Age Related Hearing Loss in Korea: A Healthcare Center-based Study

Joong Ho Ahn, MD¹, Jae-Jun Song, MD², Moo Kyun Park, MD³, Jun Ho Lee, MD⁴, Sung Won Chae, MD⁵

¹Department of Otolaryngology, Asan Medical Center, University of Ulsan College of Medicine, Seoul,  
²Department of Otorhinolaryngology–Head and Neck Surgery, Dongguk University Ilsan Hospital, Dongguk University College of Medicine, Ilsan,  
³Department of Otorhinolaryngology–Head and Neck Surgery, Soonchunhyang University Bucheon Hospital, Soonchunhyang University College of Medicine, Bucheon, Korea  
⁴Department of Otorhinolaryngology, Seoul National University Hospital, Seoul National University College of Medicine, Seoul,  
⁵Department of Otorhinolaryngology–Head and Neck Surgery, Korea University Guro Hospital, Korea University College of Medicine, Seoul, Korea

Background: Age-related hearing loss is a common degenerative disorder among older individuals that warrants attention in a society with an aging population. The objectives of this study were to investigate age-related hearing loss and to estimate the prevalence of age-related hearing loss in Korea using a healthcare center-based study.

Methods: Persons older than 50 years of age visiting a selected health promotion center were recruited (n=10,118). Pure tone audiometry was performed on the subjects, and the average hearing thresholds were obtained using 500 Hz, 1,000 Hz, 2,000 Hz, and 4,000 Hz for the six-dimension method.

Results: The prevalences of age-related hearing loss for subjects older than 65 years were 36.8% at a cutoff of ≥26 dBHL and 10.1% at a cutoff of ≥41 dBHL. When age and gender were corrected for, the estimated prevalences of age related hearing loss for those subjects greater than 65 years in the general population were 45.8% at a cutoff value of ≥26 dBHL and 14.8% at a cutoff value of ≥41 dBHL.

Conclusion: Our study provides important information concerning age-related hearing loss in Korea. The estimated prevalence of age-related hearing loss in the general population in Korea was high.

Key Words: Age related hearing loss, Prevalence, Pure tone audiometry

INTRODUCTION

Age-related hearing loss refers to a symmetrical hearing defect that occurs after 65 years of age with no underlying cause⁵. Age-related hearing loss is characterized by reduced hearing sensitivity and speech understanding in noisy environments, slowed central processing of acoustic information, and impaired localization of sound sources⁵. More than 10% of the population have problems communicating due to hearing loss, and this rate increases up to 40% in those older than 65 years³.

Hearing abilities are poorer in industrialized societies than in isolated or agrarian societies⁴,⁵. A nationwide study of hearing disorders in the United Kingdom showed that 92% of the study subjects older than 60 years had sensorineural hearing loss at greater than 25 dB hearing levels (HL), and 31% had hearing loss at greater than 45 dBHL⁶. Data from the Framingham cohort in the United States reported that 29% of the cohort had a greater than 26 dBHL⁷. A study done with a group of Koreans older than 65 years showed that 37.8% had a mean threshold greater than 27 dBHL.
Table 1. Study subjects by gender and age

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-54</td>
<td>2,459 (63.5)</td>
<td>1,412 (36.5)</td>
<td>3,871 (100)</td>
</tr>
<tr>
<td>55-59</td>
<td>2,003 (65.1)</td>
<td>1,076 (34.9)</td>
<td>3,079 (100)</td>
</tr>
<tr>
<td>60-64</td>
<td>1,024 (63.3)</td>
<td>594 (36.7)</td>
<td>1,618 (100)</td>
</tr>
<tr>
<td>65-69</td>
<td>621 (64.3)</td>
<td>345 (35.7)</td>
<td>966 (100)</td>
</tr>
<tr>
<td>70-74</td>
<td>279 (66.1)</td>
<td>143 (33.9)</td>
<td>422 (100)</td>
</tr>
<tr>
<td>≥75</td>
<td>110 (67.9)</td>
<td>52 (32.1)</td>
<td>162 (100)</td>
</tr>
<tr>
<td>Total</td>
<td>6,496 (64.2)</td>
<td>3,622 (35.8)</td>
<td>10,118 (100)</td>
</tr>
</tbody>
</table>

and 8.3% had a mean threshold greater than 40 dBHL. Age-related hearing loss adversely restricts one or more dimensions of quality of life, namely, physical, emotional, cognitive, and social function. Even mild to moderate hearing loss can induce significant social and emotional handicaps. Age-related hearing loss has been considered a risk factor for functional decline. The total cost of first-year treatment of age-related hearing loss in United States was approximately $8.2 billion in 2002. This cost is expected to increase to about $51.4 billion in 2030 according to the increase in age-related hearing loss.

The purposes of this study were to determine age-related hearing loss in subjects visiting a selected health promotion center and to estimate the prevalence of age-related hearing loss in Korea using demographic correction.

Materials and Methods

A total of 11,539 people older than 50 years visited the Asan Hospital Health Promotion Center between December 2006 and February 2008 for secondary prevention or health examinations. They were from Seoul or Gyeonggi province, both industrial areas. Patients with a history of otologic disease, ototoxic drug use, or head trauma were excluded from the study, as were those whose difference in hearing threshold between the two ears was greater than 10 dB. Otologic examinations were done by an otolaryngologist, and subjects with abnormal eardrum findings were excluded from the study. A total of 10,118 subjects older than 50 years were recruited.

Of this total, 6,496 (64.2%) were males and 3,622 (35.8%) were females. Mean age was 55.8±6.2 years. The difference in gender proportion in the different age groups was not significant (p>0.09) (Table 1).

Pure-tone air conduction thresholds were measured in a quiet room using a GSI 10 audiometer (VIASYS Healthcare Inc., Conshonhocken, PA, USA). The six-dimensional method was performed for 500 Hz, 1,000 Hz, 2,000 Hz, and 4,000 Hz to obtain pure tone averages.

The pure tone average of six-dimensional methods = \( \frac{500 \text{ Hz} + 2 \times 1,000 \text{ Hz} + 2 \times 2,000 \text{ Hz} + 4,000 \text{ Hz}}{6} \)

The average of both ears was used for analysis. The pure tone average of both ears at each frequency was obtained for frequency analysis.

Subjects were grouped according to age as follows: 50-54, 55-59, 65-69, and 70-75. The prevalence of hearing loss in each age and gender groups was obtained at 26 dBHL and 41 dBHL. The prevalence value from this study was corrected according to the population census data including age and sex (Korea National Statistical Office) to estimate the prevalence of hearing loss in the community. For statistical analysis, SPSS ver. 12.0 (SPSS Inc., Chicago, IL, USA) was used. In addition to descriptive statistics, the chi-square (\( \chi^2 \)) test was used for categorical data and the analysis of variance or t-test was used for continuous data.

This study was approved by the institutional review board for human studies at the Asan Hospital and was conducted according to the declaration of Helsinki. The data from the hearing examinations were provided as an anonymized sample from the Health Care Center.

Results

The mean hearing thresholds were 16.6±9.4 dBHL for males and 15.5±8.3 dBHL for females (p=0.01). In the 50-
54, 55-59, and 65-69 year age groups, the mean hearing thresholds were significantly lower in females than in males (p=0.03) (Fig. 1).

The mean hearing thresholds were lower in males at 500 Hz and 1,000 Hz (p=0.02) but lower in females at 2,000 Hz and 4,000 Hz (p=0.01) (Fig. 2).

The progress of hearing loss was more rapid at 4,000 Hz than at 500 Hz (p=0.02), and more rapid in females than in males (p=0.02) (Fig. 3A, B).

Table 2 shows the incidence of sensorineural hearing loss for each age group, with 26 dBHL and 41 dBHL as the selection criteria for age-related hearing loss.

The prevalence of hearing loss at 26 dBHL was 12.7%, and the prevalence was significantly higher in males than in females in the 50-64 age groups (p=0.03). The prevalence of hearing loss at 41 dBHL was 2.7%, with the prevalence being significantly higher in males than in females in the 55-64 age groups (p=0.04).

For subjects over 65 years, the prevalences of hearing loss were 36.8% at 26 dBHL and 10.1% at 41 dBHL (Table 2).

**Table 2.** Prevalence of age-related hearing loss at each cutoff point by age and gender

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>≥26 dBHL</th>
<th>≥41 dBHL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>50-54</td>
<td>5.9'</td>
<td>3.2'</td>
</tr>
<tr>
<td>55-59</td>
<td>10.5'</td>
<td>5.5'</td>
</tr>
<tr>
<td>60-64</td>
<td>17.4'</td>
<td>12.6'</td>
</tr>
<tr>
<td>65-69</td>
<td>31.2'</td>
<td>27.2'</td>
</tr>
<tr>
<td>70-74</td>
<td>41.2'</td>
<td>41.3'</td>
</tr>
<tr>
<td>≥75</td>
<td>65.5'</td>
<td>71.2'</td>
</tr>
<tr>
<td>Total</td>
<td>14.1'</td>
<td>10.2'</td>
</tr>
</tbody>
</table>

p<0.05

Fig. 1. Gender differences in hearing threshold averages for each age group. In the 50-54, 55-59, and 65-69 year age groups, the mean hearing thresholds were significantly lower in females than in males.

Fig. 2. Gender differences in hearing threshold averages at each frequency. The mean hearing thresholds were lower in males at 500 Hz and 1,000 Hz (p=0.01) but lower in females at 2,000 Hz and 4,000 Hz (p=0.02).
The estimated prevalences of hearing loss for people over 50 years in Korea were 22.7% at the 26 dBHL criteria and 6.5% at the 41 dBHL criteria. For those over 65 years, the numbers were 45.8% at 26 dBHL and 14.8% at 41 dBHL (Table 3, Fig. 4).

**DISCUSSION**

Age-related hearing loss includes all conditions that lead to hearing loss in the elderly\(^{15}\), and it is a common geriatric syndrome\(^{16}\).

Age-related hearing loss can be histopathologically classified into four types: sensory, neural, metabolic, and cochlear conductive types\(^{17,18}\).

Some people refer to age-related hearing loss as hearing loss due solely to aging. However, it is very difficult to isolate age effects from other contributors to age-related hearing loss. It is probably more accurate to regard age-related hearing loss as a mixture of acquired auditory stresses, trauma, and otologic disease superimposed upon the aging process\(^2\).

Because the method for reporting hearing loss differed among studies\(^7,8,19\), and the study populations had different
make-ups, comparison with previous age-related hearing loss data was difficult. Analysis of the Framingham cohort showed that the prevalence of hearing loss at above 26 dBHL was 29% (32.5% in males, 26.7% in females) in the United States. A 1995 nationwide United Kingdom study of hearing disorders reported that 92% of the subjects over 60 years had hearing loss at above 25 dBHL and 31% had hearing loss at above 45 dBHL. The prevalence of age-related hearing loss for a cohort of Chinese subjects was 96.5% at the 25 dBHL criteria and 38.7% at the 40 dBHL criteria. Another epidemiologic study on hearing loss showed that 45.9% of the study cohort had hearing loss. In studies based on pure tone audiometry, the prevalence of hearing loss was 26% at 26 dBHL in subjects between 60 and 75 years.

Based on our study, the estimated prevalence of hearing loss for those older than 65 years in Korea was 45.8% at the 26 dBHL criteria and 14.8% at the 41 dBHL criteria. These findings are comparable with previous reports.

At 500 Hz and 1,000 Hz, women had significantly higher hearing thresholds than men in all age groups, while men had higher hearing thresholds at 2,000 Hz and 4,000 Hz. Below 1 kHz, women showed higher hearing thresholds than men, but above 1 kHz, men had the higher hearing thresholds. These findings represent a ‘gender reversal’ phenomenon, which is related to the greater likelihood of noise exposure in older men and higher prevalence of cardiovascular disease in older women.

A community survey is the ideal method to study the prevalence of age-related hearing loss, but it is also more costly. Because our subjects were recruited on a voluntary basis, self-selection bias was inevitable. However, the results of the present study showed an expected age-related deterioration of hearing thresholds. The prevalence of age-related hearing loss in this study was comparable with that seen in previous reports.

Compared to the general population, our study group had more younger subjects and male subjects. Because the prevalence of age-related hearing loss varies with age and gender, we obtained a new average by weighing age and gender according to the demographic data from the Korea National Statistical Office. Every 5 years, the Korea National Statistical Office conducts a population census and releases its projections of the population of Korea. It is the most reliable data on the proportions of age and sex. The estimated prevalences of age-related hearing loss was higher than that without correction for demographic data. The estimated prevalence of age-related hearing loss showed a higher prevalence than the previous study done in Korea. The difference in prevalence suggests an increase in age-related hearing loss. In addition, the difference could be related to the difference in where the study subjects are from and if soundproof rooms were used. We believe that our study presents a more reliable data because our subjects were evaluated in soundproof rooms. The estimated prevalences of this study are more comparable with previous reports of other countries.

In this study, subjects whose difference in hearing thresholds between the two ears was greater than 10 dB were excluded because age-related hearing loss refers to a symmetrical hearing defect occurring after the age of 65 with no underlying cause. Though this study only examined air conduction thresholds, those with conductive hearing loss might have been included. Other likely confounding factors such as income, education level, and lifestyle were not considered as these were beyond the realm of the aim of this study.

Considering the resources and difficulties involved in recruiting subjects, the present study represented a time-saving and relatively reliable way to determine age-related hearing loss and to estimate the prevalences of age-related hearing loss.

**SUMMARY**

The prevalence of age-related hearing loss in Korea was estimated to be 45.8% at the 26 dBHL criteria and 14.8% at the 41 dBHL criteria for those older than 65 years. The prevalence was higher in women than in men, and the difference was significant at 500 Hz and 1,000 Hz. The estimated prevalences were comparable with previous reports, and the results were considered reliable due to the use of soundproof rooms in the study.

**연구배경:** 노인성 난청은 흔한 만성적 질환으로 미국의 경우 65세 이상 노인 중 1/3 이상이 난청을 가지고 있다. 성인과 달리 노인의 난청은 나이가 들어감에 따라 만성적 질환과 함께 천천히 진행되고, 또 여러 가지 사회적·정치적 요인과 함께 나타난다. 본 연구 건강검진센터의 청력검사 소견을 인구통계 자료를 이용하여 보정하여 우리나라의 노인성 난청의 유병률을 알아보고자 하였다.

**방법:** 2006년 1월부터 2008년 11월까지 서울아산병원 건강검진센터를 내원한 인원 중 50세 이상인 11,481예를 대상으로 하였다. 남자는 6,496명, 여자는 3,622명이었으며 평균 나이는 55.8±6.2세였다. 모든 환자는 순음청력 장비를 이용하여 500 Hz, 1,000 Hz, 2,000 Hz, 4,000 Hz의 기도청력 역치를 측정하였다. 한쪽 귀의 청력역치의 평균은 6분법을 이용하였고, 연령군과 남녀에 따른 청력역치를 구하여 남녀에 따른 차이를 비교하였다.
수별 청력역치를 구하였고, 남녀에 따른 주파수별 난청의 진행 양상을 파악하였다. 실제 우리나라의 인구의 연령비 및 성비를 2006년 통계청의 장래인구추계 결과를 이용하여 보정하여 노인성 난청의 유병률을 추산하였다.

결과: 남자의 청력역치는 16.6±9.4 dBHL이었고, 여자의 경우 15.5±8.3 dBHL로 여성에서 유의하게 낮았고(p<0.05) 이를 연령군에 따라 나누었을 때 50-54세, 55-59세, 65-69세 군에서는 여성의 청력역치가 유의하게 높았다. 남녀의 청력 역치를 주파수별로 비교하였을 때 500 Hz, 1,000 Hz에서는 여성의 청력역치가 유의하게 높았으나 2,000 Hz, 4,000 Hz에서는 남자의 청력역치가 유의하게 높았다(p<0.05). 남녀 모두 고주파 영역에서 청력역치의 증가 폭이 더 컸다고 고주파 영역에서 상대적인 난청의 진행이 더 빠른 것을 알 수 있었다.

본 연구에서 난청의 유병률은 실제 우리나라의 인구의 연령비/성비에 보정하여 50세 이상에서 26 dBHL 이상의 난청 유병률은 22.7%, 41 dBHL 이상의 난청 유병률은 6.5%로 추산할 수 있었다. 또한 65세 이상을 대상으로 하였을 때 26 dBHL 이상의 난청 유병률은 45.8%, 41 dBHL 이상의 난청 유병률은 14.8%로 추산할 수 있었다.

결론: 우리나라에서의 노인성 난청의 유병률은 45.8%로 추산할 수 있었으며, 청력역치는 여성에서 유의하게 낮게 측정되었으며, 고주파 영역에서 상대적인 난청의 진행이 더 빠랐다.

ACKNOWLEDGEMENTS

The authors have no conflict of interest concerning this work.

REFERENCES


