



NEONATAL HEARING SCREENING IN THE REDE CEGONHA HOSPITAL

Triagem auditiva neonatal em hospital da Rede Cegonha

Tamizaje auditivo neonatal de un hospital de la Rede Cegonha

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ABSTRACT

Objective: To evaluate the profile of neonates who underwent neonatal hearing screening (NHS) and their mothers in a public hospital linked to the Rede Cegonha strategy, concerning sociodemographic characteristics and health outcomes. **Methods:** Cross-sectional, retrospective and documentary study, based on data from medical records of a maternal and child hospital in the city of Porto Alegre, Rio Grande do Sul. The sample consisted of 1,818 mother-baby dyads, who performed NHS from May 2014 to May 2015. The results of the NHS and maternal and neonatal clinical characteristics were analyzed. For data analysis, the statistical program SPSS version 21.0 was used. **Results:** Of the 1,818 neonates who underwent NHS, 359 (19.74%) had some risk indicator for hearing loss. Neonatal failure in NHS was associated with risk indicators for hearing impairment (presence of congenital HIV, $p = 0.035$; congenital cytomegalovirus, $p = 0.048$; and exposure to ototoxic drugs, $p = 0.011$) and between absence of any risk indicator for hearing impairment with respiratory dysfunction ($p = 0.043$) and neonatal sepsis ($p = 0.021$). In neonates without these indicators, this association occurred in those whose mothers had urinary tract infection during pregnancy ($p = 0.015$). **Conclusion:** Significant associations were found between NHS failure and maternal and infant characteristics that are not considered as risk indicators for hearing impairment.

Descriptors: Maternal-Child Health Services; Speech, Language and Hearing Sciences; Neonatal Screening; Hearing.

RESUMO

Objetivo: Avaliar o perfil de neonatos que realizaram triagem auditiva neonatal (TAN) e suas mães em um hospital público vinculado à Rede Cegonha, no que diz respeito às características sociodemográficas e aos desfechos de saúde. **Métodos:** Estudo transversal, retrospectivo e documental, baseado em dados de prontuários de um hospital materno-infantil da cidade de Porto Alegre, Rio Grande do Sul. A amostra foi composta por 1.818 díades mãe-bebê, que realizaram TAN no período de maio/2014 a maio/2015. Foram analisados os resultados da TAN e as características clínicas maternas e dos neonatos. Para a análise dos dados, utilizou-se o programa estatístico SPSS, versão 21.0. **Resultados:** Dos 1.818 neonatos que realizaram a TAN, 359 (19,74%) tinham algum indicador de risco para deficiência auditiva. Houve associação entre falha dos neonatos na TAN e indicadores de risco para deficiência auditiva (presença de HIV congênito, $p=0,035$; citomegalovírus congênito, $p=0,048$; e exposição a drogas ototóxicas, $p=0,011$) e entre ausência de algum indicador de risco para deficiência auditiva com disfunção respiratória ($p=0,043$) e sepse neonatal ($p=0,021$). Nos neonatos sem esses indicadores, essa associação aconteceu naqueles cujas mães tiveram infecção de trato urinário na gestação ($p=0,015$). **Conclusão:** Verificaram-se associações significativas entre



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Received on: 02/19/2019

Accepted on: 08/13/2019

falha na TAN e características maternas e do bebê que não são consideradas como indicadores de risco para deficiência auditiva.

Descritores: Serviços de Saúde Materno-Infantil; Fonoaudiologia; Triagem Neonatal; Audição.

RESUMEN

Objetivo: Evaluar el perfil de neonatos que han realizado el tamizaje auditivo neonatal (TAN) y sus madres de un hospital público vinculado al programa Rede Cegonha respecto las características y los resultados en la salud. **Métodos:** Estudio transversal, retrospectivo y documental basado en los datos de historias clínicas de un hospital materno-infantil de la ciudad de Porto Alegre, Rio Grande de Sur. La muestra ha sido de 1.818 díadas madre-bebé que han realizado el TAN en el período entre mayo/2014 y mayo/2015. Se han analizados los resultados del TAN y las características clínicas maternas y de los neonatos. Se utilizó el programa estadístico SPSS en la versión 21.0 para el análisis de los datos. **Resultados:** De los 1.818 neonatos que han realizado el TAN, 359 (19,74%) tenían algún factor de riesgo para la discapacidad auditiva. Hubo asociación entre la falla de los neonatos del TAN y los indicadores de riesgo para la discapacidad auditiva (presencia del HIV congénito, $p=0,035$; citomegalovirus congénito, $p=0,048$; y la exposición para drogas ototóxicas, $p=0,011$) y entre la ausencia de algún indicador de riesgo para la discapacidad auditiva con disfunción respiratoria. ($p=0,043$) y sepsis neonatal ($p=0,021$). En los neonatos sin esos indicadores, la asociación se dio en aquellos cuyas madres tuvieron infección del trato urinario en la gestación ($p=0,015$). **Conclusión:** Se verificaron asociaciones significativas entre la falla del TAN y las características maternas y del bebé que no son consideradas como indicadores de riesgo para la discapacidad auditiva.

Descritores: Servicios de Salud Materno-Infantil; Fonoaudiología; Tamizaje Neonatal; Audición.

INTRODUCTION

The Rede Cegonha (RC) is a strategy of the Ministry of Health, established under the Unified Health System (*Sistema Único de Saúde - SUS*), which has been in force in Brazil since 2011, regulated by Ordinance No. 1,459. One of its objectives is to foster the implementation of a new model of health care for women and children, focusing on delivery, birth, growth, and child development. This strategy assures babies the right to safe and humanized birth, healthy growth, and development, with follow-up to 24 months of age. To serve this quality population, RC is organized into four subdivisions: prenatal, delivery and birth; puerperium and comprehensive attention to child health; and the logistics system: sanitary transportation and regulation⁽¹⁾.

The hospitals belonging to the RC send a monthly report, which contains various health data, including those related to the field of speech therapy: the performance of breastfeeding and newborn hearing screening (NHS). This professional is qualified to work in joint accommodation (JA) and neonatal intensive care units (ICU), passing through the evaluation, therapy, follow-up, referral for evaluations, or even to assist other professionals⁽²⁾.

NHS is critical for the early detection of hearing-related abnormalities in newborns. Since August 2010, the examination of evoked otoacoustic emissions (EOE) has been mandatory in all children born in the national territory by Law No. 12.303 / 2010⁽³⁾. This exam shows direct evidence of the active cochlear mechanism and its absence is related, in most cases, to sensorineural hearing loss⁽⁴⁾. NHS results in “pass” or “fail”. When the outcome is “failed,” the test should be performed again. If the “failure” persists, it is indicated to perform the brainstem auditory evoked potential test (BAEP - automatic or in screening mode)⁽⁵⁾. BAEP is composed of a series of waves, captured by surface electrodes positioned on the cranial surface, generating neural responses and pointing cochlear integrity. This test also includes an electrophysiological measurement of the eighth nerve and low brainstem auditory function⁽⁴⁾.

For newborns and infants with hearing impairment risk indicators (IRDA), the choice is already automatically assigned to BAEP, automatic or in screening mode⁽⁵⁾. According to the Ministry of Health⁽⁵⁾, based on the Joint Committee on Infant Hearing (2007)⁽⁶⁾ and the Multiprofessional Committee on Hearing Health (2010)⁽⁷⁾, among the IRDA are: heredity; exposure to ototoxic drugs such as aminoglycoside antibiotics and / or loop diuretics; hyperbilirubinemia; severe perinatal anoxia; Neonatal Apgar score from 0 to 4 in the first minute, or 0 to 6 in the fifth minute; exposure to congenital infections; children with craniofacial malformations involving ear and temporal bone; people with genetic syndromes that express hearing impairment; and those who have experienced postnatal bacterial or viral infections.

NHS should preferably be performed in the first days of life (24 hours to 48 hours after birth), in the maternity ward, and at most during the first month of life, except in cases where the health of the child do not allow it^(6,7).

Regarding the state of Rio Grande do Sul, only four hospitals were provided with equipment to perform the NHS through the RC policy, and in one of these, the present study was conducted. Thus, it is evident the performance

of the Speech-Language Pathology professional focused on performing NHS in health services in which the CR strategy is implemented. This knowledge may qualify the assistance already provided under the program, enabling the elaboration of new actions and care strategies by all professionals who are part of the assistance team.

This study aims to evaluate the profile of neonates who underwent neonatal hearing screening (NHS) and their mothers in a public hospital linked to the Rede Cegonha, regarding sociodemographic characteristics and health outcomes.

METHODS

This is a cross-sectional, retrospective, and documentary study, conducted in a maternal and child hospital which is part of the RC Strategy in the city of Porto Alegre, Rio Grande do Sul, Brazil. The sample consisted of 1,808 mother-baby dyads who were hospitalized in the JA and/or the Neonatal ICU from May 2014 to May 2015, and who received speech therapy. Data from medical records were collected in 2016.

In this study, we considered all the medical records of infants who underwent NHS, in the JA and/or Neonatal ICU, and their mothers, who had a record of NHS results. We excluded participants who did not have a complete NHS record or those whose medical records incomplete.

Information was collected from medical records and other hospital records, which did not require the use of an informed consent form. However, the consent of the hospital for the study was requested, and a confidentiality agreement was signed regarding the information accessed. Data regarding the mother were analyzed, considering gestational period, gestational age, mode of delivery and pathologies that occurred during and / or before pregnancy. The babies' data were also analyzed: weight, Apgar score in the first and fifth minutes, sex, complications, place of hospitalization (Neonatal JC / ICU) and NHS result, as well as the presence of IRDA.

For data analysis, the statistical program SPSS version 21.0 was used. Continuous data were described as mean and standard deviation; and categorical data in absolute frequency (n) and percentage. The comparison between categorical variables was analyzed using Pearson's chi-square test. It was adopted a significance level of 5%.

This study was approved by the Research Ethics Committee of the Federal University of Health Sciences of Porto Alegre (UFCSPA; Opinion No. 1.332.958) and the Ethics Committee of Presidente Vargas Maternal and Child Hospital (Opinion No. 1.387.303). The research followed the guidelines of Resolution No. 466/12 of the National Health Council, which regulates research involving human beings in the country⁽⁸⁾.

RESULTS

Among the 1,818 dyads participating in the study, 918 babies (50.5%) were male and 1,468 (80.74%) were admitted to the AC. The average weight of newborns was 3191.89 grams, with great variation (570 to 4935 grams). The average gestational age was 38 ± 8 weeks. The average Apgar score in the first minute was 8.06 and, in the fifth minute, 9.20. Among the participants, at least one risk indicator was observed in 359 dyads (19.74%), and 228 babies (63.50%) in this group were admitted to the Neonatal ICU. Among the neonates without IRDA (n = 1459; 80.25%), 1,337 (91.63%) were admitted to the AC. Prevalence of normal delivery was observed among the dyads evaluated. (n=1168; 64,2%). Table I shows detailed information on the dyads according to the presence or absence of IRDA in infants.

Figure 1 shows the newborn's NHS result in the presence or absence of IRDA and according to the type of assessment test applied (OAE or BAEP).

It can be observed in the flowchart (Figure 1) that most of the newborns evaluated in the described period are neonates without IRDA, totaling 80.25% (1,459) of the sample. Of these, 51 (3.49%) were referred for retest after BAEP. Among infants with IRDA, there were 46 (12.8%) neonates referred for retest after BAEP.

Among the IRDA already established in the literature, the results of NHS with exposure to ototoxic drugs (aminoglycoside antibiotics and / or loop diuretics by the neonate), congenital infections (toxoplasmosis, rubella, cytomegalovirus, syphilis and HIV) were selected for analysis. consanguinity, heredity, and syndrome that expresses hearing impairment in the newborn, as they are more prevalent in the sample. There was statistical significance in BAEP failures in both ears (BE) for those with a history of exposure to HIV (n = 11; 22.9%; p = 0.035) and cytomegalovirus (n = 3; 42.9; p = 0.048) congenital. Although frequent maternal habits and pathologies were identified during hospitalization, none of them were associated with BAEP failure in BE in this group. We also identified pathologies related to neonates, with respiratory dysfunction (RD) (n = 9; 7.5%; p = 0.043) and sepsis (n = 6; 6.1%; p = 0.021) statistically associated with BAEP failure in BE, as shown in Table II.

Table I - Risk indicators for hearing impairment and characteristics of neonates who underwent neonatal hearing screening between May 2014 and May 2015 at Presidente Vargas Maternal and Child Hospital, Rio Grande do Sul, Brasil, 2016 (n=1.818).

	Neonates with IRDA	Neonates without IRDA	Total neonates (with and without IRDA)
Via of birth - n (%)			
Normal Birth	192 (53.5)	976 (66.9)	1168 (64.2)
Caesarean Birth	167 (46.5)	483 (33.1)	650 (35.8)
Sex - n (%)			
Feminine	159 (44.3)	741 (50.8)	900 (49.5)
Masculine	200 (55.7)	718 (49.2)	918 (50.5)
Weight (grams)			
Average (DP)	2848.09 (865.03)	3276.60 (504.26)	3191.89 (617.02)
Minimum-Maximum	570 – 4815	1190 – 4935	570 – 4935
Gestational Age (weeks)			
Average (DP)	37±6 (3.17)	39±1 (1.48)	38± 8 (2.02)
Minimum-Maximum	26 - 42±4	25±7 - 41±8	25±7 - 42±4
Apgar 1'			
Average (DP)	6.92 (2.39)	8.34 (1.04)	8.06 (1.52)
Minimum-Maximum	0 – 10	0 – 10	0 – 10
Apgar 5'			
Average (DP)	8.66 (1.31)	9.34 (.59)	9.20 (.83)
Minimum-Maximum	2 – 10	5 – 10	2 – 10

n: total number; SD: standard deviation. IRDA: risk indicators for hearing impairment; Apgar 1': Average Apgar in the first minute; Apgar 5': Medium Apgar in the fifth minute

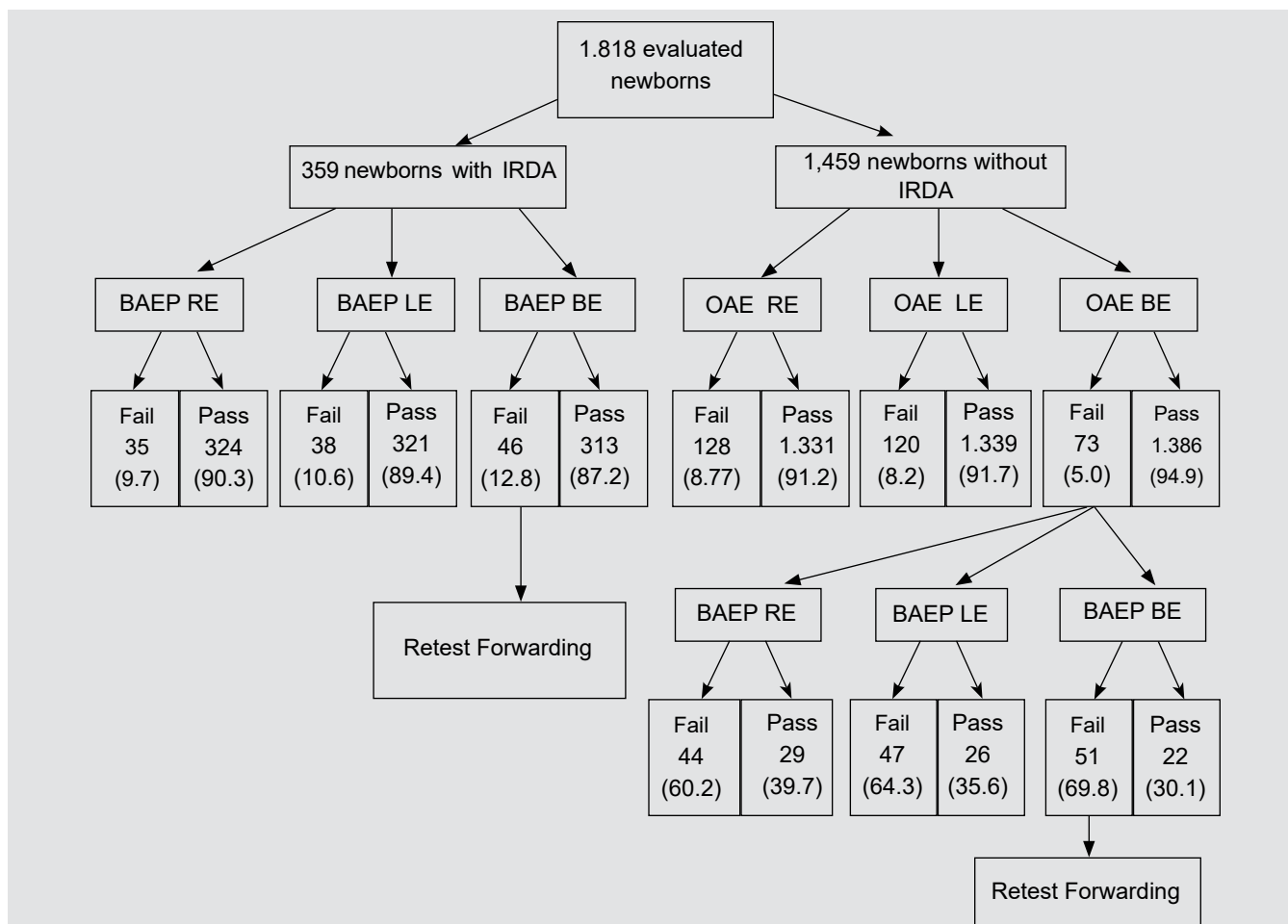


Figure 1 - Flowchart of neonatal hearing screening of newborns born between May 2014 and May 2015, Presidente Vargas Maternal and Child Hospital, Rio Grande do Sul, Brazil, 2016

Legend: RE: right ear; LE: left ear; BE: both ears; BAEP: brainstem auditory evoked potential; OAE: otoacoustic emissions. Numerical results are considered as n (%).

Table III shows statistical significance in OAE failures in OA in neonates whose mothers had urinary tract infection (n = 12; 6.6%; p = 0.015).

Table II - Results of brainstem auditory evoked potential compared with risk indicators for hearing impairment and characteristics of mother and baby, neonates who underwent neonatal hearing screening at Presidente Vargas Maternal and Child Hospital, between May 2014 and May 2015, Rio Grande do Sul, Brasil, 2016.

	BAEP LE			BAEP RE			BAEP BE		
	Pass n (%)	Fail n (%)	p value	Pass n (%)	Fail n (%)	p value	Pass n (%)	Fail n (%)	p value
IRDA									
Syphilis	51 (92.7)	4 (7.3)	0.481	51 (92.7)	4 (7.3)	0.627	50 (90.9)	5 (9.1)	0.511
HIV	41 (85.4)	7 (14.6)	0.318	38 (79.2)	10 (20.8)	0.015*	37 (77.1)	11 (22.9)	0.035*
Cytomegalovirus	5 (71.4)	2 (28.6)	0.163	5 (71.4)	2 (28.6)	0.142	4 (57.1)	3 (42.9)	0.048*
Toxoplasmosis	22 (84.6)	4 (15.4)	0.502	24 (92.3)	2 (7.7)	1.000	22 (84.6)	4 (15.4)	0.759
Consanguinity	2 (66.7)	1 (33.3)	0.286	2 (66.7)	1 (33.3)	0.266	2 (66.7)	1 (33.3)	0.338
Heredity	15 (78.9)	4 (21.1)	0.129	17 (89.5)	2 (10.5)	0.707	15 (78.9)	4 (21.1)	0.284
Syndrome that expresses hearing impairment in the newborn	8 (88.9)	1 (11.1)	1.000	8 (88.9)	1 (11.1)	0.607	8 (88.9)	1 (11.1)	1.000
Exposure to ototoxic drugs	146 (93.6)	10 (6.4)	0.025*	149 (95.5)	7 (4.5)	0,004*	144 (92.3)	12 (7.7)	0.011*
Maternal Factors									
Smoker	32 (88.9)	4 (11.1)	0.782	31 (86.1)	5 (13.9)	0.374	30 (83.3)	6 (16.7)	0.435
Drug addiction	23 (85.2)	4 (14.8)	0.510	25 (92.6)	2 (7.4)	1.000	23 (85.2)	4 (14.8)	0.764
ITU	26 (86.7)	4 (13.3)	0.541	27 (90.0)	3 (10.0)	1.000	26 (86.7)	4 (13.3)	1.000
DMG	7 (87.5)	1 (12.5)	0.595	6 (75.0)	2 (25.0)	0.178	6 (75.0)	2 (25.0)	0.273
HAS	7 (77.8)	2 (22.2)	0.245	8 (88.9)	1 (11.1)	0.607	7 (77.8)	2 (22.2)	0.324
Hypothyroidism	2 (66.7)	1 (33.3)	0.286	3 (100)	0 (0)	1.000	2 (66.7)	1 (33.3)	0.338
Newborn Factors									
DR	113 (94.2)	7 (5.8)	0.045*	115 (95.8)	5 (4.2)	0.013*	111 (92.5)	9 (7.5)	0.043*
Jaundice	81 (91.0)	8 (9.0)	0.693	83 (93.3)	6 (6.7)	0.310	80 (89.9)	9 (10.1)	0.466
Sepsis	94 (94.9)	5 (5.1)	0.036*	96 (97.0)	3 (3.0)	0.009*	93 (93.9)	6 (6.1)	0.021*

RE: right ear; LE: left ear; BE: both ears; BAEP: brainstem auditory evoked potential; DR: respiratory dysfunction; GDM: gestational diabetes mellitus; SAH: systemic arterial hypertension; UTI: urinary tract infection. * There was statistical significance. The maximum significance level assumed was 5% (p≤0.05). Statistical analysis of these data was performed using Pearson's chi-square test.

Table III - Results of otoacoustic emissions compared with maternal and infant characteristics, neonates without risk indicator for hearing impairment who underwent neonatal hearing screening at Presidente Vargas Maternal and Child Hospital, Rio Grande do Sul, Brasil, 2016.

	OAE LE			OAE RE			OAE BE		
	Pass n (%)	Fail n (%)	p value	Pass n (%)	Fail n (%)	p value	Pass n (%)	Fail n (%)	p value
Maternal Factors									
Alcoholic	6 (100)	0 (0)	1.000	6 (100)	0 (0)	1.000	6 (100)	0 (0)	1.000
Smoker	121 (89.0)	15 (11.0)	0.249	118 (86.8)	18 (13.2)	0.078	116 (85.3)	20 (14.7)	0.331
Drug addiction	22 (91.7)	2 (8.3)	1.000	19 (79.2)	5 (20.8)	0.052	19 (79.2)	5 (20.8)	0.196
UTI	175 (95.6)	8 (4.4)	0.043*	176 (96.2)	7 (3.8)	0.011*	171 (93.4)	12 (6.6)	0.015*
GDM	144 (92.9)	11 (7.1)	0.757	145 (93.5)	10 (6.5)	0.366	140 (90.3)	15 (9.7)	0.432
SAH	43 (93.5)	3 (6.5)	1.000	45 (97.8)	1 (2.2)	0.177	42 (91.3)	4 (8.7)	0.646
Hypothyroidism	31 (96.9)	1 (3.1)	0.511	32 (100)	0 (0)	0.106	31 (96.9)	1 (3.1)	0.166
Disorders Psychological	20 (87.0)	3 (13.0)	0.429	19 (82.6)	4 (17.4)	0.136	18 (78.3)	5 (21.7)	0.183
Newborn Factors									
RD	29 (100)	0 (0)	0.164	29 (100)	0 (0)	0.171	29 (100)	0 (0)	0.041
Jaundice	38 (100)	0 (0)	0.068	38 (100)	0 (0)	0.072	38 (100)	0 (0)	0.011

RE: right ear; LE: left ear; BE: both ears; OAE: O = Otoacoustic emissions; RD: respiratory dysfunction; GDM: gestational diabetes mellitus; SAH: systemic arterial hypertension; UTI: urinary tract infection. * There was statistical significance. The maximum significance level assumed was 5% ($p \leq 0.05$). Statistical analysis of these data was performed using Pearson's chi-square test.

DISCUSSION

In this study we analyzed data from a convenience sample of a maternal and child hospital in the city of Porto Alegre, Rio Grande do Sul. It was observed a higher prevalence of vaginal delivery compared to cesarean section. This finding may be due to public policies, such as RC and Rede Humanizadas^(1,9) since the hospital in question is linked to these strategies. In fact, comparing the findings of the present study with the average of vaginal delivery in the city of Porto Alegre (48.11%), the Southern Region (37.53%) and Brazil (42.85%), it is noted that the incentive on the humanization of childbirth seems to be effective, becoming a motivation to perform vaginal deliveries in greater number the change of conception proposed by RC and other maternal and child policies.

Concerning Comprehensive Child Health Care, hearing impairment is considered a public health problem, due to its prevalence, and above all due to the multiple consequences that can lead to human development, in intellectual, social and linguistic aspects, cognitive and emotional⁽¹⁰⁾. Thus, the control and analysis of NHS epidemiological data should be performed by all speech therapists working in this activity. These measures are necessary to monitor changes in population health, which may result in hearing impairment and care for these children. In this sense, the associations found in the present study between NHS results and some characteristics of maternal and child health not considered in IRDA, such as maternal urinary tract infection, sepsis, and respiratory dysfunction are noteworthy. Among the factors not associated with IRDA, in the group with at least one risk indicator, an association was found between NHS failure and sepsis ($p = 0.021$). Neonatal sepsis is the third leading cause of neonatal mortality, being surpassed only by prematurity and intrapartum complications (or asphyxia at birth)⁽¹¹⁾. Empirical treatment of neonatal sepsis usually involves an association between an aminoglycoside antibiotic (gentamycin) and a beta-lactam, always considering the profile⁽¹²⁾.

Also the newborn's respiratory capacity to adapt to the extrauterine environment is critical for survival. Neonatal respiratory dysfunctions can arise for several reasons: delayed adaptation or maladaptation for extrauterine life; existing conditions (congenital or surgical anomalies) or acquired conditions (pulmonary infections occurring pre or postpartum⁽¹³⁾).

Also in this sense, an association was observed between infant failure in the OAE test and maternal urinary tract infection ($p = 0.015$) and jaundice in the newborn itself ($p = 0.011$). Urinary tract infection is common in young women and represents one of the most common clinical complications during pregnancy. Pregnancy causes anatomical and hormonal changes that can have clinical repercussions, for example, gradual uterine enlargement may lead to some degree of extrinsic urinary compression, favoring vesicoureteral reflux and increasing the incidence of pyelonephritis.

Besides, changes in vaginal flora may cause vulvovaginitis and low urinary tract infections (cystitis). If left untreated, women may experience complications such as premature labor and intrauterine growth restriction. The recommended treatment for these urinary tract infections is usually antibiotic therapy, but those commonly used are not ototoxic⁽¹⁴⁾.

Regarding jaundice, when babies have high serum bilirubin levels (hyperbilirubinemia), this condition is considered an IRDA. IRDA was adopted at the hospital under investigation, in this case, established by the Joint Committee on infant hearing⁽⁶⁾, hyperbilirubinemia requiring blood transfusion or septicemia-positive culture. Thus, in this sample, no case was identified to perform the BAEP. With these results, it is necessary to establish protocols with strict control of cases of jaundice, as well as the use of highly effective phototherapy, which represents preventive measures for hearing disorders resulting from hyperbilirubinemia⁽¹⁵⁾.

The NHS, in the present study, was performed in the first hours of the newborn's life, before hospital discharge, and according to the flow chart and techniques proposed by the Ministry of Health(2012)⁽⁵⁾. Considering predicted IRDA, congenital infections (HIV and cytomegalovirus) and exposure to ototoxic drugs (aminoglycoside antibiotics and/or loop diuretics) by the neonate were factors associated with BAEP failure. These findings, therefore, agree with the literature⁽⁷⁾.

Exposure to intrauterine HIV proved to be the second most prevalent congenital infection in the current study (n = 48), being surpassed only by syphilis (n = 55) and is associated with NHS failure(p=0,035). The association between HIV infection and hearing impairment is being reported in the literature and what has been seen is that, in the initial phase of the disease, the involvement ends up being smaller and, over the years, the disorders become more frequent⁽¹⁶⁾. Clinical manifestations are very variable and can be evidenced by encephalopathies, both static and progressive in nature; neuropsychomotor developmental delay; language delay; mental disability; hyporeflexia; and pyramidal signs⁽¹⁷⁾. Among the many infections that can affect children with HIV, are those that affect the upper airways, especially sinusitis and otitis externa and media, responsible for the high incidence of conductive hearing disorders. Thus, in these children, hearing impairment may be related to other factors, including the viral damage itself on peripheral and central nervous structures. Therefore, HIV can be considered a risk factor for both peripheral and central hearing impairment for children and adolescents^(18,19).

Exposure to cytomegalovirus (CMV) was uncommon in the sample (n= 7) of the present study, but it was nonetheless associated with NHS failure (p= 0.048). CMV belongs to the herpes virus family and is a frequent cause of infection in humans. This virus undergoes periods of activation and latency and once infected, the virus remains indefinitely in the body of the host and may reactivate at any time^(20,21). Vertical transmission of CMV may be transplacental after primary or recurrent maternal infection, but may also occur if there is exposure to contaminated lower genital tract (GIT) secretions at delivery or during breastfeeding⁽²¹⁾. These newborns may have a cognitive impairment, retinitis, and/or cerebral palsy, as well as sensorineural hearing loss, considered one of the most common sequelae, which explains the results of the present study. Hearing loss following congenital CMV infection may begin late, although progressive loss may occur. Therefore, children with CMV infection should be evaluated regularly to ensure early detection of hearing loss and appropriate care⁽²²⁾.

Therefore, it is reinforced that health promotion is related to these concepts, since the performance of NHS, as well as the general health of the population, is an influencing factor. It is important to leave the population able to act on their quality of life, encouraging them to have control and know the importance of this process. This knowledge may qualify the assistance already provided within the scope of RC by enabling the elaboration of new actions and strategies of care for the NB and their mothers, not only by Speech-Language Pathologists but also by all those who are part of the care team.

As a limitation of this study, we can point out the regionalization of the data, as it brings results from a population sample of a maternal and child hospital, which may differ in other locations in Brazil. Thus, further studies are needed to describe the characteristics and results of NHS in other regions of Brazil.

It is considered that the production of epidemiological data on NHS should be stimulated, to be based on the causal elements and to serve as a basis for the development of strategies and public policies for the prevention and promotion of hearing health.

CONCLUSION

In this study it was possible to recognize the associations of neonatal hearing screening failure with risk indicators for hearing impairment due to infectious diseases (HIV and CMV) and exposure to ototoxic drugs. In addition to these, there was also an association with neonatal jaundice, respiratory dysfunction, sepsis, and maternal urinary

tract infection. The referral for diagnosis, the interpretation of how the population of this hospital is behaving and the possibility of comparing these data with other hospitals help to guide health interventions, aiming at reducing risks of diseases and other diseases and establishing conditions that assure the services possibilities to act in the promotion, protection and recovery in health.

CONFLICTS OF INTEREST

The authors state that there were no conflicts of interest in the execution of this research.

CONTRIBUTIONS

Luíza Silva Vernier, Carla Castelli and Shayenne Rothermel contributed to the conception of the article, data collection, analysis and discussion of the data and the writing of the article. **Tatiana Paniz and Claudia Zanini** contributed to the conception of the article and the analysis and discussion of the data. **Daniela Centenaro Levandowski** contributed to the supervision of all stages of the writing of the article, including data analysis and discussion, and writing of the article.

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How to cite: Vernier LS, Castelli CTR, Rothermel SS, Paniz TC, Zanini C, Levandowski DC. Neonatal hearing screening in the rede cegonha hospital. *Rev Bras Promoç Saúde*. 2019;32:8965.
