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Original Research

Some associated factors in hearing loss among children aged 2–5 in kindergartens in Hai Duong Province, Vietnam

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ABSTRACT

Background: Hearing disorder in children is generally recognized as a public health issue. The associated factors of hearing loss in children continue to be unknown in Vietnam. The goal of this study was to analyse some associated factors of hearing loss among children aged 2–5 in selected kindergartens in Hai Duong Province, Vietnam, in 2018.

Methods: A cross-sectional study was conducted among children aged 2–5 years old at 4 kindergartens in Hai Duong Province, Vietnam. The researchers directly interviewed the children's mothers at the kindergartens in order to collect information about prenatal, perinatal and postnatal factors. After that, children did the otoacoustic emission (OAE) test and completed by an auditory brainstem response (ABR) test for the positive diagnosis of hearing impairment.

Results: The subjects of the study were 1,090 children aged 2–5 and their mothers at kindergartens in Hai Duong Province, Vietnam. The results revealed a variety of factors associated with hearing loss among these children, including maternal rubella (OR = 7.15; 95% CI: 1.51–26.19), severe jaundice (OR = 8.70; 95% CI: 2.64–28.95), prolonged oxygen use (OR = 12.90; 95% CI: 3.00–55.67) and chronic ear infections (OR = 9.81; 95% CI: 5.45–17.55).

Conclusion: The study found that maternal rubella, severe jaundice, prolonged oxygen use and chronic ear infections were the associated factors of hearing loss among preschool children in Hai Duong Province, Vietnam. Children suffering from these factors should undergo the OAE and ABR tests to ensure early detection of hearing loss.

Keywords: Hearing loss, hearing impairment, hearing disorder, Hai Duong, Vietnam.

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INTRODUCTION

Hearing loss (HL) is one of the most disabling conditions and major global health burdens contributing adversely to the social and economic development of countries if it is not properly managed. The World Health Organization (WHO) estimates that approximately 5% of the population, equivalent to 466 million people worldwide, suffer from hearing loss. This includes 34 million children who suffer from this problem.[1] the vast majority of people affected live in the world's low-income and middle-income countries.[2]Vietnam is part of the Southeast Asian region, which has the second-highest rate of HL among children around the world, only after the South African region.[3]Many different conditions lead to partial and total deafness. HL in children has many causes, including congenital causes, meaning those that are present at birth or soon thereafter, and acquired causes, those which occur as a child ages.[4] HL may be the result of a combination of several of these factors; however, it is not always possible to determine the exact cause. While many causes of hearing loss may occur, the WHO estimates that approximately 60% of hearing loss is due to preventable causes.[5]

Children aged 2–5 years old are the target groups and should be considered for study because it is at this stage that children begin to develop strong community communication skills through learning at school and interacting with other people. Therefore, intervention, such as early detection of hearing loss, targeting preschool children provides the opportunity for affected children to experience typical physical and mental development, as well as social integration. Nevertheless, lower- and middle-income countries, including Vietnam, are facing obstacles in implementing early hearing screening programs and follow-up services because of the prioritization of life-threatening illnesses, high accessibility costs and a lack of human and material resources. Knowledge of children suffering from hearing loss in Vietnam is still limited. According to the Ministry of Labour, War Invalids and Social Affairs in Vietnam, neurological disorders and hearing disability are the second most common, accounting for 17.00% after mobility disability (29.0%).[6] The report of the Vietnam Ministry of Education and Training showed that 180,000 children under 18 years have HL.[7]This study analysed some associated factors of hearing loss in children aged 2–5 years in selected kindergartens in Hai Duong Province, Vietnam. This study provides evidence for proposing and implementing solutions to improve hearing ability, as well as for preventing hearing loss in children.

METHODS

In this study, 1,090 children aged 2–5 years at 4 kindergartens (including Hop Tien, Nam Chinh, HoaSu and Hoa Thuy Tien) in Hai Duong Province, Vietnam, in 2018 were tested for hearing loss, and their mothers were interviewed.

Inclusion criteria

Children aged 2 years (24 months) to 5 years (60 months) at the time of screening who were attending the selected kindergartens, as well as their mothers, were invited to participate in the study.

Exclusion criteria

If the children's families did not agree to have their children participate in the research, they were not included in the study.

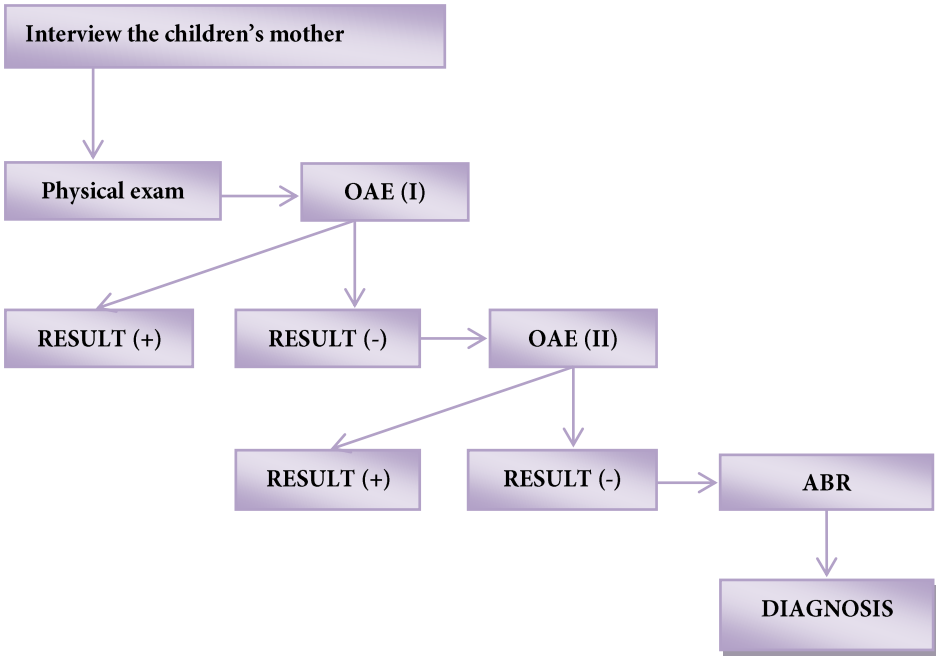

Figure 1. Hearing loss screening

Interview

Upon receiving their signed informed consent, a professional researcher used the same questionnaire to interview all participating mothers. It took about 40 minutes to complete each interview.

The questionnaire for HL

The questionnaire for HL in children aged 2–5 in kindergartens in Hai Duong Province was based on the questionnaire for HL in children aged 2–5 years old in Hanoi [34]. After analysis, the researchers in this study found that the Cronbach'salpha of this questionnaire was 0.78. Moreover, the researchers used this questionnaire to interview 20 mothers with children aged 2–5 at the Ear-Nose-Throat Department in the National Hospital of Paediatrics in Vietnam. All mothers were able to understand the questions; hence, the questionnaire for HL in children aged 2–5 years did notneed be designed again.

Hearing screening measurements

The hearing screening measurement has three steps, as follows:

Step 1. Physical exam in children

The ear, nose and throat doctors working at the National Hospital of Pediatrics checked the children's ears to identify any problems.

Step 2. OAE test

Investigators brought OAE machines to the selected pre-primary schools and measured cochleae according to standard procedures.

Step 3. Method audiometry

The children underwent ABR testing if their OAE test was negative in the first screening.

The cochlear measurement method offers two results. The first is "PASS," which is considered a positive OAE result indicating normal hearing. The second is "REFER," which is considered negative OAE result indicating that the child has reduced hearing. Negative OAE results occur when children do not respond to sounds with frequencies ranging from 500–4,000Hz and 30dB intensity. ABR testing took place within the audiology laboratory of the National Hospital of Paediatrics in Hanoi, Vietnam. Hearing loss was classified as mild (21–40dB HL), moderate (41–70 dB HL) and severe and profound (>70 dB HL). All tests were performed by qualified biomedical staff at the department of Ear-Nose-Throat, National Hospital of Paediatrics, Hanoi. Collected data was entered and managed by EpiData software and analyzed using SPSS 20.0.

Data analysis

The collected data was cleaned, including correcting spelling errors, handling missing data and eliminatingnon-pertinent information, before encryption.Data was entered twice independently using EpiData 3.1 software. Based on the structure of the questionnaire, the researcher used a form to check for logic and accuracy of the data set. If any indicator was illogical, the records were compared with their hardcopies to find and fix the mistakes. Any data adjustment was recorded. After that, the data was analysed using SPSS software version 20.0. First, the study undertook descriptive statistics to describe variables (total counts and percentages). Second, some associated factors of hearing loss among children in preschool in Hai Duong Province were described by significant testing (OR with CI 95%).

RESULTS

Table 1.Characteristic of the study's participants (N=1,090)

Characteristics	Hearing loss (n=51)		No hearing loss (n=1,039)	
	n	%	n	%
Age				
2 years old	8	6.7	112	93.3
3 years old	16	5.3	288	94.7
4 years old	15	5.0	287	94.0
5 years old	12	3.3	352	96.7
Gender				
Males	27	2.5	562	51.5
Females	24	2.2	477	43.8
Total	**51**	**4.7**	**1,039**	**95.3**

Table 1 shows that after undergoing OAE and ABR testing, 51 out of the 1,090 children were diagnosed with hearing loss in the study. The 2-year-old group had the highest hearing loss rate, accounting for 6.7%. In contrast, the 5-year-old group only accounted for 3.3%. The number of children aged 2 was the lowest with 120 children (accounting for 11%), as opposed to the group of children aged 5, which was 364 children (accounting for 33.4%). In addition, the percentage of female children aged 2 was 4.8%,which was more than three times that of the group of female children aged 5 (approximately 15.9%).

Table 2.Childwith a family member suffering from HL (N=1,090)

Factor	Hearing loss (n=51)		No hearing loss (n=1,039)	
	Number	(%)	Number	(%)
Child witha family member suffering from HL	3	5.9	2	0.2

In the study, there were 5 children whose families had memberssuffering from hearing loss; 5.9% of children suffering hearing loss had family members with hearing loss (Table 2).

Table 3 reports that maternal rubella was associated with hearing loss among the children, OR = 7.15 (95% CI: 1.51–26.19).

Table 3.The association between prenatal factors and hearing loss in children aged 2–5 years old in Hai Duong Province

Prenatal factors		Hearing loss (n=51)		No hearing loss (n=1,039)		OR (95% CI)
		n	%	n	%	
Maternal influenza	**Yes**	1	2.0	7	0.8	2.91
	No	50	98.0	1,032	99.1	(0.35-24.43)
Maternal rubella	**Yes**	3	5.8	9	0.9	7.15
	No	48	94.2	1,030	99.1	(1.51-26.19)
Maternal measles	**Yes**	0	0	2	0.2	-
	No	51	100	1,037	99.8	

Table 4.The association between perinatal factors and hearing loss in children aged 2–5 years old in Hai Duong Province

Perinatal factors	Hearing loss (n=51)		No hearing loss (n=1,039)		OR (95% CI)
	n	%	n	%	
Gestational age					
Preterm (<37 weeks)	1	2.0	4	0.4	5.21
Full term (≥ 37 weeks)	50	98.0	1,035	99.6	(0.56–47.15)
Birthing					
Caesarean section	19	37.2	430	41.4	0.82
Vaginal delivery	32	62.8	609	58.6	(0.47–1.50)
Birthweight					
< 2500 gram	2	3.9	9	0.9	4.72
≥ 2500 gram	49	96.1	1,030	99.1	(0.98–22.20)
Prolonged oxygen use					
Yes	3	5.9	5	0.5	12.90

No	48	94.1	1,034	99.5	(3.00–55.67)
Severe jaundice					
Yes	4	7.8	10	1.0	8.70
No	47	92.2	1,029	99.0	(2.64–28.95)

Table 4 demonstrates that 5 perinatal factors (including gestational age, birthing, birth weight, prolonged oxygen use and severe jaundice) were the associated factors of hearing loss. The strength of the association was highest for prolonged oxygen use, with OR=12.90 and CI: 3.00–55.67.

Table 5 shows that roseola, encephalitis, meningitis and chronic ear infections were the postnatal factors associated with hearing loss. However, children suffering from chronic ear infections may have a higher risk of HL.

Table 5.The association between postnatal factors and HL in children aged 2–5 years old in Hai Duong Province (N=1,090)

Postnatal factors		Hearing loss (n=51)		No hearing loss (n=1,039)		OR(95% CI)
		n	%	n	%	
Roseola	**Yes**	2	3.9	10	1.0	4.20(0.89–19.68)
	No	49	96.1	1,029	99.0	
Pertussis	**Yes**	-	-	1	0.1	-
	No	51	100	1,038	99.9	
Meningitis	**Yes**	1	2.0	3	0.3	6.91(0.70–67.58)
	No	50	98.0	1,036	99.7	
Chronic ear infections	**Yes**	28	54.9	115	11.1	9.81(5.45–17.55)
	No	23	45.1	924	88.9	

DISCUSSION

In this study, the number of children participating increased according to age. Among children who were screened for HL, 2-year-old children had the lowest number, accounting for 11%. On the contrary, the highest number of children were aged 5 years old, accounting for 33.4%. However, this difference is not statistically significant (p>0.05). The difference in the number of children of all ages in the study may be due to the children's ages when starting school. The 4 schools in the study were public schools, so they only accepted children aged 2 and up. Therefore, the number of children in these kindergartens increased according to age. In addition, some families only permit their children go to kindergarten when they are older than 2 years old. This may explain why the number of 2-year-olds in the study was the lowest.

There are many risk factors during pregnancy that lead to hearing loss in children. If the mother is infected with rubella, syphilis, measles or a certain infection during pregnancy, the child is at higher risk of hearing loss.[8] In addition, genetic causes can be important factors in hearing loss in infants and children.[9] The study reported that 3 children suffering hearing loss had a family member with hearing loss, accounting for 5.9% of children with HL. However, worldwide studies have shown that genetic factors may be associated with hearing loss in infants and young children. Identifying genes and their effects on hearing loss is very complex and difficult.[9,10]

In this study, mothers with rubella during pregnancy were at risk for having children with HL, OR = 7.15 (95% CI: 1.51–26.19). This result was similar to some other research results in Vietnam. Research by author Le Thi Thu Ha showed that children whose mothers were infected with a virus (mainly rubella) during pregnancy were approximately 7.97 times more at risk for hearing loss, OR = 7.97 and CI: 3.69–17.20. Studies worldwide have shown that rubella infection during pregnancy is an important risk factor for hearing loss.[11] Yang's study at the Neonatal Intensive Care Unit showed that children with hearing loss have rubella antibodies (IgG).[1]

Hypoxia status is closely associated with hearing loss. The function of cochleae would be normal when there was sufficient oxygen and blood perfusion. In infants with hypoxia or asphyxia, the cochlear ganglion cells were affected first. More severe lack of oxygen would cause destruction of the cochleae, especially the outer hair cells and vascular layers. However, there was no defined threshold level of hypoxia affecting hearing loss. Furthermore, infants with respiratory distress were often ventilated and/or alkaline condition that oxidizing and reducing blood flow to the cochlea and the auditory nerve transmission path. The low concentration of oxygen in the blood could cause hearing loss but not due to damaged auditory nerve pathways; hearing loss in this case is due to a lack of oxygen in the auditory centre of the temporal cortex.[13]This study also found that prolonged oxygen treatment was an intervening factor in the active treatment of children with poor hearing, with OR = 12.90 and CI: 3.00–55.67.

The relationship between severe jaundice and abnormal condition after birth with hearing loss in children has been given in the medical literature worldwide and in Vietnam. Freely increased bilirubin could cause damage to the brain stem'snuclear auditory nerve. It could also destroy the auditory nerve and cochlear ganglion cells due to the stagnation of nerve neuron intracellular calcium. Corti-organ and auditory nerve transmission through the thalamic-cortical pathways were typically not affected. Clinically, this has been linked to cochlear hearing loss.

Chronic ear infection is also a leading cause of hearing loss among children reported by the WHO.[14] A study conducted with 400 preschool children aged 4–6 years in Albania found that chronic ear infection in objective examination significantly increase the likelihood of hearing loss, with OR = 1.82 and CI 1.33–2.51.[15] Similarly, the study in Hai Duong Province also found that chronic ear infection was one of the postnatal factors in children aged 2–5 years old.

CONCLUSION

Some factors, such as maternal rubella, severe jaundice, prolonged oxygen use and chronic ear infections, were associated with hearing loss among preschool children in Hai Duong Province. Children suffering from these factors should undergo OAE and ABR testingto ensure early detection of hearing loss.

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CONFLICT OF INTEREST: None declared.

ETHICAL APPROVAL: The study was approved by Hanoi Medical University.

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