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Infants Hearing Assessment process after referring newborn hearing screening

Processo do diagnóstico audiológico de bebês após a falha na triagem auditiva neonatal

Proceso del diagnóstico audiológico de bebés después del fallo en la audición neonatal

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Abstract

Introduction: Hearing assessment is essential until the third month of life in order to enable early intervention, allowing the child's proper speech and language development. Nevertheless, this process faces several barriers that may delay its conclusion. **Purpose:** To investigate aspects in the hearing assessment process in infants who refers newborn hearing screening (NHS), describing the age at which screening and diagnosis were performed, the reasons for evasion or loss to follow up, and reasons for missing appointments during the process, reasons for delay in completing the diagnosis, and the audiological results of those who completed this process. **Methods:** This is a quantitative, descriptive, and observational study that was carried out at a hearing health center in São Paulo. The study analyzed 68 medical records from children who referred NHS, born in São Paulo city maternity hospitals, and then referred to a hearing health center, from January to June 2019. Data were analyzed based on the quality criteria established by national and international committees. **Results:** There was an adherence lower than expected for hearing assessment (76.5%); contact with parents using mobile phones, after missing the appointments, was not efficient (75%). NICU stay for more than five days was the most common risk indicator (25%). Half of the children analyzed process completed the diagnosis, 42.2% of the children were still in the process, and 7.7% were lost in the process. Most of the children who completed the diagnosis had some type and degree of hearing loss (65.4%). **Conclusion:** Although NHS is being performed as expected in more than 95% of the newborns, hearing assessment is not being completed in more than

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MBG: methodology conception, data collection and study outline.
SNF: study conception, methodology, data collection and critical review.
DRL: study conception, methodology, critical review and guidance.

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90% of the children who referred NHS. New strategies are needed in order to reduce loss to follow-up in the hearing assessment process.

Keywords: Diagnosis; Neonatal Screening; Lost to Follow-up; Hearing; Hearing Loss; Newborn

Resumo

Introdução: É imprescindível o diagnóstico audiológico até o terceiro mês de vida para que se possa iniciar uma intervenção precoce, permitindo que a criança desenvolva adequadamente a fala e a linguagem. Porém este processo enfrenta diversas barreiras que dificultam sua conclusão. **Objetivo:** Analisar o processo do diagnóstico audiológico em bebês que falharam na triagem auditiva neonatal, descrevendo a idade na realização da triagem e do diagnóstico, os motivos das evasões e faltas durante o processo, motivos para demora na finalização do diagnóstico, e os resultados audiológicos daqueles que finalizaram este processo. **Métodos:** Estudo quantitativo, descritivo, observacional, realizado em um Centro de Referência em Saúde Auditiva. Foram analisados os prontuários de 68 crianças que falharam na TAN, nas maternidades da Prefeitura Municipal de São Paulo, e encaminhadas para o Centro de Referência, no período de janeiro a junho de 2019. Os dados foram analisados com base nos critérios de qualidade estabelecidos por comitês nacionais e internacionais. **Resultados:** O serviço teve adesão abaixo do esperado no diagnóstico audiológico (76,5%) e o contato com os que evadiram, via telefone, não foi eficiente (75%). O indicador de risco com maior ocorrência foi a permanência na UTI por mais de cinco dias (25%). Das crianças que permaneceram no processo, metade concluiu o diagnóstico, o restante não tinha encerrado (42,2%) ou evadiu do mesmo (7,7%). A maioria das crianças que finalizaram o diagnóstico, apresentavam alguma perda auditiva (65,4%). **Conclusão:** O critério de qualidade não foi alcançado no comparecimento ao diagnóstico, sendo abaixo dos 90% recomendáveis. Novas estratégias necessitam ser tomadas, diminuindo a evasão no diagnóstico audiológico, dentre elas, outras formas de contato com as famílias e a integração entre atenção básica e os serviços de referência em Saúde Auditiva.

Palavras-chave: Diagnóstico; Triagem Neonatal; Perda de Seguimento; Audição; Perda Auditiva; Recém-nascido

Resumen

Introducción: La evaluación después de hacer referencia a la detección auditiva del recién nacido es una parte esencial del proceso y el proceso de diagnóstico debe terminar en el tercer mes de vida, con el fin de iniciar la intervención temprana, lo que permite el mejor desarrollo del habla y el lenguaje posible. Este proceso enfrenta varias barreras que pueden retrasar el deseo de la línea de tiempo. **Objetivo:** Analizar el proceso del diagnóstico audiológico en los bebés que fallaron en la detección auditiva, describiendo la edad en la que se realizó la selección y el diagnóstico, los motivos de evasión y ausencias durante el proceso, los motivos de la demora en la realización del diagnóstico y los resultados audiológicos correspondientes quien completó este proceso. **Métodos:** Estudio cuantitativo, descriptivo, observacional, realizado en un Centro de Referencia de Salud Auditiva. Se analizaron las historias clínicas de 68 niños que fallaron la detección auditiva en las maternidades de la Prefectura Municipal de São Paulo y se enviaron al Centro de Referencia, de enero a junio de 2019. Los datos se analizaron en base a los criterios de calidad establecidos por los comités nacionales e internacionales. **Resultados:** El servicio tuvo una adherencia por debajo de lo esperado en el diagnóstico audiológico (76,5%) y el contacto con los que escaparon, vía telefónica, no fue eficiente (75%). El indicador de riesgo con mayor ocurrencia fue la estancia en UCI por más de cinco días (25%). De los niños que permanecieron en el proceso, la mitad completó el diagnóstico, el resto no lo había terminado (42,2%) o lo había evadido (7,7%). La mayoría de los niños que completaron el diagnóstico tenían alguna pérdida auditiva (65,4%). **Conclusión:** No se alcanzó el criterio de calidad al momento de atender el diagnóstico, estando por debajo del 90% recomendado. Es necesario tomar nuevas estrategias, reduciendo la evasión en el diagnóstico audiológico, entre ellas, otras formas de contacto con las familias y la integración entre atención primaria y servicios de referencia en Salud Auditiva.

Palabras clave: Diagnóstico; Tamizaje Neonatal; Perdida de Seguimiento; Audición; Pérdida Auditiva; Recién Nacido

Introduction

Hearing skills are essential functions for the child to be able to properly develop speech and language abilities and the total or partial interruption of these functions may cause delay in the child's development[1-3]. Therefore, the early diagnosis of hearing loss combined with the immediate and appropriate speech-language pathology intervention can avoid delays not only in the process of children's literacy, but also in their psychosocial development[1-3].

There are many causes of hearing loss, requiring a thorough investigation so that intervention measures can be taken early[1-3]. As part of the Joint Committee on Infant Hearing (JCIH) 2019 update, it is recommended methods for screening, diagnosis and audiological monitoring, considering neonatal, progressive and late-onset hearing loss, including auditory neuropathy spectrum disorder[3]. This version recommendations also updated the Risk Indicators for Hearing Loss, by classifying them as perinatal and postnatal causes. The indicators are as follows: family history of early, progressive or late-onset hearing loss; NICU stay for more than 5 days; hyperbilirubinemia with exchange blood transfusion; aminoglycosides for more than 5 days; asphyxia/hypoxia; extracorporeal membrane oxygenation (ECMO); intrauterine infections, such as herpes, rubella, syphilis, toxoplasmosis, cytomegalovirus (CMV) and congenital ZIKA virus; craniofacial anomalies, including microtia/atresia, atrial dysplasia, cleft palate; congenital microcephaly and congenital or acquired hydrocephalus; abnormalities in the temporal bone; syndromes associated with hearing loss; viral and bacterial infections, including viral herpes, smallpox, meningitis or encephalitis; trauma to the temporal bone; chemotherapy; family concern about the child's language development.

The Universal Neonatal Hearing Screening (UNHS), which was published by Federal Law No. 12,303 of 2010[4], was an important milestone for the early identification of hearing loss, as well as for children's hearing health[2]. Screening should be a quick and simple process before hospital discharge and using physiological tests to identify possible hearing disorders in neonates[1-3]. There are different methodologies for children with and without risk factors. Thus, Otoacoustic Emissions (OAE) are used for children without risk, while the Automatic Auditory Brainstem Response (AABR) is used for children with risk factors in their medical history, due to the greater probability of presenting auditory neuropathy spectrum disorder[1-3]. The child who fails screening should be retested within 30 days after discharge and, if an unsatisfactory response is detected, the child should be referred for audiological hearing assessment and, when a hearing loss is identified, speech-language pathology intervention should be started immediately[1-3]

JCIH recommends an immediate intervention in infants with hearing impairment, indicating protocols and presenting quality criteria to measure the performance of early identification of hearing loss. The proposed criteria means to reach improvements in screening, diagnosis and intervention services[1,3]. Screening should be performed up to one month of age, except for children who remain in the NICU for a long period, in which screening should be performed as soon as possible. Then, the diagnosis must be completed by 3 months and the intervention must start the most at 6 months of age, in order to meet the criterion known as 1-3-6 EHDI Plan[1]. Services that meet the 1-3-6 EHDI Plan can try to achieve the 1-2-3 benchmark, enabling early intervention to start and facilitating diagnostic assessments, since the babies stay longer in natural sleep, when they are younger.[3]

The diagnosis that is carried out in hearing health centers allows the investigation of a hearing loss through a battery of tests, including a specific evaluation in four frequencies (500 Hz, 1000 Hz, 2000 Hz and 4000 Hz), both by air and bone conduction, whenever necessary[1,5]. Estimation of hearing thresholds must be obtained by electrophysiological and electroacoustic tests, such as ABR with click stimulus and frequency specific stimuli, OAE, and Tympanometry with 1000 Hz probe. These tests do not depend on the infants' subjective response, since young children are unable to respond to acoustic stimuli in a reliable manner[3]. The intervention should start as soon as the hearing loss is identified, and rehabilitation should include parents' guidance and support, and hearing aids adaptation, if necessary.

Due to the various tests that imply natural sleep, scheduling follow-up visits is common, in order to continue hearing assessments and, therefore, family adherence is essential [6].

Evasions or missing appointments, in the different stages of neonatal hearing health pro-

gram, can impact in the quality assurance and, consequently, for children's development because of undiagnosed losses present [7-12]. Because some families do not attend the hearing assessment appointments for different reasons, the identification and search of strategies that could minimize loss to follow up would bring benefits to families and health services[6,7,13]. In certain cases, families need to deal with the possibility of the newborn having a hearing loss along with other comorbidities[11,14]. In addition, social, economic and cultural factors can be reasons for loss to follow up in any clinical care[6,9]. Therefore, families should be informed about hearing loss[3,7,8] with information about each stage of the neonatal hearing health program. Parents must understand which rights are guaranteed, as well as benefits of early identification of hearing loss, including the importance of speech-language therapy, when necessary[6-8].

Knowing the importance of early identification, diagnosis and intervention of hearing loss, and the recommended quality criteria regarding each step of this process, this study aimed to analyze the hearing assessment process for infants after referring newborn hearing screening, describing the ages when UNHS and hearing assessment was concluded, reasons for loss to follow up, reasons for delays in completing hearing assessment, and hearing status of those who completed this medical and audiological process at a hearing health center in São Paulo City.

Methods

This is a quantitative, descriptive and observational study including documentary analysis of medical records, in the "diagnosis" session, of newborns and infants who referred UNHS in maternity hospitals in São Paulo City. Infants were referred to Centro Audição na Criança (CeAC/DERDIC), which is a Hearing Health Center accredited by the Ministry of Health to perform hearing assessment and intervention in young children. CeAC receives children referred from any region of São Paulo City, despite being a reference for South and North regions.

This study is part of a set of data collection from students from the "Child in Hearing" research group at the Post Graduation Program in Audiology and Speech-Language Pathology at PUC-SP under the guidance of Professor Doris Ruthy Lewis, and approved by the Research Ethics Committee under CAAE no. 91750618.0.0000.5482.

Infants were chosen by a convenience method, because they were scheduled for hearing assessment at the hearing health care center from January to June 2019.

The worksheet with identification data of infants who referred UNHS and were scheduled for hearing assessment was made available by the hearing health center. Mobile/Telephone contacts were made with the families of children who missed the assessment appointment in order to identify the reason for the absence, and a new date for this appointment was offered. At the same time, medical records from children who attended the appointments were analyzed, in order to collect data for age when beginning the assessment process, child's risk factors, missing appointments, hearing status, and loss to follow up during this process.

Collected data were entered into an Excel spreadsheet for descriptive and inferential statistical analysis. Then, the following data was crossed and analyzed: I) Attendance and loss to follow up at hearing assessment; II) Child age when referred to the hearing health center; III) Child age when hearing assessment was completed and analyzed according to JCIH (2007 and 2019) recommendations; IV) Reasons for the loss to follow up during hearing assessment; V) Association among age at the beginning and conclusion of the hearing assessment process; VI) Association between the number of risk factors and the child's age when assessment was ended; VII) Reasons for the child's hearing assessment process having not been completed yet; VIII) Result of the children's audiological diagnosis, divided into four categories: normal, sensorineural hearing loss, conductive hearing loss and mixed hearing loss; IX) Association between the duration of the diagnosis and the categories of the audiological results.

The Mann-Whitney U test was performed to compare the child's age in the referral with the group who attended all the process and the group who missed the appointment. The Student's t-test was used to compare the mean ages of children at the end of the diagnosis in the groups with and without risk factors. In turn, the Mann-Whitney U test was also used to obtain the duration of the hearing assessment; and Spearman's rank correlation coefficient was used to calculate the correlation between the diagnosis duration and the child's age

at referral. The Kruskal-Wallis Test investigated the association between the duration of the assessment and the result by category of hearing status. The choice between techniques in the analysis of quantitative variables was based on the preparation of normal probability graphs. A significance level of 5% ($p<0.05$) was adopted for all analyses.

Results

This study includes results from January to June 2019. The sample consisted of 68 children, being 30 (44.1%) female and 38 (55.9%) male. As for attendance, 52 children attended the hearing assessment process (76.5%) and 16 were lost to follow up in the first appointment (23.5%).

The mean age for children who attended the hearing assessment is lower than that observed in the group who was lost to follow up (Table 1). However, there was no difference between the age distributions when age in which the child was referred for assessment was considered, for both categories (p-value=0.800), indicating that attendance is not associated with age on referral.

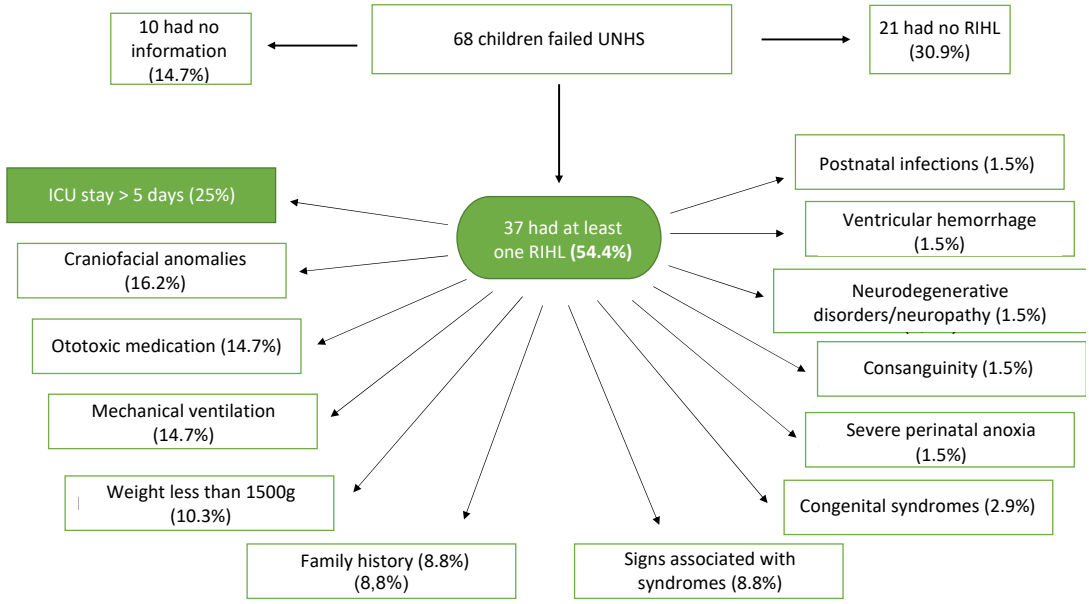
Table 1. Descriptive summary of the child's age at referral (days) according to attendance at diagnosis.

Attended the diagnosis	N	Mean	Standard deviation	Minimum	Median	Maximum
No	16	62.3	35.0	21.4	54.4	116.4
Yes	52	70.5	71.4	13.4	45.4	339.0
Total	68	68.6	64.6	13.4	45.4	339.0

Legend: *Mann-Whitney U test; N=number of subjects.

As for the presence of risk factors, 21 infants (30.9%) had no risk factors, 37 (54.4%) had at least one risk, and there was no information for 10 children (14.7%), because of loss to follow up in the first appointment, and no data was possible to find for some children. The most prevalent risk indicator was NICU stay for more than 5 days (25%), followed by craniofacial abnormalities (16.2%), ototoxic drugs (14.7%), mechanical ventilation (14.7%) and birth weight below 1500 g (10.3%). Other risk factors were reported in less than 10% of the children: family history, and signs associated with syndromes (8.8%); congenital syndromes (2.9%); severe perinatal anoxia, consanguinity, neuropathies/neurovegetative disorders, ventricular hemorrhage and postnatal infections, with 1.5% for each indicator. The same infant can present more than one risk factor and, therefore, the total number of risks is greater than the total number of children. The following flowchart provides a better understanding of presence/absence of risk factors and their distributions (Figure 1).

For 16 children who did not attend the first appointment for assessment, telephone contact was not possible for 12 (75%) families, and four reasons were listed for missing the appointment: parents made an option to attend a private clinic in order to perform the hearing assessment (6%); mother informed that the appointment date was not given when the child referred NHS (6%); mother was sick in the appointment scheduled (6%); the mother answered the phone, but decided to hang up during the call (6%).



Legend: UNHS=Universal Neonatal Hearing Screening; RIHL=Risk Indicators for Hearing Loss; ICU=Intensive Care Unit.

Figure 1. Flowchart of Risk Indicators for Hearing Loss (RIHL) of children referred for audiological diagnosis.

For 52 children who attended the appointments, 26 (50%) completed the whole process, 22 (42.3%) have not yet completed the diagnostic, and 4 (7.7%) were lost to follow up during the process. The researchers tried to contact these 4 children's families, but for 2 children (50%) the contact was not possible; another mother hung up the phone during the call (25%); and one child's mother reported that the child has finished the hearing assessment, the results were normal (25%), meaning a loss for documentation category in this case.

The medical records of the 22 children were analyzed in order to understand the reasons the children had not yet completed the diagnosis; it could be noticed that 11 (50%) children were difficult to test due to craniofacial anomalies, difficulties to sleep during the test, or they used hospital devices, among others, which made it impossible to complete the diagnosis; 4 missed the appointment and new dates were rescheduled (18%); 1 was sick (5%); 1 was hospitalized (5%); and 5 were classified as "other" (23%).

The study prepared a descriptive summary including children's age, for those who completed the diagnosis (Table 2), and another one regarding the child's age at diagnosis according to the occurrence of the risk factors (Table 3). Table 3 shows that the total number of children is 25 (and not 26, as reported in Table 2) because no information of a risk indicator was found for one child who completed the diagnosis. Although the children's mean and median age at the end of the diagnosis was higher for the group with risk factors than for the group with no risks, there was no significant difference (p-value=0.126).

Table 2. Descriptive summary of the child's age at the end of the diagnosis (days).

N	Mean	Standard deviation	Minimum	Median	Maximum
26	122.6	70.3	35	98	292

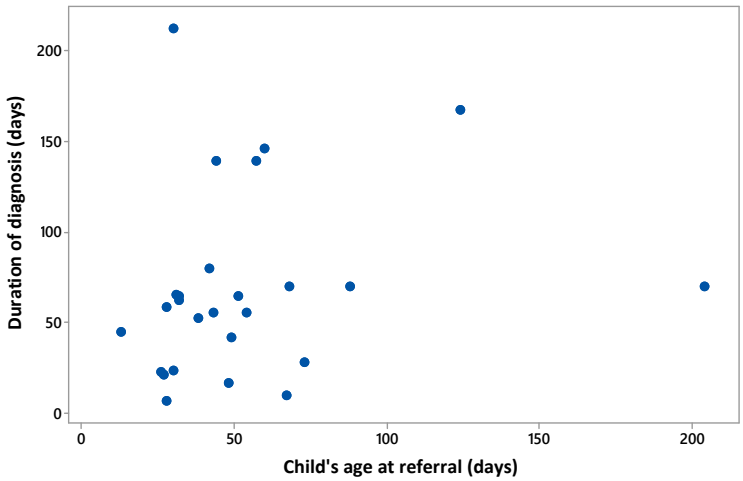
Legend: N=number of subjects.

Table 3. Descriptive summary of the child's age at the end of the diagnosis (days) according to the presence of risk indicator..

Risk indicator	N	Mean	Standard deviation	Minimum	Median	Maximum
No	7	97.0	36.0	48	95	158
Yes	18	133.9	79.7	35	100	292
Total	25	123.6	71.5	35	99	292

Legend: *Student's t-test; N=number of subjects.

Nevertheless, a trend was observed when analyzing the child's age at referral from the maternity to the assessment, and the duration of the diagnosis (Figure 2). It can be observed that the later the children are referred to assessment, the diagnostic conclusion can last longer. The value of the Spearman's rank correlation coefficient of the two variables is 0.38 (p-value=0.054), that is, a marginal p-value was obtained in the correlation coefficient significance test.



Legend: *Spearman's rank correlation coefficient.

Figure 2. Dispersion diagram of the child's age at referral and the duration of the diagnosis.

At the end of the diagnosis, 9 (34.6%) children had normal results and 17 (65.4%) had some type of hearing loss, being 14 children with bilateral hearing loss (82.4%) and 3 with unilateral hearing loss (17.6%) (Table 4).

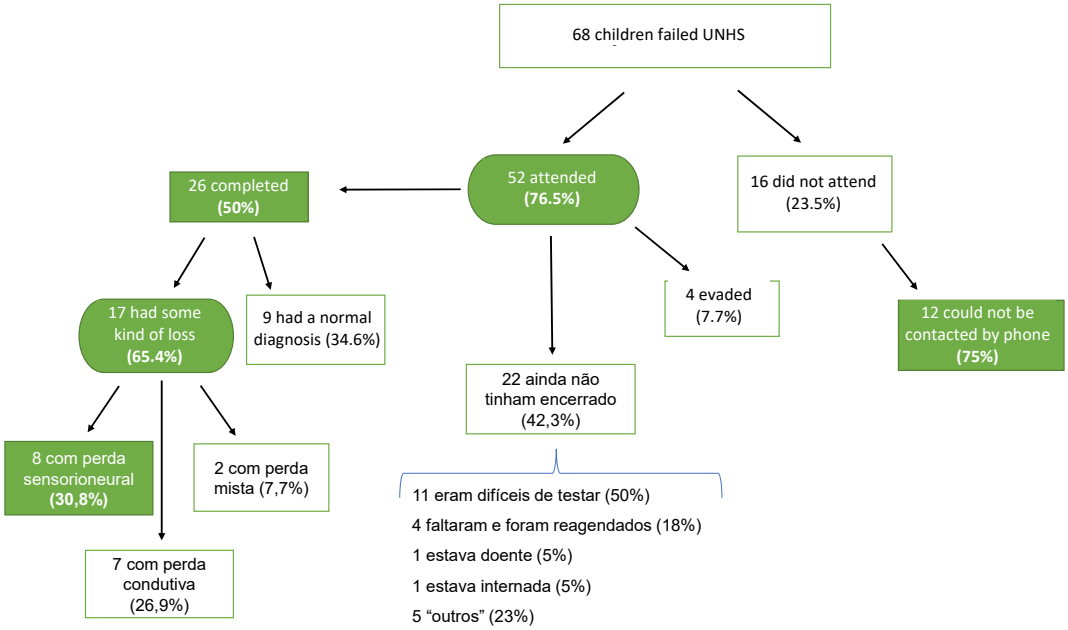
Table 4. Distribution of frequencies and percentages of the diagnostic result.

Diagnostic result	N	%
Normal	9	34.6
Conductive hearing loss	7	26.9
Mixed hearing loss	2	7.7
Sensorineural hearing loss	8	30.8
Total	26	100

Legend: N=number of subjects; %=percentage.

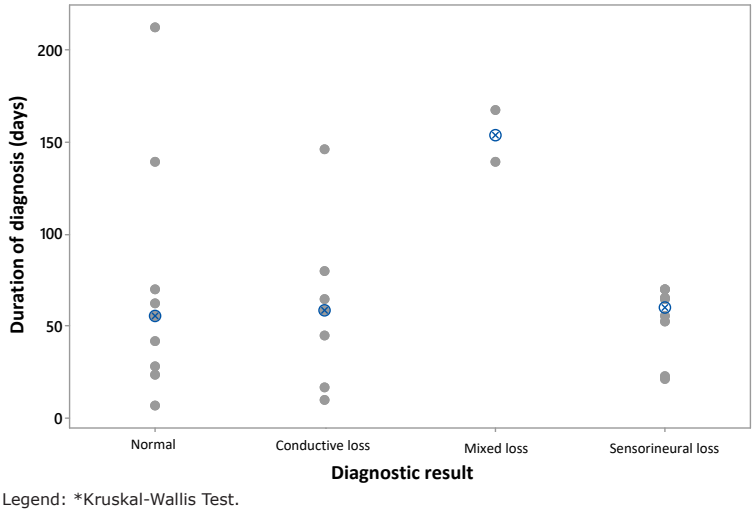
In order to understand the process performed in the diagnosis, Figure 3 shows a flowchart with attendance, miss to follow up at the first appointment and throughout the process, and diagnostic conclusion.

When analyzing the individual and median values of the duration of the diagnostic process, the duration was longer for those with mixed hearing loss when compared to the other types of loss (Figure 4). There was also a great variability in the duration of the diagnosis when the result was normal. There was no difference between the distributions of diagnosis duration in the four results categories (p-value=0.252).



Legend: UNHS=Universal Neonatal Hearing Screening.

Figure 3. Flowchart of the audiological diagnosis process.



Legend: *Kruskal-Wallis Test.

Figure 4. Individual and median values of the duration of the diagnosis in each category of the diagnosis result.

Discussion

Although the study sample is small and the statistical significance has not been evidenced, the results show a trend in the aspects investigated.

Of the 68 children who failed UNHS and were referred for diagnosis, 52 (76.5%) attended and 16 (23.5%) missed the first appointment. According to the proposed quality criteria[1,2], this rate was below the 90% attendance recommended by JCIH and COMUSA. Loss to follow up is present in all stages of the child hearing health program[6,9], negatively impacting the immediate intervention of those who have hearing loss. In Belo Horizonte, the evasion in the retest of the UNHS and in the reassessment of those who passed the screening and had some RIHL was 28.1% and 67.7% respectively, which influences the time required in the following stages of the program[12]. Other countries do not differ from the reality found in Brazil, as in the USA, which reported an evasion rate of 31.1% of the families in the diagnostic process between 2014 and 2016[7].

The descriptive summary (Table 1) shows a median age of 45.4 days for children referred for diagnosis. Therefore, infants had about a month and a half of life when they arrived for the diagnosis, thus exceeding the quality criteria established by international and national recommendations[1-3]. The maximum age at referral was 339 days for a child who had several risk factors, such as NICU, mechanical ventilation, ventricular hemorrhage and use of ototoxic drugs. However, hospital discharge occurred before one month, which is not consistent with the delay of almost a year to reach a diagnosis. This delay may have occurred due to the child's health problems, leading to the non-completion of the diagnosis. It should be noted that no data were found in the medical records that showed the reasons for the delay in diagnosis and loss to follow up. In this case, the active search carried out by Primary Care would be essential to support the child as soon as possible, and, consequently, to carry out the hearing assessment. Studies have shown that the lack of communication with the family about the neonatal hearing screening program, personal family problems, distance from the diagnosis site, lack of professionals' knowledge about hearing loss, additional health problems and sociodemographic aspects can increase family loss to follow up at any stage of the child hearing health program[3,6,9,11,14,15].

Loss to follow up in the process between the maternity hospital and the hearing health service may be due to a number of reasons, from the occurrence of several risk indicators, to the lack of understanding of the failure of UNHS and the consequences of hearing loss[6,9,11]. Before hospital discharge, it is important that professionals can talk about UNHS, diagnosis and child hearing loss, and its consequences, as families need to understand the importance of the program, so that there is a reduction in loss to follow up [6,7,9,15].

Regarding children who have at least one risk factor (54.4%), the NICU stay for more than five days is reported to be more frequent, as it is showed by several studies[10,16,17]. It was noted that the majority of children who were admitted to the NICU and used ototoxic drugs were low-weight newborns and/or that used mechanical ventilation. Babies with risk factors are expected to have a higher incidence of refer in UNHS and referrals for diagnosis, as well as a higher incidence of hearing impairment[14,17]. A study carried out in a Taiwan hospital[17] investigated the risk associated with low birth weight and found that severe perinatal asphyxia, craniofacial anomalies, mechanical ventilation and the use of ototoxic drugs contributed to hearing impairment in neonates[17].

In the present study a contact was tried in order to investigate the reasons why families missed the first appointments (23.5%). Telephone contact was not possible for 12 (75%) of the 16 children who missed the appointment, and this same difficulty in contacting families via telephone is reported by other studies[7,15]. One of the studies made telephone calls for families of children with risk factors who needed audiological monitoring, but 25% of the families could not be reached through the telephone numbers offered. The difficulty in contact would be explained by the difficulty in the area for coverage of telephone operators, with poor network signals, and by the constant changes in telephone numbers[15].

There were four more loss to follow up (7.7%) after the beginning of the diagnosis process. These children who missed the test scheduled after the second appointment never returned to the service. The percentage of evasion found in the study should be understood as an alert for the search of new adherence strategies. Aiming to seek strategies to decrease the "loss to follow-up" (LTFU), and loss in audiological follow-up, Georgia's

early identification and intervention program in the United States included text messages as a way of contacting parents of the children who missed the appointment. The initiative resulted in a good response from families to remember the date of the new appointment[7].

This study also analyzed children who did not complete the diagnosis (42.3%), since it is necessary to understand this high rate and identify possible difficulties For this, the factors that could impact the delay in completing the diagnosis were identified in the medical records and it was observed that 50% of these children were considered difficult to test, as they had craniofacial anomalies; used hospital devices, such as tracheostomy and gastrostomy; were premature; had malformations; had difficulty sleeping during audiological assessments and/or had a very small ear canal or head. In these cases, the diagnostic service team must be trained to care for children with these adverse conditions[3], and sedation could be used to complete the tests in some cases. In addition, it is important to note that there were also absences in scheduled appointments and rescheduling, probably due to the children's health condition, significantly affecting the conclusion of the diagnosis[1,3].

A study conducted in Canada identified the reasons for late or incomplete diagnosis in children who failed UNHS and reported that the delay in completing the diagnosis was associated with children's comorbidities, interfering with completion before three months of life. One third of the children studied had additional disabilities and 46.7% of the 30 children had associated syndromes or stayed in the NICU for more than five days[11].

Regarding the children who attended the diagnosis, 26 (50%) completed the process, which is below the 90% recommended [1]. The median age of the children at the conclusion of the diagnosis was 98 days, or about three months, indicating that the children who completed the diagnosis met the quality criteria established by the JCIH (2007), which recommends completion of the diagnosis by the infant's three months of life[1]. According to these data, the service has not yet reached the 1-3-6 EHDI Plan in 90% of children who failed UNHS and therefore cannot progress to the 1-2-3 benchmark yet. Thus, the service must develop strategies to improve the quality of the program for the benefit of the program and the children[1,3].

Even with the median age of the child at the conclusion of the diagnosis following the recommendations of the JCIH (2007), there were cases that exceeded the recommended target. A maximum age of 292 days was found in the survey of age at the conclusion of the diagnosis, which requires investigation of episodes that may have impacted the conclusion of the diagnosis before three months[11]. In this specific case, the child was hospitalized for three months in the NICU, being referred to the stage of diagnosis four months after birth. During the diagnosis process, the occurrence of diseases led to missed appointments and rescheduled appointments, which may have negatively affected the time to complete the diagnosis and start the intervention. In another case, a child was referred for diagnosis at 30 days and completed after 243 days. When analyzing the medical record and the dates when the child was present to carry out the evaluations, it was found that the child evaded for three months during the process. However, the medical records do not provide information on the reason for absences, as investigating the reasons for the absence in the scheduled appointments is not part of the institution's routine. Contact with families via text message and/or active search through primary care could have mitigated the long period of evasion[8].

The dispersion diagram (Figure 2) that relates the child's age at referral and the duration of the diagnosis shows a trend in increasing the duration, according to the increase in age at referral. Thus, the greater the age at the time of referral, the longer the diagnosis will be completed, since these children undergo electrophysiological tests, which require natural sleep for a prolonged time. When children grow up, they stay awake longer, thus increasing the difficulties in being able to carry out assessments in natural sleep[3].

In turn, the results of the audiological diagnosis show that 65.4% of the children had some type of hearing loss, reporting a higher frequency for sensorineural hearing loss, permanent, and requiring immediate intervention after diagnosis. Therefore, the UNHS is essential so that timely diagnosis and intervention may be provided to assist in the global development of children with hearing loss[1-3]. The study also found that children who had mixed hearing loss needed more time to complete the diagnosis (Figure 4). This can be explained by the fact that the changes in the middle ear affect the diagnosis and

demand a longer evaluation, with bone transducers, which cause the child to wake up frequently. There is already a study that shows that middle ear conditions and late diagnosis are directly related[11], which suggests a delay in the speech-language pathology intervention process and, consequently, in the child's development.

This study showed that other aspects, such as additional health problems, difficulties sleeping during the tests, and ineffective contact by phone with families who are missing scheduled tests, can result in evasion or late completion of the audiological diagnosis. These conditions will affect early intervention and, consequently, the language development of these children. Therefore, the search for strategies to optimize care with greater effectiveness in contact with families scheduled for the baby's audiological diagnosis after the failure in UNHS would bring benefits to children and services.

In addition, the application of telecommunications technology to the delivery of speech-language pathology could bring numerous benefits in the early diagnosis of deafness, as the continuing education of professionals in Primary Care, Family Health Teams (ESF) and maternity hospitals, together with the hearing health reference services, could assist in the identification of children who evade at any stage of the process, both in the retest after the failure in the screening, and in the diagnostic process. In this way, there would be the necessary integration between the different levels of health care, constituting a truly integrated network of health care for newborns and young children.

Conclusion

Infants' attendance at audiological diagnosis was below the recommended rate by international and national scientific communities.

The attempt to find the reason for absences in diagnostic appointments via telephone contact with families was not efficient, requiring an investigation of strategies that prove to be effective in the active search for these babies who missed appointments.

Although the ages at the conclusion of the diagnosis are partially within the established criteria, there is a great variability of reasons that lead to an increase in the time necessary for the completion of the diagnosis.

The results of the audiological diagnosis showed that the majority of children had hearing loss, with a higher occurrence of sensorineural hearing loss.

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