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The Effectiveness of Hearing Aids in Enhancing *Auditory Perception in Children with Hearing Impairment*

Abd Al-Salam Salem Masoud Al-Busaifi[1]

[1] *Hearing and speech section - Sorman College of Medical Technology - Sabratha University.*

Email : Z5973481@gmail.com

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Abstract

Hearing impairments are among the most significant developmental challenges affecting children's linguistic, cognitive, and social growth, particularly during early childhood when auditory input plays a crucial role in language acquisition and communication, this study aimed to evaluate the effectiveness of hearing aids in enhancing auditory perception among children with mild to moderate hearing loss, by assessing improvements in auditory and linguistic abilities following the use of hearing devices, the study sample consisted of 30 children aged between 6 and 10 years who were fitted with hearing aids and monitored over a specified period, a quasi-experimental design was employed, involving pre- and post-intervention assessments using a series of standardized auditory and cognitive tests, as well as behavioral observations and reports from parents and teachers in both home and educational settings, the results indicated significant improvement in several aspects of auditory perception, including the ability to discriminate between verbal and non-verbal sounds, increased accuracy in word recognition, and enhanced auditory attention and interaction in daily environments, the effectiveness of the hearing aids was particularly evident among children who received early intervention, reinforcing the importance of timely diagnosis and auditory rehabilitation, no significant adverse effects related to the use of hearing aids were reported, indicating high levels of acceptance and functional compatibility, the study concludes that hearing aids are an effective tool in improving various dimensions of auditory perception and play a pivotal role in supporting linguistic and cognitive development in children with hearing loss, the findings underscore the need to strengthen early screening programs and raise awareness among parents, educators, and healthcare providers about the critical role of early auditory intervention and the provision of appropriate hearing devices during the early years of development.

Keywords: Hearing Aids - Auditory Perception Hearing- children- Impaired Individuals.

Introduction

There has been increasing interest in recent times among specialists in disability studies and special education to support individuals with special needs so that they may live normal lives like their typically developing peers, their personalities, like those of non-disabled individuals, are subject to influence, however, individuals with special needs face numerous obstacles-regardless of the type or severity of their disability-stemming either from a lack of societal awareness or from challenges inherent in the individual's own personality, such factors may lead to disturbances and issues in the personality of the person with a disability as a result of that disability (Al-Najjar, Tariq Mohamed El-Sayed, 2013). Disability has long been a persistent concern in human societies from ancient times to the present day, societies have varied in their perspectives and treatment of individuals with disabilities, influenced by prevailing values, traditions, religious beliefs, and social norms (Al-Adrah, Ibrahim, 2016). One of the disabilities that has become increasingly prevalent in recent times is hearing impairment, which ranges in severity from mild hearing loss to profound hearing loss or complete deafness (Al-Khatib, Jamal, 1998) When a student receives information accurately and clearly through the senses, their cognitive processes are likely to be correct, resulting in accurate information processing, this however, depends on the integrity of their auditory perception, if there is any distortion or inaccurate auditory perception of information, it can lead to faulty or confused processing, and thus incorrect interpretation, consequently, their responses or reactions may be inappropriate (Al-Rousan, Farouq, 2006, p: 175). Auditory perception-with its components (auditory discrimination, auditory memory, auditory-verbal association, and auditory interpretation of instructions) is considered one of the most critical auditory skills that should be developed in hearing-impaired individuals, especially those with partial hearing loss at the elementary school level.

At this stage, students with hearing impairments heavily rely on auditory perception to comprehend the surrounding aspects of life, it serves as their primary means of accessing knowledge and awareness through their connection with the external world, enabling the formation of various sensory perceptions that support their understanding (Mohamed Faheem Mostafa, 2001). Auditory perception is one of the most fundamental cognitive processes that enable a child to interact with the world around them, It forms the basis for language acquisition, vocabulary development, and the enhancement of both verbal and non-verbal communication skills, This ability begins to develop in the early stages of life and is influenced by the quality and nature of the auditory input to which the child is exposed, However, any impairment in the auditory system-whether congenital or

acquired-can lead to delays in the development of auditory perception, which in turn negatively affects linguistic, social, and cognitive development,

One of the studies that addressed this aspect is the study by Saleh, et, al, 2022 titled "The Level of Auditory Memory in Children with Hearing Impairment According to the Variables of Assistive Hearing Devices and the Age at Which Hearing Loss Occurred, the study aimed to identify the level of auditory memory among children with hearing impairment aged between 4 and 7 years, as well as to examine the significance of differences in auditory memory levels based on two variables: the type of hearing device used (hearing aids vs, cochlear implants) and the timing of hearing loss (congenital-pre-lingual deafness vs, acquired-post-lingual deafness) the study sample consisted of 20 children, with 10 using hearing aids and 10 using cochlear implants, while considering the age at which hearing loss occurred, the participants were purposefully selected from the Syrian Organization for Persons with Disabilities (Aamal) in Damascus, the researchers employed an auditory memory scale developed by the author, whose validity and reliability were verified within the Syrian context, the study yielded the following findings: There were no statistically significant differences in the total and subscale scores of the auditory memory scale attributable to the type of hearing device used (hearing aids or cochlear implants),statistically significant differences were found in the total and subscale scores of auditory memory in favor of children with acquired hearing loss (post-lingual), as opposed to those with congenital hearing loss.

Elizabeth, M, Fitzpatrick, et, al. (2012) conducted a study in Canada entitled "Comparison of Outcomes in Children with Hearing Aids and Cochlear Implants", aiming to evaluate the performance of children with sensorineural hearing loss ranging from moderate to severe, by comparing the effectiveness of hearing aids versus cochlear implants, the study sample included 41 children with bilateral sensorineural hearing loss who used cochlear implants, along with 20 children with moderate hearing loss who used hearing aids, Participants were aged between 6 and 18 years, the researchers employed a range of assessment tools, including speech recognition tests, standardized measures of speech and language production, and evaluations of reading and writing skills, the findings revealed no statistically significant differences between the two groups in terms of speech recognition or expressive language abilities, However, children who used hearing aids outperformed their peers with cochlear implants in receptive language, auditory memory, and reading comprehension.

Yoshinaga - Itano, et, al. (2010) conducted a study in the United States entitled: "Describing the Trajectory of Language Development in the Presence of Severe-to-Profound Hearing Loss:

A Closer Look at Children with Cochlear Implants Versus Hearing Aids, the study aimed to examine the language development trajectories of children with severe-to-profound hearing loss, comparing those who used cochlear implants with those who used hearing aids, the sample consisted of 87 children aged between 48 and 87 months, all of whom had received early intervention services through a home-based intervention program in Colorado, most children received services from auditory-verbal therapists, the researchers utilized the Auditory Comprehension subtest of the Preschool Language Scale.

Third Edition (PLS-3), as well as the Expressive Language subscale from the Minnesota Child Development Inventory (covering birth to 36 months),Findings indicated that participants demonstrated language growth equivalent to 4 to 7 years on these assessments, aligning with age-appropriate expectations observed in children with normal hearing, However, children who used hearing aids showed greater deviation from the age-equivalent developmental trajectory in auditory language comprehension and single-word expressive vocabulary tasks compared to their peers with cochlear implants, the study concluded that accelerated language development is possible for some children with severe-to-profound hearing loss and may be facilitated through cochlear implantation, despite the valuable insights provided by previous studies, there remains a pressing need to specifically examine the effectiveness of hearing aids in enhancing auditory perception-an essential component in the language development of children with hearing impairment, this need is particularly significant in light of the varying degrees of hearing loss and the individual differences in response to assistive technologies, hence, the current study aims to investigate the impact of hearing aid use on the development of auditory perception skills in this population, with the goal of contributing to the improvement of early intervention programs and guiding clinical decision-making with greater precision and efficacy.

In this context, hearing aids are considered one of the most effective assistive tools aimed at improving hearing quality in children with varying degrees of hearing loss, these devices function by amplifying surrounding sounds and delivering them clearly to the ear, thereby enabling the brain to analyze and process auditory input in a manner closer to normal hearing, the role of hearing aids goes beyond merely enhancing auditory capacity; they also play a critical part in fostering the perception of both linguistic and non-linguistic sounds, which directly contributes to the development of speech, comprehension, and communication skills, Numerous recent studies have indicated that early intervention through the provision of appropriate hearing aids can lead to significant improvements in auditory perception development, especially when

combined with auditory training and language rehabilitation programs, the earlier the intervention occurs, the greater the likelihood of language development following a more typical trajectory, thereby reducing the developmental gap between children with hearing loss and their typically developing peers, Based on these considerations.

This study seeks to explore the effectiveness of hearing aids in enhancing auditory perception among children by evaluating auditory and linguistic performance before and after the use of hearing aids, It aims to analyze the impact of these devices on sound and word recognition, auditory response speed, and interaction with the surrounding environment, Additionally, the study highlights the importance of early detection of hearing impairment and the role of auditory technologies in improving the quality of life for children from psychological, educational, and social perspectives.

1. Study Procedures

1.1. Methodology Used

This study employed a quasi-experimental design, which is well-suited to the research objective of evaluating the impact of hearing aids on auditory perception in children with hearing loss, the design involved measuring changes in the children's auditory abilities before and after the introduction of hearing aids, without the use of a control group, Pre-and post-intervention assessments were conducted using standardized auditory and cognitive tests to determine the extent of improvement attributable to the intervention, quantitative results were further supported by qualitative data, including behavioral observations and reports from parents and teachers, in order to provide a comprehensive understanding of the functional outcomes in real-life settings, the methodological approach is particularly appropriate for applied research involving limited samples and field conditions where full experimental control is not feasible.

1.2. Study Sample

Given the importance of accurately representing the target population in studies addressing auditory development issues in children, the study sample was carefully selected to align with the research objectives and questions, The sampling process aimed to capture the diversity of hearing loss cases in terms of degree and type, thereby enhancing the generalizability of the findings to the broader population under investigation, the study sample consisted of thirty (30) children who had been diagnosed with varying degrees of hearing loss (mild, moderate, severe), ranging in age from 6 to 10 years. A stratified random sampling technique was employed to ensure proportional and systematic representation of different degrees of hearing loss within the study population.

This approach contributed to the reliability and validity of the results and the soundness of the conclusions drawn.

1.3. Study Instruments

Given the nature of this study, which aims to evaluate the effectiveness of hearing aids in enhancing auditory perception among children with hearing impairments, a diverse set of tools was employed, combining both quantitative and qualitative methods.

The selection of these instruments was guided by their appropriateness for the target age group, as well as their ability to yield accurate and reliable data reflecting the real-life use and impact of hearing aids, the study instruments included, first, objective and subjective audio logical assessments used to determine the degree and type of hearing loss, These assessments included audiograms and auditory brainstem response (ABR) tests, in addition to age-appropriate behavioral hearing tests that rely on the child's ability to respond, furthermore, auditory perception tests were used to measure the child's ability to discriminate sounds, recognize words, and comprehend spoken language, these tests were administered both before and after a period of hearing aid use, allowing for precise measurement of changes in auditory performance, to capture behavioral and communicative changes in the child's natural environment, semi-structured interviews and questionnaires were administered to parents and teachers, These tools gathered qualitative data regarding their observations of the child's auditory behaviors and linguistic and social interactions in daily life, finally, a daily monitoring log was maintained to document the duration and consistency of hearing aid use, this tool provided valuable insight into the relationship between usage adherence and improvements in auditory and perceptual abilities.

1.4. Study Procedures:

To evaluate the effectiveness of early auditory intervention using hearing aids in children with hearing impairment, a structured research methodology was employed to ensure the accuracy and reliability of the findings, The study procedures included the following steps:

1. Initial Assessment: A comprehensive baseline evaluation was conducted for all participating children to determine the degree of hearing loss and the level of auditory perception, Standardized and validated assessment tools were used prior to the fitting of hearing aids.
2. Provision of Hearing Aids: Each child was fitted with an appropriate hearing aid based on individualized recommendations provided by a team of

audiology and speech-language professionals, ensuring that the specific needs of each participant were addressed.

3. Periodic Follow-Up: Participants underwent regular follow-up over a period ranging from six months to one year, during this time, changes in auditory perception were monitored using the same assessment instruments applied in the initial evaluation, ensuring consistency in measurement.
4. Data Collection and Analysis: Upon completion of the follow-up period, data were collected and subjected to statistical analysis to determine the extent of improvement in auditory perception. The analysis also explored potential associations between the degree of improvement and variables such as duration of hearing aid use and severity of hearing loss.

1.5. Data Analysis Methods

The study employed a rigorous statistical analysis methodology to interpret the data collected through measurement tools and to determine the effectiveness of hearing aids in enhancing auditory perception among children with hearing impairments, the analysis process included several interrelated stages, beginning with descriptive statistics, followed by inferential tests, and concluding with the examination of relationships between variables, in the first stage, descriptive statistical methods were utilized to analyze the demographic and audio logical data of the study sample, including variables such as age, gender, type and degree of hearing loss, and the type of hearing aid used, this analysis provided a comprehensive overview of the sample characteristics and established a foundational understanding for interpreting subsequent results, in the second stage, inferential statistical tests (such as paired-samples t-tests or ANOVA, depending on the nature of the variables) were applied to examine differences in auditory perception levels before and after the use of hearing aids, these tests were instrumental in identifying whether statistically significant differences could be attributed to the intervention, in the final stage, correlational and regression analyses were conducted to explore the strength and direction of relationships between independent variables (e.g, duration of hearing aid use, degree of hearing loss, age of the child) and the dependent variable (level of auditory perception), these analyses offered deeper insights into the factors influencing the effectiveness of hearing aids and helped identify the most predictive variables related to auditory improvement, all statistical procedures were performed using advanced software such as SPSS to ensure the accuracy of results and provide quantifiable outcomes suitable for scientific interpretation and validation.

1.6. Study Findings

The findings of this study demonstrated the tangible effectiveness of hearing aids in enhancing auditory perception among children with varying degrees of hearing

impairment, Statistical analyses revealed a significant improvement in the children's ability to distinguish sounds and words following a period of hearing aid use, with success rates in auditory perception tests increasing by up to 35% compared to pre-intervention assessments, this indicates that hearing aids play a direct role in improving the auditory brain's capacity to process sound signals, thereby enhancing functional auditory performance in this population, Furthermore, the results indicated that the efficacy of hearing aids varies depending on the severity of hearing loss, Children with mild to moderate hearing loss showed greater improvement compared to their peers with severe hearing loss, with the former group achieving a 40% increase in auditory performance, versus 20% in the latter group, this disparity underscores the importance of early detection and timely intervention, as individuals with less severe impairment tend to derive greater benefit from amplification devices, the data also revealed a clear positive correlation between the duration of hearing aid use and improvement in auditory perception.

Children who consistently used their hearing aids for more than six months achieved better outcomes than those with shorter usage periods, This finding highlights the critical role of consistent and prolonged use in maximizing the long-term benefits of hearing amplification, in addition, the study underscored the value of integrating auditory and language training programs alongside hearing aid use, Children who received such supplementary interventions exhibited more substantial gains in comprehension and communication skills compared to those who did not.

These results were further supported by parental and teacher reports, which noted noticeable improvements in listening behaviors, attention, and verbal interaction following hearing aid adoption, Such subjective observations align with objective auditory assessment data, enhancing the reliability of the findings, Collectively, these outcomes suggest that hearing aids, when combined with appropriate rehabilitative interventions, can significantly improve auditory and communicative outcomes in children with hearing loss, this reinforces the need for a comprehensive, multidisciplinary approach to the management of pediatric hearing impairment.

2.Presentation and Analysis of Results

2.1. Quantitative Results Analysis

Using the paired-sample t-test, the auditory perception results of children were compared before and after the use of hearing aids, the results showed a statistically significant increase ($p < 0.05$) in the rates of sound and word

discrimination, the mean performance score before using the hearing aids was 45%, which increased to 80% after six months of use.

2.1.1. Effect of Hearing Loss Severity on Effectiveness

The sample was divided into two groups based on the severity of hearing loss (mild to moderate, and severe to profound), the first group showed greater improvement compared to the second group, with a mean improvement in auditory perception of 40% for the first group, compared to 20% for the second group.

2.1.2. Duration of Hearing Aid Use and Its Relationship to Improvement

An analysis of the relationship between the duration of hearing aid use (less than 3 months, 3 months, and more than 6 months) and the level of improvement showed that children who used hearing aids for more than 6 months achieved the best results in auditory perception tests.

2.2. Qualitative Results Analysis

2.2.1. Reports from Parents and Teachers

Qualitative data was collected through questionnaires and interviews with parents and teachers, which indicated a noticeable improvement in children's ability to respond to sounds, understand instructions, and engage in social interactions. These observations reflect the positive impact of hearing aids on children's daily lives.

2.2.2. Role of Rehabilitative Interventions:

The data revealed that children who participated in accompanying auditory and language training programs showed faster and greater improvement in auditory perception compared to those who did not receive such interventions, this highlights the importance of integrating rehabilitative therapy alongside hearing aid use.

Summary of the Analysis

The results underscore the effectiveness of hearing aids as a vital tool in enhancing auditory perception among children-particularly when used consistently and from an early age, they also emphasize the necessity of providing complementary rehabilitative support, moreover, the findings show that the degree of hearing loss significantly influences the extent of benefit gained from hearing aids, which calls for the development of targeted therapeutic programs tailored to the specific needs of each case.

3. Discussion

Hearing impairment is one of the most common sensory disabilities affecting children, and it can significantly impact their linguistic, cognitive, and social development-particularly during early childhood, Given the crucial role of auditory perception in language acquisition and communication skills development, effective rehabilitative interventions are essential to mitigate the consequences of hearing loss and improve the quality of life for affected children, Among such interventions, hearing aids occupy a vital role as assistive technological devices aimed at enhancing the ability to perceive sounds and comprehend speech,Findings from the study demonstrate that hearing aids play a pivotal and effective role in improving auditory perception skills in children with hearing impairment, Regular use of hearing aids contributed significantly to better discrimination of sounds and words, as well as enhanced language comprehension over time, Furthermore, early intervention with hearing aids emerged as a key factor in promoting auditory and linguistic development, Children who began using hearing aids at younger ages exhibited greater progress compared to those who received these devices at later stages, moreover, the study revealed that the effectiveness of hearing aids varies according to the severity and type of hearing loss, Children with mild to moderate hearing loss showed more marked improvements in auditory perception compared to those with severe or profound hearing impairments.

A strong correlation was also observed between consistent, long-term use of hearing aids and improvement in auditory abilities, underscoring the importance of daily adherence to hearing aid use as part of a comprehensive auditory rehabilitation plan another critical factor enhancing the effectiveness of hearing aids was the integration of complementary rehabilitative programs, such as auditory and language training, These programs contributed to the development of communication and social interaction skills, further maximizing the benefits of hearing aids and supporting a holistic approach to treatment that combines technological and behavioral strategies ken together, these findings suggest that hearing aids, when employed within a comprehensive and individualized rehabilitation framework, represent an effective means of improving auditory perception in children with hearing impairment-particularly when applied early, used consistently, and supported by structured rehabilitative interventions.

3.1.Limitations

Despite the positive findings regarding the effectiveness of hearing aids in enhancing auditory perception among children with hearing impairment, several limitations should be considered when interpreting the results, First, the sample size was limited to 30 children, which may affect the generalizability of the

findings to a broader population of hearing-impaired children, Second, the study was conducted over a specific follow-up period, which might not capture the long-term effects of hearing aid use on auditory perception and language development, Third, the study relied on behavioral observations and reports from parents and teachers, which may introduce subjective biases or variability in assessments, finally, there was limited control over environmental and social factors that could influence auditory perception development, such as the level of family support and the quality of intervention services provided, potentially impacting the ability to isolate the effect of hearing aids independently.

3.2. Recommendations

In light of the findings of this study, which demonstrated a positive impact of hearing aids on enhancing auditory perception among children with hearing impairment, the researcher recommends the following:

1. Enhancing early hearing screening programs for newborns to ensure timely intervention and the prompt provision of appropriate hearing aids.
2. Providing suitable hearing aids to all eligible children, particularly those with mild to moderate hearing loss, given their proven effectiveness in improving sound discrimination and word recognition skills.
3. Integrating regular auditory training programs into rehabilitation plans, alongside hearing aid use, to maximize the development of auditory and language skills.
4. Developing awareness and training programs for parents and teachers to enable them to effectively support hearing-impaired children in both home and educational environments, and to monitor their auditory and linguistic progress.
5. Encouraging future research with larger sample sizes, longer follow-up periods, and more diverse age groups and degrees of hearing loss, in order to generalize findings and enhance the quality of intervention practices.

Conclusion

In light of the findings of this study, it is evident that the use of hearing aids is an effective tool in enhancing auditory perception among children with hearing impairments, particularly in cases ranging from mild to moderate hearing loss, the comprehensive follow-up-through auditory and cognitive assessments, as well as behavioral observations and reports from parents and teachers-demonstrated

significant improvements in the children's ability to discriminate sounds, recognize words, and engage with their auditory environment, these results underscore the critical importance of early intervention and the provision of appropriate hearing assistive devices in supporting the auditory and linguistic development of children, accordingly, the study recommends the adoption of early hearing screening programs and the provision of adequate support for children and their families to maximize the benefits of hearing aid use and promote equitable educational and social opportunities.

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