

# DEVELOPMENT OF LANGUAGE SKILLS IN CHILDREN WITH COCHLEAR IMPLANTS: DOES THE GENDER HAVE ANY INFLUENCE?

## *Desenvolvimento da linguagem em crianças com implante coclear: terá o gênero alguma influência?*

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### ABSTRACT

**Purpose:** to evaluate the gender's influence in the development of language skills in children with severe to profound sensorineural deafness after cochlear implant. **Methods:** thirty children, 12 females and 18 males, aged between 8 years and 1 month and 10 years, with severe to profound congenital bilateral sensorineural deafness with cochlear implant were studied. The language structures analyzed were semantics, morphosyntax and phonology. The assessment tool used was the Observation Grid Language - school level. **Results:** the average hearing age was of 72 months for females and 72.7 months for males. The scores obtained in the three structures were statistically similar between genders. Into each structure, the comparison of each test, were also similar. **Conclusions:** gender did not influence the development of oral language in children with cochlear implants, in the three linguistic structures studied.

**KEYWORDS:** Cochlear Implants; Language; Gender Identity

### ■ INTRODUCTION

The absence of hearing experiences resulting from the existence of congenital severe to profound deafness, influences in a very significant way the development of language in children<sup>1</sup>, thus jeopardising school performance and the social interaction of the children.

Cochlear implant is a revolutionary element on both the hearing (re)habilitation and the improvement of the quality of life of the children with this type and degree(s) of deafness, when performed at an early stage<sup>2-8</sup>. This method of treatment is recommended for children with severe to profound congenital

sensorineural deafness, in which the benefit of hearing correction with conventional hearing aid is limited.

According to some researchers, it is expected that the children with surgically implanted cochlear implants, at an early age, may reach a development equivalent to what would be expected for their chronological age<sup>3</sup>. However, the auditory performance and the development of language may be influenced by a number of factors<sup>2,7,9</sup>.

The influence of gender on the process of language acquisition and development in normal hearing children is currently discussed with some attention. In this respect, there seems to be no consensus between the various authors<sup>10</sup>. Mendes et al. (2012)<sup>11</sup> and Rezende et al. (2005)<sup>12</sup> analysed the influence of gender on the development of the linguistic skills in hearing children and found no statistically significant differences between genders. On the other hand, Normand et al. (2008)<sup>13</sup> studied the lexical and grammatical development in male and female children and found a slight advantage of the female gender up to 36 months. The same

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was observed in the studies of Sandri et al. (2009)<sup>10</sup> who analysed the communicative profile in children between 1 and 3 years of age, having observed a superiority of the female gender, although the differences between genders were not statistically significant. The influence of gender in children with the cochlear implant has also been the subject of investigation<sup>9,14-16</sup>. However, there also appears to be no convergence in the results and observations by different authors. In their records regarding the studies of children with cochlear implant, Ching et al. (2013)<sup>14</sup>, Geers et al. (2007)<sup>15</sup> and Geers et al. (2003)<sup>16</sup> concluded that female children have been showing better results in language than male children. The studies of Gérard et al. (2010)<sup>9</sup> concluded that there were no statistically significant differences between genders regarding language development.

We have found no references, in literature, of researches conducted in Portugal that have focused on this topic. This occurrence, in particular, underlines the interest of the present study. The aim of this study is to assess the influence of gender in language skills, semantics, morphosyntax and phonology in children with severe to profound congenital bilateral sensorineural deafness after cochlear implant.

## METHODS

The present study had the approval of the Ethics Committee of the Hospital Centre and University of Coimbra, to which the protocol no. CHUC-75-12 was attributed.

The study carried out was a prospective and transversal type. Thirty children with severe to profound congenital bilateral sensorineural deafness with a unilateral cochlear implant were studied. The procedure took place in the Otorhinolaryngology Service of the Hospital Centre and University of the institution of origin.

The sample consisted of 12 female children and 18 males. The numerical difference did not prove statistically significant. The inclusion criteria of the children in this study were as follows: i) chronological age between 8 years and 1 month and 10 years of age; ii) diagnosis of profound congenital bilateral deafness; iii) unilateral cochlear implant; iv) absence of associated neurological or development pathologies; v) primary school frequency; vi) exposure to a predominantly oral stimulation. The children who did not meet the requirements above mentioned were excluded. The average age at the time of the diagnosis was  $25.31 \pm 10.3$  months for the males and  $25.17 \pm 7.0$  months for females. The average age at the time of the cochlear implant was

$32.61 \pm 7.8$  months for males and  $30.33 \pm 7.0$  months for females. At the time of the diagnosis the male children were, in average,  $25.31 \pm 10.3$  months, while the female children were  $25.17 \pm 7.0$  months old.

According to the Service standards, the amount of speech therapy prior to cochlear implant surgery is on average 4 months.

All children were assessed within the framework of regular speech therapy sessions carried out at the Cochlear Implants Functional Unit, that take place after discharge from the initial auditory habilitation program, after the cochlear implant placement.

The linguistic competences data were collected with the Language Observation Grid – school level (GOL-E). This assessment tool is part of the Assessment of Children with Cochlear Implants Protocol (PAC-IC) and it is standardized for Portuguese children between 5 years and 7 months old and 10 years of age. The observation grid, developed by Kay et al. (2003)<sup>17</sup>, allows the assessment of three major linguistic structures (semantics, morphosyntax and phonology) in primary school aged children.

Each assessment structure is made up of various tests. The semantic structure consists of three tests. The first is *word definition*, which analyses the ability to describe concepts. The second test, *naming classes*, assesses the vocabulary range in relation to superordinate terms. The third test, *opposites*, assesses the knowledge of opposite terms. The morphosyntactic structure is assessed in four tests. The first one, *recognition of agrammatical sentences*, assesses the ability to make grammatical judgements. The second test, *coordination and subordination of sentences*, analyses the ability to build complex subordinate and coordinate sentences from two simple sentences. The third and fourth tests, *word order in a sentence* and *derivation of words* assess the ability to order words to form sentences and the use of morphological rules to create derived words. There are four tests for the phonologic structure. The first two, *selection of words* and *selection of pseudo-words* test the capacity of auditory discrimination. The *identification of words that rhyme* and *syllabic segmentation* are two other tests that are part of this structure. The first aims to assess the ability to identify rhymes and the second, the ability to segment words into syllables.

The following tests were used for statistical analysis of the sample: Pearson's Chi-square test ( $\chi^2$ ) and the Student t-test by SPSS 20, with a minimum significance level (p) of 0.05. The results are presented as the mean ( $\bar{X}$ ) and standard deviations (SD).

## ■ RESULTS

The average hearing age, 72 months for female children and 72.7 months for males, was similar,  $p=0.873$ .

On the general analysis of the results it was found that in all three linguistic structures studied, semantics, morphosyntax and phonology, the

values of the scores obtained for each gender were very similar. They were generally higher in male children: semantics 16.89, morphosyntax 21.11 and phonology 26.83, than in female children: semantics 14.42, morphosyntax 13.75 and phonology 25.33. However, there were no statistically significant differences when comparing both genders. The results are shown in Table 1.

**Table 1 – Average score obtained on the semantics, morphosyntax and phonology structure, in children with cochlear implants, distributed according to gender, assessed with the Language Observation Grid – School Level**

GOL-E	Female $\bar{X} \pm D P$	Male $\bar{X} \pm D P$	<i>p</i>
Semantics	14.42±7.9	16.89±10.7	0.50
Morphosyntax	13.75±11.7	21.11±12.8	0.12
Phonology	25.33±11.7	26.83±10.6	0.71

Key: GOL-E: Language Observation Grid – School Level  
Statistical Test: Student t-test:  $p=0.05$

There were also no relevant differences on the particular analysis of the semantics, morphosyntax and phonology test structures.

The scores registered on the children, on the semantics structures tests, proved to be slightly higher for the male gender, on the *word definition*

test, 6.61±4.8 vs 5.17±3.3 and *naming classes* 5.28±3.4 vs 4.58±2.5. The *opposites* test was the exception, in which the results were very similar among genders. However, there were no statistically significant differences in all the cases. Table 2 presents such detailed results.

**Table 2 – Mean score obtained on the semantic structure tests, in children with cochlear implant, distributed according to gender, assessed with the Language Observation Grid – School Level**

GOL-E	Female $\bar{X} \pm D P$	Male $\bar{X} \pm D P$	<i>p</i>
Word definition	5.17±3.3	6.61±4.8	0.37
Naming classes	4.58±2.5	5.28±3.4	0.55
Opposites	4.58±2.6	4.78±3.1	0.86

Key: GOL-E: Language Observation Grid – School Level  
Statistical Test: Student t-test:  $p=0.05$

When observing the different components of the morphosyntactic structure, the differences found were not significant either. However, in this particular structure the average score for males was, in all

tests, higher than the females, especially in *agrammatical sentence recognition* 8.61±6.1 vs 5.25±5.1 and *sentence word order* 5.78±3.4 vs 3.92±3.7, as can be seen in Table 3.

**Table 3 - Mean score obtained on the morphosyntax tests, in children with cochlear implant, distributed according to gender, assessed with the Language Observation Grid – School Level**

GOL-E	Female $\bar{X} \pm D P$	Male $\bar{X} \pm D P$	<i>p</i>
Recognition of agrammatical sentences	5.25±5.1	8.61±6.1	0.13
Coordination and subordination of sentences	2.67±2.4	3.72±3.0	0.33
Word order in sentences	3.92±3.7	5.78±3.4	0.17
Derivation of words	1.92±2.1	3.0±2.8	0.27

Key: GOL-E: Language Observation Grid – School Level

Statistical Test: Student t-test:  $p=0.05$

Once the data obtained on the phonology tests was determined, the inexistence of statistically significant differences when comparing genders was evident. It is worth highlighting that the results of the scores on the four tests, presented closer

results among themselves, with the exception of the *syllabic segmentation* test, in which the mean value was higher in male children, 8.22±2.3 vs 7.00±2.8, as shown in Table 4.

**Table 4 – Mean scores obtained on the phonology structure tests, in children with cochlear implant, distributed according to gender, assessed with the Language Observation Grid – School Level**

GOL-E	Female $\bar{X} \pm D P$	Male $\bar{X} \pm D P$	<i>p</i>
Discrimination of word pairs	6.58±3.2	6.50±3.3	0.94
Discrimination of pseudo-words	6.33±2.87	6.06±3.1	0.80
Identification of words that rhyme	5.17±4.5	6.06±3.7	0.56
Syllabic segmentation	7.00±2.8	8.22±2.3	0.21

Key: GOL-E: Language Observation Grid – School Level

Statistical Test: Student t-test:  $p=0.05$

## ■ DISCUSSION

When analysing the results of the semantics, morphosyntax and phonology structures, comparing the female and male genders, a superiority in the male results was evident in all the studied structures. This difference of values was more evident in the morphosyntax structure. Although the differences in all structures between both genders were not statistically significant, it is nonetheless a notable finding. A research by Gérard *et al.* (2010)<sup>9</sup>, conducted with children with cochlear implants and using a scale that evaluates five components of oral language also concluded that there were no significant differences between genders<sup>9</sup>, thus supporting the results obtained in this study. Mendes *et al.* (2012)<sup>11</sup> and Rezende *et al.* (2005)<sup>12</sup> verified the same conclusion in their studies with normal hearing children. Although the study carried out by Normand *et al.* (2008)<sup>13</sup> did not find any statistically significant differences in hearing children, it nonetheless verified, contrary to our findings, that the female children had a slight advantage in language gains. The data registered by Sandri *et al.* (2009)<sup>10</sup> on the analysis of the communicative profile of the normal hearing children between the ages of 1 and 3 years old, has also differed from the data we found. Those authors verified a tendency for larger linguistic gains among female children.

The tendency of the observed values was similar in the individualized analysis of the results achieved by both genders in the linguistic structure tests, although, generically speaking, there were no statistically relevant differences. On the semantics structure the male gender reached higher results on the *definition of words* and *naming classes* tests. The results between both genders were only similar on the *opposites* test. In the field of morphosyntax, the results were, in all tests, higher in males. It is worth mentioning that on the *recognition of agrammatical sentences* and *word order in a sentence* tests, the differences between the registered values were more evident.

Regarding phonology and despite the achieved values being very close in both genders, it was noted that the observed tendency was the same and the values registered in male children overlapped those achieved by female children.

The results by Ching *et al.* (2013)<sup>14</sup> also differ with regard to their tendency concerning our findings. In a study involving 134 children with cochlear implants, up to the age of 3, in which language development was assessed, those authors found that the best results were associated to the female gender. This was also corroborated by Geers *et al.* (2007)<sup>15</sup> in a study conducted with 200 children and by Geers *et al.* (2003)<sup>16</sup> when they assessed 181 children from 8 to 9 years of age with cochlear implants. In effect, despite having no significant differences recorded, the doubt is maintained as to a possible influence of gender on linguistic gains of children with cochlear implant.

Although implanted children are capable of developing good linguistic capacities, the great variability of results between genders, observed by different authors, remains a matter of motivation<sup>9,14-16</sup>. It is a fact that the number of individuals in our sample was relatively small. Future studies, with a larger sample, which will be used for a better characterization and recognition of the language gains in reference to gender, may help clarify this fact and optimize the (re)habilitation process of children with cochlear implant, in case the differences between both genders are recognized.

## ■ CONCLUSIONS

Gender had no significant influence in the development of the linguistic skills (semantics, morphosyntax and phonology), in children with severe to profound congenital bilateral sensorineural deafness after cochlear implant, evaluated with the assessment tool, Language Observation Grid – School level. In the different tests for each linguistic structure, gender did not prove to be a variable capable of influencing the results achieved by children users of cochlear implant.

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## RESUMO

**Objetivo:** avaliar a influencia do gênero no desenvolvimento da linguagem de crianças com surdez severa a profunda neurossensorial, após implante coclear. **Métodos:** foram estudadas 30 crianças, 12 do gênero feminino e 18 do masculino, entre os 8 anos e 1 mês e os 10 anos com surdez severa a profunda neurossensorial bilateral congênita com implante coclear. Avaliaram-se as estruturas linguísticas semântica, morfossintaxe e fonologia. Utilizou-se o instrumento de avaliação: Grelha de Observação da Linguagem - nível escolar. **Resultados:** a idade auditiva média foi de 72 meses no gênero feminino e 72.7 meses no masculino. As pontuações obtidas nos três níveis linguísticos foram estatisticamente semelhantes, quando comparados os gêneros. Nas provas de cada estrutura linguística também não se verificaram diferenças estatisticamente significantes. **Conclusões:** o gênero não influenciou o desenvolvimento da linguagem oral nas crianças utilizadoras de implante coclear, nas três estruturas linguísticas estudadas.

**DESCRIPTORES:** Implantes Cocleares; Linguagem; Identidade de Gênero

## ■ REFERENCES

- Kim L-S, Jeong S-W, Lee Y-M, Kim J-S. Cochlear implantation in children. *Auris, nasus, larynx*. 2010;37(1):6-17.
- Russell JL, Pine HS, Young DL. Pediatric Cochlear Implantation: Expanding Applications and Outcomes. *Pediatric Clinics of North America*. 2013;60(4):841-63.
- Fortunato C, Bevilacqua M, Costa Md. Análise comparativa da linguagem oral de crianças ouvintes e surdas usuárias de implante coclear. *Rev CEFAC*. 2009;11(4):662-72.
- Anderson I, Weichbold V, D'Haese PSC, Szuchnik J, Quevedo MS, Martin J et al. Cochlear implantation in children under the age of two—what do the outcomes show us? *Int J Pediatr Otorhinolaryngol*. 2004;68(4):425-31.
- Moret ALM, Bevilacqua MC, Costa OA. Implante coclear: audição e linguagem em crianças deficientes auditivas pré-linguais. *Pró-Fono R. Atual. Cient*. 2007;19:295-304.
- Wolfgang KG, Jafar H, Brigitte E, Wolf DB. Speech Perception Performance in Prelingually Deaf Children with Cochlear Implants. *Acta Otolaryngol*. 2000;120:209-13.
- Polat B, Başaran B, Kara H, Ataş A, Süoğlu Y. The impact of social and demographic features on comprehensive receptive and expressive performance in cochlear implant patients. *Kulak Burun Bogaz Ihtis Derg*. 2013;23(2):90-5.
- Mlynski R, Plontke S. Cochlear implants in children and adolescents. *HNO*. 2013;61(5):388-98.
- Gérard J, Deggouj N, Hupin C, Buisson A, Monteyne V, Lavis C et al. Evolution of communication abilities after cochlear implantation in prelingually deaf children. *Int J Pediatr Otorhinolaryngol*. 2010;74:642-8.
- Sandri MA, Meneghetti SL, Gomes E. Perfil comunicativo de crianças entre 1 e 3 anos com desenvolvimento normal de linguagem. *Rev CEFAC*. 2009;11(1):34-41.
- Mendes JCdP, Pandolfi MM, Carabetta Júnior V, Novo NF, Colombo-Souza P. Fatores associados a alteração da linguagem em crianças pré-escolares. *Rev. soc. bras. fonoaudiol*. 2012;17(2):177-81.
- Rezende MA, Beteli VC, Santos JLFd. Avaliação de habilidades de linguagem e pessoal-sociais pelo Teste de Denver II em instituições de educação infantil. *Acta Paul Enferm*. 2005;18:56-63.
- Normand M, Parisse C, Cohen H. Lexical diversity and productivity in French preschoolers: developmental, gender and sociocultural factors. *Clin Linguist Phon*. 2008;22(1):47-58.
- Ching T, Dillon H, Marnane V, Hou S, Day J, Seeto M et al. Outcomes of early- and late-identified children at 3 years of age: findings from a prospective population-based study. *Ear Hear*. 2013;34(5):535-52.
- Geers AE, Nicholas JG, Moog JS. Estimating the Influence of Cochlear Implantation on Language Development in Children. *Audiol Med*. 2007;5(4):262-73.
- Geers A, Nicholas J, Sedey A. Language skills of children with early cochlear implantation. *Ear & Hearing*. 2003;24(1 Suppl):46S-58S.
- Sua Kay E, Santos M, Ferreira A, Graça D, Calado A. Grelha de Observação da Linguagem – nível escolar. Lisboa: Escola Superior de Saúde do Alcoitão, 2003.

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