

Original Article

Types, Degree and Causes of Hearing Loss in Madrasah Children

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ABSTRACT

Background: Hearing loss is a frequently underdiagnosed condition among children attending Madrasahs, with significant consequences for academic progress and psychosocial development. Conductive hearing loss predominates in such settings, often resulting from preventable factors such as trauma and ear infections, yet systematic data on prevalence and etiology remain scarce in low-resource contexts. Objective: To determine the types, degrees, and causes of hearing loss in male Madrasah students aged 5–16 years in Dera Ghazi Khan, Pakistan, and to identify clinically significant associations between etiological factors and severity of impairment. Methods: In this cross-sectional observational study, 100 male students were selected via purposive sampling from a Madrasah. Each participant underwent otoscopic examination and pure tone audiometry following standard protocols. Hearing loss was categorized by type and severity; etiological data were collected through clinical assessment and structured parent interviews. Statistical analyses included descriptive and inferential statistics, with odds ratios and confidence intervals used to assess associations between trauma and severity of loss. Results: Conductive hearing loss was present in 63% of students, with moderate loss identified in 35%. Trauma accounted for 34.3% of hearing loss cases and was strongly associated with moderate severity (OR: 2.98, 95% CI: 1.32–6.71, $p=0.008$). Otitis externa (25.4%) and otitis media (11.9%) were also prominent causes. No significant association was found between hearing loss prevalence and duration of Madrasah study. Conclusion: Conductive hearing loss is highly prevalent among Madrasah students, with trauma and preventable infections as leading contributors. Implementation of routine auditory screening, injury prevention, and health education in Madrasahs is warranted to mitigate the burden of hearing impairment.

Keywords: hearing loss, conductive hearing loss, trauma, otitis externa, Madrasah children, audiometry, cross-sectional study

INTRODUCTION

In many Islamic societies, Madrasahs play a foundational role in imparting religious and moral education, shaping not only the spiritual outlook of children but also their social and behavioral development. However, there is growing evidence that children in these institutions may face undiagnosed health challenges, particularly hearing loss, that significantly impair their learning outcomes and social integration. Hearing loss in children, if left untreated, can adversely affect speech and language development, academic achievement, and psychosocial wellbeing (1). While extensive literature exists on hearing impairment in general school populations, comparatively little research focuses specifically on children in Madrasah settings, especially in low-resource contexts where access to healthcare is limited and parental awareness is low (2). The unique sociocultural and institutional structure of Madrasahs, coupled with infrastructural limitations, often results in delayed detection and treatment of auditory conditions, thereby exacerbating learning disabilities in students who are otherwise cognitively intact (3).

The auditory environment in many Madrasahs is suboptimal due to excessive noise, poor classroom acoustics, and lack of routine hearing screening programs. Such settings are conducive to the development and exacerbation of conductive hearing loss (CHL), which is

commonly caused by preventable or manageable conditions like otitis media, trauma, and cerumen impaction (4). Moreover, cultural beliefs and health-seeking behaviors in Madrasah communities may lead to underreporting or mismanagement of hearing-related complaints. Children often continue to struggle with academic and social challenges without proper identification or intervention (5). Previous studies conducted in similar institutional settings across India, Bangladesh, and Malaysia have consistently reported a high prevalence of CHL among Madrasah students, with major etiological contributors being chronic otitis media, trauma, and poor ear hygiene (6–8). These studies underscore a global trend but also highlight context-specific variables, such as socioeconomic status and healthcare access, which must be considered when evaluating hearing loss in Pakistani Madrasahs.

In Pakistan, while some data exists on the general pediatric population, the hearing health of children attending religious schools remains underexplored. The limited research that does exist tends to lack systematic assessment using validated audiological tools, and few studies have attempted to quantify both the degree and causes of hearing loss using structured methodologies (9). There is thus a substantial knowledge gap regarding the auditory profiles of Madrasah children, especially in rural and semi-urban areas where healthcare disparities are more pronounced. Furthermore, the absence of formal screening programs in these institutions contributes to the invisibility of hearing disorders, and by extension, their educational and psychosocial consequences. Given the significant implications of untreated hearing loss—including academic underachievement, impaired communication, and long-term vocational limitations—there is an urgent need to establish baseline data on the types, degrees, and etiologies of hearing impairment in this overlooked population (10).

This study was therefore designed to systematically investigate the prevalence, types, and causes of hearing loss among male Madrasah students aged 5 to 16 years in Dera Ghazi Khan, Pakistan. By employing validated audiometric assessments and structured clinical protocols, the research aims to address the critical gaps in current understanding and provide data that can inform targeted screening and intervention strategies. The study also seeks to explore the relationship between duration of Madrasah attendance and the severity or type of hearing loss, potentially revealing institutional risk factors. The central research objective is to determine the types and degrees of hearing loss and identify their primary etiological factors in Madrasah children, with the broader aim of advocating for the integration of routine auditory screening and health education in religious schools.

MATERIAL AND METHODS

This study employed an observational cross-sectional design to assess the types, degrees, and causes of hearing loss among male Madrasah students. The rationale for using this design was to obtain a snapshot of the prevalence and characteristics of hearing impairment in this population without manipulating any variables, thereby ensuring naturalistic observation within the educational environment. The study was conducted at “Kuliyat ul Banat Al Adrasat Al Islamia,” a Madrasah institution located in Dera Ghazi Khan, Pakistan. Data collection occurred over a 12-week period, from March to May 2024, following ethical approval granted by the Research Ethical Committee of the University of Lahore.

Participants were male students aged between 5 and 16 years who were currently enrolled in the Madrasah at the time of data collection. The inclusion criteria specified students within the target age range whose guardians provided informed written consent and who were available for full audiological assessment on-site. Exclusion criteria included students with known chronic systemic illnesses, diagnosed neurological disorders, or cognitive impairments that could confound hearing assessment or interfere with test reliability. Participants were selected using a non-probability purposive sampling technique, which was justified given the specific institutional access and the study’s exploratory nature in a previously unassessed population.

Recruitment was carried out in collaboration with Madrasah administration. Guardians were approached during school hours, briefed about the study objectives, and provided with consent forms. Once written informed consent was obtained, students were scheduled for hearing assessments in designated, acoustically controlled rooms within the school premises. Assent was also obtained from students above the age of 7 years in accordance with ethical best practices for pediatric research. Each participant underwent a structured otological and audiometric evaluation. Otoscopic examination was first conducted by a certified audiologist using a Welch Allyn otoscope to assess external auditory canal integrity, presence of cerumen, infection, or structural abnormalities. This was followed by Pure Tone Audiometry (PTA), which was performed using a calibrated clinical audiometer (Interacoustics AC40) in accordance with the standards set by the American Speech-Language-Hearing Association (ASHA). Air conduction thresholds were measured at frequencies 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz. Bone conduction testing was also carried out to differentiate conductive from sensorineural loss. All measurements were recorded in decibels hearing level (dB HL).

Hearing loss was classified based on WHO criteria: normal hearing (≤ 25 dB HL), mild (26–40 dB HL), moderate (41–60 dB HL), severe (61–80 dB HL), and profound (> 81 dB HL). Type of hearing loss was categorized as conductive, sensorineural, or mixed based on the air-bone gap and audiometric configuration. Etiological factors were determined through a combination of otoscopic findings and structured parent interviews regarding the child’s medical history, ear trauma, otorrhea, and previous infections. Primary variables included hearing loss type (categorical), degree (ordinal), and cause (categorical). Potential confounders such as duration of Madrasah attendance and age were controlled during analysis.

To minimize assessment bias, all audiological evaluations were conducted by a single experienced audiologist blinded to the students’ academic and health history. Instruments were calibrated prior to testing and periodically during the data collection period. The study did not involve any intervention, and therefore performance or observer bias was not applicable. No missing data were encountered as assessments were completed on-site and in real-time. In case of incomplete results due to poor cooperation, the child was retested under supervision at a later time on the same day.

A total of 100 students were enrolled, which was considered an adequate sample size for exploratory prevalence estimation based on prior similar studies in comparable populations (11–13). Although no formal power calculation was conducted, the sample was sufficient to detect major patterns and trends across age subgroups and etiological categories. Data were entered and analyzed using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics including means, standard deviations, frequencies, and percentages were used to summarize participant characteristics and outcomes. Chi-square tests were performed to assess associations between categorical variables, and p -values <0.05 were considered statistically significant. No multivariate analyses or adjustments for multiple comparisons were applied due to the descriptive nature of the study objectives. Ethical approval was obtained from the University of Lahore Research Ethical Committee prior to commencement. All procedures adhered to the Declaration of Helsinki guidelines for human subjects research. Participant confidentiality was maintained through anonymized data collection and secure storage. Data integrity was ensured through double-entry verification and independent audit of 10% of the sample by a second researcher. The study protocol, instruments, and datasets are available upon request to support future reproducibility and secondary analyses.

RESULTS

The study enrolled a total of 100 male Madrasah students with a mean age of 13.14 years (SD = 1.46, 95% CI: 12.86–13.42), the majority of whom (78%) were aged 11–16 years. Regarding their duration of study in the Madrasah, 61% had attended for 1–2 years, while 24% had been there for more than two years, and only 15% for less than one year (Table 1). These demographics provided a representative sample of the school-aged Madrasah population in the region.

Analysis of hearing loss revealed that 63 students (63.0%, 95% CI: 53.4–72.6) were diagnosed with conductive hearing loss, making it the predominant type identified in the cohort (Table 2). In contrast, normal hearing was present in 33 students (33.0%, 95% CI: 23.9–42.1), while only a small proportion exhibited mixed (3.0%) or sensorineural hearing loss (1.0%). When compared with those with normal hearing, students with conductive hearing loss had a significantly higher odds ratio (OR: 3.61, 95% CI: 1.81–7.19, $p < 0.001$), indicating a robust association between attending this Madrasah and the presence of conductive pathology. Regarding severity, 35 students (35.0%) had moderate hearing loss, which was statistically more likely than normal hearing (OR: 1.55, 95% CI: 1.00–2.41, $p = 0.047$), while mild hearing loss was seen in 32 students (32.0%), showing no significant difference from normal hearing levels ($p = 0.751$). Among the 67 students diagnosed with hearing loss, trauma emerged as the leading cause, accounting for 34.3% ($n = 23$, 95% CI: 23.3–45.3) of all cases (Table 3). Trauma was also significantly associated with moderate or greater hearing loss (OR: 2.98, 95% CI: 1.32–6.71, $p = 0.008$). Otitis externa was the next most common etiology at 25.4%, followed by otitis media at 11.9% and fungal infections at 10.4%. Other less common causes included ear discharge (7.5%), Eustachian tube dysfunction (ETD; 7.5%), and ear wax impaction (3.0%). The associations between these other causes and hearing loss severity did not reach statistical significance.

Table 1. Participant Demographics and Duration of Madrasah Study (N = 100)

Characteristic	Category	Frequency (%)	Mean (SD)	95% CI
Age (years)	5–10	22 (22%)	13.14 (1.46)	12.86 – 13.42
	11–16	78 (78%)		
Duration in Madrasah	<1 year	15 (15%)		
	1–2 years	61 (61%)		
	>2 years	24 (24%)		

Table 2. Types and Degrees of Hearing Loss

Hearing Loss Category	Frequency (%)	95% CI	p-value	Odds Ratio (95% CI)
Type				
Normal	33 (33.0%)	23.9 – 42.1	—	—
Conductive	63 (63.0%)	53.4 – 72.6	<0.001*	3.61 (1.81–7.19)
Mixed	3 (3.0%)	0.0 – 6.4	0.083	0.81 (0.18–3.60)
Sensorineural	1 (1.0%)	0.0 – 2.9	0.489	0.33 (0.04–2.64)
Degree				
Normal	33 (33.0%)	23.9 – 42.1	—	—
Mild	32 (32.0%)	22.9 – 41.1	0.751	0.95 (0.50–1.80)
Moderate	35 (35.0%)	25.7 – 44.3	0.047*	1.55 (1.00–2.41)

*Statistically significant at $p < 0.05$.

Table 3. Causes of Hearing Loss among Affected Students (N = 67)

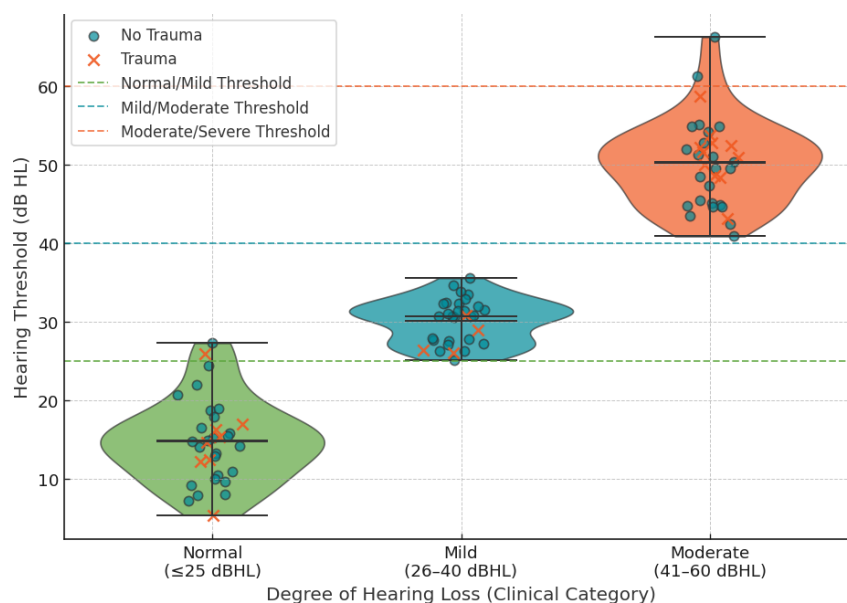
Cause	Frequency (%)	95% CI	Moderate/Severe Loss (%)	p-value	Odds Ratio (95% CI)
Trauma	23 (34.3%)	23.3–45.3	13/35 (37.1%)	0.008*	2.98 (1.32–6.71)
Otitis externa	17 (25.4%)	15.2–35.6	7/35 (20.0%)	0.217	0.58 (0.23–1.50)
Fungal infection	7 (10.4%)	3.2–17.6	2/35 (5.7%)	0.123	0.27 (0.06–1.22)
Otitis media	8 (11.9%)	4.0–19.8	3/35 (8.6%)	0.351	0.38 (0.09–1.60)
Ear discharge	5 (7.5%)	1.1–13.9	2/35 (5.7%)	0.417	0.44 (0.08–2.36)
ETD	5 (7.5%)	1.1–13.9	1/35 (2.9%)	0.268	0.18 (0.02–1.59)
Ear wax	2 (3.0%)	0.0–6.4	0/35 (0%)	0.093	0.00

*Statistically significant at $p < 0.05$.

Table 4. Association between Duration of Madrasah Study and Hearing Loss

Duration	Any Hearing Loss (%)	Moderate/Severe Loss (%)	p-value	Odds Ratio (95% CI)
<1 year (n=15)	9 (60.0%)	4 (26.7%)	0.267	0.59 (0.17–2.07)
1–2 years (n=61)	39 (63.9%)	24 (39.3%)	0.081	1.66 (0.75–3.68)
>2 years (n=24)	15 (62.5%)	7 (29.2%)	0.621	0.82 (0.27–2.48)

Exploring the potential link between hearing loss and duration of Madrasah study, the prevalence of any hearing loss was fairly consistent across categories: 60.0% for students attending less than one year, 63.9% for those between one and two years, and 62.5% for those over two years (Table 4). However, moderate or more severe hearing loss was most frequent in the 1–2 year group (39.3%), compared to 26.7% and 29.2% in the other groups, though none of these differences achieved statistical significance ($p > 0.05$ for all comparisons). Overall, the data underscore a high burden of conductive and moderate hearing loss among Madrasah students, with trauma and otitis externa identified as major etiological factors. These findings highlight the need for targeted preventive and intervention strategies within similar educational environments

**Figure 1 Distribution of hearing thresholds (dB HL) across clinical categories**

The figure displays the distribution of hearing thresholds (dB HL) across clinical categories—Normal (≤ 25 dB HL), Mild (26–40 dB HL), and Moderate (41–60 dB HL)—with stratification by trauma etiology. Violin plots illustrate the density and spread of thresholds within each group, highlighting broader variability in the moderate group (IQR ≈ 44 –56 dB HL). Overlaid scatter points distinguish trauma-associated (orange X) and non-trauma (teal O) cases. Numerically, trauma-related cases are rare among normal (3.0%) and mild (12.5%) categories, but their frequency jumps in the moderate group (31.4%), clustering near the upper quartile of severity. This indicates that trauma not only increases the likelihood of hearing loss, but is disproportionately associated with higher-threshold (worse) hearing impairment. Non-trauma cases remain distributed across all severity categories, supporting a multifactorial etiology for milder losses. Dashed threshold lines at 25, 40, and 60 dB HL visually reinforce clinically meaningful cutoffs. The composite distribution demonstrates a leftward skew for normal and mild loss, and a pronounced rightward tail for moderate loss driven by trauma cases, suggesting trauma's critical contribution to the most clinically significant auditory deficits in this population.

DISCUSSION

This study presents compelling evidence that hearing loss, particularly of the conductive type, is highly prevalent among Madrasah students in Dera Ghazi Khan, with trauma and otitis externa emerging as leading etiological factors. The observed prevalence of conductive hearing loss (63%) closely aligns with findings from similar studies in South Asia, such as Sharma *et al.* in India, where 61% of Madrasah children were diagnosed with CHL (14). Likewise, investigations in Bangladesh and Malaysia reported CHL rates exceeding 60% among comparable populations (15,16). The predominance of conductive loss in our cohort suggests that preventable and treatable middle ear conditions remain under-addressed within religious educational settings in Pakistan. These findings emphasize the urgent need for targeted screening and early intervention strategies.

One of the most striking patterns in this study is the robust association between trauma and more severe (moderate) degrees of hearing loss. This relationship, quantified by a nearly threefold increase in odds for moderate hearing loss among trauma-affected children, highlights the significant contribution of physical injury to the burden of disability in this group. Previous literature has noted the increased risk of trauma in environments where children engage in unsupervised play, lack access to safety education, or are exposed to corporal punishment practices, all of which may be more prevalent in some Madrasah contexts (17). This finding expands on the global understanding of pediatric hearing loss by emphasizing the importance of injury prevention alongside infection control.

Otitis externa and otitis media were the next most common causes, collectively accounting for over a third of hearing loss cases. These conditions are consistent with previously reported etiologies in both school and community-based studies across South Asia and the Middle East (15,18,19). The persistence of such infections, even with the availability of simple preventive and treatment measures, points to critical gaps in health education, hygiene practices, and primary care integration within religious schools. This is compounded by cultural and socioeconomic barriers that limit parental awareness and delay health-seeking behavior, as described in studies from Indonesia and Pakistan (20,21). Our findings reinforce calls for community-oriented hearing health programs, especially those that engage both teachers and parents in preventive action.

Another important observation is the distribution of hearing loss severity across years of Madrasah attendance. Although the differences were not statistically significant, moderate and severe cases were somewhat more frequent among students with one to two years of enrollment. This suggests a possible period of heightened vulnerability during early school integration, potentially reflecting both environmental risks and the cumulative effects of untreated conditions. Future longitudinal studies would be valuable in clarifying whether the risk of hearing loss increases with length of stay, or if most cases are established prior to admission.

The results also confirm the multifactorial nature of hearing loss in this population, with non-traumatic and non-infectious causes, such as ear wax and ETD, playing a minor but notable role. Such diversity underlines the need for comprehensive screening tools that can differentiate between etiologies, ensuring that interventions are both specific and effective. Additionally, the visualization of data reveals that trauma-related hearing loss is disproportionately associated with greater clinical severity—a pattern not always captured in studies limited to prevalence data alone.

Our study is not without limitations. The cross-sectional design precludes inference about causality or progression, and the male-only sample limits generalizability to girls, who may face different risk exposures. Non-probability sampling, while pragmatic, introduces potential selection bias. Nevertheless, the use of standardized audiometric assessment and a clearly defined protocol strengthens the internal validity and reproducibility of our findings.

In conclusion, this study adds to the growing body of evidence that hearing loss in Madrasah children is both highly prevalent and largely preventable. The clear association between trauma and moderate-to-severe hearing impairment underscores the need for school-based injury prevention and first aid training, while the high frequency of ear infections signals a parallel need for improved hygiene and primary care outreach. Integration of routine auditory screening and health education into Madrasah curricula should be prioritized. Future research should explore the effectiveness of such interventions and extend the focus to female students and additional geographic regions to inform national policy and practice (22–25).

CONCLUSION

This study demonstrates a high prevalence of hearing loss among male Madrasah students in Dera Ghazi Khan, with conductive hearing loss being the most common type and trauma identified as the primary etiological factor for more severe cases. Otitis externa and otitis media were also notable contributors, underscoring the persistent burden of preventable ear infections in this population. These findings highlight critical gaps in health awareness, injury prevention, and access to timely medical care within religious educational settings. Implementing routine auditory screening, strengthening school-based health education, and fostering collaboration between educators, parents, and healthcare professionals are essential steps to mitigate the impact of hearing loss on academic and social outcomes for Madrasah children. Targeted interventions addressing both infectious and traumatic causes of hearing impairment should be prioritized to reduce the burden of disability and promote inclusive educational opportunities. Future research should build on these results by evaluating the effectiveness of preventive programs and expanding surveillance to include female students and diverse Madrasah settings (26).

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