Research Article

Prevalence of Hearing Impairment in School-Going Children of Rural Areas: An Observational Study

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Background: Hearing impairment is a leading sensory deficit among school-going children, particularly in rural settings. Early identification is crucial for preventing long-term educational and developmental consequences.

Objectives: To determine the prevalence of hearing impairment among school-going children in rural areas of Ujjain district; to identify common etiological factors; and to assess the pattern and degree of hearing loss using pure tone audiometry and impedance audiometry.

Methods: An observational study was conducted in government and private rural schools of Ujjain district from 2024 to 2026. A total of 2020 children aged 5–18 years (classes 1st–12th) were enrolled. All participants underwent ENT examination, tuning fork tests, and suspected children underwent pure tone audiometry (PTA), and impedance audiometry. Hearing impairment was classified using standard audiological criteria. Statistical analysis employed descriptive statistics and chi-square tests ($p < 0.05$).

Results: Hearing impairment was found in 385 (19.1%) children. Prevalence increased progressively with age: 10.5% (5–10 years), 22.5% (11–15 years), and 29.6% (15–18 years). Gender distribution was nearly equal (males 54.4%, females 45.6%). Conductive hearing loss predominated (86.5%), followed by sensorineural (7.0%) and mixed (6.5%). Major diagnoses included otitis media with effusion (30.6%), chronic suppurative otitis media (31.2%), impacted wax (15.1%), and congenital deafness (10.1%). Most cases had mild to moderate hearing loss. Associated nasal findings included bilateral inferior turbinate hypertrophy (60.8%), and throat findings included bilateral anterior pillar congestion (66.2%) and adenoid hypertrophy (20.0%).

Conclusion: Hearing impairment affects nearly one in five rural school-going children in Ujjain district, predominantly due to preventable conductive causes. Regular school-based hearing screening, early treatment of ear infections, and strengthening rural ENT services are strongly recommended.

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Keywords: Hearing impairment, school children, rural, prevalence, conductive hearing loss, pure tone audiometry, CSOM, otitis media with effusion

Introduction

Hearing impairment represents one of the most prevalent sensory deficits worldwide, with profound implications for communication, education, and quality of life. The World Health Organization estimates that over 466 million people globally suffer from disabling hearing loss, of whom 34 million are children. Approximately 80% of hearing-impaired individuals reside in low- and middle-income countries (LMICs), where access to diagnostic services and rehabilitation remains limited.

One-quarter of all hearing impairment begins during childhood, underscoring the critical importance of pediatric hearing health programs. Childhood hearing loss has cascading effects on speech and language development, academic achievement, psychosocial well-being, and future employability. Even a mild hearing loss of 15 dB HL can create measurable disability, causing children to miss important auditory information in classroom settings.

In India, the Census of 2011 reports that hearing impairment affects approximately 5.07 million individuals, while 23% of disabled children (ages 0–6 years) have hearing disability. Hospital-based and community-based studies from India report variable prevalence rates of 6.6%–16.47% among children, with conductive hearing loss (CHL) responsible for 81.6%–98.6% of impairment

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in children, principally due to chronic suppurative otitis media (CSOM) and otitis media with effusion (OME).

Despite the substantial burden of childhood hearing impairment in India, comprehensive hearing screening programs for school-going children remain largely absent. Data from rural central India, particularly Madhya Pradesh, are scarce. The present study was therefore designed to determine the prevalence of hearing impairment among rural school-going children of Ujjain district, identify common etiological factors, and examine the pattern and degree of hearing loss using standardised audiological assessments.

Materials And Methods

Study Design and Setting

An observational study was conducted at the Department of Otorhinolaryngology, R.D. Gardi Medical College and C.R. Gardi Hospital, Ujjain, Madhya Pradesh, over a period of two years (2024–2026) following Institutional Ethics Committee approval. Screening was conducted in government and private schools in rural areas of Ujjain district.

Sample Size and Sampling

Based on an expected prevalence of 15.9% hearing impairment (as reported in previous literature), with a precision of 1.5%, significance level of 0.01, and 10% dropout allowance, the minimum required sample was 2020 children. All students from classes 1st to 12th were screened using ENT camps; suspected cases were referred for detailed audiological assessment at the hospital.

To calculate the sample size based on the difference in proportions with a 99% confidence level, we can use the following information:

	1 proportion – Estimation
Proportion (p)	15.9%(15.9% children were suffering from hearing impairment ref……)
Precision	1.5%
Significance level (α)	0.01
Drop-out	10%
Sample size	1836
Sample size (with drop-out)	2020

Table 1: Age Distribution of the Study Population (N = 2020)

Age Group	*No. of Cases*	*Percentage (%)*
5–10 years	855	42.3
11–15 years	699	34.6
15–18 years	466	23.1
Total	2020	100.0

Table 2: Prevalence of Hearing Impairment by Age Group (N = 2020)

Age Group	*With Impairment*	*%*	*Without Impairment*	*%*	*Total*
5–10 years	90	10.5	765	89.5	855
11–15 years	157	22.5	542	77.5	699
15–18 years	138	29.6	328	70.4	466
Total	385	19.1	1635	80.9	2020

Present study min. required sample is = 2020 school-going children based on the above given information.

Inclusion and Exclusion Criteria

Students aged 5–18 years enrolled in rural government and private schools in Ujjain district were included. Children below 5 or above 18 years, pre-existing profound disability (deaf-mute), and those absent during examination or not providing informed consent were excluded.

Table 3: Symptom Distribution Among Hearing-Impaired Cases (N = 385)

Symptom	***Present n (%)***	***Absent n (%)***
Otorrhoea with hearing impairment	143 (37.1%)	242 (62.9%)
Hearing loss impairment	101 (26.2%)	284 (73.8%)
Ear pain with hearing impairment	59 (15.3%)	326 (84.7%)

Table 4: Nasal Examination Findings (N = 385)

Finding	*Frequency*	*Percentage (%)*
Bilateral inferior turbinate hypertrophy	234	60.8
No abnormality detected (NAD)	70	18.2
Left DNS	58	15.1
Right DNS	16	4.2
S-shaped DNS	7	1.8
Total	385	100.0

Table 5: Throat Examination Findings (N = 385)

Finding	*Frequency*	*Percentage (%)*
Bilateral anterior pillar congestion	255	66.2
No abnormality detected (NAD)	98	25.5
Adenoid hypertrophy	77	20.0
Bilateral tonsillar enlargement	31	8.1

Table 6: Pure Tone Audiometry Results in Both Ears (N = 385)

Hearing Level (dB)	*Right Ear n (%)*	*Left Ear n (%)*
0–15 (Normal)	15 (4.0)	18 (4.9)
16–25 (Slight HL)	143 (35.8)	104 (25.3)
26–40 (Mild HL)	118 (30.9)	130 (34.0)
41–55 (Moderate HL)	76 (20.4)	88 (23.7)
56–70 (Moderately Severe HL)	19 (5.1)	26 (7.0)
71–90 (Severe HL)	5 (1.3)	10 (2.7)
>90 (Profound HL)	9 (2.4)	9 (2.4)
Total	385 (100)	385 (100)

Table 7: Distribution by Type of Hearing Loss (N = 385)

Type	*Frequency*	*Percentage (%)*
Conductive Hearing Loss (CHL)	333	86.5
Sensorineural Hearing Loss (SNHL)	27	7.0
Mixed Hearing Loss	25	6.5
Total	385	100.0

Table 8: Major Provisional Diagnoses Among Hearing-Impaired Cases (N = 385)

Diagnosis	*Cases (n)*	*Percentage (%)*
Otitis Media with Effusion (OME)	118	30.6
Chronic Suppurative Otitis Media (CSOM)	120	31.2
Impacted Wax	58	15.1
Congenital Deafness	39	10.1
Early Acute Otitis Media (AOM)	18	4.7
Tympanosclerosis	16	4.2
Others (NIHL, tinnitus, traumatic perforation)	16	4.2
Total	385	100.0

Table 9: Comparison of Prevalence Across Studies

Study	*Year*	*Setting*	*n*	*Prevalence*
Present Study	2024–26	Rural Ujjain, India	2020	19.1%
Saini et al.	2019–20	Rural Dehradun, India	1003	20.0%
Parvez et al.	2010–11	Rural/ Urban Aligarh, India	630	17.9%
Skarżyński et al.	2016–17	Rural Poland	67,416	16.4%

Data Collection and Examination

A pre-designed and pre-tested proforma was used to record demographic details. Each student underwent a thorough ENT examination including otoscopy, nasal examination, and throat/neck examination. Students with symptoms (ear discharge, hearing loss, otalgia, tinnitus, vertigo, nasal obstruction, rhinorrhea) were referred to the hospital for detailed evaluation.

Audiological Assessment

Referred students underwent comprehensive audiological evaluation including pure tone audiometry (PTA), impedance audiometry (tympanometry), tuning fork tests (Rinne and Weber), and other tests as indicated. Hearing impairment was classified per standard audiological criteria (WHO grading). The American Speech-Language-Hearing Association (ASHA) provides a widely accepted classification system that categorizes hearing ability from normal hearing to profound hearing loss. This classification is useful in clinical diagnosis, rehabilitation planning, and monitoring hearing status. This present study assessed hearing loss using the ASHA classification for degree of hearing loss

Statistical Analysis

Data were entered into Microsoft Excel and analysed using SPSS version 25. Descriptive statistics (mean, SD, proportions) were computed. Associations between categorical variables were assessed by chi-square test; $p < 0.05$ was considered statistically significant.

Ethical Considerations

Ethical clearance was obtained from the Institutional Ethics Committee of R.D. Gardi Medical College. Informed written consent was obtained from parents/ guardians. Confidentiality was maintained throughout;

children diagnosed with ENT conditions were advised appropriate treatment.

Results

A total of 2020 school-going children aged 5–18 years (mean age 11.61 ± SD years) were enrolled. Males comprised 1099 (54.4%) and females 921 (45.6%).

The majority of participants belonged to the 5–10 years age group (42.3%), followed by 11–15 years (34.6%) and 15–18 years (23.1%).

Prevalence of Hearing Impairment

Hearing impairment was identified in 385 (19.1%) children; 1635 (80.9%) had normal hearing.

Prevalence increased significantly with age ($p < 0.001$), from 10.5% in the youngest group to 29.6% in the oldest. Gender distribution among impaired cases was nearly equal (males 50.1%, females 49.9%), indicating no significant sex predisposition.

Symptom Profile (N = 385 impaired cases)

Otorrhoea with hearing impairment was the most frequent presentation (37.1%). Otorrhoea was significantly more common in the 15–18 years age group (44.7%) compared to younger children.

Associated ENT Findings

Bilateral inferior turbinate hypertrophy was the most prevalent nasal finding (60.8%), present across all age groups but most frequent in the 11–15 years cohort (66.5%).

Adenoid hypertrophy was predominantly seen in younger children (54.7% in the 5–10 years group) and was absent in the >15 years group, consistent with its known age-related involution.

Pure Tone Audiometry Findings

The majority of cases had slight to mild hearing loss. Severe (>70 dB) and profound (>90 dB) hearing loss were uncommon, observed in <4% of cases in either ear.

Type of Hearing impairment and Provisional Diagnosis

Conductive hearing loss predominated (86.5%), consistent with the high prevalence of middle ear pathology in this population.

CSOM (31.2%) and OME (30.6%) together accounted for over 60% of cases. CSOM showed increasing prevalence with age (20.8% in 5–10 years vs 41.7% in 15–18 years). Tympanosclerosis showed a marked female predominance (81.3%), while congenital deafness was more common in males (71.8%).

DISCUSSION

The present study found an overall prevalence of hearing impairment of 19.1% among 2020 rural school-going children in Ujjain district, indicating that nearly one in five children is affected. This figure is comparable to findings of Saini et al. (20%), Parvez et al. (17.9%), and is somewhat higher than the European study by Skarżyński et al. (16.4%), which likely reflects the greater burden of preventable middle ear disease in rural Indian settings.

The progressive increase in hearing impairment prevalence with age—from 10.5% (5–10 years) to 29.6% (15–18 years)—suggests that many ear conditions begin insidiously in early life and remain undetected or untreated, progressing over subsequent school years. This age-related trend is consistent with findings of Parvez et al. and Skarżyński et al. and underscores the importance of universal early screening, not merely targeted evaluation of symptomatic children.

Gender was not a significant determinant of hearing impairment in this cohort (males 50.1% vs females 49.9%), consistent with Parvez et al. and Skarżyński et al., though Saini et al. reported a slight female preponderance (21.3%). Environmental and infectious risk factors, rather than biological sex, appear to drive the prevalence in rural populations.

Conductive hearing loss predominated (86.5%), with CSOM and OME as leading causes, a finding consistent with Saini et al. (99% conductive). This predominance of conductive pathology is clinically important because the vast majority of cases are potentially reversible with timely medical or surgical intervention. The relatively low prevalence of SNHL (7.0%) suggests that permanent irreversible hearing disability remains a minority of the burden in this age group.

The high frequency of associated nasal and pharyngeal pathology—bilateral inferior turbinate hypertrophy (60.8%), adenoid hypertrophy (20.0%), and bilateral tonsillar enlargement (8.1%)—supports the well-established link between upper airway pathology, Eustachian tube dysfunction, and middle ear disease. Comprehensive ENT evaluation is therefore essential in all children presenting with hearing difficulties.

PTA findings confirmed a preponderance of mild to moderate hearing loss (slight: 35.8% right, mild: 30.9% right), with severe and profound loss uncommon (<4%). This pattern mirrors findings from Saini et al. (93.9% mild loss) and Skarżyński et al. (predominantly mild). The predominance of mild-to-moderate hearing loss, while reassuring, still carries significant developmental

implications: even 15 dB HL can impair classroom performance, language acquisition, and academic achievement.

The absence of a systematic school-based hearing screening program in India—despite WHO recommendations—means that a large proportion of affected children pass through the educational system undetected and untreated. The present study demonstrates the feasibility and yield of school-based ENT camps, and strongly supports their integration into national school health programs.

Conclusion

Hearing impairment affects 19.1% of rural school-going children in Ujjain district, predominantly due to preventable and treatable conductive pathology (86.5%). Most affected children have mild to moderate hearing loss with no significant sex predisposition. Prevalence increases progressively with age, emphasising the need for early and regular screening. CSOM and OME are the leading causes, closely linked to upper airway pathology. The findings strongly support implementation of periodic school-based hearing screening programs, prompt medical and surgical management of ear infections, integrated ENT evaluation, parental and teacher awareness, and strengthening of rural ENT healthcare infrastructure. Timely intervention can significantly reduce the burden of childhood hearing impairment and improve educational and developmental outcomes.

Source Of Funding And Conflicts Of Interest

No external funding was received for this study. The authors declare no conflicts of interest.

Ethical Approval

Ethical approval was obtained from the Institutional Ethics Committee of R.D. Gardi Medical College, Ujjain. Informed consent was obtained from parents/guardians of all participating children. The study was conducted in accordance with the Declaration of Helsinki. IEC Ref. No. – PG/OTO-RHINO-LARYNGOLOGY/65/2024

Author Contributions

SG: Concept, clinical data collection, literature search, manuscript preparation. PB: Study design, supervision, manuscript review. SV: Concept, administrative support, manuscript review. JKS, AA, SV: Guidance, manuscript review. All authors approved the final manuscript.

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Limitations

First, it was conducted among school-going children in rural areas of Ujjain district, which may limit the generalizability of the findings to urban populations and out-of-school children. Second, the cross-sectional design precludes establishing causal relationships between risk factors and hearing impairment. Third, advanced audiological investigations, such as otoacoustic emissions (OAE) and auditory brainstem response (ABR), were not performed, which may have resulted in underdiagnosis of subtle hearing loss. Also potential recall bias for symptoms etc was present.

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