E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/15.02.410

Research Article

Microbial Profile of Chronic Suppurative Otitis Media in Patients Attending a Tertiary Care Hospital

Dr. T. Arul Dhivya[1], Dr. S. Vanathi[2*], Dr. V. Senthilkumar[3], Dr. S. Swarna[4]

[1]Assistant Professor, Department of Microbiology, Government Medical College, Pudukkottai, Tamil Nadu.

[2]Associate Professor, Department of Microbiology, Government Medical College, Pudukkottai, Tamil Nadu.

[3]Government Medical College, Dindigul, Tamil Nadu.

[4]Associate Professor, Department of Microbiology, Government Thoothukudi Medical College, Thoothukudi, Tamil Nadu.

Corresponding Author: Dr. S. Vanathi

Received: 01.09.25, Revised: 02.10.25, Accepted: 10.11.25

Abstract

Background: Chronic Suppurative Otitis Media (CSOM) is a persistent infection of the middle ear and mastoid cavity, characterized by ear discharge through a perforated tympanic membrane. It remains a major cause of hearing loss, particularly in developing countries.

Materials and Methods: This cross-sectional observational study was conducted over two years in the Department of Microbiology, Veer Surendra Sai Institute of Medical Sciences & Research, Odisha, India, involving 202 patients clinically diagnosed with CSOM. Aural swabs were collected aseptically and processed for bacterial and fungal cultures. Bacterial isolates were identified by standard biochemical methods, and antimicrobial susceptibility was tested using the Kirby-Bauer disk diffusion method according to CLSI guidelines. Fungal isolates were identified by macroscopic and microscopic characteristics.

Results: Out of 202 samples, 182 (90.09%) showed microbial growth; 140 (76.92%) were monomicrobial, and 42 (23.07%) were polymicrobial. Among 165 bacterial isolates, Staphylococcus aureus (32.72%) was the most common, followed by Pseudomonas spp. (28.48%), E. coli (11%), and Klebsiella pneumoniae (9.09%). Among 59 fungal isolates, Candida albicans (60%) was predominant, followed by Aspergillus niger (52.17%) and A. flavus (39.13%). All Gram-positive isolates were 100% sensitive to Vancomycin and Linezolid, while Gram-negative isolates showed highest sensitivity to Gentamicin (93.61%), Amikacin, Imipenem, and Meropenem (85.10% each). Resistance to cephalosporins and amoxicillin-clavulanic acid was noted.

Conclusion: CSOM continues to be a polymicrobial infection dominated by Staphylococcus aureus and Pseudomonas spp. Emergence of multidrug resistance, particularly to cephalosporins and ß-lactam/ß-lactamase inhibitors, necessitates culture-based antibiotic therapy. Ciprofloxacin and aminoglycosides remain effective options, although caution is advised due to ototoxicity risk.

Keywords: Chronic Suppurative Otitis Media, Staphylococcus Aureus, Pseudomonas Spp., Candida Albicans, Antibiotic Resistance.

INTRODUCTION

Ear is an important sensory organ responsible for hearing and balance, and ear infections continue to be one of the most common health problems worldwide [1]. Among these, otitis media remains a significant cause of morbidity and preventable hearing loss, particularly in developing countries. It is estimated that about 65 to 330 million people across the globe suffer from ear infections, and nearly 60% of them experience varying degrees of hearing impairment [2]. Ear discharge is one of the most common clinical manifestations of middle ear infection and typically arises from the middle ear cavity in otitis media [3]. Otitis media (OM) refers to a group of infectious and inflammatory diseases affecting the middle ear cleft and mastoid cavity [4]. Chronic Suppurative Otitis Media (CSOM) is defined as chronic otorrhea persisting for more than six weeks through a perforated tympanic membrane. It represents a stage of ear infection in which inflammation of the middle ear mucosa becomes irreversible, leading to

continuous or intermittent discharge, hearing loss, and potential complications if left untreated [5]. Dysfunction of the Eustachian tube plays a major role in the pathogenesis of CSOM and is found in approximately 70% of patients undergoing middle ear surgery [6]. The Eustachian tube is shorter, wider, and more horizontal in children, which facilitates the spread of infection from the nasopharynx to the middle ear cavity, explaining the higher prevalence of CSOM among pediatric populations [7]. Depending on the site of pathology, CSOM is broadly classified into two clinical types: the Tubo-tympanic type (mucosal) and the Attico-antral type (squamous [8]). The tubo-tympanic type involves the pars tensa of the tympanic membrane and is considered a safe or benign type, as it rarely leads to serious complications. The attico-antral type involves the pars flaccida and is regarded as the unsafe or dangerous form because of its tendency to cause bone erosion and life-threatening intracranial complications [9]. If not diagnosed and treated appropriately, CSOM may lead to a spectrum of serious sequelae. Intratemporal complications include persistent tympanic membrane perforation, mastoiditis, facial nerve paralysis, labyrinthitis, and labyrinthine fistula. Extratemporal manifestations may present as postauricular, zygomatic, Bezold's, or Luc's abscesses, as well as parapharyngeal or retropharyngeal abscesses [10]. Intracranial complications such as extradural abscess, subdural empyema, meningitis, brain abscess, lateral sinus thrombophlebitis, cerebrospinal fluid otorrhea, and otitic hydrocephalus are also well documented [11]. Long-standing CSOM can result in conductive hearing loss ranging from 20 to 60 dB, which can significantly impair learning, communication, and social development, particularly in children. In severe cases, it can progress to sensorineural hearing loss, permanent disability, or even mortality due to central nervous system involvement [12]. The associated treatment costs and complications make CSOM a major public health problem in resource-limited settings. The microbiological etiology of CSOM is polymicrobial, involving both aerobic and anaerobic bacteria as well as fungi [13]. The most commonly implicated bacterial pathogens are *Staphylococcus aureus* and *Pseudomonas aeruginosa*, followed by members of the Enterobacteriaceae family such as *Klebsiella pneumoniae*, *Escherichia coli*, *Proteus mirabilis*, and *Citrobacter* species. Fungal infections, particularly those caused by *Candida albicans* and *Aspergillus* species, have been increasingly recognized, often as secondary infections following prolonged or indiscriminate antibiotic therapy [14]. The extensive use of broad-spectrum antibiotics and topical steroid preparations has contributed to the emergence of resistant bacterial strains and fungal superinfections, complicating the management of CSOM [15]. The growing problem of antimicrobial resistance is of major concern in the treatment of CSOM [16]. The indiscriminate and inappropriate use of antibiotics, lack of proper medical follow-up, and self-medication have led to the persistence of chronic infections and the emergence of multidrug-resistant (MDR) organisms such as Methicillin-Resistant *Staphylococcus aureus* (MRSA) and extended-spectrum β-lactamase (ESBL) producing Gram-negative bacteria [17]. In addition, *Pseudomonas* species are known to produce Metallo-β-lactamases (MBLs) such as Imipenemase (IMP), Verona Imipenemase (VIM), Sao Paulo Metallo-β-lactamase (SPM), Florence Imipenemase (FIM), Adelaide Imipenemase (AIM), and New Delhi Metallo-β-lactamase (NDM), which confer high levels of resistance to carbapenems and other β-lactam antibiotics. These enzymes can be detected using phenotypic methods such as the EDTA-Carbapenem Inactivation Method (eCIM) [18]. The emergence of multidrug-resistant strains limits therapeutic options, highlighting the need for culture-based antibiotic selection. Given the polymicrobial nature of CSOM and changing resistance patterns, continuous microbiological surveillance is essential [20]. Understanding local microbial flora and susceptibility profiles guides empirical therapy, prevents complications, and improves outcomes. Persistent or recurrent cases unresponsive to antibacterial treatment should prompt evaluation for fungal etiology [21]. This study aimed to assess the microbial profile and antimicrobial susceptibility patterns of CSOM isolates in patients at a tertiary care hospital in Odisha, providing local data to inform effective management.

MATERIALS AND METHODS

Study Design and Population

A cross-sectional observational study was conducted in the Department of Microbiology, Veer Surendra Sai Institute of Medical Sciences & Research, Odisha, India, over two years. A total of 202 patients diagnosed clinically with CSOM in the ENT outpatient department were enrolled after obtaining informed consent.

Ethical Clearance

The study was approved by the Institutional Ethics Committee of the Veer Surendra Sai Institute of Medical Sciences & Research, Odisha, India (Ethical Approval No. 2015/P-I-RP/143 dated 15.11.2017). Written informed consent was obtained from all participants or their guardians prior to sample collection.

Inclusion Criteria

- Patients with ear discharge for >6 weeks with perforated tympanic membrane.
- No systemic or topical antimicrobial therapy within the preceding 7 days.

Exclusion Criteria

- Ear discharge <6 weeks duration.
- Otitis externa.
- Recent antibiotic use (within 7 days).
- Previously registered cases.

Sample Collection

Aural discharge was collected using two sterile cotton swabs under aseptic precautions after cleaning the external auditory canal with 70% alcohol. One swab was used for direct microscopy (Gram stain, KOH mount), and the other for culture.

Culture and Identification

- Bacterial Culture: Inoculated on Blood agar and MacConkey agar, incubated at 37°C for 24–48 hours.
- Fungal Culture: Inoculated on Sabouraud Dextrose Agar (SDA), incubated at 25°C and 37°C for up to 7 days.

Bacteria were identified based on colony morphology, Gram staining, and standard biochemical reactions. Fungi were identified macroscopically and microscopically (LPCB mount, germ tube test, chlamydospore formation).

Antimicrobial Susceptibility Testing

Performed using the Kirby-Bauer disk diffusion method on Mueller-Hinton Agar according to CLSI guidelines (2023) [22]. Antibiotics tested included:

- For Gram-positive bacteria: Vancomycin, Linezolid, Gentamicin, Ciprofloxacin, Clindamycin, Cefoxitin, Amoxyclav, Ceftriaxone, Cotrimoxazole.
- For Gram-negative bacteria: Gentamicin, Amikacin, Imipenem, Meropenem, Ciprofloxacin, Ceftazidime, Piperacillin/Tazobactam, Amoxyclav.

Minimum inhibitory concentration (MIC) was determined for selected isolates using broth microdilution.

Detection of Metallo-β-Lactamase (MBL) Production

Carbapenem-resistant *Pseudomonas* and *Acinetobacter* isolates were screened for MBL production. The presence of MBL enzyme was confirmed using the EDTA-Carbapenem Inactivation Method (eCIM) as per CLSI guidelines. Isolates showing inhibition zones increased by ≥5 mm around meropenem discs with EDTA compared to discs without EDTA were considered MBL positive.

Statistical Analysis

All collected data were entered into Microsoft Excel and analyzed using SPSS software V26. The results were expressed in terms of frequencies and percentages. Associations between microbial isolates and clinical variables were analyzed using the Chi-square test, and a p-value < 0.05 was considered statistically significant.

RESULTS

A total of 202 patients clinically diagnosed with Chronic Suppurative Otitis Media (CSOM) were included in the study. Among these, 182 samples (90.09%) showed positive microbial growth, while 20 samples (9.90%) showed no growth on culture.

Out of the 182 positive cultures, 140 (76.92%) yielded monomicrobial growth, whereas 42 (23.07%) exhibited polymicrobial growth patterns, consisting of bacterial–bacterial and bacterial–fungal combinations (Table 1).

E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/15.02.410

Table 1: Isolation of Microorganisms among CSOM Patients (n=202)

Isolation of Microorganisms	Number	Percentage (%)
Total growth	182	90.09
Monomicrobial growth	140	76.92
Polymicrobial growth	42	23.07
No growth	20	9.9

Bacterial Isolates

In the present study, a total of 165 bacterial isolates were obtained from patients with Chronic Suppurative Otitis Media (CSOM). The predominant bacterial pathogen isolated was Staphylococcus aureus, accounting for 54 isolates (32.72%), followed by Pseudomonas spp. with 47 isolates (28.48%). Other bacteria isolated included Escherichia coli (18 isolates, 11%), Klebsiella pneumoniae (15 isolates, 9.09%), Citrobacter spp. (12 isolates, 7.27%), Proteus mirabilis (9 isolates, 5.45%), and Streptococcus pneumoniae (1 isolate, 0.6%). Coagulase Negative Staphylococci (CONS) were isolated in 9 cases (5.45%). Overall, Gram-positive organisms (38.17%) were slightly more common than Gram-negative organisms (61.82%), with Staphylococcus aureus being the single most predominant organism. The distribution of bacterial species is shown in Table 2.

Table 2: Bacterial Isolates (n=165)

Organism	Number	Percentage (%)
Staphylococcus aureus	54	32.72
CONS (Coagulase Negative Staphylococci)	9	5.45
Pseudomonas spp.	47	28.48
Escherichia coli	18	11
Klebsiella pneumoniae	15	9.09
Citrobacter spp.	12	7.27
Proteus mirabilis	9	5.45
Streptococcus pneumoniae	1	0.6

Fungal Isolates

Fungal isolates were identified in a subset of patients with Chronic Suppurative Otitis Media (CSOM). Among the yeasts, Candida albicans was the most frequently isolated species, accounting for 21 cases (60%), while Candida non-albicans species were found in 14 cases (40%). Regarding molds, Aspergillus niger was the predominant species with 12 cases (52.17%), followed by Aspergillus flavus (9 cases, 39.13%), Aspergillus fumigatus (2 cases, 8.69%), and Talaromyces marneffei (1 case, 1.69%). These findings indicate that Candida species and Aspergillus species are the major fungal pathogens implicated in CSOM, with Candida albicans and Aspergillus niger being the most common isolates as shown in Table 3.

Table 3: Fungal Isolates (n=59)

Organism	Number of Cases	Percentage (%)
Candida albicans	21	60
Candida non-albicans	14	40
Aspergillus niger	12	52.17
Aspergillus flavus	9	39.13
Aspergillus fumigatus	2	8.69
Talaromyces marneffei	1	1.69

E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/15.02.410

Demographic Distribution of CSOM Patients

Analysis of the demographic profile revealed that the most affected age group was 1–10 years, accounting for 62% of cases. This higher prevalence in children is likely related to anatomical and functional differences of the Eustachian tube, which predispose them to middle ear infections. Among adults, the 41–50 years age group was the next most commonly affected, representing 31% of cases (Fig. 1). Regarding sex distribution, female patients were more frequently affected (65.38%) compared to males (34.61%), which may be influenced more by socio-environmental and behavioral factors rather than inherent biological differences.

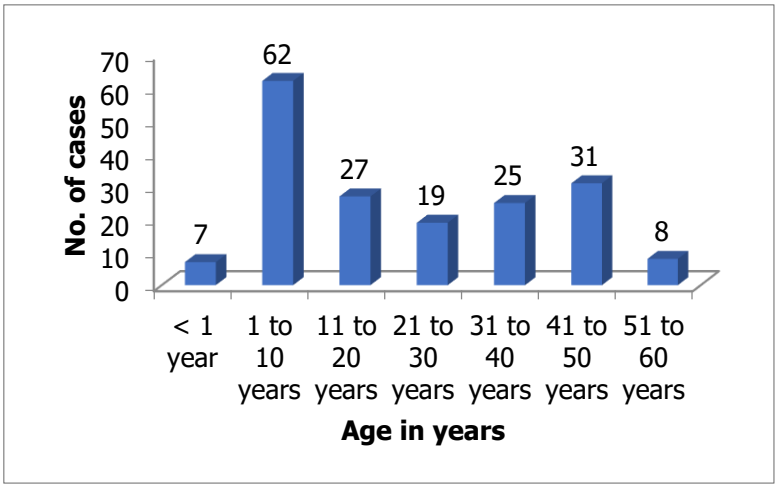

Fig: 1 Demographic Distribution

Socioeconomic Distribution

CSOM was more prevalent in patients from lower socio-economic groups, with an urban-to-rural ratio of 1:2 (Fig 2).

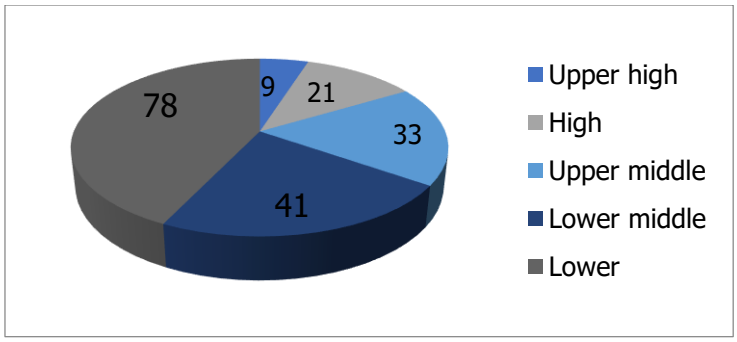

Fig: 2 Socioeconomic Distribution

Antimicrobial Sensitivity of *Staphylococcus aureus*

Among the bacterial isolates, Vancomycin and Linezolid showed 100% sensitivity. Gentamicin was effective against 92.59% of isolates, while Cefoxitin demonstrated 87.03% sensitivity. Moderate sensitivity was observed for Amoxyclav (74.07%), Ampicillin/Sulbactam (70.37%), Levofloxacin (70%), Ciprofloxacin (69%), Clindamycin (69%), and Cotrimoxazole (69%). Lower sensitivity was noted for Ceftriaxone (62.96%), Erythromycin (50%), and Penicillin (41%), indicating variable efficacy among commonly used antibiotics (Table 4).

Table 4: Antimicrobial Sensitivity Pattern of *Staphylococcus aureus*

Antibiotic	Number Sensitive	Percentage (%)
Vancomycin (MIC)	54	100
Linezolid	54	100
Gentamicin	50	92.59

Cefoxitin	47	87.03
Amoxyclav	40	74.07
Ampicillin/Sulbactam	38	70.37
Levofloxacin	38	70
Ciprofloxacin	37	69
Clindamycin	37	69
Cotrimoxazole	37	69
Ceftriaxone	34	62.96
Erythromycin	27	50
Penicillin	22	41

Antimicrobial Sensitivity of Pseudomonas spp.

Pseudomonas spp. isolates showed the highest sensitivity to Gentamicin (89.36%), followed closely by Amikacin, Meropenem, Imipenem, and Ciprofloxacin, each with 85.1% sensitivity. Moderate sensitivity was observed for Cefoperazone/Sulbactam (82.97%), Ampicillin/Sulbactam (80.85%), and Piperacillin/Tazobactam (78.72%). Ceftazidime also demonstrated 78.72% sensitivity, indicating generally high susceptibility of Pseudomonas isolates to aminoglycosides, carbapenems, and certain β-lactam/β-lactamase inhibitor combinations.

Table 5: Antimicrobial Sensitivity Pattern of Pseudomonas Spp.

Antibiotic	Number Sensitive	Percentage (%)
Gentamicin	42	89.36
Amikacin	40	85.1
Meropenem	40	85.1
Imipenem	40	85.1
Ciprofloxacin	40	85.1
Cefoperazone/Sulbactam	39	82.97
Ampicillin/Sulbactam	38	80.85
Piperacillin/Tazobactam	37	78.72
Ceftazidime	37	78.72

DISCUSSION

This study evaluated the microbial profile and antimicrobial susceptibility patterns in CSOM cases at a tertiary care hospital, and the findings align in part with, but also show some divergence from, recent studies from India and other developing-country settings. We observed a culture positivity rate of approximately 90% (182/202 cases), with monomicrobial growth in 76.9% and polymicrobial growth in 23.1%. This high culture yield is comparable to some reports, though others document lower yields — for example, a study from New Delhi found 64.6% positivity (407/630 samples) in CSOM patients [23]. In our series, the most common bacterial isolate was *Staphylococcus aureus* (32.72%) followed by *Pseudomonas spp.* (28.48%). This distribution differs somewhat from many Indian studies in which *Pseudomonas* often predominates. For instance, Shinde et al. found *Pseudomonas aeruginosa* in 41% and Staphylococci in 28.2% of isolates [24]. Similarly, another study from Durgapur found *Pseudomonas* species in 43.7% of CSOM cases and *Staphylococcus* spp. in 27.4% [25]. Such variation in predominant organisms may reflect geographic, demographic, antibiotic-use differences, and referral bias in tertiary centres. The detection of 59 fungal isolates in our study reinforces that CSOM may be polymicrobial and suggests that fungal assessment is important — consistent with findings by Nagraj & Premalatha [26]. The highest prevalence was observed in the 1–10-year age group (62%) with a second peak in the 41–50 years group (31%). The predominance in children aligns with anatomical and functional Eustachian-tube differences in this age group. Female patients comprised 65.38% of cases compared with 34.61% males, and CSOM was more common among lower socio-economic strata with an urban : rural ratio of 1 : 2. This socio-economic association aligns with reports that

overcrowding, poor hygiene, malnutrition and limited healthcare access contribute to CSOM burden [27]. These findings underscore the importance of targeted preventive strategies such as improved hygiene, timely management of upper respiratory tract infections, and avoidance of water ingress into the ear in vulnerable populations. In Gram-positive isolates (mainly *S. aureus*), we recorded 100% sensitivity to Vancomycin and Linezolid and 92.59% sensitivity to Gentamicin. However, susceptibility to Amoxicillin-Clavulanic acid (74.07%) and Ceftriaxone (62.96%) was significantly lower, indicating emerging resistance to cephalosporins and β-lactam/β-lactamase-inhibitor combinations — a trend also noted by Hussain et al. in Srinagar [28]. For *Pseudomonas spp.*, sensitivity was highest to Gentamicin (89.36%), Amikacin/Imipenem/Meropenem/Ciprofloxacin (≈85.10%), with somewhat lower sensitivity to Piperacillin-Tazobactam (78.72%) and Ceftazidime (78.72%). While these figures are encouraging, the diminished percentages for cephalosporins and β-lactam/β-lactam-inhibitor combos highlight the necessity that empirical therapy should be guided by local data. In this regard, Deshmukh & Manthale reported *P. aeruginosa* in 32.1% of CSOM cases and significant resistance to fluoroquinolones and antipseudomonal penicillins (48.7% and 41.7%, respectively) [29].

The emergence of multidrug-resistant organisms in CSOM is increasingly recognised. For example, a biofilm-focused study described that 70% of isolates in CSOM produced biofilms, with *Pseudomonas* and MRSA dominating among high producers; Gentamicin remained the most effective agent, whereas Amoxicillin-Clavulanic acid, Ceftriaxone and Cefuroxime showed substantial resistance [30]. Biofilm formation further reduces antibiotic penetration and efficacy, suggesting that culture and sensitivity results may underestimate the real-world challenge. These findings have several clinical implications. Empirical therapy in CSOM should address both Gram-positive cocci (especially *S. aureus*) and Gram-negative rods (especially *Pseudomonas spp.*). Based on our results and others, aminoglycosides (Gentamicin, Amikacin) and carbapenems retain reliable activity, but their systemic usage is limited by concerns such as ototoxicity, cost and route of administration. Fluoroquinolones (e.g., Ciprofloxacin) provide broad coverage (Gram-positive and Gram-negative) and are suitable for topical or oral use, though use in children is cautionary. The recorded resistance to cephalosporins and β-lactam/β-lactam-inhibitor combinations suggests empirical use of such agents without culture support may be suboptimal — local antibiograms should guide treatment, as supported by Shinde et al. [24]. Fungal co-infections should be considered in CSOM cases unresponsive to antibacterial therapy, with early fungal culture and antifungal therapy where indicated. Preventive efforts focused on socio-economic determinants (hygiene, nutrition, preventing ear-water exposure) remain foundational in reducing incidence and chronicity of CSOM.

Limitations

Our study is subject to limitations similar to those in comparable investigations. Being a single-centre tertiary hospital study, results may not represent all community settings. Anaerobic cultures and molecular resistance testing (e.g., extended-spectrum β-lactamases (ESBLs), metallo-β-lactamases (MBLs)) were not performed; for example, one study reported ESBL detection at 30.9% among Gram-negative isolates in CSOM. Also, correlation of microbial profile with clinical outcomes (hearing loss, recurrence, complications) was beyond the scope of this study.

Future Directions

- Regular surveillance of microbial profiles and antimicrobial susceptibility patterns in CSOM at regional and institutional levels is critical to update empirical treatment protocols.
- Inclusion of anaerobes, fungal species and biofilm-forming potential in routine laboratory workup could improve management of refractory cases.
- Research into safe, effective topical agents with anti-biofilm activity may offer new avenues for CSOM management.
- Public health interventions addressing socio-economic determinants and ear care education (e.g., avoiding water into the ear, early URTI treatment) should be intensified in high-risk populations.

CONCLUSION

Chronic suppurative otitis media remains a significant clinical challenge due to its diverse microbial etiology and the rising trend of antibiotic resistance pattern like MRSA. Our study reinforces that CSOM remains a significant burden, particularly in children and lower socio-economic groups, and that the microbial etiology continues to involve *S. aureus* and *Pseudomonas spp.*, with rising resistance to many conventional antibiotics. Empirical therapy should be guided by up-to-date local sensitivity patterns and combined with preventive strategies to reduce complications and the emergence of resistant pathogens.

Conflict of interest

The authors declare no conflict of interest.

REFERENCES

1. Khatun MR, Alam KM, Naznin M, Salam MA. Microbiology of chronic suppurative otitis media: an update from a tertiary care hospital in Bangladesh. Pakistan journal of medical sciences. 2021 May;37(3):821.
2. Kumar KR, Navya S, Basavarajappa KG. A study of bacterial profile and antibiotic susceptibility pattern of chronic suppurative otitis media among patients attending a tertiary care centre, Davangere. Sch J App Med Sci. 2014;2(5B):1606-2.
3. Smitha NR, Jnaneshwara KB, Patil AB, Harshika YK, Medegar S. A study of aerobic bacteriological profile of chronic suppurative otitis media in a tertiary care hospital, South India. Indian Journal of Microbiology Research. 2020;5:470-5.
4. Chander VS, Kavinkumar A. Microbiological profile of chronic suppurative otitis media presenting to a tertiary care teaching hospital-A cross-sectional study. Int Arch Integr Med. 2019 May 1;6(5):5-11.
5. Kaur P, Sood AS, Sharma S, Awal G. Microbiological profile and antimicrobial susceptibility pattern of chronic suppurative otitis media in a tertiary care centre. Tropical Journal of Pathology and Microbiology. 2018;4:1-3.
6. Vaidya K, Madhup SK, Shrestha BL, Gautam A, Tuladha NR. Bacteriological and mycological profile of chronic suppurative otitis media among patients visiting Dhulikhel Hospital. Annals of Clinical Chemistry and Laboratory Medicine. 2015 Mar 19;1(1):37-41.
7. Goyal D, Pal N, Agrawal Y, Hooja S. A study of bacteriological profiles, biofilm production, and antibiotic susceptibility among isolates of chronic suppurative otitis media at a tertiary care hospital. Medical Journal of Dr. DY Patil Vidyapeeth. 2025 Jan 1;18(1):92-8.
8. Kumar D, Agarwal MK, Prakash P. Bacteriological profile of chronic suppurative otitis media in patients at a tertiary level hospital. Eastern Journal of Medical Sciences. 2016;1(1):5-7.
9. Akter F, Khaled MS, Akhter F, Khan MJ, Yusuf MA. Pattern of Bacterial Isolates and their Antimicrobial Susceptibility Profiles of Chronic Suppurative Otitis Media Patients attended at a tertiary Care Hospital in Bangladesh. Bangladesh Journal of Medical Microbiology. 2024 Dec 5;18(1):30-6.
10. Saranya SK, Vazhavandal G, Ganesh BV, Ismail M, Uma A, Subramaniam T. Bacteriological and mycological profile of chronic suppurative otitis media in a tertiary teaching hospital, Trichy, Tamilnadu. International Journal of Pharmaceutical Science Invention. 2015 Jan;4(1):13-9.
11. Kombade SP, Kaur N, Patro SK, Nag VL. Clinico-bacteriological and antibiotic drug resistance profile of chronic suppurative otitis media at a tertiary care hospital in Western Rajasthan. Journal of Family Medicine and Primary Care. 2021 Jul 1;10(7):2572-9.
12. Yadav K, Kaushik S, Rani K, Tyagi Ak. Bacterial Profile and Antimicrobial Susceptibility Pattern of Chronic Suppurative Otitis Media from a Tertiary Care Hospital in Kannauj, Uttar Pradesh, India. Journal of Clinical & Diagnostic Research. 2021 Apr 1;15(4).
13. Dhingra S, Vir D, Bakshi J, Rishi P. Mapping of audiometric analysis with microbiological findings in patients with chronic suppurative otitis media (CSOM): a neglected clinical manifestation. Critical reviews in clinical laboratory sciences. 2023 Apr 3;60(3):212-32.
14. Aishwarya B, Prithi NK. Aerobic Bacterial Profile and Antibiotic Susceptibility Pattern of Chronic Suppurative Otitis

Media in a Tertiary Care Centre in Kerala. Journal of Evolution of Medical and Dental Sciences. 2019 Sep 2;8(35):2713-9.
15. Naik BS. A Clinicopathological and Microbiological Study of Active Chronic Suppurative Otitis Media in A Teriary Care Hospital. European Journal of Cardiovascular Medicine. 2022 Apr 1;12(2).
16. Navya MR. Aerobic Bacteriological Study of Chronic Suppurative Otitis Media with Special Reference to Methicillin Resistant Staphylococcus Aureus and ß-Lactamases in Gram Negative Bacilli (Doctoral dissertation, Rajiv Gandhi University of Health Sciences (India)).
17. Çetin YS, Mollamehmetoğlu SO, Düzenli U, Turan M, Bozan N. Treatment of multi-drug resistant microorganisms in chronic suppurative otitis media. B-ENT. 2022 Jan 1;18(1):44-51.
18. Sahu R, Baral P, Sahu BK, Singh S, Sahu MC. Understanding antibiotic resistance patterns in chronic suppurative otitis media (CSOM) at a Tertiary Care Hospital. Microbes and Infectious Diseases. 2024 Dec 15.
19. Rath S, Das SR, Padhy RN. Surveillance of bacteria Pseudomonas aeruginosa and MRSA associated with chronic suppurative otitis media. Brazilian journal of otorhinolaryngology. 2017 Mar 1;83(2):201-6.
20. Dos Santos PA, Silva MJ, Gouveia MI, Lima LN, Quaresma AJ, De Lima PD, Brasiliense DM, Lima KV, Rodrigues YC. The prevalence of metallo-beta-lactamese-(MßL)-Producing Pseudomonas aeruginosa Isolates in Brazil: a systematic review and meta-analysis. Microorganisms. 2023 Sep 21;11(9):2366.
21. Mahore SK, Mahore RK, Parmar S. A Study to Identify and Isolate the Most Common Organism Causing Chronic Suppurative Otitis MEDIA (CSOM) in Patients Attending ENT OPD/IPD of Tertiary Care Hospital. International journal of health sciences.;6(S1):9023-35.
22. CLSI. Development of in vitro susceptibility test methods, breakpoints, and quality control parameters. CLSI guideline M23. 2023.
23. Mahajan RK, Agarwal S, Jeram H, Vashishtha RC. Antimicrobial susceptibility pattern of bacterial isolates in patients of chronic suppurative otitis media in a tertiary care hospital in India. Int J Res Med Sci. 2018 Nov;6(11):3705-9.
24. Shinde KJ, Pathak NA, Katake NJ. Study of bacteriological profile in chronic suppurative otitis media and their pattern of antibiotic sensitivity. Int. J. Otorhinolaryngol. Head Neck Surg. 2021 Apr;7(4):663.
25. Priscilla R, Tiwari A, Thakur JK, Kumari P. Microbial profile with their antimicrobial susceptibility pattern in ear discharge of Chronic suppurative otitis media patients at a tertiary care hospital in Durgapur. Asian Journal of Medical Sciences. 2022 Jul 1;13(7):154-8.
26. Nagraj M, Premalatha DE. Bacteriological and mycological profile of chronic suppurative otitis media. Int J Otorhinolaryngol Head Neck Surg. 2018 May;4(3):754-8.
27. Chander VS, Kavinkumar A. Microbiological profile of chronic suppurative otitis media presenting to a tertiary care teaching hospital-A cross-sectional study. Int Arch Integr Med. 2019 May 1;6(5):5-11.
28. R Sharma, S., Singh, S., Mishra, A., & Singh, P. (2020). The microbial burden in chronic suppurative otitis media patients along with their antibiogram. Tropical Journal of Pathology and Microbiology, 6(3), 217–222. https://doi.org/10.17511/jopm.2020.i03.02
29. Deshmukh KA, Manthale D. Prevalence and antibiotic susceptibility of Pseudomonas aeruginosa isolated from chronic suppurative otitis media. Int J Otorhinolaryngol Head Neck Surg. 2017 Jan;3(1):56-60.
30. Taha AB. Bacteriological profile, antibiotic susceptibility, and biofilm formation in children with chronic suppurative otitis media. International Journal of Pediatric Otorhinolaryngology. 2025 Jan 1;188:112208.