

# Predictors of language and auditory skills in Egyptian children with a cochlear implant

Asmaa Abdel Hamid<sup>a</sup>, Mohammed Elshazly<sup>b</sup>, Tarek Eldessouky<sup>c</sup>, Hosam Abdel Ghaffar<sup>e</sup>, Ahmed Radwan<sup>f</sup>, Ahmed Abdel Monem<sup>d</sup>

<sup>a</sup>Lecturer of Phoniatrics, Phoniatrics Unit, Kasr Aini, Cairo University, <sup>b</sup>Professor of ENT, Department of ENT, Cairo University, <sup>c</sup>Assistant Professor of Audiology, Beni Suef University, <sup>d</sup>Professor of Audiology, Fayoum University, <sup>e</sup>Specialist of ENT Student's Hospital, Cairo University, <sup>f</sup>Assistant Lecturer of Phoniatrics, Beni Suef University, Egypt

Presented by Asmaa Abdel Hamid as oral presentation in the 13th international conference on cochlear implants and other implantable auditory technology, Munich, Germany, June 2014.

Correspondence to Asmaa Abdel Hamid, Phoniatrics Unit, Cairo University, Haram St. Giza, Egypt  
Tel: +20 100 435 4095, +20 111 321 1152;  
fax: +20 235 604 090;  
e-mail: drasmaa\_arm2009@yahoo.com

**Received** 07 November 2014

**Accepted** 09 February 2015

**The Egyptian Journal of Otolaryngology**  
2015, 31:170–175

## Aim

The aim of this study was to investigate the prognostic factors contributing toward the comprehension and production of Arabic language as well as auditory abilities after cochlear implantation of Egyptian children.

## Participants and methods

A total of 150 children with severe to profound sensory neural congenital hearing loss were implanted with multichannel cochlear implants. Children had received their implants 3 months to 2 years before the onset of the study. They had received their implants between the age range of 3 and 6 years. Tests of receptive, expressive language, and sets of auditory abilities were administered. Characteristics of the child and the family (age before implant and duration of implant use, preimplant use of hearing aids and language therapy, parents' involvement in therapy, mode of communication at home, type of the implant, and geographic distribution) were considered the predictors. Predictors of total language and auditory abilities were determined using statistical analysis by univariate and multivariate analyses.

## Results

Some significant predictors of language and auditory skills in this study included duration of implant use, use of auditory mode of communication and parent interaction. There is a positive correlation between language age and both individual and total auditory abilities scores.

## Conclusion

Prognostic factors for language and auditory abilities are useful in a rehabilitation program after cochlear implantation.

## Keywords:

auditory abilities, language age, multichannel cochlear implants

Egypt J Otolaryngol 31:170–175  
© 2015 The Egyptian Oto - Rhino - Laryngological Society  
1012-5574

## Introduction

Cochlear implant systems comprise an externally worn microphone and a microprocessor programmed to extract intensity, frequency, and timing cues from acoustic signals. The system transforms these acoustic cues into an electrical code. Internally, a surgically placed receiver relays the transmitted code to an implanted array of contacts in the cochlea to stimulate surviving auditory neuron [1]. With experience, children understand speech, environmental sounds, and music with varying degrees of success [2–5].

Young children who experience severe to profound sensorineural hearing loss (SNHL) face challenges in developing spoken language because of an inability to detect acoustic–phonetic cues that are essential for speech recognition, even when fitted with traditional amplification devices (hearing aids). More than half of such children are treated with cochlear implantation [6].

Cochlear implantation is associated with significant improvements in comprehension and expression of

spoken language over the first 3 years of implant use. Infants and toddlers who receive implants show rapid improvements in auditory skills during the first year of device use irrespective of age at implantation, although younger children achieve higher scores. Children who undergo implantation at a younger age acquire auditory skills closer to those of their peers with normal hearing (at a younger age) [7].

Much of the recent research in pediatric cochlear implantation is focused not only on documenting language achievements in this population but also determining what factors might influence the outcome. Documented reasons for poor performance include late age of implantation, poor nerve survival, inadequate fitting, insufficient cognitive skills, educational

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

and social environments emphasizing manual communication, and limited parental support [8].

This study was carried out to gain a better understanding of the prognostic factors that promote spoken language development and auditory abilities after cochlear implantation in Egyptian children; these predictors help in the implementation of a rehabilitation program for better language and learning outcome after cochlear implantation, and help these children develop language normally and to be enrolled in mainstream education.

---

## Aim of the study

### Aim

The aim of this study was to investigate prognostic factors contributing toward the comprehension and production of Arabic language as well as auditory abilities after cochlear implantation in Egyptian children.

---

## Participants and methods

In all, 150 cochlear implant (CI) children with preoperative bilateral congenital severe-to-profound hearing loss were included in this study. The children were implanted with multichannel CI at Wadi El Neel Hospital as a part of CROP (Cochlear Implant Rehabilitation Outreach Program) and were seen during their routine postimplant follow-up.

Full insertion of the electrode array was performed in all the children using three different implant systems: Medel Sonata (Austria) with Opus II processor, Cochlear Freedom (Australian) CI system, and Advanced Bionics (American) HiRes 90k with a Harmony processor. The children had received their implants for periods of 3 months to 2 years before the onset of the study. They received their implants in age range between 2 and 6 years. The children were from different Egyptian governorates. They were classified according to the geographic distribution of their area of residence into four classes. The study was carried out from the period from October 2013 to February 2014.

All the children were subjected to the protocol of cochlear implant assessment applied in Kasr Al Aini Hospital in addition to some auditory tasks from the EARS Assessment Program [9].

### Preoperative selection

Patients were selected according to the following criteria.

### Inclusion criteria

- (1) Children with an average IQ above 89 and average cognitive abilities.
- (2) Children aged 3–6 years, both sexes, with unilateral CI fitting, prelingual profound SNHL.
- (3) The same midquartile socioeconomic strata (according to scoring of the scale for determination of family socioeconomic status for health research in Egypt) [10].

### Exclusion criteria

- (1) Other congenital anomalies or syndromes, profound SNHL is not a part of syndrome.
- (2) Medical disorder or previous failed cochlear implantation.
- (3) Psychological, attention, or behavior disorders.
- (4) Neurological disorders.

### Preoperative patients' and parents' interview

- (1) Personal history: age, sex, birth order, parental consanguinity, and the presence of a similar condition in the family.
- (2) Prenatal, natal, and postnatal history and milestones of development for exclusion of postlingual or other acquired causes of hearing loss.

### Postoperative assessment of history

The history was assessed with a particular focus on the following variables:

- (1) Age before implantation.
- (2) Duration of implant use.
- (3) Preimplant use of hearing aids and language therapy [type and duration (0 = no hearing aid use or language therapy; 1 = use hearing aid for 6 months or less; 2 = use hearing aid more than 6 months)].
- (4) Postoperative means of communication at home (auditory, gestural, or both).
- (5) Maternal involvement in therapy, the duration of time that the mother spends talking to the child (0 = mother does not talk with the child, 1 = mother talks throughout daily activities, 2 = mother talks throughout daily activities in addition to structured therapy with her child).
- (6) Means of communication at home: either gestural or auditory verbal or all communication methods.
- (7) Geographic distribution: either Cairo, Delta governorates, upper Egypt, or Coastal areas.

General examination, vocal tract examination, ear and nose examination, and neurological examination were performed.

Local examination of the scar of the implant was performed and the device was checked.

An adaptation of auditory skills checklist [11], which is an assessment tool that uses a combination of a structured parent interview and clinician observation to obtain information about functional auditory skills development, was used; this checklist includes the following:

- (1) Auditory detection and localization.
- (2) Auditory discrimination of
  - (a) Loud and soft sound.
  - (b) High pitch–low pitch sound.
  - (c) Continuous–interrupted sounds.
  - (d) Discrimination of environmental sounds from speech sounds.
  - (e) Discrimination between different environmental sounds.
  - (f) Discrimination of six Ling sounds.
  - (g) Discrimination between long and short sounds.
- (3) Auditory comprehension.

#### Does the child

- (1) Follow one-step direction.
- (2) Follow two-step direction.
- (3) Follow three-step direction.

All abilities were assigned a score of 0 = does not have the skill, 1 = emerging skill development, and 2 = consistently shows the skill (the total score is 22).

#### Auditory abilities were assessed from Arabic modifications of tests by the EARS (Evaluation of Auditory Responses to Speech) test [9]

- (1) *Monosyllabic word discrimination/identification*: Five monosyllabic words pictures are introduced to the child; he/she is asked to repeat and/or point to the correct picture (1 point for repeating and 1 point for pointing). The child was assigned a score out of 10.
- (2) *Polysyllabic word discrimination/identification*: Five polysyllabic words pictures are introduced to the child; he/she is asked to repeat and/or point to the correct picture (1 point for repeating and 1 point for pointing). The child was assigned a score out of 10.
- (3) *Open set word discrimination/identification*: Five monosyllabic words were spoken to child without any cues and the child was asked to guess the word spoken by the examiner once; he/she was assigned a score (out of 10) according to the number of correct sounds and words.

- (4) *Familiar sentence repetition*: Ten familiar words were spoken to the child and he/she was asked to repeat it correctly: (with a total score of 10).
- (5) *Language testing was performed using the Arabic language test* [12]: Each child was assigned receptive, expressive, and total language ages at the time of examination (postoperatively).

Data were collected, tabulated, and analyzed statistically.

#### Statistical analysis

Precoded data were statistically analyzed using the Statistical Package of Social Science Software program (SPSS), version 21. Data were summarized using frequency and percentage for qualitative variables or mean and SD for quantitative variables. Comparison between groups was performed using the  $\chi^2$ -test or Fisher's exact test for qualitative variables, or independent-sample *t*-test or one-way analysis of variance (with post-hoc Tukey's test) for quantitative variables. Pearson or Spearman correlation coefficients were calculated to signify the association between quantitative and ordinal variables, respectively. Linear regression models were constructed to obtain the significant predictors of auditory and language scores. *P* values less than 0.05 were considered statistically significant and those less than 0.01 were considered highly significant.

## Results

This study was carried out on 150 Egyptian children with cochlear implants; language and auditory assessments were performed to determine the predictors for better outcome using univariate and multivariate analyses.

#### Univariate analysis of predictors showed the following:

- (1) Non significant predictors (*P* value <0.05) for language and auditory skills included: sex, age, type of implant, and duration of preoperative therapy (Table 1).
- (2) High significant predictors (*P* > 0.01) for language and auditory abilities: duration of implant use and high participation of mothers in therapy (always talks to her child).
- (3) For residence, the best predictor was residence in Cairo, followed by residence in the Delta and residence in upper Egypt.
- (4) For mode of communication at home, the best predictor was the auditory mode, followed by mixed auditory and gestural modes, and gestural mode of communication.

**Multivariate analysis of predictors showed the following**

(1) High significant predictors for language and auditory abilities were duration of CI use, optimal level of care by mothers, and auditory mode of communication at home ( $P > 0.01$ ) (Table 2).

(2) Female sex and duration of preoperative language therapy (>6 months) were highly significant in terms of language output ( $P > 0.01$ ).

Correlations between total language age with both total and individual auditory skills were highly significant ( $P > 0.01$ ) (Table 3).

**Table 1 Predictors of total language age and total auditory skills scores (univariate analysis)**

Variables or items	Total language age	P value	Total auditory score	P value
Sex				
Male	17.1 ± 8.0	0.1	40.4 ± 15.8	0.4
Female	19.3 ± 9.6	NS	38.1 ± 15.2	NS
Age at receiving implant	$r = 0.108$	0.2 (NS)	$r = -0.048$	0.6 (NS)
Duration of CI use	$r = 0.624$	<0.001 (HS)	$r = 0.642$	<0.001 (HS)
Type of CI				
Medel	17.1 ± 7.9	0.09	38.7 ± 14.1	0.3
Freedom	20.9 ± 8.7	NS	41.9 ± 16.5	NS
AB	17.7 ± 12.5		35.6 ± 19.5	
Type of communication at home				
Gestural mode of communication	13.0 ± 5.3♣	<0.001	30.4 ± 12.0♣	<0.001
Gestural and auditory mode of communication	20.7 ± 7.6¶	HS	43.4 ± 13.8¶	HS
Auditory mode of communication	27.9 ± 9.1#		56.3 ± 7.3#	
	$\rho = 0.599$	<0.001 (HS)	$\rho = 0.615$	<0.001 (HS)
Region				
Cairo	19.9 ± 8.8¶	0.02	42.9 ± 16.0♣	0.02
Delta	18.1 ± 10.2¶	S	37.3 ± 14.2♣	S
Costal governorates	12.7 ± 4.2		32.7 ± 13.9	
Upper Egypt	14.7 ± 6.0♣		33.2 ± 13.8#	
Mother care				
Present	20.5 ± 8.5	<0.001	44.2 ± 13.0	<0.001
Absent	11.0 ± 5.1	HS	24.1 ± 11.9	HS
Level of mother's care				
Sometimes talks	14.8 ± 4.5	<0.001	35.1 ± 8.7	<0.001
Always talks	24.0 ± 8.5	HS	49.7 ± 12.0	HS
Preoperative therapy				
Present	23.7 ± 8.1	<0.001	49.5 ± 11.8	<0.001
Absent	13.7 ± 6.6	HS	30.9 ± 12.8	HS
Duration of therapy				
≤6 months	22.2 ± 7.6	0.08	49.6 ± 12.3	1.0
>6 months	25.7 ± 8.6	NS	49.4 ± 11.4	NS

Groups with different symbols are statistically significantly different at a  $P$  value of 0.05 (post-hoc Tukey's test),  $r$  = Pearson correlation coefficient,  $\rho$  = Spearman correlation coefficient, Different symbols means that there are significant difference between gestural, gestural with auditory and auditory only mode of communication.

**Table 2 Predictors of total language and total auditory scores (multivariate analysis)**

Items or variables	Total language score adjusted ( $F^2 = 0.708$ )				Total auditory score adjusted ( $F^2 = 0.739$ )			
	$\beta$ coefficient	SE of $\beta$	t-Value	P value	$\beta$ coefficient	SE of $\beta$	t-Value	P value
Constant	-4.5	1.7	-2.6	0.009	3.3	2.8	1.2	0.2
Sex (F/M)	2.2	0.8	2.8	0.006	1.7	1.3	1.3	0.2
Duration of CI use	0.6	0.1	8.2	<0.001	1.1	0.1	8.3	<0.001
Presence of mother's care	4.6	1.0	4.4	<0.001	11.3	1.7	6.6	<0.001
Optimal level of mother care	4.0	1.1	3.5	0.001	4.5	1.9	2.4	0.02
Preoperative hearing aid fitting and language therapy	1.6	1.0	1.6	0.1	4.2	1.7	2.5	0.01
Duration of preoperative language therapy (>6 ms)	4.5	1.3	3.6	<0.001	0.8	2.1	0.4	0.7
Auditory mode of communication at home	3.5	0.7	5.1	<0.001	5.9	1.1	5.2	<0.001
Geographic distribution	0.2	0.4	0.6	0.5	0.2	0.6	0.3	0.8

**Table 3 Correlation between language and auditory skills scores**

	Total language score	
	<i>r</i>	<i>P</i> value
Auditory discrimination	0.561	<0.001HS
Obedying order	0.787	<0.001HS
Monosyllabic words	0.726	<0.001HS
Bisyllabic words	0.757	<0.001HS
Open set	0.771	<0.001HS
Sentence repeat	0.75	<0.001HS
Total auditory score	0.824	<0.001HS

Correlations between total language age with individual auditory skills were highly significant for all skills; The correlation between total language age with the total auditory score was significant ( $r = 0.824$  and  $P < 0.001$ ).

## Discussion

The children included in this study represented a broad spectrum of characteristics. Children of both sexes had been using their implants for periods of 3 months to 2 years. They had received their implants at age ranges between 3 and 6 years. Their preoperative language and auditory levels differed according to whether they had received early hearing aids and preoperative therapy; mode of communication at home differed according to the care and awareness of parents. Patients from different Egyptian governorates were represented; all these variables were represented in the study as predictors that helped determine whether these are valuable in the prognosis of language and auditory abilities in CI children or not and to which extension as regard each variable alone (univariate analysis) or with regards of other variables (multivariate analysis).

Duration of CI use was found to be significant in both univariate (Table 1) and multivariate analyses (Table 2) for total language and auditory skills. This is in agreement with a previous study that indicated the importance of duration of use of cochlear implants when evaluating benefits of the device [13]. Magmata *et al.* [14] reported that length of implant use accounted for the greatest variance in performance among a group of 61 children with implants.

However, age of implantation was found to be a significant predictor in prognosis in other studies [7]. Early implantation may take advantage of neuronal flexibility inherent in critical periods of auditory-based learning [15], but in this study, it was found to be a nonsignificant predictor (Table 1). A study by Geers *et al.* [16] reached the conclusion that children who had received implantation early (before the age of 5 years) achieved language skills close to their normally hearing peers after 4–7 years of use of this implant and also found that age of implantation in the group of children who had received implantation before the age

of 5 years was not a significant predictor of language performance as children between 2 and 3 years of age did not show a significant advantage over those who had received implantation between the ages of 4 and 5 years.

As regards gender difference in language outcome, it was found that girls have better language outcome than boys, and this is evidenced that girls show verbal advantage over boys in both hearing [17] and hearing-impaired populations [18].

Preoperative fitting of hearing aids and regular language therapy over months were found to be significant predictors for auditory abilities; duration of language therapy of more than 6 months is a significant predictor for language outcome (Table 2). These findings are in agreement with those of a study that reported that preimplantation performance across candidates provided an estimate of a language-learning trajectory for children with severe to profound SNHL and without cochlear implants [19].

Auditory mode of communication with the child was also found to be the best one, followed by mixed auditory and gestural communication than just the gestural mode of communication (Table 2). Use of a visual (i.e. sign) language system did not provide the linguistic advantage that had been anticipated. Children educated without the use of signs showed a significant advantage in their language as a study showed that children in oral programs (including both auditory-verbal and traditional oral approaches) performed significantly better on a battery of speech perception tests than did those children using total communication [20]. Geers and Moog [21] found that those in oral programs showed better speech and auditory skills than those in TC settings. However, Miyamoto *et al.* [22] described the speech perception results of 19 prelinguistically deafened children and found that communication mode did not play a significant role in speech-perception abilities.

Maternal involvement in therapy was found to be a significant predictor (Table 2) as language exposure and caregivers' mentoring provides the context for language learning. Spencer [23] examined different behavioral indicators of parental involvement related to their children's education and development before and after cochlear implantation. Findings indicated an association between high levels of parental involvement, for example, learning sign language, advocating for their child's needs, devoting time and effort to take their child to the cochlear implantation clinic for follow-up, and monitoring children's language achievement. DesJardin *et al.* [24] found that mothers' higher sense

of involvement was associated with mothers' enhanced language facilitation strategies and their children's improvement in language abilities.

Maternal engagement in early communication reflected in higher scores of parent-child interactions was associated with increased development in spoken language skills. Language comprehension and expression are influenced by parent-child interactions in bidirectional spoken communication [25,26].

## Conclusion

Significant predictors of language and auditory abilities including duration of implant use, auditory mode of communication, parents' involvement in therapy, and optimal level of parental communication with the child showed a significant advantage in prognosis. There is a positive correlation between language age and both individual and total auditory abilities' scores. These predictors should be considered during rehabilitation to achieve better language and learning outcomes.

## Acknowledgements

The authors are very grateful to Professor Dr. Ashraf Abou El Ezz, Professor of Phoniatics Cairo University, for proof reading the article and the useful assessment test supported by him.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

## References

- Niparko JK. Speech, language, and reading skills after early cochlear implantation. *JAMA* 2004; 291:2378-2380.
- Dettman SJ, Pinder D, Briggs RJ, Dowell RC, Leigh JR. Communication development in children who receive the cochlear implant younger than 12 months: risks versus benefits. *Ear Hear* 2007; 28 (Suppl):11S-18SS.
- Geers A, Tobey E, Moog J, Brenner C. Long-term outcomes of cochlear implantation in the preschool years: from elementary grades to high school. *Int J Audiol* 2008; 47:Suppl 2:S21-S21S30.
- Holt RF, Svirsky MA. An exploratory look at pediatric cochlear implantation: is earliest always best?. *Ear Hear* 2008; 29:492-511.
- Nicholas JG, Geers AE. Will they catch up? The role of age at cochlear implantation in the spoken language development of children with severe to profound hearing loss. *J Speech Lang Hear Res* 2007; 50:1048-1062.
- Bradham T, Jones J. Cochlear implant candidacy in the United States: prevalence in children 12 months to 6 years of age. *Int J Pediatr Otorhinolaryngol* 2008; 72:1023-1028.
- McConkey Robbins A, Koch DB, Osberger MJ, Zimmerman-Phillips S, Kishon-Rabin L. Effect of age at cochlear implantation on auditory skill development in infants and toddlers. *Arch Otolaryngol Head Neck Surg* 2004; 130:570-574.
- ASHA. Technical report: cochlear implants. *Am J Speech Lang Pathol* 2003; 24:1-35.
- Esser-Leyding B, Anderson I. EARS® (Evaluation of Auditory Responses to Speech): an internationally validated assessment tool for children provided with cochlear implants. *ORL J Otorhinolaryngol Relat Spec* 2012; 74:42-51.
- Scoring of scale for measuring family socioeconomic status for health research in Egypt). *Eastern Mediterranean Health Journal*; Vol 18, No 9. 2012.
- Meinzen-Derr J, Wiley S, Creighton J, Choo D. Auditory Skills Checklist: clinical tool for monitoring functional auditory skill development in young children with cochlear implants. *Ann Otol Rhinol Laryngol* 2007; 116: 812-818.
- Kotby M, Khairy A, Baraka M, El-Shobarry A, Rifaie, N. Language testing of Arabic speaking children. *Proceedings of the XXIII World Congress of the International Association of the Logopedics and Pediatrics*; August 1995.
- Nikolopoulos TP, O'Donoghue GM, Archbold S. Age at implantation: its importance in pediatric cochlear implantation. *Laryngoscope* 1999; 109:595-599.
- Miyamoto RT, Osberger MJ, Todd SL, Robbins AM, Stroer BS, Zimmerman-Phillips S, Carney AE. Variables affecting implant performance in children. *Laryngoscope* 1994; 104:1120-1124.
- Sharma A, Tobey E, Dorman M, Bharadwaj S, Martin K, Gilley P, Kunkel F. Central auditory maturation and babbling development in infants with cochlear implants. *Arch Otolaryngol Head Neck Surg* 2004; 130:511-516.
- Geers AE, Nicholas JG, Sedey AL. Language skills of children with early cochlear implantation. *Ear Hear* 2003; 24 (Suppl):46S-58SS.
- Fenson L, Pethick S, Renda C, Cox JL, Dale PS, Renznick JS. Short-form versions of the MacArthur communicative development inventories. *Appl Psycholinguist* 2000; 21:95-115.
- Easterbrooks SR, O'Rourke CM. Gender differences in response to auditory-verbal intervention in children who are deaf or hard-of-hearing. *Am Ann Deaf* 2001; 146:309-319.
- Niparko JK, Tobey EA, Thal DJ, Eisenberg LS, Wang NY, Quittner AL, Fink NE. CDaCI Investigative Team. Spoken language development in children following cochlear implantation. *JAMA* 2010; 303:1498-1506.
- Hodges AV, Dolan Ash M, Balkany TJ, Schloffman JJ, Butts SL. Speech perception results in children with cochlear implants: contributing factors. *Otolaryngol Head Neck Surg* 1999; 121:31-3134.
- Geers AE, Moog JS. Speech perception and production skills of students with impaired hearing from oral and total communication education settings. *J Speech Hear Res* 1992; 35:1384-1393.
- Miyamoto RT, Houston DM, Kirk KI, Perdew AE, Svirsky MA. Language development in deaf infants following cochlear implantation. *Acta Otolaryngol* 2003; 123:241-244.
- Spencer PE. Individual differences in language performance after cochlear implantation at one to three years of age: child, family, and linguistic factors. *J Deaf Stud Deaf Educ* 2004; 9:395-412.
- DesJardin JL, Eisenberg LS, Hodapp RM. Sound beginnings: supporting families of young deaf children with cochlear implants. *Infant Young Child* 2006; 19:179-189.
- Spencer PE, Meadow-Orlans KP. Play, language, and maternal responsiveness: a longitudinal study of deaf and hearing infants. *Child Dev* 1996; 67:3176-3191.
- Quittner AL, Leibach P, Marciel K. The impact of cochlear implants on young deaf children: new methods to assess cognitive and behavioral development. *Arch Otolaryngol Head Neck Surg* 2004; 130:547-554.