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Evaluation of hearing health in children with HIV/AIDS

Avaliação da saúde auditiva em crianças com HIV/AIDS

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ABSTRACT

Purpose: To evaluate the hearing capacity of children with HIV/AIDS and its association to patient age and time of diagnosis. **Methods:** This descriptive cross-sectional study included 23 children with HIV/AIDS monitored in two specialized medical centers in Joao Pessoa, Brazil. The children underwent basic audiometric evaluation (audiometry and immittance measurements), and the findings were analyzed using descriptive statistics. The study was approved by the Research Ethics Committee, protocol number 343/11. **Results:** The audiometric examination detected 39 abnormal ears, which had a high incidence of mild hearing loss. Among the immittance measurements, a type B curve was the most prevalent, followed by curve types A and C, respectively. There was an association between the hearing loss type to both the patient age and the time of HIV diagnosis, with a significant difference for both variables (p<0.001). **Conclusion:** Children with HIV/AIDS experience hearing loss correlated with their age and time of initial infection. Education of the family and the HIV-infected child is clearly needed on measures that can be adopted to preserve hearing health.

Keywords: Hearing; Hearing loss; Health education; Acquired immunodeficiency syndrome; Speech, language and hearing sciences

RESUMO

Objetivo: Avaliar a audição de crianças com HIV/AIDS e analisar os resultados dessa avaliação, associando-os à faixa etária e ao tempo de diagnóstico. **Métodos:** Caracteriza-se por ser um estudo descritivo e transversal. Foram incluídas 23 crianças com HIV/AIDS, em acompanhamento em dois serviços de atendimento especializado (SAE), em João Pessoa (PB). As crianças foram submetidas à avaliação audiológica básica (audiometria e imitanciometria) e os achados foram analisados com o uso de estatística descritiva. **Resultados:** No exame audiométrico, observou-se 39 orelhas alteradas, apresentando maior ocorrência para perda discreta. Na avaliação imitanciométrica, predominou a curva do tipo B, seguida da curva A, As e C, respectivamente. Ao associar os tipos de perdas auditivas à faixa etária e ao tempo de diagnóstico do HIV, obteve-se diferença (p<0,001) para ambas as variáveis. **Conclusão:** Crianças portadoras de HIV/AIDS apresentam perda auditiva e existe associação com a idade e com o tempo de infecção. Evidencia-se a necessidade de realizar um trabalho educativo junto aos familiares e à própria criança com HIV, acerca de medidas que podem ser adotadas para preservar, ao máximo, a saúde auditiva.

Descritores: Audição; Perda auditiva; Educação em saúde; Síndrome de imunodeficiência adquirida; Fonoaudiologia

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INTRODUCTION

Acquired immunodeficiency syndrome (AIDS) is an infectious and contagious disease caused by the Human Immunodeficiency Virus (HIV), which attacks the immune system responsible for protecting the organism against infectious disease. At the beginning of the 80s, AIDS was limited to specific at-risk groups. However, the spread of this disease led this virus to infect individuals of different age groups, children included. The number of school-aged children living with AIDS has increased, partially due to the availability of therapies that improve survival and quality of life[1,2].

Studies[3-7] suggest that children with HIV are especially vulnerable to hearing disorders. Hearing loss hampers or destroys oral communication, which has direct repercussions on the social and family environments. Hearing impairment carries a stigma and affects self-esteem, causing affected individuals to perceive themselves as disabled and dependent, which results in social exclusion. In children, hearing impairment may hinder their access to education, which has clear socio-economic consequences[8].

Studies evaluating the hearing in children with HIV/AIDS have demonstrated that 32.8% of individuals analyzed suffer from hearing loss[9]. Another study[7] reports a higher prevalence of hearing loss (59.4%) in children and adolescents with HIV/AIDS, in addition to alterations in the central auditory pathways[5,6]. As hearing loss increases in severity, vocabulary, phonological awareness, auditory discrimination, and school achievement declines, and the incidence of articulation difficulties, changes, and omissions increases[10].

In a prior study[11], the authors observed delayed development of auditory skills in an HIV-infected child due to hearing loss, possibly caused by the antiretroviral therapy.

Given this risk, the early diagnosis of hearing disorders in children with HIV/AIDS is particularly important, as any alteration may hamper their language development and create communication difficulties during learning, education, and social bonding[8].

Therefore, this study assessed hearing loss in children with HIV/AIDS and correlated it with their age and the time of diagnosis.

METHODS

This descriptive cross-sectional study was performed at two medical centers specializing in HIV treatment located in João Pessoa (PB), Brazil.

In total, 23 children diagnosed with HIV/AIDS, who satisfied the following inclusion criteria, were evaluated: previous exposure, or not, to antiretroviral therapy during pregnancy, birth and/or after birth and/or undergoing treatment, and aged between 2 and 10 years old.

To analyze the association between hearing function and age, the children were divided into two groups: Group A, comprising children up to 4 years and 11 months of age, and Group B, comprising children aged between 5 and 10 years and 11 months. The average age was 5.67 years.

To verify the association between hearing results and the time since diagnosis, the children were allocated into three groups: Group 1 (children diagnosed when aged less than 1 year), Group 2 (diagnosed between 1 and 2 years) and Group 3 (diagnosed when aged over 2 years).

The study was approved by the Research Ethics Committee (REC) of the Hospital Lauro Wanderlei, Universidade Federal da Paraíba (UFPB), protocol number 343/11. Parents and legal guardians were informed on all procedures to be performed and provided written informed consent for study participation according to Resolution number 196/96 of the National Health Council.

Each child was assessed based on anamnesis, meatoscopy analysis, and conventional or pure-tone conditional and immittance audiometry. Audiometric data were collected using an otoscope (Missuri®); AA1200 audiometer (Starkey®) with TDH-39 phones and B-71 bone vibrator; and an immittance meter model AT-237 (Interacoustic®) containing a contralateral earphone (model TDH-39) and a probe connected to the main equipment.

The following parameters were evaluated:

- Pure-tone conditional audiometry: the hearing threshold at frequencies between 500 to 4000 Hz for air conduction in children aged between 2 years and 6 years and 11 months;
- Pure-tone conventional audiometry: the hearing threshold at frequencies between 250 to 8000 Hz for air conduction in children aged between 7 years and 10 years and 11 months, and hearing thresholds at frequencies between 500 and 4000 Hz for bone conduction when the air conduction threshold was diminished (higher than 15 dB NA);
- Acoustic immittance: tympanometry curve and contralateral acoustic reflex thresholds at 500, 1000, 2000, and 4000 Hz, and ipsilateral at 1000 and 2000 Hz frequencies.

The auditory results were classified as normal or abnormal, according to previously reported standards for pure-tone audiometry[12] and acoustic immittance[13].

The pure-tone audiometry results were considered normal at hearing thresholds for air conduction up to 15 dB NA and altered when the threshold was above normal in at least one frequency per ear. Hearing loss was classified by type as conductive, sensorineural, or mixed[12], and by severity as mild, moderate, or severe[14]. To assess the type of hearing loss, when the hearing thresholds for bone conduction could not be obtained, the case was classified as undetermined. This scenario was caused by conditional difficulties limited by time or age, or due to cases where the child did not return to complete the procedure.

Nomenclature unique from the one proposed for hearing loss classification was required and was adopted to indicate

hearing threshold alterations at a single frequency, specifically at 250 Hz, 6000 Hz, or 8000 Hz. Therefore, the designated term was "hearing loss at isolated frequencies".

Immittance measurements were considered normal when the tympanometry curve was classified as type A, that is, characterized by a maximal compliance peak at or near the atmospheric pressure equal to 0 daPa, with variation that did not exceed -100 daPa. The stapedius muscle acoustic reflexes were divided into three categories: absent (absent bilateral reflexes at all the frequencies in the ear analyzed); partially present (bilateral reflexes were present at one or more frequencies in the tested ear); and present (reflexes were present at all the frequencies in the tested ear.

The results were analyzed according to each ear (n=46) and not by the number of individuals within the sample (n=23). The data absolute distributions, univariate, and bivariate percentages were obtained, and inferential statistics were applied using the Fisher's exact test because the Chi-square test requirements were not met. Statistical significance was designated at a p-value of 5%.

RESULTS

Notably, only two patients showed bilaterally normal audiometric results. The audiometric evaluation results are illustrated in Table 1.

Table 1. Pure-tone audiometry results in HIV-infected children (n=46 ears)

Result	n	%
Normal	07	15.2
Abnormal*	39	84.8
Total	46	100

*All hearing loss types

For pure-tone audiometry, moderate hearing loss was observed in the majority of patients (76.95%); the prevailing type was undetermined (30.6%), followed by sensorineural (28.2%). The pure-tone audiometry results, as well as the type and severity of hearing loss in each ear, are shown in Table 2.

The immittance examination reveals the tympanometry curves and acoustic reflexes of the stapedius muscle. A type A tympanometry curve was observed in 5 (10.9%) ears. The prevalence of type B tympanometry curve was 67.4%, and the absence of acoustic reflexes was detected in 65.2% (Table 3).

The patient age and audiometric and immittance results were similarly distributed, and there were no associations between the individual categories for tympanometry, acoustic reflexes, and age groups. The audiometric results were significantly associated with patient age, and the audiometric diagnosis varied significantly between the age groups. Undetermined hearing loss was found in 0% of patients in Group B and 60% of those in Group A, while hearing loss at an isolated frequency occurred in 19.2% of patients in Group B (Table 4).

Table 2. Hearing loss in each ear diagnosed by pure-tone audiometry

Variable	n	%
Hearing loss type		
Undetermined	12	30.8
Sensorineural	11	28.2
Conductive	8	20.5
Hearing loss at isolated frequencies	5	12.8
Mixed	3	7.7
Hearing loss severity		
Slight loss	30	76.9
Mild loss	08	20.5
Moderately severe loss	01	2.6
Total	39	100.0

Table 3. Immittance testing comprising tympanometry and acoustic reflex in HIV-infected children (n=46 ears)

Variable	Total Group	
	n	%
Tympanometry		
Type A	5	10.9
Type B	31	67.4
Type As	5	10.9
Type C	4	8.7
Type Ad	1	2.2
Acoustic reflex		
Absent	30	65.2
Partially present	15	32.6
Present	1	2.2
Total	46	100.0

There was a significant correlation between the hearing evaluation results and the age at diagnosis. Among the children in Group 3, 6 ears (37.5%) were diagnosed with sensorineural hearing loss, which was significantly higher than observed in the other age groups (Table 5).

DISCUSSION

In Brazil, the HIV incidence in children has decreased with the adoption of measures to prevent its vertical transmission[15]. Although the population of this study, which included children aged up to 10 years, was small, it proved an adequate size for statistical evaluation compared to prior investigations of individual cases or of a similar sample population[16,17].

Table 4. Association between audiometry, tympanometry, and acoustic reflex results and patient age in HIV-infected children (n=46 ears)

Variable	Age group						p-value
	Group A		Group B		Total Group		
	n	%	n	%	N	%	
Audiometric diagnosis							
Normal	3	15.0	4	15.4	7	15.2	p<0.001*
Conductive	2	10.0	6	23.1	8	17.4	
Sensorineural	3	15.0	8	30.8	11	23.9	
Mixed	-	-	3	11.5	3	6.5	
Undetermined	12	60.0	-	-	12	26.1	
Hearing loss at isolated frequencies	-	-	5	19.2	5	10.9	
Tympanometric diagnosis							
Type A	3	15.0	2	7.7	5	10.9	p=0.884
Type B	14	70.0	17	65.4	31	67.4	
Type C	1	5.0	3	11.5	4	8.7	
Type As	2	10.0	3	11.5	5	10.9	
Type Ad	-	-	1	3.8	1	2.2	
Acoustic reflex							
Absent	11	55.0	19	73.1	30	65.2	p=0.267
Partially present	8	40.0	7	26.9	15	32.6	
Present	1	5.0	-	-	1	2,.2	
Total	20	100.0	26	100.0	46	100.0	

*Significant values (p<0.05) - Fisher's Exact test

Note: Group A = aged up to 4 years and 11 months; Group B = aged between 5 to 10 years and 11 months

In studies of hearing assessment in children and adolescents with HIV/AIDS using pure-tone audiometry, conductive hearing loss was the most frequently reported type[17,18]. Author[7] observed reported conductive (58%), mixed (23.6%), and sensorineural (18.4%) hearing loss in affected juvenile patients. Another study[19] investigated the hearing loss type in each ear and reported conductive hearing loss in the right ear in 22.5% of patients and left in 33.7%, sensorineural in the right in 10.1% and left in 7.9%, and mixed in the right ear in 9% of patient and left in 7.9%.

In contrast, another investigation[20] found that sensorineual hearing loss was more prevalent in children with HIV/AIDS, occurring in 64%, and mild severity was the most frequent (44%).

The results of this study showed that the hearing in children with HIV/AIDS might be abnormal and vary in type, severity, and hearing loss configuration. Only 15.2% of the ears analyzed had normal pure tone hearing during the audiometric examination.

It must be emphasized that conductive hearing loss is not restricted to children with HIV/AIDS[21]; ear infections in the presence of risk factors that may affect the auditory system occur most commonly during childhood[22]. In general, hearing loss in individuals with HIV/AIDS can be caused by opportunistic infections, ototoxic drugs, or direct viral infection[23,24].

In the immittance tests, a high prevalence of abnormal tympanometry without audiometric change was observed, which demonstrates the importance of this exam in identifying possible tympanic cavity and auditory tube abnormalities early. These conditions are common in children and may not be detected on pure-tone audiometric examination during the initial phase because pure-tone thresholds may not yet be compromised.

In the acoustic reflex evaluations, most of the children were diagnosed with conductive hearing loss and type B disease on tympanometry, which may indicate a problem with the measurement itself. In these cases, an absence or increased acoustic reflex is expected.

Previous research revealed that HIV invades the central nervous system (CNS) during the first phase of infection, and this may be associated with the initial manifestation of AIDS in up to18% of infected children[25].

In this study, the highest incidence of hearing loss was detected in children aged 5 years or older, although a significant prevalence of undetermined hearing loss was

Table 5. Association between the audiometry, tympanometry, and acoustic reflex results and time of HIV/AIDS diagnosis in juveniles (n=46 ears)

Variable	Time of diagnosis (years)								p-value
	Group 1		Group 2		Group 3		Total Group		
	n	%	n	%	n	%	n	%	
Audiometry diagnosis									
Normal	3	15.0	1	10.0	3	18.8	7	15.2	p<0.001*
Conductive	1	5.0	4	40.0	3	18.8	8	17.4	
Sensorineural	4	20.0	1	10.0	6	37.5	11	23.9	
Mixed	-	-	1	10.0	2	12.5	3	6.5	
Undetermined	12	60.0	-	-	-	-	12	26.1	
Loss at frequencies of 6000 Hz and 8000 Hz	-	-	3	30.0	2	12.5	5	10.9	
Tympanometric diagnosis									
Type A	3	15.0	-	-	2	12.5	5	10.9	p=0.196
Type B	14	70.0	7	70.0	10	62.5	31	67.4	
Type C	-	-	3	30.0	1	6.3	4	8.7	
Type As	3	15.0	-	-	2	12.5	5	10.9	
Type Ad	-	-	-	-	1	6.3	1	2.2	
Acoustic reflex									
Absent	12	60.0	7	70.0	11	68.8	30	65.2	p=1.000
Partially present	7	35.0	3	30.0	5	31.3	15	32.6	
Present	1	5.0	-	-	-	-	1	2.2	
Total	20	100.0	10	100.0	16	100.0	46	100.0	

*Significant values (p<0.05) – Fisher's exact test

Note: Group 1 = time of diagnosis less than 1 year; Group 2 = time of diagnosis between 1 and 2 years; Group 3 = time of diagnosis more than 2 years

observed in children aged up to 4 years. A previous study[18] showed a higher prevalence of hearing abnormality in children with HIV/AIDS aged between 3 and 6 years compared to older children between 7 and 10 years. In another study[20], the prevalence of hearing loss in patients with HIV/AIDS aged between 6 months and 5 years was 33%, which was significantly lower than that observed in this study (85%) in children younger than 5 years. However, it is alarming that this hearing loss may progressively compromise the affected regions, thus suggesting the requirement for further investigations in children with HIV/AIDS.

The present study showed a higher frequency of sensorineural and conductive hearing loss in Group B children (aged 5 years or older) compared to younger children (Table 4), however, children with HIV typically experience conductive hearing loss secondary to middle ear abnormalities[18].

In HIV infected children, early diagnosis is known to result in better control of the viral infection. HIV-infected children experience a rapid disease progression, which renders them very susceptible to opportunistic infections[15]. One study revealed that there were no hearing abnormalities observed at 16 and 32 weeks after initiating antiretroviral therapy[26].

Among the studies investigating hearing problems in children with HIV/AIDS, none have reported the age of disease diagnosis, yet all assert the importance of early diagnosis of hearing problems. In this study, the as the time before diagnosis lengthened, the severity of hearing impairment increased, shown by the high prevalence of sensorineural hearing loss (37.5%) (Table 5). Another study[27] detected a high viral load in patients with otologic clinical manifestations, further indicating the association between hearing loss and the time of diagnosis.

Most studies of HIV-infected individuals (children or adults) report a higher prevalence of ear infections in addition to auditory symptoms, such as buzzing and ear ache, especially in patients undergoing antiretroviral therapy[7,19,24,27,28]. Therefore, audiometric examinations are important to monitor the hearing of children with HIV/AIDS, with the aim of preventing future hearing loss and other otic sequelae.

CONCLUSION

There was a significant association between hearing abnormalities, the patient age, and the time of HIV diagnosis in the population evaluated.

We conclude that children with HIV/AIDS are susceptible to several types of hearing conditions at different ages during early childhood (up to 10 years and 11 months of age), and at different times of diagnosis.

Therefore, monitor the hearing of children with HIV/AIDS is important, as is educating their families on measures to prevent hearing loss, which may aid language development and school performance in affected children.

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