

MINISTRY OF EDUCATION AND TRAINING      MINISTRY OF HEALTH  
NATIONAL INSTITUTE OF HYGIENE AND EPIDEMIOLOGY

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**LẠI THU HÀ**

**SOME EPIDEMIOLOGICAL CHARACTERISTICS, RISK  
FACTORS OF SENSORINEURAL HEARING LOSS AND  
EFFECTIVENESS OF HEARING AID ON CHILDREN  
UNDER 3 YEARS OLD AT THE NATIONAL CHILDREN  
HOSPITAL**

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## LIST OF PUBLISHED ARTICLES RELATED TO THE THESIS

1. Lai Thu Ha, Vu Dinh Thiem, Phan HUU Phuc (2020), "Risk factors in children with hearing loss under 3 years old at the Audiology and Speech language Therapy centre at National Children Hospital in 2018-2019" , Journal of Medicine and Pharmacy, No. 4, pp. 109-111.
2. Lai Thu Ha, Vu Dinh Thiem, Phan HUU Phuc (2021), "Evaluating the effectiveness of hearing aids for children with hearing loss under 3 years old at the National Children Hospital in 2018-2019", Journal of Community Medicine, No 6.
3. Vu Dinh Thiem, Lai Thu Ha, Phan HUU Phuc (2021), "Some epidemiological characteristics of children with hearing loss under 3 years old at the National Children Hospital in 2018-2019", Journal of Community Medicine , No 6.

## INTRODUCTION

According to the National Academy of Hearing and Communication Diseases of America, hearing loss is the most common congenital abnormality in young children. Every year in the United States, about 12,000 newborn babies with hearing loss are diagnosed. In addition, approximately 4,000 to 6,000 children aged 0-3 years are found to have hearing loss even though these children pass the newborn hearing screening test. A total of 16,000 - 18,000 babies and infants are detected with hearing loss each year. Hearing loss in children causes serious consequences on children's language development, communication and learning. With the development of science and technology, children with hearing loss will have normal hearing after intervention, but late detection and intervention greatly affect the success of treatment. In Vietnam, there is no newborn hearing screening program, "risk factors for hearing loss" is a relatively new concept for most pediatricians, and the government does not provide support for interventions. Therefore, children with hearing loss in our country are often diagnosed late, the intervention is not thorough, leading to a very low rate of hearing loss children having been successfully intervened.

To provide some epidemiological characteristics of children with hearing loss under 3 years of age, risk factors and the effectiveness of hearing aids in children with hearing loss, thereby build up hearing monitoring procedures and hearing aid wearing recommendations for children with hearing loss, this research is conducted.

## **OBJECTIVES OF THE STUDY**

Objective 1: Describe some epidemiological characteristics of sensorineural hearing loss in children under 3 years old at the Audiology and speech language therapy centre in the National Children Hospital in 2018-2019.

Objective 2: Identify risk factors for sensorineural hearing loss in children under 3 years of age.

Objective 3: Evaluate the effectiveness of hearing aid interventions to improve hearing in sensorineural hearing loss children under 3 years old.

## **NEW SCIENTIFIC POINTS AND PRACTICAL VALUES OF THE TOPIC**

Currently, there are not many studies on the situation of hearing loss in children, especially in children under 3 years old.

This study has identified some risk factors for hearing loss in children, thereby helping to build up hearing monitoring procedures for children with these risk factors. This will help detect hearing loss in children as soon as possible, setting prerequisites for successful interventions on children.

The study has also evaluated the effectiveness of hearing aid interventions on children with hearing loss, thereby knowing which degree of hearing loss that benefits well from the hearing aids. This helps clinicians have the right direction when prescribing treatment for children with hearing loss.

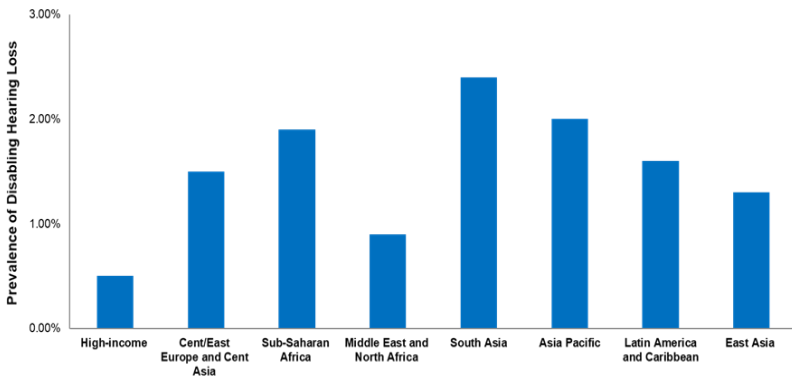
## **STRUCTURE OF THE THESIS**

The thesis consists of 100 pages, excluding references and appendices, with 27 tables, 19 figures and 12 charts. Introduction (2 pages), overview (34 pages), methodology (17 pages), results (24 pages), discussion (20 pages), conclusion (2 pages) and recommendations (1 page).

## Chapter 1. OVERVIEW

### 1.1 The situation of children with hearing loss in the world and in Viet Nam

Worldwide: In 1995, WHO estimated that 120 million people have permanent binaural hearing loss (>40 dB HL) globally. In 2005 the number was doubled to 278 million. By 2018, there were about 466 million people with hearing loss in the world, accounting for over 6.1% of the world's population. Of these, 432 million were adults (93%) and 34 million were children, accounting for about 7%.



**Figure 1.1. Rate of hearing loss of children (0-15 years old) in regions**

The importance of hearing loss in children is reflected in the following facts:

Hearing loss is the most common birth defect in the United States

- There are 2-5 children out of every 1000 children were born with permanent severe congenital hearing loss in both ears

- 3 more children of these 1000 children will get acquired hearing loss during the first years of life or school age

- Everyday, 33 babies (12,000 children/year) are born in the US with permanent hearing loss

- Children who spend time in the neonatal intensive care unit (NICU) fall ~~are~~ in the group of high-risk for hearing loss, with at least one in 50 children get severe hearing loss.

- Some children are born with normal hearing, but there are many causes for progressive hearing loss when children start primary school.

- Research shows that 90% of young children's understanding comes from unintentionally listening to what's going on around them, so learning will be hindered when children have hearing loss even mild hearing loss.

- 17/1000 children under 18 years old have hearing loss

- Today, the number of children with severe and profound hearing loss is less than a half of what it was in the past, but the number of children with mild to moderate hearing loss has increased tenfold.

- Otitis media is the most common infection in children and the leading cause of hearing loss in young children.

- Nearly every child has periods of hearing loss related to otitis media from birth until they are 10 years old.

- 10-15% of children do not pass the school hearing screening test

In Viet Nam

There is very few research on this issue. Most research uses sensory instruments or screening tests. In 2001, author Le Thi Lan and her colleagues conducted a study about auditory responses on 900 high-risk infants at the hospital for Mother and Child Protection with handmade bells. The results showed that the rate of non-response to sound in this group was 4.4%. Author Pham Thi Coi and colleagues used cochlear sound assessment to assess hearing for 823 children under 5 years old in Bac Ninh, Thai Nguyen, Phu Tho, showing that 4.87% of children suspected of having hearing loss. Author Pham Thu Thuy used OAE (otoacoustic emission) to assess hearing for 12202 newborns at the Hanoi

Obstetrics and Gynecology Hospital, the results showed that 3.4% of babies did not pass this screening test.

For children with risk factors, there are also very few studies, in the study of author Le Thu Ha in 2011 on 305 children with high risk factors at the neonatal department in National Children Hospital, it was shown that the rate of hearing loss in this group was 15%.

## **1.2. Hearing loss**

### **1.2.1. Definition of hearing loss**

Hearing loss is a total or partial loss or impairment of hearing that prevents a child from hearing at normal distances and intensities of sounds. Hearing loss has sensorineural hearing loss, conductive hearing loss, and mixed hearing loss. Sensorineural hearing loss includes hearing loss in the cochlea and behind the cochlea. Hearing loss at the cochlea is caused by damage to the hair cells of the cochlea, hearing loss behind the cochlea is damage to the auditory nerve. This is permanent hearing loss which is not treatable with medication, acupuncture, or acupressure.

### **1.2.2. Degrees of hearing loss**

According to ASHA (2010), we have

Normal hearing: hearing threshold is better than or equal to 15 db

Very mild hearing loss: 16-25 dB

Mild hearing loss: 20 - 40dB

Moderate hearing loss: 41-55dB

Severe moderate hearing loss: 56-70 dB

Severe hearing loss: 71-90 dB

Profound hearing loss  $\geq$  91 dB

## **1.3. High risk factors for hearing loss**

In 1982, the JCIH – Joint Committee Infant Hearing recommended 7 groups of children who are at risk of hearing loss. In 1990, the risk factor



classification was expanded and recommendations were made for the identification and management of children with hearing loss. Accordingly, children with the following risk factors should be screened for hearing problems:

\* Newborn (under 28 days old).

Risk factors identified in the neonate include:

- Having family member with congenital or progressive hearing loss
- Infections during pregnancy, diseases that are associated with hearing loss such as: toxoplasmosis, rubella, CMV, herpes, syphilis.

- Craniofacial abnormalities include morphological abnormalities of the auricle, ear canal, low hairline..

- Birth weight less than 1500g.

- High bilirubin level requiring blood transfusion.

- Taking antibiotics of aminoglycosis group for more than 5 days (gentamycin, tobramycin, kanamycin, streptomycin) and taking diuretics in combination with aminoglycosis group.

- Meningitis.

- Very weak at birth, which may include infants who have Apgar score of 0-3 in 5 minutes or those who do not breathe on their own in 10 minutes.

- Children on mechanical ventilation in 10 days or more.

- Signs or symptoms associated with syndromes which have sensorineural hearing loss, such as Waardenburg or Usher.

\* Risk factors for children from 29 days to 2 years old.

Risk factors for hearing loss include:

- Parents or caregivers of the children have problems of hearing, speech, language or developmental delays.

- Meningitis.

- Risk factors from infancy which are associated with sensorineural hearing loss (CMV, prolonged mechanical ventilation and genetic diseases).

- Head trauma, especially with longitudinal and transverse temporal fractures.

- Signs or symptoms associated with hearing impairment syndromes such as Waardenburg or Usher syndrome.

- Taking antibiotics of aminoglycosis group more than 5 days (gentamycin, tobramycin, kanamycin, streptomycin) and taking diuretics in combination with aminoglycosis group.

- Children with neurodegenerative diseases such as neurofibromatosis, epilepsy, Friedreich's ataxia, Huntington's chorea, Werding-Hoffmann, Charcot-Marie-Tooth.

- Children with infections that cause hearing loss, such as mumps and measles.

#### **1.4. Intervention for children with receptive hearing loss**

Today, with the development of science and technology, the level of hearing loss is no longer a barrier. Regardless of the level of hearing loss the child get, there are hearing technologies to help them have normal hearing. This is very meaningful for children, their families and the society. There are 2 technologies which are hearing aids and cochlear implant. Hearing aids are suitable for children with mild to severe hearing loss, cochlear implant is used for children with severe to profound hearing loss. However, for children's language development, after interventions with hearing aids or cochlear implant, children need speech therapy. In addition, the age at intervention is very important because the brain prioritizes language development in the first years of life.

## CHAPTER 2: RESEARCH METHODOLOGY

### 2.1. Research sites:

Audiology and Speech language Therapy centre- National Children Hospital.

**2.2. Research duration:** From January 2018 to August 2019.

### 2.3. Research subjects

**2.3.1. Objective 1:** Children aged 0-36 months who were diagnosed with sensorineural hearing loss in the Audiology and Speech language therapy centre - National Children Hospital from January 2018 to August 2019.

**2.3.2. Objective 2.** There are 2 groups of study subjects.

- Disease group: These are children selected for objective 1 but randomly selected.

- The control group: Children aged 0-36 months who came to be vaccinated at the National Children Hospital and children in the Hearing screening program in Hai Ba Trung district (Hanoi) who passed the hearing screening test.

**2.3.3. Objective 3:** Children received hearing aids intervention at the Audiology and Speech language therapy center (National Children Hospital) from January 2018 to August 2019.

### 2.4. Research methodology

#### 2.4.1. Objective 1

Reserch design: A cross-sectional descriptive study based on a group ~~population~~ of children with hearing loss aged 0-36 months, diagnosed with receptive hearing loss.

Sample size: 461 children diagnosed with hearing loss were received by at the Central Children's Hospital's audiology center from 1/2018 to 8/2019.

### 2.4.2. Objective 2.

- Study design: A case-control study to determine risk factors for hearing loss in children, designed in a 1:1 ratio.

- Sampling method: Random

- Formula to calculate sample size:

$$n = \frac{(1+r)^2}{r(\ln OR)^2 p(1-p)} \times C$$

In there:

n: Minimum sample size

r: Ratio of sample size between the 2 groups, because the control group and the disease group were designed in a 1:1 ratio, so r = 1

p: The rate of exposure to risk factors of the control group, with the neonatal resuscitation rate in Vietnam being 7%, we have p=0.07

$$C = (z\alpha/2 + z\beta/2)^2$$

$\alpha$  is a type 1 error, take  $\alpha = 0.01$

$\beta$  is type 2 error, take  $\beta = 0.05$

We have C=19.84

$$OR=10$$

Substituting the numbers in, we have n = 230 for both control and disease groups. In this study, n = 570 (each group is 285)

### 2.4.3. Objective 3.

- Study design: Self-control intervention.

- Study sample size: Children who have been wearing hearing aids from January 2018 to August 2019. Because the study evaluates the effectiveness of hearing aids, it will evaluate each ear, so the sample size t is 71 ears.

## **2.5. Data management and analysis**

The information was collected based on homogeneous research samples. Data were entered and processed by Epi data 3.0 software and stata software 2.6.

Ethical aspects of research. The research protocol was approved by the Scientific Council, the Ethical Council of the National Children Hospital and the National Institute of Hygiene according to the certificate No. 1297/BVNTW-VNCSKTE .

## Chapter 3. RESULTS

### 3.1. Some epidemiological characteristics of hearing loss in children under 3 years old at the National Children's Hospital.

#### 3.1.1. Gender

**Table 3.1. Prevalence of hearing loss by gender**

Gender	N	%
Male	281	61
Female	180	39
Total	461	100

From January 2018 to August 2019, 461 children under 3 years old were diagnosed with hearing loss at the Audiology and Speech language therapy centre. In which, there are 281 boys, accounting for 61% and 180 girls, accounting for 39%.

#### 3.1.2. Newborn hearing screening

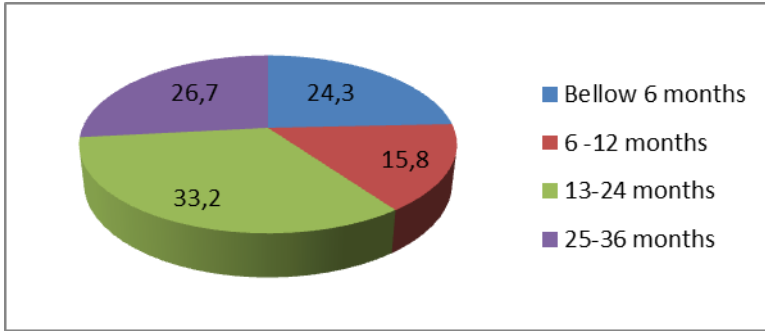
**Table 3.2. Neonatal screening rate Screening newborn hearing**

Newborn hearing screening	N	%
Yes	48	10,4
No	410	88,9
Don't know	3	0,7
Total	461	100

Out of 461 children with hearing loss, only 48 children were screened by newborn hearing screening, accounting for 10.4%, and 410 children were not screened, accounting for 88.9%. There were 3 children of which whose parents did not know if they had done newborn hearing screening for their child.

### 3.1.2. Age of hearing loss detection

Chart 3.1. Rate of hearing loss by age of detection



The most commonly detected age of hearing loss is 13 -24 months group (153 children - 33%), followed by 25-36 months (123 children - 26.7%), thirdly is 0-6 months (112 children -24.3%).

### 3.1.3. Unitarelal and bilateral hearing loss

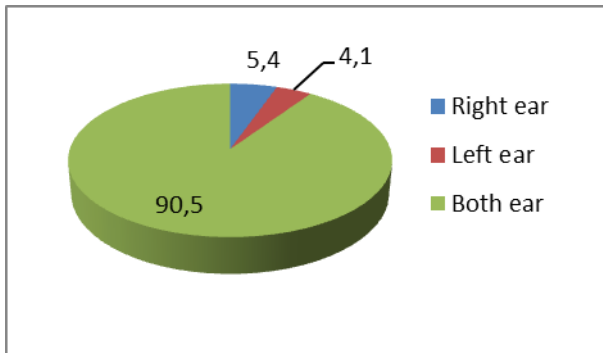
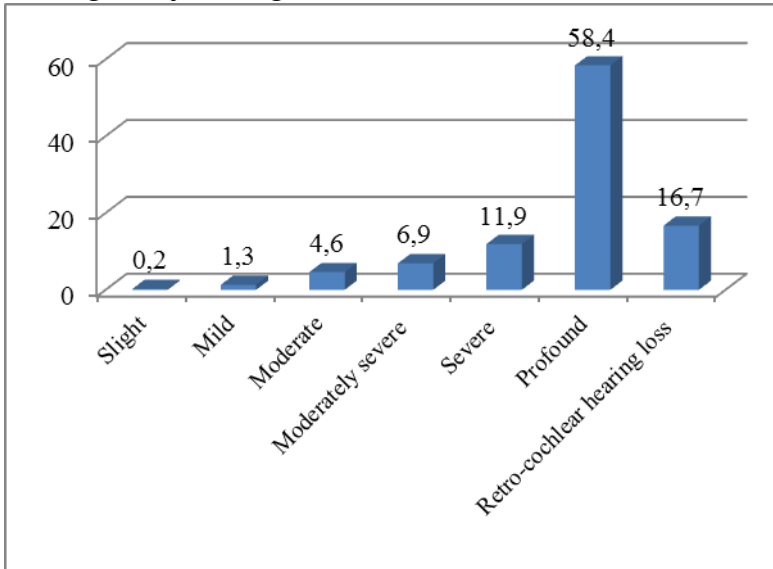


Chart 3.2. Unitarelal and bilateral hearing loss

There were 44 unilateral children with hearing loss, accounting for 9.5%, of which there were 19 cases of hearing loss in the right ear and 25 cases of hearing loss in the left ear. Bilateral hearing loss are 417 children, accounting for 90.5%.

### 3.1.4. Degrees of hearing loss:

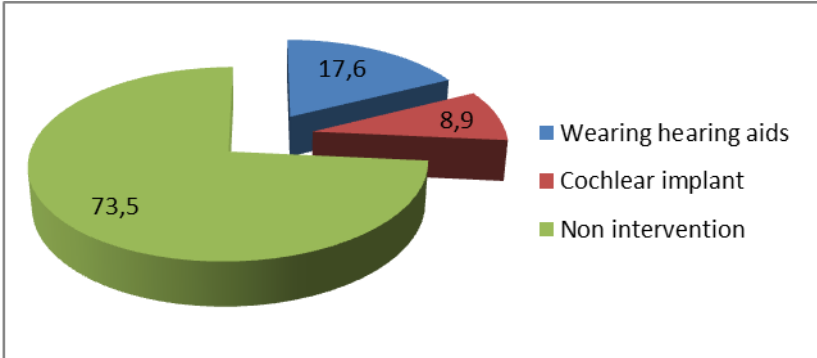


**Figure 3.3. Degrees of hearing loss**

Hearing loss at profound degree accounted for the highest rate with 269 children (58.4%), ranking second was severe hearing loss with 55 children accounting for 11.9%, third place was moderately severe hearing loss with 32 children (6.9%). Retro-cochlear hearing loss (ANSD) had 77 children which accounted for 16.7%.



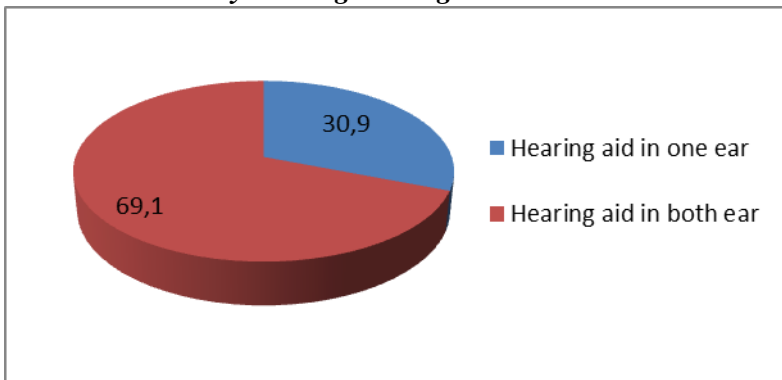
### 3.1.7. *The current status of interventions for children with hearing loss*



**Figure 3.4. Intervention on children with hearing loss**

Among 461 children with hearing loss, 122 children received intervention, accounting for 26%, or less than 1/3 of the number of children with hearing loss, of which 81 children were wearing hearing aids, accounting for 17.6%. The number of children receiving cochlear implantation was 41, accounting for 8.9%.

### 3.1.8. *Intervention by wearing hearing aids*



**Figure 3.5. Wearing hearing aids intervention**

Among 81 children who received intervention by wearing hearing aids, there were 25 children wearing a single-sided hearing aid, accounting for 30.9%, and there were 56 children wearing binaural hearing aids, accounting for 69.1%

### 3.1.10. The average intervention period by age group

**Table 3.5. The average intervention period by age group**

Age of diagnosis	The average intervention period (months)			
	N	Media	IQR	
Under 6 months old	12	6.9	1.8	12.6
6-12 months old	17	2.8	0.7	9.1
13-24 months old	37	3.4	1	6.5
25-36 months old	34	2.5	0.75	8.3

The intervention period on children from 25-36 months old was the fastest (2.5 months), ranking second was the intervention period on the age group of 6-12 months old (2.8 months), followed by the group of children aged 13 – 24 months (3.4 months). The longest intervention period was the one for children aged under 6 months old (6.9 months).

### 3.2.2. *Analysis of risk factors for hearing loss by multivariable regression*

**Table 3.8. The relationship between factors and hearing loss – the multivariable regression model**

Factors	OR correction	95% CI
Male	1.5	1.1-2.2
Low birth weight	1.5	0.7-3.1
Premature birth	1.4	0.7-2.8
Jaundice after birth	0.9	0.5-1.6
Asphyxia after birth	3.8	1.2-12.2
Mechanical ventilation	2.7	0.9-8.8
Having family member with early hearing loss history	20.5	4.8-88.5
Neonatal resuscitation	4.0	1.8-8.9

Boys have a 1.5 times higher risk of hearing loss than girls (OR=1.5 [1.1-2,2]). Children with asphyxia after birth have a risk of hearing loss 3.8 times higher than normal children (OR=3.8 [1,2-12,2]). Children with a history of neonatal resuscitation have a 4 times higher risk of hearing loss than normal children (OR=4.0 [1.8-8.9]). Children in families with people with early hearing loss have a 20.5 times higher risk of hearing loss than other children (OR=20.5 [4.8-88.5]).

### ***3.2.3.2. Analysis of risk factors for hearing loss behind the cochlea (ANSD) by multivariable regression***

**Table 3.10. The relationship between the factors and ANSD according to the multivariable regression model**

Factor	OR correction	95% CI
Male	2.4	0.9-6.1
<b>Premature birth</b>	<b>3.6</b>	<b>1.1-11.5</b>
Low birth weight - under 2500 gr	0.8	0.2-2.8
<b>Jaundice after birth</b>	<b>9</b>	<b>3.8-21.4</b>
<b>Neonatal resuscitation history</b>	<b>3.3</b>	<b>1.01-10.8</b>

Premature infants had a 3.6 times higher risk of developing ANSD than full-term infants (OR=3.6 [1.1-11.5]). Infants with neonatal jaundice were 9 times more likely to develop ANSD than infants without neonatal jaundice (OR=9 [3,8-21,1]). Children with a history of neonatal resuscitation had a 3.3 times higher risk of ANSD than children without this history (OR=3.3 [1.01-10.8]).

### 3.3. Evaluation of the effectiveness after intervention by wearing hearing aids

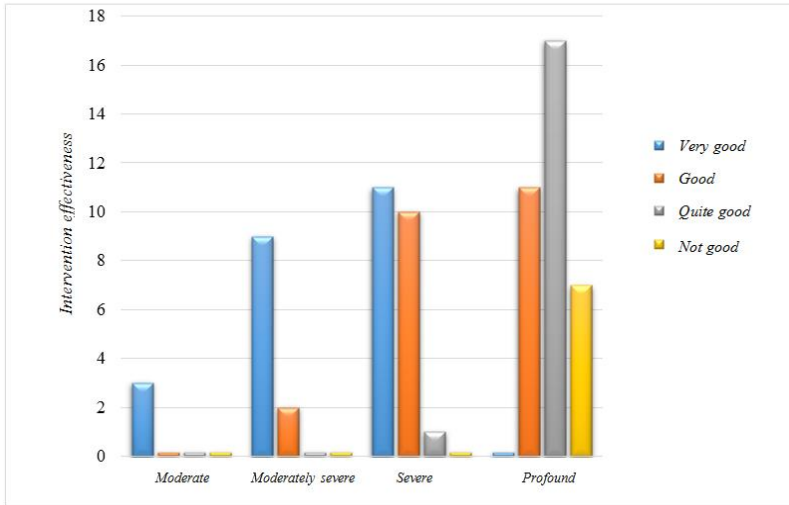
#### 3.3.1. Average hearing improvement after wearing hearing aids

**Table 3.11. Average hearing improvement after wearing hearing aids**

Improvement		Average $\pm$ SD	Min	Max
Average hearing threshold (PTA)		49.2 $\pm$ 9.5	23.3	66.7
Hearing threshold in frequency ranges (PTA)	500Hz	47.5 $\pm$ 10.9	15	70
	1000Hz	49.9 $\pm$ 10.5	15	65
	2000Hz	50.2 $\pm$ 10.1	29	70
	4000Hz	47.9 $\pm$ 10.2	20	70
SII (%)		38.5 $\pm$ 27.4	0	97
Maximum word comprehension (%)		60.9 $\pm$ 38.5	0	100
Maximum sentence comprehension (%)		73.0 $\pm$ 34.2	0	100

The average improvement in hearing threshold in 71 hearing loss ears after wearing hearing aids was  $49.2 \pm 9.5$ . In which the improvement at 500 Hz was  $47.5 \pm 10.9$ ; frequency 1000 was  $49.9 \pm 10.5$ ; frequency 2000 Hz was  $50.2 \pm 10.1$ ; frequency 4000 Hz was  $47.9 \pm 10.2$ . SII improved  $38.5 \pm 27.4\%$ . Maximum word comprehension improved  $60.9 \pm 38.5\%$ . Maximum sentence comprehension improved by  $73 \pm 34.2$ .

### 3.3.3. The effectiveness of wearing hearing aids by the degree of hearing loss



**Figure 3.8. The effectiveness of wearing hearing aids by the degree of hearing loss**

Hearing loss at moderate degree had a very effective intervention with hearing aids. Moderate-severe hearing loss had 9/11 ears with very good effect with hearing aids accounting for 81.8%, severe hearing loss had 11 ears with very good effect (50%), profound hearing loss had no ear with a very good response to a hearing aid, there were 11 ears that responded well (31.4%) and 7 ears that responded poorly (20%).

## Chapter 4. DISCUSSION

### 4.1. Some epidemiological factors on children with hearing loss

The most common age of hearing loss detection is from 13-24 months (153 children - 33%), the least common age of hearing loss detection is 0-6 months (112 children-24.3%). Children aged 0-6 months with hearing loss are diagnosed at least because the newborn hearing screening program in our country has not been popularized. According to this study, only 48 children out of 461 children had their hearing screened, accounting for 10.4%. While developed countries such as the US, Australia...have had hearing screening programs for all newborns, our country only has a few large hospitals in big cities that offer newborn hearing screening such as the National hospital of obstetrics and gynecology, Hanoi hospital of obstetrics and Gynecology, Tu Du Hospital and some obstetric and pediatric hospitals in provinces and cities such as Hai Phong, Da Nang, etc., so it is not possible to diagnose early hearing loss in children of this age. The most common age of hearing loss detection is from 13-24 months, this is thought to be due to the negative effect of hearing loss on children's language development, thus, children at the age of 2 who have delayed language development are often taken to the doctors by their parents, and they are accidentally diagnosed with hearing loss.

Profound hearing loss accounted for the highest rate with 269 children (58.4%). The reason is not because the percentage of children with severe / profound hearing loss is the highest in the community, but because children with severe /profound hearing loss can be diagnosed easier than children with lower hearing loss degree,

and they are taken to audiology centers by their families for medical examination. In fact, in the community, a large proportion of children with mild-moderate hearing loss are not diagnosed because children with hearing loss at this degree still have the ability to respond to sounds, recognise when their names are called, or still respond to loud sounds. Thus, their families do not take their children to an audiology center for examination, in fact, depend on the children's language problem manifestation (slurred speech, slur) or psychology, they take their children to other specialties such as psychiatry or rehabilitation. If doctors in these specialties do not send these children to check hearing loss, it is easy to overlook hearing loss problem on children.

#### **4.2. Risk factors for hearing loss**

Risk factors for hearing loss have been identified in the study included premature birth, neonatal jaundice (or jaundice after birth), history of neonatal resuscitation treatment, having family member with early hearing loss history, and birth asphyxia. Over 48 hours of neonatal resuscitation treatment is considered by the JCIH to be one of the high risk factors for hearing loss. The rate of children in the neonatal intensive care unit having hearing loss is 2-15%, while this rate in normal children is 0.3%. According to this study, children with a history of neonatal resuscitation have a 7.1 times higher risk of hearing loss than children without a history of neonatal resuscitation with  $P < 0.05$ . According to a study by Zarinn on 325 children aged 6-12 months with a history of neonatal resuscitation, 3.6% of these children had mild and moderate hearing loss. The cause is thought to be due to the treatment methods that the babies receive while lying in the neonatal intensive care unit. The problems of low birth weight

and premature birth, which are very common in infants in the neonatal intensive care unit, should also not be missed. In another study, it was suggested that the noise in the neonatal intensive care unit and the antibiotic Gentamycin used to treat infants during their neonatal resuscitation were a risk of hearing loss in children.

According to the results of this study, children with a history of neonatal jaundice have a 9 times higher risk of ANSD than children without a history of neonatal jaundice, with  $P < 0.05$ . The rate of ANSD children with a history of neonatal jaundice is 73.6%. This rate is higher than the rate of 50% from Rance author. The reason is thought to be that when a child has jaundice, the concentration of bilirubin in the blood increases, crosses the blood-brain barrier, poisons the brain parenchyma, if the poisoned area is where the auditory nerve passes through, it will cause nerve toxicity to this nerve. Therefore, children with neonatal jaundice, especially hemorrhagic jaundice, are at risk of ANSD. This study also showed that an increased free bilirubin index was associated with ANSD (OR: 4.6, 95% CI: 1.6-13.5,  $p = 0.002$ ), not total or conjugated bilirubin. According to another study by Amin, 28 out of 100 children with severe jaundice had ANSD, accounting for 28%, this study also showed that free bilirubin is related to ANSD like Sanjiv's study. According to Saluja's study on 13 jaundiced neonates with blood transfusion, up to 6 children had ANSD, accounting for 46%, there was no significant difference in gestational age and birth weight. Thus, it can be seen that neonatal jaundice is a high risk factor for auditory nerve spectrum disorders, especially hemorrhagic jaundice.



### **4.3. The effectiveness of wearing hearing aids:**

The effectiveness of wearing hearing aids depends on the children's degree of hearing loss. According to the recommendations of hearing aid manufacturers, mild to severe hearing loss responds well to hearing aids, especially mild - moderate severe hearing loss. According to this study, moderate - severe hearing loss degree has 9/11 ears showing very good response to hearing aids accounting for 81.8%, profound hearing loss degree has no ear showing very good response to hearing aids. Thus, it can be seen that the results of the study are very consistent with the recommendations of hearing aid manufacturers. However, in this study, the effectiveness of wearing hearing aids was not investigated in children with mild and moderate hearing loss. The reason was that the parents of these children refused intervention for their children because according to them the children can still hear. This is an entirely incorrect viewpoint, because even in children with very mild hearing loss, there can still be 10% loss of speech signal at a distance of 01m and in noisy environments. For children with mild hearing loss, this rate is 25-40%, for children with moderate hearing loss it is 50-100%.

## CONCLUSION

### **1. Several epidemiological characteristics in the group of children with hearing loss at the National Children's Hospital**

The most common age of hearing loss detection was from 13-24 months old (33.2%), the least common age of hearing loss detection was from 6-12 months old (15.8%). The percentage of children who are screened for newborn hearing was small (10.4%). Profound hearing loss accounted for the highest rate among children with hearing loss (58.4%), followed by severe (11.9%), moderate severe (6.9%), moderate (4.6%) and mild (1.3%). Auditory neuropathy spectrum disorder accounted for 16.7% of children with hearing loss. Only 26.5% of children with hearing loss received intervention, of which 17.6% wore hearing aids and 8.9% received cochlear implants. The average period from the time of diagnosis of hearing loss to the time of intervention was 3 months.

#### **1. High risk factors for hearing loss**

High risk factors for hearing loss include: male gender, birth asphyxia, neonatal resuscitation history, having family member with early hearing loss history, premature birth, neonatal jaundice

#### **2. The effectiveness of wearing hearing aids**

Cochlear implants perform well with moderate to severe hearing loss, and poorly with profound hearing loss. All children with moderate hearing loss respond very well with hearing aids, while this rate of the group of children with moderate-severe hearing loss is 81.8%, severe hearing loss is 50%, and there is no child with profound hearing loss responds very well to hearing aids. However, there are still 31.4% children with profound hearing loss respond well to hearing aids.

## RECOMMENDATION

- Applying research results to develop procedures for monitoring and managing children with risk factors for hearing loss, such as children with neonatal resuscitation treatment history, postpartum asphyxia, family member with early hearing loss history, neonatal jaundice, in order to diagnose hearing loss early in these children.
- There is a need of carrying out further research on hearing loss behind the cochlea and disseminating this disease identification to pediatricians, psychiatrists, otolaryngologists, rehabilitation, special educators for this disease still remains not commonly known in Vietnam, so that children will receive proper diagnosis and intervention.
- Conducting more cohort studies on children with high risk factors for hearing loss to assess later progressive hearing loss.