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Effects of hearing aid on improving cognition and depressive symptoms in elderly

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ABSTRACT

Background: The prevalence of dementia among people aged over 60 years is between 5–7%, with the numbers of those affected globally predicted to double every 20 years between 2010 and 2050. While cognitive impairment and dementia have a negative impact on the individual, caregivers and society, the financial burden of cognitive decline and dementia are also a major source of concern. However, there is some cause for optimism in the form of potentially modifiable risk factors which can prevent or delay dementia. In this study we investigate the effect of hearing aid on improving cognition and depressive symptoms in elderly individuals with hearing impairment.

Methods: Patients with hearing impairment were selected based on inclusion and exclusion criteria and prescribed with similar type of hearing aid. MMSE and GDS scores were obtained before fitting hearing aid and 3 months after fitting hearing aid.

Results: A total number of 66 patients, 40 males (61%) and 26 females (39%) were included in the study. Before using hearing aids, the mean MMSE score was 18.98±5.37 (range 10–26), and it increased to 21.08±4.77 (range 12–27) after 3 months of hearing aid use (p<0.005). The GDS analysis revealed a mean score of 6.85±2.81 (range 3–11) before using hearing aid and it decreased to 5.44±1.82 (range 3–8 after using the hearing aid (p<0.005).

Conclusions: Treating hearing loss with hearing aid may reduce burden associated with cognitive decline and depression.

Keywords: Cognitive decline, Dementia, Depression, Hearing aid

INTRODUCTION

Presbycusis is age related sensorineural hearing loss. With improvement in health care facilities, the proportion of elderly population and hence presbycusis is increasing. The incidence of hearing loss ranges from 30%–60% for people over 65 years and 70%–90% for people over 85 years. ¹⁻³ In spite of its high prevalence, significant negative impact on quality of life and burden to society, hearing loss is often undertreated. A recent report in the U.S showed, only 1 in 7 adults aged 50 years and older with hearing impairment used hearing aid.

With increase in elderly population, the prevalence of dementia is also increasing. By 2050, the number of people affected by dementia is predicted to double to over 131 million.⁴ While about 2/3 of dementia patients have a genetic cause, 1/3 of them have a modifiable risk factor. Lifestyle measures such as improvement in education, reduction in smoking and appropriate management of hearing loss, diabetes and obesity significantly contribute for delaying the cognitive impairment. As dementia impairs the quality of life and imparts a significant financial burden on the society, if its onset could be delayed by a few years, it would be a great achievement.

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Several studies indicate that people with hearing loss may develop cognitive decline earlier than peers with normal hearing. Hearing loss has been recognized as a modifiable risk factor for dementia and is estimated to account for about 9.1% of the disease.5 Studies have reported an association between hearing loss, cognitive decline and dementia. Studies have also been conducted to determine whether the remediation of hearing loss could reduce the risk of accelerated cognitive decline. Based on the scientific links between hearing loss and cognition, various interventions, from hearing aid and cognitive training to established lifestyle interventions like reducing social isolation and better nutrition have been tried to improve hearing as well as cognition. These interventions though not mutually exclusive support one another. It is also true that people with hearing impairment restrict their physical activities and social contacts. This causes worsening of depressive symptoms, the self-assessed health conditions, and their performance in social activities.

We conducted this study with an objective to investigate the effect of hearing aid on improving cognition and depressive symptoms in elderly individuals with hearing impairment.

METHODS

The study was conducted from April 2019 to December 2019 for a period of 9 months in a secondary care hospital. Pre-post type of interventional study design was used in the study. Institutional ethical committee approval was obtained and all patients attending hospital with hearing impairment were subjected to complete clinical examination and pure tone audiometry. Study subjects were selected based on inclusion and exclusion criteria.

Patients aged more than 65 years whose pure tone audiogram showed more than 40 dB hearing loss, pure sensorineural type or mixed with sensorineural predominance and willing to use hearing aid were included in the study.

Previous hearing aid users, patients unfit to use hearing aid or not willing to use hearing aid, patients with conductive hearing loss in audiogram, those with sudden sensorineural hearing loss and tinnitus, patients with neurological deficit or confusional state and patients with uncontrolled co morbid conditions were excluded from the study.

After explaining the purpose of the study, a written informed consent for the participation in the study was obtained. General characteristics, marital status, living conditions [nursing home/ elderly care home/ staying alone or with partner] of the patients were noted. Similar type of hearing aid was prescribed for all patients.

A separate observer used Geriatric Depression Scale (GDS) and Mini Mental State Examination (MMSE) to assess depression and cognitive performance of the patients respectively. These tests were performed before

prescribing a hearing aid and repeated 3 months after using the hearing aid. The scores were compared.

The Geriatric Depression Scale -short form consisting of 15 short questions, which required responses of yes/no type was used for detecting the depressive symptoms in elderly. Based on Sheikh and Yesavage suggestion, a cut-off score of 7 was used. Scores of >7 indicated depression and <7 indicated no depression 6.

The mini mental state examination consisting of standardized questions, divided into 6 parts, to assess orientation, memory, attention and calculation, language, motor function and perception was used to assess cognition. According to the answers, the total score ranged from 0 to 30.

Institutional ethical committee approval was obtained and proceeded with the study. Quantitative data were expressed as the mean and Standard deviation whereas qualitative data were expressed as percentual differences. The parametric data were compared using the Student's t-test. P value <0.05 level was considered statistically significant.

RESULTS

A total number of 66 patients, 40 males (61%) and 26 females (39%) were included in the study. Demographic details were given in Table 1.

Table 1: Demographic details.

Total participants		N (%)
Sex	Male	40 (61)
	Female	26 (39)
Age in years (Mean±SD)		72.57±3.82
		(range 65 to 83)
Marital status	With partner	43 (65)
	Widowed	23 (35)
Living condition	Alone	4 (6)
	Old age home	10 (15)
	Care of relatives	11 (17)
	With partner at home	41 (62)

Their age ranged from 65 to 83 years, with a mean of 72.57 and standard deviation of 3.82 years. Among 66 patients, 23 patients were widowed and remaining 43 were living with their partners. Among 66 patients, 4 patients were living alone in their house, 10 in old age home, 11 at the care of relatives and 41 were living at their home along with their partner. With regard to pure tone audiometric tests, the mean hearing loss in the right and left ear was 64.16 dB and 64.83 dB respectively.

Before using hearing aid, the mean MMSE score was 18.98±5.37 (range 10–26), and it increased to 21.08±4.77

(range 12–27) after 3 months of hearing aid use (p<0.005). The GDS analysis revealed a mean score of 6.85 ± 2.81 (range 3–11) before using hearing aid and it decreased to 5.44 ± 1.82 (range 3–8) after using the hearing aid (p<0.005). Table 2 shows MMSE and GDS values.

Table 2: MMSE and GDS values.

	Before fitting aid Mean±SD	3 months after fitting aid Mean±SD	P value
MMSE	18.98±5.37 (range 10–26)	21.08±4.77 (range 12–27)	<0.0001
GDS	6.85±2.81 (range 3–11)	5.44±1.82 (range 3–8)	<0.0001

On comparing two groups, living with partner and widowed patients, MMSE showed 18.7 ± 5.48 and 19.52 ± 5.25 scores respectively with a 'p' value of 0.557 and GDS showed 6.98 ± 2.84 and 6.61 ± 2.81 , before using hearing aid and after using hearing aid for 3 months respectively with a 'p' value of 0.616. Neither the MMSE nor the GDS scores showed any statistically significant difference (p > 0.05).

DISCUSSION

Following World War II, scientists studied the connection between cognitive and auditory processing. The number of publications linking hearing and cognition started to remarkably grow in 1990's. Two main hypotheses have been proposed to explain the association between hearing loss and cognitive decline/dementia. First hypothesis is "Common cause model". In this model, hearing loss and decline share common, cognitive age-related neurodegenerative mechanism caused by microvascular diseases and inflammation.7 The second hypothesis, known as the "cascade" hypothesis, where long-term deprivation of auditory input may impact on cognition either directly, through impoverished input, or via effects of hearing loss on social isolation and depression. a) Cascade via auditory deprivation: Auditory deprivation for a long time results in reduced cortical input, leading to neuroplastic changes, leading to cognitive decline and dementia. b) Cascade via social effects: Hearing loss results in social disengagement that is reduced participation in social leisure activities and withdrawal from social interactions, leading to loneliness and depression, causing accelerated brain atrophy and accelerated cognitive decline. c) Cognitive load: Hearing loss causes diversion of cognitive resources from memory function into auditory processing, thus increasing the cognitive load, leading to cognitive decline and dementia. Requirement of increased compensatory cognitive effort to fill in the gaps caused by missing speech information may result in a reduced availability of cognitive resources dedicated for encoding speech into memory. The working

memory in older adults is already reduced further aggravating the cognitive load.⁸⁻¹²

One of the earlier study was by Lin et al, who studied 1984 older adults. Their baseline cohort consisted of participants without cognitive impairment as measured on the Modified Mini-Mental State Examination (MMMSE) all of whom underwent audiometric testing and were followed for 6 years. Compared to those with normal hearing, individuals with hearing loss had a 24% increased risk for incident cognitive impairment. The rates of cognitive decline and the risk for cognitive impairment were found to be linearly associated with the severity of the hearing loss. The authors concluded that hearing loss was independently associated with accelerated cognitive decline and incident cognitive impairment in community-dwelling older adults. This helped us to study the effect of hearing aid on cognition.

Amieva et al reported in one of the large scale prospective population based study, the association between self-reported hearing loss and cognition over a 25-year period. Unaddressed self-reported hearing loss was found to be associated with a faster rate of cognitive decline than that was determined for hearing aid users and those with normal hearing. They concluded that the use of hearing aid may slow cognitive decline by addressing the communication difficulties thereby improving mood and social interactions.² This was similar to our study where hearing aid improved cognition.

Though we think that the individuals with hearing loss do not perform well if cognitive tests are to be administered using auditory stimuli, studies prove that the link between hearing loss and cognitive impairment remains the same whether cognitive tests are administered through the auditory or visual modality. ¹⁴ So the auditory signal has to be presented at an adequate level when administering cognitive tests.

Hearing loss is also a risk factor for depression. ¹⁵ That's one of the reasons why we discuss both MMSE and GDS scores of the elderly patients with hearing loss. For elderly people, sensorial deficits like hearing impairment have negative implications on their socio-environmental interactions, causing social isolation and dependence. Hence sensory deprivation may cause anxiety, thus worsening their depression. Gazzola et al who observed an association between chronic dizziness and worsened depressive symptoms in elderly people concluded that elderly people with dizziness and hearing deficit were twice as likely to present depressed mood. ¹⁶ Our study was in accordance to these studies as hearing impaired were depressed and improved with hearing aid.

Chang et al in a study concluded that among elderly people with hearing impairment, besides hearing level, marital status, general health perception and the social environment are significantly associated with the self-perceived hearing handicap.¹⁷ According to these studies

the social status is important in the self-perception of hearing loss, although in our present study the two groups of married and widowed subjects displayed no significant differences in either the MMSE or the GDS scores.

CONCLUSION

Hearing aid play an important role in improving the hearing ability and delaying or reversing the cognitive decline. Modern hearing aids use advanced technologies like frequency specific amplification, acoustic feedback cancellation, background noise cancellation, direct streaming from phones leading to better speech perception. Though our study has a few limitations like a small sample size, a small study period and self report of hearing aid use frequency, it gives us major conclusion like among elderly individuals with hearing impairment, greater number of depressive symptoms were associated with cognitive impairment and they can be improved by using hearing aid. A longitudinal study is required to determine the casual relationship between the long-term use of hearing aid and the progression of cognitive function.

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Ethical approval: The study was approved by the

Institutional Ethics Committee

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