

# NEWBORN HEARING SCREENING PROGRAM: THE INFLUENCE OF THE LIFESPAN OF NEWBORNS IN THE RESEARCH OF TRANSIENT OTOACOUSTIC EMISSIONS

## *Programa de triagem auditiva neonatal: influência do tempo de vida dos recém-nascidos na pesquisa das emissões otoacústicas transientes*

Ângela Ribas <sup>(1)</sup>, Juliana Cabral <sup>(2)</sup>, Vania Gonçalves <sup>(3)</sup>,  
Claudia G. O. Gonçalves <sup>(4)</sup>, Lorena Kozlowski <sup>(5)</sup>

### ABSTRACT

**Purpose:** this study seeks to analyse the results of neonatal auditory screening by means of transient otoacoustic emissions in newborn babies in relation to their different lifespans. **Method:** the medical charts of 1689 babies, previously analysed in 2008, were evaluated in two maternity wards of SC. The babies were divided into two groups: in group 1 screening had been completed in the first 24 hours after birth, and in group 2, it had been completed between 24 and 48 hours after the babies' birth. **Results:** in group 1, of the 894 babies submitted to NAC, the index of "failure" was 4.5%, equivalent to 39 babies. In group 2, of the 795 babies and 1.5% (12) "failed" the test. The findings demonstrated that NAC carried out by means of TOAE in the babies during the first 24 hours of birth presented a higher "failure" index than NAC completed after 48 hours of birth. **Conclusion:** NAC should be completed at the maternity wards before hospital discharge, but only after the first 24 hours of life due to the great incidence of artifacts that may be encountered.

**KEYWORDS:** Hearing; Hearing Loss; Neonatal Screening

### ■ INTRODUCTION

It is through language that human beings establish social interactions, and in this context, when it comes to verbal communication, listening is fundamental because it is through this sense that learning oral language occurs.

It is known that a person with a hearing disability can suffer in different aspects of life. More specifically in children, deafness promotes devastating effects, preventing, in many cases, normal language development, a fact that greatly affects their social integration, the process of schooling, and later, even their insertion into the labor market. A severe bilateral hearing loss affects about one in every 1,000 newborns, and when including babies coming from intensive care units, this number rises to 20-40 per 1000 <sup>1</sup>.

When deafness is quickly detected in children from an early age, interventions can have good results, since the effects of hearing loss will be minimized with the use of electronic devices such as hearing aids and cochlear implants as well as methods of qualification aimed at developing auditive and language abilities <sup>2</sup>.

In 2010 Law 12303/10 was signed by the President of Brazil and provides for compulsory evoked otoacoustic emissions testing <sup>3</sup> on all live births in Brazil.

<sup>(1)</sup> Speech-Language Pathologist; Faculty of Speech-Language Pathology at Universidade Tuiuti do Paraná - UTP, Curitiba, PR, Brazil; Doctorate in Urban Development and Environment.

<sup>(2)</sup> Speech-Language Pathologist; Specialization in Audiology at Universidade Tuiuti do Paraná - UTP, Curitiba, PR, Brazil.

<sup>(3)</sup> Speech-Language Pathologist; Specialization in Audiology at Universidade Tuiuti do Paraná - UTP, Curitiba, PR, Brazil.

<sup>(4)</sup> Speech-Language Pathologist; Faculty of Speech-Language Pathology at Universidade Tuiuti do Paraná - UTP, Curitiba, PR, Brazil; Doctorate in Collective Health.

<sup>(5)</sup> Speech-Language Pathologist; Faculty of Speech-Language Pathology at Universidade Tuiuti do Paraná - UTP, Curitiba, PR, Brazil; PhD in Auditive Perception.

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OAEs are a type of acoustic energy generated by outer hair cell contractility during the active mechanism of cochlear function. There are two types of otoacoustic emissions, spontaneous, which occur in the absence of sound stimulus, and evoked, which occur in the presence of the sound stimulus. For the testing, transient evoked otoacoustic emissions (TEOAE) are routinely used <sup>4</sup>.

TEOAE uses a click sound transient of short duration and low frequency to generate stimuli every 12 to 20 ms. The response generated by the baby's ear is captured by a microphone probe adapted to the ear canal. This is an inexpensive procedure that can be performed in newborns, and is objective, non-invasive, and painless <sup>5</sup>.

As TEOAE are found in almost all individuals with hearing thresholds to 25 dB HL, it is an interesting feature for detecting hearing losses in this population. The presence of TEOAE suggests integrity of cochlear physiology to the level of normal hearing, which is up to 25 dB HL <sup>6,7</sup>. The procedure has helped pediatricians quickly identify children with hearing loss and babies who fail the screening should be referred for complete audiological evaluation <sup>8</sup>.

Thus, newborn hearing screening (NHS) is a way to facilitate the early diagnosis of hearing loss in children. NHS should be performed soon after birth or in the first month of life of the newborn so that the diagnosis can be defined by three months of age and intervention can be initiated by six months of age, in view of the damage caused by the hearing loss <sup>9,10</sup> hearing. In Brazil most of the services perform NHS before the newborn is discharged from the hospital, but there is no standard indicating whether the test should be applied in the first 24 hours of the baby's life or later, during the first 48 hours of life. Thus it is unclear if this time element will affect the outcome of the testing.

The aim of this study was to analyze the results of newborn hearing screening performed by TEOAE at different times after birth for newborn babies.

## ■ METHOD

This study was approved by the institutional Ethics Committee 046/2007.

This is a cross-sectional epidemiological study that assessed the hearing of two groups of newborns from two hospitals that perform NHS, with Group 1 (maternity 1 - MI), having TEOAEs conducted within the first 24 hours of the baby's life, and Group 2 (maternity 2 - MII), having TEOAEs performed after 24 hours (between 24 and 48 hours) from birth.

We analyzed NHS results of 894 babies from MI and 795 babies from MII, with a total of 1689 tests,

over a period of one year. Inclusion criteria used were the charts of full-term infants and mothers who agreed to participate in the study and signed an informed consent form. The study excluded babies from the NICU.

The TEOAE research was conducted with properly adjusted ILO equipment from Otodynamics. The procedure was performed by a professional audiologist with the baby asleep after breastfeeding, in a quiet environment.

TEOAE were collected in both ears of newborns. The machine was adjusted for the screening program, i.e. Quick Screener. This program consists of a non-linear pattern where three stimuli of one intensity and a fourth stimulus of higher intensity and of opposite polarity are presented. The clicks have a frequency range of 400 to 6,000 Hz and intensity was set to 80dB, and no later adjustments were made.

A pass/ fail result was adopted for the two groups, with the equipment noting a failure as any baby with hearing thresholds greater than 25 dB HL. The criteria employed for these analyses were: amplitude response (signal/ noise ratio) equal to or greater than 3dB SIL; reproducibility of 50%; probe stability of not less than 70%, as suggested by literature <sup>7</sup>.

Babies who failed the screening were retested in seven days, but the results were not used in this study.

The data were entered into a spreadsheet and statistical procedures were applied for editing data using Statistica - Release 7 software, outlining the significant relationships and TEOAE results, considering the time for the exam, to a level of 0.05 (5%). We used a chi-square test that enables the analysis of TEOAE test results related to the age (24-28 hours) of the baby at the time of test completion.

## ■ RESULTS

In MI, of the 894 infants assessed, 472 (52.8%) were female and 422 (47.2%) male, and in MII, of 795 infants, 430 (54%) were female and 365 (46%) male.

Table 1 shows the data obtained during the performance of the NHS in the two groups.

Analysis by the chi-square test, significance level of 0.05 (5%), resulted in  $p = 0.0006$ , i.e., the test result is significant, showing that the failure rate is significantly higher for Group 1.

Calculating the ratio between otoacoustic emissions results, it can be observed that in Group 1 the occurrence of test failure is nearly three times higher than in Group 2 (PR = 2.89).

**Table 1 - Comparison of the results of TEOAE (pass or fail) for time since birth for Groups 1 and 2 (N = 1689)**

Time since birth	PASS		FAIL	
	Absolute Freq.	Relative Freq.	Absolute Freq.	Relative Freq.
within 24 hours	855	95,6	39	4,4
after 24 hours (25 to 48 hours)	783	98,5	12	1,5

Chi-square test for significant relationships and survey results of TEOAE, considering the time for the exam, for a significance level of 0.05.

In MI, of the 39 babies who failed the NHS, 35 were retested, and, of these, 16 failed the second screening, i.e. 54% of the sample gave a false positive in the first screening. In comparison, in MII, of the 12 babies who failed the NHS, 11 were retested, and 8 failed the second screening, only 27% false positive.

## ■ DISCUSSION

According to Table 1, of 894 infants undergoing NHS within the first 24 hours after birth, 855 (95.5%) “passed” the test and 39 (4.5%) “failed”. Of the 795 babies that underwent NHS, but between 24 and 48 hours of age, 783 (98.5%) “passed” the test, while 12 (1.5%) “failed.” These numbers are consistent with the literature. Research indicates that NHS failure rates at close to 5%<sup>11</sup>.

Statistical analysis performed in this study shows that the failure rate is three times higher in Group 1. This finding agrees with similar studies in which the authors report that there may be a high “glitch” rate in newborns with less than 48 hours since birth undergoing NHS<sup>12</sup>. In a hearing screening program, researchers evaluated 130 newborns using TEOAE. There were 50 newborns within 24 hours of birth and 80 with between 24 and 48 hours since birth. The results of this study showed that NHS carried out on the second day of life was more stable and had a lower index of interference artifacts<sup>13</sup>.

These assumptions allow us to infer that the “pass” result in NHS is related to the lifetime of the newborn, i.e. increasing NHS “pass” indices as the newborn adds hours of life<sup>14</sup>.

Isaacson<sup>15</sup> stated in his work that NHS using TEOAE showed a higher number of “failures” in the first 48 hours of life, and Melo et al.<sup>16</sup> relate in their study that there is no more appropriate time that between the first 24 and 54 hours of life for the TEOAE NHS research program. The authors suggest that it be performed before hospital discharge in all newborns after 24 hours of life.

One of the hypotheses for the higher failure rate in Group 1 is that the presence of vernix can

generate artifacts that interfere with the quality of the test result.

A study performed in 400 ears registered a statistically significant difference when comparing the percentage of vernix obstructing the canal in newborns of less than 24 hours in age (14.2%) and newborns with more than 24 hours in age (11.7%). The authors found that of the 85 ears that failed the NHS, 62% had vernix blocking the ear canal. After cleaning, 67% of the sample passed the retest, changing the percentage of “pass” from 79% to 84%<sup>17</sup>.

This finding agrees with other work where the authors found 15% of failures in hearing screening by TEOAE and reported an increased occurrence of “pass” after cleaning the vernix, 76% to 91% of the sample<sup>12</sup>.

Another hypothesis for the failed hearing screening was the decreased mobility of the tympanic membrane caused by the presence of fluid in the middle ear. The literature indicates that this fluid may cause a temporary conductive hearing loss<sup>18</sup> and during the first day of life with the presence of amniotic fluid in the middle ear space can influence the TEOAE recording. It is expected that after 48 hours of life, that middle ear and tympanic membrane clear out and gain mobility<sup>19</sup>.

Therefore, when analyzing the results of the retest, it can be inferred that in the sample studied, probably the high number of failures in Group 1 was due to changes in the external and middle ear that occurred, naturally, in the early days of baby’s life. In Group 1, the incidence of false positives was double that of Group 2.

## ■ CONCLUSION

This study demonstrated that the failure rate is significantly higher for Group 1, which allows us to infer that there is a more appropriate time for NHS using TEOAE, i.e., after 24 hours of birth (between 24 and 48 hours), before hospital discharge.

## RESUMO

**Objetivo:** este estudo visa analisar os resultados da triagem auditiva neonatal por meio das emissões otoacústicas transientes em bebês recém-nascidos em relação a diferentes tempos de vida. **Método:** foram analisados os prontuários de 1689 bebês avaliados no ano de 2008, em duas maternidades de Santa Catarina. Os bebês foram divididos em dois grupos: no grupo 1 a triagem foi realizada nas primeiras 24 horas após o nascimento, e no grupo 2, foi realizada entre 24 e 48 horas após o nascimento dos bebês. **Resultados:** no grupo 1, dos 894 bebês submetidos a triagem, o índice de “falha” foi de 4,5%, equivalente a 39 bebês. No grupo 2, dos 795 bebês, 1,5% (12 bebês) “falharam no teste”. Os achados demonstraram que a triagem realizada por meio das emissões otoacústicas transientes nos bebês nascidos nas primeiras 24 horas apresentaram maior índice de “falha” do que a triagem realizada após 48 horas do nascimento dos bebês. **Conclusão:** a triagem auditiva neonatal deve ser realizada nas maternidades, antes da alta hospitalar, porém, após as primeiras 24 horas de vida, a fim de evitar a interferência de artefatos.

**DESCRITORES:** Audição; Perda Auditiva; Triagem Neonatal

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Mailing Address:

Ângela Ribas

Rua José Isidoro Biazetto 845 – ap 501

Curitiba – PR

CEP: 81200-240

E-mail: angela.ribas@utp.br