The relationships between cognitive function and hearing loss among the elderly

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Abstract. [Purpose] Research related to dementia has gained momentum in South Korea and studies have found that the auditory sense affects dementia. This study aims to examine the relationship between the decline in hearing function and the overall cognitive function among the elderly. [Subjects and Methods] Eighty-two older adults aged 65–90 years (mean age: 79.3, SD: 5.2) participated. The Korean Mini-Mental State Examination was used to assess cognitive function. Further, to assess the hearing function, pure-tone audiometry was performed prior to the cognitive function test. We used a paired t-test and Pearson's correlation test for the analysis. [Results] Generally, the higher the frequency band, the more hearing loss was identified among the elderly. In addition, the difference in hearing between both ears was significant; particularly, hearing loss in the right ear was significantly higher than that in the left. Cognitive function was not related to age, however, the correlation between cognitive function and hearing loss in the right ear was statistically significant. [Conclusion] Hearing loss influences cognitive function among the elderly.

Key words: Cognitive function, Hearing loss, Elderly

INTRODUCTION

Elderly persons are predisposed to a variety of diseases due to conditions such as the metabolic syndrome and dysendocrinie, which result from a deterioration of physiological functions. Dalton et al.1) report that the severity of hearing loss was significantly associated with decreased function of the mental and physical components in elderly. Typical diseases of the elderly are presbycusis and dementia. Thus, this study aims to explore the correlation between the two diseases. In general, people with presbycusis have a high hearing threshold at high frequencies. The condition is due to the normal aging process, including blood circulation and hormonal imbalance. As they get older, individuals’ hearing threshold at high frequencies decreases at a rapid pace2). In addition, elderly persons experience many issues that could undermine physical abilities related to memory, cognitive, language, speech production, and visual information processing. The inability to process various types of information, as well as cognitive dysfunction, may damage one’s intellectual capacity, which may further hamper the ability to perform day-to-day activities independently. Cognitive dysfunction is one of the major symptoms of dementia3–5).

Lin et al. and Lee6, 7) have reported a correlation between cognitive function and hearing loss, and also indicated that hearing loss is a predictor for Alzheimer’s disease. However, such studies are based on the observations of patients’ families. Hence, it is difficult to attribute the findings to the hearing loss levels of the subjects themselves. In view of this, the current study examined the correlation between hearing loss and cognitive function among elderly persons, using the audiometry test.
SUBJECTS AND METHODS

To analyze hearing loss and cognitive function ability among the elderly, 82 elderly people (32 males, 50 females) who attended seniors’ welfare centers and care centers for the elderly, located in Busan, Kyungsang-namdo, in South Korea were selected to participate in the study. Their mean age was 79.1 years (SD: 5.3), ranging from 65 to 90 years. Written informed consent was obtained from each subject.

The data for this study were collected from June 2014 to March 2015. The Korean Mini-Mental State Examination (K-MMSE), a standardized test used extensively in hospitals and community welfare centers, was used to test the subjects’ cognitive function. Prior to the administration of this test, an audiometry test was conducted. The elderly persons’ hearing loss levels were measured individually in a quiet room at the hospital or the community welfare center. Other than the subject, an audiologist and a guardian were present in the examination room. The audiologist explained the testing procedures to the subject, and the guardian repeated the instructions if the subject did not fully understand them the first time or could not successfully follow them. In addition, the subjects were asked to freely express their feelings or intentions to their guardian, so that the audiologist could assess whether they were cooperating during the test. Subjects who did not fully cooperate during the audiometry test were excluded from the study. The speech therapist slowly gave each subject instructions for the cognitive function test, at different volumes and speeds, keeping in mind their hearing loss levels. Following this, if the subject declined to participate further, the test was halted and the subject was excluded from this study. The data were analyzed using the Statistical Package for Social Sciences (Version 22, IBM). Changes in hearing loss and cognitive function were analyzed using descriptive statistical analysis and a paired t-test. The relationship between hearing loss and cognitive function was analyzed using Pearson’s correlation coefficient.

RESULTS

The subjects’ hearing loss levels decreased at higher frequencies for both ears, specifically at frequencies of 4,000 Hz or more (Table 1). There was a significant difference between the hearing threshold of the right ear (Rt-E) and that of the left ear (Lt-E). In general, the level of hearing loss in the Rt-E was 5–10 dB higher than that in the Lt-E.

The subjects’ average cognitive function index was 20.1 (SD: 4.9), as shown in Table 2, with a range of 6 to 29. There was no significant association between the cognitive function and age. There was a statistically significant correlation between hearing loss in the Rt-E and the cognitive function (r=0.33, p<0.05).

DISCUSSION

This study revealed that hearing loss in elderly persons is more severe at low frequencies than at high frequencies. Moreover, the Rt-E showed higher levels of hearing loss than the Lt-E. This result is consistent with the common characteristics shared by presbycusis patients. This study did not confirm any variations in cognitive function levels according to age. A strong relationship between cognitive function and hearing loss was found, especially when there was a moderate loss of 50 dB or more in hearing levels at high frequencies (4,000–8,000 Hz). Previous studies have reported that older people with hearing loss have higher levels of depression or higher score on the dementia index, as compared to those with normal hearing ability. This means that hearing loss influences elderly persons’ cognitive function.

Pure-tone audiometry is a test that can identify the central auditory system and the peripheral auditory system. The central auditory system is related to word acceptance and is directly connected with the communication function with others. Elderly people who have lost their hearing may have difficulty in communicating when they receive physical therapy due to decline in physical function and exercise capacity. Therefore, physical therapists should not overlook the state of hearing loss at the time of treatment for the elderly. And in promoting exercise capacity of elderly with hearing loss, the physical therapists should explore physical therapeutic approaches that exploit behavioral and visual clues rather than verbal clues.

| Table 1. Hearing thresholds in both ears | Hz | Rt-E (n=82) | Lt-E (n=82) |
|------------------------------------------|----|-------------|-------------|
| 500                                      |    | 45.4 ± 28.3 | 36.2 ± 18.7** |
| 1,000                                    |    | 46.7 ± 24.2 | 35.7 ± 16.0*** |
| 2,000                                    |    | 47.0 ± 23.0 | 39.3 ± 16.3*** |
| 4,000                                    |    | 60.0 ± 22.6 | 55.0 ± 18.3*  |
| 8,000                                    |    | 69.3 ± 21.6 | 67.6 ± 21.7  |

Values are presented as mean HL (± SD). *p<0.05, **p<0.005, ***p<0.001 different between Rt-E HL and Lt-E H.

| Table 2. Correlation between hearing loss and cognitive function among elderly persons | Rt-E (n=82) | Lt-E (n=82) |
|-------------------------------------------------------------------------------------|-------------|-------------|
| K-MMSE mean (± SD)                                                                | 20.1 (± 4.9) | 0.34*       |

*p<0.05.
ACKNOWLEDGEMENT

This work was supported by the Catholic University of Pusan, Republic of Korea

REFERENCES

1) Dalton DS, Cruickshanks KJ, Klein BE, et al.: The impact of hearing loss on quality of life in older adults. Gerontologist, 2003, 43: 661–668. [Medline] [CrossRef]
2) Lebo CP, Reddell RC: The presbycusis component in occupational hearing loss. Laryngoscope, 1972, 82: 1399–1409. [Medline] [CrossRef]
3) Plante EM, Beeson PM: Communication and communication disorders: a clinical introduction, 3rd ed. Boston: Pearson Education, 2008, pp 300–310.
4) Bryan KL, Drew S: A survey of communication disability in an elderly population in residential care. Int J Rehabil Res, 1989, 12: 330–332. [CrossRef]
5) Higashijima M: Relationship between swallowing dysfunction and decreased respiratory function in dementia patients. J Phys Ther Sci, 2013, 25: 941–942. [Medline] [CrossRef]
6) Lin FR, Metter EJ, O’Brien RJ, et al.: Hearing loss and incident dementia. Arch Neurol, 2011, 68: 214–220. [Medline] [CrossRef]
7) Lee YM: The predication model for behavioral and psychological symptoms of dementia in Alzheimer’s disease. Joong-Ang University, Dissertation, 2010.
8) Koh DH, Lee JD, Lee HJ: Relationships among hearing loss, cognition and balance ability in community-dwelling older adults. J Phys Ther Sci, 2015, 27: 1539–1542. [Medline] [CrossRef]
9) Herbst KG, Humphrey C: Hearing impairment and mental state in the elderly living at home. BMJ, 1980, 281: 903–905. [Medline] [CrossRef]
10) Robert P, Omyike CU, Leanjets AF, et al.: Proposed diagnostic criteria for apathy in Alzheimer’s disease and other neuropsychiatric disorders. Eur Psychiatry, 2009, 24: 98–104. [Medline] [CrossRef]
11) Albers K: Hearing loss and dementia: new insights. Minn Med, 2012, 95: 52–54. [Medline]