24 (21.8)
>30 dB HL	4 (3.6)	6 (5.5)	8 (7.3)	15 (13.6)	24 (21.8)
Total	110 (100.0)	110 (100.0)	110 (100.0)	110 (100.0)	110 (100.0)

Table 3 present, the proportion of ears with BC thresholds ≤20 dB HL decreased progressively with increasing frequency, from 61.8% at 0.5 kHz to 31.8% at 8 kHz. Conversely, thresholds >30 dB HL increased from 3.6% at 0.5 kHz to 21.8% at 8 kHz. This frequency-wise pattern demonstrates a progressive deterioration in BC hearing sensitivity, particularly at the higher frequencies.

Table 4: Association Between Duration of CSOM and Presence of Sensorineural Hearing Loss in the Study Ear (n = 110)

Duration of CSOM	SNHL absent, n (%)	SNHL present, n (%)	Total, n (%)	χ^2	*P*-value
<5 years	29 (93.5)	2 (6.5)	31 (100.0)	10.49	0.015
5–10 years	31 (83.8)	6 (16.2)	37 (100.0)		
11–15 years	17 (68.0)	8 (32.0)	25 (100.0)		
>15 years	10 (58.8)	7 (41.2)	17 (100.0)		
Total	87 (79.1)	23 (20.9)	110 (100.0)	-	-

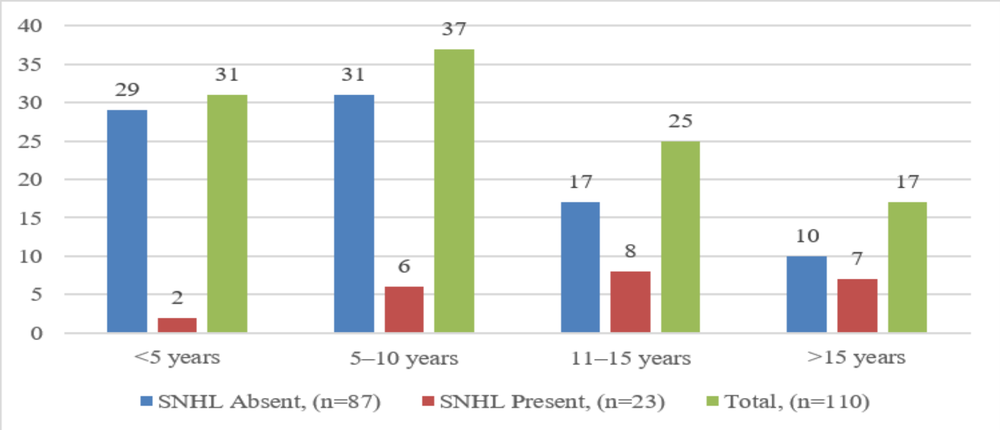

Figure 1: Association Between Duration of CSOM and Presence of Sensorineural Hearing Loss in the Study Ear

Table 4 and figure I, present that SNHL was present in 6.5% of participants with CSOM duration <5 years, increasing to 16.2%, 32.0%, and 41.2% among those with disease duration of 5–10, 11–15, and >15 years, respectively. The association between duration of CSOM and SNHL was statistically significant (χ^2 = 10.49, P = 0.015). Thus, longer duration of CSOM was significantly associated with a higher frequency of SNHL.

Table 5: Association Between Otoscopic Severity of CSOM and Elevated Bone-Conduction Threshold in the Study Ear (n = 110)

Otoscopic severity	BC threshold ≤20 dB HL, n (%)	BC threshold >20 dB HL, n (%)	Total, n (%)	χ^2	*P*-value
Mild	30 (83.3)	6 (16.7)	36 (100.0)	15.04	<0.001
Moderate	31 (68.9)	14 (31.1)	45 (100.0)		
Severe	11 (37.9)	18 (62.1)	29 (100.0)		
Total	72 (65.5)	38 (34.5)	110 (100.0)		

Table 5 demonstrate that elevated BC thresholds (>20 dB HL) were observed in 16.7% of participants with mild otoscopic disease, 31.1% with moderate disease, and 62.1% with severe disease. The association between otoscopic severity and elevated BC threshold was statistically significant (χ^2 = 15.04, P < 0.001). This indicates that increasing otoscopic severity of CSOM was significantly associated with poorer BC hearing thresholds.

Table 6: Comparison of Selected Biochemical Parameters Between Male and Female Participants (n = 110)

Biochemical parameter	Male (n = 64), Mean ± SD	Female (n = 46), Mean ± SD	*t*-value	*P*-value
Haemoglobin (g/dL)	13.8 ± 1.4	12.7 ± 1.3	3.91	<0.001
Fasting blood glucose (mg/dL)	94.6 ± 11.8	92.8 ± 10.7	0.81	0.420
Total cholesterol (mg/dL)	182.4 ± 31.6	178.7 ± 29.8	0.60	0.550
Serum creatinine (mg/dL)	0.91 ± 0.16	0.78 ± 0.14	4.12	<0.001

Table 6 show that male participants had significantly higher mean haemoglobin levels than females (13.8 ± 1.4 vs. 12.7 ± 1.3 g/dL; P < 0.001) and higher mean serum creatinine levels (0.91 ± 0.16 vs. 0.78 ± 0.14 mg/dL; P < 0.001). No statistically significant sex-wise differences were observed in fasting blood glucose (P = 0.420) or total cholesterol (P = 0.550). These findings indicate that the observed differences in haemoglobin and creatinine were statistically significant, whereas glucose and cholesterol levels were comparable between the sexes.

Table 7: Comparison of Bone-Conduction Threshold Categories Between Study and Control Ears (n = 110)

Bone-conduction threshold category	Study ear, n (%)	Control ear, n (%)	χ^2	*P*-value
≤20 dB HL	72 (65.5)	100 (90.9)	22.42	<0.001
21–25 dB HL	22 (20.0)	8 (7.3)		
26–30 dB HL	10 (9.1)	2 (1.8)		
>30 dB HL	6 (5.5)	0 (0.0)		
Total	110 (100.0)	110 (100.0)	-	-

Table 7 show that normal BC hearing (≤20 dB HL) was observed in 65.5% of study ears compared with 90.9% of control ears. In contrast, higher BC threshold categories were more frequent in study ears, with 20.0% having thresholds of 21–25 dB HL, 9.1% having 26–30 dB HL, and 5.5% having >30 dB HL, compared with 7.3%, 1.8%, and 0%, respectively, in control ears. The overall difference in BC threshold categories was statistically significant (χ^2 = 22.42, P < 0.001), demonstrating significantly poorer BC hearing in the study ears.

Discussion

In the present study, 74.5% participants were non-smokers and 25.5% were smokers. SNHL/mixed hearing loss was identified in (13.4% non-smokers and 39.3% smokers. Thus, the proportion of participants demonstrating a sensorineural or mixed component was substantially higher among smokers. The association was statistically significant on chi-square analysis.

Rajput et al. (2020), in a study of 154 patients with mucosal-type CSOM, reported SNHL in 19.5% patients and found that prolonged disease was associated with deterioration of BC thresholds. Their findings support the concept that persistent mucosal disease may have consequences extending beyond the middle-ear conductive mechanism [8]. Although their principal analysis focused on disease duration rather than smoking, the observed sensorineural component is compatible with the present finding that additional risk factors may influence cochlear involvement.

In a study of unilateral safe CSOM, smoking was identified among the factors associated with increased occurrence of SNHL, together with longer disease duration and active discharge [9].

In present study, a consistent elevation of BC thresholds in the study ear compared with the contralateral control ear across all tested frequencies. The inter-ear difference progressively increased with frequency, suggesting greater involvement of high-frequency hearing. Paired *t*-test analysis confirmed that the differences were statistically significant at all frequencies assessed (all $P < 0.001$). The progressive increase in the inter-ear difference from 4.4 dB at 0.5 kHz to 8.5 dB at 8 kHz is particularly noteworthy. This pattern indicates that the sensorineural component, or at least the elevation of BC thresholds, was more pronounced at higher frequencies. A similar frequency-dependent elevation of BC thresholds was reported by Amali et al. (2017), who observed significantly poorer BC thresholds in CSOM-affected ears compared with the contralateral normal ears, with the disparity becoming more prominent at higher frequencies [10]. The direction and frequency pattern of their findings are therefore comparable with those of the present study.

Shetty et al. (2019) also emphasized that the sensorineural component of chronic otitis media may be overlooked when the hearing deficit is primarily interpreted as conductive. Their study supports the importance of examining BC thresholds separately rather than assuming that the hearing impairment in chronic middle-ear disease is entirely attributable to the air-conduction component [11].

More recently, Singh et al. (2025), in a prospective study specifically involving tubotympanic CSOM, reported SNHL in 13.3% patients. Their findings further support the presence of a sensorineural component in mucosal/tubotympanic disease and demonstrate that this phenomenon is not restricted to squamosal disease [12]. Similarly, Saadaldeen et al. (2025), studying unilateral tubotympanic CSOM with the opposite ear as a control, found significantly elevated BC thresholds in diseased ears and reported greater involvement of higher frequencies [13]. The close agreement between these recent findings and the present frequency-specific results strengthens the evidence that chronic mucosal CSOM may be associated with measurable changes in cochlear hearing sensitivity. Thus, the present findings demonstrate a significant BC threshold shift but do not, by themselves, establish irreversible cochlear hair-cell injury. The proportion of study ears with thresholds ≤20 dB HL decreased progressively from 61.8% at 0.5 kHz to 31.8% at 8 kHz. Conversely, the proportion with thresholds >30 dB HL increased from 3.6% at 0.5 kHz to 21.8% at 8 kHz. The intermediate threshold categories also shifted towards higher values with increasing frequency. The findings are broadly consistent with those reported by Amali et al. (2017), who demonstrated greater BC threshold elevation at higher frequencies in patients with

CSOM [10]. Saadaldeen et al. (2025) similarly reported that higher frequencies were more affected than speech frequencies in patients with tubotympanic CSOM [13]. These observations suggest that high-frequency audiometric assessment may provide greater sensitivity for identifying early auditory effects of prolonged middle-ear disease.

Rajput et al. (2020) also demonstrated progressive deterioration of mean BC thresholds with increasing duration of mucosal CSOM, with mean thresholds increasing from 16.9 dB in patients with shorter disease duration to 22.9 dB in the longest-duration group [8].

In present study, SNHL was present in only 6.5% participants with disease duration <5 years. The proportion increased to 16.2%) among those with 5–10 years of disease, 32.0% among those with 11–15 years of disease, and 41.2% among those with disease duration >15 years. The association was statistically significant. Rajput et al. (2020) reported a comparable duration-related pattern in mucosal CSOM. In their cohort, the mean BC threshold increased with increasing disease duration, and the longest-duration group demonstrated significantly greater BC impairment than the shortest-duration group [8]. Their results provide important support for the present observation that prolonged mucosal disease may be associated with progressive deterioration in cochlear hearing sensitivity.

Jha and Singh (2022), in a prospective observational study of 149 patients with unilateral CSOM, reported SNHL in 25.5% of participants, while conductive hearing loss accounted for 69.8% and mixed hearing loss for 4.7%. Their study used the contralateral normal ear as a control and concluded that a sensorineural component occurs in a substantial proportion of patients with CSOM [14].

The most recent evidence is provided by Saadaldeen et al. (2025), who studied 60 patients with unilateral tubotympanic CSOM and found a statistically significant association between SNHL and longer disease duration (P = 0.018) [13]. Their findings are remarkably concordant with the present result and suggest that duration of disease may be an important clinical marker for identifying patients at greater risk of sensorineural involvement.

Singh et al. (2025) similarly concluded that the risk of SNHL in tubotympanic CSOM increases with the persistence of disease and emphasized the potential value of early treatment [12]. Taken together, these findings suggest that chronicity may not simply represent a marker of disease severity but may also reflect cumulative exposure of the middle and inner ear to inflammatory processes.

In present study, BC thresholds >20 dB HL were found in 16.7% participants with mild disease, 31.1% with moderate disease, and 62.1% with severe disease. The association was statistically significant. Rajput et al. (2020) demonstrated that long-standing mucosal CSOM was associated with elevated BC thresholds, supporting the relationship between the severity and chronicity of middle-ear disease and sensorineural auditory effects [8]. Jha and Singh (2022) likewise demonstrated a substantial sensorineural component among patients with CSOM, although their population included both mucosal and squamosal disease [14].

Saadaldeen et al. (2025) reported that larger tympanic membrane perforations were significantly associated with SNHL in unilateral tubotympanic CSOM (P = 0.036) and also demonstrated significantly elevated BC thresholds in affected ears [13]. These findings complement the present observation because greater perforation and more severe otoscopic disease may represent clinical markers of a larger or more persistent inflammatory insult.

Male participants had significantly higher mean haemoglobin levels and serum creatinine levels

than females. In contrast, no statistically significant differences were observed for fasting blood glucose or total cholesterol. The findings are broadly consistent with those reported by Sairam et al. (2014), who established sex-specific hematological and biochemical reference intervals in a large multicentric Indian population. Their study demonstrated higher haemoglobin and serum creatinine reference values in males compared with females, while fasting glucose and total cholesterol showed relatively overlapping distributions between the sexes [15].

Normal BC hearing (≤20 dB HL) was observed in 65.5% study ears compared with 90.9% control ears. Conversely, thresholds of 21–25 dB HL were observed in 20.0% study ears compared with 7.3%) control ears; thresholds of 26–30 dB HL occurred in 9.1% study ears versus 1.8% control ears; and thresholds >30 dB HL were present in 5.5% study ears compared with none of the control ears. The reported chi-square analysis demonstrated a statistically significant difference. The findings are consistent with Rajput et al. (2020), who demonstrated increased BC thresholds in patients with long-standing mucosal CSOM and reported that the sensorineural component became more evident with prolonged disease [8]. They are also consistent with the prospective observations of Singh et al. (2025), in which a measurable SNHL component was identified in patients with tubotympanic CSOM [12]. Saadaldeen et al. (2025) similarly found significantly higher BC thresholds in the diseased ear and greater involvement of higher frequencies [13]. Dobrianskyj et al. (2019), while examining chronic otorrhoea and SNHL, also highlighted the importance of comparing affected ears with clinically normal contralateral ears when investigating possible sensorineural effects of chronic middle-ear disease [16].

Bhutta et al. provided an updated overview of the pathogenesis, clinical features, hearing impairment, and management of chronic suppurative otitis media (CSOM). Their work supports the rationale for evaluating hearing loss and potential sensorineural involvement in patients with long-standing CSOM in the present study [17].

Limitations of the Study

- The study was conducted at a single centre, which may limit the generalizability of the findings to other populations
- The sample size was relatively small (n = 110), potentially limiting the statistical power for subgroup analyses.
- Although the contralateral ear served as an internal control, subclinical bilateral or age-related auditory changes could not be completely excluded.
- Potential confounding factors such as occupational noise exposure, ototoxic drug exposure, socioeconomic factors, and nutritional status were not comprehensively evaluated.
- Smoking history was based on participant-reported information and may therefore be subject to recall or reporting bias.
- The study primarily assessed pure-tone BC thresholds; additional objective measures such as otoacoustic emissions and auditory brainstem response could have provided further evidence of early cochlear dysfunction

Conclusion

In present study, Patients with long-standing unilateral mucosal CSOM demonstrated significantly elevated BC hearing thresholds in the diseased ear compared with the contralateral control ear across all tested frequencies. The magnitude of threshold shift increased progressively with frequency, with the greatest mean difference observed at 8 kHz (8.5 dB). Higher BC threshold categories were also significantly more frequent in study ears. Smoking, longer disease duration, and greater otoscopic severity were significantly associated with poorer sensorineural hearing status.

Overall, these findings suggest that long-standing unilateral mucosal CSOM may be associated with early or subclinical sensorineural cochlear involvement, particularly at higher frequencies. Routine audiological monitoring, including bone-conduction assessment, may be considered in patients with long-standing CSOM to facilitate early detection of sensorineural hearing impairment.

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Author Contributions

SK: Conceptualization, study design, data collection, clinical evaluation, and manuscript preparation.

KRR: Data collection, patient follow-up, clinical assessment, and literature review.

AS: Study supervision, methodology, data analysis, interpretation of findings, and critical revision of the manuscript.

SS: Overall supervision, clinical guidance, methodological review, and critical revision of the manuscript.

Note: I have used the initials AS, KRR, SK, and SS corresponding to the four listed authors.

Conflict of Interest: The authors declare that there is no conflict of interest.

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