

# Analysis of Hearing Loss and Deafness in Infants Three Months of Age with a History of Otoacoustic Emission (OAE) “Refer” The Neonatal Period at Dr. Wahidin Sudirohusodo Hospital Makassar

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**Abstract:** ***Introduction:** Newborns with risk factors and without identified risk factors is recommended for the possibility of hearing loss and deafness. Identification of disturbances in the cochlea and retro cochlea is a part of the screening of hearing loss and deafness that can be easily discovered through the examination of OAE and ABR. **Materials and methods:** This study is a cohort prospective, conducted from March until December 2015 in the neonatal intensive care unit (NICU) at Dr. Wahidin Sudirohusodo Hospital Makassar. The descriptive analysis using the SPSS program. (Tolong ditambahi lagi bagian ini dan jelaskan SPSS apa yg digunakan) **Results:** The study results showed that in NICU, there are 39 newborns "Refer" (44.32 %) and in treatment room with 12 babies "Refer" (36.37 %), and after a 3 month old baby by using a re-examination OAE and ABR. The results showed that the infants of NICU and a rooming provide the results of "Pass" on all infants (100 %), which means there is not found any hearing loss and deafness. **Conclusions:** Based on the results, we can concluded that the "Refer" results of the OAE examination at the first screening is not a final diagnosis because after re-examination of the after 3 months of age infants did not show the hearing loss and deafness.*

**Keywords:** Otoacoustic emission (OAE), Brainstem evoked response (B), newborn screening

## 1. Introduction

Hearing is one of the very important sense in humans; therefore closely linked to the process of formation of speech and language. Hearing disorders in infants or children who are present at birth will cause the speech, language, cognitive, social, and emotional disorders. Early detection of hearing loss and deafness in newborns is an important step in early intervention, with the hope of disruption in the process of formation of the ability to speak and communicate. Lotfi et al (2007) reported in neonates born hearing screening at the Hedayat and Milad hospital in Teheran, there are about 1 in 1.000 babies with hearing loss.<sup>1</sup> While Ghasemi et al (2006) found the incidence of two of every 1.000 babies.<sup>2</sup>

There are two types of screening newborn hearing in the last two decades; the Auditory Brainstem Response (ABR) tool which was first introduced by Davis (1976) and Otoacoustic Emissions (OAE) by Kemp (1997). Gold standard infant hearing screening is OAE and ABR. Although OAE and ABR is the Gold Standard, but in some countries that have been doing a national program for Newborn Hearing Screening (NHS) are not all using both modalities such as in India, Philippines and Vietnam.<sup>3,4</sup>

Interest hearing screening in newborns is the finding of hearing loss and deafness as early as possible to allow for immediate intervention, the examination is objective, practical, automatic and non-invasive.<sup>5</sup>

Otoacoustic emission is a low-intensity noise generated in the normal cochlea, either spontaneously or response of an acoustic stimulus. OAE is assessing the integrity of the outer and middle ear and outer hair cells cochlear. Test results are easily readable due to the criteria stated Pass or Refer (not pass). Pass means the results showed good state of the cochlea, while Refer result means no interference cochlea, requiring further examination for screening at the age of 3 months in the form of ABR. OAE test results can be affected by the vernix caseosa, debris and the condition of the middle ear. If the screening is performed 24 hours after birth may cause results refer about 5-20%. Balkany (1998) reported the neonates aged less than 24 hours vernix caseosa filled ear canal to be drained out within 24-48 hours after birth; therefore, the results obtained refer. Before the examination tympanometry OAE is necessary to check, to see the condition of the middle ear in order the false results can be avoided.<sup>6,7</sup>

Based on the infant hearing screening groove HTA (kepanjangan) (2006), infants with the OAE test

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results shows refer to the initial screening examination back (re-screening) with successive checks tympanometry, DPOAE(kepanjangan), and ABR ranging in age from 3 months. If the result remains the same immediately refer examination diagnostic ABR or ASSR (kepanjangan).<sup>8</sup>

This study aimed to determine whether the hearing loss and deafness occurs after the age of three months with a history of OAE "Refer" in the neonatal period.

## 2. Materials and Methods

This study is a prospective cohort study, with examination OAE "refer" all babies born, will be evaluated after 3 months of age, with tympanometry, DPOAE and BERA examination. This study was conducted at the Dr. Wahidin Sudirohusodo hospital in March through December 2015. All post-baby care in the Neonatal Intensive Care Unit (NICU) and rooming with Refer OAE test results were then evaluated after the baby's aged were 3 month old. Samples are entire populations that met the inclusion criteria. The sampling is via OAE examination of infants who were treated in the NICU and a rooming of Dr. Wahidin Sudirohusodohospital, then we recorded the data relating to the study.

The inclusion criteria are all babies cared for in the Neonatal intensive Care Unit (NICU) and rooming hospital, the infants with 3 months of age with a history of OAE Refer, and their parents are willing to include the baby in this study. While the exclusion criteria are the infants with the external acoustic meatus atresia and craniofacial abnormalities.

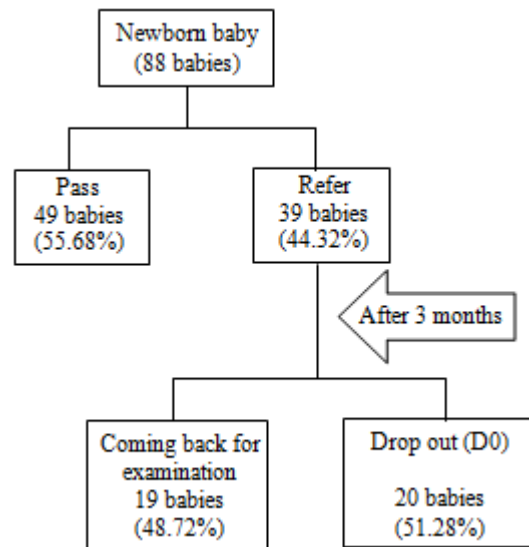
All the data obtained are recorded in the form of study data, and then each was analyzed with the descriptive method using SPSS (versi apa). The protocol was conducted in accordance with principles of Good Clinical Practice, including obtaining written informed consent from each participant's parent or legal guardian before study entry, and was approved by the human studies committees applicable to each study site.

Population, design and objective penelitian harus lebih dijelaskan, saya yang akan tambahkan nanti dok.

## 3. Results

Subjects were treated in nursing infants of Neonatal Intensive Care Unit (NICU) and infant rooming with results of Refer OAE. Then we evaluated the babies after 3 months of age. The Refer results in this study did not distinguish between unilateral (one ear) and bilateral (both ears), so if there is a unilateral Refer result, it is still regarded as one (1) Refer subject.

### NICU Patient Care



**Figure 1:** The Results of percentage of infants who participated in the study

According to the figure 1 above, there are 88 infants who participated in the initial screening study (newborn), as many as 49 infants (55.68%) examined the outcome OAE Pass and 39 infants (44.32%) shows the results Refer. During the follow-up of the next stage in infants aged 3 months to 19 infants (48.72%) who came back and 20 infants (51.28%) who expressed Drop out (DO).

**Table 1:** The characteristics of the study sample in NICU patients with OAE results Refer to the initial screening

No.	Sample characteristics	Total (n=39)	Percentage
1.	Sex	18	46.2
	Male	21	53.8
2.	Age (day)	17.18	
	Mean (SB)		
3.	Gestation		
	< 32 weeks	11	28.2
	32-36 weeks	20	51.3
	≥ 37 weeks	8	20.5

In the table above obtained 39 infants with early screening Refer OAE, which consists of the male with 18 infants (46.2%), the 21 infants of female (53.8%). The mean age of the baby at the time of the OAE initial screening examination is about 17 days. Babies born at gestational age below the 32 weeks were 11 infants (28.2%), 32-36 weeks were 20 infants (51.3%) and the babies that was born at the gestational age above 37 weeks are 8 infants (20.5%).

**Table 2:** Examination results of the OAE, ABR and ASSR once the babies aged 3 months

OAE	ABR		ASSR	
	Normal (%)	Abnormal (%)	Normal (%)	Abnormal (%)
Pass 19				
Refer 0	19 (100%)	0	19 (100%)	0

Table 2 shows the examination conducted in infants aged 3 months, namely OAE, ABR and ASSR, with the number of babies being examined as many as 19 babies, show the results obtained OAE Pass (100%) followed by examination of ABR and ASSR also obtained the normal results (100%).

Join patients

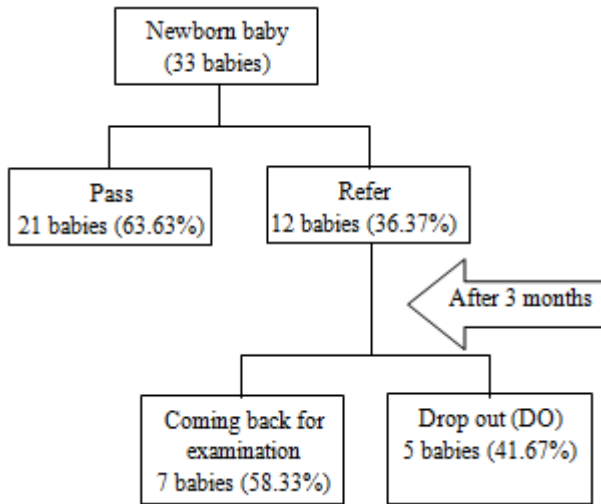


Figure 2: The results percentage of infants who participated in the study

In figure 2, there are 33 babies who participated in the initial screening study (newborn), as many as 21 infants (63.63%) examined the outcome OAE Pass and 12 infants (36.37%) shows the results Refer. During the follow-up of the next stage in infants aged 3 months, there are only 7 infants (58.33%) who came back and 5 infants (41.67%) expressed Drop Out (DO).

Table 3: Examination results of the OAE, ABR and ASSR once the babies aged 3 months

OAE	ABR		ASSR	
Pass	7	Normal (%)	7 (100%)	Normal (%)
Refer	0	Abnormal (%)	0	Abnormal (%)

Table 3 shows the examination conducted in infants aged 3 months, namely OAE, ABR and ASSR, with the number of babies being examined as many as seven babies. The results of the OAE all shows the indicated of Pass (100%) followed by the examination of ABR and ASSR with all normal (100%).

4. Discussion

Early detection of hearing loss in newborns with and without risk factors, is important due to the habilitation of hearing loss can be done as early as possible so that communication delays can be prevented from the outset.<sup>9</sup>

Universal Newborn Hearing Screening (UNHS) and Targeted Newborn Hearing Screening (TNHS) can be early detection of hearing loss, thus allowing intervention before age 6 months.<sup>9</sup>

Neonatal hearing screening is considered a process, not an event, accompanied by follow-up for parents and their babies. Start of instructions pre-screening to treatment and follow-up of infants diagnosed with hearing loss and deafness.<sup>9</sup>

In this study of 88 infants were examined at the initial screening (newborn), who were treated in the NICU care.

The results of the initial screening showed OAE Pass as many as 49 infants (55.68%) and showing the results Refer as many as 39 infants (44.32%). While the infant of rooming-in, there are 33 babies were examined at the initial screening (newborn). The results of the initial screening showed OAE Pass as many as 21 infants (63.63%) and shows the Refer as many as 12 infants (36.37%). The Joint Committee on Infant Hearing (JCIH) in 2007 recommends that the failure of the first stage may not achieve the 10%.<sup>3</sup>

In this study, the results of the initial screening OAE in excess of 10%, we were able to achieve a guide as recommended by JCIH. This happens due to several factors, including the initial inspection or newborn done on average at day 17 or at 2 weeks of the babies age.<sup>3</sup> Bantock and Croxon (1998) reported that the inspections of OAE as an initial screening should be in infants aged of 3 to 4 weeks because if the examination is done before the age of the possibility of the ear canal still had debris and there are still remnants of the amniotic fluid and vernix caseosa, as well as cochlear yet mature in premature infants that can interfere with OAE response that can show the false positive results.<sup>10</sup> Vohr et al (1993) also reported that the patient's age can affect the results of OAE. Waiting until the baby is aged a few weeks before screening will provide more opportunities for debris in the ear canal to be clean naturally.<sup>11</sup> In this study it was not done because the baby at that age were out of the hospital, there are many obstacles to visits to the homes of infants among them, the address listed in records medic hospital less complete, as well as the baby place to stay were located far from the hospitals.

Another factor that could cause a false positive result is OAE screening. Brass and camps (1994) mentions that screening tests need to be done in a quiet and soundproof room. However, soundproof room is not required if the available space is still. Probe improper size or ear probe should lead to the tympanic membrane.<sup>12</sup> Raquel Mari Onoda et al (2011) have been screened for hearing and deafness in Brazil, screening is performed in three stages. The first phase of the newborn age 2 days, then the second stage screening in infants aged 3 weeks. The third stage is continued screening in infants aged 3 months. The researchers' goal screening three stages to avoid the false-positive test results OAE.<sup>13</sup>

Once the babies aged three months follow-up test, the post-baby care NICU parents who came to bring their baby back for further investigation were 19 infants (48.72%) and the infants who otherwise drop out for further examination as many as 20 babies (51.28%). In infants rooming parents who brought their baby to do the further investigation are 7 infants (58.33%) and the other who was drop out as many as 5 babies (41.67%). This result is similar to the studies conducted by Abdullah A. et al. (2006) that during the follow-up of infants at the age of 3 months, found 39 cases (65%) who came back for visit and 21 cases (35%) otherwise drop out.<sup>14</sup> Several reasons, caused by some parents are too busy to bring their babies back for follow-up. This is due to a lack of understanding of the status of their hearing loss in infants, although previously described all matters relating to the tests, some parents do not bring their

babies for further screening because of the distance between their home and the place of inspection.

The tests done after the baby is 3 months of age includes Tympanometry, OAE, ABR and ASSR. OAE is a screening tool is not invasive, it is easy to perform and does not require a long time. This examination should not be conducted in a soundproof room, it is enough in the still room. OAE sensitive to cochlear function and the lesions found in the cochlea will affect the response of the OAE. Before the examination is done, firstly the OAE tympanometry examination in order to see the condition of the middle ear, if the results of tympanometry type A means normal, then forwarded to the OAE examination, it is require normal middle ear function. The BERA (Brainstem Evoked Response Audiometry) examination is an examination to determine the threshold of hearing or lesion on retrocochlea area and serves to ensure that the results of the OAE so advanced handling will be expedited. ASSR (Auditory Steady State Response) can provide information on a specific frequency hearing threshold automatically and simultaneously.<sup>15</sup>

In this study the Tympanometry, OAE, ABR and ASSR examination in infants aged 3 months post treatment nor of rooming NICU, everything are within normal limits. We found no hearing loss and deafness.

In the Wrigton (2007) literature, the incidence of hearing loss was 2-3 in every 1.000 babies.<sup>16</sup>In Iran, Lotfy et al (2007), in neonatal hearing screening showed that among the 1.000 babies born in Tehran, only one hearing impaired<sup>1</sup>. Ghasemi et al (2008), in the city of Mashhad, found that the incidence rate is 2 per 1.000 infants, the rate of hearing loss is 9 out of 1.000 babies and the amount of hearing loss are two of 1.000 babies.<sup>2</sup>it is very different in this study, because in this study the high number of drop outs and a short study time; therefore, it is very difficult to find babies who have a hearing loss and deafness. Perhaps among babies who otherwise drop out (DO) are babies who have a hearing loss and deafness.

According to JCIH (2007) the relationship between hearing loss and risk factors were not statistically significant. This means that the infant may suffer hearing loss without having a history of risk factors, only 2-5% of infants with a record of high risk of moderate or severe hearing loss and also 50% of infants with congenital hearing loss did not have evidence of risk factors. Thus JCIH (2007), suggested that hearing screening to be performed on all infants with or without high risk factors recommended to be re-evaluated at 3 months of age. Thus, it is recommended that audiologist uses hearing screening for all babies are not just for babies at high risk. In other words, all babies should be screened at their birth.<sup>3</sup>

Hearing screening tests should include in addition to long-term follow-up, the number of drop outs are few and proper data management system, including doctors, nursing staff, hospital management, medical records staff, and audiologists.

Limitations in this study include, some parents of the infants refuse to do the tests, and the number of dropouts (DO) was high.

## 5. Conclusion

From the results of our study, it can be concluded that the OAE examination at the initial screening in newborns hospitalized in NICU care and rooming shows the results Refer OAE and Pass. OAE examination in infants 3 months of age with a history of OAE "Refer" all shows the Pass results. BERA examination in infants 3 months of age with a history of OAE "Refer" all shows the normal results. Based on the study results obtained, it can be recommended that all infants at initial screening with the results of the OAE "refer" to do the re-screening after they are aged three months and the results of OAE pass with risk factors should be followed up by six months until the baby is three years old, initial screening in newborns should be done when the infants are aged three to four weeks.

## 6. Future Scope

(Tolong tuliskan apa harapan ta kedepannya terkait dengan penelitian ta ini). Contohnya:

To find out more about the role of obesity and overweight on the incidence of the metabolic syndrome, it is necessary to do a cohort study and controlling factors that may affect the metabolic syndrome.

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