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Comparison of dementia risk in geriatric individuals who use and do not use hearing aids

Bachelorarbeit

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SYMBOLS AND ABBREVIATIONS

ARHL: Age Related Hearing Loss

EAC: External Auditory Canal

CHL: Conductive Hearing Loss

HZ: Hertz

MMSE: Mini Mental State Examination

PAF: Population Attributable Fraction

SNHL: Sensorineural Hearing Loss

TM: Tympanic Membrane

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ABSTRACT

COMPARISON OF DEMENTIA RISK IN GERIATRIC INDIVIDUALS WHO USE AND DO NOT USE HEARING AIDS

By combining hearing impairment, sensory and social isolation, it can accelerate cognitive decline or create a non-specific weakness. However, other demographic and comorbidity factors should be checked to understand the relationship between impaired hearing and cognition. Epidemiological data between populations show that hearing loss is associated with cognitive decline and creates a risk factor for the development of dementia in older adults. In this study, 38 individuals in the 60-80 age range from two state hospitals and one hearing aid center in Istanbul were included. The diagnosis of hearing loss from mild to very severe according to pure voice audiometry averages; 19 individuals with hearing aid use for at least 1 year and 19 individuals with no hearing aid. MMSE inventory was applied to individuals with open-ended questions. Mann Whitney U and Chi-Square tests were applied as statistical analysis. As a result of the study, a statistically significant difference was observed between MMSE score and hearing impaired individuals with and without hearing aid.

Key Words: Dementia, geriatric, hearing aid, hearing loss, MMSE.

1. INTRODUCTION

As the human population ages, age-related diseases and weaknesses have become more and more common, and it has long been known that our brains shrink with age, losing nerve cells. Hearing problems, which affect the majority of the geriatric population in particular, are at the forefront of these diseases. Therefore, it is necessary to better understand how hearing loss in aging affects the peripheral and central nervous systems and what perceptual deficits it leads to.

There is growing interest in better understanding the pathophysiological relationships between hearing loss and dementia. The relationship between hearing loss, dementia diagnosis and the role of sensory therapy has been on the agenda for some time and more relevant research is needed to inform new clinical approaches. Current understanding of the topic requires a great deal of interaction between experts who can integrate both experience and research in various fields, including hearing loss and dementia.

Researchers have suggested that hearing loss accelerates age-related cognitive decline and that treating hearing loss appropriately may help delay cognitive decline and dementia. Further research investigating the mechanism of the two links, as well as the basis for this link, will further enhance our ability to treat dementia [1].

Recent studies suggest that hearing loss may predict cognitive impairment and that changes affecting hearing may manifest as cognitive and behavioral symptoms relevant to the differential diagnosis of dementia. According to a study conducted by Dr. F. Lin, a researcher at the US Institute on Aging, and colleagues, older people with hearing loss have faster brain shrinkage. According to an article published in 2011, they found that hearing loss may be among the conditions that indicate a high risk of dementia and that elderly people with hearing loss are more likely to develop dementia over time than those with intact hearing [2].

In our country, there are very few studies on the relationship between hearing loss and dementia. In this study, it was aimed to apply an inventory used to evaluate patients for dementia in individuals with hearing loss and to have an idea about the risk of dementia in individuals with hearing loss. It was also aimed to show the

differences in dementia diseases observed in geriatric individuals between hearing aid users and non-users and to statistically measure the extent to which hearing loss and non-use of hearing aids affect cognitive impairment in geriatric individuals as a risk factor. The main hypothesis was that there is a significant difference in MMSE score between hearing aid users and non-users.

2. GENERAL INFORMATION

2.1 Hearing System Anatomy and Physiology

Hearing and balance systems are physically perceived in the human body through the structures located in the ear. The ear, which contains these two important systems, is basically divided into 3 parts (Figure 2.1.1).

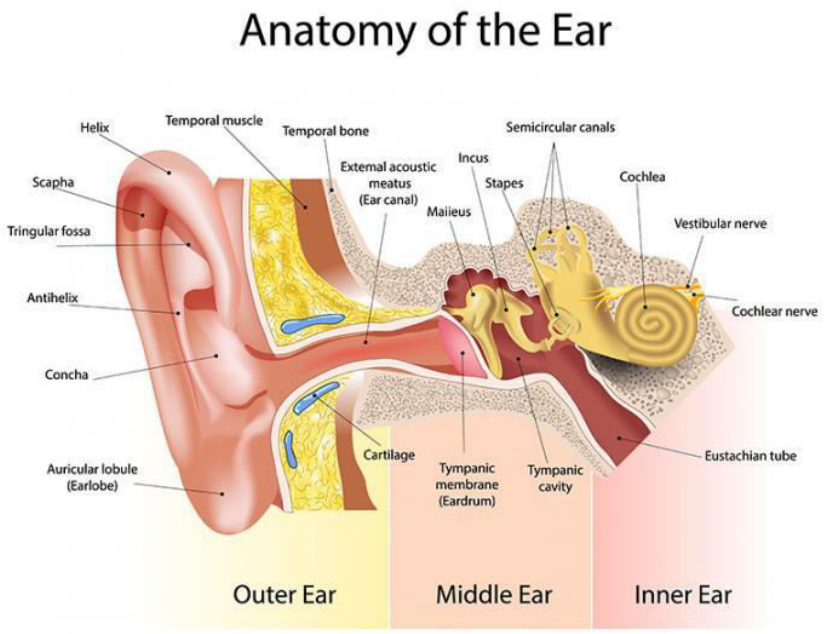


Figure 2.1.1 Anatomy of the Ear

2.1.1 External ear (*auris externa*)

The outer ear consists of the auricle (auricula), the external auditory canal (meatus acusticus externus) and the tympanic membrane (TM). The auricle is the first organ to receive sound waves from the external environment. It collects sounds and transmits them to the external auditory canal. It plays an important role in the localization of sound. The external auditory canal (EAC) consists of two parts, cartilage and bone. The outer 1/3 part of the external auditory canal is cartilage and the inner 2/3 part is bone. Since the EAC is a resonator, the sound energy received is amplified and transmitted to the eardrum. Amplification is provided by the 3000-4000 Hz resonance frequency of the external auditory canal. The eardrum, which separates the outer ear and middle ear, is located at the end of the EAC and vibrates

with the pressure created by the sound waves received from the external auditory canal and activates the ossicular chain in the middle ear. The upper loose part of the eardrum is called the pars flaccida and the lower tense part is called the pars tensa. The pars tensa forms the bulk of the eardrum and is the part that vibrates with sound waves. The light reflex or cone of light is the area that reflects the light from the otoscope [3, 4].

2.1.2 Middle ear (*auris media*)

The middle ear is an important cavity that contains the three smallest bones of the human body. The middle ear cavity is a structure with conduction and amplification function consisting of middle ear ossicles, eustachian tube, tensor tympani and stapes muscles. The middle ear ossicles are malleus, incus and stapes. The manubrium mallei connects to the tympanic membrane, the head of the malleus to the incus, the incus to the stapes and the stapes to the oval window in the cochlea. The tensor tympani muscle connects to the manubrium mallei and the stapedius muscle to the stapes. The Eustachian tube connects the middle ear cavity to the pharynx and thus keeps the air pressure in the middle ear cavity in balance with the ambient pressure [3, 4].

When sound energy is transmitted from a gaseous medium (atmosphere) to a liquid medium (perilymph), a 30 dB loss in sound waves occurs. Since the eardrum is 17 times larger than the base of the stapes, the sound rises approximately 17 times in the oval window and the malleus and incus in the middle ear amplify the sound by 1.3. As a result of this system, the 30 dB loss is compensated [3].

2.1.3 Inner ear (*auris interna*)

The inner ear, located in the temporal bone, contains receptors for hearing and balance. The bony labyrinth is filled with perilymph and the membranous labyrinth with endolymph. The membranous labyrinth consists of the vestibular labyrinth, cochlea, endolymphatic duct and endolymphatic sac.

Hearing receptor cells are located in the cochlea, which is located in the bony labyrinth and resembles a snail. The cochlea consists of three fluid-filled canals:

Scala vestibuli, scala media, scala tympani. The scala media, the canal in the center of the cochlea, is separated from the scala vestibuli by the reissner membrane and from the scala tympani by the basilar membrane. The apical end of the basilar membrane is wider and looser, while the basal end is narrower and stiffer. High frequency sounds with short wavelengths are perceived in the basal part of the cochlea and low frequency sounds with long wavelengths are perceived in the apical part [4].

Vibrations coming into the cochlea create a movement in the perilymph from the oval window to the round window. This activates the hairy cells in the organ of Corti above the basilar membrane and the hairy cells hit the tectorial membrane and convert the mechanical energy into electrochemical energy, i.e. nerve impulses. The auditory nerve receives these nerve impulses and transmits them to the central auditory system for perception.

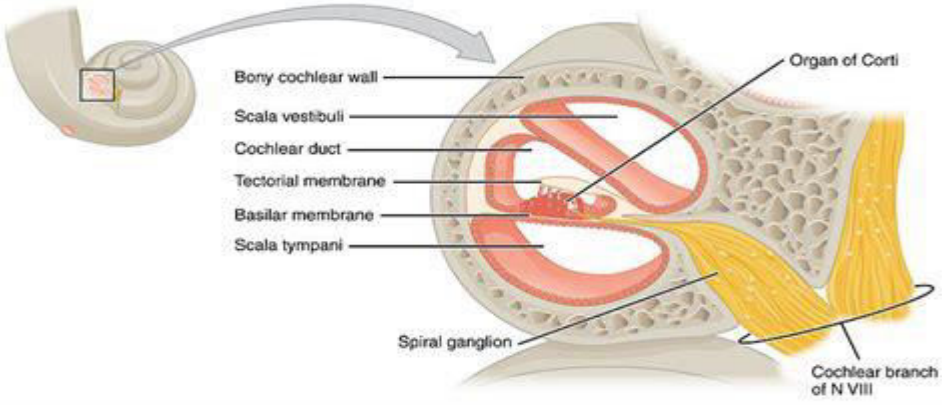


Figure 2.1.2.1 Cochlea Section

2.2 Types and Causes of Hearing Loss

Hearing loss is the inability to perceive sounds in the environment due to pathologies in any step of the auditory pathways. Hearing loss can be congenital or acquired. It can be unilateral or bilateral, sudden or slow progression. Depending on

the age at which it occurs, hearing loss types are classified as congenital or acquired, and according to the location of the pathology, hearing loss types are divided into 5.

1. Conductive hearing loss
2. Sensorineural hearing loss
3. Mixed type hearing loss
4. Central type hearing loss
5. Functional / Non-organic type hearing loss

2.2.1. Conductive hearing loss

Conductive hearing loss causes an abnormal reduction or attenuation of sound as it travels from the outer ear to the cochlea. If the structure of the conduction mechanism is impaired, its ability to transmit sound is reduced and less sound is transmitted to the cochlea. The loss occurs at the level of the outer or middle ear. It can also occur as a result of otitis externa, cerumen, acute or chronic otitis, cholesteatoma, trauma, tumors and some systemic diseases.

Conductive hearing loss is measured by comparing air and bone conduction thresholds on an audiogram. When the airway thresholds are weaker than the bone conduction thresholds, sound energy is reduced and conductive hearing loss occurs [5].

2.2.2. Sensorineural hearing loss

Sensorineural hearing loss interferes with the transmission of sound to the cochlea. It occurs as a result of pathologies in the cochlea and the neural pathways beyond it. Sensorineural hearing loss encompasses two different problems. The first is a sensorineural loss involving the inner ear and the second is a neural loss involving the auditory nerve. If the pathology occurs in the inner ear, it is called 'sensorineural loss'; if it occurs in the auditory nerve, it is called 'neural loss'. In sensorineural hearing loss, both airway and bone conduction are poor. Air and bone conduction thresholds overlap.

Although the causes of sensorineural hearing loss vary, they can be divided into two groups: congenital and acquired. Genetics, head trauma, age-related hearing loss (presbycusis), exposure to excessive noise, Meniere's disease, Meningitis are some of the factors that cause sensorineural hearing loss.

2.2.3. Mixed type hearing loss

Mixed-type hearing loss is a type of hearing loss that includes conductive hearing loss and sensorineural hearing loss. It is caused by pathologies in the inner ear as well as in the middle ear and DCI.

In mixed hearing loss, there is a decrease in both airway hearing thresholds and bone conduction hearing thresholds. However, the airway hearing thresholds are lower than the bone conduction thresholds. If there is more conductive pathology in the hearing loss, the patient has difficulty understanding speech, but speech understanding is better when the volume is loud enough and there is not much background noise. If the hearing loss is more sensorineural, speech understanding may be difficult even if the volume is loud enough.

2.3. Grading of Hearing Loss

Hearing losses are classified according to the average of pure tone hearing thresholds obtained at 500 Hz, 1000 Hz and 2000 Hz. The classification of hearing loss varies according to different scientists (Table 1) [6].

Table 2.3.1 Degrees of Hearing Loss

Degree of Hearing Loss	Northern and Downs, 2002	Jerger and Jerger, 1980	Goodman, 1965
Normal Hearing	<16	<21	<26
Slight Hearing Loss	16-25	-	-
Mild Hearing Loss	26-30	21-40	41-55
Moderate Hearing Loss	30-50	41-60	41-55
Moderately Severe Hearing Loss	-	-	56-70
Severe Hearing Loss	51-70	61-80	71-90
Profound Hearing Loss	>70	>80	>90

2.4. Hearing Loss and Cognitive Impairment

While the association between hearing loss and cognitive decline appears to be strong, the mechanism remains unresolved. Hearing impairment may accelerate cognitive decline by combining sensory and social isolation or produce a non-specific impairment. However, other demographic and comorbidity factors should be controlled for to understand the relationship between impaired hearing and cognition.

Peripheral hearing loss may more directly accelerate neurodegenerative processes. In older adults, hearing loss is associated with tissue volume loss of the temporal lobe of the auditory cortex and functionally reduced cognitive reserve of auditory cortical networks [7].

As the number of people with hearing loss increases and given the array of technological interventions currently available for auditory rehabilitation, it is important to understand whether hearing loss is a risk factor for dementia [2]. The balance of epidemiological evidence across populations suggests that hearing loss is associated with cognitive decline and constitutes a risk factor for the development of dementia in older adults, although the strength of this association is somewhat variable [8].

A 2017 study in The Lancet summarized a life course model of risk factors for dementia and reported that hearing loss in middle age is a risk factor for dementia (Figure 2.4).

This dissociation associated with the population with hearing loss (PAF) was calculated by multiplying the strength of each risk factor by the frequency of each risk factor and was set at 9%. Therefore, eliminating hearing impairment in middle age would theoretically reduce the number of dementia cases by 9% (assuming that all 9% is due solely to the causal effect of hearing loss on dementia risk) [9].

The impact of hearing loss can be profound, with social, functional and psychological consequences for the individual, including reduced attention, difficulty understanding conversations, inability to communicate with others, poor memory, uneasiness in unfamiliar environments, decreased work performance, difficulty

understanding others, irritability, stress, depression, withdrawal from social life, loneliness. On the other hand, optimal management of this condition should include an assessment of quality of life status. This is because some studies have shown that hearing loss can have a negative impact on quality of life and psychological well-being, with reports of social isolation, depression, anxiety and even cognitive decline (dementia) in those affected [10].

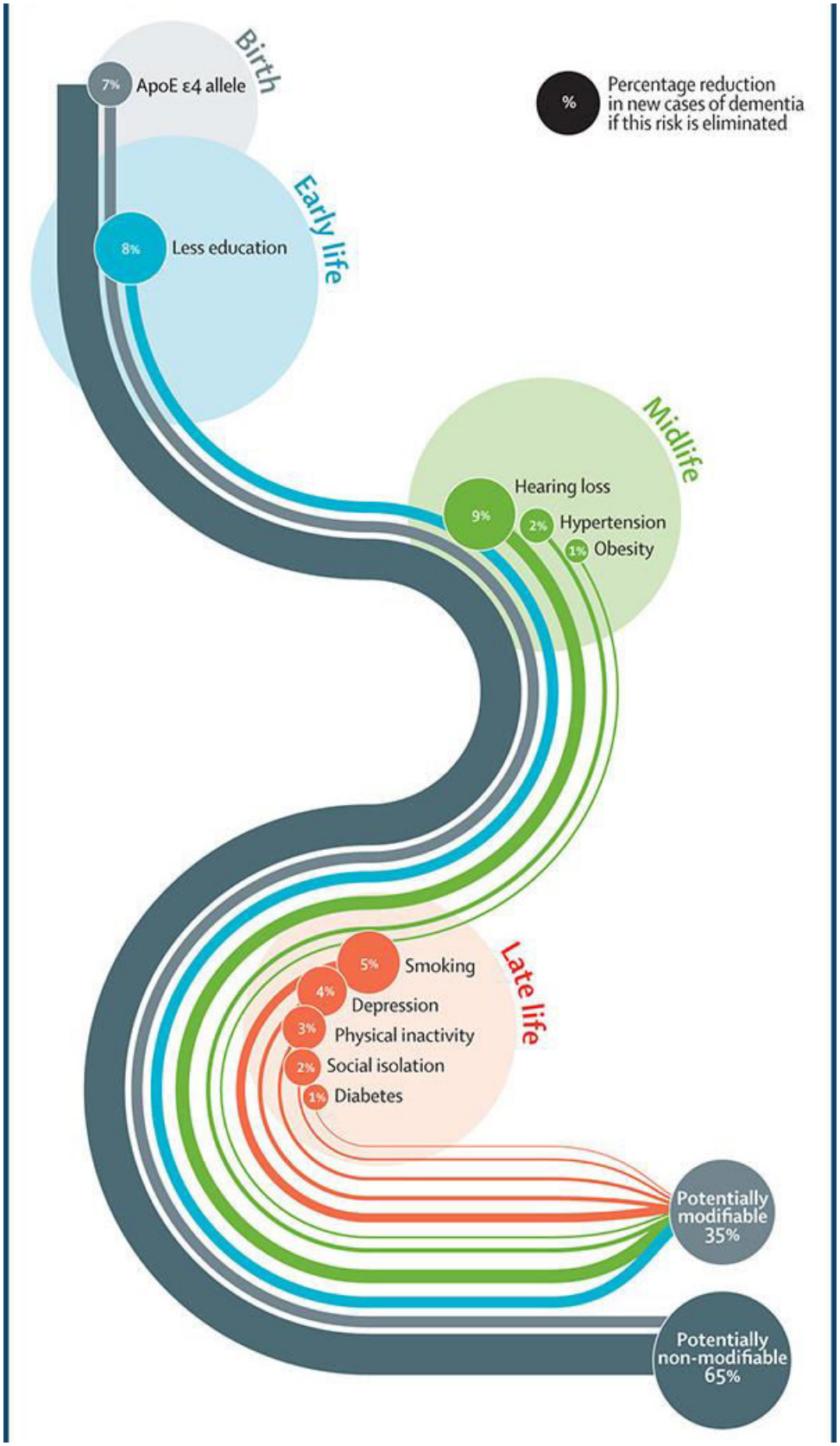


Figure 2.4 Risk Factors for Dementia

2.5. Hearing Loss and Dementia

Dementia, derived from the Latin word "mens" meaning "mind", literally means "loss of mind" and indicates a deterioration in mental abilities [11]. It reflects a progressive decline in multiple cognitive functions such as memory, orientation, language, arithmetic skills, visuospatial functions compared to premorbid levels [12].

Dementia is a clinical syndrome that develops secondary to irreversible neuronal damage and is characterized by a progressive decline in memory and cognitive functions to a degree that affects daily activities [13]. The word dementia is specifically used to describe the irreversible deterioration of memory, intelligence, reasoning ability, personality, behavior and mood as a result of widespread and diffuse pathology of the cerebral hemispheres [14].

Dementia is the most common disease characterized by loss of cognitive function in the elderly. In people aged 80 years and older, the prevalence of dementia starts from 20% and reaches up to 60% with advancing age [15].

In the World Alzheimer's Report, it was estimated that there were 35.6 million people living with dementia worldwide in 2010 and that this figure would reach 65.7 million by 2030 and 115.4 million by 2050 [1]. [1]. The devastating impact of dementia on affected individuals and its burden on family and society has made prevention and treatment of dementia a public health priority. Interventions that delay the onset of dementia by just 1 year could lead to a more than 10% reduction in global dementia prevalence in 2050 [2].

Hearing loss is common in older adults. Data from the National Institute on Deafness and Other Communication Disorders (NIDCD) show that hearing loss increases with age, with 30% of those aged 65 to 74 years and 47% of those aged 75 years and older experiencing hearing loss [16].

Some researchers have suggested that hearing loss may be associated with dementia by reducing stimulating input and inhibiting social interaction [2]. Based on many studies, researchers have concluded that individuals with dementia and hearing loss have poorer cognitive functioning than those with dementia and normal

hearing: Peters, Potter, & Scholer, 1988; Uhlmann, Larson, & Koepsell, 1986; Uhlmann, Teri. Rees, Mozlowski, & Larson, 1989; Weinstein & Amsel, 1986 [2].

In the past ten years, medical research has addressed the association of cognitive impairment with hearing loss; however, there are still many unanswered epidemiologic and clinical questions. Frank Lin et al. have published several papers showing that hearing impairment in older adults is independently associated with dementia in cross-sectional studies and dependently associated with cognitive decline and dementia in longitudinal studies. The association of hearing loss with cognitive impairment emphasizes the importance of understanding the factors that contribute to decline in cognitive functioning and may have important implications for screening and diagnosis of cognitive decline in hearing impaired older adults [17].

3. MATERIAL METHOD

For the study, with the decision dated 30 Jan 2019 and numbered 102 from the Istanbul Medipol University Non-Interventional Clinical Research Ethics Committee, the rationale, purpose, approach and methods of the research were examined and it was unanimously decided that the research was ethically and scientifically appropriate.

Thirty-eight individuals between the ages of 60-80 participated in the study. Individuals diagnosed with one of the three types of hearing loss (SNHL/CHL/MIXED) from mild to very severe according to pure tone audiometry averages were selected.

The population was selected from patients between 60-80 years of age who came to two state hospitals and one hearing aid center in Istanbul. A total of 38 patients were selected by quota sampling; 19 individuals who had been using hearing aids for at least one year, and 19 individuals who did not use hearing aids.

The study started in November 2018. The selection of patients and administration of the test was carried out between February and May 2019 after Ethics Committee approval was obtained.

Firstly, a demographic form was applied to the individuals to obtain demographic information. In the demographic form, individuals were asked to answer questions such as gender, age, education level, occupation, presence of chronic diseases, when the hearing loss was diagnosed, whether they use a hearing aid, when the hearing aid was purchased, how many hours a day the hearing aid is used [ANNEX-1]. After demographic information was obtained, the patients were administered the MMSE inventory, which is a dementia screening test developed abroad and whose Turkish validity and reliability studies have been conducted, and consists of open-ended questions. The patients with education (at least five years of education) were assessed with the Standardized MMSE and those with less than five years of education or no education were assessed with the Standardized MMSE for the Uneducated [ANNEX 2-3].

3.1. General Information about the MMSE Test

The Mini Mental State Examination (MMSE) was first published by Folstein et al. (1975). The test was developed as a short-term cognitive assessment tool for the examination of the elderly, especially the elderly with delirium and/or dementia, since the tests used to quantitatively assess cognitive performance in standard neuropsychiatric examination methods contain too many questions and take more than 30 minutes to administer. The MMSE soon became widely used both in clinical practice and among researchers. Although the test has limited specificity in terms of differentiating clinical syndromes, it is a short, useful and standardized method that can be used to determine cognitive level globally. The Mini Mental Test is a test that can be administered by physicians, nurses and psychologists who have received a short training in outpatient clinic conditions or at the bedside within 10 minutes. It consists of eleven items grouped under five main headings: orientation, recording memory, attention and calculation, recall and language, and is evaluated out of a total score of 30. Although the original test includes some instructions to be followed during the administration, it is observed that these are left quite flexible and that the practitioner often resorts to subjective evaluations [18].

Its validity and reliability in Turkey was tested in 2002 in 212 patients, 71 of whom had dementia, with an average age of 77 years, and inter-rater reliability was determined. A threshold value of 23/24 was found to be sensitive and specific. The MMSE is valid and reliable in the diagnosis of mild dementia in the Turkish population with an ideal threshold of 23/24 [18].

A version of the MMSE for illiterates was developed by Ertan et al. (MMSE-E) (Ertan et al. 1999). In the Turkish version of the MMSE, the sections evaluating time and place orientation, attention, language and visual spatial functions were revised by Babacan Yıldız et al. and made more suitable for illiterates [19].

3.1.1. MMSE administration and scoring

The MMSE consists of eleven questions and is evaluated over 30 points (Table 3.1.1) [20].

Table 3.1.1 MMSE Score Examination

SCORE	Degree of Disorder	Formal Psychometric Assessment	Daily Operation
25-30	Normal	If there are clinical signs of cognitive impairment, formal assessment of cognition may be valuable.	There may be clinically significant but mild deficits. Possibly affecting only the most demanding activities of daily life.
20-25	Mild Impairment	Formal assessment can help to better identify the deficiency and degree of the model.	Significant impact. Some inspections may require support and assistance.
10-20	Moderate Impairment	Formal assessment may be helpful if there are specific clinical indications.	A significant impairment may require a 24-hour audit.
0-10	Serious Impairment	The patient is unlikely to be testable.	Significant impairment. Possibly requiring 24-hour supervision and assistance with ADL.

4. FINDINGS

A total of 38 individuals between the ages of 60-80 participated in the study.

Table 4.1 Individuals Participating in the Study

		Age	
		60-70	71-80
		Count	Count
Gender	Female	8	8
	Male	14	8
Hearing Aid Use	Yes	9	10
	No	13	6
	Total	22	16

Statistical analyses were performed using SPSS 20 statistical package program. A probability value of 0.05 was accepted. Since the number of data was 38, normality was checked first. Normal distributions were examined according to the Shapiro-Wilk test, one of the normality tests. MMSE score did not show normal distribution (p=0.46)

Table 4.2. Normality Test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
MMSE Score	,160	38	,015	,941	38	,046

MMSE score was analyzed with non-parametric tests because it was not normally distributed. Mann Whitney U analysis was used to compare hearing aid use and MMSE score variables. Since the probability value found as a result of the test was (,000< 0.05), it was understood that there was a significant difference. In other words, there is a significant difference between the averages of hearing aid users and non-users. It was understood that the mean of those who did not use hearing aids (22, 68) was smaller than the mean of those who used hearing aids (26,58).

Table 4.3. Comparison of MMSE Score According to Hearing Aid Use

			Mean + Standard Deviation	Mann Whitney U	p
Hearing Aid Use	Yes	MMSE score	26, 58 ± 2.27	54,500	,000
	No	MMSE score	22,68 ± 2.98		

Chi-Square test was applied to determine whether the MMSE score evaluation status was dependent on the hearing aid use variable. According to the test results, the dependence between the variables was found to be statistically significant (X2=.004<0.005).

Table 4.4. Chi-Square Test Analysis

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10,955[a]	2	,004
Likelihood Ratio	13,455	2	,001
Linear-by-Linear Association	10,659	1	,001
N of Valid Cases	38		

In the chi-square test, according to the cross-tabular analysis of hearing aid use and MMSE score evaluation, 73% of hearing aid users were normal and 26% were mildly impaired according to MMSE score evaluation, while 26% were normal, 42% were mildly impaired, and 31% were moderately impaired according to MMSE score evaluation of non-hearing aid users.

Table 4.5. Cross Table Analysis of Hearing Aid Use and MMSE Score Evaluation

			Hearing Aid Use		Total
			Yes	No	
MMSE Score Evaluation	25-30-Normal	Count	14	5	19
		% within hearing aid use	73,7%	26,3%	50,0%
	21-24-Mild Impairment	Count	5	8	13
		% within hearing aid use	26,3%	42,1%	34,2%
	10-20-Moderate Disorder	Count	0	6	6
		% within hearing aid use	0,0%	31,6%	15,8%
Total		Count	19	19	38
		% within hearing aid use	100,0 %	100,0 %	100,0 %

5. DISCUSSION

In this study, a total of 38 individuals between the ages of 60 and 80, with and without hearing aids, diagnosed with hearing loss were selected. The MMSE inventory was applied to the individuals to compare the risk of hearing loss and dementia. As a result of our study, it was observed that hearing aid use had a significant relationship with MMSE score and they were interdependent.

Studies in the literature on the subject have found that elderly people with hearing loss are more likely to develop dementia over time than those with intact hearing. In the study conducted by Weinstein and Amsel in 1986, they applied the MMSE inventory to people with dementia and hearing loss in two conditions, with and without amplification, and reported an improvement in MMSE scores when amplification was provided to the participants [21]. In a subsequent study addressing the issue raised by Weinstein and Amsel (1986), Uhlmann et al. (1989) administered the MMSE in standardized form and in a written, hearing-free form to two groups of participants with dementia: those with hearing loss and those with normal hearing. They found that participants with dementia and hearing loss were significantly lower on both forms of the MMSE compared with those with dementia and normal hearing [21, 22].

There are studies in the literature on this topic involving older adults that differ in findings, study samples and data collection methods. For example, Mulrow et al. (1990) found an improvement in general cognitive function in older adults with hearing loss 6 months after hearing aid fitting. In contrast, Van Hooren, Anteunis, Valentijn, Bosma, and Ponds (2005) found that typically older adults with hearing loss did not show improved performance on cognitive tests even after one year when hearing aids were provided. MacDonald et al. (2012) recently conducted a randomized controlled trial on the effects of hearing aids on cognitive screening test scores (MMSE and Abbreviated Mental Test) for 192 older adults admitted to acute assessment units in hospitals. They found significant positive effects on MMSE scores when patients were provided with amplification and tested on consecutive days [23].

In the study conducted by Andrew H. Ford et al. and published in 2018, they found an increased risk of dementia with hearing impairment. This is an important finding, especially in light of recent recommendations that hearing loss in middle age may account for 9.1% of dementia cases worldwide and that efforts to mitigate its effects should continue to be explored [9].

In study 3 of the Journal of the American Geriatrics Society published in July 2018, data from 2,040 participants aged 50 years and older in the US Health and Retirement Study (HRS) were used. The HRS data used were collected every two years for 18 years. People who had data for at least 3 time points and started using hearing aids at some point were included. Trajectories of cognitive function were plotted based on memory test scores obtained before and after people started using hearing aids. They found that when adjusting for potential impairments, including gender, education, smoking, alcohol consumption, marital status, employment, physical activities, symptoms of depression and health comorbidities, the rate of cognitive decline on the memory test was slower than previously recognized [24].

When we examined the studies, similar results were obtained in our study. A significant relationship was observed between dementia and hearing. However, due to the limitation in the number of data, the MMSE score according to the degree of hearing loss and the duration of hearing aid use could not be included in the study. At the same time, the use of more detailed and more inventories to better evaluate the impairment in cognitive functions would provide more reliable results. However, due to our lack of competency level, individuals were evaluated only with the MMSE inventory, which we received a short training. For this reason, more studies should be conducted on hearing loss and dementia by integrating the disciplines of Psychology, Audiology and Geriatrics.

6. CONCLUSION

As a result of our research findings, a significant relationship was found between hearing aids and MMSE score. It was found statistically that the mean MMSE score of the non-hearing aid users (22.68) was smaller than the mean MMSE score of the hearing aid users (26.58) and that the two variables were dependent on each other.

In conclusion, it can be predicted that the use of hearing aids may reduce the decline in cognitive functions as it reduces the auditory deprivation caused by hearing loss. For this reason, the importance of early diagnosis and treatment of individuals with hearing loss on cognitive functions is revealed.

More studies are needed to better understand the relationship between hearing loss and dementia, especially in our country.

7. APPENDICES

ANNEX 1

DEMOGRAPHIC INFORMATION FORM					
Name and Surname:					
Date of Birth:					
Age:	☐ 60-70		☐ 71 and above		
Gender:	☐ Female		☐ Male		
Marital Status:	☐ Married	☐ Single	☐ Divorced	☐ Widow	
Education Status:	☐ Primary School	☐ Middle School	☐ High School	☐ University	☐Master's Degree/PhD
Occupation:					
Income Level:	☐ Low	☐Middle	☐High		
Phone Number:					
When were you diagnosed with hearing loss?					
In which ear is your hearing loss?	☐Right	☐Left	☐Both		
Have you ever had a hearing test?	☐Yes Where ?:……..	☐No			
Have you had a hearing test before?	☐Yes Please Specify:…….	☐No			
Have you received medication or surgical treatment for your hearing loss?	☐Yes ☐Communicable disease ☐Sugar disease (diabetes) ☐Heart problems ☐Head injury ☐High/low blood pressure ☐Headache ☐Kidney failure Other:……..	☐No			
Do you have any chronic conditions?	☐ Yes (When received?) (Which Ear) What is the frequency of use per day? ☐0-2 hours ☐3-5 hours ☐6+ hours	☐No			

ANNEX-2

STANDARDİZE MİNİ MENTAL TEST

Ad Soyad:	Yaş:	Aktif El:	Tarih: ..../...../.....
Eğitim (yıl):	Meslek:		T. Puan: .....

YÖNELİM (Toplam puan 10) ( )

Hangi yıl içindeyiz	Hangi ülkede yaşıyoruz
Hangi mevsimdeyiz	Şu an hangi şehirde bulunmaktasınız
Hangi aydayız	Şu an bulunduğunuz semt neresidir
Bu gün ayın kaçı	Şu an bulunduğunuz bina neresidir
Hangi gündeyiz	Şu an bu binada kaçıncı kattasınız

KAYIT HAFIZASI (Toplam puan 3)
Size birazdan söyleyeceğim üç ismi dikkatlice dinleyip ben bitirdikten sonra tekrarlayın (Masa, Bayrak, Elbise) (20 sn süre tanınır) Her doğru isim 1 puan ( )

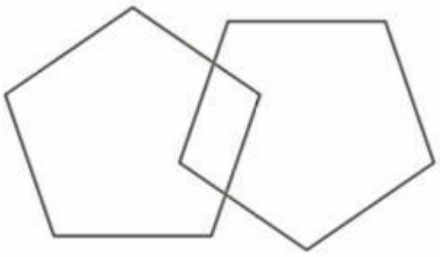
DİKKAT ve HESAP YAPMA (Toplam puan 5)
100'den geriye doğru 7 çıkartarak gidin. Dur deyinceye kadar devam edin.
Her doğru işlem 1 puan. (100, 93, 86, 79, 72, 65) ( )

HATIRLAMA (Toplam puan 3)
Yukarıda tekrar ettiğiniz kelimeleri hatırlıyor musunuz? Hatırladıklarınızı söyleyin. ( )

LİSAN (Toplam puan 9)
a) Bu gördüğünüz nesnelerin isimleri nedir? (saat, kalem) 2 puan (20 sn tut. ( )
b) Şimdi size söyleyeceğim cümleyi dikkatle dinleyin ve ben bitirdikten sonra tekrar edin. "Eğer ve fakat istemiyorum" (10 sn tut) 1 puan. ( )
c) Şimdi sizden bir şey yapmanızı isteyeceğim, beni dikkatle dinleyin ve söylediğimi yapın. "Masada duran kağıdı sağ/sol elinizle alın, iki elinizle ikiye katlayın ve yere bırakın lütfen" Toplam puan 3, süre 30 sn, her bir doğru işlem 1 puan ( )
d) Şimdi size bir cümle vereceğim. Okuyun ve yazıda söylenen şeyi yapın. (1 puan) ( )

"GÖZLERİNİZİ KAPATIN"

e) Şimdi vereceğim kağıda aklınıza gelen anlamlı bir cümleyi yazın (1puan). ( )
f) Size göstereceğim şeklin aynısını çizin. (arka sayfada) (1 puan). ( )



ANNEX 3

Eğitimsizler için Standardize Mini Mental Test

Ad Soyad: Yaş: Aktif El: Tarih: ...../...../.....
Eğitim (yıl): Meslek: T. Puan: .....

YÖNELİM (Toplam puan 10) ( )

Hangi yıl içindeyiz
Hangi mevsimdeyiz
Hangi aydayız
Hangi gündeyiz
Şu anda sabah mı, öğlen mi, akşam mı
Hangi ülkede yaşıyoruz
Şu an hangi şehirde bulunmaktasınız
Şu an bulunduğunuz semt neresidir
Şu an bulunduğunuz bina neresidir
Şu an bu binada kaçıncı kattasınız

KAYIT HAFIZASI (Toplam puan 3)
Size birazdan söyleyeceğim üç ismi dikkatlice dinleyip ben bitirdikten sonra tekrarlayın (Masa, Bayrak, Elbise) (20 sn. Her doğru isim 1 puan) ( )

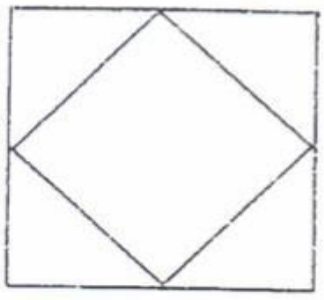
DİKKAT ve HESAP YAPMA (Toplam puan 5)
Haftanın günlerini geriye doğru sayar mısınız? Pazardan önce cumartesi gelir, ondan önce ne gelir? (Her doğru işlem 1 puan.) ( )

HATIRLAMA (Toplam puan 3)
Yukarıda tekrar ettiğiniz kelimeleri hatırlıyor musunuz? Hatırladıklarınızı söyleyin. ( )

LİSAN (Toplam puan 9)
a) Bu gördüğünüz nesnelerin isimleri nedir? (saat, kalem) 2 puan (20 sn tut. ( )
b) Şimdi size söyleyeceğim cümleyi dikkatle dinleyin ve ben bitirdikten sonra tekrar edin. "Eğer ve fakat istemiyorum" (10 sn, doğru ve tam cümle: 1 puan.) ( )
c) Şimdi sizden bir şey yapmanızı isteyeceğim, beni dikkatle dinleyin ve söylediğimi yapın. "Masada duran kağıdı sağ/sol elinizle alın, iki elinizle ikiye katlayın ve yere bırakın lütfen" Toplam puan 3, süre 30 sn, her bir doğru işlem 1 puan ( )
d) Şimdi Şimdi yüzüme bakın ve yaptığımın aynısını yapın. (1 puan) ( )

"GÖZLERİNİZİ KAPATIN"

e) Şimdi evinizle ilgili bir şey söyleyin (30 sn. anlamlı bir cümle: 1puan). ( )
f) Size göstereceğim şeklin aynısını çizin. (1 dk, kenar sayısı tam şekil için 1 puan). ( )



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ETHICS COMMITTEE APPROVAL

MEDİPOL UNV İSTANBUL MEDİPOL ÜNİVERSİTESİ

E-İmzalıdır

T.C.
İSTANBUL MEDİPOL ÜNİVERSİTESİ
Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu Başkanlığı

Sayı : 10840098-604.01.01-E.3641 31/01/2019
Konu : Etik Kurulu Kararı

Sayın Aysu SÜRKİT/ Betül Ayşe SÜLÜN

Üniversitemiz Girişimsel Olmayan Klinik Araştırmalar Etik Kuruluna yapmış olduğunuz "İşitme Cihazı Kullanan ve Kullanmayan ve Geriatrik Bireylerde Demans Riskinin Karşılaştırılması" isimli başvurunuz incelenmiş olup etik kurulu kararı ekte sunulmuştur.

Bilgilerinize rica ederim.

Prof. Dr. Hanefi ÖZBEK
Girişimsel Olmayan Klinik Araştırmalar
Etik Kurulu Başkanı

Ek:
-Karar Formu (2 sayfa)

İSTANBUL MEDİPOL ÜNİVERSİTESİ
GİRİŞİMSEL OLMAYAN KLİNİK ARAŞTIRMALAR
ETİK KURULU KARAR FORMU

	Belge Adı	Tarihi	Versiyon Numarası	Dili
Değerlendirilen Belgeler	ARAŞTIRMA PROTOKOLÜ/PLANI			Türkçe ☐ İngilizce ☐ Diğer ☐
	BİLGİLENDİRİLMİŞ GÖNÜLLÜ OLUR FORMU	29/01/2018		Türkçe ☒ İngilizce ☐ Diğer ☐
Karar Bilgileri	**Karar No: 102**	**Tarih: 30/01/2019**		
	Yukarıda bilgileri verilen Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu başvuru dosyası ile ilgili belgeler araştırmanın gerekçe, amaç, yaklaşım ve yöntemleri dikkate alınarak incelenmiş ve araştırmanın etik ve bilimsel yönden uygun olduğuna **"oybirliği"** ile karar verilmiştir.			

İSTANBUL MEDİPOL ÜNİVERSİTESİ GİRİŞİMSEL OLMAYAN KLİNİK ARAŞTIRMALAR ETİK KURULU	
BAŞKANIN UNVANI / ADI / SOYADI	Prof. Dr. Hanefi ÖZBEK

Unvanı/Adı/Soyadı	Uzmanlık Alanı	Kurumu	Cinsiyet		Araştırma ile ilişki		Katılım *		İmza
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* :Toplantıda Bulunma