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Original Article

Artigo Original

The lexical development of children with hearing impairment and associated factors

O desenvolvimento lexical de crianças com deficiência auditiva e fatores associados

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Keywords

Hearing loss
Child language
Hearing aids
Auditory perception

ABSTRACT

Purpose: This study aimed at analyzing the association between the lexical development of children with hearing impairment and their psychosocial and socioeconomic characteristics and medical history. **Methods:** An analytic transversal study was conducted in an Auditive Health Attention Service. One hundred and ten children from 6 to 10 years old using hearing aids and presenting hearing loss that ranged from light to deep levels were evaluated. All children were subjected to oral, written language and auditory perception tests. Parents answered a structured questionnaire to collect data from their medical history and socioeconomic status, and questionnaires about the features of the family environment and psychosocial characteristics. Multivariate analysis was performed by logistic regression, being the initial model composed by variables with p<0,20 in the univariate analysis. In the final model, we adopted a significance level of 5%. **Results:** The final model of the multivariate analysis showed an association between the performance on the vocabulary test and the results of phonemic discrimination test (OR=0.81; 95%CI 0.73–0.89). **Conclusion:** The results show the importance of stimulating the auditory processing, particularly the phonemic discrimination skill, throughout the rehabilitation process of children with hearing impairment. This stimulation can enhance lexical development and minimize the metalanguage and learning difficulties often observed in these children.

Descritores

Perda auditiva
Linguagem infantil
Auxiliares de audição
Percepção auditiva

RESUMO

Objetivo: Estudar o desenvolvimento lexical de crianças com deficiência auditiva e analisar sua associação com aspectos assistenciais, características psicossociais da criança e socioeconômicas das famílias. **Métodos:** Trata-se de um estudo transversal analítico, realizado em um Serviço de Atenção à Saúde Auditiva. Foram avaliadas 110 crianças com perda auditiva de grau leve a profundo, na idade de 6 a 10 anos de idade, usuárias de Aparelho de Amplificação Sonora Individual. Todas as crianças foram submetidas a testes de linguagem oral e escrita e de discriminação auditiva. Os responsáveis pelas crianças responderam a um questionário estruturado para levantamento dos dados da história pregressa e socioeconômicos, aos questionários sobre os recursos do ambiente familiar (RAF) e sobre capacidades e dificuldades dos comportamentos sociais (SDQ). Foi realizada análise multivariada pela técnica de regressão logística, sendo o modelo inicial composto pelas variáveis com valor p<0,20 na análise univariada. No modelo final, adotou-se nível de significância de 5%. **Resultados:** O modelo final da análise multivariada mostrou associação entre o desempenho na prova de vocabulário e o resultado do teste de discriminação fonêmica (OR=0,81; IC95% 0,73–0,89). **Conclusão:** O resultado reforça a importância da estimulação do processamento auditivo, principalmente da habilidade de discriminação fonêmica, durante todo o processo de reabilitação da criança com deficiência auditiva. Essa estimulação poderá potencializar o desenvolvimento lexical e minimizar as dificuldades de metalinguagem e aprendizagem, frequentemente observadas nessas crianças.

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INTRODUCTION

One of the fundamental aspects for language development is learning words and knowing how to use them correctly. Accessing the mental lexicon enables an individual to represent, through words, an object, a feeling, or an action[1].

Language and vocabulary acquisition depend on innate biological conditions and are affected by stimuli from the environment to which a child is exposed, the social relationships established, and from cognitive and memory skills. Oral language skills also depend on neuromuscular integrity and maturation, and especially, on hearing[1,2].

Along with motor aspects, hearing — related to both memory and cognition — is a determining element in oral language development. For auditory information to be processed, an acoustic signal is received by peripheral structures and carried on to the auditory cortex. While in transit in the auditory pathway, the sound is processed and interpreted, in a process called central auditory processing. The development of auditory abilities is necessary for the interpretation of these sound patterns. The latter are interpreted in the auditory cortex, and consequently, the activation of lexical representations as well as of grammatical and contextual analysis occurs, which thus establishes a mental representation of the linguistic stimulus and its storage in the memory[3,4].

Hearing impairment is a highly prevalent condition that can seriously harm language development. Therefore, it is important to ensure that children with hearing impairment can receive early diagnoses and efficient speech and audiology intervention with the purpose of minimizing its impact on their development[5].

In children with hearing impairment, lexical development can present delays or alterations, and isolated speech and language intervention alone does not guarantee an effective rehabilitation. Oftentimes, a potentially successful recovery is barred by a lack of stimuli and parental participation in this process[6,7].

In addition to the family environment, socioeconomic characteristics and social risks can have a great influence on cognitive and linguistic development[8-10].

In clinical practice, it is possible to observe great discrepancies in the auditory and linguistic development of children with hearing impairment. For this reason, it is essential to understand the difficulties faced by these children as well as the factors that influence their development, such as speech and audiology treatments, and environmental and socioeconomic factors.

Therefore, the aim of this study was to investigate the lexical development of children with hearing impairment and to analyze its association with aspects related to the care received, the psychosocial characteristics of each child, and the socioeconomic profile of their families.

METHODS

This is a cross-sectional, analytical, and observational study carried out with a nonprobability sample at an auditory health care center (AHCC) in Belo Horizonte, Minas Gerais, between September 2011 and May 2012.

This study was approved by the institution that houses the AHCC and by the ethics committee of Universidade Federal de Minas Gerais (approval report number ETIC 0316.0.203.000-10). All parents and legal guardians of the children who participated in the study signed the informed consent form.

In this study, we included children diagnosed with hearing loss, ranging from mild to profound degrees, aged between 6 and 10 years who received personal sound amplification devices (PSAD) between 2008 and 2010, without any associated conditions, and whose parents signed the informed consent form. The diagnosis of hearing loss was conducted by immittance, tonal, and vocal audiometry.

After going through the names included in the database of the health-care service in question, 206 children were identified. Considering the exclusion criteria (normal bilateral hearing, indication of otorhinolaryngological surgery, presence of associated neurological syndromes and alterations, and death), the eligible population composed of 138 children. Out of these, 110 patients were located and participated in the assessments.

The children's parents and legal guardians filled out three questionnaires: a structured questionnaire devised by the researchers, an inventory of their family environment resources (FER), and the Strengths and Difficulties Questionnaire (SDQ). These were administered by interviews conducted without the children's participation.

The first questionnaire was administered with the purpose of characterizing the sample, based on the following thematic axes: indicators of hearing loss at birth, data on the auditory diagnosis, speech and audiology intervention and treatment, school life, and socioeconomic indicators.

With the purpose of assessing the children's family environment, we used the FER questionnaire — Family Environment Resources[11] — composed of ten semi-structured questions that assess the resources available in the family environment, divided in three domains, namely resources that promote proximal processes; expected activities that signal some degree of stability in family life; and parental practices that promote a family–school relationship. In the analysis of the instrument, we used the criteria recommended by the FER author[11].

When analyzing social behavior, we used the SDQ questionnaire[12], comprising 25 semi-structured questions that assess social behavior, divided in five subscales: pro-social behavior; hyperactivity; and issues related to emotions, conduct, and relationships. In the analysis of the instrument, we used the criteria recommended by the authors of the test[12].

To assess language, we used the ABFW Child Language Test[13], elaborated for children between 3 and 12 years of age, comprising assessments in the areas of speech-language pathology and audiology, vocabulary, fluency, and pragmatics. In this study, we used only the tasks that pertained to speech-language pathology and audiology, and vocabulary. They require the child to name 118 images, divided in nine conceptual fields (clothing, animals, foods, means of transportation, furniture and professional utensils, places, shapes and colors, toys, and musical instruments). The children's answers were recorded immediately after the images were named on individual answer sheets. In the analysis, we abided by the criteria established by the authors of the test[13]. The analysis of global performance was based on the average score obtained after the images were discriminated with usual words (DUW) in

all conceptual fields. We considered as the normality criterion values above 71.5%, as suggested in the literature[14]. Owing to the sample's heterogeneity, these tests were applied to the children whose parents had informed, on the structured questionnaire, that their child was able to communicate orally.

To assess written language, we used the School Performance Test (SPT)[15], developed to evaluate students from first to sixth grade of elementary school. It is composed of three subtests: writing, arithmetic, and reading. The final classification on the SPT and on each subtest complied with the guidelines described by its author[15].

While conducting the SPT, the following criteria were considered for the writing subtest: the child had to be able to write his/her own name or the first five words given by dictation. In the reading subtest, the child had to be able to read the first five words presented. In the analysis of the SPT, the categories average–low and average–high were grouped together in the average category.

The Test of Figures for Phonemic Discrimination (TFPD) was used to assess the children's hearing abilities[16]. This is made up of 60 words that compose 30 minimal pairs. It evaluates a child's phonemic discrimination ability. Each minimal pair was presented through images, and the child had to identify the images mentioned by the examiner. The final score was classified as satisfactory or altered, according to age and the criteria mentioned in the literature[16]. We attributed a zero score to the children who were unable to take the test.

The hearing diagnoses were carried out according to the criteria established in the literature, pertaining to degree and type[17]. In the analysis of the variable degree of hearing loss, we considered the diagnosis of the ear with better hearing. The children were thus divided in three groups: mild-to-moderate degree; moderately severe-to-severe; and bilateral profound degree. The three groups counted children with neurosensory, mixed, and conductive hearing loss.

Only in the case of two children who presented normality in one of the ears, we opted for including them in the group with diagnoses of the ear with worse hearing, considering that unilateral hearing loss can influence oral and written language development as well as hearing abilities.

The data were stored electronically and typed twice. We also verified consistency of the database. For data processing and analysis, we used the statistical package Epi Info, build 7.1.0.6.

We carried out a descriptive analysis of the frequency distribution of the categorical variables, as well as analyses of the measures of central tendency and dispersion for the continuous variables. To verify the associations between the results of the vocabulary test and the FER, social behavior, aspects of speech and audiology treatment, auditory diagnoses, and the performance on the auditory tests, we used Kruskal-Wallis' test, analysis of variance, χ^2 test, and Fisher's exact test. A multivariate analysis was carried out using logistic regression analysis in which the initial model was composed of the variables with $p<0.20$ in the univariate analysis. The variables were excluded one by one according to the highest p-value in each model (backward stepwise) until all the variables had a value of <0.05 in the final model.

RESULTS

The main characteristics of the 110 children assessed in this study are shown in Table 1.

Table 1. General characteristics of the children evaluated and of their families

Characteristic	n	%
Child's gender		
Female	42	38.2
Male	68	61.8
Child's age (years)		
(Mean±SD: 8.5±1.5 years/Median: 8.5 years)		
6 ⊢ 7	24	21.8
7 ⊢ 8	19	17.2
8 ⊢ 9	22	20.0
9 ⊢ 10	18	16.3
10 ⊢ 11	27	24.5
Type of school that he/she attends		
Regular school	92	83.6
Special school	18	16.4
Age when he/she initiated school		
Up to 6 years of age	100	90.9
After 6 years of age	6	5.4
No information provided	4	3.7
Appropriate age for his/her school grade		
Yes	41	37.3
No	69	62.7
SPT result		
Low	103	93.6
Average	5	4.5
High	2	1.9
Mother's years of schooling		
(Mean±SD: 7.8±3.4 years/Median: 8 years)		
No schooling	1	0.9
1–4 years of schooling	28	25.4
5–8 years of schooling	30	27.2
9–11 years of schooling	45	41.1
Over 11 years of schooling	3	2.7
No information provided	3	2.7
Per capita income		
Up to 1 minimum salary	95	86.3
Over 1 minimum salary	12	10.9
No information provided	3	2.8
Presence of risk indicators for hearing loss		
Yes	44	40
No	66	60
Degree of hearing loss		
Profound bilateral	25	22.7
Moderately severe to severe	48	43.7
Mild/moderate	37	33.6
Type of hearing loss in the right ear		
Neurosensory	104	94.5
Mixed	2	1.8
Conductive	3	2.8
Normal hearing	1	0.9
Type of hearing loss in the left ear		
Neurosensory	104	94.5
Mixed	2	1.8
Conductive	3	2.8
Normal hearing	1	0.9

Caption: SD = standard deviation; SPT = School Performance Test

In this study, the majority (61.8%) of the participants were male, and the age average of the participants was 8.5 years. Among the children evaluated, 40% presented risk indicators for hearing loss in their medical history.

In regards to the auditory diagnoses, the most common type was neurosensory (94.5%) for both ears, and we found a greater occurrence of the moderately severe-to-severe degree (43.7%). Although the frequencies pertaining to the type of hearing loss in the right ear matched with the values obtained for the left ear, we must highlight that several combinations of hearing loss type were found. Also, the two children who had normal hearing in one of the ears had significant losses in the opposite ear, and for this reason, were retained in the study.

The majority of the children assessed attended regular school (83.6%), started their studies before or at the age of 6 (90.9%), and were not attending the school grade adequate for their age (62.7%). Moreover, the majority of the children (93.6%) scored low on the SPT.

A monthly *per capita* income of up to one minimum salary was reported by 86.3% of the families, and 41.1% of the mothers finished elementary school.

Table 2 shows the aspects related to the care received by these families.

Table 2. Description of the aspects related to care

Speech and language intervention	Values
Age of the diagnosis	
Median (years)	4.6
Amplitude (years)	0.5–9.0
Age at adaptation with a device	
Median (years)	5.8
Amplitude (years)	2.0–9.3
Length of PSAD use (hours/day)	
Median (hours/day)	10
Amplitude (hours/day)	0–18
Age when speech therapy was initiated	
Median (years)	4.0
Amplitude (years)	1.0–9.0
Duration of speech therapy	
Median (months)	36
Amplitude (months)	0.4–9.4

Caption: PSAD = personal sound amplification device

At the auditory health care center where the children assessed are treated, the time elapsed since their auditory diagnoses was given as a median of 4.6 years. The median age at the stage when hearing devices were first used and the age when speech therapy commenced was 5.8 and 4 years, respectively.

Among the children evaluated in this study, 87.3% were undergoing speech/audiology treatment. A majority of them (77.7%) underwent speech therapy less than twice a week.

Table 3 presents a description of the results obtained for the vocabulary task of the ABFW test. This task was conducted only with the children who could communicate orally (n=80).

Table 3. Descriptive aspects of the vocabulary test results

Vocabulary test	Values
Designation with usual words (%)	
Median	65.2
Amplitude	16.1–91.5
Omission of words observed per child	
Median	10.0
Amplitude	0–72
Number of substitutions presented per child	
Median	8.0
Amplitude	3–11
Predominant substitution type (%)	
Approximate co-eponyms	43.1
Distal co-eponyms	0.9
Immediate hyperonyms	1.8
Eponyms	22.0
Cultural paraphrase	1.8
Designation of function	0.9
Onomatopoeia	1.8

We observed a marked variation in the results of the vocabulary test, and the median of DUW considered satisfactory was 65.2%. The median of omitted words (ten per child) was higher than that of substitutions (eight per child). The types of substitution more frequently observed were approximate co-eponyms (43.1%) and eponyms (22%), although several other types were used by many of the children.

Table 4 presents the analysis of association between the results on the vocabulary test and the variables related to speech and audiology treatment, socioeconomic issues, and aspects of social behavior and family environment. The variables included in the initial model of the multivariate analysis are highlighted in the p-value column of Table 4.

Considering the type of hearing loss, the group that had the largest number of children who had achieved satisfactory scores on the vocabulary task was the one with mild-to-moderate loss, although only half of the children in this group achieved this score.

We observed a higher number of satisfactory scores on the vocabulary test among children who did not present any risk indicators for hearing loss, who were under speech and audiology treatment, and who attended regular school. However, better performances on the vocabulary test were observed among the children who had altered SDQ results, *per capita* income below one minimum salary, and those who attended speech therapy once a week or less.

The children whose scores on the vocabulary test were considered satisfactory were older; they achieved higher TFPD and FER scores; and their mothers were older than the rest.

Table 5 shows the final multivariate analysis model.

The TFPD results presented an independent association with the performances on the vocabulary test. For each extra point on the TFPD, the chances that the child would show altered results on the vocabulary test decreased by 20%.

Table 4. Analysis of the association between the vocabulary test results and the variables of auditory treatment, socioeconomic issues, and aspects of social behavior and family environment

Variables	DUW		Total	p-value
	Satisfactory (n=28)	Altered (n=82)		
Age				
Mean±SD (years)	9.4±1.2	8.2±1.5	–	0.0001*
Indicators of risk for hearing loss				
Yes	8	36	44	
No	20	46	66	0.2**
Degree of hearing loss				
Profound bilateral	0	25	25	
Moderately severe to severe	9	39	48	0.000**
Mild to moderate	19	18	37	
Current audiology therapy				
Yes	23	73	96	
No	5	9	14	0.2***
Audiology therapy frequency				
More than once a week	1	20	21	
Once a week or less	20	53	73	0.02***
School type				
Regular	28	64	92	
Special	0	18	18	0.002**
Parents had been informed about difficulties at school				
Yes	16	46	62	
No	12	36	48	0.9**
Mother's age (years)				
Mean±SD	35.7±6.0	33.5±6.5	–	0.2*
Mother's years of schooling				
≤8 years	12	47	59	
>8 years	16	32	48	0.19**
Father's years of schooling				
≤8 years	12	49	61	
>8 years	12	23	35	0.17**
Income per person				
Less than 1 minimum salary	21	74	95	
Higher than or equal to 1 minimum salary	6	6	12	0.04***
TFPD Results				
Median (points)	33.5	5.5	–	0.000****
Familial connection (FER)				
Median	37.9	34.9	–	0.20****
Family-school connection (FER)				
Median	6.6	6.6	–	0.4****
Family life stability (FER)				
Median	14.3	14.4	–	0.9****
Total FER				
Median	58.2	55.4	–	0.3****
SDQ				
Normal (n)	10	33	43	0.8**
Altered (n)	18	49	67	

*ANOVA test; **χ^2 test; ***Fisher's exact test; ****Kruskal-Wallis test

Caption: DUW = designation by usual words; SD = standard deviation; TFPD = Test of Figures for Phonemic Discrimination; FER = Family Environment Resources; SDQ = Strengths and Difficulties Questionnaire

Table 5. Final multivariate analysis model

Variable	OR	95%CI	p-value
TFPD Result	0.81	0.73–0.89	<0.001

Caption: OR = Odds Ratio; 95%CI = confidence interval at 95%; TFPD = Test of Figures for Phonemic Discrimination

DISCUSSION

This study was carried out at an auditory health care center, which is a reference in high-complexity cases. It belongs to a public institution that assists the central macroregion of the State of Minas Gerais. The children assessed were 8.5 years old on average; the majority attended regular school and began their studies before the age of 6. The presence of indicators of risk for hearing loss in the medical history was observed in a large number of children evaluated in this study. The most frequent hearing loss was of the neurosensory type, and the group of individuals with moderately severe-to-severe hearing loss had the largest number of children.

In regard to aspects related to the care received, we observed that the age when the hearing loss was diagnosed, the age when PSADs were first used, and the age when language and speech treatment received are not in accordance with the recommendations found in the literature[18,19]. Hearing loss diagnoses must be conducted up to the third month of life, and speech and hearing interventions must be initiated before the sixth month of life[18,19]. Better results could have been found if the children evaluated had been advised early diagnosis provided by the Neonatal Auditory Triage Program (NATP). In Minas Gerais, the state law that recommends the performance of NATP was established in 2007[20], after the birth of these patients.

According to the literature, an early diagnosis, along with systematic use of a PSAD and adequate speech and audiology treatment, optimizes the linguistic development in children with hearing impairment[5]. The span of hearing loss and psychosocial, socioeconomic, and environmental aspects can also influence the lexical development in these children[21,22].

The lexical development in the children with hearing impairment assessed in this study turned out to be below expectations. We observed a marked variation in the number of DUW among the children evaluated. It is important to highlight that the sample was composed of children with mild-to-severe hearing loss. According to the literature, alterations in the development of oral language due to auditory perception difficulties are directly related to the degree of hearing loss. As the degree of hearing loss worsens, difficulties in speech perception also increase and, consequently, the alterations in the speech will be more marked and significant. Auditory residues and the functional gain brought by PSAD are also of fundamental importance for the oral language development of children with hearing loss[23].

The larger number of word omissions in relation to the processes of word substitution is not corroborated by the literature, which reports that it is more common for a child to replace a word than to not name it[24]. However, in children with hearing loss, difficulties in auditory recognition and comprehension, that is, in receptive language, can greatly impact expressive language[10].

The higher occurrence of substitutions by approximate co-eponyms and eponyms revealed substitutions of words with others that had approximate semantic attributes. This indicates a previous knowledge of the object to be named, but also highlights delays in lexical development[25,26]. It is can be inferred that the children came close to the semantic class in question but failed in the word retrieval appropriate for their age range.

Age is another factor that can influence the language development of children. Older children have a larger repertoire of words in comparison to younger ones[27]. A national study in which the expressive vocabulary of 21 children with hearing loss who were able to communicate orally was evaluated; the authors observed that the older children had a more extensive knowledge of words in the majority of the fields evaluated by the ABFW test[9]. Similar results were found in this study, although no independent association was found between the children's age and the vocabulary test results.

The type of school attended by children with hearing impairment can also influence their lexical performance. In this study, the majority of the children studied in regular schools, and better scores on the vocabulary test were observed in this group. The social and interactive experience of children with hearing impairment who have contact with students with normal hearing can favor their lexical development, positively influencing these children's oral language[7,10]. This analysis, however, was not conducted in the present study.

The majority of the parents included in this study had been previously contacted by the school because of their children's learning issues. The lack of auditory acuity, along with language alterations found in children with hearing impairment, is a factor that can interfere with the learning process. Furthermore, lack of knowledge about hearing loss and unpreparedness for teaching and assessing children with hearing impairment on the part of teachers who work in regular schools can aggravate the difficulties in the reading and writing process in these students[24,28,29].

The difficulties in reading and writing are verified by a large number of children with low SPT scores, which can be justified by the difficulty presented by children with hearing loss in oral language tasks and also in the auditory discrimination ability evaluated by the TFPD. The learning process is complex, and hearing impairments can cause important deficits, especially in mastering symbolization, generalization, sound manipulation, and phonological awareness, which are fundamental for learning and underdeveloped in these children[30]. Sensory deficits, including unilateral hearing loss, along with lexical and phonological alterations, can cause difficulties in reading and writing. In this case, a larger amount of concrete and visual resources are necessary to minimize learning difficulties[24,31].

Reports in the literature show that lexical development can be influenced by family income and by the number of schooling years that the parents have[8,22]. In this study, we found no association between these variables. However, it is known that

verbal models, provided by the environment, can influence language development by their quantity, quality, and relations to situations faced by the child[22]. A study carried out in Brazil shows that families with high *per capita* incomes and more schooling years, including post-secondary school, tend to use more complete sentences by using more syntactic variations and better grammatical complexity, which positively influences oral language development[8]. An independent association between socioeconomic and demographic factors and the children's lexical development could not be confirmed in the present study.

In regard to social behavior, children with emotional complaints and issues related to conduct, relationships, and hyperactivity can experience difficulties related to interact socially, sustain attention, and develop communication skills[32]. It is through experience and context that a child is able to learn the meaning of a new word. A child with hearing impairment can have less opportunities for social interaction due to his/her difficulties with language[32]. However, in this study, we did not observe any association between the children's performances on the vocabulary test and the SDQ test results.

A stimulating family environment is described in the literature as fundamental for the language development process of children with hearing impairment. The family is a modifying agent of the child's reality, both positively and negatively. An environment with good-quality stimulation can be a factor of protection against language development alterations[22]. However, a family environment with few resources, difficult interpersonal relationships, and financial hardships can bring about consequences that impact the child's language acquisition, as well as physical, emotional, and psychic problems[8]. In this study, however, no association was observed between lexical development and FER.

Although several factors may influence the lexical development of children with hearing impairment, only the TFPD results were independently associated with the vocabulary test results. We found an inverse relation between these variables, that is, the higher the TFPD score, the lower the chance that the child would present alterations on the vocabulary test, thus confirming that the presence of phonemic discrimination skills favors lexical development[33]. Lexical acquisition requires the establishment of a correspondence between the phonological form of a word and its semantic representation. These aspects are strongly influenced by the development of auditory skills, which, for the most part, are impaired in this group of children[31,33].

This result reinforces the importance of auditory processing in the hearing and language development of children with hearing impairment. Regardless of the degree of hearing loss, a good phonemic discrimination performance enables an adequate lexical development. It is necessary that physiological mechanisms, such as the discrimination of sound sources and sequential sounds, temporal processing, recognition of physically distorted sounds, recognition of verbal and nonverbal sounds, and unilateral and dichotic listening, operate for auditory comprehension to occur satisfactorily[4].

In addition to alterations in the peripheral system, in children with hearing impairment, a functional difficulty in the central auditory system can also be present. Thus, the entire acoustic signal processing can be compromised, impairing speech perception and comprehension. Deficits in the lexical development of these children are common. Consequently, their phonological, metalinguistic, and learning development is also compromised[3]. The literature also reinforces the importance of phonological awareness for the lexical development of children with hearing impairment[33].

The use of electronic hearing devices in conjunction with speech and hearing therapy focused on auditory stimulation can favor neural plasticity and allow for better information processing in children with hearing impairment[34]. The first years of life are considered critical for a child's auditory and language development, as it is in childhood that the pinnacle of the maturation of the central auditory system occurs[21]. Late speech, language, and audiology interventions can cause irreversible damage[24].

In this study, the only factor associated with vocabulary alterations was the TFPD result. However, in clinical practice and in the literature, it is observable that care-related, socioeconomic and environmental factors, as well as social behavior, can interfere with lexical development. The discrepancies between the results presented in this study and others can be justified by the different statistical approaches used[5,8,9]. Considering the relevance of the topic, and for a better understanding of the language development process in children with hearing impairment, it is important that longitudinal studies be conducted with standardized methods and approaches that are specific to this group of children.

There is a lack of standardized tests with values of reference for children with hearing impairment in the national literature, which hindered the comparison of the results found for others studies that have already been published.

CONCLUSION

The TFPD results showed an association with the vocabulary test results, thus indicating that phonemic discrimination skills favor lexical development. We did not observe any associations between the individuals' performances on the vocabulary test and the socioeconomic, environmental, and social behavior variables studied.

The results reinforce the importance of stimulating phonemic discrimination skills and auditory processing throughout the rehabilitation process of children with hearing impairment. This auditory stimulation can benefit the lexical and phonological development as well as the metalinguistic and learning skills, which are frequently impaired in these individuals.

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