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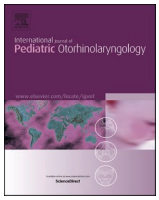

Universal neonatal hearing screening before and during the COVID-19 pandemic

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ABSTRACT

Objective: To verify the frequency of risk factors for hearing loss in newborns and their possible associations with universal neonatal hearing screening results before and during the COVID-19 pandemic.
Methods: Historical cohort study with data analysis of newborns attended in a reference hearing health service of the Unified Health System (SUS) between January 2017 and December 2021.
Results: Those born in 2020 and 2021 were 91% less likely to fail the screening than those born in 2017, 2018, and 2019; therefore, they had a lower percentage of referrals for a retest. There was a decrease in congenital syphilis (1.00%), decrease in HIV (0.95%), and an increase in toxoplasmosis (0.58%) and increase in rubella cases in 2021 in relation to 2017. Syphilis had lower frequency rates during the COVID-19 pandemic (2020–2021).
Conclusion: Newborns born in the pandemic year compared to those born pre-pandemic showed a reduction in the presence of two risk indicators for hearing loss and, consequently, a lower chance of failing the UNHS and a lower percentage of referral for retest.

1. Background

SARS-CoV-2 is a highly contaminating virus responsible for the coronavirus disease (COVID-19), which will spread worldwide by the end of 2019 [1]. The World Health Organization [2] and government agencies declared a world health emergency; in Brazil, each region adopted measures to stop the disease spread based on established demands. According to the Ministry of Health [3], pregnant women undergo physiological changes that can make them more susceptible to respiratory and other complications. Clinical manifestations in pregnant women diagnosed with COVID-19 can be both symptomatic and asymptomatic (as in the general population), with cases that progress to the point of requiring admission to an intensive care unit (ICU) [4].

Considering that congenital infections are risk factors that to the dependent connection between the placenta and the fetus, any lesion on the placenta may transmit congenital infections such as syphilis, toxoplasmosis, human immunodeficiency virus (HIV), varicella, rubella, herpes, and cytomegalovirus. They can directly damage the fetus' inner ear structures or induce immune-mediated damage in the host. Hence, COVID-19, which is a viral disease, may also affect inner ear structures [5–7].

Prevention measures have been implemented worldwide, with the aim of minimizing the spread of the virus. Social distancing measures were adopted where people should avoid crowds and maintain a minimum distance of one and a half meters between individuals and in more serious cases social isolation was indicated where people could not leave

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their homes. With the objective of reducing the transmission of the virus between individuals, the measure of social isolation has become one of the main measures, distancing people who are infected or suspected of being infected from those who are asymptomatic, thus avoiding the cascade of transmission of the new virus. Due mainly to the various physiological changes present during pregnancy, especially those of the immune and respiratory systems, pregnant women were included in the COVID-19 risk group [8]. In Brazil, a country with a low-income population, it is very difficult to control and reduce the occurrence of coronary heart disease, isolation measures may have contributed to the recurrent reduction, thus, a relevant situation for public health.

The peripheral and central auditory systems need to be intact for speech, language, and hearing skills to develop [9]. Therefore, it is greatly important to perform universal neonatal hearing screening (UNHS) and monitor the hearing of newborns with risk factors for hearing loss (RFHL) [10] to early detect hearing impairments.

The UNHS service in the state of Santa Catarina (SC), Brazil, functions based on the Neonatal Hearing Screening Care Guidelines (DATAN) [11,12], which recommends the following quality indicators to verify and monitor the effectiveness of UNHS programs in Brazil: 1) UNHS coverage rate: at least 95% of live births, aiming at 100%; 2) age in months at UNHS: within the first month of life or, in the case of premature or hospitalized babies, within the third month corrected age; 3) diagnostic referral rate: 2%–4% of newborns; 4) diagnostic attendance rate: 90%, with the diagnosis confirmed by the third month of life; 5) speech-language-hearing therapy in 95% of infants with confirmed permanent bilateral hearing loss, beginning as soon as the diagnosis is confirmed; 6) hearing aid fitted 1 month after the diagnosis in 95% of infants with confirmed bilateral or unilateral hearing loss [11].

The objective of this study was to verify the frequency of RFHL in newborns and their possible associations with UNHS results before and during the COVID-19 pandemic.

2. Materials and methods

2.1. Study design and site

This is an exploratory observational study with cross-sectional analysis of secondary data on newborns born in the Carmela Dutra Maternity Hospital (MCD), in Florianópolis, SC, and the maternity of the Regional Hospital of São José (HRSJ), in São José, SC. They underwent UNHS preferably within the first 24–48 h of life in the maternities or within 30 days of birth at the Otovida Institute – a hearing, voice, speech, and language clinic accredited by the Unified Health System (SUS) as a reference in hearing health in SC.

The newborns were registered in the service's database and were assessed with transient evoked otoacoustic emissions (TEOAE) in both ears separately and/or automated auditory brainstem response (AABR) due to RFHL [12,13]. According to SC state hearing health regulations, newborns who "pass" AABR must be referred for auditory monitoring in primary healthcare, whereas those who "fail" must be referred for retesting at a hearing health outpatient service – in this case, the Otovida Institute.

2.2. Screening procedures and data collection

Data were obtained from the database of the Otovida Institute, responsible for conducting UNHS in public maternity hospitals of Greater Florianópolis (MCD and HRSJ). The collected data encompassed prenatal care, delivery, puerperium, mothers' and newborns' sociodemographic characteristics (sex, age), and TEOAE and/or AABR results (satisfactory [pass] or unsatisfactory [fail]). These procedures also consider the presence of RFHL defined by the Joint Committee on Infant Hearing (JCIH), namely: family history of permanent deafness; likelihood of heredity; cases of consanguinity; neonatal ICU (NICU) stay longer than 5 days; extracorporeal membrane oxygenation; assisted ventilation; exposure to ototoxic drugs such as aminoglycoside antibiotics and/or loop diuretics; hyperbilirubinemia; severe perinatal anoxia; 1-min Apgar score of 0–4, or 5-min Apgar score of 0–6; birthweight less than 1500 g; communicable diseases; craniofacial anomalies involving the ears and temporal bone; genetic syndromes that usually cause hearing loss (e.g., Waardenburg, Alport, Pendred, and so forth); neurodegenerative disorders (Friedreich's ataxia, Charcot-Marie-Tooth disease); postnatal bacterial or viral infections such as cytomegalovirus, herpes, measles, varicella, and meningitis; traumatic brain injury; and chemotherapy.

2.3. Outcome variable

UNHS was considered the outcome variable, categorized into "pass" and "fail" – the latter included newborns who failed TEOAE and/or AABR in either one or both ears.

2.4. Main exposure variable

The RFHL (NICU stay longer than 5 days, antibiotic use, low Apgar score, mechanic ventilation, blood transfusion, prematurity, craniofacial anomalies and/or neurological disorders, family history of hearing loss, and congenital infections) were the exposure variables, assessed and categorized according to their presence (yes) or absence (no). They were grouped into periods (pre-pandemic [2017, 2018, and 2019] and post-pandemic [2020 and 2021]) or maternal age ($\leq$19 years; 20–29 years; $\geq$30 years).

2.5. Data analysis

The data were organized in Microsoft Excel® spreadsheets and then exported to and analyzed in StataMP®, version 14.0 (StataCorp, College Station, TX, USA). The absolute and relative frequencies and their 95% confidence intervals (95% CI) were used in the sample description. An association analysis was performed between UNHS (outcome) and RFHL and research covariates. The odds ratio (OR), estimated through logistic regression analysis, was used as an association measure in both crude (bivariate) and adjusted analyses.

Afterward, data were organized in Microsoft Excel® spreadsheets and exported to and analyzed in MedCalc® Statistical Software, version 20.027. The categorical variables of the sample were described by presenting absolute and relative frequencies and their 95% CI. The association between UNHS (outcome) and RFHL (main exposure) and research covariates was analyzed with the chi-square test. When possible, the chi-square for trend was also applied (categorized as the year of birth and maternal age). The OR was used as an association measure in the crude (bivariate) and adjusted analyses, estimated through logistic regression analysis, 2 $\times$ 2 table calculations (crude OR), or the Cochran–Mantel–Haenszel test.

2.6. Ethical aspects

This study was approved by the Research Ethics Committee of the Federal University of Santa Catarina, under CAAE: 39562720.8.0000.0121.

3. Results

The study comprised 34,801 newborns born in MCD and HRSJ between 2017 and 2021. During the pandemic, 13,367 children were assessed in the two maternity hospitals, whereas 21,434 children had been assessed before the pandemic and decreased the presence of some risk indicators and consequently the failures in screening. There was 100% coverage of live births in both maternity hospitals, considering data on live births furnished by government agencies (**Table 1**). They performed the retest n = 1211 neonates.

Table 1
Analysis of the number of referrals for retest, Florianópolis, SC (2017–2021).

Health Institution	Origin of Data	Pre-pandemic (n)	Pandemic (n)	Total (n)
Carmela Dutra Maternity Hospital (MCD), Florianópolis, SC.	SES**	10,938	6325	17,263
	DATASUS***	10,705	6752	17,457
	Otovida Institute – MCD screening	11,288	6592	17,88
Regional Maternity Hospital (HMRSJ), São José, SC.	SES	10,875	6211	17,086
	DATASUS	10,758	6534	17,292
	Otovida Institute – MCD screening	10,146	6775	16,921
General	SECRETARIA DE SAUDE DE SC	21,643	13,077	34,72
	DATASUS	21,633	12,745	34,378
	Otovida Institute – MCD screening	21,434	13,367	34,801

* Percentage coverage by Otovida; ** SES: Santa Catarina State Department of Health; *** Department of Information Technology of the Unified Health System of Brazil.

The health crisis of the COVID-19 pandemic required the adoption of many control measures, including social distancing, leading to a change in the routine of families. It is known that the collective and crowded coexistence of children in day care centers and schools increases the risk of transmission of microorganisms to families [14]. A study carried out by Backi, Pereira and Locatelli [15] regarding the number of pregnant women diagnosed with syphilis during the COVID-19 pandemic in 2020 in Santa Catarina (SC), observed that some health regions and, consequently, some municipalities followed the logic of the country where there was a decrease in the number of diagnoses during the pandemic period.

In general, 1.10% (95% CI 1.00–1.22) of newborns were referred for a retest in the reference UNHS service; the percentage was lower during the pandemic **(Table 2).** Of all neonates analyzed (34,801), n = 34,411, that is, 98.9% are not referred; in the pre-pandemic years, the total number of children was n = 21,434, of which n = 21,090 are not referred, that is 98.40%, however of the n = 13,367 newborns evaluated during the pandemic period, 99.66% (n = 13,321) are not referred. The chi-square test of proportions detects $p < 0.00001$ when comparing 98.4% (not referred pandemic) versus 99.66% (not referred pandemic).

The newborns assessed had different RFHL, whose frequencies **(Table 3)** also varied per year of birth before and during the pandemic. The n = 34,738 thousand born, n = 21,062 thousand were born before the pandemic and represented 60.6%. n = 13,284 thousand were born in the pandemic, representing 38.20%, these numbers indicate the newborns who passed the test. Fisher's test evaluates the 4 proportions, when different, it indicates that there are different proportions with $p < 0.05$, and before the pandemic 1.00% failed, and in the pandemic this number reduced 10 times (0.10%).

There were mostly no significant differences between the frequencies of newborns who passed and who failed UNHS having different RFHL during the pandemic, and in the proportion of babies who took

Table 3
– Comparison of relative frequencies of failures in neonatal hearing screening before and during the pandemic in Florianópolis, SC, 2017 to 2021 (n = 34,801).

Variable	n (pass)	% (pass)	n (fail)	% (fail)	*P*-value (Fisher's exact test)
Congenital HIV (total = 299)					<0.01
Pre-pandemic	146	48.80%	15	5.00%	
Pandemic	136	45.50%	2	0.70%	
Rubella (total = 8)					0.250
Pre-pandemic	1	12.50%	1	12.50%	
Pandemic	6	75.00%	0	0.00%	
Toxoplasmosis (total = 111)					0.598
Pre-pandemic	50	45.00%	2	1.80%	
Pandemic	58	52.30%	1	0.90%	
Various congenital infections (total = 22)					0.156
Pre-pandemic	7	31.80%	2	9.10%	
Pandemic	13	59.10%	0	0.00%	
Congenital syphilis (total = 538)					0.002
Pre-pandemic	342	63.60%	22	4.10%	
Pandemic	173	32.20%	1	0.20%	
Craniofacial anomalies and/or neurological disorders (total = 69)					0.740
Pre-pandemic	19	27.50%	5	7.20%	
Pandemic	38	55.10%	7	10.10%	
ICU stay (total = 1326)					<0.01
Pre-pandemic	720	54.30%	26	2.00%	
Pandemic	573	43.20%	7	0.50%	
Mechanical ventilation use (total = 10)					1.000
Pre-pandemic	6	60.00%	1	10.00%	
Pandemic	3	30.00%	0	0.00%	
Low Apgar score (total = 38)					0.556
Pre-pandemic	24	63.20%	4	10.50%	
Pandemic	10	26.30%	0	0.00%	
Family history of hearing loss (total = 34)					0.094
Pre-pandemic	13	38.20%	3	8.80%	
Pandemic	18	52.90%	0	0.00%	
Prematurity (total = 1257)					<0.01
Pre-pandemic	580	46.10%	45	3.60%	
Pandemic	632	50.30%	0	0.00%	
Antibiotic use (total = 362)					<0.01
Pre-pandemic	114	31.50%	6	1.70%	
Pandemic	241	66.60%	1	0.30%	
Year of birth (total = 34,738)					<0.01
Pre-pandemic	21,062	60.60%	351	1.00%	
Pandemic	13,284	38.20%	41	0.10%	

Table 2
Analysis of the number of referrals for retest, Florianópolis, SC (2017–2021).

Situation regarding referral for a retest	All (n total = 34,801)			Pre-pandemic (n total = 21,434)			Pandemic (n total = 13,367)			p[a]
	n	%	95% CI	n	% (n)	95% CI	n	% (n)	95% CI	
Not referred	34,411	98.879	98.763–98.987	21,090	98.40	98.218–98.559	13,321	99.66	99.541–99.748	<0.0001
Referred	386	1.109	1.002–1.225	344	1.61	1.441–1.782	42	0.31	0.227–0.424	<0.0001
Deceased	1	0.003	0.0000728–0.0160	0	0	0.000–0.0172	1	0.01	0.000189–0.0417	0.2054
HHOS	3	0.009	0.00178–0.0252	0	0	0.000–0.0172	3	0.02	0.00463–0.0656	0.0284
Total	34,801	100.0	98.95–101.06	21,434	61.59	60.77–62.42	13,367	38.41	37.76–39.07	0.0001

Legend: 95% CI: 95% confidence interval; HHOS: hearing health outpatient service.
[a] p-value obtained with the Chi-squared test for the comparison of two proportions (Pre-pandemic x Pandemic).
Source: Developed by the authors (2022).

antibiotics and failed UNHS (2.4%). There was also no significant difference in the proportion of newborns who took antibiotics and passed UNHS (0.3%). During the pandemic (2020–2021), most newborns with craniofacial anomalies and/or neurological disorders (grouped data) failed UNHS (0.6% passed, and 17% failed UNHS). The same was true for HIV-exposed newborns in NICU stay.

On the other hand, there were significant differences in many RFHL frequencies before the pandemic – e.g., the 1.7% proportion of newborns who took antibiotics and failed the test differed significantly from the 0.5% proportion. The comparison of fail proportions regarding RFHL between the two periods shows a greater frequency in those born before the pandemic.

The comparative analysis between percentages of newborns with HIV born before and during the pandemic who failed the screening shows that the frequencies of failures associated with some RFHL decreased during the pandemic. On the other hand, the likelihood of occurrences (OR) increased, though with no significant differences in frequencies in comparison with the larger group (**Table 4**). In some situations, newborns born during the pandemic were less likely to fail UNHS (OR lower than 1.0) than those born before it. In some of these situations, p-values were significant, making it possible to accept the OR. Congenital HIV before the pandemic induced an increase of 6 times more chances of failing the test, however in the pandemic this increase, although large, fell to 4 times more chances.

Table 4
Association between failure in the universal neonatal hearing screening and congenital infections and other risk factors, with birth before or during the pandemic as the confounding factors. Florianópolis, SC, 2017 to 2021 (n = 34,801).

Variable	Crude OR	95% CI	*P*-value
Congenital HIV			
Pre-pandemic	6.4291	3.7378 to 11.0583	<0.0001
Pandemic	4.9559	1.1848 to 20.7304	0.0284
Rubella			
Pre-pandemic	60.4697	3.7745 to 968.7736	0.0037
Pandemic	24.6033	1.3638 to 443.8433	0.03
Toxoplasmosis			
Pre-pandemic	2.4201	0.5865 to 9.9859	0.2216
Pandemic	5.6987	0.7704 to 42.1519	0.0883
Various congenital infections			
Pre-pandemic	17.322	3.5855 to 83.6853	0.0004
Pandemic	11.8398	0.6924 to 202.4697	0.088
Congenital syphilis			
Pre-pandemic	4.0499	2.5961 to 6.3178	<0.0001
Pandemic	1.9415	0.2652 to 14.2117	0.5136
Craniofacial anomalies and/or neurological disorders			
Pre-pandemic	16.0849	5.9714 to 43.3273	<0.0001
Pandemic	71.7392	29.9473 to 171.8522	<0.0001
ICU stay			
Pre-pandemic	2.2725	1.5135 to 3.4122	0.0001
Pandemic	4.5653	2.0152 to 10.3428	0.0003
Mechanical ventilation use			
Pre-pandemic	10.0759	1.2098 to 83.9183	0.0327
Pandemic	45.7022	2.3240 to 898.7598	0.0119
Low Apgar score			
Pre-pandemic	10.155	3.5047 to 29.4248	<0.0001
Pandemic	15.226	0.8777 to 264.1226	0.0614
Family history of hearing loss			
Pre-pandemic	14.0274	3.9793 to 49.4479	<0.0001
Pandemic	8.6366	0.5119 to 145.7008	0.1348
Prematurity			
Pre-pandemic	5.2247	3.7794 to 7.2225	<0.0001
Pandemic	0.2409	0.01480 to 3.9210	0.3173
Jaundice			
Pre-pandemic	Unavailable		
Pandemic	35.5435	1.8835 to 670.7528	0.0172
Antibiotic use			
Pre-pandemic	3.2118	1.4035 to 7.3500	0.0057
Pandemic	1.3525	0.1852 to 9.8787	0.766

95% CI: 95% confidence interval; OR: Odds Ratio to failure (crude OR pass = 1.000 for all).

The OR comparison between newborns born before and during the pandemic shows a 99.8% less likelihood of children failing UNHS. However, HIV-seropositive children were about 6 times (born before the pandemic) and 5 times (born during the pandemic) as likely to fail the screening. There was also a greater proportion of failures in newborns with congenital syphilis (6.0%) than in those without it (1.6%) ($p < 0.001$).

4. Discussion

The frequencies of newborns with failures associated with some RFHL decreased during the pandemic (2020–2021). Regarding comprehensive pediatric healthcare, hearing loss is deemed as a public health problem because of its prevalence and especially its multiple consequences to intellectual, social, linguistic, cognitive, and emotional development. This reinforces the relationship between these concepts and health promotion, as both UNHS and the overall health population are influencing factors. People must be enabled to work on their quality of life, encouraging them to control this process and be aware of its importance [16].

The 2019 JCIH update recommends audiological screening, diagnostic, and follow-up methods, considering neonatal, progressive, and late-onset hearing losses and auditory neuropathy spectrum disorder [5]. The 0.09 OR shows that newborns born in 2021 were approximately 91% less likely to fail UNHS than those born in 2017. However, COVID-19 is one of the viral diseases to which pregnant women are susceptible and that may impair the fetus' inner ear structures [7–11].

Hearing loss occurs up to 10 times more in high-risk newborns. The literature describes 10 RFHL, namely: family history of deafness; ICU stay longer than 5 days; ototoxic medication use; mechanic ventilation; hyperbilirubinemia with exchange transfusion; low Apgar scores (1-min: 0 to 4; 5-min: 0 to 6); birthweight less than 1500 g; and prematurity. Besides these, congenital infections, craniofacial anomalies, genetic syndromes associated with hearing loss, neurodegenerative disorders, postnatal bacterial or viral infections, traumatic brain injury, and chemotherapy are also considered RFHL. These complications are considered when choosing the most adequate UNHS protocol for each case [17,18].

Hence, 1.106% (95% CI 1.001%–1.226%) of newborns overall were referred for a retest in the reference UNHS service at SUS; the percentage was lower during the pandemic. Pre-pandemic studies in the literature show data similar to those in the present one, with screening failures ranging from 0.1% to 0.6% [19]; there were also higher results, ranging from 1.8% to 3.44% [20]. However, Brazil is far from achieving this index – retest attendance rates are low, which impairs the effectiveness of the program, as the parents' lack of commitment to reaching a diagnosis negatively impacts the subsequent stages of the program [21].

The first 3 months after conception are the most sensitive ones regarding ear development, which is when many inner and middle ear structures begin to develop. However, ear development is a dynamic process that only finishes at birth. COVID-19 is more prevalent in the third trimester, and impairments at the end of pregnancy predispose the child to ototoxic insults or infections. Sensorineural hearing loss is one of the most common and severe complications of intrauterine exposure to certain viruses, such as cytomegalovirus and rubella [22].

COVID-19 is a plausible, though transitory RFHL. Moreover, the direct virus-induced cytokine storm and the general pro-inflammatory status can negatively impact fetal brain development, possibly causing a wide range of neurological sequelae. Late diagnosis and treatment of congenital hearing loss are likely to have significant effects on both individual patients and public health, whose true magnitude will remain unknown for years. Providers can mitigate the negative effects of COVID-19 on pediatric hearing healthcare [23].

Intrauterine SARS-CoV-2 infection can potentially affect newborns' auditory systems due to intrauterine hypoxia and vertical transmission. SARS-CoV-2 can significantly influence newborns' hearing loss during

the second and third trimesters of pregnancy. Therefore, all newborns whose mothers had COVID-19 during pregnancy must have their cochlear function assessed, regardless of whether their mothers' disease had been symptomatic. Nonetheless, the understanding of this issue is not consistent and remains controversial. As the early identification and intervention of congenital hearing loss are crucial to newborns' language development, they must receive audiological assessments from various approaches, including teleaudiology, in times of COVID-19 [24].

It is also important to highlight data observed in this research that refer to the period of the Pandemic (2020–2021) in which neonates with craniofacial anomalies and/or neurological disorders (data taken together) mostly failed the UNHS test (0.6% passed the test and 17% failed the UNHS). Among these anomalies we can mention cleft lip and palate, ear microtias, ear appendages, Turner syndrome, Down syndrome, Walker Warburg syndrome, cerebellar dysgenesis, cerebral palsy, schizencephaly, microcephaly, myelomeningocele and laryngomalacia and were 4.6 times more likely to be retested. Similarly, this also occurs for newborns exposed to HIV (n = 48) who were admitted to the NICU during the pandemic period and 57.1% underwent the retest.

With regard to the use of antibiotics, it is important to emphasize that 21.46% (n = 260) of the neonates used these drugs during their hospital stay.Universal neonatal hearing screening before and during the covid-19 pandemic indicates that there is no significant increase when analyzing the retests of these neonates compared to the non-pandemic period. But there was a higher observed frequency of failure for newborns born in the pre-pandemic years and during the pandemic period, it was observed that the frequencies of newborns with failures associated with some risk indicators decreased.

Neonatal hearing screening programs in Brazil aim to carry out actions in order to minimize the consequences caused by permanent hearing loss in babies. These are actions that involve hearing screening, medical and audiological diagnosis, and therapeutic intervention, when necessary, in order to guarantee language development in babies with hearing loss [11]. Universal Neonatal Hearing Screening (UNHS) is preferably performed in maternity hospitals in the first month of life and allows the identification of possible hearing disorders in infants with or without Risk Indicators for hearing loss [13].

5. Conclusion

Given the above, the importance of UNHS aiming to identify possible hearing losses early. UNHS is one of the various policy strategies in comprehensive pediatric hearing healthcare. Strict adherence to NICU protocols and subsequent follow-up are the gold standard to detect neonatal hearing loss early and prevent its complications. Changes in the indices of the presence of risk factors for BP that occurred during the pandemic period can help in the elaboration of actions in public policies that can permanently reduce the presence of these factors.

The risk indicators for hearing loss were based on the 2007 JCIH and on the Multiprofessional Committee on Hearing Health, which determine heredity indicators; consanguinity; use of ototoxic drugs; mechanical ventilation; stay in the Neonatal Intensive Care Unit (NICU) for more than five days; hyperbilirubinemia; severe perinatal anoxia; ventricular hemorrhage; weight less than 1500 g; congenital infections; craniofacial and auricular anomalies; postnatal bacterial or viral infections; neurodegenerative disorders or sensorimotor neuropathies; head trauma and chemotherapy.

Authors' contributions

Besen E: substantial contributions to the conception or design of the work, final approval of the version to be published and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. In addition to being accountable for the parts of the work he or she has done, an author should be able to identify which co-authors are responsible for specific other parts of the work. In addition, authors should have confidence in the integrity of the contributions of their co-authors; Gonçalves LF, Tiezerin CS: substantial contributions to the conception or design of the work, final approval of the version to be published and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. In addition to being accountable for the parts of the work he or she has done, an author should be able to identify which co-authors are responsible for specific other parts of the work. In addition, authors should have confidence in the integrity of the contributions of their co-authors; Cigana LB, Paiva KM: drafting the work or revising it critically for important intellectual content, final approval of the version to be published and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. In addition to being accountable for the parts of the work he or she has done, an author should be able to identify which co-authors are responsible for specific other parts of the work. In addition, authors should have confidence in the integrity of the contributions of their co-authors; Machado MJ: drafting the work or revising it critically for important intellectual content, final approval of the version to be published and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. In addition to being accountable for the parts of the work he or she has done, an author should be able to identify which co-authors are responsible for specific other parts of the work. In addition, authors should have confidence in the integrity of the contributions of their co-authors; Quialheiro A; Samelli A: drafting the work or revising it critically for important intellectual content, final approval of the version to be published and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. In addition to being accountable for the parts of the work he or she has done, an author should be able to identify which co-authors are responsible for specific other parts of the work. In addition, authors should have confidence in the integrity of the contributions of their co-authors; Haas P: drafting the work or revising it critically for important intellectual content, final approval of the version to be published and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. In addition to being accountable for the parts of the work he or she has done, an author should be able to identify which co-authors are responsible for specific other parts of the work. In addition, authors should have confidence in the integrity of the contributions of their co-authors.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] R.M. Czeresnia, A.T.A. Trad, I.S.W. Britto, R. Negrini, M.L. Nomura, P. Pires, R. Ruano, SARS-CoV-2 and pregnancy: a review of the facts, RBGO 42 (2020) 562–568, https://doi.org/10.1055/s-0040-1715137.

[2] Organização Mundial da Saúde, A OMS Afirma Que COVID-19 É Agora Caracterizada Como Pandemia, 2020. Disponível em, https://www.paho.org/pt/news/11-3-2020-who-characterizes-covid-19-pandemic.

[3] Ministério da Saúde, Secretaria de Atenção Primária à Saúde. Nota Técnica Nº 12/2020- COSMU/CGCIVI/DAPES/SAPS/M. Infecção COVID-19 e os riscos às mulheres no ciclo gravídico-puerperal. Brasil, 2020. Disponível em, https://portaldeboaspraticas.iff.fiocruz.br/biblioteca/nota-tecnica-no-12-2020-cosmu-cgcivi-dapes-saps-ms/.

[4] Jie Yan, Juanjuan Guo, Cuifang Fan, Juan Juan, Xuechen Yu, Jiafu Li, Ling Feng, Chunyan Li, Huijun Chen, Yuan Qiao, Coronavirus disease 2019 in pregnant

women: a report based on 116 cases, AJOG 3 (1) (2020) 111–114, https://doi.org/10.1016/j.ajog.2020.04.014, jul. 2020. Elsevier BV.
[5] M.B. Galvão, S.N. Fichino, D.R. Lewis, Processo do diagnóstico audiológico de bebês após a falha na triagem auditiva neonatal, Disturb Comun 33 (3) (2021) 416–427, https://doi.org/10.23925/2176-2724.2021v33i3p416-427.
[6] T. Celik, A. Simsek, C.F. Koca, S. Aydin, S. Yasar, Evaluation of cochlear functions in infants exposed to SARS-CoV-2 intrauterine, Am. J. Otolaryngol. 42 (4) (2021), 102982, https://doi.org/10.1016/j.amjoto.2021.102982.
[7] V.C.A. Gomes, E.B.L. Badarane, I.I.C. Seto, C.T. Yamaguchi, D.B. Ferreira, A. M. Umbelino, H. de Almeida Cavalcante, Avaliação das queixas auditivas e das otoemissões acústicas em funcionários do Complexo Hospitalar Universitário da Universidade Federal do Pará com COVID-19, BJHR 4 (1) (2021) 2853–2867, https://doi.org/10.34119/bjhrv4n1-229.
[8] M.O. Almeida, T.M. Portugal, T.J.C.F. Assis, Pregnant women and COVID-19: isolation as a physical and psychic impact factor [S.L.], Rev. Bras. Saúde Materno Infant. 20 (2) (2020) 599–602, https://doi.org/10.1590/1806-93042020000200015. FapUNIFESP (SciELO).
[9] A.C.G. Cury, A.B.G.T.N. Campos, B.L. Santos, L.A. Miranda, M.G.S. Santiago, V.A. M. de Melo, J.B. Zimmermmann, Uso de tabaco, álcool, drogas ilícitas e medicamentos na gestação, aspectos sociais e suas repercussões materno-fetais, REAS 15 (6) (2022), e10381-e10381.
[10] D.M. Dias, G.O. da Silva, A.F. de Carvalho Farias, S.P.L.B. Alves, M.E. de Paula Pires, C.E. da Silva-Barbosa, P. da Costa Araújo, Importância do diagnóstico precoce da deficiência auditiva na infância: revisão integrativa da literatura, Res. Soc. Dev. 11 (7) (2022), e2611729623-e2611729623, https://doi.org/10.33448/rsd-v11i7.29623.
[11] JOINT COMMITTEE ON INFANT HEARING, Position statement: principles and guidelines for early hearing detection and intervention programs, The Joint Committee on Infant Hearing 4 (2) (2019) 1–44.
[12] BRASIL. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Ações Programáticas Estratégicas. Diretrizes de Atenção da Triagem Auditiva Neonatal. Ministério da Saúde, 2012. 19 p. Disponível em: <http://bvsms.saude.gov.br/bvs/publicacoes/diretrizes_atencao_triagem_auditiva_neonatal.pdf>. Acesso em: 10 mai. 2022.
[13] Doris Ruthy Lewis, Chapchap Mônica Jubran, Triagem auditiva neonatal universal (Tanu) – boas práticas atuais, in: MARCHESAN, Irene Queiroz et al. Tratado Das Especialidades Em Fonoaudiologia 112, São Paulo, Roca, 2014, pp. 1455–1466. Cap.
[14] A.M. Carvalho, A.A. Carvalho, P.L. Martins, Impacto da pandemia covid-19 no perfil de internações pediátricas: análise comparativa dos anos 2018 a 2020, Revista Interdisciplinar Ciências Médicas 6 (2) (2022) 36–40.
[15] A.L.G. Backi, L.C.G. Pereira, C. Locatelli, in: Incidência de sífilis na gestação antes e durante a pandemia da COVID-19 no estado de Santa Catarina e sua relação com o IDH. Research, Society And Development, Research, Society and Development, 2022, 248111537239, https://doi.org/10.33448/rsd-v11i15.37239 [S.L.], v. 11, n. 15.
[16] L.S. Vernier, C.T.R. Castelli, S.S. Rothermel, T. de Carvalho Paniz, C. Zanini, D. C. Levandowski, Triagem auditiva neonatal em hospital da Rede Cegonha, RBPS 32 (2019), https://doi.org/10.5020/18061230.2019.8965.
[17] J.D. Pinto, L. Ferreira, D.A. Temp, V. Dias, D.E. Rohers, E.P.V. Biaggio, Evasão no reteste da Triagem Auditiva Neonatal: relação com indicadores de risco para deficiência auditiva, CEFAC 21 (2019), https://doi.org/10.1590/1982-0216/20192142519.
[18] A.L. de Freitas Rezende, L.M. de Resende, E.A. de Almeida Carvalho, P. Avan, S. A. da Silva Carvalho, Avaliação de Crianças com Indicadores de Risco para Deficiência Auditiva Atendidas em um Serviço de Referência em Triagem Auditiva Neonatal, Disturb Comun 31 (4) (2019) 630–640, https://doi.org/10.23925/2176-2724.2019v31i4p630-640.
[19] A.A.T. Kemp, C.R. Delecrode, G.C.D. Silva, F. Martins, A.C.F. Frizzo, A.C. V. Cardoso, Neonatal hearing screening in a low-risk maternity hospital in São Paulo state, Braz. J. otorhinolaryngol 81 (2015) 505–513, https://doi.org/10.1016/j.bjorl.2015.07.010.
[20] M. Gaffney, D.R. Green, C. Gaffney, Newborn hearing screening and follow-up: are children receiving recommended services? Publ. Health Rep. 125 (2) (2012) 199–207.
[21] M.A.D. Padilha, E.C.S. Maruta, M.F.D. Azevedo, Ocorrência de alterações auditivas em lactentes expostos à transmissão vertical do HIV, ACR 23 (2018), https://doi.org/10.1590/2317-6431-2017-1965.
[22] P. Kosmidou, I. Karamatzanis, S. Tzifas, A. Vervenioti, D. Gkentzi, G. Dimitriou, Hearing outcomes of infants born to mothers with active COVID-19 infection, Cureus 14 (6) (2022), https://doi.org/10.7759/cureus.25571.
[23] C.M. Jenks, M. DeSell, J. Walsh, Delays in infant hearing detection and intervention during the COVID-19 pandemic: commentary, Otolaryngol. Head Neck Surg. 166 (4) (2022) 603–604, https://doi.org/10.1177/01945998211067728.
[24] X. Meng, K. Zhu, J. Wang, P. Liu, Can SARS-CoV-2 positive pregnant women affect the hearing of their newborns: a systematic review, Am. J. Otolaryngol. 103523 (2022), https://doi.org/10.1016/j.amjoto.2022.103523.