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Comparative Cognitive Evaluation Using MoCA in Children with and Without Hearing Aids

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Abstract: ***This study compares cognitive abilities in children with normal hearing and those using hearing aids, aged 10-12 years. Conducted over eight months at Little Flower Hospital and Research Centre, the research utilized the Montreal Cognitive Assessment (MoCA) tool to assess cognitive domains including attention, language, memory, and orientation. Ninety participants were equally divided between the two groups. Results revealed that children without hearing impairments scored significantly higher in multiple cognitive areas, such as attention and tailored cognitive support strategies for children with hearing impairment. The purpose of this study is to compare the cognitive abilities of children with normal hearing and those using hearing aids using the Montreal Cognitive Assessment (MoCA).***

Keywords: Montreal Cognitive Assessment (MoCA), Cognitive development

1. Introduction

Five percent of the world's total population needs adequate support to manage their hearing impairments, which also affects children. As per scientific calculations, above 650 million people will have disabilities in hearing by 2050. A person with hearing thresholds of 20Db may have disabilities in hearing. Hearing loss may range from mild to profound in severity, which can affect one ear or both ears and make it difficult to hear voices and sounds etc. People with such disabilities make use of hearing aids, cochlear implants, and other assistive technologies with captions [(1)].

Disabilities in hearing or hearing loss are a common condition in children, which can cause delays in learning language skills and disorders related to social integration [(2,3)]. These causes can be reduced with interventions made through audiology and auditory rehabilitation [(3,4)]. One such example of audiological intervention is hearing aids [(5)]. Studies have explored factors affecting the use of hearing theraids, the parent's educational level and socioeconomic statuses. In addition to the results, there were two more factors: parents' knowledge in hearing aid usage and parent- child interactions [(6,7)].

Parents who were using these hearing aids for the first time were facing difficulties with little knowledge and could not apply newer skills to these hearing aids. However, there was no information provided to parents for overcoming these difficulties [(8,9,10)]

From six to twelve years, a child will start to learn scientific reasoning, understanding of physical laws of conservation, including weight and volume. Basic literacy skills such as numbers and reading are learned from the initial stage. Then, a child understands perspectives of a situation, which may be neurocognitive functions [(11)]. Such functions are a series of processes that involve the acquisition of knowledge, short-term memory, long-term memory, working memory, operational memory, attention, reasoning, processing, perception, visualization, problem-solving, planning and execution. These skills develop progressively from basic to complex forms [(11,12)].

Studies indicate with the evidence of data that children using CI and HA perform below average in various cognitive functions [(13,14)]. Highlighting these cognitive disparities emphasizes the need for early intervention and supportive strategies to enhance learning outcomes in hearing-impaired children. This study aims to evaluate the cognitive assessment in normal children and children using hearing aids.

2. Materials and Methods

This study was conducted to compare the cognitive assessment in hearing in normal children and children using hearing aids. The study was carried over 8 months period at Little Flower Hospital and Research Centre, Angamaly & Department of E.N.T. Children of age group between 10-12 years using hearing aids and the children of age group between 10-12 years without hearing impairment were the participants selected using purposive sampling, with a calculated sample size of minimum 45 for each group.

Eligibility criteria included Children using hearing aids for last one year and the normal children without hearing impairment.

Children who are affected with cerebral palsy, hypothyroidism, autism, mentally retarded and children with cochlear implants were completely excluded from the study.

Scores from the questionnaires were recorded and analyzed using statistical software, IBM SPSS (statistical package for social science) version 22. Descriptive statistics is used to assess the baseline parameters. All quantitative variables are presented as mean +/- SD. All qualitative variables are presented as frequency and percentages. Kolmogorov Smirnov test is used to assess the normality of the data. T-test or Mannwhitney will be used to compare between two groups.

3. Data Collection

The data collection process was structured to ensure precision and accuracy. After receiving ethical committee approval, for the comparative study of cognitive assessment in hearing normal children and children using hearing aids, data were collected only after obtaining written consent.

A specially designed proforma given to the parents and participants for collecting their personal details including name, age, address, education etc. Cognitive assessment of children was found out with the help of Montreal Cognitive Assessment (MoCA); the questionnaire was available in both English and Malayalam. It includes – Visuospatial/Executive, Naming, Memory, Attention, Language, Abstraction, Delayed, Recall, Orientation. The participants were divided into groups normal children without hearing impairment and children using hearing aids.

4. Results

4.1 Cognitive Assessment in normal children without hearing aids.

The MoCA questionnaire, which assess cognitive assessment, which is Visuospatial, Naming, Attention, Language, Abstraction, Delayed Recall, Orientation etc. An overview of frequency and Percentage of cognitive variables in normal children without hearing aids is given in Table 1.

Table 1: Cognition variables in normal children without hearing aids

Cognition variables		Frequency	Percentage
Visuospatial	2	14	31.1%
	4	3	6.7%
	5	28	62.2%
Naming	3	45	100.02%
Attention	2	1	2.2%
	3	8	17.8%
	4	8	17.8%
	5	3	6.7%
	6	25	55.6%
Language	0	1	2.2%
	1	9	20.0%
	2	3	6.7%
	3	32	71.1%
Abstraction	0	13	28.9%
	1	4	8.9%
	2	28	62.2%
Delayed Recall	0	20	44.4%
	5	25	55.6%
Orientation	3	1	2.2%
	4	1	2.2%
	5	1	2.2%
	6	42	93.3%

4.2 Cognitive Assessment in children with hearing aids

The MoCA questionnaire, which assess cognitive assessment, which is visuospatial, Naming, Attention, Language, Abstraction, Delayed recall, Orientation etc. An overview of frequency and percentage of cognition variables in children with hearing aids is given in the Table 2.

Table 2: Cognition variables in children with hearing aids

Cognition variables		Frequency	Percentage
Visuospatial	1	3	6.7%
	2	6	13.3%
	3	16	35.6%
	4	4	8.9%
	5	16	35.6%
Naming	1	3	6.7%
	2	1	2.2%
	3	41	91.1%
Attention	1	5	11.1%
	2	8	17.8%
	3	14	31.1%
	5	16	35.6%
	6	2	4.4%
Language	0	24	53.3%
	1	14	31.1%
	2	7	15.6%
Abstraction	0	15	33.3%
	1	5	11.1%
	2	25	55.6%
Delayed	0	19	42.2%
	1	1	2.2%
	2	9	20.0%
	3	7	15.6%
	4	3	6.7%
	5	6	13.3%
Orientation	0	1	2.2%
	2	1	2.2%
	3	1	2.2%
	4	3	6.7%
	5	15	33.3%
	6	24	53.3%

4.3 Comparative study of Cognitive assessment in normal children and children using hearing aids

An overview z -value and p-value of comparison of cognitive assessment in normal children and children using hearing aids is given in Table 3.

Table 3: Comparison of Cognitive assessment in normal children and children using hearing aids

Cognition Variables	Mean Rank		U	*z-value*	*p-value*
	No Hearing aid	Hearing Aid			
Visuospatial	49.69	41.31	824	*1.63*	*0.102*
Naming	47.50	43.50	922	*2.034*	*< 0.05*
Attention	58.33	32.67	435	4.788	*< 0.001*
Language	64.23	26.77	169	***7.109***	*< 0.001*
Abstraction	46.94	44.06	947	600	*0.549*
Delayed Recall	50.56	40.44	785	1.961	*< 0.05*
Orientation	54.26	36.74	618	4.105	*< 0.001*
Total	65.27	25.73	123	7.204	*<0.001*

When the cognition variables compared between no hearing aid and hearing aid users, the obtained U values and the Z-values are interpreted in the Table 3. There is statistically significant difference in cognitive variables, naming (<0.05), attention (<0.001), language (<0.001), delayed recall (<0.05) and orientation (<0.001). the cognition variables are significantly high in no hearing aid users. There is no significant difference in cognition variables visuospatial (0.102) and abstraction (0.549). So, we can conclude that cognition in no hearing aid children has significant high effect than hearing aid children.

5. Discussion

This study aimed to compare the cognitive assessment in hearing of normal children and children with hearing aids using MoCA questionnaire. The findings highlight significant difference among children using hearing aids and who do not use hearing aids.

In the language section of the MoCA cognition test, children without hearing aids faced difficulties compared to normal children. The mean rank for children using hearing aids was 26.77, whereas for normal children, it was 64.23. This indicates that children with hearing aids require additional time to spell words.

Notably in the attention section of the MoCA test, normal children performed with a mean rank of 58.33 compared to the children with hearing aids who had a mean rank of 32.67 indicating a notable difference in attention abilities between the two groups.

In the orientation section, children with hearing aids scored a mean rank of 36.74, whereas children without hearing aids achieved a mean rank of 54.26 clearly indicating that children without hearing aids demonstrated better orientation skills compared to those with hearing aids.

The study findings show a notable difference in visuospatial skills between the two groups. Children without hearing aids achieved a mean rank of 49.69, whereas those with hearing aids scored a mean rank of 41.31 in the visuospatial section.

The study results showed that children without hearing aids performed slightly better in abstraction, with a mean rank of 46.94, compared to children with hearing aids who scored a mean rank of 44.06

The cognitive assessment revealed a notable disparity in delayed recall abilities. Children without hearing aids achieved a mean rank of 50.56, while those with hearing aids scored a mean rank of 40.44, suggesting that children with hearing aids encountered challenges in this area.

The study revealed significant differences in cognitive assessment in hearing normal children and the children with hearing aids. The study suggests to use the hearing aids from early ages for the children facing hearing impairment for better cognition skills.

6. Conclusion

The study concludes that children without hearing impairments exhibit significantly stronger cognitive abilities across multiple domains compared to their peers using hearing aids. These findings underscore the importance of early auditory intervention, Parental involvement, and structured cognitive support. Targeted strategies may enhance the developmental outcomes of children with hearing impairments, enabling them to better adapt academically and socially.

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