



# Investigation of the effect of hearing aid on hearing disability in elderly people with presbycusis

## İşitme cihazının presbiakuzili yaşlılarda işitme engelliliğine olan etkisinin araştırılması

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### Abstract

**Aim:** To determine the effect of hearing aid on the level of hearing disability in elderly patients with presbycusis.

**Methods:** A hearing handicap inventory scale (HHI) was applied to 43 patients with presbycusis over the age of 65 years (mean age: 73.44 ± 7.03 years, range: 65-89 years, male: 26, female: 17) six months before using the hearing aid and 6 months after starting to use the hearing aid. HHI scores were compared before and after hearing aid.

**Results:** HHI scores (22.51 ± 14.81) after hearing aid use were significantly lower compared to HHI scores before hearing aid (68.97 ± 16.97) (p=0.000). There was no significant difference between HHI score gains obtained after hearing aids according to gender (p=0.737). There was no significant difference between HHI score gains obtained after hearing aids in patients with profound and severe hearing loss and the scores of the patients with moderate and moderate to severe hearing loss (p=0.521).

**Conclusion:** The hearing aid significantly reduces the level of auditory disability in elderly individuals.

**Keywords:** Hearing handicap inventory scale, hearing aid, hearing loss, presbycusis, sensorineural, elderly.

### Öz

**Amaç:** Presbiakuzili yaşlı hastalarda işitme cihazının işitsel engellilik seviyesine olan etkisini saptamaktır.

**Yöntemler:** 65 yaş üstü presbiakuzili 43 hastaya (ortalama yaş: 73.44 ± 7.03 yıl (aralık 65-89 yıl), erkek:26, kadın:17) işitme cihazı kullanmadan önce ve işitme cihazı kullanmaya başladıktan 6 ay sonra işitme engeli envanteri ölçeği (hearing handicap inventory scale-HHI) uygulandı. İşitme cihazı öncesi ve sonrası HHI skorları karşılaştırıldı.

**Bulgular:** İşitme cihazı kullanımı sonrası HHI skorları (22.51 ± 14.81), işitme cihazı öncesi HHI skorlarına (68.97 ± 16.97) göre anlamlı derecede düşüktü (p=0.000). Cinsiyetlere göre, hastaların işitme cihazı sonrası elde edilen HHI skor kazançları arasında anlamlı fark yoktu (p=0.737). Derin ve ileri işitme kaybı ile orta ve orta ileri işitme kayıpları bulunan hastaların, işitme cihazı sonrası elde edilen HHI skor kazançları arasında anlamlı bir fark yoktu (p=0.521).

**Sonuç:** İşitme cihazı, yaşlı bireylerde işitsel engellilik düzeyini önemli derece düşürmektedir.

**Anahtar Kelimeler:** İşitsel engellilik envanter skalası, işitme cihazı, işitme kaybı, presbiakuzi, sensorionöral, yaşlı.

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**Introduction**

Sensorineural hearing loss (SNHL) may occur in many conditions such as maternal diseases and drugs used in the intrauterine period, genetic factors, premature birth, ototoxicity, exposure to high-intensity noise and aging. Having so many risk factors for SNHL makes it one of the most common health problems. SNHL can cause many problems such as tinnitus, anxiety, depression and decrease in quality of life in addition to communication problems [1].

Aging is continuous and irreversible changes emerge in tissues and organs with aging. The increase in average life expectancy and the increase in the elderly population also increased the number of individuals with hearing loss [2]. The elderly hearing loss is called presbycusis [3]. In presbycusis, hearing loss is bilateral, symmetrical, progressive and sensorineural. Hearing loss usually occurs at high frequencies and other frequencies get affected over time [4, 5]. Genetic factors and environmental conditions are effective in the emergence and progression of presbycusis [6]. In addition to presbycusis, elderly people may have conductive and mixed type hearing loss [3]. In this case, the treatment modalities of hearing loss may also change. There is no medical or surgical treatment of presbycusis. The only treatment is a suitable hearing aid (HA). The use of hearing aids in individuals with presbycusis in the early stage may stop the progression of SNHL. In addition, early use of hearing aids can also prevent cognitive impairment and psychological problems [7]. Approximately, 40% of the individuals, on whom HA applied, stop using HA due to psychological problems or cognitive impairment by thinking that they do not benefit from it [8, 9]. Therefore, it is recommended that patients with presbycusis be diagnosed in the early stage and start using hearing aid early. However, there is resistance and prejudice against the early use of hearing aids in our country. For this reason, many patients in our country prefer to use hearing aids when they have a severe hearing loss.

In this study, we aimed to determine whether the hearing aid had an effect on hearing disability level in the elderly patients with presbycusis.

**Material and methods**

**Patient selection**

In this prospective study, patients admitted to the otorhinolaryngology outpatient clinic with complaints of hearing loss between February 2018 and April 2018 were evaluated. After the detailed history of all patients, ear-nose-throat examinations were performed. Patients aged 65 years and over, whose otoscopy examination was evaluated as normal, who had no acute or chronic infectious disease, have not undergone any ear surgery, have never previously used hearing aids, were diagnosed with presbycusis and in who have SNHL as bilateral 35 dB or more, were included in the study. The patients who have previously used hearing aids, patients who had ear surgery, patients under 65 years old, patients with unilateral SNHL, patients with conductive or mixed type hearing loss were excluded from the study. Patients who did not have Tip A tympanograms were also excluded from the study. Sixty patients who met the inclusion and exclusion criteria were recommended a digital programmable postauricular hearing aid. It has been planned to apply hearing handicap inventory scale (HHI) (Table 1) to the patients before the hearing aid and six months after the patient started to use the device. Although hearing aid was recommended, patients who did not use hearing aids and patients

who did not come for follow-up at the sixth month were excluded from the study. As a result, the study was completed with 43 patients.

The working protocol was prepared in accordance with the principles set out in the Helsinki Declaration. An approval was received from the clinical research ethics committee within our university (2018-6/8). Written informed consent was obtained from all patients.

Table 1. Hearing Handicap Inventory Scale.

Question	Yes	Sometimes	No
1S Does your difficulty in hearing bring you problems when using the telephone?			
2E Does a hearing problem cause you to feel embarrassed when meeting new people?			
3S Does a hearing problem cause you to avoid groups of people?			
4E Does a hearing problem make you irritable?			
5E Does a hearing problem cause you to feel frustrated when talking to members of your family?			
6S Does a hearing problem cause you difficulty when attending a party?			
7S Does a hearing problem cause you to feel frustrated when talking to co-workers, clients, or customers?			
8E Does a hearing problem cause you difficulty when going to the cinema or theater?			
9S Do you feel handicapped by a hearing problem?			
10E Does a hearing problem cause you difficulty when visiting friends, relatives, or neighbors?			
11S Does a hearing problem cause you difficulty to listen/understand co-workers?			
12E Does a hearing problem cause you to be nervous?			
13S Does a hearing problem cause you to visit friends, relatives, or neighbors less often than you would like?			
14E Does a hearing problem cause you to have arguments with family members?			
15S Does a hearing problem cause you difficulty when listening to TV or radio Does a hearing problem cause you difficulty when listening to TV or radio?			
16S Does a hearing problem cause you to go shopping less often than you would like?			
17E Does any problem or difficulty with your hearing upset you at all?			
18E Does a hearing problem cause you to want to be by yourself?			
19S Does a hearing problem cause you to talk to family members less often than you would like?			
20E Do you feel that any difficulty with your hearing limits or hampers your personal or social life?			
21S Does a hearing problem cause you difficulty when in a restaurant with relatives or friends?			
22E Does a hearing problem cause you to feel depressed?			
23S Does a hearing problem cause you to listen to TV or radio less often than you would like?			
24E Does a hearing problem cause you to feel uncomfortable when talking to friends?			
25E Does a hearing problem cause you to feel left out when you are with a group of people?			

Total score: \_\_\_\_\_ E Score: \_\_\_\_\_ S score: \_\_\_\_\_

**Assessment of hearing**

All audiological tests were performed by the authors. Clinical audiometry device (AC 40, DK-500; Interacoustics, Middelfart, Denmark) was used to evaluate the hearing levels. Pure-tone air conduction hearing threshold values of patients were measured at frequencies of 125 Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, 6000 Hz, and 8000 Hz. Pure-tone bone conduction hearing threshold values of the patients were measured at frequencies of 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz. Speech recognition threshold (SRT) and speech recognition

score (SRS) tests were performed. The pure tone average (PTA) was calculated by taking the average of hearing thresholds at frequencies of 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz. According to PTA results, the degree of hearing loss was considered to be mild (26 dB to 40 dB), moderate (41 dB to 55 dB), moderate to severe (56 dB to 70 dB), severe (71 dB to 90 dB) and profound (91 dB and above). Tympanometry measurement was performed with the impedance audiometer (AZ 26; Interacoustics, Middelfart, Denmark) in 226 Hz octave band by using 86 dB SPL probe tone stimulation. Type A tympanogram was accepted as normal.

### Hearing Handicap Inventory Scale

HHI consists of 25 questions. 12 of these questions contain information about the social situation and 13 of them contain about emotional status [10]. Every question includes three options as yes (4 points), sometimes (2 points) and no (0 points) and the total score is evaluated over 100 points. Total score; 0-16 points were considered as no handicap, 18-42 points as a mild to moderate handicap and 44-100 points as a significant handicap.

Social, emotional and total HHI scores were compared before the use of hearing aid and at the sixth month of use. HHI score gains obtained by patients after HA were compared according to gender. HHI score gains were compared between the patients with severe and profound hearing loss and the patients with moderate and moderate to severe hearing loss.

### Statistical Analysis

As a statistical method, SPSS version 21 (SPSS software, SPSS Inc., Chicago, IL, USA) was used. Percent, mean, standard deviation (SD), median, minimum and maximum values were presented for descriptive statistics. A Paired t-test was used to evaluate the difference between HHI scores before the using HA and the HHI scores that were applied at the sixth month of the HA use. Student's T-test was used to compare the HHI score gains obtained by the patients after HA according to the test. Student's T-test was used to compare HHI score gains that severe and profound hearing loss patients and patients with moderate and moderate to severe hearing loss obtained after HA. P value as <0.05 was considered statistically significant.

### Results

Of the 43 patients included in the study, 17 (39.5%) were female and 26 (60.5%) were male. The mean age was 73.44 ± 7.03 years (range, 65-89 years). HA was provided to the left ear of 23 patients (53.4%) and the right ear of 20 patients (56.6%). The results of PTA, SRT, and SRS before using the hearing aids on the right and left ears of the patients are given in Table 2. Fourteen of the patients (32.5%) had moderate hearing loss, 16 (37.2%) had moderate to severe, 11 (25.5%) were severe and two (4.6%) had profound hearing loss. Forty-one patients (95.3%) had a significant handicap and two patients (4.7%) had mild to moderate handicap according to HHI scores before using HA. According to the HHI scores applied at the six months after the use of HA, the auditory disability was completely disappeared in 17 patients (39.5%), 22 patients (51.2%) had a mild to moderate handicap and four patients (9.3%) had a significant handicap. After using hearing aids, the emotional, social and total HHI scores of women and men were significantly decreased (p=0.001) (Table 3). There was no significant difference between the gains in HHI score of the patients according to gender (p=0.737). There was no significant

difference between the HHI score gains obtained after HA in patients with the profound and severe hearing loss and the scores of the patients with moderate and moderate to severe hearing loss (p=0.521).

Table 2. Pure tone averages, speech receiving threshold values and speech discrimination rates of the patients before use of the hearing aid in the right and the left ear.

Variable	Right ear		Left ear	
	Mean ± SD	Min-Max	Mean ± SD	Min-Max
PTA (dB nHL)	64.65 ± 17.14	30-113	65.58 ± 15.92	45-112
SRT (dB nHL)	61.04 ± 16.53	30-100	60.69 ± 14.62	40-100
SRS (%)	59.58 ± 23.59	0-96	58.55 ± 24.84	0-96

PTA: pure tone averages, SRT: speech recognition threshold, SRS: speech recognition scores, SD: standart deviation, Min: minimum, Max: maximum.

Table 3. HHI scores of the patients before using the hearing aid and 6 months after.

Variable	Before HA		After HA		p
	Mean ± SD	Min-Max	Mean ± SD	Min-Max	
Total HHI Score	68.97 ± 16.97	20-96	22.51 ± 14.81	0-60	0.001
Male	69.07 ± 18.26	20-96	23.00 ± 16.33	0-60	
Female	68.82 ± 15.34	38-88	21.76 ± 12.56	6-52	
Total emotional score	33.90 ± 12.54	12-54	10.72 ± 6.94	0-24	0.001
Male	34.00 ± 9.74	12-48	11.07 ± 8.06	0-24	
Female	33.76 ± 11.02	18-54	10.23 ± 4.94	4-20	
Total social score	35.06 ± 9.32	8-52	11.76 ± 8.92	0-40	0.001
Male	35.07 ± 10.26	8-52	11.92 ± 9.55	0-40	
Female	35.05 ± 7.97	20-44	11.52 ± 8.14	0-32	

HHI: hearing handicap inventory scale, HA: hearing aid, SD: standart deviation, Min: minimum, Max: maximum.

### Discussion

As it affects the whole body, aging also affects the Corti organ, the auditory nerve, and the auditory cortex. Cell aging in the auditory pathway leads to SNHL, which is defined as presbycusis. Presbycusis causes difficulty in understanding the conversations, decreasing verbal communication skills, negatively affecting social lives and decreasing quality of life [3, 6, 11]. There are many questionnaires evaluating health quality and satisfaction level of patients using hearing aids. Glasgow Hearing Aid Benefit Profile, The Speech, Spatial and Qualities of Hearing Scale, Hearing Aid Performance Questionnaire, Satisfaction with Amplification in Daily Life, Abbreviated Profile of Hearing Aid Benefit and International Outcome Inventory for Hearing Aids are some of those. In our study, we wanted to investigate the effect of hearing aid on auditory disability rather than its effect on patient satisfaction. For this reason, we chose the HHI scale, which contains easy to understandable questions for the Turkish people.

In our study, we have found that the use of HA significantly decreases the level of social and emotional disability in elderly individuals with presbycusis. However, there was no difference in terms of the benefit that men and women with presbycusis gained from HA. In some studies, it has been reported that there is no relationship between gender and hearing aid satisfaction [12-15]. According to the studies evaluating the relationship between age and hearing aid satisfaction, different results are obtained in the literature. Many studies have found that age does not affect hearing aid satisfaction [12, 15-17]. In some studies, young elderly people were found to be more satisfied with hearing aids than older ones [18, 19]. Korkmaz et al. [20] found that the satisfaction of hearing devices decreased in advanced ages. They also stated that there is an overall

decrease in general life satisfaction due to activity limitations and increased systemic problems with advanced ages [20].

In the literature, there are many studies suggesting that the HA improves quality of life and reduces hearing disability rates [3, 21]. In the study conducted on Iranian people, Lotfi et al. [3] reported that HA improved quality of life. In their study, they applied HHI scale before and 3 months after the use of HA and found that the total HHI score decreased from 65 to 22. Vuorialho et al. [21], in their study in Finland, applied the HHI scale before the use of the hearing aid and 6 months after the use of the device and found that HHI scores decreased from 28.7 to 12.7. In our study, we also performed HHI 6 months after the patients started to use HA for the realization of auditory adaptation similar to Vuorialho et al. [21]. In our study, HHI scores performed before HA were high as in the study Lotfi et al. [3] conducted. However, in the study conducted in Finland [21], the pre-HA HHI scores were significantly lower compared to the scores both in our study and the study by Lotfi et al. [3] conducted. The reasons for such a difference between societies according to HHI scores are due to the socio-cultural differences and economic reasons. These results may be indicative of the fact that patients in advanced western countries, such as Finland, have begun to use hearing aids without increasing the level of hearing disability.

In some studies, it has been reported that hearing loss does not only affect individuals with presbycusis, but also adversely affects families and close friends [6, 21]. In our study question, #14 (Does your hearing loss cause you to argue with your family members?) was one of the questions receiving the highest scoring (not shown data). Elderly individuals with having arguments with the families or close environment can cause them to be more withdrawn and lead to social isolation. In addition, one of the biggest problems experienced by the patients in our study was to listen to the radio or television which was questioned on the HHI scale by #15 question (not shown data). Elderly people may be more directed towards television and radio, but because they do not fully understand the television and radio, dissatisfaction and unhappiness may be increasing.

HA is an important and effective rehabilitation method for moderate and moderate to severe hearing loss, and it can be recommended as a preventive method for patients with mild hearing loss [22, 23]. It has been stated that the fitting setting of the hearing aid changes the use and effect of the device [21]. Magni et al. [24] investigated the effectiveness of analog and digital hearing aids. They stated that devices with different features had differed from the benefits provided to the individuals, however, the patients benefited from both devices. In our study, all individuals were using digital and postauricular programmable HA. In addition, although HA is an effective rehabilitation method for moderate and moderate to severe hearing loss, in our study, it was found that individuals with severe and profound hearing loss also benefited from HA. With the developing HA technology and HA fitting experience, we think that hearing aids may be recommended for more severe and profound hearing loss in the future.

The limitations of our study were low patient population and lack of speech recognition scores with hearing aids.

As a conclusion, HA is an effective treatment for the rehabilitation of elderly individuals with presbycusis. HA reduces auditory disability in patients with moderate, moderate to severe, severe and profound hearing loss and significantly increase these individuals' social and emotional life quality emerging due to hearing loss.

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