

# Neonatal hearing screening: the importance of the study of risk indicators for hearing loss

## Abstract

**Objective:** to analyze the frequency of risk indicators for hearing loss and its influence on the increase number of refer cases. **Methodology:** The study was carried out in a public hospital with a sample of 796 infants who participated in the neonatal hearing screening program by transient evoked otoacoustic emission (TEOAE). **Results:** 132 (16%) newborn had some risk indicators for hearing loss. NICU stay, low Apgar score, mechanical ventilation, lower birth weight less than 1500g and use of ototoxic drugs were the most frequently risk indicators. A total of 51 (6%) newborns refer in the TEOAE test in at least one ear, and among them, 16 (31%) had a risk indicator for hearing loss. There was a statistically significant relationship between the refer rates in TEOAE with the following risk indicators: craniofacial malformation, genetic syndrome and birth weight less than 1500g. **Conclusion:** The NICU stay, low Apgar score, mechanical ventilation, birth weight less than 1500g and use of ototoxic drugs were the risk indicators most frequently in this sample and the main risk indicator associated with refer in the TEOAE teste were craniofacial malformations, genetic syndromes and birth weight less than 1500g.

**Keywords:** risk indicators, newborn, hearing loss

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## Introduction

The prevalence of bilateral congenital hearing loss is 1 to 3/1000 live births, and in neonates with risk indicators for hearing, especially those coming from the Neonatal Intensive Care Unit (NICU), this prevalence increases 20 to 50/1000 live births.<sup>1,2</sup>

Hearing is an important sense for the development of speech and language, therefore the earlier the hearing loss is detected, the greater is the chances of promoting the development of oral language close to that of normal hearing individuals.<sup>3,5</sup>

Neonatal hearing screening allows identification of those who present a probable deafness before hospital discharge and the knowledge of the population characteristics to be screened supports to guide the cases.

When the risk indicators for hearing loss is present it is necessary that the neonate be monitored audiotically, sequentially, in the first years of life, because the hearing loss can occur late and consequently affect the maturation of the auditory system, which has an unfavorable effect on the language acquisition process.<sup>6,7</sup>

Therefore, it should be emphasized that the assessment of risk indicators for hearing is done in the maternity which will allow the elaboration of auditory attention protocols, providing the creation of actions to prevent and promote hearing health.<sup>8,9</sup>

The objective of this study was to analyze the frequency of risk indicators for hearing loss and its influence on the increase number of refer cases.

## Methodology

It was a cross-sectional retrospective clinical study, conducted from January 2014 to December 2014, in a tertiary referral center. The Ethical Committee of the hospital approved the study (protocol 3395/09). Information on the pre, peri and postnatal history of the patients was collected through medical records, as well as the results of neonatal hearing screening.

The inclusion criterion were: having been born in the maternity hospital of the study, participated in the neonatal hearing screening program and informed consent signed by the parents.

The risk indicator for hearing loss stated in the international guidelines (JCIH)<sup>7</sup> were investigated for all neonate.

The assessment was performed in all babies, with 48hs or up to 30days of life, with the infant in the state of natural sleep in the lap of the mother or in the cradle of the unit. The hearing screening was performed by transient evoked otoacoustic emission (TEOAE) registred by OtoRead/Interacoustic.

A bimodal statistical test gives automatically a response score ("pass" or "refer"). The TEOAE were elicited following nonlinear click sequence at 83dB SPL, generated by a small probe positioned in the external canal, the sounds emitted bu active mechanical processes in the outer hair cells are recorded by microphone included in the probe. The values considered as "pass" were: emissions present at a signal-to-noise ratio of 6dB in at least three consecutive frequency bands, including 4000Hz. The capture time of the exam was a maximum of 64seconds. The statistical analyses were performed using the multiple logistic regression test and the significance set at  $p < 0.05$ .

## Results

Between the period of the study, a total of 796 newborn attempted the inclusion criteria and 382 (48%) were female and 414 (52%) were male. At least 132 (16%) newborns had one risk indicator for hearing loss and 161 (20%) were born preterm.

Among newborns at risk, we observed that 81 (61%) had only one risk, while 51 (39%) had two to six risks associated. Table 1 shows the frequency of risk indicators found in this study. A "refer" result in the TEOAE test was found in at least one ear of the 51 (6%) neonates and among them, 16 (31%) had an indicator for hearing loss.

No association were found between "refer" in the TEOAE test and the risk indicators such as: Low Apgar score, NICU stay > 48hours

in, use of mechanical ventilation for more than 5 days, use of ototoxic drugs, occurrence of meningitis, syphilis and congenital toxoplasmosis, mothers using illicit drugs in pregnancy, hyperbilirubinemia, and family history of hearing loss. However, craniofacial malformations, genetic syndromes and birth weight less than 1500g significantly increased the chances of “refer” in the TEOAE test (Table 2).

**Table 1** Risk indicators for hearing loss in the sample

Variable	n	%
Low Apgar	52	6.5
Birth weight < 1500g	24	3
NICU stay	67	8.4
Mechanical Ventilation	30	3.8
Ototoxic Drug	22	2.7
Meningitis	6	0.8
Congenital Syphilis	9	1.1
Congenital Toxoplasmosis	5	0.6
HIV	4	0.5
Craniofacial Malformation	5	0.6
Genetic Syndrome	3	0.4
Hyperbilirubinemia	2	0.3
Hearing loss in the Family	1	0.1

**Table 2** Logistic model adjusted to explain the TEOAE refer due to the risk indicators

Variable	$\beta$	ep	Wald	p	OR	IC(OR;95%)	
Low Apgar	0.38	0.53	0.52	0.473	1.47	0.52	4.16
Birth Weight < 1500g	2.16	0.93	5.38	0.02	8.67	1.4	53.81
NICU	0.22	0.68	0.11	0.744	1.25	0.33	4.71
Mechanical Ventilation	-1.64	1.08	2.31	0.128	0.19	0.02	1.61
Ototoxic Drug	0.5	0.93	0.29	0.593	1.65	0.26	10.22
Meningitis	0.51	1.32	0.15	0.698	1.67	0.13	22.09
Craniofacial Malformation	4.34	1.17	13.67	0	76.76	7.69	766.27
Genetic Syndrome	3.37	1.28	6.97	0.008	29.2	2.39	357.23
Constant	-2.93	0.17	293.05	0	0.05		

## Discussion

This study aimed to identify the occurrence and the influence of risk indicators for hearing loss in neonatal hearing screening.

The NICU stay and low Apgar score at birth were the most frequent risk indicators. Other authors observed a higher frequency of ototoxic medication use, family history of hearing loss, low Apgar score, hyperbilirubinemia and NICU stay.<sup>9-11</sup> Therefore, the frequent heterogeneity of risk indicators in several studies in a population to be screened justifies the importance of this identification in each hearing health program.

In our sample, 16% of the newborns had at least one risk indicator hearing loss, while other authors showed a 56% and 12% of occurrence.<sup>10,12</sup> These discrepancies occur mainly due to the difference in profile and the care type at each screening place.

It is common to observe that the presence of risk for hearing loss increases the chances of failure in hearing screening. Some studies reported a refer rate at 62.5% in infants with risk for hearing loss,

while other show a lower refer rate at 17%.<sup>13,14</sup> This variability may be a result of the population characteristics that were screened in each study, and depending on the risk associated with those children, the failure may be greater.

In this study, the craniofacial malformations, genetic syndromes and birth weight less than 1500g showed the highest number of refer rates in the hearing screening. Other studies showed a greater number of refer rates in newborns with prolonged stay in the NICU, use of mechanical ventilation and use ototoxic medications, in neonates with a family history of hearing loss and in those with a low Apgar score.<sup>8,15,16</sup>

The increase number of refer in newborns with craniofacial malformations can be justified by the fact that these alterations are related to malformation of the hearing system and nervous system.<sup>16,17</sup>

The low birth weight has influenced the increased number of refer rates in TEOAE may be the fact that these newborns often have several other risk indicators associated including the use of ototoxic drugs and prematurity.<sup>18</sup>

Lastly, the identification of the frequency of risk indicators, as well as their influence, in hearing screening programs allows the adoption of appropriate assessment protocols and guidance of the team involved in the screening and diagnosis of hearing loss, as well as in the elaboration of follow-up programs of hearing health.

## Conclusion

The most frequent risk indicators in this study were: prolonged ICU stay, low Apgar score, mechanical ventilation, birth weight less than 1500g and use of ototoxic drugs.

Craniofacial malformations, genetic syndromes, and birth weight of less than 1500g significantly increased the chances of refer in TEOAE test.

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## Conflicts of interest

Author declares there are no conflicts of interest.

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