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Occurence of indicators for hearing loss in a center of health of Rio Grande do Sul

Ocorrência dos indicadores de risco para a deficiência auditiva em um centro de saúde do Rio Grande do Sul

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ABSTRACT

Purpose: Investigate the incidence of risk indicators for hearing loss in newborn and neonatal of a neonatal hearing screening program in the state of Rio Grande do Sul. **Methods:** A retrospective, observational, descriptive study, performed by speech therapists, in a medium complexity auditory health center. Casuistry composed of 2,333 newborns with risk indicators for hearing loss, who underwent neonatal hearing screening from January 2012 to December 2016. The data analysis consisted on the description of the sample profile, according to the categorical variables and descriptive statistics of the numerical variables. **Results:** From 2012 up to 2015, the risk indicator with higher occurrence was neonatal intensive care longer than five days, whereas preterm births prevailed in 2016. Increased heredity, congenital toxoplasmosis, congenital syphilis, congenital HIV and preterm births have also been observed. The risk indicators for hearing impairment that have decreased were: neonatal intensive care longer than five days, mechanical ventilation, ototoxic drugs, hyperbilirubinemia (serum level requiring exchange transfusion), Apgar score from 0-6 at minute five, weight below 1500g, being small for gestational age and congenital syndrome. **Conclusion:** During the first four years, the risk indicator with higher occurrence was neonatal intensive care longer than five days, in spite of a decrease during the years. In the last year, the most frequent risk factor was preterm birth, which increased during the evaluated period.

Keywords: Risk index; Hearing; Hearing loss; Neonatal screening; Infant, Newborn

RESUMO

Objetivo: Verificar a ocorrência dos Indicadores de Risco para a Deficiência Auditiva em neonatos e lactentes de um programa de triagem auditiva neonatal do estado do Rio Grande do Sul. **Métodos:** Estudo retrospectivo, observacional e descritivo. Realizado por fonoaudiólogas, em um centro de saúde auditiva de média complexidade. Casuística composta por 2.333 neonatos com indicadores de risco para a deficiência auditiva, que realizaram a triagem auditiva neonatal no período de janeiro de 2012 a dezembro de 2016. A análise de dados constituiu-se na descrição do perfil da amostra, segundo as variáveis categóricas e estatísticas descritivas das variáveis numéricas. **Resultados:** Nos quatro primeiros anos analisados, o indicador de risco com maior ocorrência foi a permanência na unidade de terapia intensiva neonatal por mais de cinco dias e, no último ano, o nascimento pré-termo. Verificou-se o aumento de hereditariedade, toxoplasmose congênita, sífilis congênita, HIV congênito e nascimento pré-termo. Verificou-se, também, a diminuição dos seguintes indicadores de risco para a deficiência auditiva: permanência na unidade de terapia intensiva por mais de cinco dias, ventilação mecânica, drogas ototóxicas, hiperbilirrubinemia com necessidade de exsanguíneotransfusão, índice de Apgar de "0" a "6" no quinto minuto, peso inferior a 1500g, pequeno para a idade gestacional e síndromes genéticas. **Conclusão:** O indicador mais prevalente na amostra foi a permanência na unidade de terapia intensiva neonatal por mais de cinco dias, que reduziu ao longo dos anos. No último ano analisado, o fator de risco mais recorrente foi o nascimento pré-termo, que aumentou no período avaliado.

Palavras-chave: Indicador de risco; Audição; Perda auditiva; Triagem neonatal; Recém-nascido.

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INTRODUCTION

Newborn hearing screening (NHS) is performed by examining evoked otoacoustic emissions (EOAE) and it is popularly referred to as the "ear test". It aims to identify auditory losses greater than or equal to 35 dBHL, or that may impair the normal development of the child[1]. For being a simple and fast method, it is called screening, and it is widely used and recommended by important national and international children's hearing health care organizations[2].

There are strong reasons for the realization of the NHS, and among them, it's possible to cite the serious impact of hearing loss on cognitive development, language acquisition and social integration. In addition, the high prevalence of hearing loss (HL) should be mentioned, in which three out of 1,000 newborns with no risk indicators for hearing loss (RIHL) present some type of auditory impairment, and this number increases significantly when considering newborns (NB) from a neonatal intensive care unit (NICU). In these cases, of every 100 neonates, two to four may present changes. Finally, a reason not less important is due to the fact that the diagnosis of HL is usually late, around age 3, in populations without access to neonatal hearing screening programs (NHSP)[3].

Some early detection programs select the NB that are more likely to have some auditory impairment and perform selective newborn hearing screening (NHS), which evaluates only NB with RIHL. The aim is to direct differentiated protocols for the at-risk population, with the realization of the brainstem auditory evoked potential - Automated (BAEP-A), which is capable of identifying retrocochlear hearing loss and the spectrum of auditory neuropathy, as well as monitoring development of language and hearing until the age of three. However, it is known that NHS identifies only 50% of the cases of HL, since approximately half of the neonates, the HL is idiopathic. Thus, universal newborn hearing screening (UNHS) is recommended by all professionals in the field of audiology, since it covers all neonates, or more than 95% of them, and is therefore considered the ideal form of screening[4,5].

It is importante to point out that prenatal, perinatal and postnatal intercurrences may trigger the development of alterations in the auditory system, being characterized in the literature as RIHL[6]. Therefore, it is important to identify the newborns with RIHL, because in places where UNHS is not available, it is a way to check children who are more likely to develop auditory impairment. In addition, this follow-up also makes it possible to select neonates who, although they do not present alterations at the time of screening, may develop progressive and/or late hearing loss[5]. The health services must know and monitor the occurrence of RIHL, so that appropriate planning of prevention and follow-up programs for this population can occur[7], since socioeconomic and demographic conditions can influence the health condition of a region[8].

The objective of this study was to verify the occurrence of RIHL in neonates and infants of a neonatal hearing screening program in the state of Rio Grande do Sul (RS), from January 2012 to December 2016.

METHODS

This research is characterized by being a retrospective, observational and descriptive study. The project was approved by the Research Ethics Committee (REC) of the Cultural and Scientific Association Virvi Ramos, under the opinion of number 1.651.131 and authorization of the institution involved. The research was performed by speech therapists.

The population of study consisted of neonates and infants who underwent NHS until 6 months of age, from January 2012 to December 2016, in a total of 60 months, in a medium complexity auditory health center in Rio Grande do Sul. The institution is considered of medium complexity, since it covers a region of 49 cities and carries out medium complexity care, such as screening, diagnosis (only from 3 years of age) and auditory rehabilitation. The NHSP at the state level occurred with the acquisition of 40 equipment that perform the EOAE. The cities of Rio Grande do Sul were selected according to the following criteria: greater number of living newborns; cities that had NICU and considering all Regional Health Coordinations (RHC), in consonance with the Regionalization Master Plan (RMP)[9]. Being this way, not all cities in the State of Rio Grande do Sul have available the NHS, and babies born in places without access to the exam are referred to the cities of reference.

To the Rio Grande do Sul State Health Secretary, NHS should be offered to all newborns born in the Unified Health System (SUS) and access should occur through the referral of SUS health professional, pediatrician, obstetrician or speech therapist. Thus, the State protocol, since 2010, states that the newborn should perform the NHS, with EOAE stimulus, preferably in the hospital of the city, before discharge. If one gets a satisfactory (normal) result, but present some RIHL, it should remain in monitoring the development of hearing and language up to 3 years of age. If the NB shows an altered result in this first screening, it should be repeated within 30 days. In the retest, if there is an unsatisfactory result in one or in both ears, the neonate should be referred to the otorhinolaryngologist or pediatrician, in order to discard a middle ear alteration. Afterwards, it should be referred for evaluation in a service of medium complexity of auditory health, where the BAEP-A is performed. When the altered result persists, the medium complexity service should refer the patient for evaluation in a high complexity service for diagnosis and treatment, according to the needs of each patient[9]. In the institution, since September 2016, every child with RIHL performs the EOAE test and, regardless of the result, is referred to BAEP-A. Until then, the BAEP-A was offered only in cases of retest failure with the usage of EOAE.

In the service, initially, at the moment of the NHS, an analysis of the child's health book is performed, verifying the type of delivery, weight, height, gestational age and Apgar score of the first and fifth minute. Next, an anamnesis is made with the parents and/or guardians, when information on gestation, perinatal and postnatal period is collected, in order to investigate the presence of RIHL. The institution stores the information in a database prepared in a Microsoft Excel® spreadsheet. In addition, the results of the screening and the information collected in the interview are recorded in each patient's electronic record. Therefore, the information was

obtained through the analysis of the information contained in the database and the electronic medical record of the institution. In a Microsoft Excel® worksheet, the following data were compiled: age, sex, weight, height, gestational age, first minute and fifth minute Apgar score, in addition to the RIHL, according to the Multiprofessional Hearing Health Committee (COMUSA), which include: parents' concern about the child development, of hearing, speech, or language; history of cases of permanent deafness in the family, starting from childhood; consanguinity; permanence in the NICU for more than five days, or the occurrence of any of the following conditions, regardless on the length of permanence in the ICU: extracorporeal ventilation; assisted ventilation; exposure to ototoxic drugs, such as aminoglycoside antibiotics and/or loop diuretics; hyperbilirubinemia (with need for exchange transfusion), besides to severe perinatal anoxia; Neonatal Apgar score from "0" to "4" in the first minute, or from "0" to "6" in the fifth minute; birth weight inferior to 1,500 grams; preterm birth (the institution considered preterm birth, gestational age inferior to 37 weeks), or small for gestational age (SGA); congenital infections (toxoplasmosis, rubella, cytomegalovirus (CMV), herpes, syphilis, HIV (human immunodeficiency virus); craniofacial anomalies involving the ear and temporal bone; genetic syndromes that usually express HL (eg, Waardenburg, Alport, Pendred, among others); neurodegenerative disorders (eg, Friedreich's ataxia, Charcot-Marie-Tooth syndrome, among others); postnatal bacterial or viral infections such as cytomegalovirus, herpes, measles, varicella and meningitis; head trauma and chemotherapy[4].

In order to participate in the sample, individuals should have complete information in the electronic medical record and/or in the NHS worksheets of referred institution, have attended and performed the retest with EOAE and/or BAEP-A, when requested, and have one or more RIHL proposed by COMUSA. It is important to remember that all NB identified with RIHL at the time of the NHS were included in the study, and that performed the complete audiological evaluation with the usage of EOAE and/or BAEP-A, according to the protocol of the institution, independently of the audiological results obtained. The altered BAEP-A cases were referred to the high complexity services, located in other cities of Rio Grande do Sul, where it is possible to conclude the audiological diagnosis

For the statistical analysis of the findings, the "SAS System for Windows (Statistical Analysis System)" version 9.2 was used, in which were applied the following tests: Cochran-Armitage trend test, which verifies if there is variation or trend of increase or decrease of RIHL over the years; Kruskal-Wallis test, for comparing the numerical variables between the years and Fisher's exact test, in order to compare the number of the RIHL between the years. The used significance value was $p \leq 0.05$.

RESULTS

During the study period, 17,893 NHS-related assistence were performed, between the first test, the retest and the return in six months. Of these, 3,047 children had one or more RIHL. The sample consisted of 2,333 individuals, of which 1,015 (43.5%) were female and 1,318 (56.5%) were male, with an average age of 46.5 days, in the first examination. 714 neonates or infants were excluded from the study because they did not meet the inclusion criteria, due to the following reasons: 259 did not present the RIHL proposed by COMUSA, 232 did not have complete information, 151 did not attend the BAEP-A, 61 did not attend to the retest and, finally, 11 were older than 6 months at the time of the first test.

It was possible to observe that, in the years of 2012, 2013, 2014 and 2015, the RIHL with the highest occurrence was staying for more than 5 days at the NICU, observed in 36.69% of the studied population. An average of 17.8 days of intensive care stay of the sample was verified. However, in 2016, the most recurrent RIHL was preterm birth, being the second most prevalent RIHL (35.02%). The gestational age of the infants ranged from 24 to 42 weeks, with an average of around 37.3 gestational weeks. During the studied period, there were no cases of cytomegalovirus (postnatal), measles, head trauma and chemotherapy in the database. In addition, it was found that, over the years, the most frequent condition associated with hospitalization in the NICU was the use of ototoxic medication. The congenital infection with the highest incidence was syphilis. The annually occurrence of the RIHL, from January 2012 to December 2016, is shown in Table 1.

When comparing the occurrence of RIHL over the studied period, it was noticed a significant trend for the increase of the following RIHL: heredity, congenital toxoplasmosis, congenital syphilis, congenital HIV, and preterm birth. In 2012, 72 cases of heredity were found, which increased to 146 in 2016. Toxoplasmosis ranged from 8 cases in 2012 to 21 in 2016. Congenital syphilis was identified in 30 cases in 2012, ranging to 86, in the year 2016. In the year 2012, there was no record of congenital HIV, however, in 2016, there were 10 cases. Preterm births increased from 121 in 2012 to 193 in 2016. In Figure 1, it is possible to compare the occurrence of RIHL over the studied period.

Regarding the reduction of the indicators of risk for hearing impairment, a significant trend of reduction of the following RIHL was observed during the study: ICU stay for more than 5 days, usage of mechanical ventilation (MV), usage of ototoxic drugs, hyperbilirubinemia with need for exchange transfusion, Apgar score from "0" to "6" in the fifth minute, weight inferior to 1500g, SGA and genetic syndromes. In 2012, 193 cases of NICU permanence for more than 5 days were identified and, in 2016, this indicator decreased to 114 cases. In 2012, 50 individuals required the use of MV, and in the year 2016, this number was restricted to 14 children. The use of ototoxic drugs decreased from 124 in 2012 to 55 in 2016. Cases of hyperbilirubinemia requiring exchange transfusion have declined from 7 in 2012 to only 1 in 2016. The indicator related to the Apgar score from "0" to "6" in the fifth minute went from 19 cases, in 2012, to 17, in 2016. Inferior weight to 1500g ranged from 25 occurrences, in 2012, to 13, in 2016. Cases in which neonates were considered SGA decreased from 36, in 2012, to 23, in 2016. Finally, in the year of 2012, 7 children presented genetic syndromes, decreasing to 3, in 2016 (Figure 2).

Table 1. Occurrence of Risk Indicators for Hearing Loss over the studied period

Risk Indicators for Hearing Loss	2012	2013	2014	2015	2016	%
Parents' Concern	0	0	2	0	0	0.09
Heredity*	72	65	131	140	146	23.75
Consanguinity	9	19	14	24	29	4.07
Stay in the ICU for more than five days*	193	172	193	184	114	36.69
Mechanical ventilation*	50	57	35	43	14	8.53
Ototoxic drugs*	124	85	86	118	55	20.06
Hyperbilirubinemia with exchange transfusion*	7	7	6	8	1	1.24
Severe perinatal anoxia	1	1	0	0	4	0.26
Neonatal Apgar from 0 to 4 in the first minute	45	53	62	64	62	12.26
Neonatal Apgar from 0 to 6 in the fifth minute*	19	21	17	17	17	3.9
Weight inferior to 1500g*	25	24	18	24	13	4.46
Preterm birth*	121	154	174	175	193	35.02
Small for gestational age*	36	28	32	26	23	6.22
Toxoplasmosis (congenital)*	8	3	26	50	21	4.63
Rubella (congenital)	0	0	5	7	1	0.56
Cytomegalovirus (congenital)	1	0	0	1	0	0.09
Herpes (congenital)	0	0	6	8	2	0.69
Syphilis (congenital)*	30	23	35	88	86	11.23
HIV (congenital)*	0	0	2	7	10	0.81
Craniofacial anomaly	5	7	6	10	10	1.63
Genetic syndromes*	7	2	4	4	3	0.86
Neurodegenerative disorder	1	0	0	1	0	0.09
Cytomegalovirus (postnatal)	0	0	0	0	0	0
Herpes (postnatal)	0	0	0	1	0	0.04
Measles	0	0	0	0	0	0
Varicella	0	0	0	1	0	0.04
Meningitis	1	4	0	3	0	0.34
Head trauma	0	0	0	0	0	0
Chemotherapy	0	0	0	0	0	0

Cochran-Armitage Test (*) Risk Indicators for Hearing Loss with statistically significant values ($p \leq 0.05$)
Subtitle: ICU = Intensive Care Unit; HIV = Human Immunodeficiency Virus

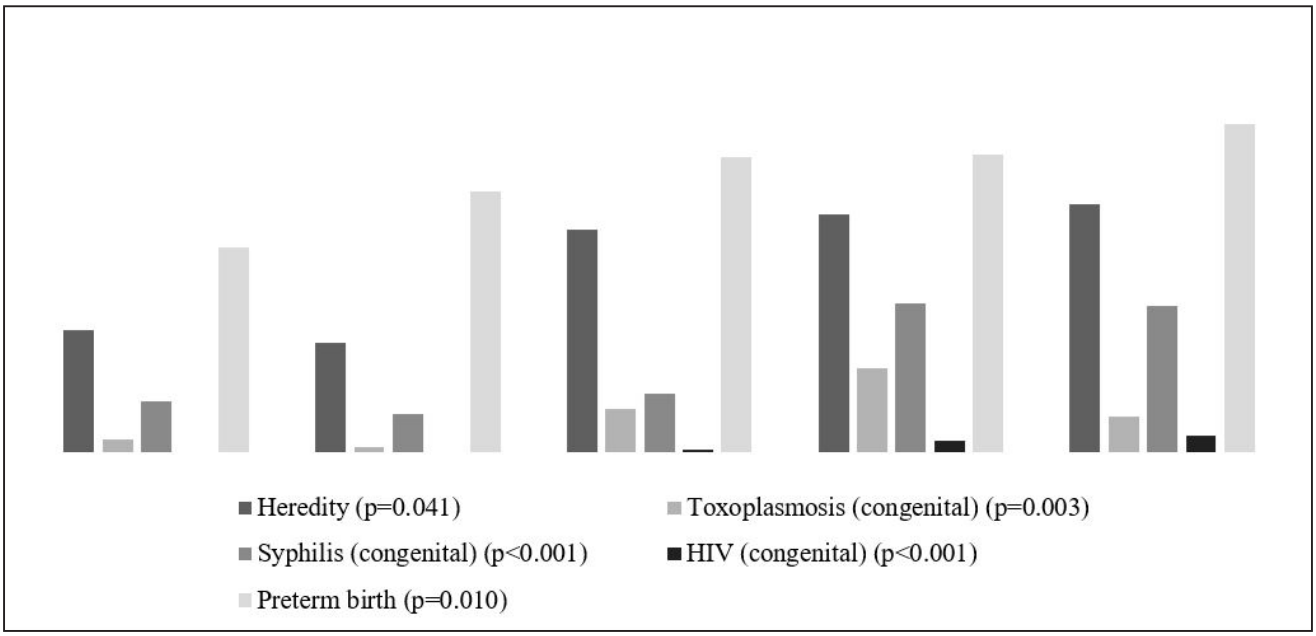

Figure 1. Comparison of Risk Indicators for Hearing Loss that increased in the period from 2012 to 2016
Subtitle: HIV = Human Immunodeficiency Virus

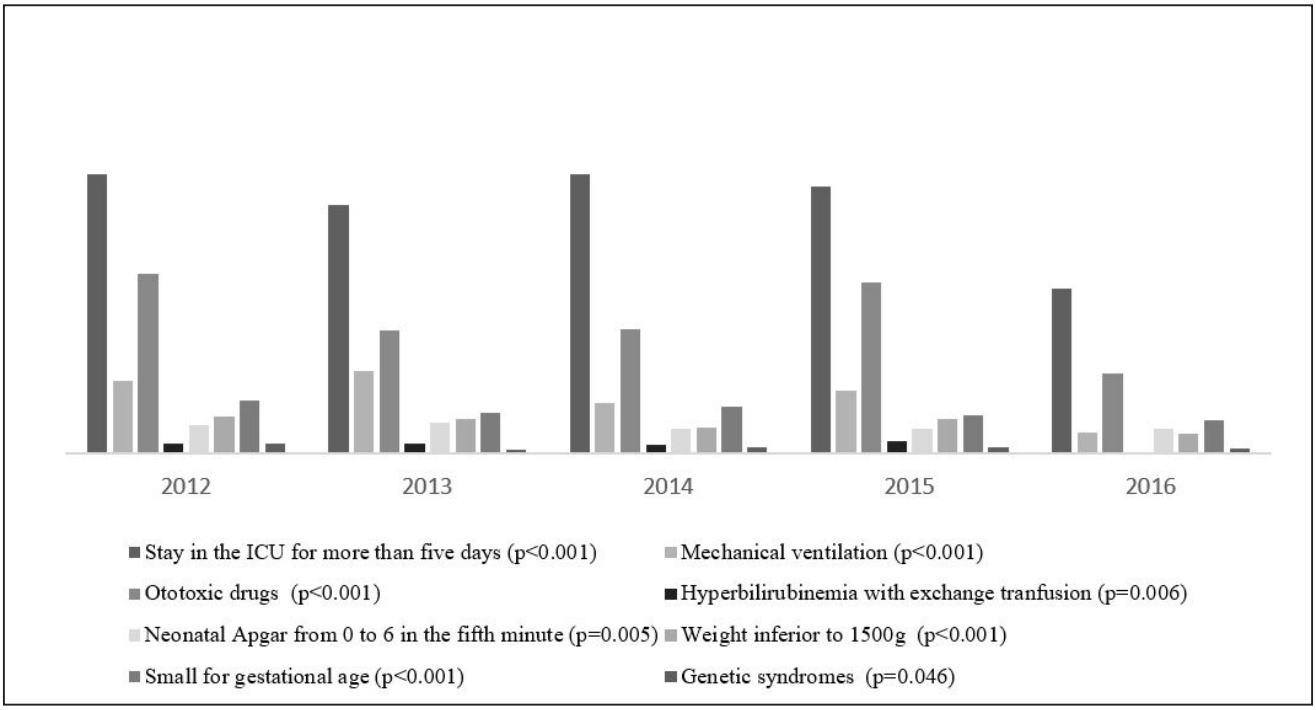

Figure 2. Comparison of Risk Indicators for Hearing Loss that decreased in the period from 2012 to 2016
Subtitle: ICU = Intensive Care Unit

DISCUSSION

The average age of the first examination was 46.5 days, however, the NHS protocols recommend that all neonates should have access to screening by the first month of life, preferably in order to identify and diagnose the hearing loss until the third month, and intervention through the habilitation procedure with hearing aids up to 6 months of age[4,5,9-11]. Some studies agree with this result and also show a greater age than the ideal one. In one study, 47.8% of the newborns underwent NHS with up to 30 days of life and 52.2%, aged over 30 days[12]. In another study, the chronological age of children ranged from 3 days to 9 months, with 80.6% of the population being screened before 3 months of age[13]. It is known that the Brazilian reality falls short from what it advocated by the NHSP of developed countries, however, taking into consideration premature infants and/or those with long periods of hospitalization, the examination can be performed until the third month of life of the infants in corrected age[10]. Considering that the study sample consisted of neonates and infants with RIHL and that a great part of them needed specialized attention and/or permanence in the NICU, it is justified the fact that the average age was higher, in relation to what is recommended. In addition, to the Health Secretary of Rio Grande do Sul State Government, the access to NHS occurs through the referral of health professionals from the SUS network[9], usually in the first consultation of the NB in the Basic Health Unit (UBS) and not before hospital discharge, that is, the NHS is scheduled via the central registry of the City Health Department. This way, there may be delays in the schedules of the newborns, which leads to the higher age verified[12].

It was observed that there are still challenges to be faced, such as the implantation of NHSP in hospitals with maternities and effective follow-up of infants with RIHL. Thus, it will be possible to reduce the large number of infants' evasion in the returns, identify late onset hearing loss and contribute to the effectiveness of the NHS coverage[14].

In view of the presented arguments, it was verified that this reality contributes in order to make the diagnostic process to occur later than the one recommended. In the Brazilian literature, it is possible to observe the late diagnosis, as in a study that was conducted in Belo Horizonte (MG), in which the average relation between the suspicion and confirmation of the hearing loss was of 4.2 months[13]. Another study showed that the average waiting time to start the use of the individual sound amplifier device (ISAD) was 26.5 months[15]. In a study carried out with the objective of analyzing the quality indicators of a selective neonatal hearing screening program in a philanthropic hospital in the city of São Paulo, the average age, in the beginning and in the end of the diagnosis, was 64.9 days (2.1 months) and 82.1 days (2.7 months), respectively, and the average age in the end of the diagnosis, was 5.1 weeks[16].

It is worth remembering that performing NHS in older children, often becomes more difficult, especially in cases where the BAEP-A is necessary, since the older child is more active than the NB, which can make the time to perform the exam longer, besides that the optimal conditions for exam effectiveness include quiet environment and neonate in natural sleep.

In the present study, the most frequent RIHL, in the first four years, was the stay in the NICU for more than five days, being the average number of days in intensive care was 17.8 days. In one publication, all the newborns from a public maternity hospital in MG were included, in the period between May 2011 and April 2013, and the average in the NICU was 22 days[17]. In another study, performed with a population born in a private hospital, the most frequent RIHL was the stay in the ICU for more than five days[18].

In the last year analyzed, the most prevalent RIHL was preterm birth. Generally, these RIHL are found in an associated way, as preterm neonates usually require intensive care. In a national study, the most frequent combination was the prematurity associated with NICU admission[19]. It is common for neonates to show the association of some RIHL, especially if they stayed in the NICU for more than five days[4]. It is known that multiple risk indicators increase the chance of compromising the auditory system and that the occurrence of hearing loss is higher in the group of children with these indicators[20,21].

In the current research, there were increases in the following RIHL: heredity, toxoplasmosis, syphilis, preterm birth and HIV. In a NHSP of a hospital in São Paulo, the records of 382 preterm infants were verified for four years, in order to compare the occurrence of RIHL over the studied period. One of the findings was the increase in the number of neonates who presented, as RIHL, family history/consanguinity[6]. Others authors have found family history of hearing loss as an isolated risk indicator with higher occurrence[19]. Preterm birth was verified in a study as the most prevalent RIHL[12]. Another study found that hearing loss had a higher occurrence in preterm NB[22]. On the other hand, the increase in cases of congenital infections may be related to the greater number of performed diagnoses, currently, performed through prenatal examinations. Taking into account what has been observed, these infections can cause HL in the neonate, even without presenting symptoms, and may be associated with the late onset and/or with the progression of the hearing loss already present at birth[6].

In 2015, the cases of congenital toxoplasmosis increased significantly, and in the following year, decreased. It is known that the prevalence of toxoplasmosis ranges from 20% to 90% in the whole human population. The main factors related to the number of cases are the geographical aspects, the risk conditions, which may vary between regions, such as feeding type, adequate water treatment and environmental exposure, being the best form of congenital toxoplasmosis prevention it is the use of precautionary measures[23]. A study carried out by the NHSP of MG, with 106 children diagnosed with congenital toxoplasmosis, showed that 60 of them had normal hearing (56.6%) and 46 had altered hearing; of these 46 children, 13 (12.3%) had conductive alterations, four (3.8%) had sensorineural hearing loss and 29 (27.4%) presented retrocochlear impairment. The comparison between children that presented other RIHL, besides toxoplasmosis, and children with toxoplasmosis only, showed no difference, suggesting that the altered audiological findings are only due to congenital toxoplasmosis. The authors concluded that, despite the early diagnosis and treatment, a high prevalence rate of hearing impairment was observed in the studied population[24].

The RIHL that reduced in the observed period were: ICU stay for more than five days, MV, use of ototoxic drugs, hyperbilirubinemia with need for exchange transfusion, Apgar score from "0" to "6" in the fifth minute, weight inferior to 1500g and syndromes genetics. A published study evidenced that the RIHL weighing less than 1500 grams, ototoxicity, exchange transfusion indication, and Apgar score from "0" to "6" in the fifth minute ranged randomly over the studied period. The use of MV has increased, and there is no data in the publication on ICU stay numbers and genetic syndromes[6].

In the present study, the most prevalent RIHL was NICU stay for more than five days, in 36.7% of the sample. This finding was similar to the study conducted in Porto Velho, Rondônia, where 37.7% of the NB stayed in the NICU[25]. Prematurity was also a RIHL with a high occurrence[12,26]. Findings have shown that the chance for a preterm infant to have hearing impairment is 1.35 times higher than that of a full-term child. In the literature, sensorineural hearing loss was identified in 0.82% of full-term NB and in 3.1% of preterm NB, that is, the chance of a preterm infant to present sensorineural hearing loss is almost double to a full-term newborn. The prevalence of hearing loss found in the general population was 5.97%, with the highest occurrence in premature children[22].

This study was limited to the verification of the RIHL occurrence. It was not possible to identify the number of children who presented hearing alterations, as well as the type of hearing loss, since children with altered BAEP-A are referred to other services of high complexity, so that the diagnosis can be concluded.

CONCLUSION

The study covered a period of five years, and in the first four years, the most frequent RIHL was the NICU stay for more than five days, constituting the most prevalent indicator in the sample, and decreasing it over the years. In the last year analyzed, the most recurrent RIHL was preterm birth, which increased in the evaluated period. Another finding worth mentioning is the increase in congenital infections such as syphilis, toxoplasmosis and HIV, showing the need of improvement in prevention programs for these diseases.

More and more, the RIHL research becomes critical to the knowledge about the auditory health of neonates and infants with risk indicators, once they are more susceptible to develop auditory impairments of retrocochlear origin, late and/or progressive onset. This way, the health network has how to properly plan, prevention and follow-up programs, aimed to decrease these intercurrences. It is important to point out the research of the HL etiologies, as well as the type of hearing loss resulting from each risk factor, in order to identify the alterations that affect the auditory nerve and/or the auditory pathways, besides factors that cause late auditory impairment, bearing in mind that these actions may contribute to the cost reduction of NHS in Brazil.

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