www.jmscr.igmpublication.org
Impact Factor (SJIF): 6.379
Index Copernicus Value: 71.58
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: https://dx.doi.org/10.18535/jmscr/v6i2.103

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

# Risk Factors and Prevalence of Hearing Impairment among Neonates in a South Indian Tertiary Neonatal Centre

Authors
**Dr Mohandas Nair[1], Dr Gireesh S[2], Dr Soumya S Nair[3], Mr Sameer P[4]**
[1]Additional professor, Department of Paediatrics, Government Medical College, Kozhikode, Kerala, India
[2]Associate Professor, Department of Paediatrics, Government Medical College, Kozhikode, Kerala, India
[3]Junior Resident, Department of paediatrics, Government Medical College, Kozhikode, Kerala, India
[4]Assistant Professor, Department of Audiology, Government Medical College, Kozhikode, Kerala, India
Corresponding Author
**Dr Gireesh S**
Associate Professor, Department of Paediatrics, Government Medical College, Kozhikode, Kerala, India

**Abstract**

**Background:** *The prevalence of hearing impairment among NICU graduates is 2-4%.Unidentified hearing impairment at birth can adversely affect speech and language development and can cause long term behavioural difficulties.. Newborn hearing screening has helped to identify hearing impairment at an early age and has helped children with deafness to make exceptional progress to acquire spoken language.*

**Aims:** *The present study aims to find out the prevalence of hearing impairment in newborns admitted to the NICU and to determine the risk factors for hearing loss.*

**Settings and Design:** *NICU of Govt. medical college, Kozhikode, Kerala, Descriptive study*

**Methods and Materials:** *902 inborn babies admitted to NICU of Govt. medical college, Kozhikode, Kerala, were evaluated for hearing impairment as part of the universal screening program. The babies were subjected to hearing screening tests (OAE/BERA) and the related risk factors were assessed.*

**Results:** *Among the 486 newborns with one or more risk factors in the sample, 20 babies were found to have hearing impairment. The risk factors considered were prematurity, birth weight less than 1500gm, birth asphyxia, mechanical ventilation, use of ototoxic drugs, sepsis, meningitis, craniofacial anomalies, syndromes associated with hearing loss and intrauterine infections.17 babies with hearing loss had 3 or more risk factors.*

**Conclusions:** *The most common risk factors in our study were the use of ototoxic drugs, prematurity, very low birth weight and low APGAR score. Use of ototoxic medicines and very low birth weight was found to be significant risk factors for hearing impairment. The study revealed that hearing impairment was more common in neonates with multiple risk factors. Early detection of hearing impairment helped in referring these newborns for trial of a hearing aid and follow up.*

## Introduction

Advances in neonatal intensive care have improved the survival of high risk preterm and critically ill term infants. These infants often need complex health care support that presents great challenges to the health care provider. Although the survival rates of NICU graduates improved much, the disabilities experienced by these

children have remained the same. Prematurity, low birth weight and its associated medical complications, birth asphyxia, congenital anomalies, infections etc. place these infants at high risk of long term complications.

Newborns admitted to Intensive Care Unit are at high risk for hearing loss resulting from exposure to a variety of factors including environment, treatments and clinical conditions.

As per the American Academy of Paediatrics Task Force on Newborn and infant hearing, significant bilateral hearing loss has been shown to be present in approximately 1 to 3 per 1000 new borns in the well baby nursery population and in approximately 2 to 4 per 100 infants in the intensive care unit population[1]. According to the U S Preventive and Service Task Force, prevalence of hearing loss in newborns with specific risk indicators is 10 to 20 times higher than in general population of newborns.[2]

NICU graduates, while being at risk for hearing loss at birth, are also at increased risk for progressive and /or late onset hearing loss.[3] When undetected, hearing loss can result in delays in language, communication and cognitive development. Early identification and intervention of hearing loss can prevent linguistic, educational and psychosocial problems.

In 1972 the Joint Committee on Infant Hearing (JCIH) delineated the first high risk factors for hearing loss. Additional risk indicators were added during further years. In 1994 the JCIH endorsed universal detection of hearing loss in newborn and stated that all infants with hearing loss be identified before 3 months of age and receive intervention by 6 months[2]. The 2000 statement promotes a system composed of screening before hospital discharge, follow up and diagnosis for infants needing additional care and the intervention and rehabilitation of infants identified with hearing loss.

As per the U S Preventive Services and Task Force, screening programmes should be conducted using one or two step validated protocol. One frequently used protocol requires a two- step screening process which includes Otoacoustic Emission (OAE) testing followed by Auditory Brainstem Response (ABR) in those who do not pass the first test. For infants with risk indicators for hearing loss, periodic monitoring for three years is required. Early intervention includes evaluation for amplification on sensory devices, surgical and medical evaluation, communication assessment and therapy. Cochlear implants are deemed most appropriate for treatment of severe to profound hearing loss and are considered only after inadequate response to hearing aid.

Several studies have been conducted on the impact of Early Hearing Detection and Intervention Programmes on language development of children with hearing loss. The results of these studies indicate that early intervention for children with hearing loss is associated with later beneficial language outcomes.

As per WHO estimates in India, the prevalence of hearing impairment in Indian population is 6.3%. The National Sample Survey Organisation in its 58th rounds estimated the population of persons with disability to be 18.44 million and 10% of this figure are likely to have hearing disability.[4] Considering such estimates there seems to be dearth of any large scale incidence of studies among neonates in Indian context.

**Relevance of the Present Study**

Newborn hearing screening programme has been implemented in Institute of Maternal and Child Health (IMCH), Govt. medical college, Kozhikode since July 2014. A strict follow up hearing screening system has also been there for the NICU admitted babies. After the implementation of the screening programme, it has been possible to identify and evaluate babies with hearing loss as early as in 3 months and to give them interdisciplinary interventions. The hearing impaired babies and their caregivers are provided with audiological, rehabilitative, medical and communicative sessions and given timely fitting and monitoring of amplification devices.

Under the "Sruthi Tharangam" project by the Government of Kerala, in order to identify hearing impairment much early in life and to provide optimum benefit, children are being provided cochlear implant and financial support for auditory visual rehabilitation. This has helped children with pre lingual deafness to make exceptional progress to acquire spoken language and produce intelligible speech.[5]

In this situation, the present study is conducted at IMCH, Kozhikode to estimate the incidence of hearing loss in inborn babies admitted in the neonatal unit and to determine the associated risk factors. The results of the study may be useful for avoidance of preventable risk factors associated with the hearing loss. They can also be made applicable for further research in the subject area.

**Objectives**

The objectives of the present study are:

1. To evaluate the prevalence of hearing impairment in inborn babies admitted in the neonatal unit of IMCH, Government Medical College, Calicut.
2. To determine the risk factors for hearing impairment in the inborn babies admitted to the neonatal unit of IMCH, Government Medical College, Calicut.
3. To estimate the association between the risk factors and hearing impairment
4. To compare the incidence of hearing impairment in the 'at risk' and 'no risk' group.

**Methodology**

- **Study Design -** Prospective study
- **Study Setting–** Newborn unit, Department of Paediatrics, Institute of Maternal and Child Health, Government Medical College, Kozhikode
- **Study Period–** one year (January 2015 to December 2015)
- **Study Subjects–** All inborn neonates admitted in newborn unit of IMCH, Calicut
- **Sample Size -** 902 newborns
- **Inclusion Criteria–** all inborn babies admitted to newborn unit and who could be followed up during the study period
- **Exclusion Criteria**– Babies expired during the follow up.

**Methods**

- All inborn babies admitted to Newborn Unit are subjected to OAE test before being discharged
- Test is done using a handheld device in relatively noise free room by trained staff.
- Patient details with risk factors and test results of each ear are entered in a proforma.
- The results are also entered in the baby card
- Results are interpreted as either "pass" (normal/emissions present) or "refer" (absent emissions).
- Those with "refer" result are asked to come for repeat testing after one month (coinciding with immunisation).
- Those who fail the retest also are subjected to Auditory Brainstem Response (BERA), in the Audiology Department.
- Those who did not come for retesting were followed up through telephone.
- Though 950 babies were enrolled in the study, risk details and follow up of 902 babies could be obtained.

**Risk indicators considered**

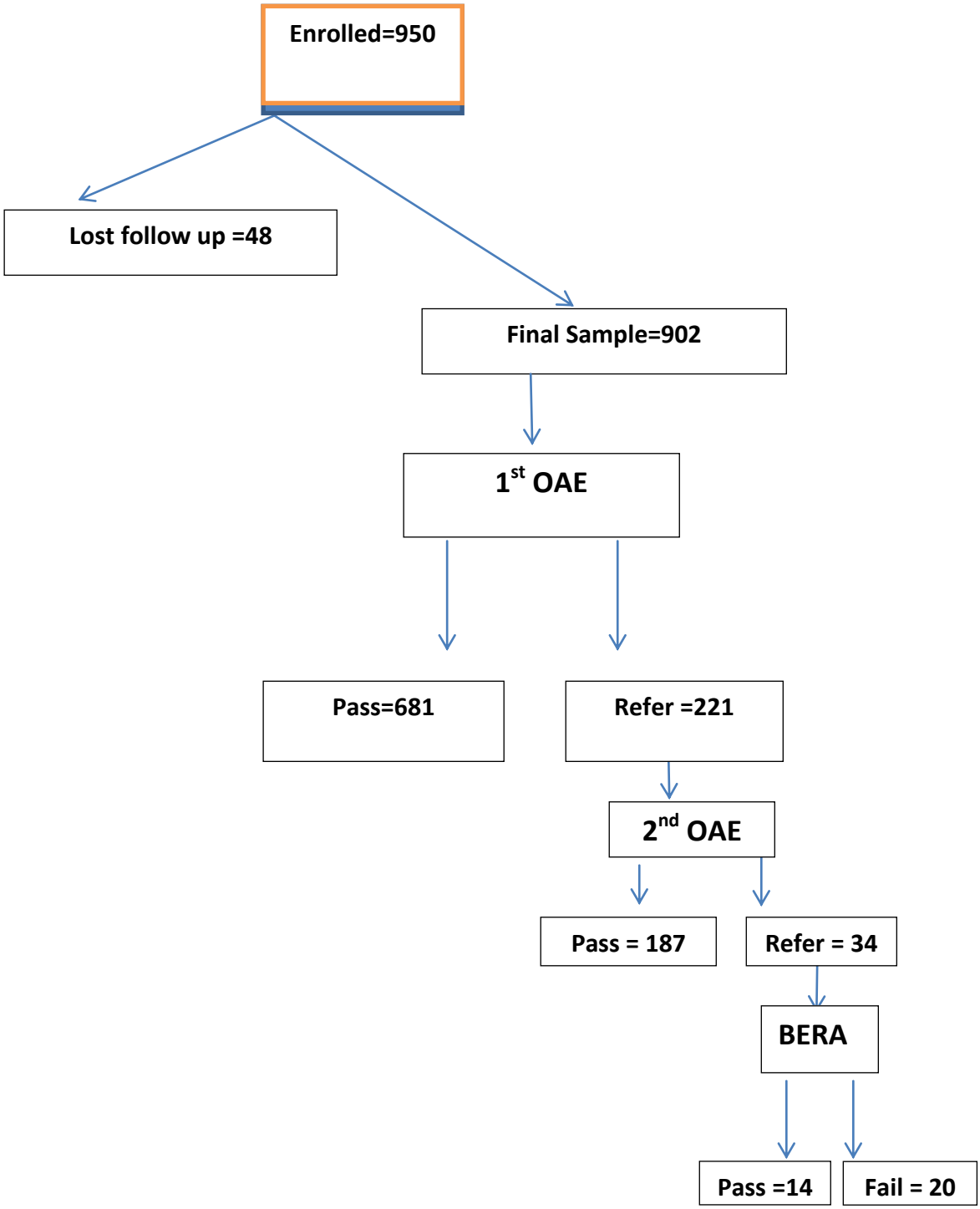
1) Consanguineous parentage
2) Family history of permanent childhood hearing loss
3) Prematurity
4) Birth weight less than or equal to 1500gm
5) Low APGAR score (0-4 at 1 minute /0-6 at 5 minutes
6) Craniofacial anomalies
7) Neonatal hyperbilirubinemia requiring exchange transfusion
8) Meningitis
9) Sepsis

10) Use of ototoxic drugs
11) Mechanical ventilation
12) Syndromes known to include permanent hearing loss
13) History suggestive of in utero infections like CMV, toxoplasmosis, herpes, syphilis, rubella

**Data Analysis**

Percentage analysis was done to know the prevalence of hearing impairment. T- test was done to know the group differences in hearing assessment of relevant subsamples. Chi-square test was done to estimate the association between hearing impairment and the risk factors. Data analysis was done using the statistical programme SPSS.

**Screening Algorithm**



**Results**

A total of 902 in borns admitted to NICU were included in the present study.

The results of the study are given below:

A) *The **descriptive statistics** of the sample is as follows*:

i. Male newborns – 55.65 %
Female newborns – 44.35 %

ii. Normal hearing - 97.78%
**I**mpaired hearing- 2.22%
Of the 20 neonates with hearing impairment, 10 were male and 10 were female.

iii. Only 1.11 % of newborns in the study sample had parental consanguinity. None of them had hearing impairment.

iv. Family history of permanent childhood hearing loss was present in 3 babies only of which one had hearing loss.

v. 34.7 % of the newborns were preterm, 4.79 % of preterm babies had hearing impairment whereas only 0.85 % of term babies had hearing loss.

vi. 8.87% newborns were very low birth weight (VLBW). 16.25 % of VLBW babies were having hearing impairment whereas only 0.85 % of newborns with birth weight more than 1500gm had hearing loss.

vii. 16.08 % of newborns had birth asphyxia. 8.28 % of these babies had hearing impairment.

viii. 10 % of newborns with hearing loss had craniofacial anomalies.

ix. 0.55% neonates required Exchange Transfusion for NNHB. None had hearing loss.

x. 25% of neonates with meningitis had hearing loss.

xi. In the study group, 8.31 % had sepsis. Only 10.67% of babies with sepsis had hearing loss.

xii. 38.58 % received ototoxic drugs. 5.17% of these babies had hearing loss. 90% of babies with hearing loss received ototoxic drugs.

xiii. 3.77% of newborns required mechanical ventilation. 26.47% babies requiring mechanical ventilation had hearing loss.

xiv. Syndrome associated with hearing loss was identified only in 0.11 % of newborns.

xv. 50 % of babies with history of intra uterine infection had hearing loss.

xvi. 85 % of the hearing impaired babies had three or more risks. Hearing impairment is more common among newborns with multiple risk factors.

**Number of Risk Factors among the newborns (Total = 902)**

| Number of Risks | Frequency | Percentage | Number of neonates with hearing impairment |
|---|---|---|---|
| No Risk | 416 | 46.11 | 0 |
| One Risk | 209 | 23.17 | 3 |
| Two Risks | 146 | 16.18 | 0 |
| Three or more Risks | 131 | 14.52 | 17 |

xvii) Distribution of newborns according to severity of hearing impairment by BERA (Total = 20) is shown below:

| Severity of Hearing impairment by BERA | Number | Percentage |
|---|---|---|
| Mild loss | 1 | 5 |
| Moderate loss | 1 | 5 |
| Severe loss | 8 | 40 |
| Profound loss | 10 | 50 |

xviii) Distribution of new-borns according to Gender and Severity of Hearing loss (Total=20) is shown below:

| Severity of Hearing impairment by BERA | Male | Female |
|---|---|---|
| Mild loss | 1 | 0 |
| Moderate loss | 1 | 0 |
| Severe loss | 4 | 4 |
| Profound loss | 4 | 6 |

xix) Distribution of Risk factors (severity wise) present in the hearing impaired newborns (Total = 20) is given below:

| Risk Factor | Severity of Hearing loss | | | | | |
|---|---|---|---|---|---|---|
| | Mild loss | Moderate loss | Severe loss | Profound loss | Total | Percentage |
| **Consanguinity** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Family history of permanent HL** | 1 | 0 | 0 | 0 | 1 | 5 |
| **Gestational age <37weeks** | 0 | 1 | 5 | 9 | 15 | 75 |
| **Birth weight </=1500g** | 0 | 1 | 3 | 9 | 13 | 65 |
| **Low APGAR score** | 0 | 0 | 4 | 8 | 12 | 60 |
| **Craniofacial abnormalities** | 0 | 0 | 0 | 2 | 2 | 10 |
| **NNHB requiring ET** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Meningitis** | 0 | 0 | 1 | 0 | 1 | 5 |
| **Sepsis** | 0 | 1 | 3 | 4 | 8 | 40 |
| **Ototoxic drugs given** | 0 | 1 | 7 | 10 | 18 | 90 |
| **Mechanical Ventilation** | 0 | 1 | 3 | 5 | 9 | 45 |
| **Syndromes known to include permanent HL** | 0 | 0 | 1 | 0 | 1 | 5 |
| **History suggestive of intra uterine infections** | 0 | 0 | 0 | 1 | 1 | 5 |

**B) Group Differences in Hearing assessment with respect to the Risk factors**

T- test was used to know the significance of difference in hearing assessment between the two groups of each risk factor. Data and results of the analysis are presented in Table-20. In Gender, Male is taken as Group 1 and Female as Group 2. In other variables, Group 1 is 'Risk Factor present' and Group 2 'Risk factor Not Present'.

**Table-1:** Data and Results of t-test for significance of difference in Hearing Assessment between the two groups of Risk Factors

**(Total = 902)**

| Risk Factor | Group 1 | Group 2 | t - value | Level of Significance |
|---|---|---|---|---|
| **Gender** | 502 | 400 | 0.514 | **Not Significant** |
| **Consanguinity** | 10 | 892 | 0.478 | **Not Significant** |
| **Family history of permanent HL** | 3 | 899 | 3.690 | Significant at 0.01 level |
| **Gestational age <37weeks** | 313 | 589 | 3.856 | Significant at 0.01 level |
| **Birth weight </=1500g** | 80 | 822 | 9.342 | Significant at 0.01 level |
| **Low APGAR score** | 145 | 757 | 5.492 | Significant at 0.01 level |
| **Craniofacial abnormalities** | 8 | 894 | 4.439 | Significant at 0.01 level |
| **NNHB requiring ET** | 5 | 897 | - 0..337 | **Not Significant** |
| **Meningitis** | 4 | 898 | 3.115 | Significant at 0.01 level |
| **Sepsis** | 75 | 827 | 5.263 | Significant at 0.01 level |
| **Ototoxic drugs given** | 348 | 554 | 4.833 | Significant at 0.01 level |
| **Mechanical Ventilation** | 34 | 868 | 10.345 | Significant at 0.01 level |
| **Syndromes known to include permanent HL** | 1 | 901 | 6.806 | Significant at 0.01 level |
| **History suggestive of intra uterine infections** | 2 | 900 | 4.644 | Significant at 0.01 level |

Gender, Consanguinity and NNHB do not show difference between the groups. Since all other risk factors have group differences at 0.01 level, they can be considered as discriminating factors in hearing.

***C) Association between Hearing impairment and Risk factors***

Chi Square test was used to find out the association between hearing impairment and each of the risk factors that showed group difference in the t-test. Where Chi Square was significant, value of Contingency Coefficient (C) showed the magnitude of association between the risk factor and hearing impairment.

**Table 2:** Chi Square test of independence between Hearing Impairment and Family history of permanent childhood hearing loss

| Family history of permanent childhood hearing loss | Hearing Impairment | | | | |
|---|---|---|---|---|---|
| | Mild | Moderate | Severe | Profound | Total |
| Present | 1 | 0 | 0 | 0 | 1 |
| Not Present | 0 | 1 | 8 | 10 | 19 |
| Total | 1 | 1 | 8 | 10 | 20 |
| $X^2$ = 20.0 df = 3 P value = 0.000 C= 0.707 | | | | | |

Since Chi square is significant at 0.01 level, the two variables are having association. The strength of association is given by Contingency Coefficient (C) equal to 0.707

**Table- 3:** Chi Square test of independence between Hearing Impairment and gestational age.

| Gestational age | Hearing Impairment | | | | |
|---|---|---|---|---|---|
| | Mild | Moderate | Severe | Profound | Total |
| <37 Weeks | 0 | 1 | 5 | 9 | 15 |
| >/=37 weeks | 1 | 0 | 3 | 1 | 5 |
| Total | 1 | 1 | 8 | 10 | 20 |
| $X^2$ = 5.2 df = 3 P value =0.158 C=0.454. | | | | | |

Since Chi square is not significant even at .05 level for three degrees of freedom, Hearing impairment is not related to Prematurity.

**Table- 4:** Chi Square test of independence between Hearing Impairment and Birth weight

| Birth weight | Hearing Impairment | | | | |
|---|---|---|---|---|---|
| | Mild | Moderate | Severe | Profound | Total |
| </=1500g | 0 | 1 | 3 | 9 | 13 |
| >1500g | 1 | 0 | 5 | 1 | 7 |
| Total | 1 | 1 | 8 | 10 | 20 |
| $X^2$ = 7.802 df = 3 P value =0.05 C=0.530 | | | | | |

Chi Square value is significant at 0.05 level for 3 degrees of freedom. The C value shows that the association is not very high.

**Table- 5:** Chi Square test of independence between Hearing Impairment and Low APGAR score

| Low APGAR score | Hearing Impairment | | | | |
|---|---|---|---|---|---|
| | Mild | Moderate | Severe | Profound | Total |
| Yes | 0 | 0 | 4 | 8 | 12 |
| No | 1 | 1 | 4 | 2 | 8 |
| Total | 1 | 1 | 8 | 10 | 20 |
| $X^2$ = 5.0 df = 3 P value =0.172 C=0.447 | | | | | |

Chi square value is not significant even at 0.05 level.

**Table- 6:** Chi Square test of independence between Hearing Impairment and Craniofacial anomalies

| Craniofacial anomalies | Hearing Impairment | | | | |
|---|---|---|---|---|---|
| | Mild | Moderate | Severe | Profound | Total |
| Present | 0 | 0 | 0 | 2 | 2 |
| Not Present | 1 | 1 | 8 | 8 | 18 |
| Total | 1 | 1 | 8 | 10 | 20 |
| $X^2 = 2.222$ df =3 P value =0.528 C=0.316 | | | | | |

Chi Square is not significant even at 95 % confidence level.

**Table- 7:** Chi Square test of independence between Hearing Impairment and Meningitis

| Meningitis | Hearing Impairment | | | | |
|---|---|---|---|---|---|
| | Mild | Moderate | Severe | Profound | Total |
| Yes | 0 | 0 | 1 | 0 | 1 |
| No | 1 | 1 | 7 | 10 | 19 |
| Total | 1 | 1 | 8 | 10 | 20 |
| $X^2 = 1.579$ df =3 P value =0.664 C=0.271 | | | | | |

Chi square is not significant. Association does not exist between hearing impairment and Meningitis.

**Table- 8:** Chi Square test of independence between Hearing Impairment and Sepsis

| Sepsis | Hearing Impairment | | | | |
|---|---|---|---|---|---|
| | Mild | Moderate | Severe | Profound | Total |
| Yes | 0 | 1 | 3 | 4 | 8 |
| No | 1 | 0 | 5 | 6 | 12 |
| Total | 1 | 1 | 8 | 10 | 20 |
| $X^2 = 2.187$ df = 3 P value = 0.534 C=0.314 | | | | | |

Chi square is not significant.

**Table- 9:** Chi Square test of independence between Hearing Impairment and use of ototoxic drugs

| Ototoxic drugs | Hearing Impairment | | | | |
|---|---|---|---|---|---|
| | Mild | Moderate | Severe | Profound | Total |
| Given | 0 | 1 | 7 | 10 | 18 |
| Not Given | 1 | 0 | 1 | 0 | 2 |
| Total | 1 | 1 | 8 | 10 | 20 |
| $X^2 = 10.278$ df = 3 P value =0.016 C=0.583 | | | | | |

Chi square value is significant at 0.01 level for 3 degrees of freedom. The magnitude of association is not very high.

**Table-10:** Chi Square test of independence between Hearing Impairment and Mechanical ventilation

| Mechanical ventilation | Hearing Impairment | | | | |
|---|---|---|---|---|---|
| | Mild | Moderate | Severe | Profound | Total |
| Yes | 0 | 1 | 3 | 5 | 9 |
| No | 1 | 0 | 5 | 5 | 11 |
| Total | 1 | 1 | 8 | 10 | 20 |
| $X^2 = 2.323$ df = 3 P value =0.508 C=0.323 | | | | | |

Hearing impairment is not related to Mechanical ventilation because chi square is not significant.

**Table- 11:** Chi Square test of independence between Hearing Impairment and Syndromes known to include permanent hearing loss

| Syndromes known to include permanent hearing loss | Hearing Impairment | | | | |
|---|---|---|---|---|---|
| | Mild | Moderate | Severe | Profound | Total |
| Yes | 0 | 0 | 1 | 0 | 1 |
| No | 1 | 1 | 7 | 10 | 19 |
| Total | 1 | 1 | 8 | 10 | 20 |
| $X^2 = 1.579$ df = 3 P value =0.664 C=0.271 | | | | | |

Chi square is not significant.

**Table- 12:** Chi Square test of independence between Hearing impairment and History suggestive of intra uterine infections.

| History suggestive of in utero infections | Hearing Impairment | | | | |
|---|---|---|---|---|---|
| | Mild | Moderate | Severe | Profound | Total |
| Yes | 0 | 0 | 0 | 1 | 1 |
| No | 1 | 1 | 8 | 9 | 19 |
| Total | 1 | 1 | 8 | 10 | 20 |
| $X^2 = 1.053$ df = 3 P value =0.789 C=0.224 | | | | | |

Chi square is not significant.

**Discussion**

In 1994 the Joint Committee on Infant Hearing Hearing (JCIH) endorsed universal detection of hearing loss in newborn and stated that all infants with hearing loss be identified before 3 months of age and receive intervention by 6 months.

Universal Newborn Hearing Screening was implemented in our institution in July 2014.The present study has been conducted in the newborn unit to detect hearing impairment among babies delivered in our institution and got admitted in the neonatal unit due to various problems; and to identify the risk factors associated with hearing loss.

Neonates were screened using otoacoustic emission (OAE) test, and in newborns with OAE 'fail' result, brainstem evoked response audiometry (BERA) was used to detect or rule out sensorineural hearing loss. Both the tests are non-invasive, quick and easy to perform.

The prevalence of hearing impairment in our study is 2.22% which is comparable with the study conducted by Beswik R et al in which the incidence of hearing loss is 2.7% [(6)]. By testing the significance of percentage, the prevalence rate of hearing impairment obtained in the study is 17 to 27 per 1000 newborns.

All babies with hearing loss in our study had one or more risk factors for hearing loss. The most common risk factors were (a) Use of ototoxic medications, (b) Prematurity, (c) Very low birth weight, (d) Low APGAR score. In a multicentre study by NIHS, the four most common risk factors were use of ototoxic medication, VLBW, assisted ventilation for more than 5days and low APGAR score. [(7)]

In the Centralised Newborn Hearing Screening Program in Ernakulam district, Kerala, the incidence of hearing loss in high risk population was found to be 0.7%. In this programme the most common risk factor was low birth weight followed by familial deafness[(8)]. Mechanical ventilation accounted for 8.8%. Similar to this study familial deafness accounted for 10.6% cases of hearing loss in another study by Declau et al [(9)]. In our study the prevalence of this risk factor (familial deafness) is 5%. Though prematurity is a common risk factor in our study group, no significant association was found in statistical analysis between prematurity and hearing impairment. This is in contrast to the study by Paula van et al which showed an increase in incidence of hearing impairment with decreasing gestational age(1.2% - 7.5% from 31 to 24 weeks)[(10)]. In our study the incidence of hearing loss in preterm babies is 4.79%. Unlike in other studies, our study included less number of extremely preterm newborns.

VLBW babies constitute 8.87% in our study population and significant association was found between birth weight and hearing loss. Kraft et al in their study observed that there was a 6 fold greater risk for hearing loss in children with birth weight <1500 gms when compared with those with birth weight between 3500 grams and 3999 grams.[(11)]

In our study 16.08% had low APGAR score. This is almost similar to that in the NIHS study which had an incidence of 13.9 %.[(12)]

No significant association between birth asphyxia and SNHL was observed in our study. A study by Georgea espindola et al demonstrated that alterations occurred in cochlear and neural components in newborns with perinatal asphyxia

who passed OAE screening [13]. But in our study BERA was not done in babies with birth asphyxia who passed OAE test. Hence a conclusion regarding this risk factor cannot be made out.

Ototoxic drugs were given to 38.8% of neonates in our study. This is similar to that observed in the National Institute of Health Sciences study. It is the most common risk factor in our study. In a study conducted by Alaee et al, use of ototoxic drugs is a significant risk factor for hearing loss[14]. In our study babies who received ototoxic drugs had multiple risk factors and if use of ototoxic drug is an independent risk factor for hearing loss could not be statistically analysed.

Only 4 neonates in our study had meningitis. Meningitis was not statistically significant risk factor in our study, which is in contrast to study by Muddasir et al in which meningitis is a significant independent risk factor[15].

In a study by Bener et al among Qatari population it was observed that parental consanguinity was more common among hearing loss cases[16] which is in contrast to our study.

In the study conducted by Silvia et al, the percentage of VLBW newborns diagnosed with hearing loss is higher than expected in general population. All those diagnosed with SNHL were preterm and had one or more risk factors associated with VLBW[17]. Our study group also had coexisting risk factors. Several studies concluded that in very preterm neonates with SNHL, coexistence of risk factors for hearing loss may be more important than individual risk factor themselves.

## Conclusion

Prevalence of hearing impairment in inborn babies admitted to IMCH, Calicut neonatal unit is 2.22%. The most common risk factors for hearing impairment in our study in the order of frequency is i) Use of ototoxic drugs ii) Prematurity iii) Vey low birth weight iv) low APGAR score. Use of ototoxic medications and very low birth weight were found to be significant risk factors for hearing impairment. Hearing impairment was more common in neonates with multiple risk factors. Early identification of hearing impairment helped in referring these neonates for behind the ear hearing aid fitting and follow up.

Since neonates in the present study had multiple coexisting risk factors for hearing loss, impact of each risk factor could not be assessed separately. Use of ototoxic drugs is found to be a significant risk factor for hearing impairment. Neonates who received ototoxic drugs had multiple coexisting risk factors. Further studies are required to analyse the independent association of ototoxic drug use and hearing impairment so as to make changes in dosing and monitoring of ototoxic drugs administered to newborns.

## References


1. American Academy of Pediatrics Task Force on newborn and infant hearing. Pediatrics.1999;103(2):527-529
2. US Preventive Services Task Force. Universal screening for hearing loss in newborns: Recommendation statement. Pediatrics.2008;122(1):143
3. Kawashiro N, Tsuchihashi N, Koga K, *et al*. Delayed post neonatal intensive care unit hearing disturbance. Intenational Journal of Paediatric Otorhinolaryngology.1996;34: 35-43.
4. Kumar S, Mohapatra B. Status of newborn hearing screening program in India. International journal of pediatric otorhinolaryngology. 2011 Jan 31;75 (1):20-6.
5. www.socialsecuritymission.gov.in/sruthitharangam
6. Beswick R, Driscoll C, Kei J, et al. Which risk factors predict postnatal hearing loss in children? Jam Acad Audiol.2013 Mar; 24(3):205-213 Vohr BR, Widen IE, Cone-Wesson B, *et al*. Identification of neonatal hearing impairment: characteristics of infants in the neonatal intensive care unit and

well- baby nursery. Ear Hear. 2000; 21(5):373-382.
7. Paul AK. Early identification of hearing loss and centralized newborn hearing screening facility-the Cochin experience Indian pediatrics. 2011 May 1;48(5):355-
8. Centralised NBHS,EKM
9. Declau F, AA Boudewayns, Jenneke Van deu Ende, Peters A. Etiologic and audiologic evaluations after universal neonatal hearing screening: analysis of 170 referred neonates. Pediatrics. 2008;121:1119-1126
10. Van Dommelen P, Verkerk PH, Van Straaten HL, Hearing Screening Working Group. Hearing loss by week of gestation and birth weight in very preterm neonates. The Journal of pediatrics. 2015 Apr 30;166(4):840-3.
11. Kraft CT, Malhotra S, Boerst A, Thorne MC. Risk indicators for congenital and delayed onset hearing loss. Otol Neurotol 2014 Dec;35(10):1839-1843.
12. Vohr BR, Widen IE, Cone-Wesson B, *et al*. Identification of neonatal hearing impairment: characteristics of infants in the neonatal intensive care unit and well- baby nursery. Ear Hear. 2000; 21(5):373-382.
13. Ribeiro GE, da Silva DP, Montovani JC. Transient evoked otoacoustic emissions and auditory brainstem response in infants with perinatal asphyxia. International Journal of Pediatric Otorhinolaryngology. 2016 Oct 31;89: 136-9.
14. Alaee E, Sirati M, Taziki MH, *et al*. Risk factors for sensorineural hearing loss among high risk infants in golestan province, Iran in 2010-2011. Iran Red Crescent Med J. 2015 Dec 20; 17(12): e20419.
15. Maqbool M, Najar BA, Gattoo I, Chowdhary J. Screening for Hearing Impairment in High Risk Neonates: A Hospital Based Study. Journal of clinical and diagnostic research: JCDR. 2015 Jun;9(6):SC18.
16. Bener A, Eihakeem AA, Abdulhadi K. Is there any association between consanguinity and hearing loss. Int J Pediatr Otorhinolaryngol 2005; 69(3):327- 333.
17. Borkoski-Barreiro SA, Falcón-González JC, Limiñana-Cañal JM, Ramos-Macías Á. Evaluation of Very Low Birth Weight (≤ 1500g) as a Risk Indicator for Sensorineural Hearing Loss. Acta Otorrinolaringologica (English Edi). 2013 Dec31;64(6):403-8.