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Analysis of newborn hearing screenings from 2018-2022

Ahmet Aksoy[a,*], Baris Sapci[a], Melek Kekul Sapci[b]

[a] *Cumhuriyet University, Faculty of Medicine, Department of Otorhinolaryngology, Sivas, Türkiye*
[b] *Cumhuriyet University, Faculty of Medicine, Education and Research Hospital Audiology Unit, Sivas, Türkiye*

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Abstract

Aim: This study aims to assess the Newborn Hearing Screening (NHS) program conducted in Sivas province between 2018 and 2022. The main objectives include determining the percentage of infants who failed the screening, investigating potential reasons, and outlining the follow-up and treatment procedures for infants diagnosed with congenital hearing loss.

Materials and Methods: This study analyzed the outcomes of otoacoustic emissions (OAE) and screening Auditory Brainstem Response (ABR) in infants undergoing newborn hearing screening. We analyzed the prevalence of congenital hearing loss and identified associated risk factors in affected infants. It also documented the types and rates of treatments administered to infants diagnosed with hereditary hearing loss.

Results: Of 6,585 babies, 27.12% failed the first hearing screening, and 15.5% failed the subsequent screening. During the second screening, 45 babies failed the tests and underwent clinical Auditory Brainstem Response (ABR) testing. We detected congenital hearing loss in 45 infants. Among these,23 infants were fitted with hearing aids, 12 underwent cochlear implantation, and 10 followed up. As a result, the rate of congenital hearing loss in infants was 0.68%.

Conclusion: Recent 5-year data on newborn hearing screening shows congenital hearing loss of 0.48% for bilateral hearing loss and 0.68% for total hearing loss, aligning with existing literature. Screening initiatives are crucial in identifying hearing loss early and integrating individuals into society through interventions that restore hearing functions while preserving cognitive development.

Introduction

A deficiency in hearing results in defects in language, speech, adaptability, and communication skills. The absence of normal hearing in the neonatal period can profoundly affect speech, language development, and cognitive, social, and emotional growth [1]. Congenital hearing loss affects around 1 in 1000 live births, with a higher frequency in high-risk groups [2,3]. Newborns may be at risk of hearing loss due to various factors. These include premature birth (gestational age ≤34 weeks), low birth weight (<1500 g), being born to deaf parents, TORCH infections, neurological disorders, hyperbilirubinemia, craniofacial anomalies, known syndromes associated with hearing loss, and severe birth asphyxia (APGAR score below seven at 5 minutes). Around 3-5% of newborns were reported to be at risk of permanent hearing loss [3].

Every year, over 500,000 babies are born with significant hearing loss. Delayed diagnosis can negatively impact their language and speech skills, and this can have an adverse effect on their academic progress [4]. A child with moderate hearing loss who does not use auditory amplification may miss up to 50% of daily conversations [5]. Early diagnosis of hearing loss in newborns is crucial because the best treatment outcomes are obtained within the first three months after birth. Early intervention before the baby reaches six months old is advisable if hearing loss is detected. It is not uncommon for families to overlook profound hearing loss in infants during their early years, while mild or moderate hearing loss may not be noticeable until the child reaches school age. Surveillance tests for hearing have been implemented to help identify hearing impairments early on [6]. The United States and other Western countries introduced newborn hearing surveillance programs in the late 1990s. Marmara University began implementing these programs in Turkey in 1996, initially at the hospital level. The first official protocol was signed in 2004 and became mandatory nationwide in 2007 [5,7]. Sivas State Hospital initiated hearing screenings in 2007,

*Corresponding author:
Email address: ahmetaksoy@cumhuriyet.edu.tr (Ahmet Aksoy)

and from May 2010 onwards, Sivas Cumhuriyet University actively conducted screenings.

The initial hearing screening tests for infants include Transient Evoked Otoacoustic Emissions (TEOAE) and screening Auditory Brainstem Response (ABR). If a baby fails these tests twice, it will undergo clinical ABR testing to determine if it has congenital hearing loss. If a diagnosis confirms hearing loss, hearing aids should be recommended. Cochlear or brainstem implants are suggested for infants without hearing aids [5,7].

We aimed to analyze the Newborn Hearing Screening (NBST) programs conducted in Sivas province between 2018 and 2022, determine the proportion of infants who failed screening, and reveal the predisposing factors that may contribute to this outcome. It also aims to present the follow-up and treatment procedures for infants diagnosed with congenital hearing loss.

Materials and Methods

Following the approval of the institutional review board for scientific ethical conduct (2023-06/26) and the Ethics Committee of Sivas Provincial Health Directorate (2023/24), a retrospective evaluation of the hearing screening results was conducted for infants referred to our clinic, serving as the reference center for Newborn Hearing Screening (NHS), between 2018 and 2022. This research included infants admitted to the neonatal intensive care unit from other hospitals within or outside the city and those born in our hospital and undergoing hearing screening. A certified nurse conducted the hearing screenings, and at the reference center, two audiometry technicians and two audiologists performed the audiology tests. Before February 2019, the newborn screening test involved TEOAE. The test serenely took place with the baby in a natural sleep and well-fed state in a quiet and calm environment, either in the mother's arms or on a flat surface.

The sample size of this study was determined retrospectively based on the total number of infants who underwent the Newborn Hearing Screening (NHS) program at our reference center between 2018 and 2022. A total of 6,585 newborns were screened during this period. No separate sample size calculation was required since all eligible newborns within the specified timeframe were included. Instead, a complete enumeration sampling method was employed, meaning that every infant who met the inclusion criteria was included in the study. This methodology eliminates potential sampling bias and enhances the generalizability of the findings.

As this study includes all infants who underwent screening at the reference center within the specified period, it did not utilize a probabilistic or non-probabilistic sampling approach but followed a census-based methodology. The study ensured a robust dataset free from selection bias by incorporating the entire screened population. It provided findings that accurately represent the outcomes of neonatal hearing screening in the region.

The Maico ERO Scan analyzer (GmbH Salzufer, 13/14, 10587, Berlin, Germany) conducted the TEOAE test. We selected the probes based on the baby's external ear canal size. The test results displayed "PASS" on the screen for ears that responded and "REFER" for those that did not. The screening test was successful if it automatically detected a "PASS" result. We utilized the TEOAE test to take bilateral measurements during hearing screenings. If we could not obtain a unilateral or bilateral emission response, we duly informed the families of the infants and requested that they undergo a retest after 15 days. During subsequent appointments, infants who did not pass the unilateral or bilateral TEOAE test underwent an examination to determine any potential influences on the test results. This examination involved an assessment of factors such as middle ear effusion and external ear canal pathologies through an otoscopic examination. After conducting this evaluation, we retested the infants.

In cases where the TEOAE test did not yield successful results in the initial two follow-ups, we recommended that individuals seek additional screening at our reference center. Our comprehensive screening procedure involved an ABR evaluation, administered with the aid of the GN Otometrics ICS Chartr EP 200 device from Denmark. The result of this assessment is defined as a "pass" or "fail." In writing, we communicated screening results to families and recorded the data in follow-up forms. Various parameters, including the gender of screened infants, birth weight, delivery method, neonatal unit stay, gestational age, place of birth (our university or referred location), TEOAE test results, and other records, such as ABR, were evaluated if available. Since February 2019, ABR has been used to assess hearing functions. Measurement was conducted using the MB 11 BERAphone Maico® device within 72 hours after birth, before the mother and baby were discharged. The reference value for the measurement was set at 35 dB nHL. A response at 35 dB nHL was considered a "PASS" when confirmed during the test. In cases where no response was obtained or could not be established, the test result was recorded as "REFER." The screening process utilized a "PASS" outcome as the success benchmark, with measurements conducted in both ears in sequence. If the result was unsuccessful, they scheduled a follow-up appointment after 14 days. Before the second test, an ear examination was performed to evaluate potential issues with the middle ear or external ear canal that could impact the results. Infants who did not pass the second test were referred to our reference center for further assessment due to suspected hearing loss.

Inclusion criteria for this study consisted of all newborns who underwent the Newborn Hearing Screening (NHS) program at our reference center between 2018 and 2022, regardless of their risk status. Both infants born in our hospital and those referred from external hospitals were included, provided they completed at least one stage of the screening process.

Exclusion criteria included infants who did not undergo any NHS testing, those with incomplete medical records preventing verification of hearing test results, and those whose parents declined participation in follow-up assessments. Infants lost to follow-up were recorded separately and not included in the final prevalence and statistical analyses dataset. However, their numbers are documented for transparency.

Newborns referred from external hospitals were managed

following the same standardized screening protocol as those born in our hospital. All infants, regardless of birthplace, underwent otoacoustic emissions (OAE) screening as a first step. If an infant failed the initial screening, a second test was performed within 15 days. Infants who failed the second screening were referred for clinical Auditory Brainstem Response (ABR) testing at our reference center.

To minimize potential selection bias, the data from referred infants were analyzed separately for comparative purposes. However, due to the standardized testing and follow-up protocol applied across all cases, significant procedural differences were not observed.

The study aimed to determine the percentage of infants who failed either TEOAE or screening ABR tests during the NHS and later underwent clinical ABR testing. The study also investigated the types and degrees of hearing loss among infants who underwent clinical ABR. Furthermore, the study determined the percentage of congenital hearing loss and identified risk factors for infants with recognized hearing loss. We reported the types and rates of treatments administered to infants with hereditary hearing loss.

Statistical analysis

Statistical analyses were conducted using Statistical Software Package for Social Science for Windows, version 22.0 (SPSS v22) (IBM Corp., Armonk, NY, USA, Licensed Software). As the study included only categorical variables, descriptive statistics were presented as frequencies and percentages (n, %). A chi-square test was used to examine the relationships between categorical variables. The Fisher-Freeman-Halton Exact Test was used when the assumption of expected cell frequencies greater than five was unmet. A p-value less than 0.05 was considered statistically significant.

Results

Between 2018 and 2022, 4,799 infants (72.88%) successfully passed the first hearing screening, whereas 1,786 infants (27.12%) required further evaluation. In the second screening, 1,509 infants (84.5%) passed, while 277 infants (15.5%) remained in the screening process. Infants who did not pass the second screening underwent clinical Auditory Brainstem Response (ABR) testing, where 232 infants were identified as having normal hearing, and 45 infants were diagnosed with congenital hearing loss. The flow chart of the patients is summarized in Figure 1.

Table 1. Treatment Modalities used in infants with congenital hearing loss, n(%).

Types of Treatment	Infants with Congenital Hearing Loss
Hearing aid rehabilitation	23(51.1)
Cochlear implant	12(26.7)
Follow-up	10(22.2)
p*	**0.038**

*: Chi-Square Test.

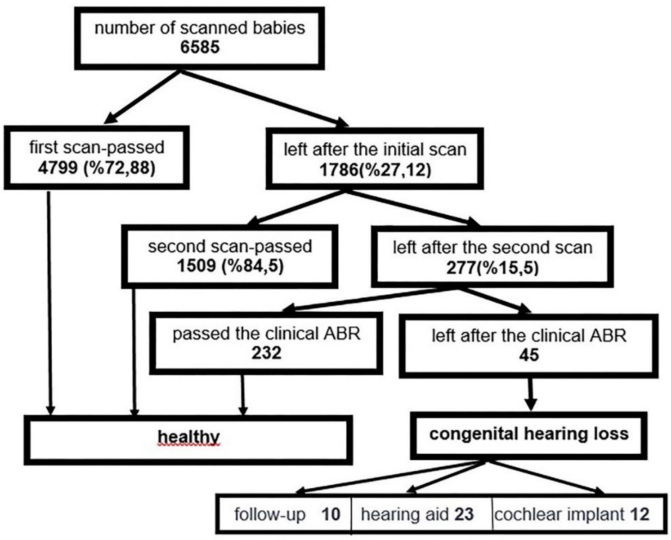

Figure 1. Results of newborn hearing screenings, [6192 screening ABR, 391 screening OAE, 45/6585=percentage of congenital hearing loss (%0.68)].

The study evaluated the 45 infants diagnosed with congenital hearing loss in depth. Thirty-one (68.9%) were male, and 14 (31.1%) were female. The analysis of treatment modalities applied in infants with congenital hearing loss revealed that hearing aid rehabilitation was the most frequently utilized method, accounting for 51.1% (n = 23) of cases (Table 1). Cochlear implantation was performed in 26.7% (n = 12) of the infants, while 22.2% (n = 10) were placed under follow-up without immediate intervention.

A chi-square test indicated a statistically significant difference in the distribution of treatment modalities; hearing aid was the most frequent treatment modality among the study group (p = 0.038). This finding suggests that selecting treatment methods is not random and may be influenced by specific clinical criteria, such as the severity of hearing loss, anatomical suitability for cochlear implantation, or other patient-related factors.

The distribution of the risk factors for congenital hearing loss between male and female infants is summarized in Table 2. Statistical analyses revealed no significant associations between congenital hearing loss risk factors and gender (p=1.000). Specifically, no significant differences were observed in prematurity, low birth weight (<1500 g), history of intensive care (≥5 days), family history of hereditary hearing loss, or craniofacial anomalies between male and female infants. These findings suggest that gender is not a determining factor in developing congenital hearing loss.

The relationship between treatment methods and gender was not statistically significant (p = 0.911) (Table 3). This finding suggests that gender is not a determining factor in selecting treatment methods. Similarly, no statistically significant association was observed between birth weight categories and the applied treatment methods (p = 0.450). Furthermore, the relationship between gestational age and treatment methods was not statistically significant (p = 0.681). Additionally, no significant association was found between the four prematurity classifications based on gestational age and the treatment methods administered (p =

Table 2. Risk factors for hearing in newborns according to gender, n(%).

Risk Factors for Infants with Congenital Hearing Loss	Male	Female	p
Premature	5(15.6)	1(20.0)	1.000[&]
Birth weight less than 1500 g	5(15.6)	1(20.0)	
Hyperbilirubinemia	0(0.0)	0(0.0)	
History of intensive care unit stay (more than five days)	9(28.9)	1(20.0)	
History of phototherapy	0(0.0)	0(0.0)	
Consanguineous marriage of parents	0(0.0)	0(0.0)	
Family history of hereditary hearing loss	7(21.9)	1(20.0)	
Craniofacial anomaly	5(15.6)	1(20.0)	
History of bacterial meningitis	0(0.0)	0(0.0)	
History of Ototoxic Drugs	0(0.0)	0(0.0)	
Apgar scores below four at 5 minutes	0(0.0)	0(0.0)	
The child with syndromic features along with congenital hearing loss	1(3.1)	0(0.0)	

[&]: Fisher Freeman Halton Exact Test.

Table 3. Treatment methods.

Variables	Hearing Aid	Implant	Follow-up	p
Gender, n(%)				
Male	15(65.2)	9(75.0%)	7(70.0)	0.911[&]
Female	8(34.8%)	3(25.0%)	3(30.0)	
Birth weight, n(%)				
Normal delivery	18(85.7)	6(60.0)	8(88.9)	
<1000 g	0(0.0)	1(10.0)	0(0.0)	0.450[&]
1000 -1500 g	1(4.8)	0(0.0)	0(0.0)	
1500 -2500 g	2(9.5)	2(20.0)	1(11.1)	
Over 4000 g	0(0.0)	1(10.0)	0(0.0)	
Birth week, n(%)				
Miad	17(73.9)	9(75.0%)	6(60.0%)	0.681[&]
Preterm	6(26.1)	3(25.0%)	4(40.0%)	
Gestational age, n(%)				
Term (38-42 weeks)	17(73.9)	9(75.0)	6(60.0%)	
Preterm (36-37 weeks)	3(13.0)	0(0.0)	4(40.0%)	0.193[&]
Moderate preterm (32-35 weeks)	1(4.3)	1(8.3)	0(0.0)	
Extremely preterm (24-31 weeks)	2(8.7)	2(16.7)	0(0.0)	

&: Fisher Freeman Halton Exact Test.

Table 4. Distribution of risk conditions in infants with congenital hearing loss, n(%).

Risk Factors for Congenital Hearing Loss in Infants	Number of Infants
No risk	21(46.7)
Intensive care unit stay for more than 5 days	3(6.7)
Family history of hearing loss	6(13.3)
Presence of Craniofacial anomalies involving the middle ear and need for intensive care unit stay for more than 5 days.	2(4.4)
Earlobe anomalies, ear canal anomalies, family history of hearing loss	5(11.1)
Earlobe anomalies	1 (2.2)
Prematurity, low birth weight, and need for intensive care unit stay for more than 5 days.	6(13.3)
Maternal diseases during pregnancy (hypothyroidism, hypertension, and gestational diabetes)	1(2.2%)
p*	**0.000**

*: Chi-Square Test.

0.193). These results indicate that factors such as preterm birth or low birth weight do not have a decisive impact on treatment selection.

This study examined the distribution of risk factors in infants with congenital hearing loss (Table 4). Among the 45 infants included in the analysis, 21 (46.7%) had no identified risk factors. However, various risk factors were detected, including a history of intensive care stay exceeding five days (6.7%), a family history of hearing loss (13.3%), and middle ear and craniofacial anomalies combined with

Table 5. Risk factors of the study group.

Variables	No Risk	Prolonged ICU stay >5 days	Hearing loss in family	Craniofacial Anomalies, Prolonged ICU Stay >5 days	Ear Anomalies, Family History of Hearing Loss	Anomalies of the auricle	Prematurity, Low Birth Weight, Prolonged ICU Stay >5 days	Pregnancy-related maternal diseases	p
Gender, n(%)									
Male	11(52.4)	3(100.0)	5(83.3)	2(100.0)	4(80.0)	1(100.0%)	5(83.3)	0(0.0)	0.352&
Female	10(47.6)	0(0.0)	1(16.7)	0(0.0)	1(20.0)	0(0.0%)	1(16.7)	1(100.0)	
Birth weight, n(%)									
Normal birth	17(94.4)	3(100.0)	4(80.0)	2(100.0)	5(100.0)	1(100.0)	0(0.0)		
<1000 g	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(16.7)	0(0.0)	
1000 -1500 g	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(16.7)	0(0.0)	**0.002**&
1500 -2500 g	1(5.6)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	4(66.7)	0(0.0)	
Over 4000 g	0(0.0)	0(0.0)		0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	
Birth week, n(%)									
Miad	17(81.0)	2(66.7)	5(83.3)	2(100.0)	5(100.0)	1(100.0)	0(0.0)	0(0.0)	**0.001**&
Preterm	4(19.0)	1(33.3)	1(16.7)	0(0.0)	0(0.0)	0(0.0)	6(100.0)	1(100.0)	
Gestational age, n(%)									
Term (38-42 weeks)	17(81.0)	2(66.7)	5(83.3)	2(100.0)	5(100.0)	1(100.0)	0(0.0)	0(0.0)	
Preterm (36-37 weeks)	4(19.0)	1(33.3)	1(16.7)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(100.0)	**0.001**&
Moderate preterm (32-35 weeks)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(33.3)	0(0.0)	
Extremely preterm (24-31 weeks)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	4(66.7)	0(0.0)	

&: Fisher Freeman Halton Exact Test, ICU; Intensive Care Unit.

a prolonged intensive care stay (4.4%).

Additionally, a combination of earlobe anomalies and a family history of hearing loss was observed in 11.1% of cases. Prematurity, low birth weight, and prolonged intensive care admission were collectively identified in 13.3% of the infants. The presence of maternal diseases during pregnancy, such as hypothyroidism, hypertension, and gestational diabetes, was noted in 2.2% of cases.

A chi-square test revealed a statistically significant difference in the distribution of risk factors ($p = 0.000$).

The relationship between various demographic and perinatal characteristics and the presence of risk factors for congenital hearing loss was analyzed (Table 5). The absence of risk factors was more frequently observed in male infants (52.4%) than in females (47.6%), but this difference was not statistically significant ($p = 0.352$).

Birth weight was significantly associated with risk factors ($p = 0.002$). Infants with normal birth weight (2500–4000 g) had the highest proportion of cases without identified risk factors (44.4%). In contrast, all infants with extremely low birth weight (<1000 g) and very low birth weight (1000–1500 g) had at least one risk factor, with some requiring prolonged intensive care stays. Additionally, infants with birth weight over 4000 g exhibited a higher prevalence of risk factors such as prematurity and intensive care admission.

Gestational age at birth was also significantly related to the presence of risk factors ($p = 0.001$). Full-term infants ($\geq$38 weeks) had the highest proportion of cases without risk factors (81%), whereas preterm infants, particularly those born at $\leq$31 weeks, showed an increased likelihood of risk factors, including prolonged intensive care stays and prematurity-related complications. Notably, all infants born at 24–31 weeks exhibited at least one risk factor, with 66.7% requiring intensive care for more than five days.

Additionally, maternal diseases during pregnancy, including hypothyroidism, hypertension, and gestational diabetes, were more prevalent in preterm births, particularly among infants requiring neonatal intensive care. The association between maternal diseases and risk factors for congenital hearing loss approached statistical significance ($p = 0.06$).

Discussion

Delayed diagnosis and treatment of congenital hearing loss have been shown to negatively impact the speech functions of infants, resulting in delayed language development and affecting their cognitive and behavioral growth [1,4,5]. It is crucial to prioritize the timely diagnosis and treatment of congenital hearing loss to mitigate the potential adverse outcomes and optimize the overall development of the infants. The American Academy of Pediatrics has recommended that infants be screened for hearing before three months and initiate any necessary treatment before six months of age in individuals with abnormal hearing tests [1-4].

Advanced objective tests are employed to evaluate hearing functions in infants during screenings. Two commonly used methods are Otoacoustic Emissions (OAE) and ABR screening. The OAE device, developed by David Kemp in 1978, evaluates the portion of the auditory pathway up to the outer hair cells in the cochlea. In contrast, the auditory pathways from the cochlear nerve to the brainstem are assessed through stimulus in the auditory brainstem. Otoacoustic emissions are an objective measurement based on recording waves generated in the cochlea in response to sound stimuli. However, debris in the ear canal, earwax, or inflammation in the middle ear can adversely affect OAE measurements. Screening ABR can be conducted more quickly; however, clinical ABR demands more time and technical expertise [1,4]. OAE and ABR tests are commonly used to evaluate different hearing domains.

Maris et al. [8] conducted a retrospective analysis on infants who failed the newborn hearing screening. They concluded that ABR should be the preferred method for newborn hearing screening due to its higher prevalence in detecting auditory neuropathy/dysynchrony [8]. The congenital hearing loss rate is reported to be between 0.1% and 0.6% [2,6].

We found the rate of congenital hearing loss in our region to be close to the literature, being 0.68%, with a bilateral rate of 0.48%. Ohl et al. [3] determined the rate of permanent hearing loss to be 3-5% and attributed this high rate to the presence of high-risk groups [3]. Genç et al. [5]reported that 0.2% of the 5485 infants had bilateral severe hearing loss. A large-scale study conducted in Japan reported a prevalence of congenital hearing loss at 1.62 per 1,000 newborns (0.162%), with bilateral cases accounting for 0.84 per 1,000 (0.084%) and unilateral cases at 0.77 per 1,000 (0.077%). Notably, these rates are lower than those in our study [9]. A systematic review of European neonatal hearing screening programs reported a prevalence of bilateral hearing loss ranging from 0.5 to 20.94 per 1,000 newborns. Most screening programmes achieved coverage rates exceeding 90% [10]. Between July 2018 and September 2020, 7,287 neonates in China were screened for hearing loss, revealing a prevalence of 3.43 per 1,000 (0.343%). Of the 25 confirmed cases, 68% (17 cases) had bilateral hearing loss (0.23% of all neonates), while 32% (8 cases) had unilateral hearing loss (0.11% of all neonates) [11]. The estimated prevalence of permanent bilateral hearing loss is 1.33 per 1,000 live births in regions with universal newborn hearing screening programs. In contrast, areas without such programs have higher prevalence rates, with 19 per 1,000 in sub-Saharan Africa and 24 per 1,000 in South Asia [12]. The observed variations in prevalence rates among the studies may be attributed to differences in study design, screening protocols, diagnostic criteria, population demographics, and healthcare infrastructure across regions.

The presence of risk factors for hearing functions in infants increases the rate of congenital hearing loss. Ototoxic medication, prematurity, low birth weight, and staying in the intensive care unit for more than seven days are reported as significant risk factors [6]. Acar et al. [2] investigated the risk factors in newborns with congenital hearing loss. They identified mechanical ventilation, family history of hearing loss, and consanguineous marriage as the most important risk factors [2].

In infants with congenital hearing loss, we observed that the most important risk factors were a family history of hearing loss, low birth weight, prematurity, and staying in the intensive care unit for more than five days. Sabbagh et al. [13] reported that premature babies (<35 weeks) had an increased risk of sepsis due to a weaker immune system, making them more susceptible to various infections and increased the risk of hearing loss. Additionally, they reported that ototoxic drugs, gestational diabetes, seizures, hyperbilirubinemia, low birth weight, consanguineous marriage, family history of hearing loss, staying in the intensive care unit for more than five days, and craniofacial anomalies further increased the rate of congenital hearing loss [7,13-16]. A study from Beijing found that 55.7% of newborns referred from hearing screening had confirmed hearing loss, highlighting the impact of comprehensive screening and risk factors such as craniofacial anomalies and low birth weight [17]. Karaca et al. [4] added that vaginal delivery and infections during pregnancy were additional risk factors for newborn hearing loss [4].

Throughout the history of hearing screening protocols, studies were initiated as school screenings and eventually extended to early periods of life. Kemaloğlu et al. [18] conducted a study on hearing screening, reporting that approximately 88% of newborns underwent NHS testing in 2013. They stressed the need for an extra hearing screening program for children in developing nations like Turkey to address factors such as infections, trauma, and ototoxicity [18]. The national hearing screening program estimates that screening can be performed in 95% of newborns, and the objective is to increase this rate [19].

Authorities report a hearing screening test conduct rate between 96-98% in Sivas province. It is crucial for infants diagnosed with hearing loss to undergo hearing rehabilitation before the age of 6 months. Eligible cases should receive hearing aids. Similarly, for infants who do not benefit from hearing aids, timely implant surgery (cochlear or brainstem implant) is necessary to enhance the child's cognitive, behavioral, and hearing functions more efficiently [2]. Among the patients, 23 received hearing aids, 12 underwent cochlear implantation, and the remaining were followed up.

Rockwell et al. [20] found that 16.2% of infants monitored in their institutions could not receive proper monitoring during the pandemic. Another research study conducted in the Maryland region of the United States reported that around one-third of infants who failed their hearing screenings in 2020 and an estimated three-fourths of those who failed in 2021 did not complete their follow-up hearing screenings or seek any follow-up care after being referred for a newborn hearing screening. The researchers emphasized that hearing screening programs across the United States were disrupted in many institutions during the COVID-19 pandemic [20,21].

The COVID-19 pandemic may have affected the newborn hearing screening program during the years covered by our study. According to information from authorized institutions, the infant hearing screening rates in Sivas decreased

from around 95% to 90%, similar to the nationwide trend during the COVID-19 pandemic in Turkey. Due to the increased workload on healthcare professionals during this period, it is essential to identify infants who were not screened for hearing loss. If hearing loss is detected later, prompt action can be taken immediately, even if the child has already started school.

The absence of immittance measurements for infants and the inability to access detailed information on risk factors for individuals with congenital hearing loss constitute the limitations of this study. In a retrospective study conducted by Bora et al. [22] between 2015 and 2017, evaluating 3490 newborns over 24 months, they reached TEOAE results for 2312 cases (66.2%), while 1178 cases (33.8%) did not have accessible test results. The study highlighted the incomplete nature of demographic data and emphasized the importance of the data recording system [22]. Given the still high rates of congenital hearing loss, screening data should be processed meticulously to ensure early diagnosis and treatment.

Limitations

The absence of extensive data on family history, prenatal factors, and environmental risks restricts the study. Its retrospective design impacts the thoroughness and reliability of its results. Additionally, being confined to a single province may not sufficiently represent national or international evaluations of neonatal hearing loss.

Conclusion

Implementing the hearing screening program in our country has been systematic and practical. A comprehensive analysis of newborn hearing screening data in our province over the last five years has indicated a congenital hearing loss rate of 0.48% for bilateral hearing loss and 0.68% overall. This rate aligns with findings reported in relevant literature. Early intervention is crucial for developing auditory functions and improving cognitive development. As a result, individuals with hearing loss can be integrated into society.

Disclosures

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