

Incidence of Presbycusis of Korean Populations in Seoul, Kyunggi and Kangwon Provinces

Presbycusis, a bilateral sensorineural hearing loss caused by changes in the inner ear, is related to multiple factors such as noise exposure and otologic disease. In institute-based studies, we tried to determine the incidence of presbycusis in Korean populations living in Seoul, Kyunggi and Kangwon provinces by gender and age groups. The subjects were people who had visited health promotion centers. Pure tone audiometry was done over 20 years on 6,028 subjects. In a community-based study, the subjects were elderly residents of Kanghwa-do area. There were no obvious factors that could cause hearing impairment in the subjects. For the pure tone audiometry, hearing threshold was obtained by using the six-dimension method. The incidence of presbycusis for subjects aged 65 years and older was 37.8% and 8.3% for ≥ 27 dB HL criterion and ≥ 41 dB HL criterion, respectively. The incidence increased with age. A statistically significant difference in the hearing threshold was found between men and women aged 65 years or older. No differences were found between the community-based study and the institute-based studies. There was a high incidence (about 40%) of presbycusis among Koreans aged 65 years or older (for ≥ 27 dB HL criterion). With an aging population, we anticipate that this report could be used to provide a basic data for the study of presbycusis.

Key Words: Presbycusis; Frail Elderly

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INTRODUCTION

Presbycusis is known to be the most common auditory dysfunction associated with increasing age. Its etiology is diverse with degenerative change, noise exposure, otologic disease, diet and genetic factors among those in consideration. There are some instances when a mild degree of presbycusis does not seriously affect daily life. However, in most cases it usually affects social and home life with complaints of hearing impairment even when the auditory status is relatively good. Serious psychological problems can occur, especially when it is accompanied by a loss of social adaptation, isolation or alienation (1). Incidence of presbycusis is a valuable indicator of its effect on society. The incidence of presbycusis has been investigated in other countries (2-5). However, there is little information about the incidence and degree of presbycusis in Koreans. Our study was carried out to deter-

mine the incidence of presbycusis in a Korean population and to present basic data for the research of presbycusis in Koreans by comparing our results with foreign studies.

MATERIALS AND METHODS

This study is comprised of two parts. In the first part, data was collected from people who visited health promotion centers located in Seoul, Kyunggi and Kangwon provinces between 1994 and 1997 (institute-based studies). The second part involved data from 300 residents of the Kanghwa-do area aged 65 years and older (community-based study).

A total of 39,004 people visited health promotion centers located in Seoul, Kyunggi and Kangwon provinces from March 1994 to February 1997. Our study was limited to subjects without factors which could affect

Table 1. Subject characteristics

		Health promotion centers		Kangwha-do		
Men	n=2,955	age	47.7±11.9 years	n=91	age	72.9±6.1 years
		aPTA	17.2±9.1 dB HL		aPTA	27.9±13.1 dB HL
Women	n=2,769	age	48.5±11.6 years	n=144	age	71.9±5.4 years
		aPTA	16.1±7.7 dB HL		aPTA	26.2±9.7 dB HL

Unit: persons, aPTA: air conduction pure tone average

hearing (otologic disease, diabetes, hypertension, tuberculosis, ototoxic drugs, etc.). Pure tone audiometry was performed using GSI38 (Grason Stadler Inc.) in a sound-proof chamber after otologic examination by otolaryngologists. The pure tone average (PTA) was obtained by using the six-dimensional method for the measured air conduction threshold of both ears at 500 Hz, 1,000 Hz, 2,000 Hz and 4,000 Hz. An otolaryngologist reviewed the physical examination and the clinical pathologic examination (complete blood count, urinalysis, stool exam, liver and thyroid function tests, etc.) of each subject, and then investigated factors that might cause any hearing abnormalities. Subjects who had abnormal findings of the ear drum (perforation, chronic otitis media, tympanosclerosis, etc) were excluded. Subjects whose difference in PTAs in both ears were greater than 10 dB were excluded from this study. A total of 5,724 subjects (2,955 males and 2,769 females) met the selection criteria. Mean ages of the subjects were 47.7 years for males and 48.5 years for females (Table 1).

Research on incidence in the Kanghwa-do area was carried out on 300 people (123 males and 177 females) over 65 years with an average of 72.1 on the basis of a systemic review and physical examination. Pure tone audiometry was performed after full otologic examination and a review of the system in Seodo-myon (Jumoon 1-Ri, Buleum 1, 2-Ri) and Samsan-myon (Sang 1, 2-Ri, Ha-Ri, Maceum 1, 2, 3-Ri, Seopo-Ri) in Incheon, Kanghwa-do from November 1998 to December 1998. People who were exposed to factors, described above, that may have caused hearing impairment were excluded. PTA was obtained by the six-dimensional method for measured air conduction threshold of both ears at 500 Hz, 1,000 Hz, 2,000 Hz and 4,000 Hz, using a Micromate 304 screening audiometer (Madsen Electronics). The results were calibrated by measuring the noise level in an audiologic test room using a Metrosonics sound analyzer. Subjects whose difference in PTAs between both ears was greater than 10 dB were excluded from the study. A total of 235 participants, 91 males and 144 females in the Kanghwa-do area met the final selection criteria. Mean ages of the participants were 72.9 years for males and 71.9 years for females (Table 1).

The pure tone average of the air conduction threshold

was calculated by obtaining the mean average of both ears. The criteria for presbycusis were pure tone averages of 27 dB hearing level (HL) and 41 dB HL or greater. For statistical analysis, a chi-square test was executed using PC/SAS version 6.12.

RESULTS

The mean air conduction pure tone average (PTA) of people who visited health promotion centers was 17.2 dB for males and 16.1 dB for females (Table 1, Fig. 1). PTA of 235 participants in the Kanghwa-do area was 27.9 dB for males and 26.2 dB for females (Table 1).

Table 2 shows the incidence of sensorineural hearing loss of subjects who visited health promotion centers for each age group, with 27 dB HL and 41 dB HL as the selection criteria for presbycusis. Using the 27 dB HL criterion, for subjects under 54 years old, the incidence was below 10%. However, marked increases were found for age groups over 55 years old. Even with using 41 dB HL as the criterion, the incidences increase with age (Fig. 2).

When the incidence of presbycusis for each age group by gender was compared with 27 dB HL as the criterion, the incidences between male and female were variable. In the comparison of the incidence of presbycusis for each age group by gender with 41 dB HL as the criterion, males had a higher incidence (roughly three times) than

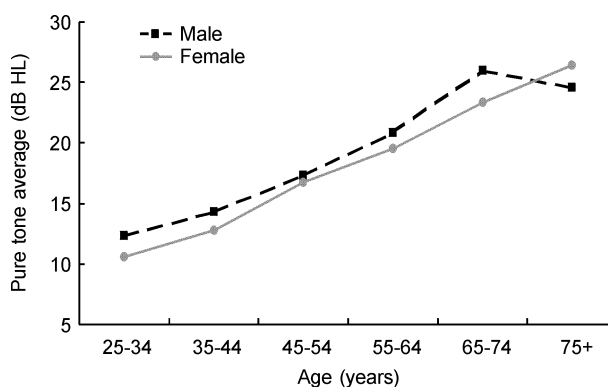


Fig. 1. Average of air conduction threshold by age and gender group (health promotion center data).

Table 2. Incidence of sensorineural hearing loss by age group (health promotion center data)

Age (yr)	No.	≥27 dB HL	≥41 dB HL
25-34	752	6 (0.8)	1 (0.1)
35-44	1796	39 (2.2)	7 (0.4)
45-54	1301	98 (7.5)	8 (0.6)
55-64	1371	220 (16.1)	27 (2.0)
65-74	446	154 (34.5)	31 (7.0)
≥75 years	58	23 (39.7)	5 (8.6)

Unit: persons (%)

Table 3. Incidence of sensorineural hearing loss in male by age group (health promotion center data)

Age (yr)	Persons (%)	
	≥27 dB HL	≥41 dB HL
25-34 (n=379)	4 (1.1)	0 (0.0)
35-44 (n=1019)	32 (3.1)	6 (0.6)
45-54 (n=642)	58 (9.0)	3 (0.5)
55-64 (n=637)	115 (18.1)	19 (3.0)
65-74 (n=243)	86 (35.4)	24 (9.9)
≥75 (n=35)	12 (34.3)	4 (11.4)

Table 4. Incidence of sensorineural hearing loss in female by age group (health promotion center data)

Age (yr)	Persons (%)	
	≥27 dB HL	≥41 dB HL
25-34 (n=373)	2 (0.5)	1 (0.3)
35-44 (n=777)	7 (0.9)	1 (0.1)
45-54 (n=659)	40 (6.1)	5 (0.8)
55-64 (n=734)	105 (14.3)	8 (1.1)
65-74 (n=203)	68 (33.5)	7 (3.5)
≥75 (n=23)	11 (47.8)	1 (4.4)

females (Tables 3, 4).

The degree of hearing impairment in subjects from the health promotion centers was analyzed. More than 90% of hearing impairment was mild or moderate in degree and the percentage of severe hearing loss increased for

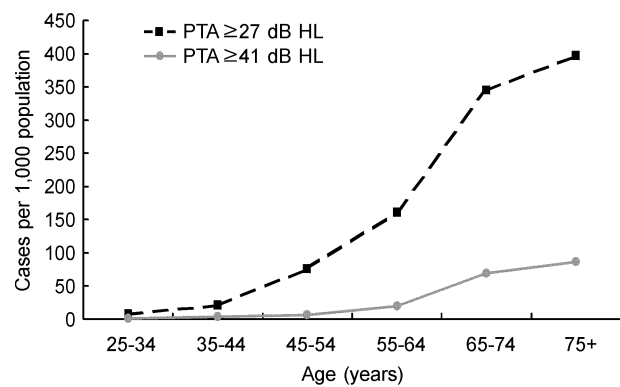


Fig. 2. Incidence of sensorineural hearing loss by age group (health promotion center data).

Table 6. Incidence of presbycusis (Kangwha-do, 235 residents, ≥65 years)

Criteria of hearing impairment	≥27 dB HL	≥41 dB HL
Men (n=91)	44 (48.4)	13 (14.3)
Women (n=144)	58 (40.3)	12 (8.3)
Total (n=235)	102 (43.4)	25 (10.6)

Unit: persons (%)

those over 45 years (American National Standard Institute, 1969) (Table 5).

The population compatible with the 27 dB HL criterion in the Kanghwa-do was 43.4%. The incidence for males was 48.4% and that for females was 40.3%. With 41 dB HL as the criterion, the incidence for males was 14.3% and that for females was 8.3% (Table 6). 75.5% of the 102 participants who showed more than 27 dB hearing loss, had hearing loss ranging between 27-40 dB and 24.5% showed more than 41 dB hearing loss.

There was a statistically significant difference between the PTAs of subjects from the health promotion centers and the Kanghwa-do area with 24.8 dB and 26.8 dB hearing loss respectively ($p=0.023$). Since mean ages of the two groups were different, multi-regression tests were performed excluding age. There was no statistically sig-

Table 5. Severity of hearing impairment by age group (health promotion center data)

Age (yr)	Hearing threshold (dB HL)					
	27-40	41-55	56-70	71-90	>91	≥27
25-34	5 (83.3)	1 (16.7)	0 (0.0)	0 (0.0)	0 (0.0)	6 (100)
35-44	32 (82.1)	4 (10.3)	1 (2.6)	1 (2.6)	1 (2.6)	39 (100)
45-54	90 (91.8)	5 (5.1)	3 (3.1)	0 (0.0)	0 (0.0)	98 (100)
55-64	193 (87.7)	19 (8.6)	5 (2.3)	1 (0.5)	2 (0.9)	220 (100)
65-74	123 (79.9)	23 (14.9)	7 (4.5)	0 (0.0)	1 (0.6)	154 (100)
≥75 years	18 (78.3)	4 (17.4)	1 (4.3)	0 (0.0)	0 (0.0)	23 (100)

Unit: persons (%)

Table 7. Incidence of presbycusis in Koreans living in Seoul, Kyunggi and Kangwon provinces (≥ 65 years)

Criteria of hearing impairment	≥ 27 dB HL	≥ 41 dB HL
Men (n=370)	142 (38.4)	41 (11.1)
Women (n=369)	137 (37.1)	20 (5.4)
Total (n=739)	279 (37.8)	61 (8.3)

Unit: persons (%)

nificant difference between the two groups ($p=0.443$). Since the pure tone averages of the two groups showed no statistical difference, we combined data from the two groups to analyze the incidence in Koreans living in Seoul, Kyunggi and Kangwon provinces. With 27 dB HL as the criterion, the incidence among subjects who were over 65 years old was 38.4% for males and 37.1% for females. With 41 dB HL as the criterion, the incidence was 11.1% for males and 5.4% for females (Table 7). Among 279 subjects whose degree of hearing loss was more than 27 dB, 218 (78.1%) showed hearing loss between 27-40 dB and 61 (21.9%) showed more than 41 dB of hearing loss.

DISCUSSION

Presbycusis is generally known as a hearing loss disorder associated with increasing age. It is a part of the senile process affected by various factors as time progresses (6). The degenerative change include three elements which can be defined as extrinsic insult, intrinsic insult and intrinsic degeneration (7). Although hearing impairment increases with aging, it has been reported that its relevance to age is rather minimal and variable. Environmental factors seriously affect the development of hearing impairment more than systemic diseases. Presbycusis can be histopathologically classified into four types, each explaining presbycusis in a different pathophysiology. They are sensory (hair cell loss), neural (ganglion cell loss), metabolic (strial atrophy) and cochlear conductive (stiffness of basilar membrane) types, of which more than 75% are the sensory type (8-10). A histopathological hypothesis of such presbycusis cannot fully explain how degeneration of the hair cell and nerve is related to injury by various environmental factors.

Active studies on the incidence of presbycusis have long been carried out in foreign countries. Reports from the National Health Survey in 1976 and the Department of Health, Education & Welfare in 1975 revealed that 40% of the total population over 75 years complained of hearing impairment and that the incidence of presbycusis in the entire U.S.A. was 7.2%. At the same time,

De Mare reported a 20% incidence for the those aged 65 years and older, while Townsend and Wedderburn reported a 33% incidence for those 65 years and older, in Britain. In studies based on pure tone audiometry, Beaver reported a 26% incidence in elderly people in London aged between 60 and 75 years, with pure tone average criterion of 40 dB HL or more (2-5). These studies showed that presbycusis has been detected in a significant number of people and incidence increases with age.

Our study was carried out through retrospective studies at health promotion centers (institute-based studies) and through a community-based study to supplement the former. Differences in the incidence distribution by age groups can be seen clearly in the retrospective study at health promotion centers. It shows that incidence increases with age and that a dramatic increase in incidence is seen especially in subjects over 65 years. In age groups 65 years and older, using 41 dB HL criterion, incidences of presbycusis were 11.1% and 5.4% for males and females, respectively. The difference was statistically significant. In the community-based study, the incidence distribution by age groups was not identified because the subjects were over 65 years. The results for incidence after performing multiple regression test with exclusion of age were not statistically different from those obtained at the health promotion centers. The difference between genders over 65 years was believed to have been related to a relatively higher chance of exposure to noise for males (shooting practice during military service). Since no gender difference has been reported previously, it can be considered as a peculiar effect of the Korean environment. However further study is required to elucidate the course for the difference between the genders.

The incidences from institute-based and community-based studies did not result in any statistically significant difference. However, the need for reinvestigation by enlarging the sampling number should be considered, in order to account for the various environmental factors involved in the cause of presbycusis. A slight difference can be seen in the distribution of presbycusis for those over 65 years in this two-part study. Most subjects showed a mild to moderate degree of hearing impairment. Based on data obtained from this study, the incidence was not much different from those reported previously in other countries. We hope that this study can be used for the future prevention of presbycusis and rehabilitative therapy by encouraging more reports and intensive study.

In this study, it was observed that presbycusis in Koreans living in Seoul, Kyunggi and Kangwon provinces showed a high incidence of 37.8% with 27 dB HL as the criterion and 8.3% with 41 dB HL as the criterion

for those aged 65 years and older. We hope this report provides basic data for the further study of presbycusis. The further study on presbycusis and the necessity for rehabilitation of hearing disability also should be considered.

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REFERENCES

1. Uhlmann RF, Larson EB, Koepsell TD. *Hearing impairment and cognitive decline in senile dementia of the Alzheimer's type. J Am Geriatr Soc* 1986; 34: 207-10.
2. Rahko T, Kallio V, Kataja M, Fagerstrom K, Karma P. *Prevalence of handicapping hearing loss in an aging population. Ann Otol Rhinol Laryngol* 1985; 94: 140-4.
3. Hearing impairment in the United States. *Stat Bull Metropol Life Insur Co* 1976; 57: 7-9.
4. Mare G de. *Aldersdovhet (in Swedish). Svensk Lakartidn*, 1963; 60: 108-15.
5. Beaver R. *Hearing Loss in the elderly - a community health perspective. Public Health* 1973; 88: 19-25.
6. Gates GA, Rees TS. *Hear ye? Hear ye! Successful auditory aging. West J Med* 1997; 167: 247-52.
7. Working group on speech understanding and aging. *Speech understanding and aging. J Acoust Soc Am* 1988; 83: 859-95.
8. Schuknecht HF. *Presbycusis. Laryngoscope* 1955; 65: 402-19.
9. Schuknecht HF. *Further observation on the pathology of presbycusis. Arch Otolaryngol* 1964; 80: 369-82.
10. Thomopoulos GN, Spicer SS, Gratton MA, Schulte BA. *Age-related thickening of basement membrane in stria vascularis capillaries. Hear Res* 1997; 111: 31-41.