Original Article

Automated ABR Screening for Hearing Loss and its Clinical Determinants among Newborns with Hyperbilirubinemia in National Hospital, Abuja, Nigeria

OI Oyinwola[1], M Mukhtar-Yola[1], AD Olusesi[2], TA Oluwasola[3]

[1]Departments of Pediatrics, [2]Ear, Nose and Throat, National Hospital Abuja, FCT, [3]Department of Obstetrics and Gynaecology, College of Medicine, University of Ibadan, Ibadan, Nigeria

Abstract

Background: Severe neonatal hyperbilirubinemia is a known risk factor for sensorineural hearing loss which is usually undiagnosed in our environment until school age due to a lack of routine screening programs. **Materials and Methods:** This cross-sectional study conducted between August 2020 and February 2021 employed a universal sampling of consecutive eligible participants after their mothers' consent. Hearing screening was conducted using an automated auditory brainstem response (AABR) device (Otoport OAE + ABR®). The proportion of AABR screening failure was assessed while associated clinical risk factors were determined using logistic regression. Statistical significance was set at 5% for all comparative analyses. **Results:** One hundred and sixty newborns below 28 days of age, delivered at 34 weeks gestation and above, who had jaundice were recruited. The prevalence of screening AABR failure in at least one ear was 26.2%. Significant risk factors for AABR screening failure in addition to extreme and hazardous hyperbilirubinemia were acute bilirubin encephalopathy (ABE) (Odds Ratio (OR) =4.44, 95% CI = 3.19-6.17), birth weight below 2500 g (OR = 3.16, 95% CI = 1.48-6.77), dull tympanic membrane (TM) (OR = 5.94, 95% CI = 2.36-14.92) and exchange blood transfusion (OR = 4.84, 95% CI = 1.87-12.58). **Conclusion and Recommendations:** The prevalence of AABR screening failure was high, and a dull TM was its strongest predictor among late preterm and term neonates with hyperbilirubinemia. Otoscopy should be included in the care of newborn with hyperbilirubinemia and screening programs established to mitigate hearing loss among high-risk neonates in Abuja.

Keywords: *AABR, hearing, hyperbilirubinemia, newborn, screening*

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Introduction

Neonatal hyperbilirubinemia is a common and, in most cases, benign condition.[1] Hyperbilirubinemia manifests clinically as jaundice, which is the yellowish coloration of skin and sclera[2] that is observed when the total serum bilirubin (TSB) reaches 5 to 10 mg/dl (86 to 170 umol/L). About 60% of term and 80% of preterm babies develop jaundice[3] in the early neonatal period, significant neonatal hyperbilirubinemia is a birth-related and preventable cause of hearing loss[4] that has been defined as a TSB level above the 95th percentile for age in hours requiring follow-up and treatment.[5]

One in every five people worldwide currently live with hearing loss and it is estimated that by 2050, one in every 10 people will have disabling hearing loss.[6] There are 34 million children, out of the 466 million people, with disabling hearing loss worldwide. The prevalence of hearing loss among high-risk preterm and term neonates according to Jose *et al*.[7] was 19.7% and 15.6%, respectively, with hyperbilirubinemia in the

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Address for correspondence: Dr. OI Oyinwola, Karshi General Hospital, Karshi, Abuja, Nigeria. E-mail: fisayooyinwola@gmail.com

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exchange transfusion threshold (ETT) range accounting for almost half of the cases. Furthermore, moderate hyperbilirubinemia has been linked to hearing loss.[3,7]

The auditory brainstem response (ABR) is the test of choice for bilirubin-induced neurologic dysfunction-related auditory damage.[8] Automated ABR (AABR) measurements reflect the status of the peripheral auditory system, the eighth nerve, and the brainstem auditory pathway.[9] The AABR is a physiological screening technology endorsed by the United States (US) Joint Committee on Infant Hearing (JCIH)[9] that is highly correlated with the degree of peripheral hearing sensitivity, having been widely used in newborn hearing screening programs[10] and found to be effective with false-negative results as low as four percent.[11]

The impact of a severe or profound hearing loss is generally well-recognized, but children with mild or moderate hearing loss also experience deficits in speech and language development.[10]

The JCIH identified hyperbilirubinemia in ETT range as one of the risk factors for hearing loss and recommends that the hearing of all infants be screened no later than 1 month of age. Despite recognizing risk factors for hearing loss to include a family history of deafness, assisted ventilation, use of extracorporal membrane oxygenation (ECMO), neonatal intensive care of more than 5 days, exposure to ototoxic drugs or loop diuretics, etc., the average age of detection of significant hearing loss is currently about 14 months while the diagnosis of mild and unilateral hearing loss oftentimes does not occur until school age.[9,12] This is because routine hearing screening is not established as a public health measure in Nigeria irrespective of risk factors, much less screening among neonates with hyperbilirubinemia.

This study therefore set out to determine the prevalence of AABR failure and its associated clinical risk factors among newborn with hyperbilirubinemia in the National Hospital Abuja. The findings should serve as guide to stakeholders and policymakers for the establishment of hearing screening programs within the Federal Capital Territory (FCT) hospitals and in Nigeria as a whole.

Materials and Methods

Ethics

The Institutional Review Board of the National Hospital, Abuja, approved the study with approval number NHA/EC/045/2019. Written informed consent was obtained from either parent before the recruitment of each subject into the study. Confidentiality was maintained during and after screening. The result of the AABR screening was communicated to the parents and those babies who failed to obtain a PASS were referred to the otolaryngology department of NHA for further evaluation and full assessment.

Study design

This was a cross-sectional study conducted in the National Hospital, Abuja (NHA), which is in the North-Central region of the country. It is a government-owned tertiary health facility that provides level II b neonatal care, serves the FCT, and receives referrals from neighboring states and other tertiary institutions across the Federation.

Selection and description of participants

The participants were recruited from the Special Care Baby Unit (SCBU) and Neonatal Intensive Care Unit (NICU) wards of the neonatal unit of the pediatric department, NHA. A total of 160 participants were enrolled. The sample size was derived using the formula for the determination of proportions for populations less than 10,000. A universal sampling of consecutive patients presenting at the study site was done after obtaining the parent's consent. All newborns delivered at ≥34 weeks gestational age (GA), who presented to and/or were admitted into the NHA SCBU/NICU within the first 28 days of life and had jaundice or were diagnosed with hyperbilirubinemia with an Apgar score of 7 and above in five minutes, were recruited into the study. Newborns who were diagnosed with perinatal asphyxia (Apgar scores less than 7 in five minutes) or hearing loss or had a family history of deafness or were admitted with suspected or confirmed toxoplasma, rubella, cytomegalovirus, herpes simplex, etc., (TORCHES) infection and meningitis were excluded from the study.

Data collection

Using a proforma, each baby's data was recorded as obtained either from medical records or history taken from the parent. Biodata including GA (determined from last menstrual period (LMP), expected date of delivery (EDD), early scans, and new Ballard score), birth weight (grams), and sex were documented. The socioeconomic class was assigned based on the socioeconomic classification scoring system by Olusanya *et al*.[13] Each subject had a serum bilirubin done at presentation as per unit protocol. This was analyzed in the NHA laboratory using a chemical analyzer that employs the colorimetric diazo method, and results were documented in the proforma.

Otoscopy was conducted for each baby before AABR screening to assess the patency of the external ear canal, presence of effusion, and integrity of the eardrum. Those babies who had wax and debris in the ear canal were rescreened on the same day if they failed the initial test.

Before the screening, the babies were fed and soothed to sleep.

Screening AABR was done at or shortly after presentation using the Otoport OAE + ABR® Advance model device from Otodynamics Ltd. (Hatfield, UK) which was still within the manufacturer's first calibration period. Each ear was assessed separately. The skin was prepared by applying an abrasive gel to reduce impedance, and pre-gelled snap electrodes were sited according to the manufacturer's recommendations; the active (positive) electrode was placed on the forehead while the reference (negative) electrodes were placed on the cheek and the earth (neutral) electrode was placed on the nape. Each ear was evaluated per time using a chirp sound at a rate of 85 Hz, stimulus intensity of 35 dBnHL, and a frequency of 1000 Hz. The stimulus was presented through insert earphones, and pre-gelled snap electrodes on the forehead, cheek, and nape were used to record the signal.

A PASS result was obtained from the device when there is a response to the stimulus at 35 dBnHL and the pass criteria are met. The criteria are based on the template correlation and the conventional FSP methodology which is a statistical measure of the likelihood that a response is present. The response is detected using template correlation (waveform identification) which is an in-built template constructed from responses from thirty neonates and is optimized for infants 34 weeks gestation to 6 weeks of age. The ambient noise level measured did not exceed 40 dBA at each testing. The test stop criteria were set to automatically terminate the test when the ABR PASS has been achieved or within 10 minutes to limit the sound exposure if a response is not detected. To reduce false positives, the test is repeated twice for that ear before a REFER result is documented.

Statistics

Data was cleaned and analyzed using the IBM SPSS Statistics version 22.0, and results were presented in tables and charts. Numerical variables were summarized using mean and standard deviation, while categorical variables were summarized using frequencies and percentages. Chi-square test was used to determine the association between two categorical variables while all statistically significant factors associated with the risk of hearing loss were graduated to binary logistic regression to determine their effect. The level of statistical significance was set at less than 0.05.

Results

One hundred and sixty (160) neonates who had hyperbilirubinemia were studied. The age range was between 2 days and 25 days as shown in Table 1. The mean age (days) ±SD was 5.81 ± 3.45, mean GA (weeks) ±SD was 37.98 ± 2.49, and the mean birth weight (grams) ±SD was 2974.8 ± 758.5. There were 97 (60.6%) males while 55 (34.4%) were late preterm neonates. About one third of the participants belonged to families in the lower socioeconomic class as shown in [Figure 1]. Severe hyperbilirubinemia (TSB ≥20 mg/dl) was found in 23 (14.4%) of the participants. Acute bilirubin encephalopathy (ABE) was found in 10 (6.3%) of the participants while 55 (34.4%) received ototoxic medications [Table 2]. The mean ± SD duration of exposure to hyperbilirubinemia was 72.39 ± 67.75 (hours). A total of 23 (14.3%) newborns with hyperbilirubinemia had a screening AABR failure (REFER) in one ear while 19 (11.9%) had a REFER in both ears as shown in Table 3. Thus, the prevalence of AABR failure, i.e. the proportion of subjects with REFER results in at least one ear, was 26.2% as shown in Figure 2.

The association between the study subject's biodata and medical characteristics and AABR findings is shown in

Table 1: Bio-demographic characteristics of study participants

Variable	Frequency	Percentage
Age (days)		
≤14	156	97.5
Above 14	4	2.5
Mean age±SD; Min, Max=5.81±3.45; 2, 25		
Gender		
Male	97	60.6
Female	63	39.4
Gestational age at birth (weeks)		
34-36	55	34.4
37-40	97	60.6
>40	8	5.0
Mean±SD; Min, Max=37.98±2.49; 34, 42		
Birth weight (g)		
1500-2499	42	26.3
2500-3999	110	68.7
4000 and above	8	5.0
Mean±SD; Min, Max=2974.8±758.5; 1640, 4200		
Place of delivery		
Home	2	1.2
Hospital	158	98.8
Pattern of Hyperbilirubinemia (TSB)		
Mild	101	63.1
Moderate	36	22.5
Severe	6	3.8
Extreme	10	6.2
Hazardous	7	4.4

Hyperbilirubinemia: mild 5.0 to 14.9 mg/dl, Moderate 15.0 to 19.9 mg/dl, Severe 20.0 to 24.9 mg/dl, Extreme 25.0 to 29.9 mg/dl, Hazardous ≥30.0 mg/dl

Table 2: Clinical characteristics of study subjects

Variable	Frequency	Percentage
In-patient Care		
Yes	135	84.4
No	25	15.6
Diagnosis		
ABE	10	6.3
Non-ABE	150	93.7
Intervention		
Follow-up	32	20.0
Phototherapy	99	61.9
EBT	29	18.1
Apnoeic attacks		
Yes	2	1.2
No	158	98.8
Refusal to/poor suck		
Yes	21	13.1
No	139	86.9
Fever		
Yes	30	18.8
No	130	81.2
Convulsion		
Yes	13	8.1
No	147	91.9
Use of ototoxic drugs		
Yes	55	34.4
No	105	65.6
NICU stay		
≤5 days	17	10.6
>5 days	2	1.3
Not applicable	141	88.1
Assisted ventilation		
Yes	21	13.1
No	139	86.9
Type of ventilation		
CPAP	8	38.1
iNO_2	13	61.9

ABE=Acute bilirubin encephalopathy, EBT=Exchange blood transfusion, NICU=Neonatal intensive care unit, CPAP=Continuous positive airway pressure, iNO_2=Intranasal oxygen

Table 3: Physical examination and pattern of AABR findings among study subjects

Variable	Frequency	Percentage (%)
Aural pit		
Yes	6	3.7
No	154	96.3
External ear		
Malformed	2	1.2
Normal	150	93.8
Low set	8	5.0
External ear canal		
Wax, Debris, Vernix	108	67.6
Otorrhoea	2	1.2
Normal	50	31.2
Tympanic Membrane		
Dullness/Retraction	23	14.4
Normal	131	81.9
Not seen	6	3.7
Increased muscle tone		
Yes	15	9.4
No	145	90.6
Head retraction		
Yes	10	6.3
No	150	93.7
Stupor		
Yes	6	3.8
No	154	96.2
AABR result		
Both ears PASS	118	73.8
One ear REFER	23	14.3
Both ears REFER	19	11.9

AABR=Automated auditory brainstem response, REFER screening failure positive, PASS screening failure negative

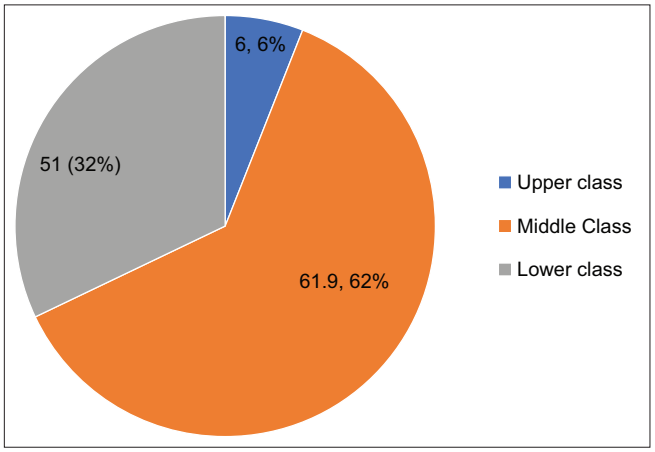

Figure 1: Family socioeconomic status

Table 4. Birth weight below 2500 g was significantly associated with screening AABR failure (χ^2 = 12.232, P = 0.002). Other factors associated with screening AABR failure were home birth (χ^2 = 5.690, P = 0.017) and ABE (χ^2 = 25.169, P < 0.001) as shown in Table 4. There was a significant association between maternal history of congenital anomaly in previous birth and screening AABR failure (χ^2 = 5.260, P = 0.022) as shown in Table 4. Extreme to hazardous hyperbilirubinemia was also significantly associated with REFER on screening AABR (χ^2 = 21.750, $P \leq 0.001$).

Risk factors for screening AABR failure

Newborns with a birth weight below 2500 g were thrice more likely to have screening AABR failure than those with normal birth weight (odds ratio (OR) = 3.16, 95% confidence interval (CI) = 1.48-6.77, $P \leq 0.001$) as shown in Table 5. Moderate hyperbilirubinemia was more likely to be associated with screening AABR failure than mild

Table 4: Bivariate analysis of associated factors on screening AABR failure

Variables	AABR Findings	
	Pass (118) *n* (%)	Referred (42) *n* (%)
Assisted ventilation		
Yes	13 (61.9)	8 (38.1)
No	105 (75.5)	34 (24.5)
Odds ratio, 95% CI	1.90, 0.73-4.97	
Maternal History of congenial anomaly in previous birth		
Yes	2 (33.3)	4 (66.7)
No	116 (75.3)	38 (24.7)
Odds ratio, 95% CI	6.10, 1.08-34.66	
External ear		
Malformed/Low set	2 (20.0)	8 (80.0)
Normal	116 (77.3)	34 (22.7)
Odds ratio, 95% CI	13.65, 2.77-67.32	
External auditory canal		
Wax/Otorrhea	80 (72.7)	30 (27.3)
Normal	38 (78.3)	12 (21.7)
Odds ratio, 95% CI	1.19, 0.55-2.57	
Eardrum		
Not visualized/Dullness/retraction	10 (34.5)	19 (65.5)
Normal	108 (82.4)	23 (17.6)
Odds ratio, 95% CI	8.92, 3.67-21.67	
Pattern of Hyperbilirubinemia		
Mild/Moderate	106 (77.4)	31 (22.6)
Severe	12 (47.8)	11 (52.2)
Odds ratio, 95% CI	0.32, 0.13-0.79	
Socioeconomic class		
Upper/Middle	74 (40.0)	35 (60.0)
Lower	44 (86.3)	7 (13.7)
Odds ratio, 95% CI	2.97, 1.23-7.26	

TSB=Total serum bilirubin; χ^2=Chi-square; df=degree of freedom. *Statistically significant

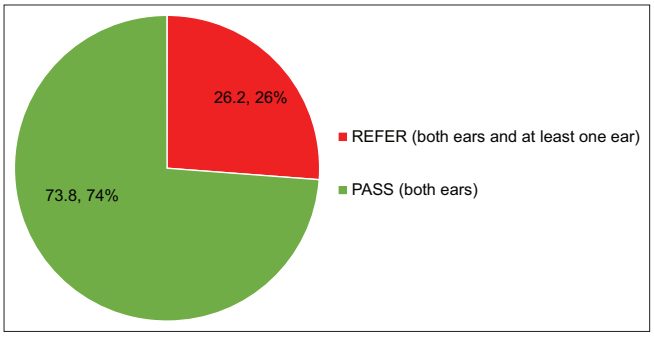

Figure 2: Prevalence of AABR failure

hyperbilirubinemia, but this was not statistically significant (OR = 1.47, 95% CI = 0.61-3.51, P = 0.374). Home birth was predictive of AABR failure (OR = 3.95, 95% CI = 3.02-5.16, P = 0.017) as was a clinical diagnosis of ABE (OR = 4.44, 95% CI = 3.19-6.17, $P \leq 0.001$).

Table 5: Logistic regression for predictors of AABR failure

Factors	Odds ratio	95% CI	*P*
Birth weight (g)			
1500–2499	3.16	1.48-6.79	<0.001
Reference category: 2500–3999			
Place of birth			
Home	3.95	3.02-5.16	0.017*
Diagnosis			
ABE	4.44	3.19-6.17	<0.001*
Exchange Blood Transfusion			
Yes	4.84	1.87-12.58	0.006*
Maternal History of congenital anomaly in previous birth			
Yes	2.70	1.44-5.07	0.022*
External ear			
Malformed	3.64	2.03-6.52	0.003*
Low set	3.00	0.93-9.65	0.024*
Reference category: Normal			
Tympanic membrane			
Dullness/retraction	5.94	2.36-14.92	<0.001*
Not seen	5.22	3.43-7.94	<0.001*
Reference category: Normal			
Pattern of Hyperbilirubinemia			
Moderate	1.47	0.61-3.51	0.374
Severe	0.34	0.02-5.03	0.688
Extreme	3.85	2.36-6.29	<0.001*
Hazardous	2.75	1.30-5.79	0.027*
Reference category: Mild			
Socioeconomic class			
Upper	4.37	1.86-10.27	0.012*
Middle	2.60	1.05-6.45	0.032*
Reference category: Lower			

ABE=Acute bilirubin encephalopathy, TSB=Total serum bilirubin, CI=Confidence interval. *Statistically significant

Discussion

The prevalence and risk of hearing impairment determined by screening AABR failure in this study were 26.2%. Although this was a hospital-based study, it agrees with the finding of Olusanya *et al.*[14] in a Lagos community where about 26.2% of attendees with historical correlates of severe neonatal jaundice in an immunization clinic were at risk of sensorineural hearing loss. Though our study participants had hyperbilirubinemia ranging from mild to hazardous and only 14.4% of them had severe hyperbilirubinemia, comparable findings were reported among those who had mainly severe hyperbilirubinemia in India[15] (28%) and Iran[16] (25.7%). The duration of exposure to bilirubin in our participants may contribute to this finding but it was not reported in those studies, thus making comparison difficult. Similarly, Falcón González *et al.*[3] reported 23.2% REFER prevalence among newborns with mild-to-severe hyperbilirubinemia

in Spain using a two-stage transient evoked otoacoustic emissions (TEOAE) screening. The drawback though is that the AABR is preferred for hearing screening in newborn with hyperbilirubinemia.[8,9]

In contrast to Can *et al.*,[17] all of our subjects were screened at or shortly after presentation unlike after the completion of treatment with phototherapy and/or EBT when recovery may have occurred, thereby producing lower prevalence of ABR failure (11%) among late preterm neonates with hyperbilirubinemia. In addition, it was noted that none of the participants in the Turkish study had TSB within the ETT range. A low prevalence of screening failure in relation to the timing of screening is affirmed in a systematic review by Akinpelu *et al.*[18] where the prevalence of abnormal ABR was reduced following treatment by phototherapy or EBT in up to 50% of those previously affected. A retrospective study conducted among preterm newborns in China also reported a low AABR failure rate of 6.8%.[19]

Also. our higher AABR failure rate may arise from the presence of other risk factors for hearing loss in our subjects, as some authors opined that the prevalence of hearing impairment increases as auditory risk factors increase.[3,7,20] This is because our subjects had hyperbilirubinemia of varying degree but in addition had other known auditory risk factors as outlined by the JCIH such as use of the ototoxic medications in 34%, assisted ventilation in 13%, and NICU stay exceeding 5 days in a few (1.3%). In contrast, Taghdiri *et al.*[21] reported a screening AABR failure rate of 4.07% in Iran where less than five percent of participants (high-risk term and late preterm NICU admissions) had other auditory risk factors.

Screening in this study was done irrespective of the timing of intervention for hyperbilirubinemia and up to twenty percent of the participants did not receive treatment with phototherapy or EBT. Unlike in some studies where the hearing tests were conducted before treatment with phototherapy or EBT and may be the reason for the higher rates of ABR failure (37.2% in Malaysia[22] and 45% in Iran[23]) reported among term neonates with moderate to severe hyperbilirubinemia. The specificity of the device used was quite high (99.79%), thus ensuring less false positives and comparably lower rates.

The variations in the proportion of positive brainstem response result occurring between studies partly because of the protocols used. In this study, the screening AABR was conducted at a stimulus intensity of 35 dBnHL, thus yielding a positive brainstem response (negative result or PASS) at this sound level meaning that subjects with mild hearing loss (21 to 30 dBnHL) may be missed. Some studies give a pass result when a response is obtained to stimuli intensity at 30 dBnHL and others at 40 dBnHL as seen in the study by Di Stadio *et al.*[24] where the prevalence of AABR failure was 16.3%. In effect, there is a possibility that some of those who have a PASS (negative) result on screening AABR could later be diagnosed with mild hearing loss on diagnostic ABR.[25]

This study also documented previously reported risk factors for hearing impairment such as extreme and hazardous hyperbilirubinemia[7,19,21,26] with attendant complications like ABE[27,28] and accompanying treatment such as exchange blood transfusion. However, unlike in other studies,[20,29] severe hyperbilirubinemia, that is TSB between 20 mg/dl to 24.9 mg/dl, was found to have a protective effect on screening AABR failure in this study, likely because 20 mg/dl is the ETT for the facility which implies a swifter and more aggressive response. Although the participants with moderate hyperbilirubinemia were more likely to fail AABR screening than those with mild hyperbilirubinemia in this study, it was not statistically significant.

Demographic characteristics such as age and GA were not significantly associated with AABR failure in this study and although there were more males than females, sex was also not associated with AABR failure which agrees with other studies.[15,30] Nevertheless, Amin *et al.*[15] reported that male sex was more at risk for hearing loss while it was a significant risk factor for persistent hearing test abnormality according to Maqbool *et al.*[20] The reason for this is unclear.

Homebirth in this study was found to be a risk factor for AABR failure and may be related to incident perinatal hypoxia, acidosis, or sepsis which increases risk of bilirubin-induced neurotoxicity and hearing loss.[18] This is in contrast with some studies which reported that the mode of delivery (especially cesarean delivery) rather than the place of delivery is associated with hearing loss.[21,24] Low birth weight (LBW) as a risk factor for AABR failure and hearing impairment in this study agrees with other studies.[3,7,20] However, Di Stadio *et al.*[24] found no association with birth weight.

A dull tympanic membrane (TM) on otoscopy was a significant risk factor for screening AABR failure in this study. These findings lack supporting evidence and may be incidental. However, many reasons for a dull TM in the study population exist including middle ear disease such as otitis media with effusion which may in some cases result in screening AABR failure and require confirmatory tympanometry but that was beyond the scope of this study. Nevertheless, the appearance of dull

TM is highly subjective and may not reflect ongoing disease. Therefore, its association with REFER AABR as seen in our study deserves further research. Likewise, a non-visualized TM was predictive of screening AABR failure in this study. The inability to see the TM on otoscopy is likely from occlusion by vernix, debris, and wax, which may prevent transmission of the sound signals from the probe to the cochlear and auditory nerve. Hearing screening with ABR is usually unaffected by middle or external ear debris[12] and to further ensure that referral rates are reduced below 4% as recommended, most researchers conduct the newborn hearing screening test on or after the third day of life as was done in this study. Nevertheless, the lack of normative data and validation of otoscopic findings in the participants by an otolaryngologist requires that these findings be interpreted with caution.

Maternal history of congenital anomaly in previous birth and malformed or low set pinnae in the subjects which may indicate the possibility of undiagnosed congenital syndromes and congenital hearing loss were also significant risk factors for screening AABR failure among the subjects in this study. Since most studies conducted on hearing loss in the newborn exclude to a considerable extent, auditory risk factors named by the JCIH, this makes comparison difficult.

Very few studies have explored the role of socioeconomic class (SEC) in the incidence of hearing loss. In this study, the participants whose families fall in the upper and middle SEC were 2 to 4 times more likely to fail the screening AABR than those from the lower SEC. This may be related to the fact that our study was conducted in a referral facility located in the FCT city center and two-thirds of the subjects were from families that belong to the upper and middle SEC. Due to the paucity of literature on the subject matter in Nigeria and Sub-Saharan Africa, we can only rely on reports from middle- and high-income countries although there may be differences in health-seeking behavior and the dynamics of socioeconomic status.

Strength

This study is a baseline for hearing assessment among newborns with hyperbilirubinemia irrespective of the cause and provides relevant clinical information to mitigate the incidence of hearing loss in this high-risk population.

Limitations of this study include the unavailability of normative data on otoscopy findings in the newborn period, unvalidated otoscopy findings by an otolaryngologist, and the possibility of undiagnosed congenital syndromes that may affect hearing.

Conclusion

The prevalence of screening AABR failure and risk of hearing impairment in at least one ear was high among newborns with hyperbilirubinemia in this study. Determinants of screening AABR failure among our study subjects include extreme or hazardous hyperbilirubinemia, ABE, exchange blood transfusion, LBW, home birth, malformed external ear, dull TM, maternal history of congenital anomaly in previous birth and upper and middle SEC.

This study therefore recommends the commencement of targeted hearing screening for high-risk neonates and the identification of risk factors for hearing loss in clinical settings through routine otoscopy alongside tympanometry.

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Conflicts of interest

There are no conflicts of interest.

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