International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

The Relationship between Prenatal Risk Factors and The Incident of Sensorineural Deafness in Children at Polyclinic ENT- Head and Neck Zainoel Abidin Hospital Banda Aceh *,

Dina Alia [1], Azwar Ridwan [1,*], Juniar [1] and Azzam Faiz Mutawakkil [2]

[1] *Department of Otorhinolaryngology - Head and Neck, Universitas Syiah Kuala, Banda Aceh, Indonesia.*
[2] *Medical Student Program, Faculty of Medicine, Universitas Syiah Kuala, Banda Aceh, Indonesia.*

International Journal of Science and Research Archive, 2023, 09(01), 410–418

Publication history: Received on 21 April 2023; revised on 02 June 2023; accepted on 05 June 2023

Article DOI: https://doi.org/10.30574/ijsra.2023.9.1.0427

Abstract

Background: Sensorineural deafness is one of congenital disorders that caused by prenatal, natal, and postnatal factors. Sensorineural deafness is a public health problem in the world due to its high prevalence and highly negative impact on child development. Objective: To determine the relation between prenatal risk factors (family history of hearing loss, ototoxic drugs consumption, history of infection, history of Diabetes Mellitus, history of gestational hypertension) with sensorineural hearing loss in children at ENT- Head and Neck Polyclinic Dr. Zainoel Abidin Hospital. Methods: This study was analytic retrospective with cross sectional design. The sampling technique used was simple random sampling. The total samples are 47 children at the ENT-Head and Neck Polyclinic of RSUDZA who has been examined with OAE, BERA and ASSR from January 2020 to December 2021 and diagnosed with sensorineural hearing loss. Data were analyzed using SPSS which bivariate analysis using Chi- square and Fisher's exact. Results: 47 children who had been diagnosed with sensorineural hearing loss included in the inclusion criteria. The mean age of children in this study was 3.44 years with male predominance of 55.3%. The most severe degree of hearing loss was found with the percentage of weight (93.6%) in right ear and (89.4%) in left ear. A history of maternal infection during pregnancy was the most common risk factor found in this study with profound hearing loss in both ears with p value = 0.05. Conclusion: No relation between prenatal risk factors and sensorineural hearing loss in children.

Keywords: Risk Factors; Prenatal; Sensorineural deafness; Hearing loss

1. Introduction

Deafness occurs when the ear's ability to convert the mechanical energy of sound vibrations into electrical energy of nerve impulses is impaired. There are three types of deafness: conductive deafness, sensorineural deafness, and mixed deafness. Conductive deafness occurs when the transmission of sound vibrations is interrupted due to interference in the outer and middle ear. Sensorineural deafness occurs in the inner ear, auditory nerve, and central auditory pathways. Mixed deafness is caused by conductive and sensorineural abnormalities [1–4]. Sensorineural deafness is a congenital disorder that can be caused by prenatal, natal, and postnatal factors [5]. Congenital deafness is a public health problem in the world because of its high prevalence and negative effects on children development. The importance of early diagnosis of congenital deafness to allow for early intervention. The golden period of brain development occurs in the first thousand days of life, starting from the time of conception until the child is two years old. This period is a time of brain development that runs very rapidly. Along with the maturity of the motor cortex, at the age of 2-3 months the baby has started vocal (sounding). At the age of 10 months, children already know repetition of sounds makes babies start to remember and shape them. At the age of 18 months, the child begins to increase his vocabulary every two hours. Brain development in the two years of life develops very rapidly compared to the next year [6,7].

* Corresponding author: Azwar Ridwan

It is difficult to detect deafness in infants, thus, the babies with deafness can be detected earlier so that speech, motor, cognitive, and social interaction disorders can be minimized. Parents' complaints usually arise when a baby or child does not respond to sound. Generally, parents complain that children cannot speak according to their developmental stage, namely: 6 months old no babbling, 12 months old no pointing or no body gestures/gestures, 15 months old vocabulary less than three words spoken, 18 months old not yet pronounce the words "ma- ma, da-da, or another name, and at the age of 2 years the spoken vocabulary is less than 25 words [1,2,8,9]. There are several risk factors that can affect the incidence of sensorineural deafness in children such as prenatal, natal and postnatal factors. Prenatal factors can be caused by genetic disorders/disturbances during pregnancy, anatomical structural abnormalities, bacterial or viral infections (TORCH), ototoxic and teratogenic drug effects. Natal factors are premature, low birth weight (<2500 grams), hyperbilirubinemia, and asphyxia. Postnatal factors occur due to bacterial or viral infections (rubella, measles, parotitis, brain infection), middle ear bleeding, temporal bone trauma [2,8,10–12].

The World Health Organization (WHO) states that in Southeast Asia there are 38,000 children born with deafness each year. In countries which no neonatal hearing screening programmes, the prevalence estimates vary from 19 per 1,000 babies to 24 per 1,000 babies in South Asia with congenital deafness. The prevalence of deafness in Indonesia is 4.2% and congenital deafness is 0.1% for each live birth. Research in Surabaya found 68% of infants and children detected sensorineural deafness but the risk factors were mostly unknown (82.23%) [2,5,13]. Registration book data of the ENT Division Community Ear Nose Throat Head Neck Surgery (ENT-KL) at the Regional General Hospital dr. Zainoel Abidin (RSUDZA) Banda Aceh was recorded from January 2018-December 2021, 267 children were examined for hearing function in the form of OAE, BERA, and ASSR. 156 (58.42%) children with sensorineural deafness and 15 (5.61%) children had a family history of having been deaf since birth. The amount of 18 (6.74%) children found their mothers experiencing TORCH symptoms. According to the study by Beeck Calkoen et al, (2019) in the Amsterdam, Netherlands, was found that genetic factors accounted for 50% of all cases of congenital sensorineural deafness, of which 70% were non-syndromic and 30% were syndromic, while 25% were acquired factors, including infection during pregnancy (TORCH). and other risk factors such as hypoxia at birth, hyperbilirubinemia, prematurity, and being treated in the neonatal intensive care unit (NICU) for 5 days [14]. Research conducted by Juan C. Ospina (2019) in Colombia, the etiology of congenital sensorineural deafness is often reported with unknown causes (37.7%), non-syndromic genetics (29.2%), syndromic genetics (3.2%), prenatal (12%), perinatal (9.6%), and postnatal (8.2%) [15,16]. Based on the high percentage of prenatal sensorineural deafness, the researchers felt it was important to know the relationship between prenatal risk factors and sensorineural deafness in children at the ENT-Head and Neck Polyclinic at RSUDZA Banda Aceh. It is expected that the results obtained in this study can be used as evaluation material, early diagnosis and intervention in children sensorineural deafness with prenatal risk factors.

2. Material and methods

This was a retrospective analytic study with a cross-sectional design to determine the relationship between prenatal risk factors and sensorineural deafness in children at the ENT- Head Polyclinic RSUDZA. The population is children with hearing loss who seek treatment at the ENT-Head and Neck Polyclinic at RSUDZA Banda Aceh from January 2020 to December 2021. The samples in this study were the children under 5 years old and diagnosed with sensorineural deafness included children diagnosed with sensorineural deafness after examining OAE, BERA and ASSR, and willing to take part in the research by signing a consent letter. The sampling technique used was simple random sampling technique. The data obtained was presented in the form of tables and graphs. Data were analyzed using statistical product and service solutions (SPSS) software. Univariate analysis was used to describe the characteristics of each research variable, and bivariate analysis was used to find the relationship between the two variables using the Chi Square test. Fisher's exact test was used if the Chi Square was not required to find the relationship between two variables of each risk factor and sensorineural deafness.

3. Results

Collecting research data on children who have been diagnosed with sensorineural deafness from January 2020 to December 2021 included research criteria, obtained 47 samples. The characteristics of the research sample are presented in table 1 below;

Table 1 The Characteristics of Research Samples

Characteristics	Frequency (n)		Percentage (%)
Age Gender		**3,44 ±0,75**	
Boy	26		55.3
Girl	21		44.7
Birth Weight			
1500–2500 gr	17		36.2
> 2500–4000 gr	29		61.7
> 4000 gr	1		2.1
Father's Occupation			
Civil Cervant	8		17
private	24		51.1
Laborer/Farmer	14		19.8
Others	1		2.1
Pekerjaan ibu			
Civil Cervant	8		17
Private	4		8.5
Laborer/Farmer	1		2.1
Housewife	34		72.3
Pendidikan ayah			
Undergraduate	9		19.1
Diploma	6		12.8
Senior High School	24		51.1
Junior High School	6		12.8
Elemantary School	2		4.3
Pendidikan ibu Undergraduate	21		44.7
Diploma	4		8.5
Senior High School	17		36.2
Junior High School	5		10.6

Table 1. Presents data on the characteristics of the patients. The mean age of the study sample was 3.44 years with a male predominance of 55.3%. Based on birth weight, 29 samples had normal birth weight, while there were 17 samples with less birth weight and 1 sample with more birth weight. In terms of parents' occupation, 51.1% of fathers work in the private sector and 72.3% of mothers are housewives. The father's education is mostly high school graduates with a percentage of 51.1%, while the mother's degree is undergraduate which 44.7%.

Table 2 presents analysis data on the results of hearing function examinations in children with sensorineural deafness. On the examination of BERA and ASSR, more severe degrees (61-80 dB) were found in the left ear with a percentage of 10.6% than in the right ear 6.4%. While very severe degrees (> 81 dB) were found more in the right ear with percentage of 93.6% of the left ear 89.4%. There were 45 samples that were bilateral and 2 samples were unilateral.

Table 2 The Results of Hearing function examinations in Children

Examinations	Right Ear	Left Ear
OAE, n (%)		
Pass	0	0
Refer	47 (100)	47 (100)
BERA, n (%)		
61 – 80 dB	3 (6.4)	5 (10.6)
> 81 dB	44 (93.6)	42 (89.4)
ASSR, n (%)		
61 – 80 dB	3 (6.4)	5 (10.6)
> 81 dB	44 (93.6)	42 (89.4)

3.1. Risk Factors Family History of Hearing Loss

Table 3 Analysis of the relationship between risk factors family history of hearing loss and sensorineural deafness

Degree of Severity (ADS)	Risk Factors Family History of Hearing Loss		p- value*
	Yes	No	
Severe	0(0)	5(10.6)	1.0
Very Severe	3 (6.4)	39 (83)	

*Fisher exact test

Based on Table 3, it is known that 3 samples (6.4%) with very severe degrees of sensorineural deafness are known to have risk factors for a family history of hearing loss. Based on statistics, it can be concluded that there is no relationship between risk factors family history of hearing loss and sensorineural deafness in both ears ($p > 0.05$).

3.2. Risk Factors History of Maternal Infection During Pregnancy

Table 4 Analysis of the relationship between risk factors history of maternal infection during pregnancy and right ear sensorineural deafness

Degree of Severity (D)	Risk Factors History of Maternal Infection during Pregnancy		P-value*
	Yes	**No**	
Severe	0 (0)	3 (6.34)	0.051
Very Severe	21(44.7)	23(48.9)	

*Chi-Squared test

Table 4. Presents 21 samples with very severe sensorineural deafness of the right ear are known to have risk factors for a history of maternal infection during pregnancy. Mothers are more infected during pregnancy Trimester (TM) II and III. Statistically, it was concluded that there is no relationship between risk factors history of maternal infection during pregnancy with right ear sensorineural deafness ($p = 0.051$).

Table 5. Presents 20 samples with very severe left ear sensorineural deafness were known to have a history of maternal infection during pregnancy. Mothers are more infected during Trimester II and III pregnancies. Statistically using the Chi-squared test it can be concluded that there is no relationship between risk factors history of maternal infection during pregnancy on left ear sensorineural deafness ($p = 0.051$).

Table 5 Analysis of the relationship between risk factors history of maternal infection during pregnancy and left ear sensorineural deafness

Degree of Severity (S)	Risk Factors History of Maternal Infection during Pregnancy		P-value*
	Yes	No	
Severe	1 (2.13)	3 (6.38)	0.051
Very Severe	20 (42.46)	23 (48.9)	

*Chi-Squared test

3.3. Risk Factors history of Diabetes Mellitus in The Mother During Pregnancy

Table 6 Analysis of the relationship between risk factors history of Diabetes Mellitus in the mother during pregnancy against right ear sensorineural deafness

Degree of Severity (D)	Risk Factors History of Diabetes Mellitus in The Mother During Pregnancy		P-value*
	Yes	No	
Severe	0 (0)	4 (8.5)	0.106
Very Severe	1 (2.1)	42 (89.4)	

*Fisher exact test

From The Table 6, can be seen that 1 sample with very severe sensorineural deafness of the right ear was born to mothers who had a history of DM during pregnancy. Based on the results of statistical analysis, it is known that there is no relationship between risk factors for a history of DM in the mother during pregnancy to right ear sensorineural deafness ($p > 0.05$).

Table 7 Analysis of the relationship between risk factors history of Diabetes Mellitus in the mother during pregnancy against left ear sensorineural deafness

Degree of Severity (S)	Risk Factors History of Diabetes Mellitus in The Mother During Pregnancy		P-value*
	Yes	No	
Severe	1 (2.1)	4 (8.5)	0.106
Very Severe	0 (0)	42 (89.4)	

* Fisher exact test

In the Table 7, can be seen that 1 sample with severe sensorineural deafness in the left ear was born to mothers who had a history of DM during pregnancy. Based on the results of statistical analysis, it is known that there is no relationship between risk factors for a history of DM in the mother during pregnancy to left ear sensorineural deafness ($p > 0.05$).

3.4. Risk Factors history of Hypertension in The Mother During Pregnancy

Table 8 Analysis of the relationship between risk factors history of hypertension in the mother during pregnancy against right ear sensorineural deafness

Degree of Severity (D)	Risk Factors history of Hypertension in The Mother During Pregnancy		P-value*
	Yes	No	
Severe	0 (0)	4 (8.5)	0.204
Very Severe	2 (4.3)	41 (87.2)	

* Fisher exact test

Table 8. Presents 2 samples with very severe sensorineural deafness of the right ear were born to mothers with a history of hypertension during pregnancy. Based on the results of statistical analysis, it is known that there is no relationship between risk factors for a history of hypertension in the mother during pregnancy with right ear sensorineural deafness (p>0.05).

Table 9 Analysis of the relationship between risk factors history of hypertension in the mother during pregnancy against left ear sensorineural deafness

Degree of Severity (S)	Risk Factors history of Hypertension in The Mother During Pregnancy		P- value*
	Yes	No	
Severe	1 (2.1)	4 (8.5)	0.204
Very Severe	1 (2.1)	41 (87.2)	

* Fisher exact test

Table 9 presents 1 sample with severe sensorineural deafness and 1 sample with very severe left ear sensorineural deafness were born to mothers with a history of hypertension during pregnancy. Based on the results of statistical analysis, it is known that there is no relationship between risk factors for a history of hypertension in the mother during pregnancy with left ear sensorineural deafness (p> 0.05).

4. Discussion

In this study, the proportion of males was 55.3% and 44.7% for females. Based on the results of a study conducted by Jauhari (2020), it was stated that the distribution of congenital sensorineural hearing loss based on gender was suffered by 66.9% of men and 33.1% of women [17]. Yussy's (2011) study in Bandung also found the incidence of congenital sensorineural hearing loss in boys were slightly taller than girls. This is in accordance with most European countries that the incidence of congenital sensorineural hearing loss is more common in males than females [18]. A study by Peny H et al (2021) in Semarang also found that men more suffer from congenital sensorineural deafness than women with a percentage of 50.9% and 49.1% [19]. Research conducted by Steffi (2018) in Malang, 35 children with a history of TORCH infection who had OAE and BERA examined at the neurotology polyclinic dr. Saiful Anwar, was found that the number of patients who experienced sensorineural deafness due to a history of TORCH infection with a ratio between men and women was 60:40. An epidemiological study of toxoplasmosis conducted by Muhaimeed, found that the male population was more than female [20]. Male predominance acquired may be an incidental finding and it is not known whether differences in ear anatomy or genetics between males and females [19]. There were 29 children with normal birth weight, while 17 children with less birth weight. The results of a study by Bambang ES et al (2015) in Yogyakarta found that low birth weight is at risk of developing sensorineural deafness, which can be detected by BERA examination. More than 27% of infants with low birth weight have an increase in the latency and interval of the BERA which indicates a peripheral or central hearing loss [21]. It was found that 3 samples (6.4%) with very severe sensorineural deafness were known to have a family history of hearing loss. However, based on statistics it was concluded that there was no relationship between a family history of suffering from deafness and sensorineural hearing loss (p> 0.05). This is in accordance with the study of Korver et al (2017), a family history of permanent congenital sensorineural deafness is a risk factor for sensorineural deafness in children, but the evidence of its relevance is low, because only 1.43% of children with a positive family history of deafness [2].

A retrospective cohort study by Driscoll et al, 380,895 infants were reported with prevalence of a family history of deafness approximately 1.09%. Mothers who have a family history of deafness are a significant factor in the occurrence of deafness in children [22]. WHO states that 60% of deafness in children is caused by genetic factors. According to Sutton and Rowe in (Driscoll, 2015) also assessed the degree of deafness based on the etiology, 38 children were found to be deaf due to genetics, 23 children had a hearing threshold >70 dB and 15 children had a hearing threshold of 70 dB. The prevalence of family history of all congenital sensorineural hearing loss cases is 7.29%. Congenital deafness from families with a positive history was identified at around 1.43% and postnatal deafness at 1.7% [23]. In the 2021, The study of Al-Balas, a statistically significant relationship was found between family history and the results referred to the first OAE. According to Shahid in (Al-Balas, 2021) also reported that the probability of an OAE referral in infants with a family history of deafness is 11 times higher than the probability of infants without a family history [24]. The use of ototoxic drugs in this study could not be analyzed because it was found that most of the mothers did not exist and did not know that they had used ototoxic drugs during pregnancy. Deafness because this drug can be unilateral or bilateral which initially affects high frequencies but can also affect all frequencies. Estimates of deafness and vestibular toxicity due to administration of this drug are 13% and 10% [25]. According to JCIH 2007, exposure to ototoxic drugs

(gentamicin and tobramycin) and loop diuretics (such as furosemide) poses a risk of deafness in childhood. Jeong et al (2021), study in Korea also found that ototoxic drugs such as aminoglycosides, loop diuretics, and vancomycin were significant risk factors for deafness in children [22].

Analysis of the relationship between history of maternal infection during pregnancy with sensorineural deafness in this study found that 21 children (44.7%) had very severe sensorineural deafness in the right ear and 20 children (42.46%) with very severe sensorineural deafness in the left ear were known having a history of maternal infection during pregnancy. Mothers are more infected during Trimester II and III pregnancies. Statistically using the Chi- squared test it can be concluded that there is no relationship between a history of maternal infection during pregnancy and sensorineural hearing loss. Very severe sensorineural deafness was obtained from mothers infected with TORCH during Trimester I pregnancy. Meanwhile, in this study, mothers were infected during Trimester II and III pregnancies. The prevalence of less than 2% of babies born from infected mothers in Trimester II pregnancy will have severe abnormalities. This study is in accordance with Jeong's research which states that sensorineural deafness has asymptomatic symptoms with a very low number of newborns who have congenital infections and mothers who have a history of prenatal infections. This happens because it is difficult to identify patients with congenital infection during the neonatal period and 1 year after birth, so it still requires more precise research with a larger population [22]. In this study, there was also no significant relationship because most mothers were infected after Trimester I pregnancy so that The prevalence for congenital sensorineural hearing loss is very small among children in this population.

Analysis the relationship between history of Diabetes Mellitus in mothers during pregnancy in the study found 1 sample with very severe sensorineural deafness in the right ear and 1 sample with severe sensorineural deafness in the left ear born from mothers with a history of Diabetes Mellitus during pregnancy. Based on the results of statistical analysis, it is known that there is no relationship between a history of Diabetes Mellitus and sensorineural hearing loss in both ears. This is due to the low level of glucose in the blood and the short term hyperglycemia, so that the microangiopathy that occurs is not severe and the sensorineural hearing loss that occurs in children is low. However, this study is not in accordance with several other studies, which show a significant relationship between mothers with a history of Diabetes Mellitus during pregnancy and sensorineural deafness in children. According to research in the United States (Fortunata, 2020) shows that there is a relationship between gestational diabetes and congenital deafness, especially the sensorineural and bilateral types. The inner ear has complex metabolic activities and is sensitive to changes in the body's homeostasis. Changes in blood sugar and insulin levels in the blood can cause deafness and vestibular disorders [5]. The study of Vernier (2019) aimed to investigate the results of Neonatal Hearing Screening (NHS) of newborns whose mothers had diabetes mellitus during pregnancy. The findings of this study are evidence of sensorineural hearing loss in newborns whose mothers have diabetes in pregnancy as assessed from the pathophysiology of the disease [26]. Maia (2005) described atrophy of the spiral ganglion associated with loss of cochlear basal cells causing a decrease in the number of nerve fibers in the lamina spiralis. Loss of cells in the basal conduits of the cochlea can cause high-frequency deafness. The inner ear is vulnerable to metabolic and circulatory stress. Gestational diabetes can cause hearing loss degree similar to Diabetes Mellitus. However, deafness related to gestational diabetes is still a matter of debate [27,28].

In this study, the analysis of the relationship between the history of hypertension in the mother during pregnancy consisted of 2 samples (4.3%) with very severe sensorineural deafness of the right ear, 1 sample (2.1%) of severe sensorineural deafness of the left ear and 1 sample (2.1%) very severe left ear sensorineural deafness born to a mother with a history of hypertension during pregnancy. Based on the results of statistical analysis, there is no relationship between a history of hypertension and sensorineural hearing loss in both ears. This is due to blood pressure that is not too high so that there is little blood vessel damage which causes hypoxic conditions in the fetus in the womb, especially hypoxia to the hearing organs (cochlear nucleus hypoxia, cochlear nerve hypoxia, or direct cochlear organ damage). Accordance with research by Nanin et al (2019), a significant relationship between maternal blood pressure and congenital deafness occurs in mothers with an average systolic blood pressure of 156 mmhg and a diastolic blood pressure of 103.7 mmhg [29]. This study is also according to Altuntas and Ozdemir in (Hanege, 2017) who reported no significant difference in outcome between hypertensive pregnancy and normal blood pressure with hearing loss. In a clinical survey of 512 mothers with pre-eclampsia, only one child had sensorineural hearing loss which was associated with several other factors, such as prematurity, fetal distress, birth asphyxia, and heredity. In Hanege's own study, it was found that there was no statistically significant difference in hearing tests performed on infants with pre-eclamptic mothers who were born after 35 weeks of gestation and babies born from healthy mothers [29]. In a study, pregnancy-induced hypertension caused sensorineural hearing loss in newborns. The study conducted by Tabrizi (2016), a statistically significant difference was found between babies whose mothers had pre-eclampsia and babies with normal mothers [30]. Research conducted by Alan (2021), reported 146 babies with pre-eclampsia mothers, 71 babies with chronic hypertension mothers, 10 babies with eclampsia mothers, and 227 babies with healthy mothers as the control group. There was a significant difference between pre-eclampsia and controls only on the BERA test. There was no

significant difference from the other groups on the BERA test [31]. This is consistent with this study which is no relationship with sensorineural deafness in hypertensive mothers and these risk factors must be looked for in more detail. In a study on the concept validity stated that pregnancy-induced hypertension (preeclampsia or toxaemia of pregnancy) can cause sensorineural hearing loss in children examined.

5. Conclusion

The most frequent prenatal risk factors were maternal infection during pregnancy (44.7%), family suffering from hearing loss (6.4%), hypertension in the mother during pregnancy (4.3%) and Diabetes Mellitus in the mother during pregnancy (2, 1%). The most severe degree of sensorineural deafness was (93.6%) in the right ear and (89.4%) in the left ear. Thus, There is no relationship between prenatal risk factors (hearing loss in the family, maternal infection during pregnancy, use of ototoxic drugs by the mother during pregnancy, DM in the mother during pregnancy, hypertension in the mother during pregnancy) and the incident of sensorineural deafness.

Compliance with ethical standards

Acknowledgments

We would like to express our sincere to all the study participants who granted their concent to be enrolled. The authors also appreciate and thank to Otorhinolaryngology-Head and Neck Department for helping this study.

Disclosure of conflict of interest

The authors have declared that no competing interests exist in this study.

Statement of ethical approval

The Study has been approved by the Health Research Ethics Committee of the Faculty of Medicine at Universitas Syiah Kuala with a number of ethical contributions KEPPKN registration number 1171012P (Description of ethical expedited number: 039/EA/FK/-RSUDZA/2022.

Statement of informed consent

All authors declare that informed consent was obtained from all individual participants included in the study.

References

[1] Alia D, Munadia, Aufie A. Language Disorders in Children (Relationship with Future Quality of Life). Syiah Kuala Universitas Press. 2021; 78.

[2] Korver AM, Smith RJ, Camp GV, et al. Congenital Hearing Loss. Macmillan Publisher Limited, part of Springer Nature. 2017; 3:1-18.

[3] Boudewyns A, Deulau F, Van DEJ, et al. Otitis media with effusion: an underestimated cause of hearing loss in infants. Otology & Neurotology official publication of the America Otology Society. 2011; 32:799–804.

[4] Kim S, Choi B, Park J, et al. Maternal and Placental Factors Associated with Congenital Hearing Loss in Very Preterm Neonates. Pediatrics and Neonatology journal. 2017; 58:236–244.

[5] Fortunata TF, Purnami N, Prajitno S, et al. Correlation between Prenatal, Perinatal, and Postnatal Factors with Congenital Hearing Loss. Eur. J. Mol. Clin. Med 2020; 7:2263– 2274.

[6] Vos B, Noll D, Pigeon M, Bagatto M, Fitzpatrick EM. Risk Factors for Hearing Loss in Children: A Systematic Literature Review And Meta-Analysis Protocol Syst Rev. 2019; 8:172.

[7] Gutiérrez-Farfán I, Reyes L, Verduzco, et al. Archives of Otolaryngology and Rhinology Risk Factors Associated with the Diagnosis of Sensorineural Hearing Loss in Children. Arch Otolaryngol Rhinol. 2018; 4:92–96.

[8] Collegium of Health Sciences Ear, Nose, Throat, Head and Neck Surgery. Main Modules Congenital Deafness in Infants and Children. 2015.

[9] Lang RR. Hearing Impairment and Language Delay In Infants: Diagnostics And Genetics. GMS Curr. Top. Otorhinolaryngol. Head Neck Surg. 2014; 13.

[10] Paludetti G, Conti G, Nardo WD, et al. Infant Hearing Loss: From Diagnosis to Therapy Official Report Of XXI Conference of Italian Society of Pediatric Otorhinolaryngology. Acta Otorhinolaryngol Ital. 2012; 32:347–370.

[11] Joint Committee On Infant Hearing. Position Statement: Principles and Guidelines for Early Hearing Detection and Intervention Programs. Pediatrics. 2007; 120:898 – 921.

[12] Awad R, Oropeza J, Uhler K. Meeting the Joint Committee on Infant Hearing Standards in a Large Metropolitan Children's Hospital: Barriers and Next Steps. Am. J. Audiol. 2019; 28:251–9.

[13] Watkin P, Baldwin M. The Longitudinal Follow up of a Universal Neonatal Hearing Screen: The Implications For Confirming Deafness In Childhood. Int. J. Audiol. 2012; 51:519–528.

[14] Calkoen EA, Engel MSD, Van DK, et al. The Etiological Evaluation of Sensorineural Hearing Loss in Children. Eur. J. Pediatr. 2019; 178:1195-1205.

[15] Oliveira JS, Rodrigues LB, Aurélio FS, Silva VB. Risk Factors and Prevalence of Newborn Hearing Loss in a Private Health Care System of Porto Velho, Northern Brazil. Rev. Paul. Pediatr. 2013; 31:299–305.

[16] Ospina GJC, Perez GIC, Guerrero D, Sanchez SNJ, Salcedo BJD. Prevalence of Sensorineural Hearing Loss in Newborns in a Hospital from a Developing Country. Rev. Salud Publica. 2019; 21:56–63.

[17] Jauhari. Detection of Hearing Loss in Early Childhood. Genius Indonesia. J. Early Child. Educ. 2020; 1:61–71.

[18] Dewi YA, Agustian RA. Brainstem Evoked Response Audiometry Characteristic Of Congenital Bilateral Sensorineural Hearing Loss In Children Diagnosed By Brain Evoked Response Audiometry. 2011; 43:77–82.

[19] Handayani P, Marliyawati D. The Relationship between Prematurity and Low Birth Weight with the Degree of Hearing Loss in Children. 2021; 5:60–65.

[20] Kurniawan S, Indrasworo D. Description of Hearing Function in Children with a History of TORCH Infection at the Neurotology Polyclinic of RSUD Dr. Saiful Anwar 1st Period. 2018.

[21] Susyanto BE, Widuri A. Risk Factors for Hearing Loss in Newborn Hearing Screening at PKU Muhammadiyah Yogyakarta Hospital. 2015; 44:30–36.

[22] Jeong J, Youk TM, Oh J, Eo TS, Choi HS. Neonatal and Maternal Risk Factors for Hearing Loss in Children Based on Population-Based Data of Korea. Int. J. Pediatr. Otorhinolaryngol. 2021; 147.

[23] Driscoll C, Beswick R, Doherty E, D'silva R, Cross A. The Validity of Family History as A Risk Factor in Pediatric Hearing Loss. Int. J. Pediatr. Otorhinolaryngol. 2015; 79:654–659.

[24] Al-Balas HI, Nuseir A, Zaitoun M, Al-Balas M, Al-Balas H. The Effects of Mode of Delivery, Maternal Age, Birth Weight, Gender and Family History on Screening Hearing Results: A Cross Sectional Study. Ann. Med. Surg. 2021; 64.

[25] Bluestone CD, Simons JP, Healy GB. Bluestone and Stool's Pediatric Otolaryngology. People's Medical Publishing House-USA. 2014.

[26] Vernier LS, Castelli CTR, Levandowski DC. Neonatal hearing screening of newborns of mothers with Diabetic Mellitus and/ or hypertension in pregnancy : a systematic literature review. 2019; 21:1–8.

[27] Selcuk A, Terzi H, Turkay U, Kale A, Genc S. Does Gestational Diabetes Result in Cochlear Damage?. Laryngol. Otol. J. 2014; 128: 961–965.

[28] Maia CAS, Campos DE, Carlos AH. Diabetes Mellitus as Etiological Factor of Hearing Loss. Braz. J. Otorhinolaryngol. 2005; 71:208–214.

[29] Hanege BY, Hanege FM, Kalcioglu MT, Gocmen A. Is Maternal Preeclampsia Risk Factor For Neonatal Hearing Loss ?. B-ENT. 2017; 13:219–223.

[30] Tabrizi AG, Mahboobeasadi, Naini AS. Preeclamsia: A New Risk Factor for Hearing Loss. Biomed. Pharmacol. J. 2016; 9(1):135–1138.

[31] Alan C, Alan MA. Maternal hypertension, pre-eclampsia, eclampsia and newborn hearing: A retrospective analysis of 454 newborns. Int. J. Pediatr. Otorhinolaryngol. 2021; 146.