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Newborn Hearing Screening Program: An Analytical Study At Combined Military Hospital Dhaka And Chattogram.

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Abstract
Background: *Although hearing loss or impairment can occur at any age, the most severe one appears before or immediately after the birth of a child. The consequences of these occurrences can lead to speech and even intellectual development function disorders. For these reasons, tests like otoacoustic emission (OAE) and/or automated auditory brainstem response (AABR) are very necessary for newborns.*
Aim of the study: *This study aimed to find out the percentage of hearing loss between normal infants and high-risk infants and also compare the hearing screening test results of normal and high-risk infants.*
Methods: *This quantitative observational cohort study was conducted at Combined Military Hospital (CMH), Dhaka and Combined Military Hospital (CMH), Chattogram in Bangladesh from January 2017 to December 2022. A total 300 neonates who underwent newborn hearing screening at any one of the mentioned hospitals were studied. A purposeful simplicity nonprobability sampling technic was used in sample selection. Data were processed, analyzed and disseminated by using the MS Office program.*
Results: *Among the total of 300 infants, 73.33% were with risk factors and 26.67% were normal infants. A total 80 normal infants underwent the OAE test of whom, 10 underwent the AABR test also; among those (n=80), 70 (87.5%) passed the OAE test and 10 (12.5%) referred to the OAE test and among those 10 normal infants, 6 (60%) passed the AABR test and 4 (40%) referred to the AABR test. On the other hand, 220 high-risk infants underwent the OAE test and among them (n=220), 200 also went through the AABR test; those (n=220), 20 (9.09%) passed the OAE test and 200 (90.91%) referred to the OAE test and among them, in 60 (30%), wave v was evident but in 140 (70%), no wave was found by the ABR test. In comparing the OAE reports we found that in normal infants, the percentages of passing (87.50%) were greater than refer (12,50%) and in risk factor infants, the percentages of passing (9.09%) were less than refer (90.91%). On the other hand, in comparing the ABR report we found that in normal infants, the percentages of passing (60%) were equal to the refer (40%) and in risk infants, the percentages of passing (30%) were less than refer (70%).*
Conclusion: *Newborn hearing screening is a technique by which it can be tested whether hearing loss is present or not. High-risk infants have more possibility to refer to both OAE and no wave in the AABR test. Newborn hearing screening, early identification and early intervention of those children who have failed in screening tests are very necessary.*

Keywords: *Newborn, Hearing screening, Hearing loss, Otoacoustic emission, OAE, AABR*

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I. INTRODUCTION

Newborn hearing loss means congenital or prenatal hearing disorder which may be sensory neural hearing loss (SNHL) or a mixed type of hearing loss. Newborn child hearing screening (NHS) services were meant to detect soon after conception hearing loss for children. These testing services introduced in most developed countries are usually performed by qualified audiologists, nurses, and medical assistants in hospitals or birth clinics before discharge from hospital and birth clinics. The main goal of neonatal hearing screening is to classify all cases of mild to serious hearing loss early. Every 0.1% or 0.2% of children of 1000 are suffering from this disorder and also this percentage increases 2.5% and 10% among the high-risk infant who is suffering from various diseases or problems during birth or maternal period [1]. Nowadays, health care refers to confirming newborn

hearing loss before 3 months by new universal hearing screening and for that, it can treat it before the age of six months [2]. In 1967, Downs and Sterritt first identified the standardized newborn hearing screening system by using a single generator and monitoring the behavioral response of children and learning it was not an easy task to highlight the importance of early childhood hearing testing because this technique was not common to most pediatricians at the start [3]. In 1980, when the electrophysiological tool became available, subjective engineering was replaced by that. After that, more than 54 Colorado hospitals in the United states maintain the universal hearing program by using objective technology like OME or AABR in 1998 [3]. A pilot program in Rhode Island and Hawaii was sponsored by the Maternal and Child Health Bureau and the Department of Education in 1989 utilizing the otoacoustic emission screening process [4]. A 'high-risk baby' is generally described as one needing more than the normal monitoring and treatment given to a safe-term newborn infant. Therefore, babies born pre- or post-term, those with premature development for gestational age, and those with manifest signs and symptoms of neurological disorders. developmental defects or congenital malformations requiring early diagnosis and care are known to be infants at high risk. According to the Joint Committee on Infant Hearing (JCIH), A high-risk baby is a child who looks healthy but has a far higher likelihood of having a health condition in the prenatal phase, such as hypothermia, hypoglycemia, apnea, infection, etcetera; it also lists risk criteria which are often associated with loss of hearing in babies and infants [5]. The most commonly used and successfully used techniques in neonatal universal hearing screens are (i) AABR and (ii) OAEs. Both OAE and AABR techniques have non-invasive records of physiological behavior that underlie natural auditory function and are easy to perform in neonates and infants [6]. Otoacoustic emission (OAE) recording normally takes less than 1 min and can be performed without audiological skills. The measurement theory of this test is that the sound waves are produced from the normal flow of the cochlear amplifier into the ear canal where the sound energy is captured. A tiny probe is inserted in the ear canal during testing and delivers sensory stimuli to the auditory system. The auditory signals are conveyed through the middle ear to the inner ear in a good ear where the cochlea's outer hair cells create an effective reaction or emissions [7]. These emissions were picked up in the probe by a microphone, processed by the screening system, and shown on the unit monitor an automatic pass or 'refer' response. In newborn hearing testing, two forms of OAE tests are commonly used: transient evoked OAEs and distortion product OAEs. Transient evoked OAEs measure cochlear activity more qualitatively and are more appropriate for topological diagnostics, whereas distortion-product OAEs offer objective data on hearing loss by theory, both distortion-product OAEs and transient OAEs allow the collection of frequency-specific information about a topic of hearing loss [4]. On the other hand, auditory brainstem response (AABR) is a possibility evoked by the auditory nerve. It can diagnose cochlea-level damage, auditory nerve, or brainstem auditory system. AABR measurements are accomplished by inserting disposable surface electrodes on the forehead and measuring the behavior of the brain wave in reaction to the sound. The AABR takes the form of five successive neural waves marked I–V, where wave I is produced in the mesencephalon as the compound action potential of the peripheral portion of the cochlear nerve and wave V. The waveform of a child is compared to the default AABR infant information model and the outcome 'pass' or 'fail' is calculated. AABR plays an important role in evaluating the lesion site-it makes it possible to differentiate between conductive and cochlear hearing loss. Globally, strategies used in UNHS are based on OAE (Otoacoustic emissions) and auditory brainstem response (AABR) [8]. Especially, methods based on AABR are well-considered due because of their high specificity, sensitivity and the high correlation between impairment and alteration in the ABR pattern [9]. With the development of automatic ABR (AABR) analysis, now results are obtained very faster which facilitates its application on a larger population [10]. The objective of this current study was to find out the percentage of hearing loss between normal infants and high-risk infants and also compare the hearing screening test results of normal and high-risk infants.

II. METHODOLOGY

This was a quantitative observational cohort study and was conducted at Combined Military Hospital (CMH), Dhaka and Combined Military Hospital (CMH), Chattogram in Bangladesh from January 2017 to December 2022. A total 300 neonates who underwent newborn hearing screening at any one of the mentioned hospitals were studied. A purposeful simplicity nonprobability sampling technic was used in sample selection. Properly written consent was taken from all the participants before data collection and the ethical clearance had been obtained from the ethical committee CMH, Dhaka. The whole study procedure was conducted following the principles of human research specified in the Helsinki Declaration [11] and executed in compliance with currently applicable regulations and the provisions of the General Data Protection Regulation (GDPR) [12]. As per the exclusion criteria of this study adult cases were excluded. OAE test reports and AABR test reports were the main data collection tools of this research. Microsoft Excel included all the details and some of them were retrieved from the patient files. The examiner also tried to include all types of information according to the test result to classify infant hearing problems. Data were processed, analyzed and disseminated by using the MS Office program.

III. RESULT

In this study, among the total of 300 infants, 73.33% were containing risk factors and the rest 26.67% of them were normal infants. In all the 80 normal infants, the OAE test and in 10 normal infants, only the AABR test was performed. Among those 80 normal infants, 70 (87.5%) passed the OAE test and 10 (12.5%) referred to the OAE test; among those 10 normal infants, in 6 (60%) cases, wave v was found present by the AABR test and in 4 (40%) cases, wave v was found absent by the AABR test. We found that 220 high-risk infants underwent the OAE test and among them, 200 underwent the AABR test. Among those 220 high-risk infants, 20 (9.09%) passed the OAE test and 200 (90.91%) referred to the OAE test; among those 200 high-risk infants in 60 (30%) cases, wave v was found present by the AABR test and in 140 (70%) cases, wave v was found absent by the AABR test. In comparing the OAE reports between the normal and risk infants, we found that in normal infants, the percentages of passing (87.50%), were greater than refer (12,50%) and in risk factor infants, the percentages of passing (9.09%), was less than refer (90.91%). On the other hand, in comparing the AABR reports between the normal and risk infants, we found that in normal infants, the percentages of wave V present (60%) were equal to wave V absent (40%) and in risk factor infants, the percentages of wave V present (30%) were less than wave V absent (70%).

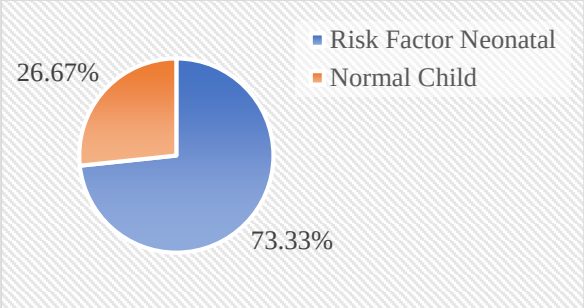

Figure 1: Ratio of normal and risk infants (N=300)

Table 1: Distribution of tests among normal infants (N=80)

Test	n	%
OAE	80	100%
AABR	10	13%

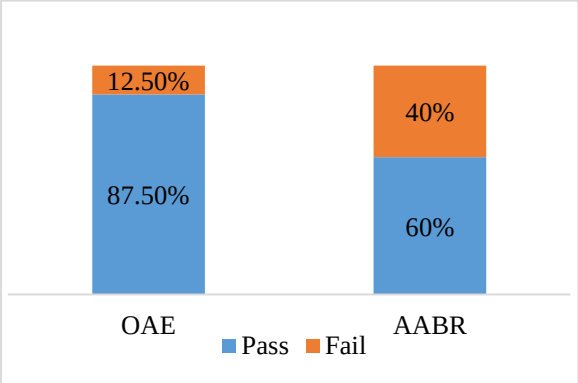

Figure 2: Test report distribution among normal infants (N=80)

Table 2: Distribution of tests among high-risk infants (N=220)

Test	n	%
OAE	220	100%
AABR	200	91%

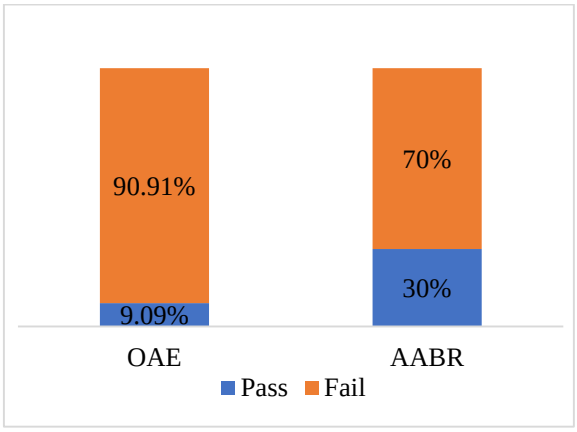

Figure 3: Test report distribution among high-risk infants (N=80)

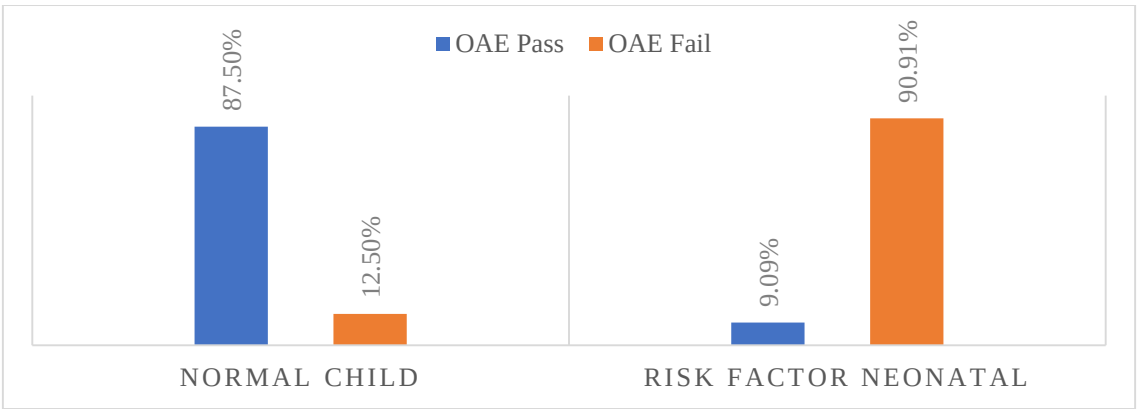

Figure 4: Comparison of OAE reports between normal and risk infants

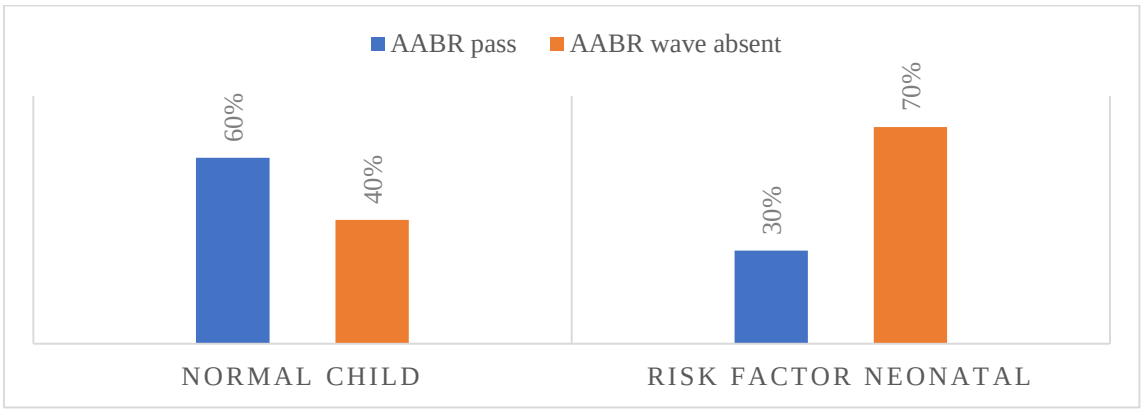

Figure 5: Comparison of AABR reports between normal and risk infants

IV. DISCUSSION

This study aimed to find out the percentage of hearing loss between normal infants and high-risk infants and also compare the hearing screening test results of normal and high-risk infants. In an earlier study, it was found that high-risk infants have more probability to refer to the newborn screening test [7]. Thomson, 1997 study also found that the (70 %) risk factor baby is mostly referred for AABR test and they cannot pass the newborn hearing screening test more than a normal infant [13]. Another study also showed that 55% of the high-risk infant mainly refer to the newborn hearing screening than a normal infant. [14] In the study, we found that 80 normal infants 70 (87.5%) passed the OAE test and 10 (12.5%) failed the OAE test and 220 high-risk infants 20 (9.09%) passed the OAE test and 200 (90.91%) failed the OAE test. So, the passing rate in the OAE test is greater in normal infants than in high-risk infants. On the other hand, the refer rate is greater in high risked infants than in normal infants. In this study, the investigator found that among 10 normal infants 6 (60%) passed the AABR test and in 4 (40%) cases wave V was found absent by the AABR test and among 200 high-risk infants in 60 (30%) cases, wave V was found present by the AABR test and 140 (70%) could not found the wave V in the AABR test.

So, the passing rate in the AABR test was greater in normal infants than in high-risk infants. On the other hand, the refer rate was greater in high risked infants than in normal infants. In the 1990s and 2000s, when otoacoustic emission (OAE) and automated auditory brainstem response (AABR) technologies first became available, many high-income countries introduced UNHS with concurrent evaluation [15]. In recent years, some additional evaluation procedures have also been implemented [16,17]. The results of those evaluations are used by policymakers as well as by the program managers to inform national "rollouts" of UNHS [18]. But it also should be noted that some studies also report on the possible harms of UNHS like parental anxiety and/or stress from waiting times for any definitive testing and amplification and even false-positive results [19,20]. All the findings of this current study may be helpful in further similar studies.

Limitation of the study:

This was a single-centered study with small-sized samples. Moreover, there were not enough books and journals available on this topic. So, we tried to collect information and literature from the internet. So, the findings of this study may not reflect the exact scenario of the whole country.

V. CONCLUSION & RECOMMENDATION

As per the findings of this current study, we can conclude that newborn hearing screening is a technique by which it can be tested whether hearing loss is present or not. This study provided a conception of the hearing loss of newborn infants and provided an analytical description of hearing loss in normal and high-risk infants. In this study, it was found that high-risk infants have more possibility to refer to both OAE and AABR screening tests. This study results also emphasized newborn hearing screening, early identification, and early intervention of those children who have been referred to the screening test. It is recommended that every hospital in our country should include newborn screening tests as a must for early intervention and for minimizing the bad effect of hearing impairment in children. For getting more specific results, we would like to recommend conducting similar studies in several places with larger-sized samples.

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Conflict of interest: None declared.

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