

Situation of hearing loss among children aged 2 to 5 at kindergartens in Hai Duong Province, Vietnam

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ABSTRACT

Background: Today, hearing loss in children is widely recognized as a public health issue. The goal of this study was to identify the prevalence, distribution and types of hearing loss among children aged 2-5 in a sample of 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. This study included the following three steps: a two-step otoacoustic emission (OAE) program, completed by an auditory brainstem response (ABR) for the positive diagnosis of hearing impairment.

Results: The subjects of the study were 1,090 children aged 2-5 years old who underwent hearing screening at kindergartens in Hai Duong Province, Vietnam. The percentage of children with true hearing loss was 4.7%, confirmed by ABR. The majority of the hearing loss in the children was conductive hearing loss (74.5%). Mild hearing loss (21-40 dB) accounted for nearly half of the children with hearing loss (49.0%).

Conclusion: The study found that hearing loss is common among preschool children in Vietnam. Routine hearing screening of school-aged children should be included in annual school health programs in Vietnam.

Keywords: Hearing loss, hearing impairment, children, Hai Duong, Vietnam

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INTRODUCTION

Hearing loss is a significant source of morbidity worldwide. Hearing loss occurs when any part of the ear, including the outer ear, middle ear, inner ear, hearing (acoustic) nerve and auditory system, is not working in atypical manner. Hearing loss can occur in all ages and has many causes. The World Health Organization (WHO) estimated that approximately 5% of the population, equivalent to 466 million people worldwide, suffer from hearing loss. This includes 34 million children suffering from hearing-loss issues.¹ The vast majority of these children live in the world's low-income and middle-income countries.² People with hearing loss face many difficulties in life, including regarding language and intellectual development, especially in children. For children, hearing is key to learning oral language, performing academically and engaging socially. Hearing loss poses a barrier to education and social integration. Most children with hearing impairment in developing countries do not complete primary education and never gain economic independence from their parents; therefore, they become trapped in poverty. Hence, detection and timely intervention would provide children with significant opportunities to recover the ability to hear, develop language skills, learn, integrate into their communities and reduce the burden on the children themselves, as well as on their families and society.

The definition of hearing loss varies across different classification systems, but usually categories of hearing loss are as follows: mild (21-40 dB hearing loss), moderate (41-70 dB hearing loss), severe and profound (>70 dB hearing loss).³ Thresholds are expressed in dB on the hearing level scale (dB HL). In terms of type, hearing loss in children can be classified

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as sensorineural, conductive and mixed type. Sensorineural hearing loss results from failure to transduce vibrations into neural impulses in the cochlea and is found mainly in very preterm infants. Conductive hearing loss results from interference with the transmission of sound through the external and middle ear and is much more common in infants. Mixed hearing impairment is a combination of the sensorineural and conductive hearing loss types.³

Vietnam is a country in the region with the second highest rate of hearing loss among children in the world, after the South African region. It is estimated that 180,000 children under 18 have hearing loss in Vietnam. Indeed, those number could be higher due to limited hearing screening programs in the country.⁴ Recently, Vietnam has started providing education and resources to professionals, teachers and families who work with or have children suffering from hearing loss.⁴ Children from 2-5 years old are the target group and should be considered for study, because at this stage, children begin to develop strong community communication skills through learning at schools and contacting with other people. This age group is also preparing to enter school. Therefore, intervention targeting preschool children, such as the early detection of hearing loss, can help provide children with the ability to experience typical physical and mental development, as well as social integration. This study was conducted to determine the prevalence of hearing loss in children aged 2-5 years in kindergartens in Hai Duong Province, Vietnam. This study will act as evidence for proposing and implementing solutions to improve hearing ability, as well as children's physical and mental development.

METHODS

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

Inclusion criteria

Children aged 2 years (24 months) to 5 years (60 months) at the time of screening who were attending the selected kindergartens 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.

Hearing screening measurements

The hearing screening measurement has three steps, including the following: (1) physical exam in children (the ear, nose and throat doctors working at the National Hospital of Pediatrics, checked the ears of children to locate any problems); (2) OAE test (investigators brought OAE machines

to the selected pre-primary schools and measured cochlear according to standard procedures); (3) method audiometry (the children were given an ABR test if their OAE test was negative after the first screening).

The cochlear measurement method offers two results. The first is "PASS," which is considered a positive OAE result and indicates normal hearing. The second is "REFER," considered a negative OAE result that means 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 took place within the audiology laboratory of the National Hospital of Pediatrics in Hanoi, Vietnam. Hearing loss was classified as mild (21-40dB HL), moderate (41-70 dB HL) or severe and profound (>70 dB HL). All tests were performed by qualified biomedical staff at the department of Ear-Nose-Throat, National Hospital of Pediatrics, Hanoi. Collected data was entered and managed by EpiData software and analyzed using SPSS 20.0.

RESULTS

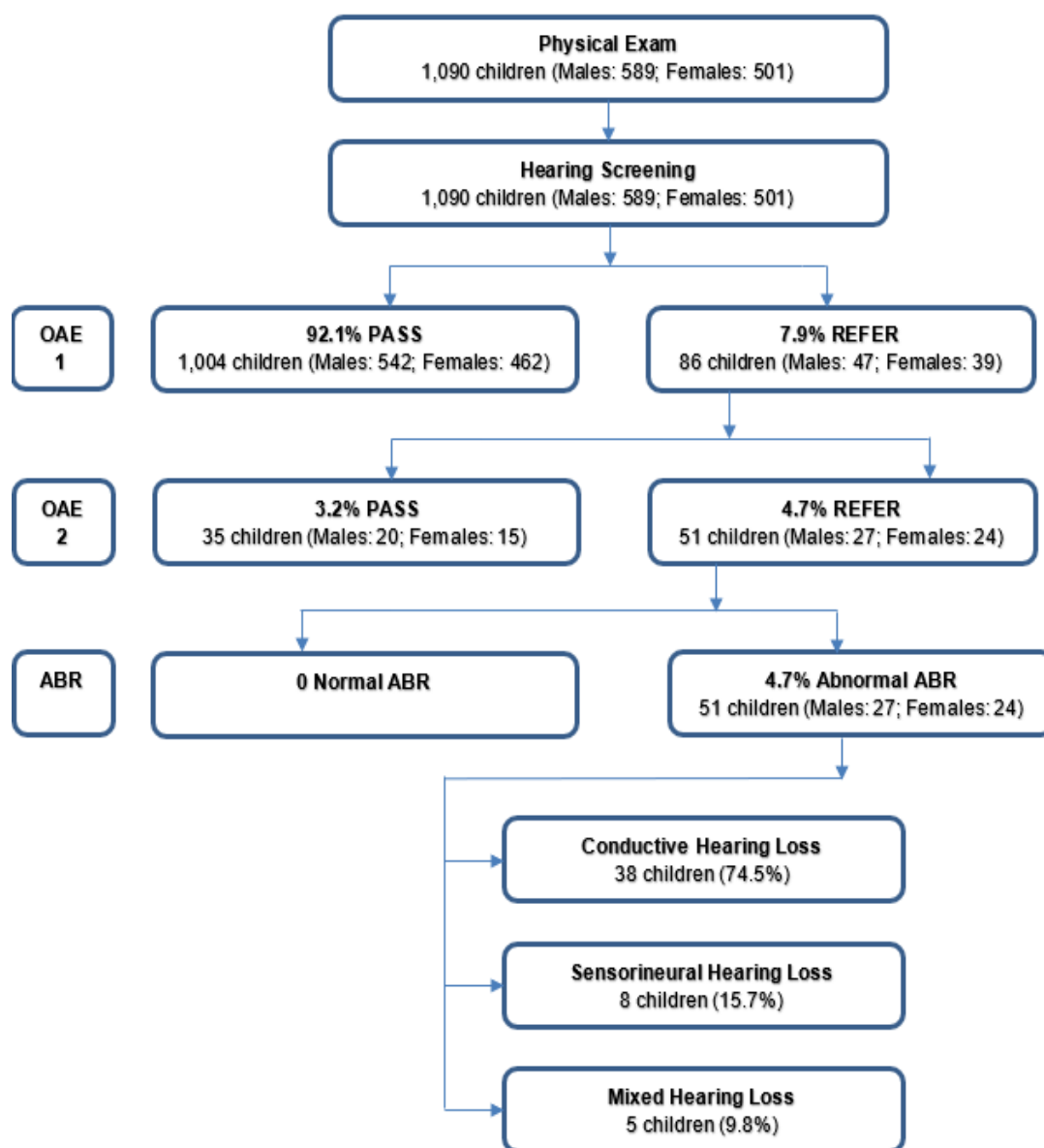


Figure 1. Hearing loss screening

Figure 1 shows the flowchart for the hearing loss screening undertaken at selected kindergartens in Hai Duong Province, Vietnam. In this study, 1,090 preschool children from 2-5 years old (including 589 males and 501 females) were screened for hearing loss. After the first screening, the number of children with negative OAE was 86, accounting for 7.9%, while the number of children with positive OAE was more than 11 times that, averaging approximately 92.1%. All of children with negative OAE results in the first screening undertook the second OAE test, wherein 51 children had negative OAE results (approximately 4.7% of the screened population). Thus, 35 children (approximately 3.2% of the screened population) had a false negative result from the first screening of OAE test. After that, children with negative OAE results in the screening were tested for ABR. The ABR found that all of these children were abnormal, accounting for 4.7% of the screened population. Most of the children - 38 children (74.5%) - were diagnosed with conductive hearing loss; whereas sensorineural hearing loss was identified in 8 children (15.7%) and mixed hearing loss in 5 children (9.8%).

After undergoing the OAE and ABR tests, 51 out of 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%.

Table 1. Age distribution of the subjects (N=1,090)

Age (years old)	Hearing loss		No hearing loss	
	(n=51)		(n=1,039)	
	n	(%)	n	(%)
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

Table 2. The ear position of children having the negative OAE result in the second screening (n=51)

Characteristics	Male	Female	Total	P-value
	(n=27)	(n=24)	(n=51)	
	n (%)	n (%)	n (%)	
Only right ear hearing loss	9 (33.3)	6 (25.0)	15 (29.4)	<0.05
Only left ear hearing loss	8 (29.6)	6 (25.0)	14 (27.5)	
Both	10 (37.1)	12 (50.0)	22 (43.1)	

Table 2 demonstrates that among children with diagnosis hearing, the number of males was higher than that of females. In addition, hearing loss in both ears had the highest prevalence rate, at approximately 43.1%. Left-ear hearing loss had the lowest incidence, at only 27.5%. This is a statistically significant difference, at $p < 0.05$.

Of 51 children with the second negative OAE measurement result were tested by ABR (Table 3). As shown in the table

above, 51 children with a second negative OAE test were classified as hearing impaired at various levels. Mild hearing loss was the most common hearing loss, accounting for 49%; moderate hearing loss accounted for 35.3% and severe hearing loss accounted for the lowest rate at only 15.7%. The number of male children suffering mild hearing loss was the highest, with 13 children having this degree of hearing loss. By contrast, female children with severe hearing loss accounted for only 3 children, which was the lowest number.

Table 3. Severity of hearing loss in children having the negative OAE result in the second screening (n=51)

Degree of hearing loss	Male	Female	Total	P-value
	(n=27)	(n=24)	(n=51)	
	n (%)	n (%)	n (%)	
Mild hearing loss (21-40 dB)	13 (48.2)	12 (50.0)	25 (49.0)	<0.05
Moderate hearing loss (41-70 dB)	9 (33.3)	9 (37.5)	18 (35.3)	
Severe hearing loss (>70 dB)	5 (18.5)	3 (12.5)	8 (15.7)	

DISCUSSION

The study showed that 4.7% children from 2-5 years old at kindergartens in Hai Duong Province, Vietnam, had hearing loss of varying levels and types.⁵ In addition, the negative OAE rate in male children was higher than that of female children. The results of this study were similar to the results of Pham ThiCoi et al. (2004) regarding the assessment of the role of cochlear sound in audiology. Pham ThiCoi et al. studied 823 children under the age of 5 in the three provinces of Bac Ninh, Thai Nguyen and Phu Tho who had negative OAE results, which accounted for 4.87% of the children studied.⁶ In the present study, the "REFER" results in the hearing loss screening study at the four kindergartens in Hai Duong Province were similar to comparable studies around the world. The study conducted by Hunt et al. (2017), undertaken with children aged 2-5 years old, showed a prevalence of hearing impairment at 5.5%, which was similar to kindergarten studies in Hai Duong Province. Similarly, the number of affected males was higher than the number of affected females.⁷ However, compared to the rate of hearing loss in children under 15 years old in Africa, the rate of hearing loss in the Hai Duong study was much lower. The rate of HL in the African study was 17.5%, which was three times higher than the rate of hearing loss in children in the present study.⁸

The difference in negative OAE rates in the studies may be due to the influence of many factors. The OAE result may be affected by noise around the measurement site. In addition, the OAE result is also affected by ear canal defects, as well as earwax or fluid inside the ear. These factors increase the false negative rate of screening method. In order to overcome the disadvantages of this method, in the first screening, the ears of the children in this study were examined for earwax or foreign objects in the ear. Moreover, the measurements were conducted in a soundproof room to minimize the influence of ambient noise on the measurement results. Therefore, noise and foreign objects in the ear can be eliminated. In any screening program, the method of screening is required to

have high sensitivity and specificity. This study used the OAE method to screen for hearing loss. Due to the advantages of the short measuring time, low cost and high sensitivity and specificity, this method is recommended in hearing screening in children around the world. This method has also proven to be suitable for children aged 2-5 years. However, more intensive hearing tests, such as the ABR for children with negative OAE results, should also be performed to provide accurate information about the hearing loss characteristics of study subjects.⁸

In this study, the first screening of children with negative OAE results was 7.9%, but after the second screening, the rate of children with negative OAE results was 4.7%. All children with the second negative OAE results were classified as having poor hearing at various levels by the ABR method. The second negative OAE result and the ABR result were the same in the study. Bilateral hearing loss is a hearing loss in both ears. The hearing loss screening results gained through OAE testing showed that bilateral hearing loss was the most common form of hearing loss, accounting for 43.1% of the hearing loss total. Hearing loss in only the right ear or left ear had low percentages of occurrence at 29.4% and 27.5%. This result was similar to the results of previous studies that conducted hearing loss screening by OAE testing. Research by Fitzpatrick (2014) reported that both-ear hearing loss in children accounts for the majority of hearing loss (46.3%).⁹

In Vietnam, most studies about hearing loss characteristics in children only stop doing in OAE tests. Therefore, only the status of children with suspected hearing impairment is known; the level of hearing loss among children more generally is not known. In this study, all children were identified with hearing loss via the second OAE test. The children who had negative OAE results in the second screening were then measured by the more specialized tests, such as the ABR, to identify children who actually have hearing loss and their hearing loss levels. The results showed that mild hearing loss (21 ≤ 40 dB) was the most common (49.0%), followed by moderate hearing loss (35.3%); severe hearing loss (> 70 dB) accounted for 15.7%.

Although there has been little research to determine the degree of hearing loss in children in Vietnam, this study's results were consistent with the results of the degree of hearing loss in primary school children in Hai Phong City. Among pupils with hearing loss in Hai Phong City, 78.5% of children had mild hearing loss (20-40 dB), only 18.5% of children had moderate hearing loss (40-60 dB), and very few pupils had serious and severe degrees of hearing loss (3.0%).¹⁰ Research conducted in Nigeria in children under 6 months of age showed that children with hearing loss in both ears 2, accounted for 83.9%, mild hearing loss accounted for the highest percentage of 45.8%, and severe and deep hearing loss was 31.2. However, the proportion with moderate hearing loss accounted for only 22.9%.¹¹ The difference in the rate of hearing loss levels may be due to the classification criteria for hearing impairment levels. There are many standards for classifying hearing impairments. The WHO classification criteria suggest that children classified as having mild hearing loss have hearing the range of 26-40 dB and that children with moderate hearing loss have hearing in the range of 41-60 dB.¹² Meanwhile, the American Speech language hearing association indicates mild hearing loss as hearing ranging from 16-25 dB and moderate hearing loss as from 26-40 dB.¹³ Thus, the classification of hearing impairment

according to hearing thresholds is varies across diagnostic classifications. Vietnam has no universal national hearing screening program for newborns and children at present. In addition, there is no routine hearing screening of children in the majority of health institutions in the country. Findings from the current study provide scientific evidence and support for the Vietnam Ministry of Health to promptly set up a national universal hearing-loss screening program for children.

CONCLUSION

Hearing loss among children from 2-5 years old is common in Hai Duong Province, Vietnam. In order to reduce the age of identification of hearing loss in children in Vietnam, national universal hearing loss programs for newborn and preschool children is strongly recommended.

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CONFLICT OF INTEREST: None to declare.

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