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The relationship between Oto-Acoustic Emission (OAE) examination results and premature birth in the ENT-Neurotology Department at Prof. Dr. I.G.N.G. Ngoerah General Hospital

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Abstract

Background: Early detection is crucial, especially for children with risk factors for hearing impairment, as 50% of newborns with risk factors experience hearing loss from birth. Children diagnosed with hearing impairment early (before the age of 6 months) and given intervention at 6 months achieve significantly better language development than those who receive intervention after 6 months. The OAE examination is ideal for assessing the integrity of outer hair cells in the cochlea and for screening, as it allows for testing newborns as early as one day old within just a few minutes.

Method: This study employs a descriptive-analytical design to analyze the correlation between OAE examination results and premature birth. Data were analyzed using univariate and bivariate methods with IBM SPSS Statistics 27 software. Univariate analysis was used to describe the characteristics of study subjects and other variables, presented in frequency distribution tables. Bivariate analysis aimed to assess the relationship between OAE results and premature birth. All analyzed data will be presented in tables and percentages.

Results: The study results indicate a significant relationship ($p < 0.05$) between OAE results and premature birth, with $p < 0.01$ showing a highly significant outcome. Prematurely born patients were 0.3 times more likely to have a high-risk OAE refer result compared to non-premature patients (PR 0.3, 95% CI 0.14–0.62). The correlation between OAE results and premature birth was positive, meaning that the higher the incidence of premature birth, the higher the likelihood of an OAE refer result.

Conclusion: A significant correlation was found between premature birth and OAE results.

Keywords: Congenital Hearing Loss; Premature Birth; OAE Test; Perinatal Factors; Postnatal Factors

1. Introduction

The process of hearing is crucial for the development of speech and language abilities. It significantly impacts a child's ability to communicate throughout life. Hearing in childhood must be continuously evaluated to ensure that children can function effectively in society, where verbal communication is predominant.[1]

According to the American Academy of Pediatrics (AAP), significant bilateral hearing loss occurs in 1 to 3 per 1,000 newborns in the healthy infant population. In Indonesia, data from the 2018 National Basic Health Research (Riskesdas) reported that 0.11% of children with congenital hearing loss were detected between the ages of 24–59 months. Additionally, data from Indonesia's Central Bureau of Statistics (BPS) in 2019 estimated the country's population at

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268,074,600 people. With a congenital hearing loss prevalence of 0.1%, this suggests that approximately 268,074 Indonesians suffer from congenital hearing loss.[2,3]

Early diagnosis of hearing impairment (before the age of 6 months) and intervention at 6 months result in significantly better language development than interventions conducted after 6 months. Children with hearing impairment but normal cognitive function can achieve normal language development if intervention occurs at or before 6 months of age. Those who receive intervention between 6 and 36 months still achieve near-normal language development. Additionally, children who receive early education and hearing impairment management within their first year of life have a >50% chance of integrating into general education schools later in life.[4]

Early detection is crucial, especially for children with risk factors for hearing impairment, as 50% of newborns with risk factors are born with hearing loss. Hearing impairment in children can be detected using subjective audiological tests, which observe behavioral responses to sound, or objective tests, such as Brainstem Evoked Response Audiometry (BERA) and Oto-Acoustic Emission (OAE). The OAE test is particularly ideal for assessing the integrity of outer hair cells in the cochlea and for screening purposes, as it allows newborns to be tested as early as one day old, with results available in just a few minutes.[5]

Currently, no accurate data exist on the correlation between OAE results and a history of premature birth, despite the fact that premature birth is a potential cause of hearing impairment. Therefore, the author is interested in collecting data on patients undergoing OAE examinations with a history of premature birth at the ENT Department of Prof. Dr. I.G.N.G. Ngoerah General Hospital.

2. Methods

This study is a descriptive-analytical study using secondary data from medical records of patients who underwent OAE examinations at the outpatient clinic. The sample was obtained using a consecutive sampling technique, where every respondent who visited the ENT outpatient clinic or Diabetes outpatient clinic at Prof. Dr. I.G.N.G. Ngoerah General Hospital and met the inclusion criteria was included in the study until the required sample size was reached. Data collected included the prevalence of premature birth, age range, gender, prenatal factors, perinatal factors, and postnatal factors.

The inclusion criteria consisted of all patients who underwent an OAE examination, while the exclusion criteria were patients with incomplete medical records related to the OAE examination.

2.1. Statistical analysis

Data were analyzed using univariate and bivariate analyses with IBM SPSS Statistics 27.

- Univariate analysis was used to describe the characteristics of the study subjects and other variables, presented in frequency distribution tables.
- Bivariate analysis aimed to assess the relationship between OAE results and premature birth.

All analyzed data were presented in tables and percentages. Since both the independent and dependent variables in the study were categorical nominal and not paired, a Chi-square test was used, with a 2×2 contingency table. Statistical significance was determined using a p-value with $\alpha = 0.05$, where a relationship was considered significant if $p \leq 0.05$.

The correlation between OAE results and premature birth was tested using the contingency coefficient correlation test. This test was used to determine whether the relationship between the nominal variables was clinically significant. A minimum correlation value of 0.3 was considered meaningful.

3. Results

There were 190 samples, with their characteristics presented in Table 1.

Table 1 Characteristics of Study Samples

Variables	**OAE pass (n = 81)**	**OAE refer (n = 109)**	**p value**
Age, median (IQR)	24 (12-36)	24 (11-54)	0.140
0-3 months	4 (4.94 %)	15 (13.76 %)	
4-6 months	1 (1.23 %)	2 (1.83 %)	
7-12 months	18 (22.22 %)	16 (14.7 %)	
13-24 months	31 (38.28 %)	22 (20.18 %)	
> 24 months	27 (33.33 %)	54 (49.53%)	
Gestation age			0.01
Premature	12 (14. 81 %)	40 (36.7 %)	
Full term	69 (85.18%)	69 (63.3 %)	
Gender			0.309
Female	29 (35.80 %)	47 (43.11 %)	
Male	52 (64.20 %)	62 (56.89 %)	
Prenatal factor			0.822
Fever	5 (6.17 %)	7 (6.4 %)	
Abortion history	6 (7.40 %)	12 (11 %)	
Sibling with hearing loss	6 (7. 40 %)	10 (9.17 %)	
Toxoplasma Infection	6 (7. 40 %)	9 (8.3%)	
None	56 (69.13 %)	68 (62. 38 %)	
Other	2 (2.5 %)	3 (2.75 %)	
Delivery method			0.57
Vaginal Delivery	71 (87.7 %)	101 (92.67 %)	
Cesarean Section	10 (12.3 %)	8 (7.33 %)	
Perinatal Factors			0.887
Asphyxia	9 (11.11%)	16 (14.68 %)	
Low Birth Weight (LBW)	7 (8.64 %)	11 (10.10 %)	
None	59 (72.85 %)	75 (68.80 %)	
Others	6 (7.40 %)	7 (6.42 %)	
Postnatal factor			0.994
Jaundice	6 (7.40 %)	12 (11.0 %)	
Seizures	6 (7.40 %)	13 (11.92 %)	
Down syndrome	5 (6.20 %)	7 (6.42 %)	
None	59 (72.80 %)	68 (62.40 %)	
Other	5 (6.20 %)	9 (8.26 %)	

Table 2 Study Results on the Relationship Between OAE Results and Premature Birth

	OAE Pass	**OAE Refer**	**p value**	**PR (IK 95%)**
Gestational Age			0.001	0.3 (0.14-0.62)
Premature	12 (14.82 %)	40 (36.69%)		
Non premature	69 (85.18 %)	69 (63. 31%)		

Respondents with Risk Factors for Premature Birth and OAE Refer Results A total of 40 respondents with risk factors for premature birth had OAE refer results, accounting for 36.69% of the sample. The p-value was < 0.05, indicating statistical significance at 0.001. The correlation coefficient was 0.3, showing a positive correlation, meaning that the higher the incidence of premature birth, the higher the occurrence of OAE refer results.

Table 3 Characteristics of Premature Patients with OAE Refer Results and Additional Risk Factors

Risk Factor	**Total (%)**
Prenatal Factor	
Fever	6 (0.15%)
History of Abortion	3 (0.075%)
Sibling with Hearing Loss	5 (0.125%)
Toxoplasma Infection	6 (0.15%)
Perinatal Factor	
Asphyxia	6 (0.15%)
Low Birth Weight (LBW)	7 (0.175 %)
Postnatal Factor	
Jaundice	3 (0.075 %)
Seizures	3 (0.075%)
Down syndrome	1 (0.025%)

Table 3 shows the number of risk factors contributing to hearing impairment in premature birth patients with OAE refer results. The highest incidence among prenatal factors was fever and intrapartum infection, each affecting 6 cases (0.15%). Among perinatal factors, the most common was low birth weight (LBW), found in 7 cases (0.175%). Among postnatal factors, the most frequent were jaundice and seizures, with 3 cases each (0.075%).

4. Discussion

This study is a cross-sectional analytical study conducted to examine the relationship between OAE results and premature birth at RSUP Prof. Dr. I.G.N.G. Ngoerah Bali Indonesia.

Newborn hearing screening is the most efficient method for early identification of hearing impairment. In this study, infants were tested using OAE, which has been recommended in previous reports as a screening protocol. The goal is to detect hearing impairment in infants before three months of age, with appropriate intervention initiated by six months at the latest.[5]

Hearing impairment is a significant and serious consequence of premature birth. The reported prevalence of hearing impairment in premature infants ranges from 8.7%. In this study, hearing impairment was confirmed in 109 cases, with a prevalence of 57.36%, which is higher than in previous studies.6

A review of diagnostic studies comparing OAE and BERA found that OAE has lower sensitivity (46.15%) but relatively high specificity (85.96%). The lower sensitivity is primarily due to auditory neuropathy cases that are not detected by OAE. The absence of auditory brainstem response (ABR) despite the presence of otoacoustic emissions (OAE) is described as auditory neuropathy or auditory dys-synchrony. In a previous study, auditory neuropathy profiles were found in 7 out of 13 infants (53.8%), indicating that this form of hearing impairment is more common in premature infants.[7,8]

Hearing impairment can be caused by premature birth and other risk factors, including prenatal, intrapartum, and postnatal factors. Variables such as respiratory disorders (duration of ventilation and oxygen therapy) also play a role.[9]

In this study, there was a significant relationship ($p < 0.05$) between OAE results and premature birth, with $p < 0.01$ indicating strong statistical significance. Premature infants were 0.3 times more likely to have a higher risk of OAE refer results than non-premature infants (PR 0.3, 95% CI 0.14-0.62). The correlation between OAE results and premature birth was positive, meaning that the higher the incidence of prematurity, the higher the rate of OAE refer results.

A study by Kalsotra et al. found that the age at which hearing impairment was diagnosed ranged from <1 month to 22 years, with an average age of 6.73 years. Similarly, Shrivastava and Gupta (2018) reported that the age of patients visiting the ENT clinic varied from 0 months to over 24 months. In this study, the highest number of patients underwent hearing examinations after the age of 24 months.[10]

Another study by Shrivastava and Gupta found a higher predisposition among females than males. However, in this study, among the 190 samples, 104 were male (54.73%) and 74 were female (40%), with a male-to-female ratio of 1.5:1. A study by Sanjay et al. (2011) reported that the distribution of males and females was nearly equal.[11]

Due to the interrelated nature of these variables, future research should use multivariate analysis to assess inter-variable relationships and determine whether confounding variables exist. This is one of the limitations of this study. Additionally, the cross-sectional study design cannot analyze cause-and-effect relationships, as it only captures data at a single point in time. Establishing a causal relationship would require a longer study period, such as a cohort study design.

5. Conclusion

This study concludes that there is a significant relationship ($p < 0.05$) between OAE results and premature birth, with $p < 0.01$ indicating statistical significance. Premature infants are 0.3 times more likely to have a higher risk of OAE refer results compared to non-premature infants (PR 0.3, 95% CI 0.14-0.62). The correlation between OAE results and premature birth is positive, meaning that the higher the incidence of prematurity, the higher the rate of OAE refer results.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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