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# Risk Factors of Hearing Impairment in New Born Infants at Prof. Dr. I.G.N.G Ngoerah General Hospital: A Retrospective Study

**Made Ayu Widyaningsih[1], Made Sukmawati[2]**

[1,2]Department of Pediatrics, Faculty of Medicine, Universitas Udayana, Prof. Dr. IGNG Ngoerah General Hospital, Bali, Indonesia

Corresponding Author: Made Ayu Widyaningsih

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## ABSTRACT

**Introduction:** The first year of life is the key to normal speech and language development, as well as intellectual and emotional growth. Identification of risk factors for hearing loss is very important for early detection, early initiation of therapy, and assessing the baby's prognosis. This study aims to determine the risk factors for hearing loss in newborns.

**Methods:** This research is a retrospective study with a case-control study design that was conducted from January to December 2021. The research sample was newborns with hearing loss at Prof. Dr. I.G.N.G. Ngoerah hospital. Hearing loss was assessed by Otoacoustic Emission (OAE). All data were analyzed with SPSS version 25.

**Results:** This study got a total of 55 cases of newborns with hearing loss and 55 control groups without hearing loss. Based on multivariate analysis, the factor that significantly influenced hearing loss in newborns was premature birth (adjusted OR=7.120; 95% CI: 1.902-26.654; p=0.004). There was no significant relationship between length of stay, APGAR score, birth weight, family history, hyperbilirubinemia, mechanical ventilation, meningitis, congenital abnormalities, and ototoxic drugs with hearing loss in newborns.

**Conclusion:** Prematurity is a risk factor for hearing loss in newborns. Premature babies should be screened for hearing to detect hearing loss early.

***Keywords:*** hearing loss, neonates, premature

## INTRODUCTION

Research shows 2-3% of babies are born with severe bilateral hearing loss and 2-4% with moderate or unilateral bilateral hearing loss. More than 80% of hearing loss in children is congenital.[1] Newborns who are treated in intensive care units are more at risk of hearing loss, hence the need for screening and detection of risk factors. Screening is important because hearing is critical to normal speech and language development, as well as future intellectual and emotional growth. The frequency of hearing loss in infants with risk factors is 10-50 times higher than in infants without risk factors for hearing loss. [2,3]

Much research is needed to investigate the influence of risk factors on the incidence of hearing loss. [4,5] Risk factors for hearing loss according to the Joint Committee of Infant Hearing (JCIH) include low birth weight, prematurity, asphyxia, seizures, long hospitalization, family history of hearing loss, mechanical ventilation, meningitis, jaundice, hypoglycemia, asphyxia, congenital abnormalities, and use of ototoxic drugs. [6,7]

Identification of risk factors for hearing loss is very important to help early detection, initiate early therapy, and assess prognosis. [1,5] This study aims to determine risk factors for hearing loss in newborns.

## METHODS

This research is an analytic observational study with a case control design. Data was collected from patient medical records. The target population is newborns with hearing loss in the period 1 January to 31 December 2021. The inclusion criteria were all newborns with hearing loss. Exclusion criteria were missing medical record data. The control group was newborns without hearing loss at Prof. Dr. I.G.N.G Ngoerah General Hospital. Data analysis was performed using the SPSS application version 25.

## RESULTS

A total of 55 samples in the case group with hearing loss and 55 samples in the control group without hearing loss. The characteristics of the study subjects are presented in Table 1. The risk factors for hearing loss were analyzed by the chi-square test and presented in the form of odds ratio (OR) and 95% confidence interval (CI) as can be seen in Table 2. Based on the chi-square analysis, the factors which has a significant effect on hearing loss in newborns is premature birth (OR=1.99; 95% CI=1.22-3.22; p=0.002)

**Table 1. Basic characteristics of research subjects in both groups**

| Variables | Case (n = 55) | Control (n = 55) | OR (95% CI) | P value |
|---|---|---|---|---|
| Prematurity | | | | |
| Prematur, n (%) | 52 (76,4) | 26 (47,3) | 1,995 | 0,002 |
| Aterm, n (%) | 13 (23,6) | 29 (52,7) | (1,22-3,25) | |
| Length of Stays, n (%) | | | | |
| ≤ 14 days | 30 (54,5) | 40 (72,7) | 0,686 | 0,037 |
| >14 days | 21 (38,2) | 27 (49,1) | (0,47 – 0,98) | |
| APGAR Score | | | | |
| Asfiksia, n (%) | 34 (61,8) | 28 (50,9) | 1,253 | 0,168 |
| Vigorous, n (%) | 21 (38,2) | 27 (49,1) | (0,84 – 1,85) | |
| Low Birth Weight, n (%) | | | | |
| Yes | 35 (63,6) | 28 (50,9) | 1,306 | 0,177 |
| No | 20 (36,4) | 27 (49,1) | (0,87 – 1,94) | |
| Family History, n (%) | | | | |
| Yes | 5 (9,1) | 2 (3,6) | 1.887 | 0,241 |
| No | 50 (90,9) | 53 (96,4) | (0,35-10,23) | |
| Hyperbilirubinemia, n (%) | | | | |
| Yes | 18 (32,7) | 13 (23,6) | 1,240 | 0,289 |
| No | 37 (67,3) | 42 (76,4) | (0,84-1,84) | |
| Ventilator, n (%) | | | | |
| <7 days | 43 (78,2) | 51 (92,7) | 0,610 | 0,031 |
| ≥7 days | 12 (21,8) | 4 (7,3) | (0,42-0,87) | |
| Meningitis, n (%) | | | | |
| Yes | 10 (18,2) | 6 (10,9) | 1,306 | 0,279 |
| No | 45 (81,8) | 49 (89,1) | (0,84-2,01) | |
| Congenital anomaly, n (%) | | | | |
| Yes | 15(27,3) | 12 (21,8) | 1,153 | 0,506 |
| No | 40 (72,7) | 43 (78,2) | (0,76-1,72) | |
| Ototoxic medication, n (%) | | | | |
| Yes | 43 (78,2) | 35 (63,6) | 1,470 | 0,093 |
| No | 12 (21,8) | 20 (36,4) | (0,90-2,40) | |

**Table 2. Multiple Logistic Regression Test Results for Risk Factors for Hearing Loss in Newborns**

| Variables | Sig. | aOR | 95% CI | |
|---|---|---|---|---|
| | | | Min | Max |
| Prematurity | 0,004 | 7,120 | 1,902 | 26,654 |
| Length of Stays ≤ 14 days | 0,224 | 0,563 | 0,223 | 1,421 |
| APGAR score (asfiksia) | 0,432 | 0,690 | 0,274 | 1,741 |
| Low Birth Weight | 0,172 | 0,430 | 0,128 | 1,443 |
| Family History | 0,072 | 6,188 | 0,851 | 45,007 |
| Ventilator | 0,072 | 0,306 | 0,085 | 1,110 |

## DISCUSSION

Factors that significantly influence hearing loss in newborns in this study is premature birth. These results are consistent with Alde et al in 2022, Song et al in 2021, Wien et al in 2017, and van Dommelen et al in 2015 which stated that premature newborns have a higher risk of hearing loss. [10–13] Meta-analytic studies show that the lower the

gestational age, the more it causes an increased risk of hearing loss.[14]

The mechanism of hearing loss in premature infants is caused by impaired cochlear formation. [15] Perilymph and endolymph are impaired in premature infants as evidenced by abnormalities in signal intensity on MRI images, which are related to sensorineural deafness. [11]

Another factor that can cause perilymph and endolymph abnormalities on MRI is hemorrhagic labyrinthitis as a result of bacterial meningitis including Streptococcus suis. Bacteria can enter the perilymph through the cochlear aqueduct by exotoxin lytic mechanism. Bacterial infection of the labyrinth can then lead to fibrosis of the labyrinth tissue. The cochlear aqueduct, which connects the perilymphatic space of the cochlea with the subarachnoid space of the posterior cranial cavity, has been shown to exhibit a short, straight, and patent pathway in the newborn, making it more susceptible to hearing loss from meningitis. Premature babies have shorter cochlear aqueducts, so they are more susceptible to cochlear damage from meningitis than term babies.[16]

This study found no significant relationship between ototoxic drugs and hearing loss in newborns. Different results were obtained in studies by Bielecki et al, Rechia et al and Maharani et al which stated that one of the most common risk factors for hearing loss is ototoxic drugs. The drugs used in sepsis can cause hearing loss by damaging the cochlea or outer hair cells due to drug concentrations in the perilymph fluid. 6 One study stated that hearing loss due to ototoxic drugs had not been detected at drug termination, but would only be detected 7 days after ototoxic drug termination, so may cause insignificant results in this study

Congenital abnormalities were not associated with hearing loss in this study. These results are similar to studies by Maharani et al and Hardani et al which stated that there was no relationship between congenital abnormalities and hearing loss.[4]

This study found that the use of mechanical ventilation had no effect on hearing loss in newborns. Maharani et al and Xoinis et al also found no association between mechanical ventilation and hearing loss in newborns. Bielecki et al stated that the application of mechanical ventilation is associated with respiratory disorders, thus triggering hypoxia in the central nervous system and possible hearing loss due to damage to the nervous system. In addition, the application of mechanical ventilation can significantly damage the peripheral segments of the auditory canal. [4,12]

Hyperbilirubinemia was not associated with hearing loss in this study. Hardani et al. found different results, which stated that risk factors for hearing loss in infants include hyperbilirubinemia.[1] In theory, hyperbilirubinemia in infants damages the auditory nuclei in the brainstem and auditory nerve, resulting in sensorineural hearing loss.[21] Hyperbilirubinemia did not affect hearing loss in this study, possibly because the sample was only a mild degree of hyperbilirubinemia which was treated with phototherapy without using exchange transfusions.[1]

The APGAR score where asphyxia was found did not affect hearing loss in this study. Hardani et al and Ohl et al found different results which stated that asphyxia increases the risk of hearing loss. Asphyxia conditions cause significant tissue hypoperfusion and reduced oxygen supply, which can cause damage to the nerves in the auditory passage and damage to cochlear hair cells. [1,2]

Low birth weight babies were not found to be significantly related to hearing loss in this study. These results are in accordance with studies by Khairy et al, Ohl et al, and Maharani et al. [2,5,6] These results differ from studies by van Dommelen et al, Cristobal, and Hardani et al which stated birth weight <1500 grams is a risk factor for hearing loss.[1,12,22] One possible reason is that the cochlea may not develop fully when the fetus is growing to a very light weight.[22] This difference could be due to

differences in birth weight cutoff used in this study <2500 grams and in other studies <1500 grams.

Length of stay was not found to be significantly related to hearing loss in this study. These results are similar to studies by Khairy et al and Maharani et al.5,6 Chou et al stated that hospitalization in the NICU >5 days is a risk factor for hearing loss, because patients who are usually hospitalized for a long time generally have problems such as hyperbilirubinemia, sepsis, asphyxia, and congenital abnormalities, thus increasing risk factors for hearing loss.[23]

Family history was found not to be associated with hearing loss in this study. This result differs from the study by Ohl et al. 2 In the majority of individuals with non-syndromic genetic hearing loss, hearing loss is associated with biallelic pathogenic variants and is inherited in an autosomal recessive manner. Nonsyndromic hearing loss can also be inherited in an autosomal dominant or X-linked manner.[24]

## CONCLUSION

Prematurity is a risk factor for hearing loss in newborns. Premature newborns should be screened for hearing to detect hearing loss early.

### *Declaration by Authors*

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