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Overview Of Hearing in Children Aged <36 Months Using Otoacoustic Emission at the Pampang Health Center, Makassar City

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ABSTRACT

Introduction: Hearing loss occurs in the newborn group up to the age of toddlers. If impaired hearing function, hearing function negatively impacts a child's social and intellectual development as well as emotional and mental health. In 2020, the WHO estimated that 34 million children worldwide had experienced hearing loss. Early detection of hearing loss has not been carried out well in developing countries, many hearing problems are not detected, there is no national neonatal hearing screening program in Indonesia is one of the causes. **Purpose:** To determine the picture of hearing loss in children <36 months of age using Otoacoustic Emission at the Pampang Health Center, Makassar City based on gender, age at the time of examination, birth weight, and risk factors. **Method:** Cross-sectional Observational Study research, the data taken was in the form of an overview of OAE results and anamnesis results data which were taken from the hearing modification test questionnaire in patients during the study. **Results:** A sample of 30 people was obtained. There were 16 (53.3%) normal hearing, 10 (33.3%) unilateral deafness, and 4 (13.3%) bilateral deafness. Hearing loss was more common in boys 7 (23.3%) out of 13 (43.3%), aged 6-12 months 5 (16.7%) people, low birth weight 1 (3.3%) people, and hearing risk factors namely preterm 2 (6.7%) people, LBW 1 (3.3%) people, born with cesario caesaria and ISPA 9 (30%). **Conclusion**: Risk factors including sex, age, birth weight, preterm, cesarean section, and upper respiratory tract infections influence the picture of children's hearing loss using Otoacoustic Emission.

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INTRODUCTION

Hearing loss can occur in all age groups. 25% of people with hearing loss occur in the group of newborns up to the age of toddlers. Ear disorders result in a negative impact on hearing function because they can interfere with social and intellectual development as well as children's emotional and mental health (Hamam K. 2019).

The results of the American Speech Language Hearing Association (ASHA) survey show that the prevalence of 131 per 1000 children has hearing loss with varying degrees of deafness. Southeast Asia has a high number of cases of hearing loss and deafness. Therefore, WHO launched the Sound Hearing 2030 program. The goal of this program is for every resident to have optimal ear and hearing health by 2030 (ASHA. 2018).

According to WHO, there are 34 million children in the world who have hearing loss, of which 1.1 per 1,000 live births have severe (sensoryeural) hearing loss. In developing countries, this figure can be higher, mostly due to infections or poorly controlled prenatal conditions (Dimitrov and Gossman 2023).

An estimated 466 million people worldwide have experienced hearing loss, 34 million are children and 60% of them are preventable. Indonesia is one of the four Asian countries with a fairly high prevalence of hearing loss, which is 4.6%, while deafness occurs in all age groups in seven provinces, which is 0.4% (Menteri Kesehatan RI. 2022).

According to the 2018 National Riskesdas Report, up to 0.11% of babies born with deafness are diagnosed between the ages of 24 and 59 months. With a prevalence of congenital deafness of 0.1% of Indonesia's population in 2019 is 268,074,600 people. Of these, 268,074 Indonesians have been deaf since birth. Due to Indonesia's annual birth rate of 2.4%, an additional 60,000 cases of congenital deafness have been discovered over the past ten years (Menteri Kesehatan RI. 2022)

West Java, which has a population of more than 37 million people and a growth rate of 1.8% per year, is estimated to have at least 600 babies born with severe bilateral congenital sensorineural deafness. Purnami research conducted at Soetomo Hospital Surabaya from 2011 to 2013 found 377 cases of the most severe/profound level of congenital sensorineural hearing loss at 87.27% (Ministry of Health of the Republic of Indonesia, 2022).

In South Sulawesi, especially at Wahidin Sudiro Hosodo Hospital, there were 39 babies with examination results in the form of referrals who were treated in the NICU room or as many as 44.32% and 12 babies with examination results in the form of referrals who were treated in the perinatology room or as much as 36.37% of the total number of babies, namely 88 babies who were screened for hearing (Uleng et al. 2016).

Hearing loss (deafness) occurs during the neonates (pre lingual deafness) resulting in disturbances in the developmental stages of speech, language, cognitive, emotional, and social communication. With these disorders, it is necessary to have early screening for neonatal deafness and immediately restore hearing using hearing aids in the optimal period of children's speech development (Susyanto and Widuri 2015).

Early detection of hearing loss has not worked well in developing countries, many hearing problems go undetected until they are two years old or older, when they should be able to speak. Parents' low understanding of hearing function is the cause of this. In addition, there is no national neonatal hearing screening program in Indonesia (Menteri Kesehatan RI. 2022)

The higher prevalence of hearing impairment and the substantial number of undetected cases in developing countries are generally attributed to limited resources, low public awareness, and inadequate hearing healthcare infrastructure. Factors such as the scarcity of screening tools, a shortage of healthcare professionals trained in audiology, and insufficient national policy support hinder the widespread implementation of hearing

screening programs. In addition, socioeconomic barriers further contribute to this issue, as many families are unaware of the importance of early hearing assessment. Consequently, hearing impairment in children is often identified only after noticeable speech and language delays have occurred (Olusanya, B. O. 2018).

Therefore, to make it easier to establish the diagnosis of hearing loss in children, screening is needed in the form of an Otoacoustic Emission (OAE) examination. The Otoacoustic Emissions test is now an important part of an objective pediatric audiological evaluation where the resulting sound can be recorded by a sensitive microphone (Kardman et al. 2023).

However, based on data provided by the Indonesian ENT-KL specialist organization in 2019, not all Otoacoustic Emission devices can be accessed at hospitals that have ENT-KL specialists (Perhati_KL 2019).

LITERATURE REVIEW

Hearing is a neural perception of sound energy so that it can help a person interact with the surrounding environment Sound identification and localization are two components of hearing (Sherwood 2018).

Air vibrations that propagate in the form of sound waves. To produce sound, air molecules must be compressed, which results in high-pressure areas, and stretched, which results in low-pressure areas. A sound source is any piece of equipment capable of creating abnormal patterns of air molecules. Sound is characterized by *pitch*, intensity, and *timbre*) (Sherwood 2018).

In theory, the hearing process of early childhood is identical to the hearing process of adults. The difference in anatomy is that children's ear canals are shorter than adults'. Through the ear canal, sound waves travel to the cochlear region through the air or ear bones. In order for the tympanic membrane to vibrate, the sound waves received by the earlobe are directed to the ear. Sound waves in the form of vibrations or mechanical energy move the oscillary levers of the oval window. These mechanical waves are then channeled through the inner ear fluid of the cochlea which will be converted into electrical energy by the difference in sodium and potassium ions. Electrical energy is transmitted to the branches of the auditory nerve (vestibulococcal nerve) which functions to maintain balance and conduct electrical impulses to the brain. Electrical impulses received by the brain will be perceived as sound stimuli (Jauhari 2020).

Hearing loss and *deafness* can occur at any age, from birth to old age, but sometimes unnoticed, especially in babies. The impact of hearing loss and deafness not only results in impaired speech and language development, but in the later stages will cause obstacles to academic development, inability to socialize, emotional behavior and reduced opportunities to get a job which will further impact the quality of life of children and parents (Somayaji et al. 2020).

Risk factors for sensory-neural hearing loss include infections, premature babies, low birth weight, and babies with treatment in the NICU. One of the risk factors for hearing loss is LBW. Deafness in newborns can be caused by a variety of conditions, including hypoxia and imperfect organ development. Risk factors include prematurity or low birth weight babies (LBW), ototoxic drugs, prolonged mechanical ventilation, low apgar score and meningitis. Hearing loss is common in children, both caused by disorders of the auditory nervous system and conductive deafness due to cerumen, middle ear fluid and tympanic membrane perforation. About six out of every thousand newborns have some type of unilateral or bilateral hearing loss (Susyanto and Widuri 2015).

The OAE (Otoacoustic Emissions) *test* is now an important part of the objective evaluation of pediatric audiology. Autoacoustic emissions in humans are sounds produced

by oscillations (contractions and elongations) of outer hair cells in the cochlea and transmitted through the middle ear to the outer ear, where they can be recorded by sensitive microphones and used as a screening tool for hearing loss (Kardman et al. 2023).

An OAE examination is done to find out if the cochlea is working normally. The outer hair cells (OHCs) of the cochlea respond to external sound stimuli with a low-pitched acoustic response known as OAE. It is said that the cochlea serves as a real organ for voices from all over the world. Once sorted in the cochlea according to its frequency, the sound will be sent to the auditory nervous system and brainstem, where it will be processed before reaching the brain for perception. Damage to outer hair cells, such as from viruses, ototoxic drugs, or insufficient blood flow to the cochlea results in OHC's being unable to produce OAE (Rai Wiryadi and Wiranadha 2019).

The results obtained using the OAE test are the results of "*refer*" and "*pass*". If the results obtained are "*referred" in* the baby after the first screening, it must be followed up by conducting a second screening, but if both are still "*referred",* it must be followed up systematically and given a referral for diagnostic tests. When the result obtained is "*pass",* parents will be given information about the development of hearing and language anticipated in the growth and development of children (World Health Organization. 2021).

METHOD

This study is a Cross-sectional Observational Study. The data taken was in the form of an overview of OAE results and anamnesis data based on informed consent sheets. The instruments used were in the form of personal data sheets and hearing measurement tools using OAE tools. This research was conducted at the Pampang Health Center, Makassar City and took place in July 2024.

This study employed an incidental (convenience) sampling technique, in which participants were recruited based on their availability and eligibility at the time of data collection. This sampling method was considered appropriate because the primary objective of the study was descriptive, aiming to provide an overview of hearing status among children aged less than 36 months who attended a primary healthcare facility. In addition, practical considerations such as limited study duration and the unpredictable attendance of eligible participants at the community health center supported the use of incidental sampling in this field-based research setting.

Nevertheless, incidental sampling has inherent limitations, including the potential for selection bias and restricted generalizability of the findings to the wider population. Therefore, the results of this study should be interpreted as a preliminary description of hearing outcomes in the study setting and may serve as a basis for future studies employing probability-based sampling methods to enhance external validity.

The self-data sheet instrument was taken from the hearing test questionnaire which was later developed into the hearing modification test (TMDD) issued in 1997 by the Directorate General of Public Health Development, Ministry of Health of the Republic of Indonesia.

The use of TMDD in this study was justified by its status as a standardized national screening tool recommended for hearing assessment in primary healthcare services in Indonesia. The instrument has been widely applied in clinical practice and previous studies, indicating adequate content validity for community-based hearing screening.

Although a separate validity and reliability re-assessment of the TMDD was not performed in this study, its application in combination with an objective hearing screening method, namely Otoacoustic Emission (OAE) testing, was expected to enhance the accuracy and methodological rigor of hearing loss detection. The integration of subjective screening

instruments with objective audiological measurements has been recommended to improve the reliability of early hearing detection programs, particularly in resource-limited settings.

The target population of this study is children who are less than 36 months old in Indonesia with an affordable population, namely children who are less than 36 months old who come to the Pampang Health Center, Makassar City when the study was conducted. The study sample is all affordable populations that meet the research criteria using incidental sampling techniques. The total population in this study is 311 people, so the percentage of relaxation used is 20% and the results of the calculation can be rounded to achieve suitability. Based on the slovin formula, 23 was obtained to be the minimum sample in this study.

Data collection is obtained through primary data, then grouped by purpose and type of data, then analyzed using the Microsoft Excel program, then presented in the form of a table and explained in the form of a narrative.

This research has received an ethical feasibility permit from the UMI Research Ethics Commission Number: 213/A.1/KEP-UMI/VI/2024. The following primary data was analyzed using the Microsoft Excel program.

Table 1. The OAE Results

OAE Results	Pass-Pass	Pass-Refer	Refer-Pass	Refer-Refer
	n (%)	n (%)	n (%)	n (%)
Gender				
Man	6 (20)	4 (13.3)	0 (0)	3 (10)
Woman	10 (33.3)	5 (16.7)	1 (3.3)	1 (3.3)
Total	16 (53.3)	9 (30)	1 (3.3)	4 (13.3)
Age				
0 – 3 Months	3 (10)		0 (0)	0 (0)
3 – 6 Months	3 (10)	0 (0)	0 (0)	1 (3.3)
6 – 12 Months	5 (16.7)	3 (10)	1 (3.3)	1 (3.3)
12 – 18 Months	3 (10)	2 (6.7)	0 (0)	1 (3.3)
18 – 24 Months	0 (0)	1 (3.3)	0 (0)	1 (3.3)
24 – 30 Months	2 (6.7)	1 (3.3)	0 (0)	0 (0)
30 – 36 Months	0 (0)	1 (3.3)	0 (0)	0 (0)
Total	16 (53.3)	9 (30)	1 (3.3)	4 (13.3)
Birth Weight Group				
LBW: <2500 grams	0 (0)	0 (0)	0 (0)	1 (3.3)
Normal: 2500-4000 grams	16 (53.3)	9 (30)	1 (3.3)	3 (10)
Macrosomia: >4000 grams	0 (0)	0 (0)	0 (0)	0 (0)
Total	16 (53.3)	9 (30)	1 (3.3)	4 (13.3)
Risk Factors				
Preterm	1 (3.3)	1 (3.3)	0 (0)	1 (3.3)
Low Birth Weight (LBW)	0 (0)	0 (0)	0 (0)	1 (3.3)
Ototoxic drugs	0 (0)	0 (0)	0 (0)	0 (0)
Family history	0 (0)	0 (0)	0 (0)	0 (0)
Other risk factors (Born SC, ISPA)	4 (13.3)	7 (23.3)	1 (3.3)	1 (3.3)
No risk factors	10 (33.3)	2 (6.7)	0 (0)	1 (3.3)
Total	15 (50)	10 (33.3)	1 (3.3)	4 (13.3)

Notes:

- Pass-Pass : Right ear pass, left ear pass → Usual
- Pass-Refer : Right ear pass, left ear refer → Unilateral Deaf
- Refer-Pass : Right ear refer, left ear pass → Unilateral Deaf
- Refer-Refer : Right ear refer, left ear refer → Bilateral Deaf

Risk factors were defined as the presence of one or more conditions known to be associated with childhood hearing loss. Each subject could present with more than one risk factor. Therefore, the distribution of specific risk factors is presented separately and is not mutually exclusive.

RESULTS AND DISCUSSION

The characteristics of the study participants are presented in this section. A total of 30 children were included in the study, consisting of 13 (43.3%) males and 17 (56.7%) females. The participants ranged in age from 0 to 36 months and were distributed across seven age categories: 0–3 months, 3–6 months, 6–12 months, 12–18 months, 18–24 months, 24–30 months, and 30–36 months. Based on birth weight, one child was classified as having low birth weight, while the remaining 29 children had normal birth weight. Parental educational backgrounds varied from elementary school to bachelor's degree level, with senior high school being the most common educational attainment (46.7%). Regarding parental occupation, participants' parents were primarily homemakers, laborers, self-employed workers, and private-sector employees. Furthermore, all parents reported spending more than eight hours per day interacting with their children (Table 2).

Table 2. Characteristics of Respondents (N= 30)

Characteristics	Categories	Frequency	Percentage (%)
Gender	Man	13	43.3
	Woman	17	56.7
Age	0-3 months	4	13.3
	3-6 months	4	13.3
	6-12 months	10	33.4
	12-18 months	6	20.0
	18-24 months	2	6.7
	24-30 months	3	10.0
	30-36 months	1	3.3
Birth Weight Group	LBW : <2500 grams	1	3.3
	Normal : 2500-4000 grams	29	96.7
	Macrosomia : >4000 grams	0	0
Parent Education	Elementary – Junior High School	3	10.0
	Senior High School	14	46.7
	Diploma	3	10.0
	Bachelor Degree	10	33.3
Parents' Work	Housewives	22	73.3
	Laborer	2	6.7
	Self employed	3	10.0
	Private Employees	3	10.0
Duration of Parent Interaction	>8 hours	30	100.0
	<8 hours	0	0
Risk Factors	Preterm	3	10.0
	Low Birth Weight	1	3.3
	Ototoxic drugs	0	0
	Family history	0	0
	Other risk (Caesarean birth, ISPA)	13	43.3
	No. risk factors	13	43.3

Based on risk factors for hearing loss, more children experience hearing loss accompanied by risk factors.

Table 3. The OAE Measurement Results

Variables	Categories	OAE Measurement Results		
		Normal Hearing	Unilateral Hearing Loss	Bilateral Hearing Loss
		n (%)	n (%)	n (%)
Sex	Male	6 (20)	4 (13.3)	3 (10)
	Female	10 (33.3)	6 (20)	1 (3.3)
Age Group (Months)	0-3	3 (10)	1 (3.3)	0 (0)
	3-6	3 (10)	0 (0)	1 (3.3)
	6-12	5 (16.7)	4 (13.3)	1 (3.3)
	12-18	3 (10)	2 (6.7)	1 (3.3)
	18-24	0 (0)	1 (3.3)	1 (3.3)
	24-30	2 (6.7)	1 (3.3)	0 (0)
	30-36	0 (0)	1 (3.3)	0 (0)
Birth Weight	Low birth weight (<2500 gram)	0 (0)	0 (0)	1(33)
	Normal (2500 – 4000 gram)	16 (53.3)	10 (33.3)	3 (10)
	Macrosomia >4000 gram)	0 (0)	0 (0)	0 (0)
Risk Factor	Preterm	1 (3.3)	1 (3.3)	1 (3.3)
	Low birth weight	0 (0)	0 (0)	1 (3.3)
	Family history	0 (0)	0 (0)	0 (0)
	Other risk factors (Cesarean section, acute respiratory infection)	4 (13.3)	8 (26.7)	1 (3.3)
	No identified risk factor	10 (33.3)	2 (3.3)	1 (3.3)

Table 3 shows the distribution of OAE measurement results among the study participants. Of the 30 children assessed, 16 (53.3%) had normal hearing, 10 (33.3%) had unilateral hearing loss, and 4 (13.3%) had bilateral hearing loss. Normal hearing was more common among females (33.3%) than males (20.0%). The highest proportion of both normal hearing (16.7%) and unilateral hearing loss (13.3%) was observed in children aged 6–12 months. Most participants had normal birth weight, accounting for 53.3% of those with normal hearing and 33.3% of those with unilateral hearing loss. Children without identified risk factors represented the largest proportion of participants with normal hearing (33.3%), while unilateral hearing loss was most frequently found among those with other risk factors, such as cesarean section and acute respiratory infection (26.7%).

Hearing Loss Based on Sex

The results of this study are in accordance with previous research at Dr.Moh Hospital. Hoesin, which shows the distribution of hearing loss by gender, is suffered by 66.9% of boys and 33.1% of women (Sarah, N.l.S., Memy, Y.D. 2015). Then the results of the study in India found that the gender with the most risk factors for hearing loss was 349 (56.93%) males out of 613 babies (Regina et al. 2017). Then the research conducted at the ENT-KL polyclinic of Sanglah Hospital stated that in the initial screening examination with OAE, more referral results were obtained than pass results, where in the right ear the referral results were obtained as much as 58% and in the left ear as much as 61% of the total number of samples (Rai Wiryadi and Wiranadha 2019). Research conducted at Dr. Kariadi Semarang Hospital also obtained results where 237 male subjects (50.9%) experienced more hearing loss (Handayani, Dwi, and Muyassaroh. 2021). Then research conducted at the NTB Provincial Hospital stated that based on gender, the most disorders were male, namely 54 people (50.5%) people (Yuliyani 2023).

A study in China examining the results of hearing screening in newborns found that boys tend to be more likely to be diagnosed with severe sensorineural hearing loss, while hearing loss is more commonly detected in girls in the category of conductive hearing loss, such as due to middle ear infections or ear structural abnormalities (Liu 2014).

Hearing Loss Based on Age Group

The results of this study are in accordance with previous research at dr. Saiful Anwar Hospital, which was obtained higher in the age range of 0 - 6 months and 7 months - 2 years with the same percentage (Anwar Periode, Kurniawan, and Indrasworo 2022). This is supported by the recommendation from the *Joint Committee on Infant Hearing* in 2007 that neonatal hearing screening should be done before the age of 3 months and interventions have been given before the age of 6 months, especially in infants with risk factors, manifestations of sensorineural deafness can appear after a few months to years after birth (Susyanto and Widuri 2015).

An assessment of the prevalence and risk factors of hearing loss in children aged 0-36 months in various countries found that hearing loss in children is often diagnosed in neonatal to toddlers (0-36 months), with a higher prevalence in developing countries. This hearing loss is often caused by a genetic disorder or ear infection (otitis media), which affects the child's ability to hear and speak. The study also emphasizes the importance of neonatal hearing screening to detect hearing loss from an early age, so that interventions can be carried out to minimize the impact on child development (Olusanya, B. O. 2018).

Hearing Loss Based on Birth Weight

The results of this study are in accordance with previous research at PKU Muhammadiyah Hospital Yogyakarta that the LBW factor affects the results of OAE examination (Susyanto and Widuri 2015). The condition of LBW is one of the risk factors for increased sensorineural hearing loss. The effect of delayed myelination in children with LBW is one of the factors that contribute to the body's imagination and physiological dysfunction, including on auditory function (Korver et al. 2017) . Babies born with LBW will have suboptimal hearing function because the development of intrauterine fetal organs and organ systems does not occur optimally (Nisotakis et al. 2016).

Prevalence and Risk Factors for Hearing Loss in Premature Infants with Low Birth WeightThis study examined the relationship between BBLR and hearing loss in premature infants. The results showed that babies with low birth weight and preterm birth weight had a higher risk of developing sensorineural hearing loss, with a prevalence of 8-12% in premature babies with very low birth weight (<1500 grams). The main risk factors include hypoxia, neonatal infections (such as meningitis), as well as the use of ototoxic drugs. Babies born with very low BBLR often require treatment involving aminoglycosides (such as gentamicin) that have damaging side effects on the cochlea (inner ear) and auditory nerve (Li, Wang, and Chen, H 2023).

From a physiological and developmental perspective, several mechanisms may explain the association between risk factors and hearing loss observed in this study. Male children are reported to have relatively slower maturation of the auditory system compared to females, including delayed development of cochlear outer hair cells and auditory neural pathways, which may increase their vulnerability to hearing impairment in early life. In addition, the age group of 6–12 months represents a critical period for auditory and language development, during which progressive congenital or postnatally acquired hearing loss becomes clinically detectable.

Hearing Loss Associated with Other Risk Factors

Risk factors such as prematurity and low birth weight are associated with auditory system immaturity, delayed myelination, and exposure to hypoxia and ototoxic medications during neonatal care. Cesarean delivery has also been linked to middle ear fluid retention due to the absence of thoracic compression during birth, potentially affecting Otoacoustic Emission (OAE) screening results. Furthermore, upper respiratory tract infections in early childhood may lead to Eustachian tube dysfunction and middle ear effusion, contributing to hearing impairment, particularly of the conductive type.

The results of this study are in accordance with previous research at the NTB Provincial Hospital showing that there are several risk factors showing a statistically significant relationship between premature gestational age and low birth weight infants (LBW) with the results of OAE examination with the values of p=0.017 and p=0.015, respectively. In the group of newborns with premature conditions, there were 29 babies with OAE referral examination results and 19 babies were passed (Yuliyani 2023). Research conducted in Poland found that hearing loss can occur in babies born at the age of 26 and 28 weeks of pregnancy by 4.2% and babies born at 29 and 32 weeks of pregnancy by 2.3%. The incidence rate increases when compared to babies born at full term (Wroblewska-Seniuk et al. 2017).

Then the results of a study in India showed that around 31.57% of premature babies with a gestational age ≤ 36 weeks had hearing loss. Motor development provides an overview of myelination in corticospinal tracts, pyramids, and corticobulars. Myelin is essential for the speed of transmission of stimuli through nerve cells. If children are preterm and LBW, it will affect the myelinization process that occurs (Regina et al. 2017).

Then the results of a study in Carolina found that babies born with sectio caesarean section were 3.2 times more likely to develop cochlear dysfunction than babies born spontaneously. Babies born with the procedure are said to be more at risk of hearing loss, because there is no thoracic compression process and there is no considerable pressure on the fetal head during the birth process such as normal delivery that passes through the birth canal, so that there is a delay in the absorption of fluid in the middle ear in babies born with this procedure. Then, the spontaneous delivery process results in the baby actively experiencing a birth reflex that is not experienced by babies born by caesarean section, in this case it will affect the process of cognitive formation of movement (praxis intelligence), and cognitive language, reading, writing, and counting (representative of intelligence) because the initial development process begins with a reflex mechanism as the basic stimulation process for brain maturation. So in theory, babies born by cesarean section have slower motor development than babies born spontaneously (Stuart 2020).

Then the results of the study in Lampung found that the inflammatory process that occurs in ISPA causes damage to the mucocilia, goblet cells, and mucous glands in the nasopharynx epithelium and middle ear. This damage causes the drainage system in the middle ear to be disrupted, while mucus production in the middle ear continues. This leads to an increase in air pressure in the middle ear (Wald ER, Nancy G 2011).

In this study, children with drug ototoxic risk factors were not obtained, but in another study conducted in Shandong province, China on 238 infants with SNHL, 117 children with drug ototoxic exposure were obtained. Otoxicant drugs cause functional impairment and/or cellular degeneration of the inner ear tissue. Hearing loss caused by ototoxic drugs initially affects the high frequency of the hearing spectrum (Jiang, Kuper, and Bright 2020).

In this study, children with family history risk factors were also not obtained, but in another study conducted by the ENT-KL Polytechnic of Banda Aceh Hospital, 13 (26.53%)

were found who had a family history of hearing loss and then experienced congenital deafness with a family history of deafness since birth (Haroen, et al., 2023).

The findings of this study have important practical implications for primary health care services, particularly at Puskesmas Pampang in Makassar. Given the higher prevalence of hearing impairment among male children and those aged 6–12 months, hearing screening should not be limited to the neonatal period but extended to routine immunization visits and child growth and development monitoring.

Children with identified risk factors such as prematurity, low birth weight, cesarean delivery, and a history of upper respiratory tract infections should be prioritized for follow-up hearing screening and audiological assessment. In addition, strengthening parental education regarding early signs of hearing loss and the importance of early detection through community-based health promotion activities may enhance screening effectiveness. This targeted screening approach may facilitate earlier intervention and help prevent delays in speech and language development.

This study has several strengths, including the use of an objective hearing screening tool (Otoacoustic Emission), a focus on early childhood populations in a primary healthcare setting, and the acquisition of ethical approval. However, some limitations should be acknowledged. The cross-sectional design precludes causal inference between risk factors and hearing loss. In addition, the study was conducted at a single primary healthcare center with a relatively small sample size (n = 30), limiting the generalizability of the findings. Reliance on medical records and parental reports for certain risk factors may also introduce information bias. Therefore, future studies employing longitudinal designs with larger sample sizes and broader geographic coverage are warranted.

CONCLUSION

Hearing loss among children aged less than 36 months at Puskesmas Pampang, Makassar, was more frequently observed in male children, with the highest occurrence detected in the 6–12-month age group. Identified risk factors included prematurity, low birth weight, cesarean delivery, and a history of upper respiratory tract infections

Although further research and audiological counseling are required, these preliminary findings allow for several actionable recommendations. Hearing screening should not be limited to the neonatal period but extended to infancy and early childhood, particularly targeting children aged 6–12 months. Male infants and children with identified perinatal or postnatal risk factors may benefit from prioritized follow-up screening and closer monitoring of speech and language development.

Furthermore, integrating Otoacoustic Emission (OAE) screening into routine maternal and child health services at primary healthcare centers, such as immunization visits and growth monitoring sessions, may enhance early detection of hearing impairment. Strengthening parental education regarding early signs of hearing loss and the importance of timely screening is also essential as part of community-based preventive strategies.

These initial findings may serve as a foundation for the development of more targeted hearing screening programs in primary healthcare settings and support future studies with larger samples and broader scope.

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