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*Original article*

# The impact of early amplification on the social development of children with hearing loss

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**Introduction**. Early amplification in children with hearing impairment plays a crucial role in their socioemotional and communicative development. Timely identification and intervention are essential to support better outcomes in communication, socialization, and emotional well-being. This study aimed to examine whether children who received hearing amplification before the age of three show better socialization outcomes compared to those amplified after the age of three.

**Methods**. The study involved 52 parents of children, aged between 7 and 11 years with hearing impairment, who completed a specially designed Likert-type questionnaire. The questionnaire consisted of three subscales: Communication, Socialization, and Emotional Stability. The age at which amplification was provided varied: 12 children (23%) received amplification during the first year of life, 17 (33%) during the second year, 13 (25%) during the third year, and 10 children (19%) during the fourth year. In most cases (22 children, or 42%), hearing loss was detected during the second year of life.

**Results**. Children who received amplification before the age of three demonstrated significantly better outcomes in socialization compared to those amplified after the age of three. Additionally, better social interaction in these children was associated with stronger verbal communication skills and greater emotional stability.

**Conclusion**. The findings emphasize the importance of early detection and timely amplification in children with hearing impairments. Amplification provided by the age of three leads to improved socialization, communication, and emotional development, thereby enhancing the overall quality of life for affected children.

**Key words:** hearing impairment, early amplification, socialization

## Introduction

Auditory perception is a complex psychophysiological process preceding the emergence of sounds and speech [1]. Any form of disturbance in auditory perception can contribute to difficulties in verbal communication or in the development of verbal communication, particularly in children. This is because speech signal perception involves both the recognition and understanding of the spoken message; therefore, any problem with perception can extend to

speech disorders and other difficulties within the communication process [2]. For this reason, research focuses on addressing issues occurring at the level of auditory perception in children to enable normal interaction with the external environment and thus, adequate speech-language development and communication. Children with auditory perception disorders experience difficulties in recognizing, processing, and interpreting auditory stimuli, which may lead to delays in speech and language development, learning difficulties, and social and emotional problems.

Amplification, or the use of hearing aids, is one of the primary therapeutic interventions for children with auditory perception disorders. While the effects of amplification have been well studied in children with moderate to severe hearing loss, there is less research on how it affects children with mild to moderate auditory perception disorders [3]. Hearing impairment is the most common congenital sensory deficit that can be detected immediately after birth. According to data provided by the World Health Organization, the incidence of congenital hearing loss among newborns is between 1% and 3% [4].

Early diagnosis of hearing impairment is of crucial importance, as it influences speech-language development, interpersonal relationships, and academic and social life. The prevention of hearing loss is achieved through the implementation of neonatal hearing screening and raising public awareness about the consequences it carries. Today, thanks to neonatal hearing screening in maternity hospitals, it is possible to identify hearing impairments and begin rehabilitation within the first months of a child's life. Following early diagnosis, it is essential to maximize the auditory potential of children with hearing loss and to stimulate its development [5]. The ability to establish relationships with others, share ideas, participate in activities, and experience the environment greatly depends on the state of hearing. Additionally, hearing provides vital information about the environment, including the presence of danger (e.g., sirens, smoke detectors, and warning shouts) [6].

Communication accompanies all human activity. All living beings have a need to communicate, but only humans possess the ability to communicate verbally. It is believed that no form of interaction among people can occur without communication, whether verbal or nonverbal. Speech is defined as language in action, the realization of a verbal symbolic system. Speech is formed and developed as a need to actualize the linguistic system, while language arises and evolves as a product of speech [7]. Amplification, therefore, is not only a means of improving hearing, but also a crucial component of the overall treatment in the rehabilitation of hearing and speech-language abilities, especially when applied early and consistently [8].

Before deciding on the selection of a hearing amplifier, it is necessary to perform a detailed audiological examination. This examination determines whether the hearing loss is conductive, sensorineural, or mixed, as well as whether it is unilateral or bilateral. In cases of unilateral hearing loss, binaural deficit occurs, resulting in difficulties with sound localization and hearing in noisy environments. Conversely, in cases of mild bilateral hearing loss, children struggle to understand soft speech, which complicates comprehension.

Intervention programs for children with articulation or phonological disorders often involve the regular or occasional use of amplification devices. Shriberg [9] recommended the use of "enhanced input" as an integral part of treatment programs for articulation disorders in children. Hodson and Paden [10] described a two-hour session with auditory amplification at both the beginning and end of each session when treating phonological disorders. They emphasized that children with phonological disorders benefited from programs including an intensified presentation of sounds and sound sequences, as that significantly helped directing the child's attention [10].

### *Aim of the Study*

The main aim of this research was to determine whether children who began using auditory amplification by the age of three demonstrated better socialization in everyday functioning compared to children who received amplification at a later age.

## Method

### *Sample*

The study included 52 parents who provided information about their children with hearing impairments (ages 7–11), with an average age of 9 years. The participants were categorized based on the age at which auditory amplification was implemented (early amplification was defined as amplification applied by the age of three). The largest number of children (17, 33%) received amplification during their second year of life. Amplification was applied during the third year for 13 children (25%), while the smallest number, 10 children (19%), received amplification during the fourth year of life or later. The earliest amplification, during the first year of life, was implemented for 12 children (23%). Hearing loss was most diagnosed in the second year of life (22 children, 42%), followed by the first year (18 children, 35%). Diagnosis was less frequent in the third year (11 children, 21%), and the least frequent in the fourth year of life or later (1 child, 2%).

### *Instruments*

For the purposes of this study, a specially designed Likert-type questionnaire was used. The questionnaire was intended for parents of children with various types and degrees of hearing impairment. It was a five-point Likert scale, where the ratings ranged from 1 (the behavior is always present in the child) to 5 (the behavior is never manifested). Parents were asked to indicate their level of agreement with specific statements. The questionnaire included statements designed to collect data on the children's communication, socialization, emotional stability, and auditory functioning in relation to the age at which auditory amplification was initiated. The questionnaire consisted of three subscales: Communication (7 items), Socialization (6 items), and Emotional Stability (7 items). This paper presents the results obtained from the Socialization subscale. Certain items on this subscale (items 3, 4, and 5) had to be reverse-coded so that higher values reflected better social abilities, while lower values indicated poorer ones. Accordingly, the theoretical minimum score on this subscale is 6, and the maximum is 30.

Before the main study, a pilot study was conducted on a small sample (15 parents of childrens with hearing dissabilities) to preliminarily assess the internal consistency of the questionnaire. Analysis using Cronbach's alpha coefficient yielded a value of 0.90, indicating high reliability of the scale. The same instrument was used in the main study without significant modifications. Validation in terms of content or construct validity was not performed, representing a limitation of the study and would be addressed in future research.

## Results

The study included 52 parents (of both sexes) of children with hearing impairments, whose hearing loss was detected and treated with amplification at different ages. The obtained data indicate that in most children (22, 42%), hearing loss was detected during the second year of life. Additionally, the average identification-to-intervention coefficient of 0.83, obtained in our study, suggests a relatively good temporal connection between the detec-

tion of hearing loss and the implementation of amplification. This may point to the importance of prompt action following diagnosis to minimize the impact of hearing loss on language development and cognitive abilities in children, indicating that early detection and amplification are key to successful intervention and development of children with hearing impairments.

Table 1 shows the sample structure, i.e., the distribution of children according to the age at which amplification was performed and the age at which hearing loss was detected, along with the total number of children in each category.

In addition, by applying the following formula: age at detection of hearing loss / age at amplification, the identification-to-intervention coefficient was calculated for each participant individually. The average identification-to-intervention coefficient for the entire sample was 0.83.

**Table 1.** Age of hearing impairment detection and implemented amplification

| Time of Amplification | Age at Hearing Impairment Detection | | | | Total |
|---|---|---|---|---|---|
| | First year | Second year | Third year | Fourth year and later | |
| During the first year | 12 | 0 | 0 | 0 | 12 |
| During the second year | 6 | 11 | 0 | 0 | 17 |
| During the third year | 0 | 9 | 4 | 0 | 13 |
| During the fourth year and later | 0 | 2 | 7 | 1 | 10 |
| Total | 18 | 22 | 11 | 1 | 52 |

The ability to establish relationships with others, share ideas, and participate in daily activities largely depends on the condition of one's hearing. The importance of sounds in a child's development can be observed even in the earliest stages of infancy, changes in voice intonation convey feelings of security, fear, or satisfaction to the baby. As the child grows, socialization extends from family members to the immediate and then wider environment. How socialization will be achieved in children with hearing loss greatly depends on the timing of amplification and the initiation of rehabilitation.

Results obtained from the Socialization subscale showed that children who began using hearing amplification before the age of three demonstrated better socialization, more easily established social contacts, and participated more actively in daily functioning (Figure 1).

Based on Figure 1, it can be concluded that most parents do not believe their child prefers to be alone rather than in the company of peers. Furthermore, most of the parents report that their child often shows initiative in establishing social contacts, as well as interest in participating in extracurricular activities. Most of the surveyed parents do not notice signs of distress in their child after being in a noisy environment, and they also believe that their children do not avoid activities involving a larger group of peers.

The results presented in Table 2 indicate a statistically significant difference on the Socialization subscale between the two groups of participants, divided based on the age at which amplification was performed (during the second year or the fourth year and later). Children who received amplification during the second year show better results on the Socialization subscale.

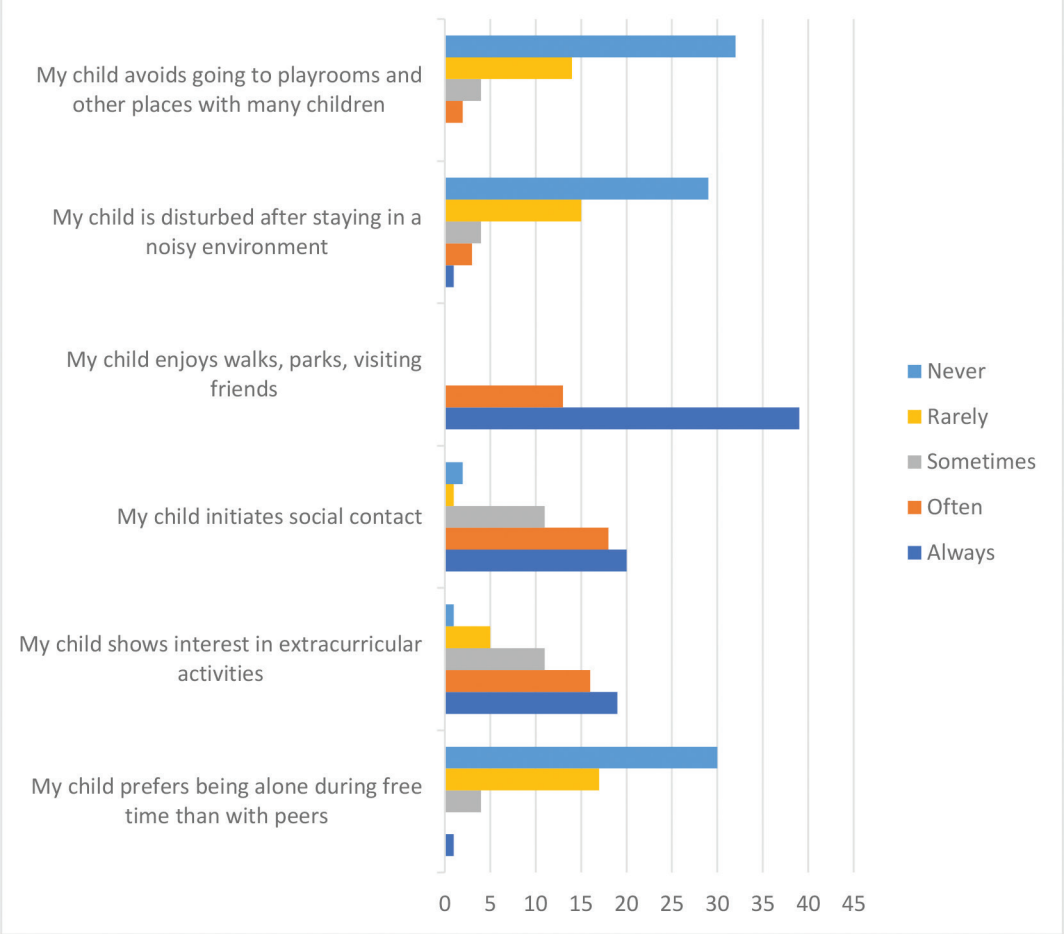


**Figure 1.** Descriptive data of the total sample results on the Socialization subscale

**Table 2.** Differences in total scores on the Socialization subscale between groups of participants divided according to the age at which amplification was applied (during the second year or fourth year and later)

| | N | Mdn | Min | Max | Man-Vitni U | Z | P |
|---|---|---|---|---|---|---|---|
| During the second year | 17 | 28.00 | 20.00 | 30.00 | 29.000 | -2.829 | .004 |
| During the fourth year and later | 10 | 22.50 | 17.00 | 30.00 | | | |

N - number of participants, Mdn - median, Min - minimum value in the sample, Max - maximum value in the sample, ManVitni U-test - test for two samples, Z - standardized score in the Mann-Whitney test, p - statistical significance

**Table 3.** Differences in the total score on the Socialization subscale between groups of participants divided according to the age at which amplification was performed (during the third year or the fourth year and later)

| | N | Mdn | Min | Max | Man-Vitni U | Z | p |
|---|---|---|---|---|---|---|---|
| During the third year | 13 | 29.00 | 20.00 | 30.00 | 25.500 | -2.467 | .014 |
| During the fourth year and later | 10 | 22.50 | 17.00 | 30.00 | | | |

N - number of participants, Mdn - median, Min - minimum value in the sample, Max - maximum value in the sample, ManVitni U-test - test for two samples, Z - standardized score in the Mann-Whitney test, p - statistical significance

Table 3 presents results indicating differences between the group of participants who received amplification in the third year of life and those who were amplified in the fourth year or later. The group that received amplification during the third year consisted of 13 participants, while the group amplified during the fourth year or later consisted of 10 participants. The results show a statistically significant difference in achievements on the Socialization subscale between these two groups. Children who received amplification during the third year demonstrated better socialization than those amplified in the fourth year or later.

To examine parents' satisfaction with the hearing aid used by their child, a short questionnaire was applied. Based on the results, 43 parents (82.7%) reported being satisfied with the hearing aid their child uses, while 9 (17.3%) were undecided, answering "yes and no." No parent reported dissatisfaction with their child's hearing aid. The results indicate that early amplification is crucial for the development of children with hearing loss, while parents simultaneously express a high level of satisfaction regarding the use of hearing amplification, which is a positive indicator of successful intervention and rehabilitation. Modern advancements in amplification technology significantly improve the quality of sound delivered to users with various types of hearing impairments. This is also confirmed by the results of this study, where all parents expressed satisfaction with the amplifiers used by their children. Parents also reported their sources of information about hearing aids. Many parents (28, 54%) stated that they received information from multiple sources (doctors, internet, family, and friends), while 13 (25%) cited doctors as their primary and sole source of information. The internet was the main source of information on the benefits of hearing aids for 10 parents (19%). Only one parent (2%) listed friends and family members as the main source of information.

## Discussion

The results of this study showed that there were significant differences in the level of socialization between the group of children who received amplification before the age of three and the group of children who were amplified in the fourth year of life or later. These differences, in favor of the children who received amplification at an earlier age, indicate that earlier amplification is associated with better outcomes in socialization and the establishment of social contacts. Specifically, the early use of amplification in children can significantly influence the development of socialization and the child's inclusion in everyday activities without relying on sign language or gestures as the primary means of communication.

Regarding verbal communication, most responses indicated that children who were amplified by the age of three frequently used verbal communication, while the use of gestures was very rare. Parents' responses to questions related to their child's emotional functioning did not show statistically significant differences between children who received amplification before the age of three and those who received it later. However, a clear connection was observed between successful social interactions, better-developed communication skills, and emotional stability. This result may indicate the significant role of parents and the child's environment in emotional functioning.

The data we obtained show that all parents are satisfied with the hearing amplification devices their children use, and that they obtain information about amplification from multiple sources. These findings highlight the need for a centralized center where parents can receive all necessary information about hearing aids.

Results from other studies also show that children who use hearing aids or cochlear implants from an early age (before the age of three) have a greater chance of developing listening and speaking skills, as these devices provide

access to auditory information during critical stages of language development, thereby enabling more successful social interactions [11]. The mentioned study on Auditory-Verbal Therapy (AVT) confirms that early amplification and a focus on auditory input help children develop speech without the need for sign language, better integrate into society, and achieve improved social interactions [11]. This therapy encourages children with hearing loss to use their residual hearing to develop verbal communication, thereby reducing the need for gestures or sign language. Additionally, Mayer and Trezek [12], in their research, emphasize that early identification of hearing loss and the use of technology allow children to more easily establish social contacts and acquire speaking skills at the same level as their peers without hearing loss [12].

## Conclusion

The results of this study indicate a high level of parental satisfaction with the hearing aids used by their children, with none of the respondents expressing dissatisfaction. Most parents reported receiving information about hearing amplification from multiple sources, reflecting their awareness of recent technological advancements in the field.

Analysis of the Socialization subscale showed that children who received amplification before the age of three demonstrated significantly better socialization outcomes compared to those who were amplified later. Moreover, a consistent association was observed between stronger communication skills, more successful social interactions, and higher levels of emotional stability.

These findings highlight the importance of early detection of hearing loss and timely amplification, as early intervention can contribute to better verbal communication, greater social inclusion, and more stable emotional development in children with hearing impairment. Accordingly, timely audiological screening and appropriate rehabilitation strategies should be recognized as essential components of pediatric care to optimize developmental outcomes for children with hearing loss.

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**Ethical approval.** The Ethics Committee of the Hospital "Serbia", East Sarajevo, Republic of Srpska, Bosnia and Herzegovina, approved the study and informed consent was obtained from all individual respondents. The research was conducted according to the Declaration of Helsinki.

**Conflicts of interest**. The authors declare no conflict of interest

### References:

1. Fatić S, Stanojević N, Stokić M, Nenadović V, Jeličić L, Bilibajkić R, et al. Electroencephalographic correlates of word and non-word listening in children with specific language impairment: An observational study20F0. Medicine (Baltimore) 2022;101(46):e31840.
2. Punišić S, Subotić M, Čabarkapa N. Uticaj intenziteta govornog signala na proces govorne percepcije kod dece sa govorno-jezičkim poremećajima. U: Sovilj M, urednik. Poremećaji verbalne komunikacije: prevencija, dijagnostika, tretman. Beograd: IEFPG; 2007.
3. Ostojić SB. Savremeni modeli amplifikacije senzoneuralnih i konduktivnih oštećenja sluha. Specijalna edukacija i rehabilitacija 2012;11(3):469–82.
4. World Health Organization. Deafness and hearing loss [Internet]. Geneva: WHO; 2024 [cited 2024 Sep 27]. Available from: https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss
5. Nikolić M, Ostojić S, Mirić D. Primena upitnika za roditelje u proceni auditivnih sposobnosti gluve i nagluve dece. 8. Međunarodni naučni

skup „Specijalna edukacija i rehabilitacija danas“. Beograd, 2014. Zbornik radova. Univerzitet u Beogradu, Fakultet za specijalnu edukaciju i rehabilitaciju, Beograd, 2014; 65–72.

6. Arlinger S. Negative consequences of uncorrected hearing loss—a review. Int J Audiol 2003;42(Suppl 2):S17–20.
7. Arsenić I. Karakteristike govora i glasa kao prediktori kvaliteta komunikacije kod odraslih osoba sa dizartrijom. Doctoral dissertation. Beograd: Univerzitet u Beogradu, Fakultet za specijalnu edukaciju i rehabilitaciju, 2019.
8. Byrne D, Dillon H, Tran K, Arlinger S, Wilbraham K, Cox R, et al. An international comparison of long-term average speech spectra. J Acoust Soc Am 1994;96(4):2108–20.
9. Shriberg LD. Natural phonologic process approach. In: Perkins WH, editor. Phonologic-articulatory disorders. New York: Thieme-Stratton; 1983. p. 137–53.
10. Hodson BW, Paden EP. Targeting intelligible speech. San Diego: College-Hill Press; 1983.
11. Maggio De Maggi M. Auditory-verbal therapy. Teach to listen to learn to speak. Auditio 2004;2(3)64–73.
12. Mayer CC, Trezek BJ. Communication, language, and modality in the education of deaf students. Educ Sci 2023;13(10):1033.

## Uticaj rane amplifikacije na socijalni razvoj dece sa gubitkom sluha

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**Uvod**. Rana primena slušnih pomagala kod dece sa oštećenjem sluha igra ključnu ulogu u njihovom socioemocionalnom i komunikativnom razvoju. Pravovremeno otkrivanje i intervencija od suštinskog su značaja za bolje ishode u komunikaciji, socijalizaciji i emocionalnom blagostanju. Cilj ove studije bio je da se ispita da li deca koja su dobila slušna pomagala pre navršene treće godine pokazuju bolje rezultate u socijalizaciji u poređenju sa onima koji su ih dobili nakon treće godine.

**Metode**. Istraživanje je obuhvatilo 52 roditelja dece sa oštećenjem sluha, uzrasta između 7 i 11 godina, koji su popunili posebno dizajniran Likertov upitnik. Upitnik je obuhvatao tri podskale: Komunikacija, Socijalizacija i Emocionalna stabilnost. Uzrast u kojoj je primenjena auditivna amplifikacija se razlikovala: 12 dece (23%) dobilo je slušna pomagala u prvoj godini života, 17 (33%) u drugoj godini, 13 (25%) u trećoj, a 10 dece (19%) u četvrtoj godini. U većini slučajeva (22 dece, odnosno 42%) gubitak sluha je otkriven u drugoj godini života.

**Rezultati**. Deca koja su dobila slušna pomagala pre treće godine pokazala su znatno bolje rezultate u socijalizaciji u poređenju sa onima koja su pomagala dobila nakon treće godine. Takođe, bolja socijalna interakcija kod ove dece bila je povezana sa snažnijim verbalnim komunikacijskim veštinama i većim stepenom emocionalne stabilnosti.

**Zaključak**. Nalazi istraživanja naglašavaju značaj ranog otkrivanja oštećenja sluha i pravovremene primene slušnih pomagala. Amplifikacija sprovedena do navršene treće godine života dovodi do boljih ishoda u socijalizaciji, komunikaciji i emocionalnom razvoju, čime se značajno unapređuje kvalitet života dece sa oštećenjem sluha.

**Ključne reči:** oštećenje sluha, rana amplifikacija, socijalizacija