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Cintra Januário, Gabriela; Aguiar Lemos, Stela Maris; de Lima Friche, Amélia Augusta;
Lindgren Alves, Claudia Regina

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ORIGINAL ARTICLE

Quality indicators in a newborn hearing screening service☆☆☆



Gabriela Cintra Januário^{a,*}, Stela Maris Aguiar Lemos^b,
Amélia Augusta de Lima Friche^b, Claudia Regina Lindgren Alves^c

^a Secretaria de Estado de Saúde de Minas Gerais, Belo Horizonte, MG, Brazil

^b Department of Phonoaudiology, Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, MG, Brazil

^c Department of Pediatrics, Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, MG, Brazil

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Quality indicators of
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Program evaluation

Abstract

Introduction: Newborn hearing screening (NHS) programs are implemented across the globe to detect early hearing impairment. In order to meet this objective, the quality of these programs should be monitored using internationally recognized indicators.

Objective: To evaluate a newborn hearing screening service (NHSS) using international quality indicators.

Methods: A retrospective cohort study on the NHSS of Minas Gerais was conducted, analyzing the services performed between 2010 and 2011. Results were analyzed according to criteria from the American Academy of Pediatrics and the Joint Committee on Infant Hearing.

Results: This study assessed 6987 children. The proportions of cases that were referred for a retest, that followed through with retest, and that were referred for diagnosis were 8.0%, 71.9%, and 2.1%, respectively. The proportion of assessed newborn children in the first 30 days of life in this study was 65%. The median age of those children who failed both the NHS and the retest was significantly higher than the other children. The chance of a child with a hearing impairment risk indicator to fail the NHS was 2.4 times higher than of those without a risk indicator.

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☆☆ Institution: Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, MG, Brazil.

* Corresponding author.

E-mail: gbcintra@gmail.com (G.C. Januário).

PALAVRAS-CHAVE

Triagem neonatal;
Lactente;
Perda auditiva;
Indicadores de
qualidade em
assistência à saúde;
Avaliação de
programas e projetos
de saúde

Conclusion: NHSS achieved three of four evaluated indicators. Despite this, it is still necessary to perform NHS earlier and to ensure that the subsequent steps are followed.

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Indicadores de qualidade em um serviço de triagem auditiva neonatal**Resumo**

Introdução: Programas de Triagem Auditiva Neonatal (TAN) são implantados em todo mundo objetivando a detecção precoce da deficiência auditiva. A qualidade destes programas deve ser monitorada utilizando indicadores reconhecidos internacionalmente, para que este objetivo seja alcançado.

Objetivo: Avaliar um Serviço de Triagem Auditiva Neonatal (STAN) com base nos indicadores internacionais de qualidade.

Método: Coorte retrospectiva com análise dos atendimentos realizados por um STAN de Minas Gerais entre 2010 a 2011. Os resultados foram analisados segundo critérios da *American Academy of Pediatrics* e do *Joint Committee on Infant Hearing*.

Resultados: Foram avaliadas 6.987 crianças. As proporções de encaminhamento para reteste, adesão ao reteste e encaminhamento para diagnóstico foram 8,0%, 71,9% e 2,1%, respectivamente. A proporção de crianças avaliadas nos primeiros 30 dias de vida foi 65,0%. A mediana de idade das crianças que falharam na TAN e no reteste foi significativamente maior do que para as demais. O risco de uma criança com indicador de risco para deficiência auditiva (IRDA) falhar na TAN foi 2,4 vezes maior do que para as demais.

Conclusão: O STAN alcançou 3 dos 4 indicadores avaliados. No entanto, ainda são necessários esforços para captação precoce de neonatos para a triagem auditiva e adesão às etapas subsequentes.

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Introduction

Hearing is the sense that connects the individual with the world of sound. Hearing loss in newborns, if not detected and treated early, compromises not only the language development of the child, but also emotional and social development.¹

Programs for early identification of hearing loss in the neonatal period are being implemented around the world, with the aim to promote an early intervention and, hence, the development of language by children with hearing impairment.^{2,3}

The evaluation of health services and programs is required as part of routine healthcare, to enable the identification of deficiencies and to visualize hearing improvement opportunities. The planning of health actions and the targeting of financial resources should preferably be based on the evidence found in evaluation studies.⁴

According to the National Health Services Assessment Program, the evaluations can address four aspects: structure, working process, outcomes, and patients' and professionals' satisfaction.⁵ Most studies targeted to the evaluation of neonatal hearing screening programs (NHSP) focus primarily on the areas of working process and outcomes, because it is possible to verify the quality of

care and the change of health status of the patient, respectively.^{6,7}

In Minas Gerais, Brazil, the State Department of Health (SES-MG) implanted the Newborn Hearing Screening State Program (NHSSP) using an outpatient model in October 2007.⁸ Currently, the Program is being implemented with the accreditation of maternity units as newborn hearing screening reference services (NHSRS).

The Municipality of Belo Horizonte has six accredited NHSRSs. These services are network-based, according to the flow of references and counter-references established by the Health Department of that city, and are accredited by the NHSSP, established by Resolution No. 1321 SES of 2007, thus following its guidelines, assessment protocols, health-care flow, and nomenclature.

On discharge from the maternity ward, newborns are referred for a serological screening test (neonatal heel prick) and other neonatal procedures at the basic health unit (BHU). At the BHU, a newborn hearing screening (NHS) test is scheduled by a health care professional, targeting one of the six NHSRSs of the municipality. Therefore, although the NHS test is performed on the maternity premises, the municipality program follows the outpatient model for neonates without hearing impairment risk indicator (HIRI) and the hospital model for evaluation of newborns with HIRI.

Neonates with no change in the NHS test (i.e., passed) are counter-referred to BHUs for monitoring of the overall development by the family health team. Neonates with a risk indicator who pass the NHS test are referred to reassessment in the service itself, six months after the NHS test, for auditory monitoring.

Newborns who fail the NHS test (some change in the test) are scheduled for retest in 15–20 days in the same service. Those who fail the retest are referred to the Children's Diagnostic Audiology Service in a municipality public hospital. Newborns identified with sensorineural hearing loss are formalized by the Hearing Health Regulatory Board of Belo Horizonte, and referred to one of the two High-Complexity Hearing Health Care Services in Belo Horizonte for complementary studies; selection, adaptation, and provision of individual hearing aids; and care monitoring and speech therapy. It is noteworthy, therefore, that the phases of diagnosis and intervention are not performed in the maternity itself, but in distinct and specialized institutions.

This study aimed to evaluate an NHSRS in the city of Belo Horizonte from January 2010 to February 2011, with reference to the quality indicators (referral to retest index, age of the newborn at the time of NHS test, attendance to the retest index, referral for diagnosis index) proposed by the American Academy of Pediatrics (AAP)⁹ and the Joint Committee on Infant Hearing (JCIH).¹⁰

Methods

This was a longitudinal, historical cohort study, in which the database of a NHSRS in the city of Belo Horizonte was analyzed with regard to services performed from January 2010 to February 2011. Data were analyzed from the NHS to the stage of reassessment and referral to specialist services for diagnosis.

The NHSRS where this study was conducted is integrated into a philanthropic hospital linked to the Brazilian Unified Health System (Sistema Único de Saúde – SUS), and is a referral center in obstetrics and gynecology in the city of Belo Horizonte, and also a referral center for high-risk cases for other municipalities in the state. Its maternity unit has 134 beds and performs an average of 850 deliveries per month. NHSRS has the ability to assess 700 children/month, accounting for approximately 35% of NHS tests billed in Belo Horizonte.

The strategy for evaluation of children in this Service is that recommended by the NHSSP: measurement of transient evoked otoacoustic emissions to stimuli (TEOAEs), in association with the observation of children's behavior to uncalibrated sound stimuli. To measure emissions, Audix Plus/Bio-logic® or AccuScreen Madsen® (both annually standardized and calibrated) equipment was used. The instruments chosen for observation of auditory behavior were a rattle ("chocalho") with four ball-bells and an "agogô" (with a big bell). The child was considered unchanged when the cochlear-blink reflex (CBR) and TEOAEs were bilaterally present. In this case, the child passed the test. The remaining patients were classified as failing the NHS test.

As evaluation criteria for TEOAEs, this study considered the presence of a difference between signal and noise >6

in 1.5, 2.0, 3.0, and 4.0 kHz; >70% reproducibility when the test was performed with Audix; and a passed/failed protocol when the test was performed with AccuScreen.

The following were considered as risk indicators for hearing loss: history of permanent familial deafness starting from childhood; length of stay in neonatal intensive care unit greater than five days; use of assisted ventilation; exposure to ototoxic drugs, such as aminoglycosides and loop diuretics; hyperbilirubinemia requiring exchange transfusion; congenital infections (toxoplasmosis, rubella, cytomegalovirus, herpes, syphilis, human immunodeficiency virus); craniofacial anomalies involving the ear and temporal bone; genetic syndromes and neurodegenerative disorders that usually are expressed with hearing loss; and postnatal bacterial or viral infections.¹¹

Twenty-one children from the service database were not included in the study due to lack of information regarding birth date and/or test results (0.3%), and 58 were excluded who underwent the NHS test at over 180 days of life (0.8%), from a total population of 6987 children.

All data were organized in Excel® spreadsheet software, and all information was processed and analyzed with PASW Statistics, version 18.

A descriptive analysis of frequency distribution of categorical variables, and an analysis of measures of central tendency and of dispersion for continuous variables were performed. The chi-squared test was used to analyze the association between NHS test outcomes, the result of the retest, retest absenteeism and reassessment absenteeism, with the presence of risk indicators for hearing impairment. The Kruskal–Wallis test was used to analyze the association of these variables with the child's age at the time of NHS test. The relative risk (RR) was calculated as a measure of the magnitude of the associations. For all analyzes, a significance level of 5% and a confidence interval of 95.0% were adopted.

The quality indicators proposed by international scientific communities were used^{9,10}:

Phase 1: NHS test

- Referral to retest rate between 5.0% and 20.0% of children who failed the NHS test;
- Completion of the NHS test in the first 30 days of life in 95.0% of the accessed children.

Phase 2: Retest

- Follow-up of at least 95.0% of children who failed the NHS test. For the initiation of programs, consider a minimum of 70%;
- Percentage of diagnosis referral <4.0% of all children evaluated.

This study received approval from the institution where the NHSRS is integrated and was approved by the Ethics Committee in Research of the originating institution, under Opinion No. ETIC 0143.0.203.439-11.

Table 1 General characteristics of the population included in the study, Belo Horizonte, 2010–2011.

Characteristics	n	%
<i>Origin</i>		
Belo Horizonte	5843	83.6
Other municipalities	742	10.6
No information	402	5.8
<i>Birth institution</i>		
Local of research	2346	33.6
Other	4623	66.1
No Information	18	0.3
<i>Time of examination</i>		
Before hospital discharge	709	10.1
After hospital discharge	6266	89.7
No information	12	0.2
<i>Risk indicator for hearing loss</i>		
Absent	6082	87
Present	905	13
Total	6987	100

Results

The information regarding 6987 children evaluated in the NHSRS outpatient clinic was analyzed from January 2010 to February 2011. [Table 1](#) shows the main characteristics of the children included in the study.

If 33.6% of the evaluated children were born in the institution where this study was conducted. Most children (89.7%) received the NHS test at the outpatient clinic after their hospital discharge, and 83.6% were from the city of Belo Horizonte. The percentage of children with risk factors for hearing loss was 13.0%.

[Fig. 1](#) shows the distribution of children according to the test results at various stages of the NHS test and the presence of risk indicators. Of the 6987 children, 6425 (92.0%) passed and 562 (8.0%) failed the NHS test. Of those who passed, 766 (11.9%) had HIRI. Of these, 761 were referred for reassessment six months after the NHS test, and five were discharged because they were already close to 6 months of age.

Among the 562 children who failed, 139 (24.9%) had HIRI. Of these, four were referred directly to the diagnosis without the retest step, due to optimal conditions of assessment and to the late time of testing (children close to 3 months of age). Only six children were CBR-negative, although they showed TEOAES bilaterally. Of these, five attended the retest and one remained CBR-negative, and was referred for diagnosis.

558 children were referred for retesting, corresponding to 8.0% of the total of children assessed. Of these, 401 (71.9%) attended the retest, 262 (62.6%) passed, and 139 (37.4%) remained with the altered result and were referred for diagnosis.

825 high-risk children were referred for reassessment (761 who passed the NHS test and 64 who passed the retest). Of these, 150 (143 who passed the NHS test and seven who passed the retest) still had not completed the six months necessary for reassessment by the close of

Table 2 Association between risk indicators for hearing loss and newborn hearing screening test and retest outcomes, Belo Horizonte, 2010–2011.

HIRI	Result				RR	95% CI
	Passed		Failed			
	<i>n</i>	%	<i>n</i>	%		
<i>NHS test</i>						
HIRI absent	5659	93.0	423	7.0	2.4	2.0–3.0
HIRI present	766	84.6	139	15.4		
<i>Retest</i>						
HIRI absent	199	66.8	99	33.2	1.3	0.8–2.0
HIRI present	63	61.2	40	38.8		

NHS, neonatal hearing screening; HIRI, hearing impairment risk indicator; RR, relative risk; CI, confidence interval.

NHS, neonatal hearing screening; HIRI, hearing impairment risk indicator; RR, relative risk; CI, confidence interval.

this study. Of those 675 who had already completed six months, 218 attended the reassessment, corresponding to an absenteeism of 67.7%. Of those children who attended, 209 (95.9%) passed and nine (4.1%) had an altered assessment; four of these children were referred for diagnosis. The remaining five children were referred for a second reevaluation in the NHSRS itself, but did not return for conclusion of the tests.

Absenteeism in the retest and reassessment phases amounted to 28.1% and 67.7% of all referred children, respectively.

147 children were referred for audiological diagnostics (four who failed NHS test, 139 who failed the retest, and 4 who failed the reassessment), corresponding to 2.1% of all children included in the study. The authors were unable to obtain the number of children with confirmed hearing loss, because the stages of diagnosis and treatment were conducted in different institutions, and also because of the lack of a comprehensive information system.

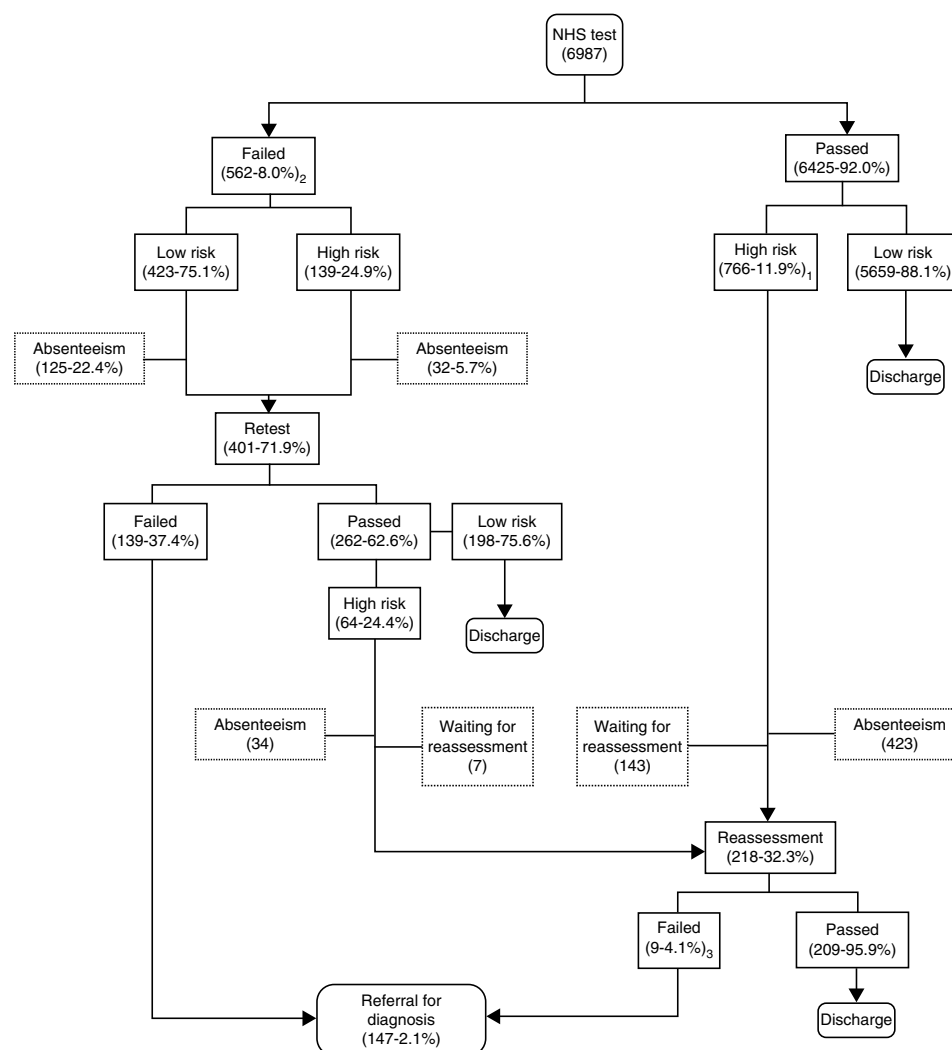
The evaluation of the association among risk indicators for hearing loss and the result of the NHS test is shown in [Table 2](#). At the moment of the NHS test, the risk of failing the exam was 2.4 times higher in the group of children with risk indicator(s) versus the group without HIRI (95% CI: 2.0–3.0). There was no statistically significant difference between groups during the retest.

The median age of NHS test completion was 23 days, ranging from 1 to 180 days. Most children (65.0%) received the NHS test in the first 30 days of life.

In the retest phase, 208 children (51.9%) were evaluated after 50 days of life and 82.3% before 90 days of life. The median age at the reevaluation stage was 209 days, i.e., close to 7 months of age.

[Table 3](#) presents an analysis of the association among the child's age and the result of the NHS test, retest results, child's origin, and HIRI. Children who failed the NHS test were evaluated at an older age than those who passed ($p < 0.0001$). Children from Belo Horizonte were evaluated at a younger age than children from the hinterlands ($p < 0.0001$). Children with HIRI were accessed at an older age than the others ($p < 0.0001$).

As for the quality indicators proposed by the scientific community, the NHSRS achieved the following results:



1 – Five children were discharged due to age close to 6 months.
 2 – Four children were sent directly to the diagnosis.
 3 – Five children did not return to complete the tests.

Figure 1 Assistance trajectory of children evaluated by a newborn hearing screening service in the city of Belo Horizonte, 2010–2011.

Phase 1: NHS test

- Referral to retest index equal to 8.0%;
- Completion of the NHS test in the first 30 days of life in 65.1% of the children.

Phase 2: Retest

- Follow-up of 71.9% of children who failed the NHS test.
- Percentage of referral for diagnosis equal to 2.1% of all children initially evaluated.

Discussion

Indicators are instruments constituted by variables that permit the identification and measurement of aspects related to a particular reality, and should be chosen to highlight

the relevant issues involved in the evaluation. The quality indicators for each phase of an NHSP were established by scientific institutions and should be used as a tool to control the effectiveness of the programs.^{9–11}

In Brazil, several NHSPs have used the international indicators proposed by the AAP and the JCIH, with mixed results.^{12–14}

According to the NHSSP, the NHRSSs funded by the State Department of Health of Minas Gerais are regarded as reference centers, not only for evaluation of neonates born within the institution itself, but also for a geographic area of pre-defined coverage. Neonates with HIRI are evaluated before their hospital discharge, regardless of municipality of residence. The six NHRSSs of Belo Horizonte are responsible for the NHS test coverage in the state capital and in three other municipalities in the metropolitan region. In this study, 83.0% of the children came from the city of Belo Horizonte, and only 33.6% were born in the institution itself.

Table 3 Association among child's age and the result of newborn hearing screening test and retest, origin of the child, and risk indicators for hearing loss, Belo Horizonte – 2010–2011.

Variable	Median of age (days)	<i>p</i> (Kruskal–Wallis)
<i>NHS test</i>		
Passed	23	<0.0001
Failed	28	
<i>Retest</i>		
Passed	48	<0.0001
Failed	64	
<i>Origin</i>		
Belo Horizonte	23	<0.0001
Other municipalities	34	
<i>HIRI</i>		
Without HIRI	23	<0.0001
With HIRI	29	

NHS, neonatal hearing screening; HIRI, hearing impairment risk indicator.

Although the literature recommends the NHS test before the child's hospital discharge,⁹ in some situations the outpatient model may be the most appropriate – or even the only viable option. In Recife, given the absence of resources for the implementation of the NHS test in three public maternity units of the city, a single outpatient model was organized, in order to offer the exam for newborns delivered in these hospitals.¹⁵ With regards to the high rate of births outside of hospital units in Nigeria, the NHS test program was implemented in health centers responsible for child immunization.¹⁶ A cost-effectiveness study of England's NHSPs, considering the existing hospital and non-hospital models, demonstrated no significant difference between the cost and effectiveness of each of these models.¹⁷

In the state of Minas Gerais, the vast majority of births occur in hospitals. In 2010, 420 hospitals that performed deliveries in the state were registered, and in 33%, the average number of births was less than 100 live births per month.¹⁸ The introduction of the NHS test in all these maternity units would be unfeasible, due to lack of financial resources. This led the state of Minas Gerais to choose an outpatient model with referral units for a particular region, considering the principle of regionalization of the SUS and the hypothesis that an excessive decentralization of health services can lead to a loss of efficiency in health care, increasing the costs without increasing the quality, contradicting the principle of economy of scale. A study in Colorado, USA, revealed that maternity units that performed a greater number of screening tests per month had better quality indicators than hospitals with a lower number of monthly screening tests.¹⁹ However, it is questionable whether the outpatient model would be more suitable as a strategy for achieving universal coverage²⁰; thus, studies that aim to analyze the coverage of the NHSSP are required.

It was observed that children with HIRI were evaluated at an older age than children without HIRI, probably due

to the need for prolonged hospitalization for some of these children. The origin of the child was also a variable that influenced the age of assessment: children living in Belo Horizonte were evaluated at a younger age than the others, suggesting greater difficulty in accessing the Service for children living in the hinterland.

In neonatal hearing screening outpatient programs in Nigeria and Maceió, Brazil, 86.4% and 73.5% of children, respectively, were evaluated in the first 30 days of life – percentages superior to those found in the present study.^{12,16} Although the quality indicator of 95.0% of children evaluated in the first month of life was not reached, it is considered that a large enough number of children have been evaluated in a timely manner to enable the diagnosis in the first 3 months of life. However, it is clear that there is a need to invest in strategies to facilitate client access, such as the adequacy of medical appointment schedules, facilitation of transportation, and decentralization of services, particularly for families living in other municipalities. The authors emphasize that, in this study, it was not possible to identify the flow of childcare in the remaining stages of diagnosis and of intervention, which is critical to evaluate the effectiveness of a program for early identification.

In the study population, 13% of children had a risk indicator for hearing impairment. This finding is similar to Brazilian studies in Vila Velha and Maceió, which found 12.6% and 10.0% of children with HIRI, respectively.^{11,12}

In the present study, it was observed that the risk of failing the screening is 2.4 times higher in the group of children with HIRI. A study in a São Paulo maternity unit found an association of failure in the hearing screening test with the following indicators: prematurity, family history of hearing loss, and congenital syndrome signs.²¹ The literature suggests that the prevalence of hearing loss is greater in children with HIRI.²² In a study of 53,121 newborns submitted to a screening test in Rhode Island, USA, a prevalence of hearing loss of 2.12:1000 was found, rising to 9.75:1000 in the group of children with one or more HIRI.²³ In Turkey, a study demonstrated a frequency of 2.9% of hearing loss in newborns with HIRI, and of 0.19% in newborns without HIRI.²⁴

The literature recommends that children with risk indicator(s) for hearing loss undergo hearing and language development monitoring until 2 or 3 years of age, due to a greater chance of developing a progressive loss.^{8,10} In accordance with that established in the NHSSP, the NHSRSs should reassess children with HIRI six months after the NHS test, both to monitor progressive losses and to identify cases of retrocochlear loss not identified by the measurement of otoacoustic emissions nor by the observation of auditory behavior in the neonatal period. In the present study, only 32.3% of children attended the HIRI reevaluation, with a median age of 209 days (approximately 7 months). Most studies have not submitted attendance data for reassessment, probably because they did not include this phase in their assistance protocols. In a study in Vila Velha, where NHS test protocols included a semiannual auditory monitoring of children with HIRI over a period of three years, a return index of 52.6% in the first reassessment and of 10.3% by the second year was found.¹² From these results, one can question those healthcare organizations that establish the NHSRS as a place for hearing reassessment and monitoring,

suggesting the need to invest in active searching strategies to ensure the return of the child. Thus, the involvement of the BHUs becomes essential for continuity in hearing healthcare of children. Continuing actions targeting family orientation, and professional guidance on the possibility of developing hearing loss and its consequences, can also reduce the absenteeism.

The AAP recommends that, in biphasic screening programs, the expected rate of referral to the second phase (retest) should fall between 5% and 20% of the total of children assessed. In this study, a rate of 8% of referral for retesting was found, which is in agreement with that proposed by the AAP. However, some screening programs with different evaluation methodologies obtained rates <3% of referrals to the second phase,²⁵ suggesting the possibility, or even the need, to reduce this rate. Although the results of NHS test programs in the literature show wide variation, most of the studies reported rates of referral for retesting between 6.0% and 10.0%.^{12,26}

The high rate of children who fail the NHS test has become a major concern among professionals. High rates of unnecessary referrals increase the cost of the programs, considering the need for skilled professionals and the use of highly complex procedures,^{19,27} as well as promoting increased absenteeism at various stages of the process.

The proportion of failures in the first stage of an NHS test program can be influenced by several factors, including the evaluation protocol used,²⁷ professional experience,^{16,19} physiological conditions of the external ear,²⁸ and the child's age at the time of evaluation.²⁹

In this study, those children who failed the NHS test as well as the retest were older than those who passed. These results are consistent with findings of a study in Nigeria.¹⁶ Studies have been performed with the aim to define the best time for the hearing screening test in newborns. In Luxembourg, 2496 neonates undergoing NHS test were evaluated, and it was observed that the proportion of unchanged results rose from 67.0% for newborns between 24 and 48 h of life to 87.6% for those with >72 h, and to 95.1% for those between the 4th and 5th day of life.²⁹

Despite the recommendation to perform the NHS test in the first month, the measurement of otoacoustic emissions in the first hours of life has not been recommended, due to the possible presence of vernix in the external ear of the newborn, jeopardizing the quality of the examination.³⁰ Data from this study also suggest that the test result is also influenced by the age of the child. It is known that the measurement of otoacoustic emissions is strongly influenced by the clinical condition of the infant, for instance, conduction impairments and gastroesophageal reflux,³⁰ and also is influenced by the internal noise, more common in the most active children. It is possible that infants are more likely to present these clinical conditions, and thus they are most likely to fail an NHS test. Such arguments reiterate the need for performing the NHS test in the first 30 days of child's life.

According to the recommendation of the AAP, the newly implemented biphasic NHSP should reach more than 70% attendance in its second phase. Programs with longer implementation must achieve a rate greater than 90%. In the present study, in the first year of operation, 71% attendance for the retest phase was observed. Similar values were found

in a study of São Paulo (73.1%).³¹ Better results were found in a study conducted in Spain (95.9%).²⁶

The investment in follow-up systems to increase the attendance rate for retest and also in the diagnostic phase has been a major challenge for screening programs, even in developed countries with structured programs for over a decade.^{6,7} The absenteeism in subsequent phases to the NHS test seriously jeopardize the diagnosis and the early intervention for children with hearing loss.^{3,6} The attendance rate for retest is an indicator that measures the actual adherence of the family and the effectiveness of the logistics for child's return implemented by the program.³

Studies have been conducted to determine the variables that can influence family adherence. A statistically significant decrease of adherence was observed in groups of children older than 30 days,¹⁶ non-firstborn infants,^{14,16} and newborns with unmarried mothers in the family, with a low frequency of prenatal care and a low level of education.¹⁴ In the present qualitative analysis, the following were considered as barriers to retest: restriction of opening hours to the public, lack of information about the importance of the NHS test, lack of material resources to travel to the place of examination, the need to bring all children to the place of the exam, lack of someone to assist with the older children, the home observation of the child's reaction to sound stimuli of greater intensity, and especially the fact that pediatricians caring for the child do not reiterate the need for attendance to retests.¹⁴ In this respect, the participation of all professionals involved in neonatal care is essential, either in the maternity or in the BHU, so that there is no conflict in the guidelines about the importance of returning for further evaluation. Therefore, it is necessary the results of the examination and its respective conduct are properly recorded, preferably in the child health booklet, to facilitate interdisciplinary work.³²

Although the absenteeism in this study was significant (29% in the retest phase and 67.7% at re-assessment), the information available allowed only ascertaining that there was no influence of the origin of the family, the child's age, and the presence of some risk indicator for hearing loss in the child's attendance to retest.

The percentage of children referred for diagnosis in this study (2.1%), while agreeing with the recommendation of the American Academy of Pediatrics, may be underestimated, when considering the high absenteeism during the retest. Values of referral for diagnosis similar to those of the present study were found in São Paulo, where 1.1% referral for diagnosis was observed, with an absenteeism rate of 26.9% in the retest.³¹

The determination of diagnoses and interventions in institutions other than the NHSRS and the absence of a computerized control system for those children undergoing the screening test have hindered the knowledge of the number of children with confirmed hearing loss, and also that of the age of the child at the time of diagnosis and the initiation of the intervention. In the first year of implementation of the municipal program, corresponding to 2010, there was no standardization of patient records among NHSRSs and the services for diagnosis and intervention, seriously compromising the flow of reference and counter-reference and, hence, the knowledge of the number of children identified in each NHSRS.

Given the absence of information from post-retest stages, this study was limited to the analysis of data until the time of referral for diagnosis. The literature is clear in stating that early detection alone does not guarantee the auditory development of the child with hearing loss, and an effective therapeutic intervention is needed, as well as an interface with the educational system.¹

Since 1999, the AAP and the JCIH have recommended the implementation of screening programs with the use of an information system for the consolidation and analysis of data. This same recommendation has been reiterated by several studies and by national and international organizations.¹⁰ The absence of a computerized system has clearly hampered or even made it impossible to obtain the results of assistance. Lack of knowledge of the health trajectory of children after referral to diagnosis seriously jeopardizes the measurement of the effectiveness of the NHSP, i.e., the identification of the number of children with hearing loss who have achieved good hearing function and language development. The lack of information also jeopardizes the process of evaluation of programs by its managers and hinders the better targeting of resources and of corrective actions for ensuring a comprehensive care for children with hearing impairment.

Regionalization strategies for reference services may even be considered, so that the exams are scheduled in the service with greater ease of access for the family. Educational programs for the patient population and for health professionals about the importance of early detection of hearing loss are fundamental to the understanding of the necessity of the child's attendance, not only at the first examination, but also at the retest and/or reassessment phase, if needed.

Future studies are necessary to know not only the evolution of the NHSRS work process, but also the quality indicators of other NHS services in the municipality and in the state. The knowledge of the limitations and advances of these programs is critical to the foundation of the actions of the respective levels of management. Strategies for implementation of integration systems among the service and other points of care of the hearing care network are essential for the consolidation and analysis of data, to provide knowledge of one of the main quality indicators proposed by the scientific community: the percentage of children with hearing impairment at birth submitted to an intervention, i.e., the adaptation of individual hearing aids and speech therapy, in a timely manner, for the satisfactory development of oral language.

Conclusion

The NHSRS where this study was conducted has reached three of the four indicators of quality reviewed. The rates of referral to retest, retest attendance, and referral for diagnosis are in agreement with those recommended by the scientific community. However, the NHS test was not performed within the frame of time recommended in 35% of the children, suggesting the need for actions that provide an easier access to the exam in less time. Although over 70% attendance was achieved in the retest in the first year of the program, the authors expect more than 90% attendance in the subsequent periods.

Thus, investments in active search strategies and in the study of evaluation protocols that reduce the number of children referred for retesting are important. The integration of children's hearing health in primary care actions should be emphasized, to ensure the continuity of care.

Conflicts of interest

The authors declare no conflicts of interest.

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