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Comparative analysis of vocabulary in normal hearing children and children with hearing loss included in regular school

Análise comparativa de vocabulário de crianças ouvintes e com deficiência auditiva incluídas em escola regular

Análisis comparativo del vocabulario de niños oyentes y con discapacidad auditiva matriculados en una escuela regular

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Abstract

Introduction: Hearing loss, even mild, limits access to auditory information necessary to develop speech and language, as well as the child's subsequent social and academic skills, impairing their communication**. Purpose:** to analyze the difference in vocabulary between hearing children and hearing-impaired children enrolled in regular schools, establishing a matched comparison regarding chronological age. **Method:** Forty-one children with hearing impairment between the ages of 7 and 12 of both genders, users of individual hearing amplification devices, were evaluated at a hearing health center in the state of São Paulo. Additionally, 41 children with normal hearing, who make up the normal-hearing group, were

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GSM: article conception; data collection; data analysis; and writing.
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evaluated. Vocabulary assessment was carried out using the Peabody Picture Vocabulary Test (PPVT-4). **Results:** The mean score obtained from the standard score in the receptive vocabulary test (PPVT-4) of children with hearing loss was 56 points, which corresponds to -3DP, and that of the children in the control group was 109 points, equivalent to +1 DP. **Conclusion:** It was concluded that chronological ages and equivalents in each group demonstrate that in the control group, the subjects tend to have an equivalent age greater than chronological age, the opposite occurring in the group of children with hearing loss. Furthermore, it was observed that this difference tends to increase with increasing chronological age in both groups.

Keywords: Hearing- aids; Hearing Loss; Vocabulary; Child; Audiologic rehabilitation.

Resumo

Introdução: A perda auditiva, mesmo que leve, limita o acesso à informação auditiva necessária para desenvolver a fala e a linguagem, além das habilidades sociais e acadêmicas da criança, trazendo prejuízos a sua comunicação. **Objetivo:** analisar a diferença de vocabulário entre crianças ouvintes e crianças com deficiência auditiva inseridas em escola regular, pareadas quanto à idade cronológica. **Método:** Foram avaliadas 41 crianças com deficiência auditiva entre 7 e 12 anos de ambos os gêneros, usuárias de aparelho de amplificação sonora individual acompanhadas em um centro de saúde auditiva no estado de São Paulo. Foram avaliadas também 41 crianças com audição normal que compõem o grupo normo ouvintes. A avaliação do vocabulário foi realizada por meio de um teste de vocabulário receptivo Peabody Picture Vocabulary Test (PPVT-4). **Resultados:** A pontuação média obtida de escore padrão no teste de vocabulário receptivo (PPVT-4) das crianças com deficiência auditiva foi de 56 pontos, que equivale a -3DP, e a das crianças ouvintes do grupo controle foi de 109 pontos, equivalente a +1 DP. **Conclusão:** concluiu-se que as idades cronológicas e equivalentes em cada grupo demonstram que, no grupo controle, as crianças tendem a ter idade equivalente maior que a cronológica, ocorrendo o oposto no grupo de crianças com deficiência auditiva. Além disso, observou-se que esta diferença tende a aumentar com o aumento da idade cronológica nos dois grupos.

Palavras-chave: Auxiliares de audição; Perda auditiva; Vocabulário; Criança; Reabilitação auditiva.

Resumen

Introducción: La pérdida auditiva, incluso leve, limita el acceso a la información auditiva necesaria para desarrollar el habla y el lenguaje, así como las habilidades sociales y académicas posteriores del niño, perjudicando su comunicación.**Objetivo:** Analizar las diferencias de vocabulario entre niños oyentes y niños con deficiencia auditiva matriculados en una escuela regular, estableciendo una comparación pareada con base en la edad cronológica. **Método:** Se evaluaron 41 niños con discapacidad auditiva entre 7 y 12 años de ambos géneros, usuarios de aparato de amplificación sonora individual, acompañados en un centro de salud auditiva en el estado de São Paulo. También se evaluaron 41 niños con audición normal que componen el grupo normoyente. La evaluación del vocabulario se realizó mediante la prueba de vocabulario receptivo Peabody Picture Vocabulary Test (PPVT-4) **Resultados:** La puntuación media estándar en el Receptive Vocabulary Test (PPVT-4) para los niños oyentes fue de 56 puntos, equivalente a -3 DE, y para los niños oyentes en el grupo control, fue de 109 puntos, equivalente a +1 DE. **Conclusión:** Las edades cronológicas y equivalentes en cada grupo demuestran que, en el grupo control, los sujetos tienden a tener una edad equivalente mayor que su edad cronológica, mientras que ocurre lo contrario en el grupo de niños con deficiencia auditiva. Además, se observó que esta diferencia tiende a aumentar con el aumento de la edad cronológica en ambos grupos.

Palabras clave: Audífonos; Pérdida auditiva; Vocabulario; Niño; Rehabilitación auditiva.

Introduction

Even mild hearing loss limits access to the auditory information necessary to develop speech and language, as well as the child's social and academic skills[1,2]. There are children with hearing impairments who, even when using hearing aids such as hearing aids and cochlear implants, have difficulty acquiring oral verbal language and, later, also in the literacy process [3,4,5].

Language plays a fundamental role in social interactions, learning, and development; it is through language that human beings demonstrate the knowledge they have acquired after organizing the perception, reception, and structuring of the information received [6,7]. Vocabulary is directly related to the development of oral language and is one of the indicators of a child's language level. In addition, it has a strong relationship with academic performance, as children who develop a vast vocabulary in preschool tend to have better results in language, reading, and cognitive skills than children with smaller vocabularies [8,9].

Some researchers suggest that, in addition to children being taught some words directly by their parents or siblings, they learn most new words through listening, also known as "incidental listening" or "passive listening"[10]. This shows the importance of having access to speech sounds through hearing, since part of vocabulary learning is a consequence of incidental listening. Thus, access to sounds is crucial in this learning process[11,12].

In general, the oral language development of a child with hearing impairment is directly proportional to the degree of loss, so that the greater the degree of hearing loss, the greater the impairment in the language acquisition process, but children who effectively use well-fitted hearing aids and/or cochlear implants have a lower risk of language delay, since hearing aids provide better access to spoken language [2,13-15].

The audibility of speech sounds obtained through hearing aids, consistency in the use of these devices, and speech-language therapy intervention are determining factors for the development of oral verbal language in children with hearing impairments to resemble the development of their hearing peers [16,17,18].

Vocabulary assessment is fundamental to understanding the lexical development of children with and without hearing impairments, as it allows measuring the range of words understood, regardless of oral production capacity. Among the instruments used for this purpose, the Peabody Picture Vocabulary Test – Fourth Edition (PPVT-4)[19] stands out, widely used in international research due to its simple application, reduced time, and strong correlation with the child's overall linguistic and cognitive performance. The PPVT-4 makes it possible to investigate receptive vocabulary by identifying pictures corresponding to orally presented words, which makes it especially relevant for populations with different levels of auditory access. Thus, its use allows us to understand the impact of auditory access and incidental listening on the language development of this population.[20]

It is important to understand the vocabulary development of children with hearing impairments in relation to that of hearing children in order to establish expectations regarding the lexical and academic development of children with hearing impairments, and it can also contribute to guiding the therapeutic plan.[21,22]

Therefore, this study sought to discuss the vocabulary characteristics of children with hearing impairments, both in comparison with hearing children and in the analysis of equivalent age. It also sought to discuss the role of incidental listening, hypothesizing that the SII (Speech Intelligibility Index) at entry 55 reflects the difficulty of listening at greater distances. In a study concerning verification measures for speech sounds at low, medium, and high intensities, with the 55 dB SPL input considered the longest distance, starting at two meters, between the speaker and the hearing aid microphone, it was shown that this results in a lower sound pressure level of speech sounds, causing lower SII values. [23]

Objective

To analyze vocabulary differences between hearing children and children with hearing impairments enrolled in regular schools.

Method

This work is part of a broader study project on the selection process of individual hearing aids for babies in the first years of life and followed the precepts established in the Code of Ethics for Re-

search with Human Beings, having been approved by the Ethics Committee of PUC-SP, according to Research Protocol No. 337/2010.

Case Study

This research was conducted at a Specialized Rehabilitation Center – CER II accredited by the Unified Health System (SUS) located in the southern zone of the city of São Paulo, which offers care to children for diagnosis and intervention of hearing impairment aged between 0 and 18 years old.

Test Group

The test group consisted of 41 children with hearing impairment, aged between 7 and 12 years, 13 male and 28 female, diagnosed with mild to profound bilateral sensorineural hearing loss, users of Individual Sound Amplification Devices (AASI) who received a personal remote microphone device of the frequency modulated (FM) type according to the criteria of the ordinance and who attended the SUS outpatient clinic during the years 2017 and 2018.

Individuals with established oral communication, bilateral hearing loss, and who did not present syndromes or other impairments associated with hearing impairment were included.

Normal Hearing Group

This group consisted of 41 children with normal hearing, aged between 7 and 12 years, 17 male and 24 female. The participants were students of a Municipal Elementary School (EMEF) located in the northwest area of the city of São Paulo, where the data collection was carried out.

This group included only users without hearing complaints and without a diagnosis of syndromes or intellectual disabilities.

Procedures

An interview was conducted with the parents or guardians, following a script of questions to gather information about the case, such as: risk indicators for hearing loss, data on hearing diagnosis, speech-language pathology intervention and follow-up, school life, and socioeconomic indicators. In addition, data from medical records, examinations, reports, and the entire evaluation battery were collected:

- Complete Audiological Evaluation;
- Programming and verification of hearing aids;
- SII values at 55 dB and 65 dB inputs;
- Evaluation of the Consistency of Amplification Use – Average hours/day;
- Hearing Category[24]; and
- Language Category[25]

In the control group, since data collection was carried out at the school, it was not possible to interview parents or guardians. Therefore, a brief explanation of the research was given to the school coordinator to clarify any doubts about the application of the vocabulary test to the students, which was administered individually and equally to the test group. As the socioeconomic indicators were not individually classified, we used the school's Socioeconomic Level Indicator (INSE), which is available in the 2016 school census[26]. This indicator aims to situate the student body within socioeconomic strata, defined by the possession of household goods, income and contracting of services by the children's families, and the educational level of their parents. In the indicator, schools are classified into groups ranging from one to six, with schools classified in "Group 1" predominantly having students with low socioeconomic levels and those in "Group 6" having students with high socioeconomic levels. The school was classified in Group 4 of the INSE.

Vocabulary Test

The instrument used to assess the vocabulary of children in both the test and control groups was the Peabody Picture Vocabulary Test 4th Edition – PPVT-4[19] a test used to assess the receptive vocabulary of adults and children from 2 years and six months of age. It has 228 pictures divided into 19 sets, each set containing 12 plates, and each plate consisting of 4 pictures. The child being examined must select the picture that best illustrates the meaning of the word spoken by the examiner. Each set presents a certain degree of difficulty. The test begins in the set corresponding to the chronological age or when there is at most one error in the set and ends when the child makes 8 or more errors in a set. After that, the analysis of the individuals' performance was carried out according to the guidelines described in the test manual. Through this test it is possible to obtain a "raw score", which will later be converted into a "standard score" and other normative scores distributed by age range and in normality curves, such as the equivalent

age, which designates where the raw score of each individual is located.

The individual falls on a growth curve of development.

This instrument has two assessment forms (A and B) paired in degree of complexity developed for reassessment, and in this study only Form "A" translated into Portuguese was used and applied to the population with vocabulary from the spoken language Brazilian Portuguese[27].

In the group of children with hearing impairment, the vocabulary assessment was carried out after verifying that the individuals had their hearing aids properly programmed, with batteries and functioning adequately.

In the control group, data collection was carried out in a classroom at the school that was reserved for the application of the test.

Statistical Analysis

The analysis was performed with the aid of SPSS (version 18) and Minitab (version 17) applications. In the hypothesis tests, a significance level of 0.05 was set.

The sex distributions in the test and control groups were compared using the chi-square test.

To compare the age distributions in the two groups, the Mann-Whitney test was applied. In the comparison of the mean responses of SII 55 and SII 65 in the test group, the paired t-test was used.

The Student's t-test was used to compare the mean PPVT scores and the mean differences between chronological and equivalent age in the test and control groups.

The correlation between the difference between the child's chronological age and the equivalent age (suggested in PPVT 4) was assessed using Pearson's correlation coefficient. Regression models were fitted, with the difference as the response variable. In an initial model, chronological age, group, and an interaction between group and chronological age were considered as explanatory variables, allowing the lines in each group to have different slopes.

Results

Initially, data analysis was performed comparing the vocabulary between children with hearing loss and their hearing peers. The test group sample consisted of 41 individuals, mostly female: 28 (68%); the control group sample also consisted of 41 individuals, mostly female N=24 (58%). There was no difference between the probability distributions of gender in the two groups (p=0.359).

Ages in both groups ranged from 7 to 12 years with a mean of 9 years, the median being 10 in the Test Group and 9 in the Control Group. There was no significant difference between the age distributions in the two groups (p=0.359).

Regarding the socioeconomic classification of the test group, none of the participants belonged to class A; 11 (26%) to class B; 21 (51%) to class C; and 9 (21%) to class D-E. All individuals attended regular schools and used oral communication. In the control group, the school where the data was collected is classified in "Group 4" of the INSE, which is equivalent to being between categories B and C.

All individuals in the test group have sensorineural hearing loss, with the majority having moderate impairment (60%, N=25), 34% (N=14) having severe impairment, 2% having mild impairment (N=1), and 2% (N=1) having profound impairment.

Regarding the hearing category, most of them (60%, N=25) were in category 6, 14% (N=6) in category 5, 21% (N=9) in category 4, and 2% (N=1) in category 1. In the language category, no child was classified in category 1, and most individuals (66%, N=27) were in category 5, 17% (N=7) in category 4, 12% (N=5) in category 3, and 4% (N=2) in category 2.

The average SII 65 score in the better ear was 59.4 (maximum 82, minimum 33), while the average SII 55 score was 45 (maximum 77, minimum 23).

The analysis showed that the average SII 65 score was higher than the average SII 55 score ($p<0.001$). The mean difference is 14.4 (95% confidence interval): [12.4; 16.4].

Seven percent (N=17) of users had SII 65 in the best ear less than 37, 34% had SII 65 between 38 and 57, and 59% greater than or equal to 58. As for SII 55 in the best ear, 37% had SII 55 less than 37, 39% had SII 55 between 38 and 57, and 24% greater than or equal to 58. The combined behavior of audibility in SII 65 and SII 55 can be evaluated in the scatter plot in Figure 1. The continuous line in the figure is formed by the points SII 65 = SII 55.

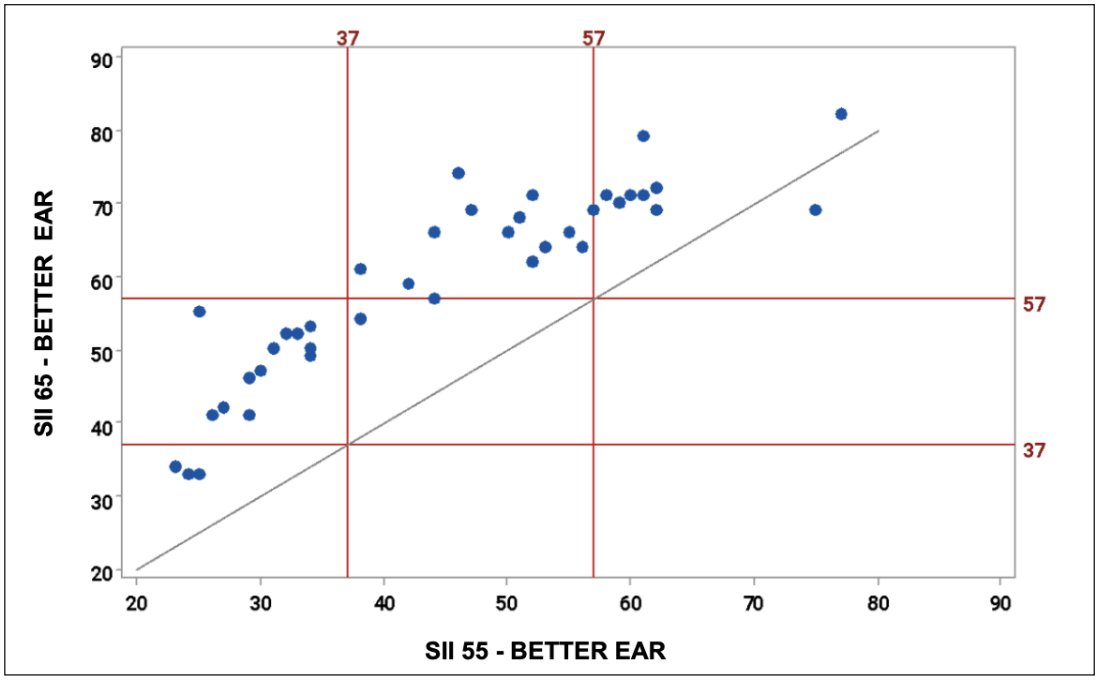


Figure 1. Scatter plot of SII 65 and SII 55 in the better ear

Regarding the children's performance in the receptive vocabulary skill using the PPVT-4 instrument, the average standard score obtained by individuals in the test group was 56 points (minimum 20 and maximum 117 points), which is equivalent to -3SD, and by the control group 109 points. (minimum 70 and maximum 144 points), with an average of +1 SD. These findings suggest that audibility directly impacts lexical acquisition, reinforcing the importance of early intervention and consistent use of hearing aids. Figure 2 represents the standard PPVT score in the test and normal hearing groups. The distributions of SII 65, SII 55, and the difference are approximately represented in Figure 2.

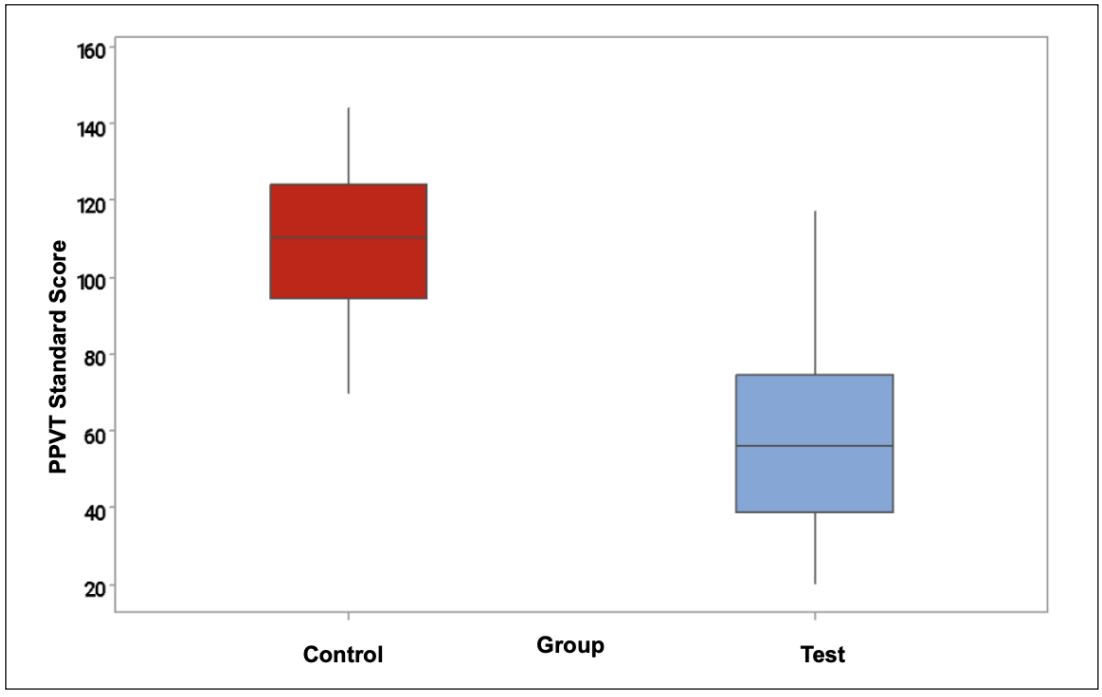


Figure 2. Box-plots of the standard score on the PPVT in the test and control groups.

The mean equivalent age in the test group was 4 years (minimum 2 and maximum 13 years) and in the control group it was 11 years (minimum 5 and maximum 20 years).

The mean difference between chronological age and equivalent age in the test group was 4 (minimum -3.3 and maximum 9.8), while in the control group the mean was -2.3 (minimum -9.3 and maximum 5.3). The mean and median differences are larger in the test group, indicating that, on average, the age indicated in the test is further from the chronological age in this group. The mean and median differences in the control group are negative, indicating that, in the control group, the age indicated in the test is greater than the chronological age.

The individual profiles of chronological and equivalent ages in each group are shown in Figure 3. It can be observed in this figure that, in the control group, they tend to have an equivalent age greater than the chronological age, with the opposite occurring in the test group. The box plots of the difference between chronological and equivalent ages in Figure 4 lead to the same conclusion.

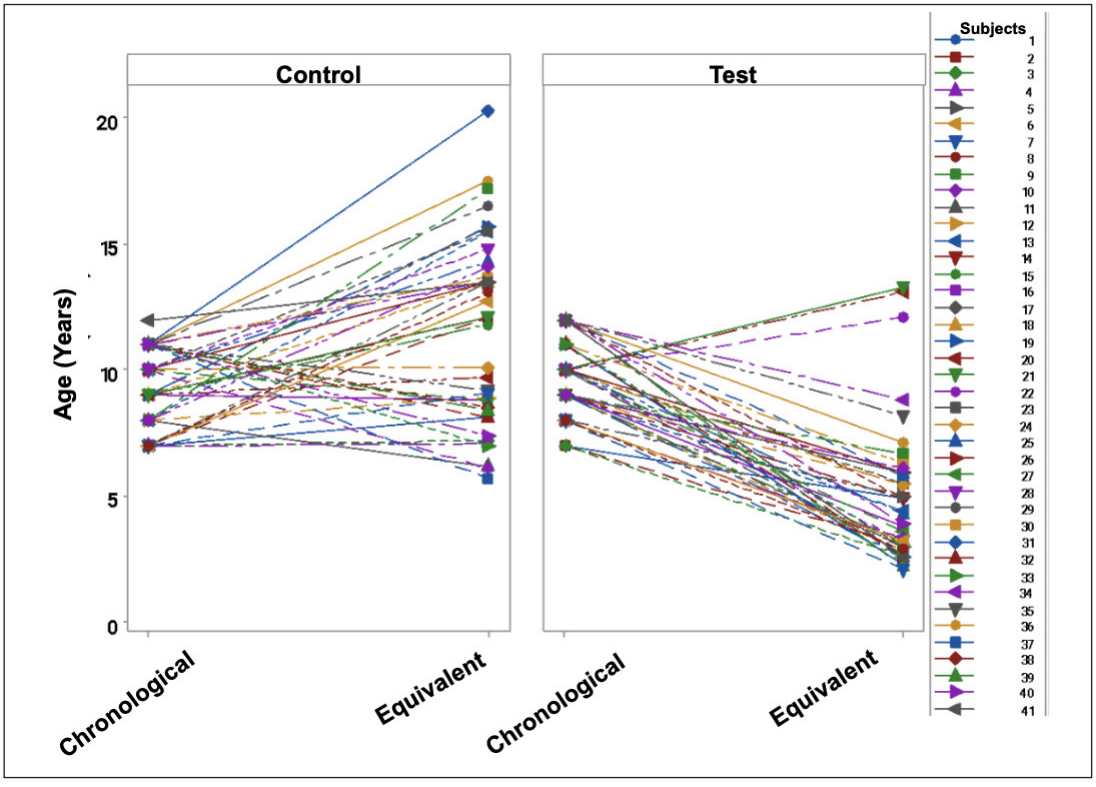


Figure 3. Individual profiles of chronological and equivalent ages in the control and test groups

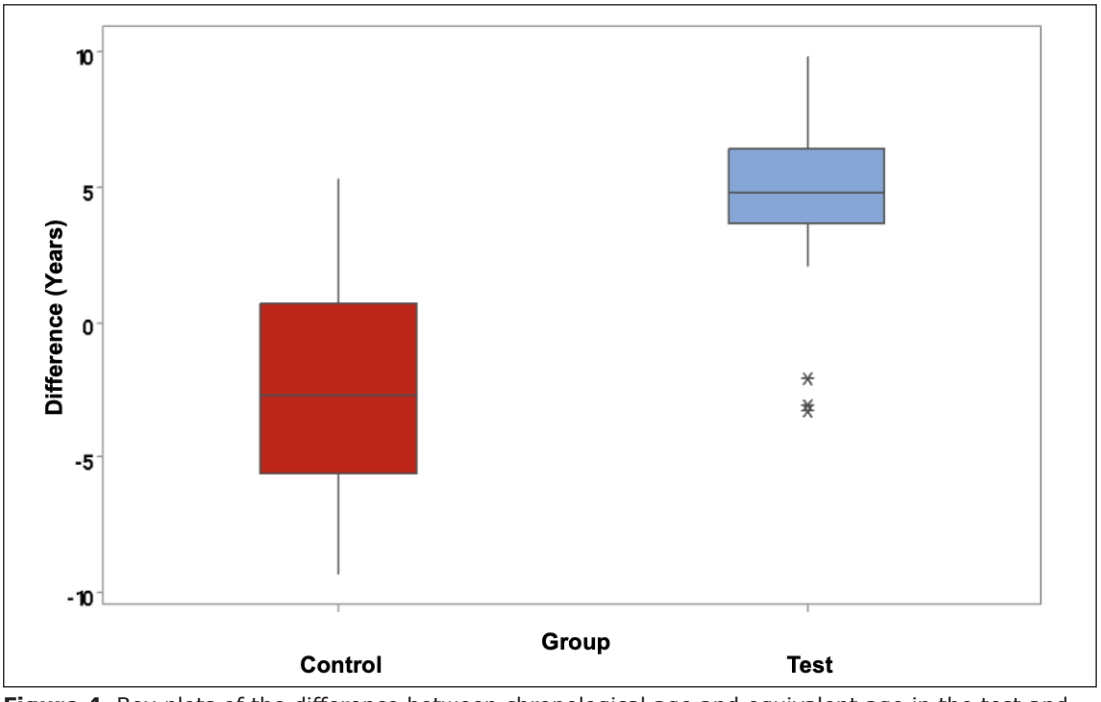
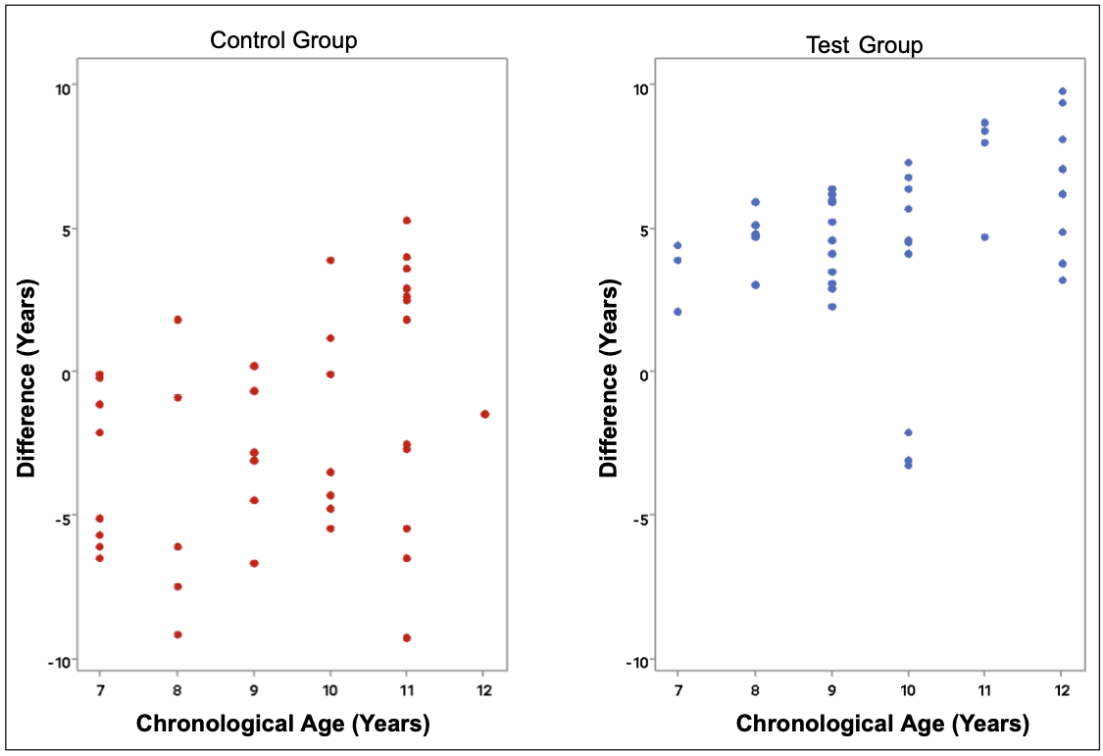


Figure 4. Box plots of the difference between chronological age and equivalent age in the test and control groups

There was a significant difference between the means of the dispersion of chronological and equivalent ages in the two groups ($p<0.001$). In the control group, the mean difference is -2.3 years (95% confidence interval: [-3.4; -1.2]) and in the test group, the mean is 4.8 (95% confidence interval: [3.8; 5.9]).

In the scatter plots of the difference between chronological age and age-equivalent chronological age (Figure 5), it is observed that the difference tends to increase with increasing chronological age in both groups. The Pearson correlation coefficient values between the two variables presented in the footnote of the figure are significant and confirm this trend. The results obtained are summarized in Table 1.



r=0,33 (p=0,033) r=0,31 (p=0,046)

Figure 5. Scatter plots of the difference between chronological age and equivalent age and chronological age in the test and control groups

Table 1. Summary of results obtained in the regression model adjustment with the difference between chronological age and equivalent age as the response variable and group and chronological age as explanatory variables (*)

Term	Coefficient	Standard Error	P
Constant	-4	0.75	<0.001
Chronological Age	0.7	0.24	0.003
Group (Test)	6.8	0.73	<0.001

(*) 7 years were subtracted from each chronological age for better interpretation of the linear coefficient of the line.

Therefore, the equations of the regression lines in each group are:

- **Control Group:** Difference = - 4 + 0.7 (Chronological age – 7);
- **Test Group:** Difference = 2.8 + 0.7 (Chronological age -7).

The interpretation of the model coefficients is:

In the control group, when the chronological age is equal to 7 years, the difference is, on average, equal to -4 years, that is, the equivalent age is equal to the chronological age plus 4 years; in the test group, when the chronological age is equal to 7 years, the difference is, on average, equal to 2.8, that is, the equivalent age is equal to the chronological age minus 2.8 years. In both groups, when the chronological age increases by 1 year, the difference increases, on average, by 0.7 years.

Discussion

To analyze vocabulary differences between hearing children and children with hearing impairments, two groups were evaluated: the test group consisted of 41 children with hearing impairments, users of individual hearing aids from a hearing health center in the state of São Paulo, the majority of whom were female, while the control group consisted of 41 hearing children, the majority of whom were female. The age of the participants in both groups ranged from 7 to 12 years, with an average of 9 years. Regarding socioeconomic classification, the majority of the test group belonged to class C, and the control group was between classes B and C. No difference was found between the probability distributions of gender or age in the two groups, that is, the groups were balanced and matched with respect to age, gender, and socioeconomic classification of both groups.

All participants in the test group had sensorineural hearing loss, most of which was moderate, with category 6 hearing, category 5 language, and attended public school. All participants used hearing aids and attended regular schools. This data shows that the studied population is able to recognize words in open sets and construct sentences of more than 5 words, meaning that this is a population that hears and speaks, and is therefore fluent in spoken language. In a longitudinal study with children who presented mild to severe hearing loss, the relationship between the degree of hearing loss and outcomes in various developmental domains was examined.[2] The findings of this study showed that children with mild to severe hearing loss were at risk of delayed language development, and the risk increased with the severity of hearing loss without amplification. Children with well-fitted hearing aids, however, had a reduced risk of language delays.

Regarding the audibility of speech sounds in the test group, assessed by SII 65 values in the better ear, the average SII 65 value was 59. More than half obtained an SII 65 in the better ear greater than or equal to 58. Research has shown that children with mild to moderately severe hearing loss with an amplified SII below 65 demonstrated greater delays in vocabulary development than children with higher SII 65 values. 27 SII 65 values below 65 were considered suboptimal, and based on research data, the required SII level (65) was indicated for children to achieve good language development.[2,23] The cutoff of 65 proposed by these authors is based on extensive work with SII and its relationship to hearing aid outcomes. It is possible to observe in the findings that if audibility is poor, despite the best efforts to adjust the hearing aid, the CI should be considered as an intervention, even if the audiometric thresholds are better than those typically expected for the CI [28].

Regarding the SII 55 values, the average value was 45% and only 24% of them obtained values greater than 58. SII 55 corresponds to speech at a soft intensity. Audibility decreases with distance and, consequently, vocabulary acquisition also decreases, since a large part of the vocabulary is acquired through incidental listening. Incidental listening consists of learning new words during everyday situations without the need to formally teach the vocabulary, therefore being the most efficient way to master oral communication [29].

As for performance in receptive vocabulary skills, the data show that the test group performed below expectations for their age, and most of them performed similarly to children of a younger chronological age. This data agrees with several studies in the literature [29,30], which report vocabulary performance below expectations in children with hearing impairment.

Although the instrument used for the vocabulary test has not yet been validated for Brazilian Portuguese, the results obtained by the group of children with normal hearing showed an estimated

curve with scores within the expected normality standards for this population, indicating that the instrument demonstrates good specificity for the age group evaluated.

In the group of children with hearing impairment who use oral language and are included in regular schools, our hypothesis was that, even having some lag in relation to hearing children, they would perform well on the vocabulary test. However, in addition to showing considerable heterogeneity in performance, most showed performance equivalent to a younger age, when compared to hearing children. Most of the children in the test group did not achieve the expected results on the vocabulary test, regardless of the degree of hearing loss and audibility for speech sounds. This data agrees with studies that prove that children with hearing impairment are not able to reach the vocabulary levels of their hearing peers[20]. Despite this, it is a homogeneous group from the point of view that they are children who are conversational and oral. The literature shows that children with hearing impairments tend to have lower vocabulary performance, as they often also have deficits in reading skills, which can negatively affect vocabulary learning [29].

When comparing chronological age and equivalent age, it was observed that the group with hearing impairments had an average equivalent age of 4 years, while the average chronological age was 9 years. In other words, these individuals had a vocabulary equivalent to an age much lower than their chronological ages. The control group, composed of hearing children, had an average equivalent age of 11 years, which is above their chronological ages. According to the literature [30], children's vocabulary grows as their chronological age increases, but it strongly depends on their reading performance, which guarantees access to a greater diversity of vocabulary.

The findings suggest that intervening variables affect vocabulary growth and that the audibility of speech sounds alone does not guarantee access to learning. Studies that characterize school performance and its relationship with vocabulary can contribute to the construction of hypotheses that support inclusive strategies for children with hearing impairments who use electronic devices.

The results indicate that inclusive strategies are necessary for children with hearing impairments who use oral language and are included in regular schools. Further studies are needed to identify facilitating variables and barriers to vocabulary growth.

Conclusion

- The group of hearing children presented a standardized score distribution on the receptive vocabulary test consistent with their age range, according to the normality standards established by the instrument.
- The individual profiles of chronological and equivalent ages in each group demonstrate that, in the control group, children tend to have an equivalent age greater than their chronological age, with the opposite occurring in the group of children with hearing impairment.
- Children with hearing impairment showed significantly lower performance in receptive vocabulary when compared to hearing children, evidencing a significant lexical delay in this population.
- The scatter plots of the difference between chronological age and equivalent age demonstrate that the difference tends to increase with increasing chronological age in both groups.

References

1. McDaid D, Park AL, Chadha S. Estimating the global costs of hearing loss. Int J Audiol. 2021; 0(0): 1–9. doi:10.1080/14992027.2021.1883197.

2. Tomblin JB, Harrison M, Ambrose SE, Walker EA, Oleson JJ, Moeller MP. Language outcomes in young children with mild to severe hearing loss. Ear Hear. 2015; 36(Suppl 1): 76S–91S.

3. Sharma A, Cormier K, Grigsby J. Effect of supplemental language therapy on cortical neuroplasticity and language outcomes in children with hearing loss. Brain Sci. 2025; 15(2): 119. doi:10.3390/brainsci15020119.

4. Estima NF, Miguel JHS, Azevedo MF, Gil D. Categorias auditivas e de linguagem em crianças usuárias de implante coclear. Distúrb Comun. 2022; 34(3): e55560.

5. Glick HA, Sharma A. Cortical neuroplasticity and cognitive function in early-stage, mild-moderate hearing loss: Evidence of neurocognitive benefit from hearing aid use. Front Neurosci. 2020; 14: 1–22. doi:10.3389/fnins.2020.00001.

6. Carvalho AJA, Lemos SMA, Goulart LMHF. Desenvolvimento da linguagem e sua relação com comportamento social, ambientes familiar e escolar: revisão sistemática. CoDAS. 2016; 28(4): 470–9. doi:10.1590/2317-1782/20162015193.

7. Almeida LGS, Lima RS, Costa KF, Lucena JMF. Uso de construções linguísticas abstratas na brincadeira entre pares de crianças. Rev Abralin. 2021; 20(2): 1–16.

8. Asaridou SS, Demir-Lira ÖE, Goldin-Meadow S, Small SL. The pace of vocabulary growth during preschool predicts cortical structure at school age. Neuropsychologia. 2017; 98: 13–23.

9. Bleses D, Makransky G, Dale PS, Højen A, Ba A. Early productive vocabulary predicts academic achievement 10 years later. Appl Psycholinguist. 2016; 37(6): 1461–76.

10. Pavia N, Webb S, Faez F. Incidental vocabulary learning through listening to songs. Stud Second Lang Acquis. 2019; 41(4): 745–68.

11. Edquist G, Flynn T, Jennische M. Expressive vocabulary of school-age children with mild to moderately severe hearing loss. Int J Pediatr Otorhinolaryngol. 2022; 162: 111281.

12. Jones A, Atkinson J, Marshall C, Botting N, St Clair MC, Morgan G. Expressive vocabulary predicts nonverbal executive function: A 2-year longitudinal study of deaf and hearing children. Child Dev. 2020; 91(2): e400–14.

13. Ambrose SE, Appenzeller M, Mai A, DesJardin JL. Beliefs and self-efficacy of parents of young children with hearing loss. J Early Hear Detect Interv. 2020; 5(1): 73–85.

14. Wake M, Carew P. Science, not philosophy, will help deaf and hard-of-hearing children reach their potential. Pediatrics. 2016; 137(1): e20153614.

15. Schmucker C, Kapp P, Motschall E, Loehler J, Meerpohl JJ. Prevalence of hearing loss and use of hearing aids among children and adolescents in Germany: A systematic review. BMC Public Health. 2019; 19(1): 1–10.

16. Ambrose SE, Appenzeller M, Al-Salim S, Kaiser AP. Effects of an intervention designed to increase toddlers' hearing aid use. J Deaf Stud Deaf Educ. 2020;25(1):55–67.

17. Gustafson SJ, Ricketts TA, Tharpe AM. Hearing technology use and management in school-age children: Reports from data logs, parents, and teachers. J Am Acad Audiol. 2017; 28(10): 883–92.

18. Muñoz K, Ortiz D, Bolinger C, Twohig MP. Intervention research to increase pediatric hearing device use: A scoping review. Am J Audiol. 2022; 31(4): 1312–19.

19. Dunn, L.M., & Dunn, D.M. (2007). Peabody Picture Vocabulary Test. Pearson.

20. Ingvalson EM, Perry LK, VanDam M, Grieco-Calub TM. Comparing Scores on the Peabody Picture Vocabulary Test and Receptive One-Word Picture Vocabulary Test in Preschoolers With and Without Hearing Loss. Am J Speech Lang Pathol. 2023 Jul 10; 32(4): 1610-1619.

21. Warner-Czyz AD, Anderson SR, Graham S, Uhler K. Expressive vocabulary word categories of children who are deaf and hard-of-hearing. J Deaf Stud Deaf Educ. 2024; 29(3): 362–76.

22. Rudge AM, Brooks BM, Grantham H. Effects of early intervention frequency on expressive vocabulary growth rates of very young children who are deaf or hard of hearing: How much is enough? J Speech Lang Hear Res. 2022; 65(5): 1978–87.

23. Figueiredo RSL, Mendes B, Cavanaugh MCV, Deperon TM, Novaes B. Audiol Commun Res. 2019; 24: e1733

24. Geers, A.E. (1994). Techiniques for assessing auditory speech percepcion and lipreading anchancement in Young deaf children, (5), 85-96

25. Moret, A. L. M., Bevilacqua, M. C., & Costa, O. A. (2007). Implante coclear: audição e linguagem em crianças deficientes auditivas pré-linguais. Pró-Fono Revista de Atualização Científica, 19(3), 295–304.

26. Deperon TM, Figueiredo RSL, Leal CF, Mendes BCA, Novaes BCAC. Audibilidade e desenvolvimento de linguagem oral em crianças com deficiência de audição. Distúrbio de comun, setembro 2018. 30(3): 551-560.

27. Instituto Nacional de Estudos e Pesquisa (INEP). (2016). Brasil no PISA 2015: análises e reflexões sobre o desempenho dos estudantes brasileiro. Brasília, Ministério da Educação, 273.

28. McCreery RW, Spratford M, Oleson J, et al. Auditory, cognitive, and linguistic factors predict speech perception in children with hearing loss. Ear Hear. 2019; 40(3): 528–42.

29. Davidson LS, Geers AE, Nicholas JG. The effects of audibility and novel word learning ability on vocabulary level in children with cochlear implants. Cochlear Implants Int. 2014; 15(4): 211–21.

30. Geers AE, Nicholas JG, Davidson LS, et al. Persistent language delay versus late language emergence in children with early cochlear implantation. J Speech Lang Hear Res. 2016; 59(1): 155–70.