

# A study of Etiological evaluation of hearing loss in children

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## Abstract

**Background:** Detecting hearing loss early in childhood is crucial for the optimal development of children. Identifying the causes of hearing impairment in the paediatric age group, up to 6 years old, along with understanding their sociodemographic background, provides an excellent opportunity to administer timely treatment and appropriate precautions. Therefore, exploring methods for early identification of hearing issues can greatly benefit these young children. **Methods:** This descriptive study was conducted at the ENT department over 18 months, involving 150 children aged between 0 and 6 years. During the study, data collection encompassed various demographic parameters and a comprehensive birth history, covering prenatal, perinatal, and postnatal details. Additionally, the children underwent thorough clinical and audiological assessments to identify risk factors and ascertain the type and severity of their hearing loss. **Results:** Mean age of study participants were  $3.80 \pm 1.22$  years with maximum 77 (51.5%) cases in the age group of 2.1-4 years. The gender distribution among the participants revealed that 56% were males, resulting in a male-to-female ratio of 1.3:1. Among the 150 patients with hearing loss, 87 (58%) were diagnosed with sensorineural hearing loss, while 63 (42%) were found to have conductive hearing loss. **Conclusion:** More than half of the patients had sensorineural hearing loss (58%) and revealed severe to profound (53.3%) degree of hearing impairment. The delayed diagnosis of hearing loss can be attributed to limited social awareness and the lack of active health surveillance.

**Key-words:** Hearing loss, etiology, sensorineural hearing impairment, conductive hearing impairment.

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**Received:** 14<sup>th</sup> June 2023

**Accepted:** 15<sup>th</sup> September 2023

**How to Cite this Article:** Bansal G, Singh G, Prinja S, Bawa A, Pushkal. A study of Etiological evaluation of hearing loss in children. J Int Med Sci Acad 2025;38(1):37-42.

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## Introduction

Hearing is crucial for language acquisition, speech development, and cognitive abilities. It enables a child to learn, differentiate sounds, recognize objects and events, and internalize various concepts. During critical periods of language development, even minor hearing impairment can hinder a child's natural progression. Hearing loss has a negative impact on a child's learning, communication, and socialization skills.

In 2014, the World Health Organization (WHO) reported more than 360 million individuals worldwide experienced varying degrees of hearing impairment. Out of this number, approximately 328 million were adults, and remaining 32 million were children [1]. Among the children affected, 7.5 million were under the age of 5 [2]. WHO also reported that approximately 42 million people over the age of 3 were dealing with some form of moderate to profound hearing impairment [3]. In children considered to be at high risk, more than 4% were diagnosed with moderate to profound hearing loss [3]. Notably, infants born in resource-rich countries were almost twice as likely to have hearing loss compared to those born in resource-poor countries (6 cases per 1000 children in resource-rich countries versus 2-4 cases per 1000 children in resource-poor countries) [4,5].

Types of hearing impairment involves conductive, sensorineural, and mixed hearing loss [6].

1. **Conductive hearing loss:** It refers to reduction in sound transmission through the external ear canal and middle ear,

and affecting passage of sound into the inner ear.

2. **Sensorineural hearing impairment** results from damage to the inner ear (cochlea) or the nerve pathways connecting the inner ear to the brain.
3. **Mixed hearing loss:** It refers to both sensorineural and conductive hearing impairment. While conductive hearing loss is more prevalent, most cases of permanent childhood hearing loss are of the sensorineural type.

Hearing loss can be classified into two main categories: congenital and acquired [7]. Congenital deafness is primarily of the sensorineural type and is present from birth. It may be associated with chromosome disorders or inborn errors of development, typically manifesting before the development of language skills (prelingual presentation).

In young children, certain variables can increase the likelihood of hearing impairment, such as infectious diseases like measles, mumps, and meningitis, as well as chronic otitis media. It is common for more than three fourth of children to experience at least one episode of acute otitis media before the age of 3, and fluid in the middle ear often persists for weeks to months after its onset [8]. Moreover, maternal infections like rubella, jaundice after birth, birth anoxia, low birth weight, ototoxic drugs and exposure to loud noises can also elevate the risk of hearing impairment and deafness. The estimated incidence of hearing loss, whether congenital or acquired, in preschool children is generally around 1 to 2 cases per 1000 children [9].

Identifying hearing impairment in children at an early stage and providing appropriate interventions can positively impact their academic achievements and communication abilities. Developed countries commonly conduct routine screenings to detect hearing issues in children. However, in developing countries, access to advanced diagnostic technology, effective hearing aids, cochlear implants, specialized schools, and other rehabilitative measures is limited and unevenly distributed. As a result, the diagnosis of hearing loss in these regions is often delayed [10]

Children living in rural areas are more likely to experience hearing impairment at a higher rate, possibly due to insufficient hygiene, restricted access to medical services, and challenges in receiving timely treatment [11,12]. Moreover, certain studies indicate that children of parents with low literacy and household income levels are more susceptible to hearing loss. A higher risk of chronic otitis media, which is associated with hearing loss, is observed in children whose parents have low educational attainment [13].

The research aimed to determine the occurrence of hearing loss and identify related factors in children up to the age of 6. The purpose of this study is to implement timely and essential preventive measures to safeguard paediatric populations from experiencing hearing impairment.

## Methodology

This descriptive study took place at the outpatient department (OPD) of the hospital. The research was conducted over a duration of eighteen months, spanning from January 2019 to June 2020. The study comprised 150 children between the ages of 0 and 6 years, whose parents provided consent for their participation. The selection of cases followed specific inclusion and exclusion criteria, outlined as follows.

### Inclusion Criteria

- All children, regardless of gender, within the age range of 0-6 years, showing indications of unilateral or bilateral hearing impairment during the 18-month period.

### Exclusion Criteria

- Children older than 6 years.
- Preterm children were not included in the study.
- Children displaying signs and symptoms of mental retardation and other neurological disorders were excluded from the study

To gather data from the sample, a comprehensive birth history encompassing prenatal, perinatal, and postnatal details was recorded to identify various risk factors associated with deafness. Additionally, information regarding previous illnesses, treatments, immunization, and accidents was obtained. Demographic parameters such as religion, occupation, income, and education were also

collected. Thorough clinical examinations were conducted, and children with earwax or fungal issues were treated before further evaluation. Audiometry tests were performed to precisely determine the type and degree of hearing loss in the children, including the following procedures:

- Brainstem evoked response audiometry (BERA)
- Impedance audiometry
- Pure tone audiometry
- Visual reinforcement audiometry (VRA) Behavioural observation audiometry (BOA)/Play audiometry.

The children were informed about the necessity of hearing aids and, based on the cause of their hearing impairment, were recommended either conservative or surgical treatment as needed. The appropriate treatment was then administered to address their hearing issues effectively.

The study followed ethical guidelines by obtaining approval from the ethical committee. Informed and written assent was obtained from the participants, ensuring their understanding and agreement to participate. The confidentiality of all collected data was upheld throughout the study.

Microsoft Excel was used to enter and compile the data, and SPSS v21.0 (IBM SPSS statistics for windows, Armonk, NY: IBM Corp, USA,). The qualitative data were presented as numbers and percentages, while continuous quantitative data were illustrated as mean±standard deviation (SD).

## Results

In this study involving 150 cases, the majority of subjects fell within the age group of 2.1-4 years, constituting 51.5% of the sample. Among the affected children, 56% were males, resulting in a male-to-female ratio of 1.3:1 (Table 1).

Regarding the demographic profile, the socioeconomic status was evaluated using the modified Kuppuswamy scale. Among the participants, 52% belonged to the lower middle class, followed by 28% in the upper lower class. A smaller proportion of cases, 12%, were from the lower class, and 8% were from the upper middle class (Table 2).

Furthermore, the study revealed that 67.8% of the cases had a rural background, while 32.7% came from an urban background.

To investigate the causes of hearing loss, the study found that 58% of the patients had sensorineural hearing loss, while 42% had conductive hearing loss (Table 3). Among those with conductive hearing loss, the most prevalent etiology was otitis media with effusion (OME), accounting for 47.5% of cases, followed by acute suppurative otitis media (ASOM) in 32.8% of cases. Chronic suppurative otitis media (CSOM) was observed in 12.7% of cases, while otitis externa was found in 4.8% of cases. The least common cause of conductive hearing loss was traumatic tympanic membrane (TM) perforation, seen in only 1.6% of cases (Table 4).

**TABLE 1: Distribution of cases based on both age and gender**

AGE	MALE	FEMALE	TOTAL NO. OF CHILDREN
0 to ≤2 YEARS	8	10	18
>2 to ≤4 YEARS	44	33	77
>4 to 6 YEARS	32	23	55
TOTAL	84	66	150

In this present study, 8 males and 10 females were in age group of 0 to <math>2</math> years, 44 males and 33 females in age group of >2 to <math>4</math> years. 32 males and 23 females were in age group of >4 to 6 years.

**Table 2: Distribution of cases based on socioeconomic class**

SOCIOECONOMIC CLASS	CHILDREN N(%)
UPPER	0 (0)
UPPER MIDDLE	12 (8)
LOWER MIDDLE	78 (52)
UPPER LOWER	42 (28)
LOWER	18 (12)
TOTAL	150 (100)

In the present study according to the modified Kuppaswamy scale, 78 (52%) cases were of lower middle class followed by upper lower class with 42 (28%) cases. However, 18 (12%) cases belonged to lower class followed by upper middle class with 12 (8%) cases.

**Table 3: Distribution of cases based on type of hearing loss**

TYPE OF HEARING LOSS	CHILDREN N(%)
CONDUCTIVE	63 (42)
SENSORINEURAL	87 (58)
TOTAL	150 (100)

In the present study, 87 (58%) children had sensorineural hearing loss and 63 (42%) children had conductive hearing loss.

**Table 4: Etiological distribution of conductive hearing loss**

RISK FACTORS	FREQUENCY N(%)
OME (OTITIS MEDIA WITH EFFUSION)	31 (49.2%)
ASOM (ACUTE SUPPURATIVE OTITIS MEDIA)	20 (31.7)
CSOM (CHRONIC SUPPURATIVE OTITIS MEDIA)	8 (12.7)
OTITIS EXTERNA	3 (4.8)
TRAUMATIC TYMPANIC MEMBRANE (TM) PERFORATION	1 (1.6)
TOTAL	63 (100)

In the present study, OME was observed as the most common etiology for conductive hearing loss in children with 31 (49.2%) cases followed by ASOM in 20 (31.7%) cases. CSOM was observed in 8 (12.7%) cases followed by otitis externa in 3 (4.8%) cases. While the least common etiology observed was traumatic TM perforation observed in 1 (1.6%) cases.

Among the 87 cases (58%) of sensorineural hearing loss, 10.3% of children had a history of neonatal meningitis, 9.2% had a history of fever, 8% had a history of hyperbilirubinemia, and 6.8% were born with low birth weight for gestational age (LBW for GA). However, the largest group, consisting of 37.9% of children, had sensorineural hearing loss with unknown causes (Table 5).

The child's hearing sensitivity was assessed according to World Health Organisation (WHO) degree of hearing impairment as follows: [14]

Normal	-	d+25	dBHL
Slight/Mild	-	26-40	dBHL
Moderate	-	41-60	dBHL
Severe	-	61-80	dBHL
Profound	-	e"81	dBHL

The study result revealed that among the cases, 36% had a mild degree of hearing loss, 10.7% had a moderate degree, 11.3% had a

severe degree, and the highest proportion of 42% had a profound degree of hearing loss (Table 6).

## Discussion

Hearing plays a crucial role in the initial stages of spoken language, reading, and learning. For young children, consistent exposure to listening experiences is vital for the development of speech and language skills, establishing a strong foundation for successful reading. Early intervention in children with hearing challenges can significantly reduce developmental setbacks. Therefore, it is essential to conduct hearing screenings for all children at birth to enable early detection and prompt intervention.

The average age of the children presenting with symptoms was found to be 3.80±1.22 years. The largest proportion of cases, 51.5%, belonged to the age group of >2 to d"4 years, followed by 36.7% in the >4 to 6 years age group, and the smallest number of

**Table 5: Etiological distribution of sensorineural hearing loss**

RISK FACTORS		CHILDREN N(%)
ANTENATAL	H/O INFECTION TO MOTHER	2 (2.3)
	H/O USE OF OTOTOXIC DRUGS BY THE MOTHER DURING PREGNANCY	4 (5)
	BIRTH ASPHYXIA	2 (2.3)
PERINATAL/INTRANATAL	PROLONGED/ OBSTRUCTED LABOUR	5 (5.7)
	LBW FOR GA	6 (6.8)
POSTNATAL	NEONATAL SEPTICEMIA	3 (3.4)
	NEONATAL MENINGITIS	9 (10.3)
	HYPERBILIRUBINEMIA	7 (8)
	OTOTOXIC MEDICATIONS	2 (2.3)
	HISTORY OF FEVER	8 (9.2)
SOCIAL HISTORY	HEAD INJURY	5 (5.7)
	FAMILY HISTORY	1 (1.1)
NO IDENTIFIABLE RISK FACTOR		33 (37.9)
TOTAL		87 (100)

Out of 87 cases of sensorineural hearing loss, 9 (10.3%) children had history of neonatal meningitis, 8 (9.2%) children had history of fever, 7 (8%) had history of hyperbilirubinemia while, 6 (6.8%) children presented as low birth weight for gestational age. However, majority of 33 (37.9%) children were reported to have unknown causes of sensorineural hearing loss

**Table 6: Distribution of cases according to the degree of hearing loss**

GRADES	FREQUENCY N(%)
MILD	54 (36)
MODERATE	16 (10.7)
SEVERE	17 (11.3)
PROFOUND	63 (42)
TOTAL	150 (100)

In our analysis, mild degree was observed in 54 (36%) cases, moderate degree in 16 (10.7%) cases, severe degree in 17 (11.3%) cases and profound degree was observed in maximum of 63 (42%) cases.

cases, 12%, were in the 0 to <sup>2</sup> years age group. Detecting hearing loss at an early age is crucial for the management and rehabilitation of deaf children. Early detection can significantly prevent deaf mutism and improve outcomes for the affected children.

In our study involving 150 children, 56% were males, and 44% were females. The male-to-female ratio among children with hearing loss was found to be 1.3:1, which aligns with a similar study conducted by Dippen et al on 60 infants, where the male-to-female ratio was also 1.3:1 [15]. It was observed that there was a slightly higher number of male patients than female patients in our study. This difference could be attributed to increased attention given by parents to male children. However, as the patients were randomly selected, this variation is likely due to chance. The prevalence of

male predominance in hearing loss cases is commonly reported in the literature by various other authors as well, including Doifode PV et al, Bhadauria et al, Aiyer RG et al, and Singh M et al [16-19].

The sociodemographic profile of the cases in our study revealed that 67.8% of the children belonged to a rural background, while 32.7% came from an urban background. This difference in distribution can be attributed to factors such as illiteracy, poor sanitary conditions, inadequate personal hygiene, and overcrowding in rural areas, which contribute to a higher incidence of diseases among rural populations. The variation may also result from a lack of awareness about the disease among rural communities, limited healthcare facilities, restricted access to medical services, and a lack of proper referral services to specialized centres.

In another study conducted by Parvez A et al at Aligarh, it was found that 13.5% of cases in the urban group had hearing loss, whereas 18.8% of cases in the rural group were affected [20]. This observation is consistent with our study, where the occurrence of hearing loss was higher among rural children compared to those in urban areas.

In our study, the majority of cases, 52%, belonged to the lower middle class, followed by 28% in the upper lower class, based on the modified Kuppuswamy scale. Among the parents of the children included in the study, skilled workers constituted the largest group with 31.3%, followed by clerical/farmer/shop owner with 30%. Additionally, 18.7% of parents were unskilled workers, 14.7% were semi-skilled workers, and 3.3% were unemployed. In terms of education, most parents of the children, 38.7%, had completed high school, while 28.7% had middle school education, and 10.7% were illiterate.

This observed pattern might be due to a lack of awareness among parents regarding hearing loss in their children. It highlights the need to study the sociodemographic profile of preschool children to plan and deliver appropriate facilities effectively. Early diagnosis of hearing impairment is crucial, especially since people from lower socioeconomic classes and rural areas are often unaware of available rehabilitative measures in society. Poverty can also contribute significantly to their lack of knowledge.

Similarly, Parvez A et al conducted a study where they found that 30% of the children came from families belonging to the lower socioeconomic class, 25% from the lower middle class, 20% from the upper middle class, 13.33% from the middle class, and 11.67% from the upper class. [20].

In our study, sensorineural hearing loss was found to be more prevalent, accounting for 58% of cases, while conductive hearing loss constituted 42% of cases. The majority of subjects came from economically disadvantaged families and were involved in manual occupations. Many of them sought handicap certificates or were referred from primary health care centres, indicating a low level of awareness among parents regarding available support for their children.

Similarly, Adegbiyi WA et al also reported that sensorineural hearing loss was the most common type, with 61.4% of cases, followed by conductive hearing loss (27%) and mixed hearing loss (12%) [21].

In our study, OME was the most common cause of conductive hearing loss in children (49.2%), followed by acute suppurative otitis media (ASOM) in 31.7% of cases. Traumatic tympanic membrane (TM) perforation was the least common cause (1.6%). Among children with sensorineural hearing loss, neonatal meningitis was the most common etiological factor (10.3%), followed by fever (9.2%), hyperbilirubinemia (8%), and low birth weight for gestational age (6.8%). A significant proportion of cases (37.9%) had unknown causes of sensorineural hearing loss.

Other studies have also reported similar findings regarding the etiological causes of hearing impairment in children, with otitis media, neonatal jaundice, febrile illness, birth trauma, and maternal infections being identified as potential risk factors [22].

Gutierrez-Farfan et al found that risk factors such as hypoxia, prematurity, low birth weight, ototoxic drugs, jaundice with exsanguineous-transfusion, meningitis, jaundice treated with phototherapy, and maternal infections were related severe to profound sensorineural hearing impairment in children under 3 years of age [23]. Samdi MT et al also reported that 73.20% of children had predisposing risk factors, with febrile illness being the most common risk factor, followed by middle ear infections [24]. The

presence of risk factors significantly affects the auditory system and can lead to hearing impairment, but it can also occur in the absence of identifiable risk factors, emphasizing the importance of universal hearing screening programs.

Regarding the degree of hearing loss, our study observed a distribution of 36% mild, 10.7% moderate, 11.3% severe, and 42% profound degrees of hearing loss. Archbold et al noted that children with mild to moderate hearing loss are less likely to be diagnosed at early ages due to their developing speech and language skills being intelligible to teachers [25]. Consequently, they may go unnoticed and receive less support from school or health professionals compared to children with severe or profound hearing impairments.

The presence of risk factors significantly affects the auditory system and can lead to hearing impairment, but not all cases of hearing impairment are associated with identifiable risk factors. Therefore, there is a need for universal hearing screening programs to ensure early detection and intervention.

<b>Conflict of Interest:</b>	Author declare no COI
<b>Ethics:</b>	There is no ethical violation as it is based on voluntary anonymous interviews
<b>Funding:</b>	No external funding
<b>Guarantor:</b>	Dr. Sumit Prinja, will act as guarantor of this article.

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