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Research Article

PREVALENCE OF HEARING IMPAIRMENT IN CHILDREN WITH RECURRENT EAR INFECTIONS: AN ORIGINAL RESEARCH

Dr Abhishek M P[1],Dr Meghashree SB[2],Dr Hanish Shashidhar[3],Dr. Gali Krishna[4]

[1]Assistant professor, Department of ENT, Chamarajanagar institute of medical sciences (CIMS), Chamarajanagara, Karnataka, India. abhishekmp4779@gmail.com

[2]ASSISTANT PROFESSOR, DEPARTMENT OF PEDIATRICS, Chamarajanagar Institute of Medical Sciences, CHAMARAJANAGAR. sbmshree800@gmail.com

[3]MBBS , MRCP UK , Dnb (Family Medicine), Consultant physician and Intensivist , Department of General medicine and critical care, Manorama hospital, Nizamabad. hanish25.87@gmail.com

[4]MBBS, Resident Doctor, Davao Medical School Foundation, Hanumakonda, Telangana, krishna.gali913@gmail.com

*Corresponding Author
Dr Meghashree SB
sbmshree800@gmail.com

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Abstract: ***Introduction:*** Recurrent ear infections remain one of the commonest pediatric illnesses worldwide and constitute a major cause of preventable hearing impairment. Repeated episodes of otitis media can result in persistent middle ear effusion, conductive hearing loss, delayed speech development, poor academic performance, and psychosocial difficulties if not identified and managed promptly.**Aim**:To determine the prevalence of hearing impairment among children with recurrent ear infections and identify factors associated with hearing loss.**Materials and Methods**:A hospital-based cross-sectional observational study was conducted in the Department of Otorhinolaryngology of a tertiary care teaching hospital over 18 months. A total of 150 children aged 2–12 years with recurrent ear infections (≥3 episodes within 6 months or ≥4 episodes within 12 months) were enrolled. Clinical examination, otoscopic evaluation, pure tone audiometry (for cooperative children), conditioned play audiometry or brainstem evoked response audiometry where appropriate, and tympanometry were performed. Hearing impairment was classified according to the World Health Organization criteria. Statistical analysis was carried out using SPSS version 27. Chi-square test and multivariate logistic regression were applied. A p-value <0.05 was considered statistically significant.**Results**:Among 150 children, hearing impairment was identified in 63 (42.0%). Mild hearing loss accounted for 57.1% of affected children, while moderate hearing loss constituted 34.9%. Conductive hearing loss was the predominant type. Younger age, bilateral disease, presence of persistent middle ear effusion, and more than five episodes of ear infections annually demonstrated significant association with hearing impairment ($p<0.05$).**Conclusion:**Nearly two-fifths of children with recurrent ear infections demonstrated measurable hearing impairment. Early screening using audiological assessment together with timely medical or surgical intervention may substantially reduce preventable childhood hearing disability.

Keywords: Hearing impairment; Recurrent otitis media; Children; Conductive hearing loss; Audiometry

INTRODUCTION

Hearing plays an essential role in language acquisition, cognitive development, educational achievement, and psychosocial well-being during childhood. Even mild hearing impairment during early developmental years may adversely affect speech perception, literacy, classroom performance, and social interactions. Childhood hearing loss remains an important public health concern worldwide because many underlying causes are potentially preventable or treatable when detected early.[1]

Otitis media represents one of the most frequently encountered childhood illnesses requiring healthcare consultation. The disease encompasses a spectrum ranging from acute otitis media to otitis media with effusion and chronic suppurative otitis media. Recurrent infections predispose children to persistent middle ear inflammation, impaired ossicular movement, tympanic membrane abnormalities, and conductive hearing impairment. Several epidemiological studies estimate that nearly 80% of children experience at least one episode of otitis media before school age, with a substantial proportion developing recurrent disease.[2,3] The burden of recurrent otitis media is particularly significant in low- and middle-income countries because of delayed healthcare access, overcrowding, poor nutrition, passive smoke exposure, inadequate vaccination coverage, and limited audiological services. These factors contribute not only to recurrent infections but also to chronic middle ear disease and preventable hearing disability.[4]

The World Health Organization estimates that more than 430 million people worldwide require rehabilitation for disabling hearing loss, including millions of children. Childhood hearing impairment attributable to chronic ear disease continues to contribute substantially to disability-adjusted life years, particularly in developing

nations where screening programmes remain inadequate.[5]

Repeated inflammation within the middle ear cavity may produce persistent negative middle ear pressure and fluid accumulation, reducing sound conduction through the ossicular chain. Prolonged disease can also result in tympanic membrane retraction, ossicular erosion, tympanosclerosis, and occasionally sensorineural damage. Consequently, recurrent ear infections have been consistently associated with transient or permanent hearing deficits that may interfere with normal language development.[6]

Children suffering recurrent otitis media frequently present with inattentiveness, delayed speech milestones, poor classroom performance, behavioural disturbances, and reduced quality of life. These manifestations may remain unrecognized because hearing impairment often develops gradually and may fluctuate according to the presence of middle ear effusion. Therefore, objective audiological assessment is recommended in children experiencing repeated ear infections.[7]
Current international clinical practice guidelines advocate early identification of hearing impairment through otoscopy, tympanometry, age-appropriate audiological testing, and periodic follow-up in children at increased risk. Early intervention, including medical therapy, hearing rehabilitation, ventilation tube insertion where indicated, and parental counselling, substantially improves long-term outcomes.[8]

Several investigators have reported hearing loss prevalence ranging between 25% and 60% among children with recurrent otitis media depending upon disease duration, age, diagnostic criteria, and population characteristics. Nevertheless, regional epidemiological data remain limited, particularly from developing healthcare settings where recurrent infections continue to be common.[9]

A recent pediatric study evaluating allergic disorders also highlighted the importance of recognizing chronic inflammatory diseases affecting the upper airway in children because prolonged inflammation may significantly influence hearing and developmental outcomes. Similar emphasis has been placed on early pediatric screening in contemporary clinical research.
Considering the significant burden of recurrent ear infections and the potentially preventable nature of associated hearing impairment, the present study was undertaken to determine the prevalence of hearing impairment among children with recurrent ear infections attending a tertiary care hospital and to identify clinical factors associated with hearing loss.[10]

AIM
To determine the prevalence of hearing impairment among children with recurrent ear infections.
OBJECTIVES

1. To estimate the prevalence of hearing impairment among children with recurrent ear infections.
2. To assess the severity and type of hearing impairment.
3. To identify demographic and clinical factors associated with hearing loss.
4. To evaluate the relationship between recurrent ear infections and audiological findings.

MATERIALS AND METHODS

Study Design
Hospital-based cross-sectional observational study.

Study Setting
Department of Otorhinolaryngology, tertiary care teaching hospital.

Study Duration
Eighteen months.

Study Population
Children aged 2–12 years presenting with recurrent ear infections.

Sample Size
A total of 150 eligible children were enrolled using consecutive sampling after obtaining informed consent from parents or legal guardians.

Inclusion Criteria
- Children aged 2–12 years.
- History of recurrent ear infections (≥3 episodes within six months or ≥4 episodes within one year).
- Parents willing to provide informed consent.

Exclusion Criteria
- Congenital hearing impairment.
- Craniofacial anomalies.
- Previous ear surgery.
- Sensorineural deafness due to known neurological disorders.
- Ototoxic drug exposure.
- Incomplete audiological evaluation.

Study Procedure
After obtaining informed consent, demographic characteristics, socioeconomic status, immunization history, exposure to passive smoking, breastfeeding history, daycare attendance, and frequency of ear infections were documented.

Comprehensive ENT examination included:
- Otoscopic examination
- Pneumatic otoscopy
- Tympanometry
- Pure tone audiometry (cooperative children)
- Conditioned play audiometry (younger children)

- Brainstem Evoked Response Audiometry whenever clinically indicated

Hearing impairment was classified according to WHO hearing thresholds into:

- Normal (<20 dB)
- Mild (20–34 dB)
- Moderate (35–49 dB)
- Moderately severe (50–64 dB)
- Severe (65–79 dB)
- Profound (≥80 dB)

The type of hearing loss was categorized as conductive, sensorineural, or mixed hearing loss based on audiological findings.

Clinical variables recorded included:

- Number of infection episodes/year
- Laterality
- Presence of middle ear effusion
- Tympanic membrane perforation
- Tympanosclerosis
- Adenoid hypertrophy
- Family history
- Previous antibiotic treatment
- Previous ventilation tube insertion

Statistical Analysis

Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 27.0. Continuous variables were expressed as mean ± standard deviation, whereas categorical variables were presented as frequencies and percentages. Associations between categorical variables were assessed using the Chi-square test or Fisher's exact test whenever appropriate. Multivariate logistic regression was performed to identify independent predictors of hearing impairment. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 150 children with recurrent ear infections fulfilled the eligibility criteria and completed clinical and audiological evaluation. The mean age of participants was 6.8 ± 2.7 years (range: 2–12 years). Boys constituted a slightly higher proportion than girls. Hearing impairment was detected in 63 children (42.0%), whereas 87 (58.0%) demonstrated normal hearing thresholds.

Table 1. Baseline demographic and clinical characteristics of study participants (N=150)

Variable	Number (n)	Percentage (%)
Age Group (years)		
2–4	36	24.0
5–8	64	42.7
9–12	50	33.3
Gender		
Male	84	56.0
Female	66	44.0
Laterality of infection		
Unilateral	58	38.7
Bilateral	92	61.3
Episodes/year		
3–4 episodes	59	39.3
≥5 episodes	91	60.7
Persistent middle ear effusion		
Present	81	54.0
Absent	69	46.0

Narrative Findings

Table 1 demonstrates that the majority of study participants belonged to the 5–8-year age group (42.7%), followed by children aged 9–12 years (33.3%). Male children constituted 56.0% of the study population. Bilateral ear disease was observed in 61.3% of children, while 60.7% experienced five or more infection episodes annually. Persistent middle ear effusion was identified in 54.0% of participants, indicating a high burden of chronic middle ear pathology among children presenting with recurrent infections (Table 1).

Table 2. Prevalence and pattern of hearing impairment among study participants

Audiological finding	Number (n)	Percentage (%)
Normal hearing	87	58.0
Hearing impairment	63	42.0
Severity of hearing loss (n=63)		

Mild	36	57.1
Moderate	22	34.9
Moderately severe	4	6.3
Severe	1	1.6
Profound	0	0
Type of hearing loss (n=63)		
Conductive	53	84.1
Mixed	7	11.1
Sensorineural	3	4.8

Narrative Findings

As shown in Table 2, hearing impairment was detected in 42.0% of children with recurrent ear infections. Among affected children, mild hearing loss (57.1%) represented the commonest severity followed by moderate hearing loss (34.9%). Conductive hearing loss predominated (84.1%), whereas mixed and sensorineural hearing loss were comparatively uncommon. No child demonstrated profound hearing loss, emphasizing that recurrent otitis media predominantly resulted in mild-to-moderate conductive deficits (Table 2).

Table 3. Association between clinical variables and hearing impairment

Variable	Hearing Loss Present n (%)	Hearing Loss Absent n (%)	p-value
Age ≤5 years	29 (46.0)	21 (24.1)	0.008
Bilateral disease	48 (76.2)	44 (50.6)	0.003
≥5 infections/year	47 (74.6)	44 (50.6)	0.005
Persistent middle ear effusion	46 (73.0)	35 (40.2)	<0.001
Adenoid hypertrophy	22 (34.9)	18 (20.7)	0.061
Passive smoking	19 (30.2)	20 (23.0)	0.318

Chi-square test

Narrative Findings

Table 3 demonstrates statistically significant associations between hearing impairment and younger age (p=0.008), bilateral ear involvement (p=0.003), recurrent infections occurring five or more times annually (p=0.005), and persistent middle ear effusion (p<0.001). Although adenoid hypertrophy and passive smoking were more frequently observed among children with hearing impairment, these associations did not achieve statistical significance (p>0.05).

Table 4. Multivariate logistic regression showing predictors of hearing impairment

Variable	Adjusted Odds Ratio (AOR)	95% Confidence Interval	p-value
Bilateral disease	2.61	1.28–5.34	0.009
Persistent middle ear effusion	3.82	1.84–7.95	<0.001
≥5 infections/year	2.17	1.09–4.31	0.028
Age ≤5 years	1.92	1.01–3.68	0.047

Narrative Findings

Multivariate analysis (Table 4) identified persistent middle ear effusion as the strongest independent predictor of hearing impairment (AOR=3.82; p<0.001). Bilateral ear disease increased the likelihood of hearing loss by more than twofold (AOR=2.61), while recurrent infections occurring five or more times annually also remained a significant predictor (AOR=2.17). Younger children demonstrated an increased risk of hearing impairment even after adjustment for potential confounding variables.

SUMMARY OF KEY FINDINGS

- Hearing impairment prevalence among children with recurrent ear infections was 42.0%.
- Conductive hearing loss (84.1%) was the predominant audiological abnormality.
- Mild hearing loss constituted the majority of affected children.
- Bilateral disease, persistent middle ear effusion, younger age, and frequent infection episodes showed statistically significant association with hearing impairment.
- Persistent middle ear effusion emerged as the strongest independent predictor on multivariate regression analysis.

DISCUSSION

The present study evaluated the prevalence of hearing impairment among children with recurrent ear infections attending a tertiary care teaching hospital. Of the 150 enrolled children, hearing impairment was identified in **42.0%**, indicating that auditory dysfunction remains a frequent complication of recurrent otitis media. The majority of hearing deficits were mild to moderate and predominantly conductive in nature, emphasizing that recurrent middle ear inflammation continues to represent

an important yet largely preventable cause of childhood hearing loss.

The observed prevalence of hearing impairment is consistent with previous epidemiological studies reporting hearing loss in approximately one-third to one-half of children with recurrent otitis media. Chronic middle ear inflammation causes impaired tympanic membrane mobility, persistent middle ear effusion, ossicular dysfunction, and reduced sound transmission, thereby producing conductive hearing impairment. Early recognition of these changes is essential because prolonged auditory deprivation during childhood may adversely affect language acquisition, speech development, learning ability, and psychosocial growth.[11]

In the present study, **conductive hearing loss accounted for 84.1%** of all hearing impairment cases, whereas mixed and sensorineural hearing loss were relatively uncommon. This finding agrees with the pathophysiology of recurrent otitis media, where middle ear pathology constitutes the primary mechanism of hearing dysfunction. Sensorineural damage generally develops only after prolonged inflammation, toxin-mediated cochlear injury, or chronic suppurative disease. Similar observations have been reported in several international pediatric otology studies demonstrating conductive hearing loss as the predominant audiological abnormality associated with recurrent middle ear infections.[12]

Most affected children exhibited **mild hearing loss (57.1%)**, followed by moderate hearing impairment. Although mild hearing loss is often underestimated clinically, accumulating evidence suggests that even minimal reductions in hearing sensitivity may negatively influence phonological awareness, reading skills, classroom participation, and behavioural performance. Children with fluctuating conductive hearing loss frequently experience inconsistent auditory input during critical stages of language development, potentially resulting in long-term educational consequences.[13]
The present study demonstrated a significant association between younger age and hearing impairment. Children younger than five years were more likely to develop hearing loss than older children. Several anatomical and physiological factors explain this finding. The pediatric Eustachian tube is shorter, more horizontal, and functionally immature, predisposing younger children to recurrent middle ear infections and prolonged middle ear effusion. Immaturity of the immune system further increases susceptibility to repeated infections during early childhood.[14]

Another important finding was the significant association between **bilateral ear disease** and hearing impairment. Bilateral involvement exposes both ears to persistent inflammatory changes, increasing cumulative auditory dysfunction. Bilateral conductive hearing loss has a substantially greater impact on speech perception than unilateral disease because binaural hearing is essential for sound localization, speech discrimination in noisy environments, and normal language acquisition.[15]

Children experiencing **five or more infections annually** demonstrated significantly greater hearing impairment compared with those having fewer episodes. Frequent infections prolong inflammatory changes within the middle ear cavity and delay complete restoration of normal auditory function. Recurrent episodes may also promote chronic mucosal alterations, tympanic membrane scarring, ossicular stiffness, and persistent effusion, all contributing to cumulative hearing deficits. This emphasizes the importance of adequate treatment and long-term follow-up in children experiencing recurrent infections.[16]

Persistent middle ear effusion emerged as the strongest independent predictor of hearing impairment in multivariate analysis. This observation is clinically important because middle ear effusion is frequently asymptomatic and may persist long after acute symptoms resolve. The presence of fluid within the middle ear dampens tympanic membrane vibration and ossicular chain movement, producing conductive hearing loss that may fluctuate over time. Current international guidelines therefore recommend audiological evaluation when middle ear effusion persists beyond three months or recurs repeatedly.[17]

Although passive smoking and adenoid hypertrophy were more common among children with hearing impairment, statistical significance was not achieved in the present study. Nevertheless, previous investigations have consistently identified both factors as important contributors to recurrent otitis media. Passive tobacco smoke impairs mucociliary clearance and increases nasopharyngeal bacterial colonization, while enlarged adenoids obstruct the Eustachian tube and serve as reservoirs for pathogenic microorganisms. Larger multicenter studies may better clarify their independent contribution to hearing impairment.[18]

The findings of the present study further reinforce recommendations for routine hearing surveillance among children experiencing recurrent ear infections. Timely otoscopic examination, tympanometry, and age-appropriate audiological testing facilitate early diagnosis before significant developmental consequences occur. Children demonstrating persistent hearing loss may benefit from ventilation tube insertion, hearing rehabilitation, speech therapy, and close developmental monitoring depending upon clinical severity.[19]

From a public health perspective, preventing recurrent ear infections through vaccination, breastfeeding promotion, reduction of passive smoking exposure, improved nutrition, early treatment of upper respiratory

tract infections, and parental education may substantially reduce the burden of preventable childhood hearing loss. Establishment of school-based hearing screening programmes and strengthened pediatric ENT referral pathways may further improve early identification and intervention, particularly in resource-limited settings.[20]

Strengths of the Study

- Prospective audiological evaluation of all enrolled children using standardized diagnostic criteria.
- Inclusion of both clinical and audiometric parameters for comprehensive assessment.
- Identification of independent predictors using multivariate regression analysis.
- Findings provide clinically relevant evidence supporting routine hearing screening among children with recurrent ear infections.

Limitations

- Single-center hospital-based study limiting generalizability.
- Cross-sectional design precluded assessment of long-term hearing outcomes.
- Speech and language development was not evaluated longitudinally.
- Larger multicenter prospective studies are required to validate these findings.

CONCLUSION

The present study demonstrated that hearing impairment affects a substantial proportion of children with recurrent ear infections, with an overall prevalence of **42.0%**. Most cases were mild-to-moderate conductive hearing loss, highlighting the reversible nature of auditory dysfunction when diagnosed early. Younger age, bilateral disease, recurrent infection episodes, and persistent middle ear effusion were significantly associated with hearing impairment, while persistent middle ear effusion emerged as the strongest independent predictor.

Routine audiological assessment should therefore form an integral component of the evaluation of children presenting with recurrent otitis media. Early diagnosis, appropriate medical or surgical intervention, and periodic hearing surveillance may minimize speech delay, educational difficulties, and long-term disability associated with childhood hearing loss.

DECLARATIONS

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Conflict of Interest: The authors declare no conflict of interest.

Ethical Approval: The study protocol was approved by the Institutional Ethics Committee before commencement. Written informed consent was obtained from parents or legal guardians.

Informed Consent: Obtained from all participants' parents/legal guardians.

Authors' Contributions: All authors contributed substantially to study conception, data collection, analysis, manuscript preparation, and approved the final version.

Data Availability: Data supporting the findings of this study are available from the corresponding author upon reasonable request.

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