



The Relationship between Hearing Impairment and the Incidence of Dementia in an Elderly Community in Indonesia at 2021

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Research Article

Volume 5 Issue 2

Received Date: November 17, 2021

Published Date: December 28, 2021

DOI: 10.23880/phoa-16000195

Abstract

Introduction: Hearing impairment is one of the problems that occur in the elderly due to the aging process. Although this is a normal process, not everyone experiences this disorder. About half of the elderly who are over 75 years old are known to have this disorder.

Objective: The aim of this study is to determine the relationship between hearing impairment and the presence of dementia in an Elderly Community of Indonesia.

Methods: An analytic observational with cross sectional research design type. The participants were 33 elderly in an elderly community in Surakarta, Indonesia. The patient was asked to fill out a Mini Mental State Examination (MMSE) questionnaire and undergoes audiometric examination. Data were analyzed statistically using SPSS. Data were analyzed using ETA correlation test and contingency coefficient correlation test, also $p < 0.05$ was used.

Results: Audiometric examination of patients without demensia was in the normal category (71.4%), whereas most of those with dementia suspicion were in the moderate-severe hearing impairment category (36.8%). Conclusion: There is a tendency that the more severe the degree of hearing impairment from the audiometric examination, the more likely it is to have dementia.

Keywords: Hearing Impairment; Dementia

Abbreviations: MMES: Mini Mental State Examination; WHO: World Health Organization; AAN: American Academy of Neurology.

Introduction

Several studies have shown a statistically significant correlation between hearing impairment and cognitive decline. Hearing impairment in older age has been estimated to account for approximately 9% of cases of dementia. Acquired hearing impairment is commonly caused by damage to cochlear, while dementia is due to cortical degeneration [1,2]. Dementia has become one of the greatest

global challenges for health and social care in this century. Two of more common types of dementia are Alzheimer, which is characterized as a progressive, unremitting and neurodegenerative disorder; and vascular dementia, which is mainly caused by hypertension and arteriosclerosis [3]. According to data statistics from the World Health Organization, if a person's hearing thresholds are more than 25 dB in both ears is said to have hearing impairment. Almost one-third of people over 65 years of age suffer from disabling hearing impairment. This disorder is indicated by hearing sensitivity reduction (especially at high frequencies), decreased understanding of speech in noisy environments, delayed central processing of acoustic information, and

compromised localization of sound sources [3].

The number of residents in the city of Surakarta based on data obtained based on the results of the 2020 population census by the Central Statistics Agency, is 522,000 people, with the number of elderly around 12.15%. The percentage of the elderly has increased compared to 2010 which was 10.34% [4]. Hearing impairment affects about 30-35% in the population aged 65-75 years and 40-50% in the population over 75 years [5]. According to data from the World Health Organization (WHO), the number of people with dementia in 2015 was around 47 million people worldwide and is expected to increase in 2030 to 75 million people [6]. Study by Liu CM, et al. [7] concluded that patients aged 45 to 64 years with hearing impairment showed significantly stronger and more positive associations with dementia occurrence than patients aged 65 to 74 years or 75 years or older with no hearing impairment. Dementia and hearing impairment are neurologic conditions in elderly, each having huge impact on quality of life. There are a lot of literature suggests that these two conditions are corelated and that hearing impairment could be a risk factor for the development of dementia in elderly. This study was conducted to determine the relationship between hearing impairment and the incidence of dementia in the elderly in Surakarta, Indonesia.

Materials and Methods

This research was conducted in March 2021 with elderly who are members of an elderly community as participants. Research respondents who were included in the sample criteria were patients aged more than 60 years, the patient who can communicate well, the patient has never used a hearing aid before, and the patient is willing to be a research participant. The exclusion criteria in this study were the use of ototoxic drugs, exposure to noise in the patient's daily life, and history of ear infections. From these criteria, the research sample obtained was 33 patients. This research was an analytic observational with cross sectional research design type.

Patients who have passed the sample criteria will be asked to fill out a Mini Mental State Examination (MMSE) questionnaire. With this audiometric examination, it will determine the presence of hearing impairment in patients who meet the criteria while the MMSE questionnaire will provide us with information on dementia scores in patients. The MMSE score result will give us an assessment score, which will later be divided into two groups: the normal group if the score is >24, and the abnormal group for respondents who are not included in the normal group. After that, the research participants will be subjected to an audiometric test to see if there is a hearing impairment in the patient.

The Mental State Examination (MMSE) is the commonly used screening test for the assessment of cognitive function. The MMSE is a structured scale consisting of 30 points grouped into 7 categories: orientation to place, orientation to time, registration, attention and concentration, recall, language, and visual construction. The MMSE score is given based on the number of items that are perfectly correct; Lower scores indicate poor performance and worsening cognitive impairment. The total score ranges from 0-30 (perfect performance). The MMSE is highly reliable for assessing impaired cognitive function and can be widely used as a simple test to screen for impaired cognitive function. This instrument is recommended as a screening for global cognitive assessment by the American Academy of Neurology (AAN) [8]. Pure tone audiometry is a hearing test instrument that can produce pure tones of various frequencies. The resulting sound is transmitted through headphones to the ears of the person being tested for hearing each to measure hearing acuity. In this study, prior to the audiometric examination, a physical examination of the ear will be carried out, fortunately to find out whether there is cerumen or dirt in the respondent's ear canal. If there is cerumen or wax in the ear, it will be cleaned first, so that this pure tone audiometric examination gets maximum results [9].

Results

Univariate Analysis

This study involved 33 patients with research data in the form of age, gender, audiometric examination, and dementia. The description of the research data is as follows (Table 1).

Variable	F	%
Age (Year)	67.45 +3.55 (Mean +SD)	
Gender		
Male	15	45.50%
Female	18	54.50%
Audiometry		
Normal	14	42.40%
Mild Hearing Loss	3	9.10%
Moderate Hearing Loss	7	21.20%
Moderate-Severe Hearing Loss	7	21.20%
Severe Hearing Loss	2	6.10%
Dementia		
Normal	14	42.40%
Abnormal	19	57.60%

Table 1: Basic Data of Research Subjects.

Based on Table 1, it is known that the age of the 33 patients involved in the study was on average 67.45 +3.55 years, where most of the patients were 18 females (54.5%) and the rest were male, 15 people (45,5%). Based on the audiometry results in this study, there were 14 people (42.4%) with no hearing impairment. Each moderate hearing LOSS degrees, and moderate- severe hearing loss degrees were 7 people (21.2%). Also, dementia was found in 19 people (57.6%).

Bivariate Analysis

Bivariate analysis in this study was to determine the relationship between age, gender, and audiometric examination on dementia. Numerical-nominal data (age) was tested by ETA correlation test, while nominal/ordinal-nominal categorical data (gender and audiometry) was tested by contingency coefficient correlation test with the following results (Table 2).

Variable	Dementia (MMSE Score)		r	p-value
	Normal	Abnormal		
	(n=14)	(n=19)		
Age ^a	66.36 ±3.10	68.26 ±3.72	0.269	0.13
Gender^b				
Male	8(57.1%)	7 (36.8%)	0.198	0.247
Female	6(42.9%)	12 (63.2%)	0.528	0.013*
Audiometry				
Normal	10(71.4%)	4(21.1%)		
Mild hearing Loss	2(14.3%)	1(5.3%)		
Moderate Hearing Loss	2(14.3%)	5(26.3%)		
Moderate-Server Hearing Loss	0(0.0%)	7(36.8%)		
Server Hearing Loss	0(0.0%)	2(10.5%)		

Notes: a: Eta correlation test; b: contingency coefficient correlation test; * significant at $\alpha=5\%$.

Table 2: Relationship of Age, Gender and Audiometry to Dementia.

The average age for patients without dementia (normal group) was 66.36+3.10 years, while those with dementia (abnormal group) were on average 68.26+3.72 years. There is a tendency that older people will suffer from the dementia. Based on the results of statistical tests, age ($r = 0.269$; $p = 0.130$) did not have a significant relationship with dementia. Gender in patients without dementia was mostly male (57.1%), while in dementia group, the majority were women (63.2%). There is a tendency that women will most likely suffer dementia. The results of the statistical test, gender ($r=0.198$; $p=0.247$) did not have a significant relationship with dementia.

Most of the audiometric examinations in patients without dementia were in the normal category (71.4%), whereas most of those with dementia were in the moderate-severe hearing loss category (36.8%). There is a tendency that the more severe the degree of hearing loss from the audiometric examination, the more likely it is to have dementia. The results of the audiometric examination statistical test ($r = 0.528$; $p = 0.013$) had a significant relationship with dementia with the strength of the relationship being in the moderate category ($r = 0.400-0.599$). The relationship between age

and audiometry in this study used the Spearman rank test because the data were numerical-ordinal data with the following results (Table 3).

Audiometry	Age	r	p-value
Normal	64.79 ±2.64	0.574	<0.001*
Mild Hearing Loss	70.33 ±3.06		
Moderate Hearing Loss	68.57 ±1.51		
Moderate-Severe Hearing Loss	70.57 ±3.46		
Severe Hearing Loss	67.00 +2.83		

Notes: Spearman rank correlation test; * significant at $\alpha=5\%$.

Table 3: Relationship between age and audiometry.

The age of patients with audiometry results in the normal category was 64.79+2.64 years, Mild hearing loss averaged 70.33+3.06 years, Moderate hearing loss was 68.57+1.51, Moderate-severe hearing loss averaged 70.57+3.46 years and severe hearing loss was averaged average 67.00 +2.83 years. There is a tendency that patients with hearing impairment disorders have an older age than patients with

normal audiometric examinations. The results of statistical tests showed that age (0.574; $p < 0.001$) had a significant relationship with audiometric examination with the strength of the relationship being in the moderate category ($r = 0.400 - 0.599$).

Discussion

Hearing impairment may lead to increased social isolation eventually increasing the risk of dementia onset. The risk of hearing impairment increases with age and is associated with lower scores on tests of memory and a higher risk of incident all-cause dementia. Hearing impairment involves central auditory dysfunction and peripheral hearing impairment [2,7]. In the research data, the group of respondents with hearing impairment has a higher average age than the group of respondents without hearing impairment. This is in accordance with research conducted by Lin FR, et al. [10] which shows over the age of 65 years, there are about 40-50% of the population experiencing hearing impairment. The risk increases further to 83% by the time we reach 70 years of age. Dementia is a cognitive disorder experienced by the elderly caused by damage to brain nerve cells in certain parts causing in a decrease in the ability to communicate with other body nerves and resulting in the appearance of symptoms according to the damaged brain area such as reduced memory, decreased ability to think, understand things, consider and understand language also lower mental intelligence. Wingfield A, et al. [11] said that the risk of developing dementia also increases every 20 years in the elderly period. Analysis based on our research data also shows that respondents with abnormal MMSE results are an older age group than respondents with normal MMSE results [11].

After analyzing the results, it was found that there was a significant relationship between hearing impairment and the incidence of dementia. The more severe the degree of hearing impairment from the audiometric examination, the more likely it is to have dementia. In this study, we have tried to get rid of several confounding factors in data collection, such as the use of ototoxic drugs, exposure to noise in the patient's daily life, and ear infections. So, it is hoped that the data showing hearing impairment in respondents is purely from a degenerative process. Based on the results of a meta-analysis conducted by Zheng L, et al. [12] it was shown that hearing impairment may be an independent risk factor for dementia occurring in the general population, which can be inherited from the community. On the results of the subgroup analysis showed that this association did not appear to be influenced by the study characteristics of diagnostic methods for hearing impairment, validation strategies for dementia, and duration of follow-up. In addition, Zheng L, et al. [12] also

found a significant relationship between hearing impairment and dementia. So it can be concluded that the independent risk factor for dementia in the adult population in general is hearing impairment. A systematic review with total of seventeen studies, which twelve of them were prospective cohort and four of them were cross sectional studies, showed that hearing impairment to be associated with dementia or cognitive decline [13].

The data obtained regarding the degree of deafness were also very varied, but after analyzed, there was no significant effect on the occurrence of dementia. Mild, moderate, and severe deafness can all influence the occurrence of dementia in research respondents. This is in accordance with the research conducted by Lin FR et al. [10] who concluded that mild, moderate, and severe deafness are both risk factors for dementia, even up to a risk of 3 to 5 times compared to the elderly without hearing impairment. Hearing impairment is related with trouble in understanding speech. Patients with hearing impairment may experience long-term inconvenience in life, such as difficulties in communication and social isolation, which suggests that hearing impairment, may be associated with dementia. Higher levels of hearing impairment are associated with an increased risk of social isolation. Social isolation and depression have been found to exacerbate cognitive impairment [7,14].

Hearing impairment can certainly lead to stress or depression for the sufferer because it is the main factor that prevents sufferers from being able to communicate, which ultimately causes someone who suffers from hearing impairment to withdraw from the social environment, including people with hearing impairment [13,15]. This is evidenced in a study conducted by Flatt JD, et al. [16] who analyzed the relationship between depression and the incidence of dementia in civilians, both men and women in the United States. The results showed that depression was associated with a significantly higher risk of dementia for both women and men. Overall, older adults with depression had an approximately 70% higher risk of dementia, with men having twice the risk and women having a 60% higher risk, compared with those without depression.

Conclusion

In this cross-sectional analytical study, hearing loss was statistically associated with the presence of dementia, especially at older ages. This finding corroborates published studies. Therefore, the protection of hearing health becomes relevant, as well as the early diagnosis and treatment of its deficiencies, aiming to mitigate this risk factor for the development of dementia in the elderly.

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