

## Prevalence of sensorineural hearing loss in newborns in a hospital from a developing country

### Prevalencia de hipoacusia neurosensorial del recién nacido: hospital en un país en vía de desarrollo

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#### ABSTRACT

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**Objective** This study aimed to determine the prevalence of nonsyndromic congenital sensorineural hearing loss at the Hospital Universitario San Ignacio, Bogotá, Colombia, and to describe the risk factors associated with this condition.

**Materials and Methods** A prospective, observational cross-sectional study with bivariate analysis was conducted. A three-phase process using the Otoacoustic Emissions test screened all live newborns between June 2013 and June 2014. Negative cases were confirmed by Automated Auditory Brainstem Response test.

**Results** A total of 962 newborns were screened with Otoacoustic Emissions test bilaterally: 401 males (46.36%), 464 females (53.64%). The mean weight was 2 798.10 g (95%CI: 2 766.51 - 2 839.76). The mean height was 48.60 cm (95%CI: 48.38 - 48.79). The mean age was 16.24 days (95%CI: 15.47 - 17.01). The mean maternal age was 27.37 years (95%CI: 26.76 - 27.98). There was a family history of hearing loss in 9.48% of the cases (n=90), and a family history of genetic diseases in 100 cases (10.56%). There were 14 cases of TORCH infections (1.45%), 375 admissions to the NICU (39.06%), 160 cases of neonatal jaundice (20.1%), and 79 cases of postpartum infections (8.21%). One live newborn presented with microtia.

**Conclusions** The prevalence of congenital sensorineural hearing loss was 0.31% in both ears, and 0.11% in one ear. Currently, Colombia lacks a public universal newborn hearing screening program, and its future implementation faces great challenges.

**Key Words:** Hearing loss; newborn; mass screening; hearing tests (*source: MeSH, NLM*).

#### RESUMEN

**Objetivos** Este estudio busca determinar la prevalencia de la hipoacusia neurosensorial congénita no sindrómica en el Hospital Universitario San Ignacio de Bogotá, Colombia, y describir sus factores de riesgo.

**Materiales y Métodos** Estudio observacional, transversal y prospectivo con análisis bivariado. Todos los nacidos vivos entre junio de 2013 y junio de 2014 fueron tamizados con Emisiones Otoacústicas. Los casos negativos fueron confirmados con Potenciales Evocados Auditivos de Tronco Cerebral.

**Resultados** Un total de 962 neonatos fueron tamizados de forma bilateral con Emisiones Otoacústicas: 401 de sexo masculino (46,36%) y 464 de sexo femenino (53,64%). El peso promedio fue de 2 798,10 g (IC95%: 2 766,51 – 2 839,76). La talla promedio fue de 48.60 cm (IC95%: 48,38 - 48,79). La edad promedio fue de 16,24 días (IC95%: 15,47 - 17,01). La edad materna promedio fue de 27,37 años (IC95%: 26,76 - 27,98). Se encontró historia familiar de hipoacusia en 9.48% de los casos (n=90) e historia familiar de enfermedades genéticas en 100 casos (10,56%). Hubo 14 casos de infecciones por TORCH (1,45%), 375 admisiones a la UCI Neonatal (39,06%), 160 casos de ictericia neonatal (20,1%) y 79 casos de infecciones postnatales (8,21%). Un nacido vivo presentó microtia.

**Conclusiones** Se encontró una prevalencia de hipoacusia neurosensorial congénita del 0,31% en ambos oídos y de 0,11% en un oído. Actualmente Colombia carece de un programa nacional de tamización de hipoacusia neonatal, y su futura implementación conlleva grandes retos.

**Palabras Clave:** Pérdida auditiva; recién nacido; tamizaje masivo; pruebas auditivas (*fuentes: DeCS, BIREME*).

**C**ongenital sensorineural hearing loss (CSNHL) is the most prevalent sensory impairment in newborns (1). It affects approximately 2-4 per 1 000 live births in developed countries (2), with a prevalence of 3-4 per 1 000 for mild or unilateral cases, and 1 per 1 000 for profound bilateral hearing loss (3,4). This means that its frequency is higher than that of congenital metabolic disorders, like phenylketonuria or sickle cell disease (2,5). In neonatal intensive care units (NICU), its incidence increases to 2.1%-17.5% (4). Hearing loss is classified based on the average thresholds obtained at 500, 1 000, and 2 000 Hz: mild: 21-40 dB HL; moderate: 41-70 dB HL; severe: 71-90 dB HL; profound >91 dB HL (1).

CSNHL has been associated with genetic causes in approximately 50% of the cases, and with environmental factors in the remaining 50% (1,2). Regarding genetic cases, two-thirds (66%) are caused by nonsyndromic hearing loss, and one-third (33%) by syndromic hearing loss in association with more than 600 different syndromes and 125 genes (2).

About 75% of syndromic CSNHL cases have an autosomal recessive inheritance pattern, and the most common syndromes are Usher syndrome, Jervell & Lange Nielsen syndrome, and Pendred syndrome (1). However, inherited nonsyndromic genetic causes of CSNHL represent a more relevant group, being associated with mutations in more than 150 different loci (1,6). Approximately 37% of nonsyndromic CSNHL cases are related to an autosomal recessive mutation in gene GJB2 (gap junction beta-2), which codes for connexin 26 (cx 26), a gap junction protein (cell-to-cell channels) found in cochlear cells that facilitates potassium transport in the endolymph (1,6). Some studies report the most common etiology of CSNHL is unknown (37.7%), followed by nonsyndromic genetic type (29.2%), prenatal (12%), perinatal (9.6%), postnatal (8.2%), and syndromic genetic type (3.2%) (7). 30-50% of unknown cases may actually be associated with nonsyndromic causes, specifically with mutations in the connexin 26 gene (7).

In utero infections, specifically TORCH (toxoplasmosis, syphilis, rubella, cytomegalovirus, herpes simplex virus 2), are an important environmental cause of CSNHL. Cytomegalovirus is responsible for most intrauterine infections and has been associated with almost one-third of CSNHL cases (8). Toxoplasmosis is also a known risk factor; 15-

25% of children with untreated toxoplasmosis will develop CSNHL (8). Neonatal sepsis is also known to cause permanent damages in the inner ear of infants, especially when it is accompanied by premature rupture of membranes, premature birth, or maternal fever during labor (8).

The consequences of hearing loss in children are catastrophic. It is known that moderate hearing loss of at least 40 dB distorts the patient's perception of voices, including the perception of their own voice, affecting language production (8). Children with undetected hearing loss may have delayed speech and language development (9,10). An early diagnosis of CSNHL has a great impact on the quality of life of children with CSNHL, since it has been observed that if hearing loss is treated early, it improves communication skills (11). For this reason, in developed countries, universal newborn hearing screening programs (UNHS) are promoted for early detection and prompt intervention (12).

In 1972, the Joint Committee on Infant Hearing was founded in the United States (US), listing the risk factors associated with CSNHL: family history of hearing loss, intrauterine infections, craniofacial abnormalities, birth weight less than 1 500 grams, severe hyperbilirubinemia (requiring exchange transfusion, since kernicterus affects the cochlear nuclei and inferior colliculus), ototoxic medications, bacterial meningitis, APGAR score (less than 4 at 1 minute or less than 6 at 5 minutes), prolonged mechanical ventilations of more than 5 days, and syndromic causes (13). The Joint Committee on Infant Hearing recommends that all infants should be screened for hearing loss no later than 1 month of age (14), while the American Academy of Pediatrics proposes a target of 95% of newborn population for this screening program (15).

Currently, both the Otoacoustic Emissions (OAE) and the Automated Auditory Brainstem Response (AABR) tests are used as screening tools for hearing loss (9,12). OAE are sounds generated by outer hair cochlear cells in response to specific sound stimuli, measured by a sensitive microphone placed in the ear. They are spontaneous and reflect the proper functioning of the outer hair cells in the organ of Corti. OAE responses may be spontaneous (physiologic response) or evoked (response for a specific stimulus), and do not differentiate the severity of hearing loss. They are considered positive (pass) when hearing is above 30 dB and negative (fail when

the hearing capacity is below this threshold, no matter the degree of hearing loss. Therefore, OAE do not detect mild hearing loss, and are specifically designed to detect moderate to severe hearing loss. OAE have 80 to 90% sensitivity and 90% specificity (9,16), are affordable, easy and quick to perform, and do not require sedation (12). In addition, OAE are generally cheaper than AABR, which are more accurate but take longer to perform (6). A two-step approach with OAE followed by AABR has demonstrated to have a sensitivity of 91.7% for the detection of newborn sensorineural hearing loss (12,17).

Currently, Colombia lacks a public UNHS program, being only limited to private institutions (9), and there still are great challenges to implement it (10). The DANE (National Statistics Administrative Department) has reported a prevalence of auditory disability in 5 per 1 000 habitants in the general population (9). In 2005, a law was passed regarding the rights of people with hearing impairments, and it put forth the need of a UNHS in article 43. However, statistical data regarding congenital hearing loss is insufficient to establish a UNHS in the country, as well the equipment, professionals and financial resources necessary to this end (10). Since 2013, the Department of Otolaryngology at Hospital Universitario San Ignacio (HUSI) has implemented a mandatory hearing screening program using Otoacoustic Emissions (OAE) for every child born at the institution.

The present study aimed to study the prevalence of CSNHL in nonsyndromic children born at HUSI, given the great impact it has on their psychosocial and cognitive development. In addition, it sought to determine the presence of the risk factors for hearing loss described in literature for this population. Finally, proposals are made to improve the newborn hearing screening program for early detection of CSNHL.

## MATERIALS AND METHODS

### Research design

A prospective, observational cross-sectional study with bivariate analysis was conducted from June 2013 to June 2014 at Hospital Universitario San Ignacio, in Bogotá, Colombia.

### Sampling

All live births between June 1, 2013 and June 1, 2014 at Hospital Universitario San Ignacio were included in the study. During this period, 2 091 infants were born alive in the institution; however, only 962 neonates took part of the mandatory hearing screening program. They were all screened using OAE and their data were collected. All

neonates with a known syndromic disease were excluded from the study since the objective was to determine risk factors in nonsyndromic children. The data of each patient were collected and entered into a database, from which the statistics of the study were obtained.

Since 2013, all newborns born at Hospital Universitario San Ignacio undergo hearing screening tests freely and independently from this study. However, the low coverage of our hearing screening program (46%, with only 962 participants out of 2 091 total live births) might be due to several reasons: first, the existence of a separate pre-term child care program in our institution, where patients receive a hearing screening test independently from our program; the lack of parental awareness and education on the relevance of this disorder; socioeconomic or transportation difficulties in the patient's social support network; lack of commitment of the medical and nursing staff.

An informed consent was obtained from every parent and/or caregiver. All the ethical procedures and international and national norms were followed according to the Declaration of Helsinki and Resolution 8430 of the Ministry of Health and Social Protection of Colombia. Moreover, the study was approved by the Research Committee from the School of Medicine of the Hospital Universitario San Ignacio.

### Instruments

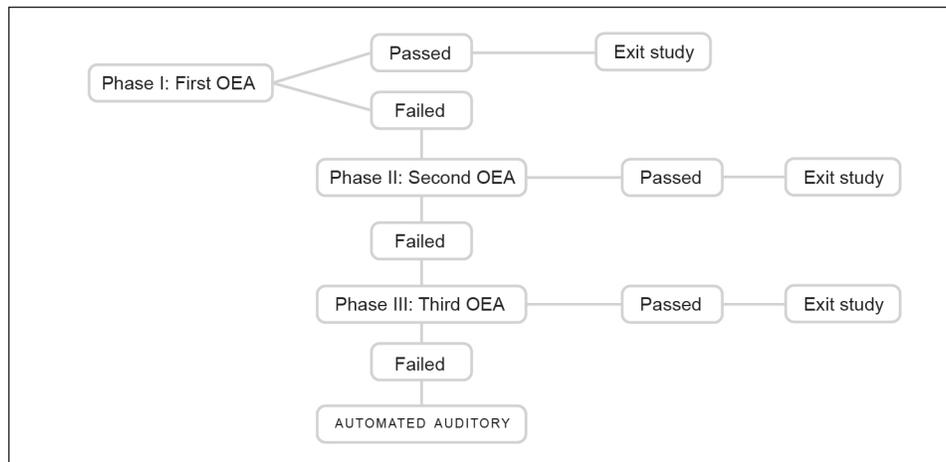
Throughout the study, every caregiver of the live newborns that attended the hearing screening procedure with OAE at our institution was asked to fill up a questionnaire oriented to identify known risk factors for CSNHL (Table 1). The result of the hearing screening test was also documented. This questionnaire was performed by the audiologist, along with the parent and/or caregiver, during the same appointment of the hearing screen test. Every time the patient attended, the result of the test was recorded in a new questionnaire.

The hearing screening was done in phases (Figure 1). The first OAE done to the patient was Phase I. Children who did not pass the initial test (or failed), advanced to Phase II, where a new OAE was performed 3 months after the initial one. Again, children who did not pass Phase II test were re-evaluated at Phase III, performing a third OAE to the patient 3 months after the second one. In the cases where the last OAE result was negative, an AABR was performed to confirm the diagnosis of hearing loss. On the contrary, the test was not repeated in the cases that passed the first screening phase. Nevertheless, the parents and/or caregiver were educated for signs that would raise the suspicion of decrease of communication abilities of the infant.

**Table 1.** Questionnaire for congenital sensorineural hearing loss

Name of the patient:	
Medical record identification number:	
Mother’s name:	
Telephone number:	
Date of birth:	
Sex: male: female:	
Age of screening (days):	
Otoacoustic emissions results:	
Right ear: passed: failed:	
Left ear: passed: failed:	
1. Is there a family history of deafness?	
Yes: No:	If yes, please specify who:
2. Is there a family history of genetic disease?	
Yes: No:	If yes, please specify who:
3. Did you have any of the following infections during pregnancy? Toxoplasmosis: Cytomegalovirus: Rubella: Syphilis: Herpes: HIV:	
4. Did the newborn have jaundice at birth?	
Yes: No:	If yes, did the newborn require exchange transfusion?
Yes: No:	
5. Did the newborn weight less than 1500 grams at birth?	
Yes: No:	Weight at birth (grams):
Height at birth (centimeters):	
6. Did the newborn require orotracheal intubation?	
Yes: No:	If yes, please specify number of days:
7. Did the newborn require admission to the Neonatal Intensive Care Unit?	
Yes: No:	If yes, please specify number of days:
8. Did the newborn present any postnatal infection?	
Yes: No:	If yes, please specify which:
If yes, please specify which antibiotic he/she received:	
9. Did the newborn present any head trauma?	
Yes: No:	If yes, please specify when:

**Figure 1.** Study phases



**Variables**

The variables included in the questionnaire, and used for the subsequent analysis, were: sex, age at screening, height and weight at birth, maternal age, family history of hearing loss, family history of genetic disease, TORCH infections, severe neonatal jaundice that required treatment with exchange transfusion, non-severe jaundice, birth weight less than 1 500 g, requirement of mechanical

ventilation and duration in days, requirement of neonatal care unit and duration in days, postnatal infections and postnatal exposure to antibiotics, head trauma after birth, and Otoacoustic Emissions results (passed or failed).

**Statistical analysis**

For quantitative variables, a statistical analysis was obtained by calculating the measures of central tendency

(means and standard deviations) with a 95% confidence interval. Statistical analysis for qualitative variables included the evaluation of frequencies in percentages for categorical variables, as well as a bivariate analysis looking for associations between the frequency of abnormal screening results with known risk factors for CSNHL. The chi-square test, along with the measures of central tendency, was performed with STATA 12. A p-value < 0.05 was considered statistically significant.

## RESULTS

During the period from June 1, 2013 to June 1, 2014, a total of 2 091 infants were born alive at the Hospital Universitario San Ignacio. Data were obtained from 962 newborns that attended the hearing screen program on outpatient consultations at our institution during this period of time, that is, 46% of the total live newborns. An OAE was performed to all of the children that underwent the hearing screening (first phase) and had the questionnaire filled by the caregiver. It was not possible to acquire data from the rest of the infants born during this year, since they did not attend the hearing screening session.

The population screened during the first phase included 962 patients, 401 males (46.36%), 464 females (53.64%), and 97 cases with no gender specified on the questionnaire or clinical records. The mean age of the participants at the time of screening was 16.24 days (95%CI: 15.47-17.01). The mean maternal age was 27.37 years (95%CI: 26.76-27.98).

Regarding the known risk factors for CSNHL, only 9.48% (n=90) of the patients had a positive family history of hearing loss: 2 of them from a first-degree relative (mother), and the rest from second-degree relatives and beyond. There was a positive family history of genetic diseases in 10.56% (n=100) of the cases. The prevalence of TORCH infections was of 1.45% (n=14), with 64.29% cases of toxoplasmosis (n=9), 21.43% (n=3) of congenital syphilis, 7.14% cases (n=1) of herpes simplex and HIV, respectively; there were no reported cases of rubella or cytomegalovirus. None of the patients had a history of severe jaundice, kernicterus, nor requirement of exchange transfusion. Nevertheless, 20.1% (n=160) of the patients had a history of neonatal jaundice that was not severe.

The mean weight of the study population at birth was 2 798.10 g (95%CI: 2 766.51 – 2 839.76), of which 2.71% (n=26) weighted under 1 500 g. The mean height at birth was 48.60 cm (95%CI: 48.38-48.79). There were 38 cases (4.38%) that required orotracheal intubation and mechanical ventilation, with a mean duration of intubation of 2.57 days (95%CI: 1.62-3.53). There were 375 patients

(39.06%) admitted at the NICU, with a mean stay of 7.56 days (95%CI: 6.64-8.48), secondary to prematurity, lung immaturity, hypoglycemia, or jaundice. 79 patients (8.21%) had some type of infection at birth, and all were treated with wide spectrum antibiotics, mainly aminoglycosides. The most common reported infection was early-onset or late-onset neonatal infection (n=43, 54.43%), followed by pneumonia (n=11, 13.92%). Lastly, one live newborn presented with microtia, and there were no cases of cranioencephalic trauma. Tables 2 and 3 summarize the population characteristics.

**Table 2.** Population characteristics - qualitative variables

Variables	Frequency	Percentage
<b>Sex</b>		
Male	401	46.4
Female	464	53.7
Not reported	97	10.1
<b>Intubation</b>		
Orotracheal intubation	38	4.4
None	829	95.6
Not reported	95	9.9
<b>Neonatal intensive care unit (NICU)</b>		
NICU	375	39
No NICU	585	60.1
Not reported	2	0.2
<b>Jaundice</b>		
Jaundice	160	20.1
No jaundice	636	79.9
Not reported	166	17.3
<b>Infections</b>		
No postnatal infections	883	91.8
Total postnatal infections	79	8.2
Neonatal infection	43	54.4
Pneumonia	11	13.9
Potentially infected	10	12.7
Neonatal sepsis	4	5
Premature rupture of membranes	3	3.8
Bacterial vaginosis in the mother	2	2.5
Conjunctivitis	2	2.5
Congenital syphilis	1	1.3
Maternal chickenpox	1	1.3
Bronchiolitis	1	1.3
Unknown	1	1.3
<b>Postnatal antibiotics</b>		
No antibiotics	883	91.8
Antibiotics	79	8.2
<b>TORCH infections</b>		
Total TORCH infections	14	1.5
Toxoplasmosis	9	64.3
Cytomegalovirus	0	0
Rubella	0	0
Congenital syphilis	3	21.4
Herpes simplex	1	7.1
HIV	1	7.1
Cranioencephalic trauma	0	0
Weight less than 1 500g	26	2.7
Family history of hearing loss	90	9.5
Family history of genetic disease	100	10.6

**Table 3:** Population characteristics - quantitative variables

Variables	Mean	Standard deviation	95%CI
Weight at birth (grams)	2 798.1	576.1	2 766.5 – 2 839.8
Height at birth (centimeters)	48.6	3.3	48.4 – 48.8
Age at screening (days)	16.2	11.9	15.5 - 17
Maternal age (years)	27.4	7.5	26.8 – 27.9
NICU stay (days)	7.6	9	6.6 – 8.4
Intubation duration (days)	2.6	2.8	1.62 - 3.5

At the first screening test, 7.17% (n=69) of the newborns had abnormal results: 38 (55.10%) in both ears, and 44.92% (n=31) in one ear. Only 29 newborns (42.02%) that had an abnormal result at the first screening test attended the second screening phase three months later. From these, 17.24% (n=5) had abnormal results at the Phase II test: 80% (n=4) in both ears, and 20% (n=1) in one ear. Only one patient attended the third screening phase with OAE, obtaining an abnormal result in both ears, which was later confirmed with AABR. 40 subjects abandoned the study after Phase I, and three more subjects aban-

doned the study after Phase II, which in total corresponds to 43 subjects (4.47% of the total study population) with abnormal OAE results that abandoned the study without completing the three phases of the screening.

The 5 subjects that obtained abnormal OAE in the second phase of the study correspond to 0.52% of the study population. One of these participants was subsequently diagnosed with trisomy 21, and was excluded from this analysis for having a syndromic disease. After excluding her, the percentage of congenital sensorineural hearing loss lowered to 0.42% (n=4), of which 3 cases (0.31%) corresponded to both ears, and 1 case (0.11%) to unilateral hearing loss. The only participant of the Phase III screening was a male child that had bilateral hearing loss confirmed with AABR. He had a hospital stay of 12 days at the NICU secondary to prematurity without requiring orotracheal intubation. Distribution by sex and affected ear at the three phases of the screening tests is shown in Table 4.

**Table 4.** Distribution by sex and laterality of evoked otoacoustic emissions results

	Sex			Total
	Male	Female	No sex reported	
<b>Total</b>	464	401	97	962
<b>Phase I</b>				
No results reported	2	8	2	12
Normal results	426	366	89	881
Total abnormal results	36	27	6	69
Abnormal result right ear	9	5	0	14
Abnormal result left ear	9	6	2	17
Abnormal result bilaterally	18	16	4	38
<b>Phase II</b>				
Normal result	15	7	2	24
Total abnormal results	2	2	1	5
Abnormal result right ear	1	0	0	1
Abnormal result left ear	0	0	0	0
Abnormal result bilaterally	1	2	1	4
<b>Phase III</b>				
Normal results	0	0	0	0
Total abnormal results	1	0	0	1
Abnormal result in both ears	1	0	0	1

Statistical analysis of the data by chi-square showed a statistically significant association between a higher frequency of abnormal results in the first screening test and the following aspects: jaundice ( $X^2=17.77$ ;  $p=0.000$ ); orotracheal intubation ( $X^2=38.54$ ;  $p=0.000$ ); NICU admission ( $X^2=64.81$ ;  $p=0.000$ ); weight under 1 500 g ( $X^2=72.39$ ;  $p=0.000$ ); postnatal infections ( $X^2=36.87$ ;  $p=0.000$ ); postnatal use of antibiotics ( $X^2=31.55$ ;  $p=0.000$ ). However, there were no statistically significant associations between the frequency of abnormal results at the first screening and sex, TORCH infections, nor a positive family history of hearing loss or genetic disease.

During the second phase, there were no statistically significant associations between the frequency of abnormal results and any of the studied variables.

## DISCUSSION

Sensorineural hearing loss is a public health issue, widely under-recognized, which can cause severe impairment in the neurocognitive and psychosocial development of the child. Universal hearing screening at birth is currently recommended, as well as audiological intervention (hearing amplification) before the age of

six months, to diagnose and treat hearing loss early and prevent disability.

This study results suggest that the prevalence of CSNHL at Hospital Universitario San Ignacio is similar to the one generally reported in the literature. At the end of the study, congenital hearing loss was confirmed in four subjects, which corresponds to a prevalence of 0.42%, with three cases (0.31%) in both ears, and 1 case (0.11%) in one ear. It is important to point out that the prevalence is inverted compared to the prevalence reported in the literature, since in bilateral hearing loss in this population was more prevalent than unilateral cases; this may be secondary to the high-risk population that is treated at our institution.

Furthermore, it was found that the risk factor most commonly associated to CSNHL in our institution was a history of NICU admission. In this study, 39.06% of the participants were admitted to the NICU, and only 4.38% of them required orotracheal intubation with mechanical ventilation. This was further correlated with a positive association between NICU admission and a failed result in OAE, being statistically significant.

None of the study subjects had severe head trauma or infection by cytomegalovirus as risk factors, which is very favorable given that the latter is one of the most common pathogens associated with congenital hearing loss. It should be noted that even though there is no access to molecular testing for congenital CMV infection diagnosis at our hospital, but there was no clinical suspicion of the disease in any of the newborns.

In addition, the high rate of false positives (false negative results or false “fail” results) during the first screening was expected given the widely known sensibility of the OAE. In the first phase of this study, the result of negative OAE was 7.17%, which lowered to 0.42% by the third phase. This could be explained by false positives secondary to middle ear diseases, earwax impaction, and immaturity of the auditory pathway in preterm infants, among other reasons. Consequently, it is of vital importance to follow the neonates who fail the hearing screening the first time and repeat the test.

It is worth mentioning that a high number of subjects were lost during follow-up ( $n=43$ ), which is one of biggest limitations of our study. This occurred especially during Phase III, in which three of four patients who failed the second OEA did not return. Their current hearing condition is unknown, despite multiple attempts to contact them. Future research should attempt to investigate the prevalence of the disorder at a wider scale, with a multi-center study.

Syndromic diseases were an exclusion criterion for the study, given that the prevalence of CSNHL in these pa-

tients is different. However, a participant completed the three phases without being diagnosed with trisomy 21; once the diagnosis was made, she was excluded.

Finally, the coverage of the hearing screening program was 46%, which is below the target recommendation of 95%. This could be explained because there is a preterm child and mother care program at our institution for all preterm infants that works independently from the hospital; it conducts hearing screening tests for premature patients as well, so this specific population was not monitored for this study. Moreover, there are some newborns whose parents and/or caregivers did not live in the city, reason why they returned to their homes after birth and did not come back for the hearing screening test.

Since the coverage rate is lower than recommended, the hospital has implemented measures to improve it. Some of these include making the hearing test the same day that newborns attend their pediatrician appointment, so that caregivers have less transportation issues; keeping constant communication with the NICU to ensure that patients have a hearing test appointment before being discharged from the hospital; and calling the caregivers to confirm the hearing test appointment ensuring assistance. In addition, both the medical and nursing staff have received training on the importance of performing the tests to newborns within adequate timeframes, and the positive impact that the test has in their overall wellbeing.

Being aware of the risk factors is important in order to suspect CSNHL in some infants. Every live newborn should undergo the universal hearing screening test, given that 50% of newborns with moderate to profound hearing loss do not have any known risk factors (18). In contrast, 95% of neonates with some known risk factor for hearing loss have normal hearing, while 2-5% of newborns with one or more of these risk factors present with moderate to profound hearing loss (19).

The diagnosis and treatment of congenital hearing loss is of vital importance for neonates, given that early assessment and intervention are determining for language development. When newborns are diagnosed with CSNHL, they should receive treatment in the first 6 months of life (7). Different studies have proven that intervention before 6 months of age is crucial for infants with hearing loss to acquire the same language abilities as an infant with normal hearing (19). The goal of treatment is to maximize language and comprehension skills in these patients in order to have a normal life, as any other child.

Even though there are limitations to this study, this is a tool that helps raising awareness on the need for a public and universal neonatal hearing screening program in our country. Likewise, to the best of the authors' knowle-

dge, this is the first study in Colombia to assess and measure the frequency of risk factors, CSNHL in nonsyndromic newborns, and the relationship between these two entities. Finally, as coverage rates were measured, improvements are being developed to increase them and aim at universal coverage ♣

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**Conflict of interest:** None.

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