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Impact of socioeconomic factors on paediatric cochlear implant outcomes

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ABSTRACT

Objectives: The study was aimed at evaluating the impact of certain socioeconomic factors such as family income, level of parents' education, distance between the child's home and auditory verbal therapy clinic, and age of the child at implantation on postoperative cochlear implant outcomes.

Methods: Children suffering from congenital bilateral profound sensorineural hearing loss and a chronological age of 4 years or younger at the time of implantation were included in the study. Children who were able to complete a prescribed period of a 1-year follow-up were included in the study. These children underwent cochlear implantation surgery, and their postoperative outcomes were measured and documented using categories of auditory perception (CAP), meaningful auditory integration (MAIS), and speech intelligibility rating (SIR) scores. Children were divided into three groups based on the level of parental education, family income, and distance of their home from the rehabilitation– auditory verbal therapy clinic.

Results: A total of 180 children were studied. The age at implantation had a significant impact on the postoperative outcomes, with an inverse correlation. The younger the child's age at the time of implantation, the better were the postoperative outcomes. However, there were no significant differences among the CAP, MAIS, and SIR scores and each of the three subgroups. Children from families with an annual income of less than \$7,500, between \$7,500 and \$15,000, and more than \$15,000 performed equally well, except for significantly higher SIR scores in children with family incomes more than \$15,000. Children with of parents who had attended high school or possessed a bachelor's or Master's master's degree had similar scores, with no significant difference. Also, distance from the auditory verbal therapy clinic failed to have any significant impact on a child's performance.

Discussion: These results have been variable, similar to those of previously published studies. A few of the earlier studies concurred with our results, but most of the studies had suggested that children in families of higher socioeconomic status had better speech and language acquisition.

Conclusions: Cochlear implantation significantly improves auditory perception and speech intelligibility of children suffering from profound sensorineural hearing loss. Younger The younger the age at implantation, the better are the results. Hence, early implantation should be promoted and encouraged. Our study suggests that children who followed the designated program of postoperative mapping and auditory verbal therapy for a minimum period of 1 year seemed to do equally well in terms of hearing perception and speech intelligibility, irrespective of the socioeconomic status of the family. Further studies are essential to assess the impact of these factors on long-term speech acquisition and language development.

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1. Introduction

A cochlear implant is a device that can help children with severe to profound hearing loss acquire the ability to hear and develop communication skills like their normally hearing peers [1,2].

Significant advances have been made in the field of cochlear implantation technology, which have led to marked improvements in postoperative outcomes. However, postimplantation outcomes vary widely [3]. There still remains a subset of children who fail to gain maximal benefit, even after years of persistent usage of the device on a daily basis [4]. There is apparently a multitude of factors affecting the performance of a child postimplantation. These include patient characteristics such as cochleovestibular anatomy [3], duration of deafness [5], age at onset of deafness, age at implantation [6,7], duration of implant use, length of daily device use [8], and preoperative level of residual hearing [9]. A younger age at implantation, especially before the age of 24 months, is associated with an increased rate of speech acquisition. This rate is comparable with the rate of speech acquisition in normally hearing peer groups [10].

Other factors that have been reported to influence the performance of children after cochlear implantation involve social and educational considerations. These include predominant mode of communication, such as oral or sign language [11], parental and familial expectations [12], socioeconomic status, family income [13], and postimplantation auditory verbal therapy [14].

Cochlear implantation outcomes can be affected by socioeconomic factors in many ways. The earlier a child undergoes cochlear implantation, the greater are the chances that the child will develop near-normal linguistic skills [15]. Furthermore, spoken language scores are known to slope downward with increasing age at the time of implantation [16].

Parental education and familial income constitute the main factors on the basis of which families are categorized into various socioeconomic groups. These factors are known to be predictive of communication skills in children with normal hearing [17]. Children belonging to families of higher socioeconomic status have been found to have better reading skills [18]. One factor contributing to this finding may be that a higher family income has been associated with a higher level of maternal education and increased involvement of the mother when communicating with the child.

Wu et al. have observed that implanted children belonging to predominantly non-English-speaking, socioeconomically disadvantaged backgrounds develop speech perception at a significantly slower rate as compared to a normalized national cohort [13]. They concluded that socioeconomic status is inextricably linked to causative factors, such as parental education and support, patient compliance with the device, mode of communication, and type of school and rehabilitation program attended. All these factors are known to have a significant impact on the overall outcome after cochlear implantation [19–23].

There is a direct relationship between socioeconomic status and spoken language comprehension skills that has been observed in all the above-cited studies. This is attenuated when a multivariable analysis is carried out, taking into account factors such as family income, maternal education, and maternal involvement in enhancing the communication of the child [3].

Cochlear implantation, along with aural rehabilitation, results in increased access to acoustic information and spoken language, leading to higher rates of placement in mainstream schools [24]. This decreases the overall educational cost of an implantee. Hence, auditory verbal therapy is known to improve postimplantation performance significantly because it is associated with a higher rate of improvement in auditory resolution and speech perception [25,26]. Therefore, parents are advised to have the child attend

auditory verbal therapy sessions for up to 2 years after implantation because an increased number of therapy hours has been associated with greater speech emphasis [11].

The demanding schedules of therapy sessions require a considerable deal of zeal and compliance among parents. This becomes increasingly difficult for patients from a lower socioeconomic group who may have time constraints, loss of work, expenses involved, and increasing distance of the patient's residence from the therapy clinic. Patients who live at a distance more than about 30 miles (50 km) from the therapy clinic usually have to apply for leave from work and be absent from their families and homes to be able to attend auditory verbal therapy sessions according to the designated time schedule. Families who live far from the implant center often have to shift their households temporarily and rent a home near the implant center to obtain maximal benefit. This applies especially to younger children, who always need to be accompanied by parents [14].

We have conducted a retrospective study in a tertiary care hospital in a city in India. This was done in an attempt to ascertain the impact of socioeconomic factors such as parental education, family income, and distance from the therapy clinic on postoperative cochlear implant outcomes.

India is a land of extremely diverse landscapes, with a wide socioeconomic disparity in society. With a population of over 1.25 billion people [27], the country has relatively few cochlear implant centers, most of which are located in and around the major metropolitan cities. Consequently, parents often have to travel a significant distance to obtain access to a cochlear implant center for their deaf child.

There is a paucity of studies investigating relationships among socioeconomic factors such as parental education, family income, and distance from the child's residence to the therapy clinic. These factors are thought to have a significant impact on postoperative mapping and rehabilitation and hence on overall cochlear implantation outcomes. To design programs that would optimize the benefits of cochlear implantation for children from diverse socioeconomic groups, these factors should be investigated further.

2. Materials and methods

This was a retrospective observational study in which no power calculations were made. The study data were retrieved from patients' records from January 1, 2006 until December 1, 2014. Children younger than 4 years who underwent unilateral cochlear implantation were included.

In each case, a few socioeconomic variables, such as parents' education, family income, and distance of the residence from the speech therapy clinic were documented based on parent report, education certificate, income certificate, and proof of address. The distance between the patient's home and the clinic was recorded using Google maps. These factors were then analyzed and correlated with postimplantation outcome.

India boasts of a rich cultural and linguistic diversity; thus, there are about 1652 languages and many dialects that are spoken throughout the country [28]. We have used categories of auditory perception (CAP), meaningful auditory integration (MAIS), and the speech intelligibility rating (SIR) to assess the postoperative outcomes uniformly because very few standardized questionnaires for speech perception are available in languages other than English.

2.1. Participants

Children with a chronologic age of 4 years or younger at the time of implantation, with bilateral congenital profound sensorineural hearing loss, normal intellect, and radiologically normal

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