



The relationship between onset of single sided deafness and educational achievement

Mert Cemal Gökgöz¹, Murat Bınar¹, Hamdi Taşlı¹, Songül Özdemir², Bülent Satar¹

¹Department of Otolaryngology, Gülhane Training and Research Hospital Training and Research Hospital, Ankara, Turkey

²Department of Otolaryngology, Audiology Laboratory, Gülhane Training and Research Hospital, Ankara, Turkey

ABSTRACT

Objectives: This study aims to determine if there is an association between onset of single sided deafness (SSD) and education level in Turkish males who are diagnosed with SSD.

Patients and Methods: A total of 238 male patients aged between 18 and 47 years, diagnosed as SSD before 10 years old, were prospectively enrolled. According to the onset time of SSD, patients were divided into three groups as under two years old, between 2-5 years old, and between 5-10 years old.

Results: The results showed that onset time of SSD affected educational achievement. Although total of 238 patients had been diagnosed SSD before the age of 10 years, no significant relationship was recognized between the patients with SSD and normal ones in terms of educational level.

Conclusion: According to results of this study, children with SSD and their families should be encouraged that this situation will not impact their educational developments in the future.

Keywords: Deafness; education; hearing loss.

Unilateral hearing loss (UHL) is single-sided hearing loss that may be caused by various factors such as congenital reasons, meningitis, trauma, surgery, tumors, immunological, rheumatologic disorders, idiopathic, etc.^[1] Binaural hearing is important because of the auditory system combining auditory information from both ears and ensuring transmission to the central auditory system, leading to higher perception than monaural hearing.^[2,3] Also, binaural hearing increases the intelligibility of speaking in difficult listening conditions and determines which side sound comes from.^[2,3] Thus, a spatial dimension is added to perception. The sound is perceived lower in the contralateral ear, due to the head shadow effect. The difference arising

from the head shadow effect (which is about 6-12 dB) is especially noticeable when sound is directed towards the bad ear and noise towards the healthy ear in a crowded environment.^[4]

The possible relationship between UHL and educational achievement has been investigated before, however, the impact of single side deafness (SSD) on educational level is still controversial.^[1,2] Some investigators reported that children with UHL have lower educational scores in school compared to those with normal hearing.^[5,6] However, other researchers reported that children with UHL do not differ from those with normal hearing in terms of educational achievement.^[8] In one of the recent studies, the investigators reported that children with UHL

Received: August 08, 2017 Accepted: January 09, 2018

Correspondence: Mert Cemal Gökgöz, MD. SBÜ Gülhane Eğitim ve Araştırma Hastanesi Kulak Burun Boğaz Kliniği, 06010 Etilik, Ankara, Turkey.

e-mail: drmcgokgoz@gmail.com

Doi: <http://dx.doi.org/10.5606/Tr-ENT.2018.78278>

have worse speech-language scores compared to those with normal hearing.^[5]

The aim of this study was to determine if there is an association between onset of SSD and education level and to compare them with the average educational status of the Turkish population in same age groups.

PATIENTS AND METHODS

Study population

A total of 238 patients with SSD who were admitted to our clinic for any reason between April 2014 and June 2016 were prospectively enrolled in this study. All subjects were evaluated with a history review, a detailed otorhinolaryngologic examination, pure tone audiometry and Stenger test. Some of the patients also had auditory brainstem response test when needed. Age and educational level were noted. Only those patients in whom onset of SSD was before 10 years of age were included. Subjects were excluded if they had been diagnosed with SSD after 10 years of age. Also, subjects with chronic ear disease, history of otologic surgery, and abnormal otoscopic examination were excluded. The study protocol was approved by the Gülhane Military Medical Faculty Ethics Committee and all participants provided written informed consent. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Statistical analysis

Statistical analyses were performed using SPSS for Windows Version 15.0 software (SPSS Inc., Chicago, IL., USA). The values were expressed as mean(s), standard deviation(s) (mean±SD), and percentages when needed. Comparison of discrete variables between groups were conducted using chi-square test. Correlations between variables were explored using the Spearman correlation test. Significance was defined as $p < 0.05$.

RESULTS

The study population consisted of 238 male patients with single-sided deafness (SSD) (left=121; right=117). The mean age of the study group was 23.2±3.7 years (min=18; max=47). Onset of SSD was before two years in 118 patients (49.6%), 2 to 5 years period in 100 patients (42%)

and 5 to 10 years period in 20 patients (8.4%) (Table 1).

Based on the history, most of the patients indicated unknown etiology (n=128). Other causes of UTHL were febrile diseases (n=55), mumps (n=29), trauma (n=21), meningitis (n=4), and familial (n=1) (Table 2).

The number of the patients that graduated from primary school, middle school, high school, and university were 32 (13.4%), 68 (28.6%), 79 (33.2%), and 59 (24.8%), respectively (Table 3).

While 21% of patients have primary school graduation in 0-2 age group, in 5-10 age group only 7.5% of patients have the same graduation (Figure 1). Statistical analysis showed a significant

Table 1. Patient groups according to onset of single-sided deafness

Age groups	n	%
0-2 years	118	49.6
2-5 years	100	42
5-10 years	20	8.4
Total	238	100

Table 2. Etiology of single-sided deafness in the study population

Proposed etiology	n	%
Febrile disease	55	23.1
Mumps	29	12.2
Trauma	21	8.8
Meningitis	4	1.7
Familial	1	0.4
Unknown	128	53.8
Total	238	100

Table 3. Final educational status of patients with single-sided deafness in the study population

Educational status	n	%
Primary school	32	13.4
Middle school	68	28.6
High school	79	33.2
University	59	24.8
Total	238	100

Table 4. Turkish population final education levels in 2014 and 2015 compared to study group

Age groups	2014-Turkish population	2015-Turkish population	Study group
	%	%	%
Primary	4.72	2.67	13.40
Middle school	28.94	28.52	28.60
High school	36.06	34.62	33.20
University	30.26	34.17	24.80

positive correlation between the onset of SSD and education level ($p < 0.001$, $r = 0.592$).

When we split the patients into two subgroups according to laterality of SSD, neither left nor right side was associated with any of the investigated parameters ($p = 0.740$).

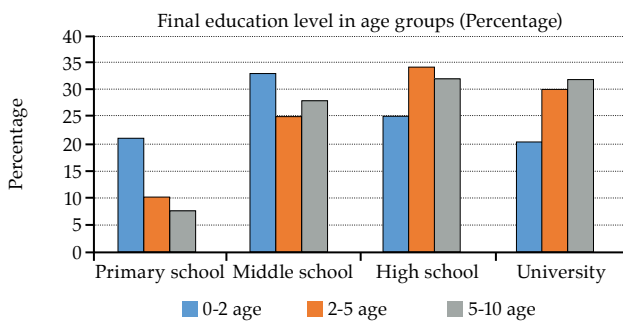
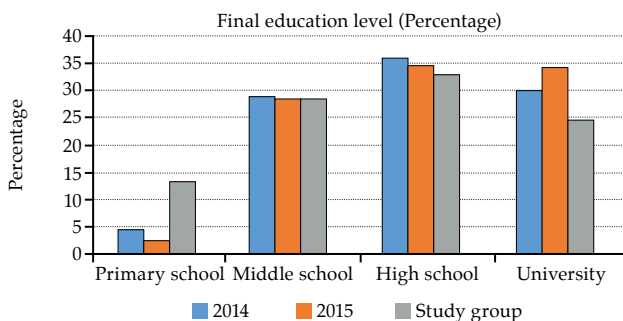
Final education level and final age parameters were rearranged according to the 2014 and 2015 Educational Data of Turkish Statistical Institute in males. Primary school, middle school, high school and university completion rates of our study were compared with the educational data

of Turkish population for the same age groups. There was no significant difference in final educational level between the groups except for the primary school graduation rates. Completion rates for secondary school and high school were the same, while university graduation rates were 30.26% in 2014 and 34.17% in 2015 for the Turkish population compared to 24.80% in the study group (Table 4).

DISCUSSION

Children with SSD have problems with intelligibility of speaking, determining which side sound comes from, and auditory perception, especially in crowded and multi sound sources environments.^[1] In the end, some patients experience a decline in self-confidence and retardation of speech and language development with problems regarding social, familial and educational life. In the literature, SSD has been shown to be associated with a low IQ score and accompanying negative effects on learning and language development.^[6] However, other studies have revealed that IQ scores are not affected in patients with SSD.^[7] Borton et al.^[8] showed that the quality of life of both patients and their families was reduced and patients had difficulty in accepting UHL.

Our study compared the final education levels of 238 male patients with SSD with the normal Turkish population for the same age groups. While completion rates of middle school and high school were the same, university completion rates for the Turkish population were 30.26% in 2014 and 34.17% in 2015 compared to only 24.80% in the study group. The difference was thought to be especially related to onset of SSD in the first two years of life. Perhaps the negative effects of SSD in all age groups can be lessened by raising

**Figure 1.** Final education levels by age groups.**Figure 2.** Turkish population final education levels in 2014 and 2015 compared to study group.

the awareness of patients, relatives, and teachers regarding hearing aids, contralateral route of signals (CROS) and cochlear implant options.

One of the most important factors affecting educational status and success is onset of UHL. The educational status of the group with onset of hearing loss at age 0-2 was found to be significantly lower than the other groups. The rate of university graduation among the age groups of 0-2, 2-5 and 5-10 was 20.38%, 30.11% and 32%, respectively. Speech and language, intelligence development and behavioral skills start to develop especially in the 0-2 age group. However, speech perception continues maturation throughout adolescence. Some auditory skills develop before speech perception matures and periodically rearrange to create effective ways of adult speech perception.^[9,10] When the process of speech development and the pathways of perception are taken into consideration, the importance of age comes up. Fischer's study is important in this sense, that indicates closing the gap between the same age group by eliminating delays in speech and language development with increasing age.^[11] However, low values in speech and language scores do not directly reflect the educational situation.^[5]

In our study, the reason of hearing loss did not affect the educational status. Only one patient had familial single sided deafness, because genetic diseases often cause bilateral hearing loss and we rarely encounter genetic reasons in SSD patients. The cause in 45.8% of the patients was not congenital, but from pathological development after fever, mumps, trauma, etc. The 56.8% of patients with unknown etiology likely had congenital causes that could be determined by newborn hearing screening programs.^[12] Early detection of hearing loss is important for rehabilitation and patient-family consciousness.

Although some studies reported that the presence of right or left ear hearing loss affects the educational status,^[7,11] in our study there is no statistically significant difference between left and right side in terms of educational status. Teachers should take precautions in the classrooms for students with SSD by arranging

their sitting plan to increase hearing capacity considering the pathologic ear.^[13,14] Godfrey and Grimshaw^[15] study showed that when emotional toning was done, the right ear understood and distinguished better. In this context, numerical and verbal abilities may change according to the side of hearing loss, but it did not reflect on the results of our study group.

One of the limitations of our study is that there are many factors that can affect the educational situation. Some of these are socioeconomic status of the patient and his/her family, the level of education of family, the place of residence and educational opportunities there, and the presence of other physical, mental and metabolic diseases affecting intelligence. Our study included the assessment of patients with SSD who applied to our clinic in a two-year period and comparison of their final education level with Turkish male population at same age group.

According to results of this study, there is no difference in final educational achievement between normal hearing ones and patients with SSD especially in post-lingual groups. Children with SSD and their families should be encouraged that this situation will not affect their educational developments in future. Families should be made aware, teachers should be informed about this situation, and the places of the students should be planned in the class. Hearing aids, Frequency Modulation (FM) systems that amplify the teacher's voice in class, CROS, and cochlear implants should be presented to patients.^[16] The importance of protecting the healthy ear from loud noise should be explained, newborn screening for early diagnosis should be strengthened, and treatment should be started as early as possible, to increase the educational level of patients.

Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding

The authors received no financial support for the research and/or authorship of this article.

REFERENCES

1. Paul A, Marlin S, Parodi M, Rouillon I, Guerlain J, Pingault V, et al. Unilateral Sensorineural Hearing

- Loss: Medical Context and Etiology. *Audiol Neurootol* 2017;22:83-88.
2. Bess FH, Tharpe AM. Unilateral hearing impairment in children. *Pediatrics* 1984;74:206-16.
 3. Humes LE, Allen SK, Bess FH. Horizontal sound localization skills of unilaterally hearing-impaired children. *Audiology* 1980;19:508-18.
 4. Newton VE. Sound localisation in children with a severe unilateral hearing loss. *Audiology* 1983;22:189-98.
 5. Lieu JE, Tye-Murray N, Karzon RK, Piccirillo JF. Unilateral hearing loss is associated with worse speech-language scores in children. *Pediatrics* 2010;125:e1348-55.
 6. Purcell PL, Shinn JR, Davis GE, Sie KC. Children with unilateral hearing loss may have lower intelligence quotient scores: A meta-analysis. *Laryngoscope* 2016;126:746-54.
 7. Lieu JE, Karzon RK, Ead B, Tye-Murray N. Do audiologic characteristics predict outcomes in children with unilateral hearing loss? *Otol Neurotol* 2013;34:1703-10.
 8. Borton SA, Mauze E, Lieu JE. Quality of life in children with unilateral hearing loss: a pilot study. *Am J Audiol* 2010;19:61-72.
 9. Moore DR. Listening difficulties in children: bottom-up and top-down contributions. *J Commun Disord* 2012;45:411-8.
 10. Werner LA. Issues in human auditory development. *J Commun Disord* 2007;40:275-83.
 11. Fischer C, Lieu J. Unilateral hearing loss is associated with a negative effect on language scores in adolescents. *Int J Pediatr Otorhinolaryngol* 2014;78:1611-7.
 12. Morton CC, Nance WE. Newborn hearing screening--a silent revolution. *N Engl J Med* 2006;354:2151-64.
 13. Hartvig Jensen J, Johansen PA, Børre S. Unilateral sensorineural hearing loss in children and auditory performance with respect to right/left ear differences. *Br J Audiol* 1989;23:207-13.
 14. Noh H, Park YG. How close should a student with unilateral hearing loss stay to a teacher in a noisy classroom? *Int J Audiol* 2012;51:426-32.
 15. Godfrey HK, Grimshaw GM. Emotional language is all right: Emotional prosody reduces hemispheric asymmetry for linguistic processing. *Laterality* 2015;??:1-17.
 16. Van de Heyning P, Távora-Vieira D, Mertens G, Van Rompaey V, Rajan GP, Müller J, et al. Towards a Unified Testing Framework for Single-Sided Deafness Studies: A Consensus Paper. *Audiol Neurootol* 2016;2:391-8.