

An Effect of Amplification on Hearing Ability, Cognition, and Depression among Middle and Late Adulthood

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ABSTRACT

Background: Age-related hearing loss in middle adulthood (MA) and late adulthood (LA) is a highly prevalent health condition. It will negatively impact on an individual's cognitive, social, and psychological functions. An effect of amplification on hearing ability, cognition, and depression among MA and LA are sparse. **Objective:** The aim of the study was to investigate an effect of amplification on hearing ability, cognition, and depression among middle and LA. **Methods:** A cohort study where 18 MA and 20 LA with hearing impairment aged 50–75 years was selected. Pure tone audiometry, Mini Mental State Examination, and geriatric depression scale were assessed pre and post 6 weeks of amplification. Parameters such as hearing thresholds, cognitive score, and depression level were measured. The statistical tests were used for analyzing the parameters within and across groups. **Results:** The result shows a significant difference ($P < 0.05$) with respect to hearing thresholds and cognitive scores within both the groups. A significant difference ($P < 0.05$) was observed in right ear between both the groups. No significant difference ($P > 0.05$) was noted in the level of depression between both the groups. **Conclusion:** An evident difference in the hearing thresholds and cognitive scores were noted with respect to amplification in both the groups. Thus, it can be concluded that the amplification has a significant impact on an individual's quality of life. It should be considered as an important factor during the management of hearing impairment among middle and late-adulthood.

Keywords: Age-related hearing loss, Amplification, Cognitive impairment, Depression, Quality of life
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INTRODUCTION

The hearing impairment is a condition of partial or total loss of hearing ability. It varies from a person to person based on the type, degree, and configuration of hearing loss. The nature of the hearing loss could be bilateral or unilateral; symmetrical or asymmetrical; progressive or sudden in onset; fluctuating or stable; and congenital or acquired. According to National Centre for Environmental Health 2018 report, hearing loss is considered as the third commonest enduring physical condition. Four hundred and thirty-two million people were diagnosed with hearing loss in the year of 2018. It was observed to be more prevalent in males (8.5%) than the female population (6.7%). On an approximate, 50% of the congenital or prelingual hearing loss are due to genetic causes which includes both genetic syndromes (For e.g., CHARGE, Usher syndrome) and non-syndromic genetic inheritance (For e.g., autosomal dominant non-syndromic hearing loss, X-linked non-syndromic hearing loss).^[1] The rest 50% of the hearing loss are caused by preventable causes.^[2]

Age-related hearing loss (ARHL) or presbycusis in middle adulthood (MA) and late adulthood (LA) is a highly prevalent health condition which affects 20% of the individuals aged 45–59 years and 33% of the individuals aged above 60.^[3,4] It is characterized as a gradual, progressive, and bilateral symmetric sensorineural hearing loss which formerly affects the high frequency region in the cochlea. It is considered as the second most common condition among the geriatric population. It is also a multifactorial condition which is caused by both intrinsic factors such as genetic predisposition and extrinsic factors includes environmental noise exposures, cardiovascular disease, and ototoxic medications. The inner ear degeneration which comprises of cochlear inner and outer hair cells loss, spiral ganglion cells degradation, or trophy of stria vascularis results in ARHL.^[5]

The prevalence rate has been increasing, which is estimated to be one-fourth of the population by 2050 whereas one-tenth

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of the population with hearing impairment will require aural rehabilitation.^[6] The hearing aids are the primary rehabilitative option for ARHL. Yet, averagely individuals take 10 years since they notice the hearing related problems to the time when they look for treatment options.^[7] It is the major concern because if ARHL is left untreated it will negatively impact on an individual's social and psychological functions. It is also associated with cognitive functions.^[8-11] Late-life dementia is a foremost cause of disability across the world, which approximately affects 6.5% of the individuals aged above 65 years.^[12] It is caused by the age-related changes in cognitive functions and followed by a reduction in memory, learning, thinking, and language.^[13] According to the world report 2016, the incidence of late-life dementia will double every 20 years.^[14] ARHL and late-life dementia may be comorbid while the communication problems intensify the behavioral issues which includes depression.^[15] ARHL has numerous associated health conditions which includes enhanced social isolation, reduced self-esteem, symptoms of depression, disease burden, and hospitalization risk. Thus, it is considered as a risk factor for depression.^[16]

The previous literature provides strong evidence on the association among hearing ability, cognition, and depression. The results support the fact that ARHL is associated with cognitive impairment which leads to depression among geriatric population. However, still several studies are from western countries. Furthermore, exploring an effect of amplification on hearing ability, cognition, and depression is sparse. It leads to hearing impairment left untreated which results in cognitive impairment and depression. To overcome these issues, amplification is considered as the important factor in the management of hearing impairment and the present study aimed to investigate an effect of amplification on hearing ability, cognition, and depression among middle and LA in Tamil Nadu region.

Aim

The aim of the study was to investigate an effect of amplification on hearing ability, cognition, and depression among middle and LA.

Objectives

The objectives were as follows – (i) To investigate the hearing thresholds, cognitive scores, and level of depression pre- and post-amplification among MA and LA separately and (ii) To correlate hearing thresholds, cognitive scores, and level of depression pre- and post-amplification between MA and LA.

METHODS

Participants

The clinical study was approved by institutional review board of Aanvii Hearing Solutions Pvt. Ltd, Bangalore, Karnataka. A total of 38 individuals with hearing impairment of both male and female aged 50–75 years were considered as participants for the study using a non-random sampling method. They were grouped into two – Group A consists of 18 MA (50–60 years) and Group B consists of 20 LA (61–75 years). None of the participants were worn hearing aids before the participation in this research study. All the participants were native Tamil speakers and volunteers. The participants with no significant medical history; presence of any external, middle ear disorders, neurological and depression symptoms, cognitive issues, and any intake of ototoxic drugs were recruited in the current study. Any participant with the above-mentioned conditions was excluded from the study as this could affect the outcomes of the study.

Objective Analysis

Pure tone audiometry (PTA) is an objective test procedure used to determine the hearing thresholds of the participants. During the first session, the testing was performed unaided and the hearing thresholds were obtained across the standard audiometric test frequencies from 250 Hz to 8 kHz using Universal Galaxy – I audiometer with TDH39 headphones and Radioear B72 bone vibrator. Air conduction, bone conduction thresholds, and pure tone average were measured as per standard audiometric test procedures.^[17]

Subjective Analysis

Mini mental state examination is a 30-point questionnaire was administered to measure cognition in a face-to-face interview method. A 15-item questionnaire and geriatric depression scale are used to measure depression that was administered in a clinical setup with a cutoff score set at ≥ 5 points.

Amplification

All the participants were using 12 channel digital hearing aid bilaterally coupled with standard ear hook. The hearing aid gain was determined by Connexfit fitting formula. The targets were generated using Signia Connex software version 9.9. All the hearing aids were set to have a universal program along with omnidirectional microphone, speech and noise management, and feedback cancellation features. The other program and volume controls were disabled. All the participants were educated on the use, care and maintenance, and instructed to use at least 8 h per day for 6 weeks. The data logging feature was used to track the overall usage during the follow-up visit.

Statistical Analysis

The parameters such as hearing thresholds, cognitive scores, and level of depression were assessed pre-amplification during the first session as baseline and readministered 6 weeks post amplification during a follow-up visit. The obtained data were tabulated using SPSS software v26 and subjected to analysis. Paired sample “t”-test was done to compare the pre- and post-amplification measures within both the groups. Independent “t” test was administered to investigate an effect of amplification on hearing thresholds, cognitive scores, and level of depression among MA and LA.

RESULTS

The hearing thresholds, cognitive scores, and level of depression were compared pre- and post-amplification within both the groups.

On comparison, the result shows that in Group A, 22.22% had moderate hearing loss; 33.33% had moderately severe hearing loss, and 44.45% had severe hearing loss whereas in Group B, 10% had moderate hearing loss; 25% had moderately severe hearing loss; and 65% had severe hearing loss. The significant difference had been noted in hearing thresholds pre- and post-amplification conditions yet no changes in the degree was observed. In Group A, 50% of the individuals had mild cognitive impairment pre-amplification whereas only 16.66% was found post-amplification. In Group B, pre-amplification 80% of the individuals had mild cognitive impairment while it reduced to 35% of post-amplification. In Group A, 50% of the individuals had depressive symptoms pre-amplification whereas 44% of the individuals had post-amplification. In Group B, 55% of the individuals were found to have depression in both pre- and post-amplification conditions. From the above-mentioned results, it is evident that post-amplification, Group A found to have better hearing thresholds, more cognitive scores, and mild depression level when comparing to Group B [Figures 1 and 2].

Table 1 shows a significant difference ($P < 0.05$) with respect to hearing thresholds and cognitive scores within both the groups.

Furthermore, a significant difference ($P < 0.05$) was observed in the right ear between both the groups. The cognitive scores also showed a significant difference ($P < 0.05$) between both the groups. No significant difference ($P > 0.05$) was noted in the level of depression between both the groups.

DISCUSSION

The purpose of this study is to investigate the effect of amplification on hearing thresholds, cognition, and depression among middle and LA. The key finding of the present study is that hearing thresholds and cognition were significantly improved with the usage of hearing aid. It was strengthened by the PTA and cognition scores during the follow-up visit post 6 weeks of amplification.

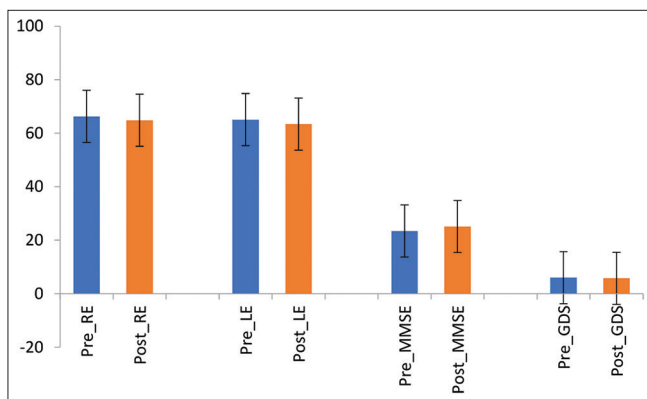


Figure 1: Overall mean of hearing thresholds, cognitive scores, and level of depression pre- and post-amplification among Group – A. Error bars indicate SD

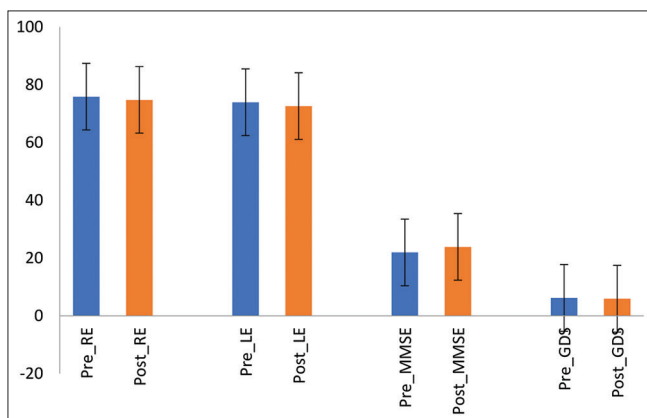


Figure 2: Overall mean of hearing thresholds, cognitive scores, and level of depression pre- and post-amplification among Group – B. Error bars indicate SD

In this study, we certainly chose to investigate the effect on amplification on hearing thresholds, cognition, and depression because previous studies have stated the association of ARHL, age-related cognitive impairment, and depression and how it declines as the age increases.^[18] Besides, importance of amplification in reducing the risk of hearing loss, cognitive impairment, and depression had been reported.^[19] However, the present study is aimed to measure the effect of amplification on hearing thresholds, cognition, and depression among middle and LA.

Hearing Thresholds

The hearing aid usage in geriatric population is hypothesized to improve the hearing ability, cognitive functions, and the depressive symptoms.^[19] In the present study, when comparing hearing thresholds pre- and post-amplification within Group A with Group B, significant difference is noted in both the groups. It shows that a notable effect is observed in hearing ability due to provided appropriate amplification. Interestingly, a significant difference is found especially in the right ear when comparing between both the groups. It could be due to the dominance of the left hemisphere in hearing cues perception.^[20] Besides, Group A shows better thresholds post amplification than the Group B. It is predominantly due to the age factor. As age increases, the degradation occurs more and in a rapid rate. As the degree of hearing loss increases, it increases the risk of cognitive issues and cause social isolation and depression.^[18] A cohort study also stated that individuals with hearing impairment are more prone to develop dementia than those without hearing impairment.^[21]

Cognitive Scores

ARHL is independently associated with age-related cognitive decline (ARCD) in community dwelling older individuals aged 70–90 years.^[22] However, the precise mechanism for the association between ARHL and ARCD remains ambiguous. It could be due to neural degeneration, sensory degradation/deprivation, depletion of cognitive resources, and social isolation/depression.^[23] A recent study found that hearing impairment may account 9.1% of the cognitive decline worldwide and the efforts to reduce those adverse effects should be explored in further.^[21] The results of the present study provide an elucidation for it. On comparison of pre- and post-amplification, cognitive scores show a significant difference within and between both the groups. It is evident that the amplification plays a key role in cognitive functions.^[24]

Level of Depression

Approximately 11.4 to 19.1% of the individuals with hearing impairment have depressive symptoms. A meta-analysis had stated that hearing impairment is an ailment which is associated with

Table 1: Comparison of hearing thresholds, cognitive scores, and level of depression pre- and post-amplification across Group A and B

Parameters	Mean±SD				P-value
	Group A (n=18)		Group B (n=20)		
	Pre	Post	Pre	Post	
RE_PTA	66.29±16.1	64.81±15.95	75.83±11.2	74.74±10.95	0.30 ^a
LE_PTA	65.08±15.2	63.39±15.02	73.91±11	72.58±11.08	0.05
MMSE	23.44±2.09	25.11±1.56	21.95±1.87	23.85±1.63	0.33 ^a
GDS	6±2.49	5.77±2.12	6.2±1.85	5.9±1.41	0.94

^a $P < 0.05$ is significant, PTA: Pure tone audiometry, MMSE: Mini mental state examination, GDS: Geriatric depression scale

depression especially in adults aged above 65 years.^[15] Hearing impairment is significantly associated with increased depression.^[25] Hearing aids are considered to be an effective solution for improvising the cognitive functions and depressive symptoms among older adults^[26] but on contrary in the present study, no significant difference was noted within and between both the groups. It may be due to the limited period of amplification. Thus, prolonged duration of hearing aid usage should be recommended to reduce the depression among the older adults.

Clinical Implications

- In individuals with hearing impairment, along with routine audiological evaluation cognition and level of depression can be evaluated to rule out cognitive impairment and depression if any
- It can also be done pre and post amplification to monitor the progress of hearing ability, cognition, and level of depression to improve an individual's QoL
- As these procedures are easy and less time consuming, it can be used during routine audiological evaluation in all clinical setups.

Limitations

- Among individuals with hearing impairment, duration of hearing impairment was not divided as subgroups
- Along with PTA other tests, evaluating speech measures could have been incorporated.

CONCLUSION

An evident difference in the hearing thresholds and cognitive scores was noted with respect to amplification in both the groups. Thus, it can be concluded that the amplification has a significant impact on an individual's quality of life. It should be considered as an important factor during the management of hearing impairment among middle and late-adulthood to reduce the risk of ARHL, cognitive impairment, and depression. Besides, the duration of hearing aid usage also creates a significant impact on an individual's QoL.

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