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Original Article / Çalışma - Araştırma

The impact of social and demographic features on comprehensive receptive and expressive performance in cochlear implant patients

Koklea implantı yapılan hastalarda sosyal ve demografik özelliklerin komprehensif reseptif ve ekspresif performans üzerine etkisi

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Objectives: This study aims to observe the effects of social and demographic factors on the language development of prelingual pediatric cochlear implant patients.

Patients and Methods: Between April 2006 and April 2010, 44 children (26 boys, 18 girls; mean age 81.1±16.9 months; range 54 to 115 months) who were prelingually implanted and who had an implant experience of at least 36 months were retrospectively analyzed. Only the patients without mental-motor retardation, cochlear anomaly and revision surgery and who continued their education without any interruption were selected. Receptive and expressive vocabulary tests were performed on these patients. Social and demographic features including gender, implant age, parents' education status and annual income were recorded. The relationship between language development and socio-demographic factors were investigated.

Results: Patients implanted before the age of 36 months showed better levels of receptive and expressive language. Children with higher maternal education levels showed significantly better expressive and receptive equivalent language ages. Annual income of the families had significant positive impacts on the language development of the children who were implanted before the age of 36 months.

Conclusion: Both expressive and receptive language skills over 36 months of implant experience are significantly associated with age at the time of the implant and socio-economic status of the parents.

Key Words: Cochlear implantation; expressive language; receptive language.

Amaç: Bu çalışmada sosyal ve demografik özelliklerin prelingual pediatrik koklea implantı yapılan hastaların dil gelişimi üzerindeki etkileri gözlendi.

Hastalar ve Yöntemler: Nisan 2006 - Nisan 2010 tarihleri arasında prelingual olarak implant takılan ve en az 36 ay implant deneyimi olan 44 çocuk (26 erkek, 18 kız; ort. yaş 81.1±16.9 ay; dağılım 54-115 ay) retrospektif olarak incelendi. Yalnızca mental-motor retardasyonu, koklear anomalisi olmayan ve revizyon cerrahisi yapılmayan ve eğitimini ara vermeden kesintisiz sürdüren hastalar seçildi. Bu hastalara reseptif ve ekspresif kelime testleri yapıldı. Cinsiyet, implant yaşı, ebeveynlerin eğitim durumu ve yıllık gelirleri gibi sosyal ve demografik özellikleri kaydedildi. Dil gelişimi ve sosyo-demografik faktörler arasındaki ilişkiler incelendi.

Bulgular: Otuz altı aydan önce implant takılan hastaların reseptif ve ekspresif dil düzeyleri daha iyiydi. Maternal eğitim düzeyi yüksek olan çocukların ekspresif ve reseptif eş değeri dil yaşları anlamlı düzeyde daha iyiydi. Ailelerin yıllık gelirlerinin 36 aydan önce implant takılan çocukların dil gelişimine anlamlı düzeyde olumlu etkileri vardı.

Sonuç: Otuz altı aydan sonra takılan implantlarda hem ekspresif hem de reseptif dil becerileri, implant yaşı ve ebeveynlerin sosyo-ekonomik durumları ile anlamlı düzeyde ilişkilidir.

Anahtar Sözcükler: Koklea implantasyonu; ekspresif dil; reseptif dil.

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Early fitting of hearing aids when sufficient residual hearing is present has a significant impact on language development.[1] However, for infants with a hearing loss level exceeding the limits of conventional amplification, no other treatment option is available than cochlear implants.

The ultimate goal of pediatric cochlear implantation is to provide sufficient hearing for speech and language development.[2] However, this goal may not be met in a proportion of implanted children and implantation may not always provide sufficient hearing for them to acquire adequate language skills.[3-5] There may be many factors that impact on the success of the implant.

Most children with profound deafness develop language abilities at approximately half the rate of their normal hearing peers. On the other hand, cochlear implantation enables access to a substantial amount of auditory information, which allows impaired children to develop language skills more rapidly than their non-implanted peers.[6] Language development following cochlear implantation takes place at a rate comparable to that shown by hearing children with similar initial language skills.[7] Early implantation minimizes the gap between the chronological and linguistic age, where this period is the most critical period of the language development. When the implanted child continues with device usage, the linguistic abilities of the child increase, so catching up or coming close to their hearing peers is possible.[5,8]

It is well known that effective language use requires successful development and integration of a range of language subskills. An implanted child should achieve "successful orchestration" of all five rule systems of communication, including pragmatics, semantics, syntax, morphology, and phonology.[9] Therefore, comprehensive evaluation of each of these areas presents the communication outcomes. Following cochlear implantation, some aspects of language are enhanced more than others; first of all, receptive and expressive concepts are enhanced, but the development of comprehension of syntax and morphology may be delayed.[10,11] In order to evaluate these skills, a number of tests are available with largely similar contents.[12]

The purpose of this study was to observe the benefits of early cochlear implantation in terms of development of expressive and receptive language. Some of the social and demographic factors that were thought to effect language development were also observed. The language outcomes of children who used their implants for at least 36 months were compared with those of children with normal hearing in terms of receptive and expressive language skills according to implant ages and some other social and demographic factors.

PATIENTS AND METHODS

Patients who were implanted in the prelingual period at the İstanbul University Faculty of Medicine Department of Otolaryngology, Head and Neck Surgery between April 2006 and April 2010 were evaluated retrospectively. Children who used their implants for at least 36 months and continued regularly with their education program were selected. Patients with mental or motor retardation, cochlear anomalies and active implant electrodes less than 12 were excluded from the study. Also, some of the parents declined to participate in this study. According to these criteria, the study was conducted on 44 patients (26 boys, 18 girls; mean age 81.1±16.9 months; range 54 and 115 months).

For the evaluation of the language outcomes of cochlear implantation, Turkish Communication Behaviors Inventory (TIGI) were used.[13] The test material was enhanced after the assessment of 3679 non-retarded children with normal

Table 1. Distribution of the selected demographic features

	n	%
Gender		
Male	26	59.10
Female	18	40.90
Side		
Right	39	88.60
Left	5	11.40
Implant		
Advanced bionics	5	11.40
Medel	28	63.60
Neurelec	4	9.10
Nucleus	7	15.90
Implant age		
≤36 months	25	56.80
>36 months	19	43.20

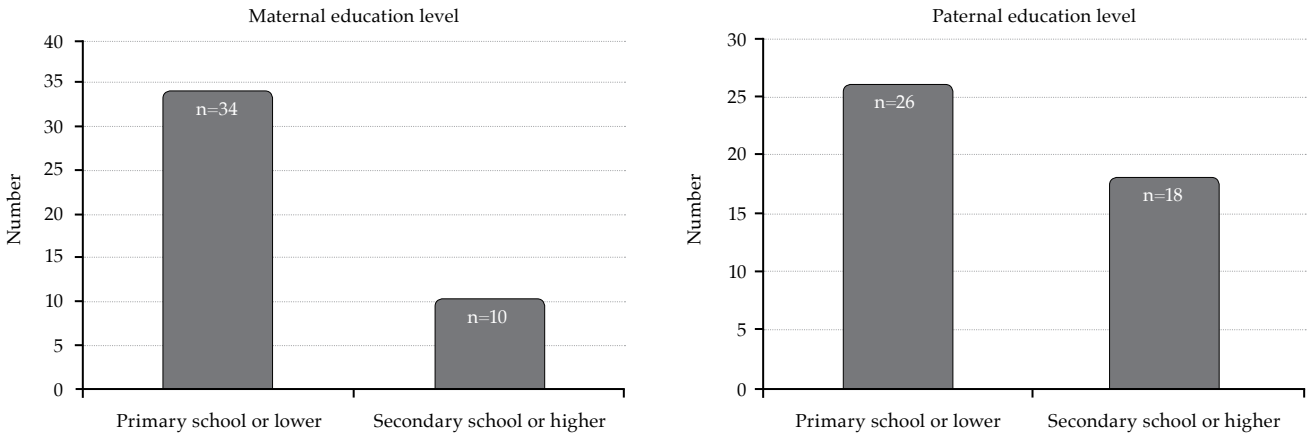

Figure 1. *Parental education levels.*

hearing levels, and standardized for the children between 2 to 12 years of age.

Social and demographic characteristics including the age at implantation, current age, gender, parental education status, and annual family income were also recorded. Parents were asked about satisfaction with the implant device and related technical support. The relations between the language development and factors like the age at the implantation and socio-demographic factors were observed.

The statistical analysis of data was performed using the SPSS (SPSS Inc., Chicago, Illinois, USA) version 17.0. The Mann-Whitney U-test or the Wilcoxon test was employed for ordinally scaled and abnormally distributed variables. A result of $p \leq 0.05$ was considered significant.

RESULTS

The patients were implanted between 13 and 71 months with a mean age of 35.4 months. Before the age of 36 months, 25 patients (56.8%) were implanted; the remaining 19 (43.2%) were implanted after the age of 36 months (Table 1).

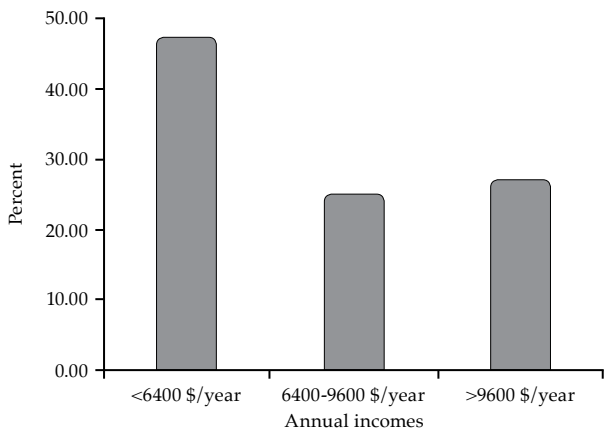

Figure 2. *Annual family incomes.*

Evaluation of parental educational levels demonstrated that 34 mothers (77.27%) had an education level equivalent to primary school or lower and 10 mothers (22.73%) had an education level equivalent to high school or greater. Unfortunately, similar results were observed in paternal education levels; 26 fathers (59.1%) graduated from primary school or lower and 18 fathers (40.9%) completed high school or greater (Figure 1).

Assessment of the annual incomes of families showed that 21 of the families had an income lower than $6400/year, 11 families had an income of $6400-$9600/year and 12 families had an income higher than $9600/year (Figure 2).

The evaluation of language development demonstrated that equivalent ages for expressive language ranged between 25-82 months of age with a mean equivalent age of 50.2 months. Equivalent receptive language ages were lower than equivalent expressive language ages and ranged between 25-70 months with a mean age of 44 months. Patients implanted before the age of 36 months showed better levels for receptive and expressive language and this was statistically significant ($p<0.05$) (Figure 3, 4).

Children with higher maternal education levels showed significantly better expressive and receptive equivalent language ages ($p<0.05$). No significant relation was observed between paternal education levels and children's language levels (Figure 5).

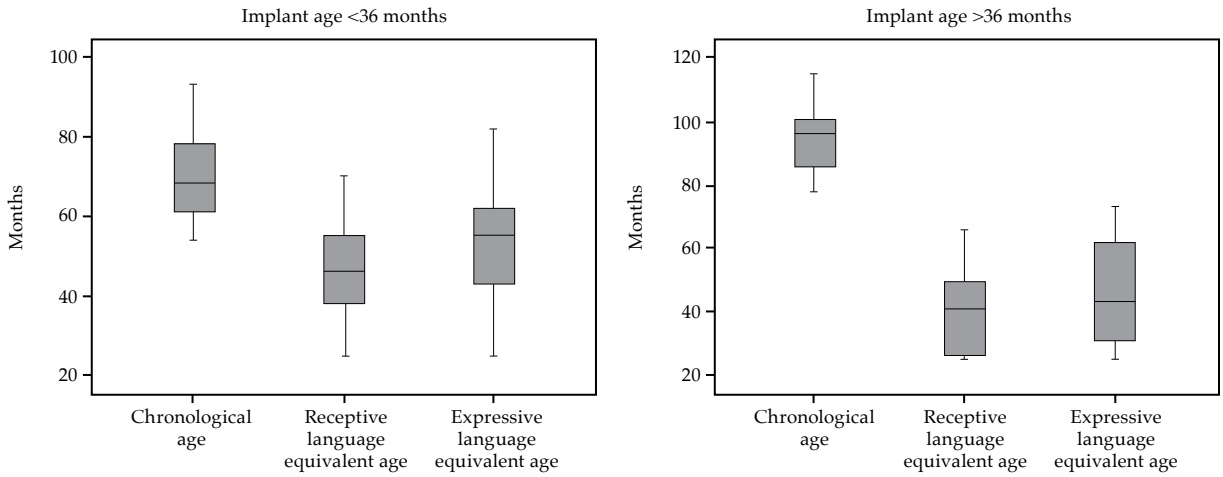

Figure 3. *Receptive and expressive language equivalent ages (months) distribution.*

Annual income of the families had significant positive impacts on the language development of children who were implanted before the age of 36 months ($p<0.05$). Similar effects were not observed in the group implanted after the age of 36 months (Figure 6). No relation was observed between family satisfaction and the implant device, related technical support and language development.

DISCUSSION

Current results demonstrate that early implantation in infants has significant effects on the development of receptive and expressive language skills, minimizing language delays and promoting the development of age-appropriate skills.[14,15] It is well known that the period between the second and fourth year of life is a critical period in language development.[16]

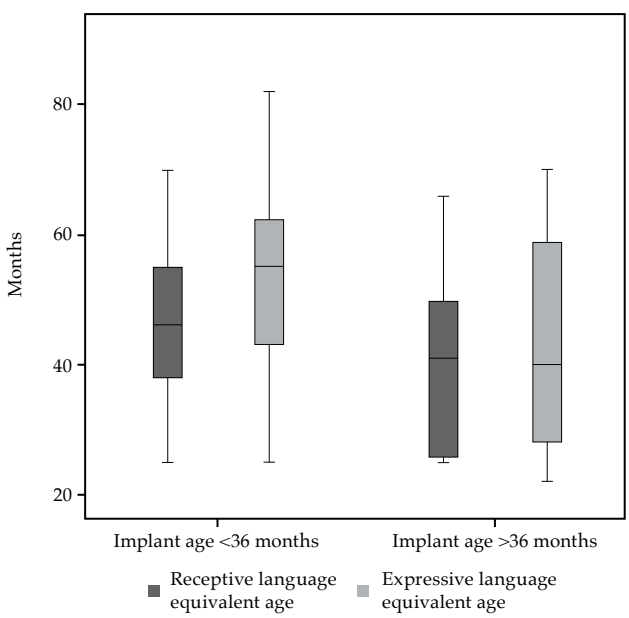

Figure 4. *Comparison of expressive and receptive language equivalent ages between implant age groups.*

It has been thought that girls exhibit a verbal advantage over boys in both normal hearing and impaired hearing populations[17,18] but the present analysis demonstrates no difference in language development between male and female children. In the literature this advantage was apparent in females after 4-6 years of implant use, where girls scored significantly better than boys in measures of speech production, English language competence and reading skills.[18]

Characteristics of the prelingually deaf children's families and the educational levels of the parents may affect the rate of language acquisition following cochlear implantation. In our study the impact of parental education levels on language development were found to be as expected. Most of the parents had an educational level equivalent to primary school or lower, similar to the general public educational levels in Turkey.[19] We are not aware of any study in the English literature linking parental education levels and language development in implanted children. Maternal educational levels were significantly related with children's language development in both implant age groups; accordingly, maternal education level ameliorates the child's linguistic success. It seems

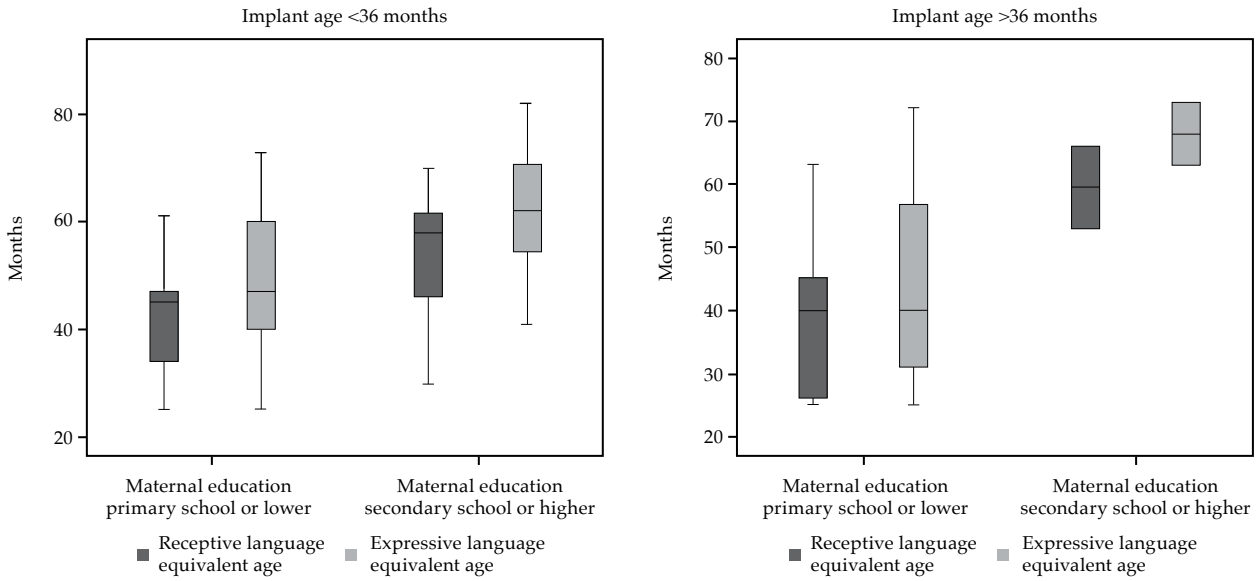

Figure 5. *Comparison of expressive and receptive language equivalent ages according tomaternal education level groups.*

that in the Turkish family structure mothers feel themselves more responsible than fathers about raising children, such that the educational levels of the fathers were irrelevant.

Results concerning family income determined that higher family incomes provided better receptive and expressive language levels in the early implanted group. But there was no correlation between income and language development in the late implanted group. There are few studies about the correlation between family environment and language development. Family factors associated with language progress in children with hearing loss include higher parent education and income[18,20] and parental involvement in linguistic development.[21,22] The impact of these family factors may interact with educational factors, since children enrolled in oral-aural preschools tended to exhibit a more favorable family environment profile.[23]

In summary, several publications as well as our study demonstrated that the age at implantation was the most critical factor for language

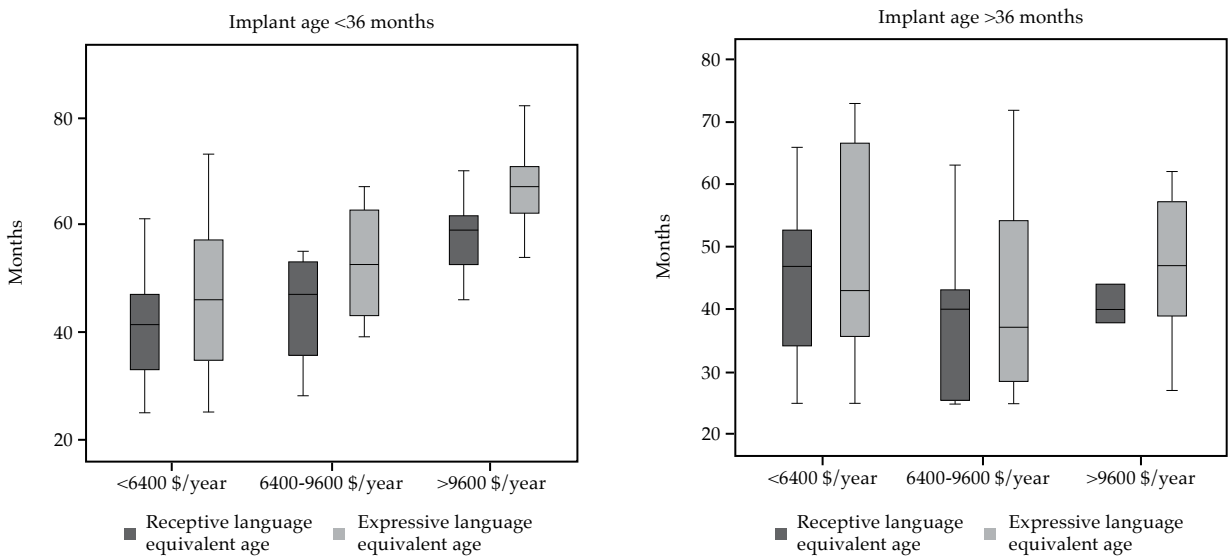

Figure 6. *Comparison of expressive and receptive language equivalent ages among different family income groups.*

development. Besides the age at implantation, other factors are also important for language development in children, such as maternal education and family income.

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