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Influence of IQ on language age in children with cochlear implants

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Abstract:

Introduction: Many kids with profound hearing loss receive cochlear implantation. Language performance after implantation depends on many variable factors like: hearing age, cause of hearing loss, rehabilitation programs, and intellectual abilities. We wonder if the cognitive function and intellectual state of kids with cochlear implants impact the development of oral language.

Aim of the study: To measure the intelligence quotients (IQ) in kids with cochlear implants (CI) & its effect on the language age.

Subjects and Methods: The current cross-sectional study enrolled 60 prelingual children with cochlear implants aged among three to nine years.

Results: The mean of IQ was (90.8±4.1) & the mean of language age was (37.8±13.9). There was a significant positive association among the IQ scores & language age of CI kids.

Conclusion: The intellectual abilities of prelingual CI children have a great influence on the language performance.

Keywords: Cochlear implants, IQ, Intellectual abilities, Language age.

1. Introduction

Hearing loss, whether it is congenital or acquired, is a common sensory impairment [1]. In young children, hearing loss reflects on many aspects of life, the most obvious one is language and communication which is extended to social isolation and affects psychosocial aspect [2].

Now, Cochlear insertion is stated as a standard intervention for children with acquired or congenital hearing loss who cannot achieve any benefits from hearing aids. CI has changed lives of many hearing-impaired individuals [3].

Language performances (including receptive, expressive, and pragmatic) after CI differ from one child to another. The wide variety is attributed to a disparity of several factors such as: the cause of hearing loss, the age of implantation, the side of implants (unilateral or bilateral), type of the implant, the mode of communication after implantation, the rehabilitation programs, and the cognitive abilities of the child [4].

Theory of mind explains the continuous development of the cognitive abilities of a child (especially the nonverbal tasks). Furthermore, it helps to achieve better upgrading of the language aspects as the child grows. In CI children, linguistic

function and communication after the implants depend on the state of the cognition, first visually then later verbal as the child progress [4].

The cognitive function can be assessed by a score as IQ (intelligence quotient) which is a standardized method for measuring the intellectual abilities. In normal hearing individuals, IQ is tested by both verbal and nonverbal tests. However, in hearing impairment, IQ is evaluated by nonverbal tests. These tests measure skills such as processing speed, visual-spatial, and fluid intelligence [5]. Using nonverbal tests ensures assessing the cognition function without the language confounds [6].

So, as long as the hearing impaired children have language and communication access by CI, could the intellectual abilities be more refined for better results? [7]. This needs more studying and understanding the factors that influence oral language outcomes, and how to improve the rehabilitation programs to obtain maximum benefit from CI [8].

The investigation's aim was to know the influence of IQ on the language age for CI children.

2. Subjects & Methods

2.1. Subjects

The current cross-sectional research has been conducted at Fayoum University - Faculty of Medicine- Phoniatrics Unit, during the period from December 2022 to December 2023 and enrolled 60 children with cochlear implants.

Inclusion criteria

- 1- Children age is between 3 and 9 years.
- 2- Children were prelingually cochlear implanted.
- 3- Hearing age more than 1 year.

Exclusion criteria

- 1- The children had no other disabilities.

2.2. Methods

Clinical history was taken from children's parents about name, age, gender, address, parental consanguinity, prenatal, natal, and post-natal history in addition to detailed history of the hearing loss (age of discovery, duration, onset, cause, family history, and previous history of hearing aids usage and duration).

Arabic language assessment was done using the Preschool Language Scale-4

“Arabic Version” of **Abu-Hasseba (2011)** to obtain their receptive, expressive, and total language ages [9].

A nonverbal IQ was done for all children, using Stanford Binet Intelligence Scale “4th Arabic Version” [10].

Auditory evaluation was done by using aided free field audiometry with two points scale. ≤ 40 dB was considered satisfactory response (1=Satisfactory) and >40 dB was unsatisfactory response (0=Unsatisfactory).

2.3. Statistical Methods

- We collected the data & entered it to Microsoft Access. Data analysis has been performed by utilizing the Statistical Package of Social Science (SPSS) software version twenty-two in windows seven (SPSS Inc., Chicago, IL, USA). Simple descriptive analysis for the data has been performed in the form of percentages and numbers of qualitative data, and arithmetic means as central tendency assessment, SD as a calculation of dispersion of quantitative parametric data. Pearson correlation test was used to test the correlation between

variables. The P-value<0.05 was considered as statistically significant.

3. Results

Sixty cochlear implanted children were enrolled in the present investigation. The mean age among group was (71.6±20.6) months with 55% were males versus 45% were females. For consanguinity, 78.3% were positive (Table 1).

Table 1: Description of demographic data:

Variables	Number (n=60)	
Age (months)		
Mean ±SD	71.6±20.6	
Sex		
Male	33	55%
Female	27	45%
Consanguinity		
Positive	47	78.3%
Negative	13	21.7%

The mean age of cochlear implantation among study group was (37.6±10.8) months, mean language age was (37.8±13.9), and mean IQ was (90.8±4.1). Most of the cases wore unilateral devices, only one child was wearing bilateral CIs, and 91.7% showed satisfactory results in aided free field audiometry (Table 2).

Table 2: Description of clinical characteristics:

Variables	Number (n=60)	
	Mean ±SD	
Age of cochlear implantation (months)	37.6±10.8	
language age	37.8±13.9	
IQ	90.8±4.1	
Side	No.	%
Unilateral	59	98.3%
Bilateral	1	1.7%
Free field audiometry		
Satisfactory	55	91.7%
Unsatisfactory	5	8.3%

There was a significant positive association among the IQ scores and age of language of CI kids (Table 3) & (Figure 1).

Table 3: Association among IQ scores & language age for CI children:

Variables	Language age		
	r	P-value	Sig.
IQ scores	0.33	0.01	S

*Test used: Pearson correlation test.

*significant P-value below 0.05

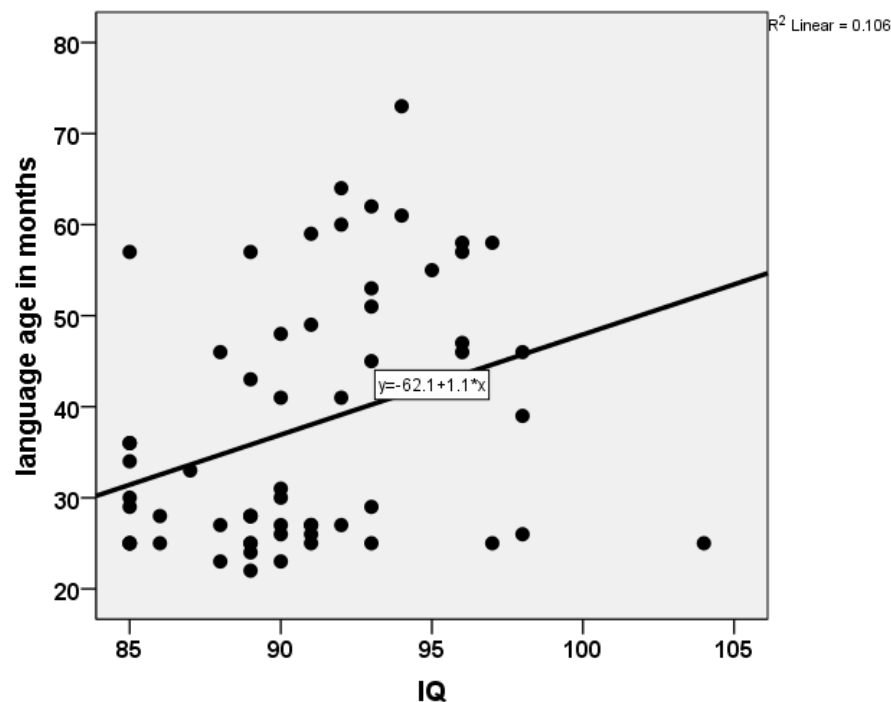


Figure 1: Association among IQ scores & language age for CI children.

4. Discussion

In our research, it was found that the cognitive abilities have influence on the oral language outcome of the CI children that aged between 3 to 9 years. The IQ scores of the children were predictor of their language ages including receptive and expressive

performance. This is compatible with other studies which found that intellectual abilities of CI children were predictor of the language outcomes [5] [7] [8] [11]. Some researchers found an association among IQ & receptive language abilities [12], others

between IQ and expressive language [13] [14]. Even if other disabilities existed, still the intellectual abilities play a fundamental role in the language performance post implantation [15].

The nonverbal IQ, as a part of cognitive function, is closely related and attached to language development and performance post implantation [16]. As long as the nonverbal intellectual abilities have high scores, the language abilities will be developed. Consequently, that improves the inner speech and working memory and then refines verbal IQ as well [17].

On the other hand, some studies suggested that the intellectual state represented in IQ did not greatly affect the

language development of these children, but they concluded that IQ is one of many factors reflected in language abilities after the implantation. These various factors like: hearing age, age of implantation, cause of hearing loss, rehabilitation programs, and mode of communication the children use [18] [19]. Furthermore, there was a suggestion that the age of implantation had a greater effect on language outcomes than IQ [6] [20].

5. Conclusion

From the present study, we concluded that prelingual CI children achieve better language outcomes post implantation when they have good cognitive and intellectual abilities.

Ethical approval and consent to participate: This investigation has been carried out with ethical approval from the research ethical committee of the faculty of medicine at Fayoum University. Approval ID was (M622).

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