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Original Article

Screening for Auditory Processing Difficulties in Older Adults with Hearing Impairment Using Screening Checklist for Auditory Processing in Adults

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BACKGROUND: Aging enhances changes in the central and peripheral auditory systems. It is expected that older adults population would experience auditory processing deficits. Therefore, early identification of these individuals will help in making appropriate referrals, which in turn might help in early diagnosis and management of the problem.

METHODS: Fifty-five participants diagnosed with hearing impairment were screened for the existence of auditory processing difficulties using Screening Checklist for Auditory Processing for Adults-Modified 2-point rating scale. The data were collected using direct interview and telephonic interview with the participant.

RESULTS: A total of 26 participants with bilateral symmetrical sensorineural hearing loss (47.3%) exhibited auditory processing difficulties.

CONCLUSION: It can be understood that all older adults with hearing impairment need to undergo screening using Screening Checklist for Auditory Processing for Adults. This will further help in deciding and customizing the management options required for each older adult with bilateral symmetrical sensorineural hearing loss.

KEYWORDS: Hearing impairment, Screening Checklist for Auditory Processing for Adults, older adults, auditory processing difficulties

INTRODUCTION

Hearing Impairment (HI) is the third most common medical problem in the elderly. According to the National Institute on Aging, 1 in 3 people between the ages of 65 and 74 have HI, and more than half of people over the age of 75 have HI. Age-related sensorineural HI is slow-moving, symmetrical HI (mainly at high frequencies) that is exacerbated in noisy situations and affects more than 90% of older people with HI.[1]

The ear is primarily involved in detecting the frequency and intensity of sounds, and the auditory pathway is involved in decoding these sounds into what is called auditory processing.[2] According to Stewart,[3] the signal in cochlear degrades by the presence of peripheral HI. This degraded signal is further transferred to a central auditory system that is unable to make fine discriminations or employ its inherent intrinsic redundancy in older adults. Therefore, for better encoding, peripheral system is very important as central auditory nervous system relies on the integrity of auditory signal from the auditory nerve of both ears.

Literature reports an association between HL and Auditory Processing Difficulties (APD). From a sample of 2015, adults >55 years, Stach et al[4] reported an increase in detection of auditory processing abnormality with age (binaural abnormality of 27.3% for older adults aged 64 years; 44.3% for older adults aged 65-74 years; and 69.0% for older adults aged >75 years). In spite of the elderly patients constituting the largest population recommended to use hearing aids, only 10%-21% essentially use the hearing aids.[4] This low percentage of hearing aid usage can be attributed to several factors, one being the presence of APD. Hence, it becomes of immense importance to assess and rehabilitate the elderly population with HI and experiencing APD to improve their overall quality of life.

Although numerous diagnostic tests are available to measure and describe the condition of the auditory processing, they are time-consuming, expensive, exhausting, and tiring[3] thereby requiring a larger effort from both clinician and patient. Therefore, it is inevitable to begin the assessment protocol by making use of a screening tool. Screening is vital, according to Chermak,[5] as it

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allows for timely intervention. This is especially important in a developing country like India, where the population is large and financial aids are scarce. Therefore, the current study was undertaken to highlight screening the older adults with HI using Screening Checklist for Auditory Processing in Adults (SCAP-A). The SCAP-A consists of 12 questions, which tap the auditory separation/closure, auditory integration, and temporal ordering, along with memory and attention.[6]

METHODS

Participants

The study was carried out after obtaining an Institute Ethical Committee Clearance referenced Approval No: Dr. SRC-BNGRC/T/IEC/139/2021.

The checklist SCAP-A developed by Yathiraj and Vaidyanath[6] to be answered by older adults was administered to 55 individuals (32 males and 23 females) over the age of 50-86 years (mean 67.23 years). All participants were fluent in speaking English with no reported speech or language issues. Before enrolling in the study, a written consent was taken from the participants. All participants were diagnosed with bilateral symmetrical sensorineural HI, ranging from mild to severe degrees in Department of Hearing Studies, Bangalore, using Clark's classification.[7] The thresholds of the participants were identified through pure-tone audiometry testing. Both air and bone conduction modes were tested from 250 Hz to 8 KHz and 250 Hz to 4 KHz, respectively. All the participants had age-related HI. The presence of history of middle ear pathology or cognitive impairments was excluded from the study. Likewise, all the recruited participants had no history of hearing aid usage.

Procedure

All participants meeting the inclusion and exclusion criteria were randomly selected using Simple Random Sampling Method. Further, recruited participants were administered with SCAP-A, a 2-point rating scale. It comprises of 12 questions that tap auditory memory, auditory attention, auditory separation/closure, and temporal ordering abilities. It contains 2 checklists, one for the individual to complete by himself/herself and the other for a close family member to complete. The data were collected using 2 methods: direct interview with participant and telephonic interview of the participant. The questions were read aloud to the participant one by one, with examples supplied if the questions were not understood. Likewise, the questions were repeated if needed.

A score of "0" was given for the presence and "1" for the absence. The checklist was administered only in English language. The results of the individual questions, as well as the overall score, were totaled. All the participants who scored more than 50% (a score of ≥6 out of 12) were deemed at a risk for auditory processing disorder.

Statistical Analysis

The obtained data were entered into a Microsoft Excel 2013 sheet and were analyzed using IBM's Statistical Package for Social Sciences (SPSS) software (Version 20).

RESULTS

A total of 55 individuals were included in the study, with an average age of 67.23 years (50 to 86 years). The sample size comprised 23 (41.8%) female participants and 32 (58.2%) male participants.

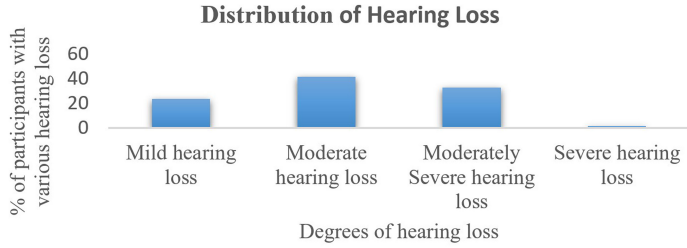

Figure 1. The distribution of hearing loss.

All the participants exhibited bilateral symmetrical sensorineural HL with degree ranging from mild to severe. Figure 1 represents the distribution of participants with various degrees of HI.

Figure 1 explains the degree of HI considered for the study. A total of 13 (23.6%) participants had mild degree HI, 23 (41.8%) participants had moderate degree HI, 18 (32.7%) with moderately severe HL, and 1 (1.8%) with severe degree HI in both ears. From this graph, we can understand that the majority of the participants had a moderate degree of HL.

Further, the presence of auditory processing difficulties in older adults with bilateral symmetrical sensorineural HI was determined using the SCAP-A. Figure 2 highlights the total percentage of APD in older individuals recruited for the study. A total of 26 participants (47.3%) exhibited APD.

The below analysis highlights the scores obtained on each question in SCAP-A by the participants of the study.

Question 1

Figure 3 illustrates that, the majority of participants (35) required frequent repetitions and only a few (20) participants did not require repetitions during the discourse.

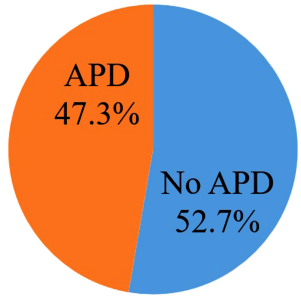

Figure 2. The overall number of older individuals having hearing loss and difficulty with auditory processing.

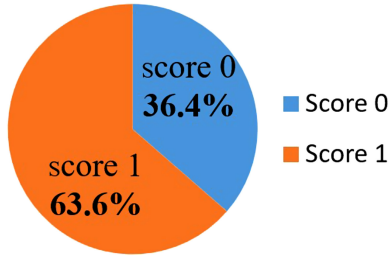

Figure 3. The data with frequent repetitions when listening to someone speaking normally.

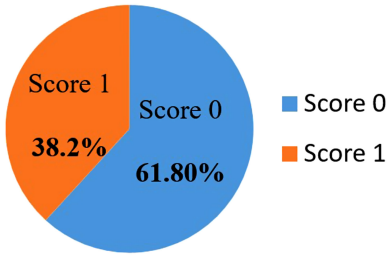

Figure 4. The data of listening to conversation for more than 10 minutes.

Question 2

Figure 4 indicates that, 34 participants could focus on someone speaking continuously for more than 10 minutes. Whereas, only 21 participants showcased difficulty in paying attention to someone speaking continuously for more than 10 minutes.

Question 3

Figure 5 indicates 45 participants had difficulty to focus on speech in presence of background noise and only 10 participants could manage the task.

Question 4

Figure 6 showcases that 40 participants had trouble remembering the correct order and only 15 participants can successfully manage the task.

Question 5

Figure 7 showcases that only 21 participants experienced difficulty to remember within a minute and a majority of the participants (34) could remember what was told in a short span of time.

Question 6

Figure 8 indicates that a majority of participants (43) had difficulty comprehending speech in the presence of background noise and only 12 participants could comprehend speech in the same given situation.

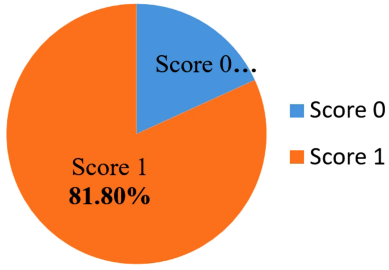

Figure 5. The data of difficulty to focus on speech in noise.

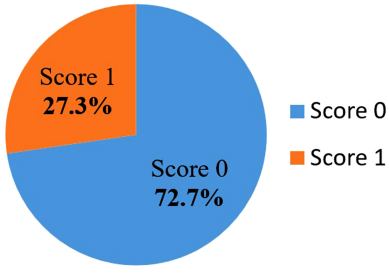

Figure 6. The data of difficulty to recall in correct order.

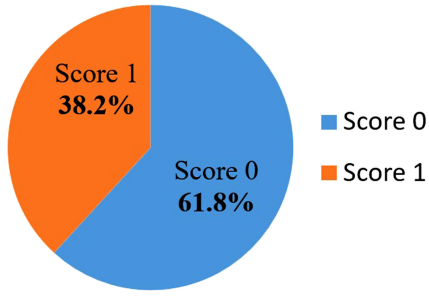

Figure 7. The data of forgetting in a short span of time.

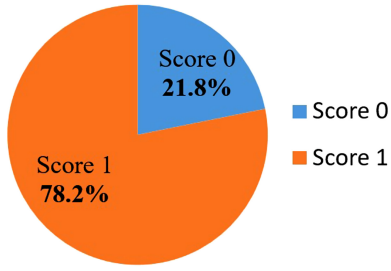

Figure 8. The data of difficulty comprehending speech in noise.

Question 7

Figure 9 indicates that only 17 participants had difficulty recalling names of 5 people from long-term memory. A total of 38 participants could perform the task adequately.

Question 8

Figure 10 indicates 36 participants did not show any delay in responding to their friends or family members when spoken to, whereas 19 participants needed longer time to respond.

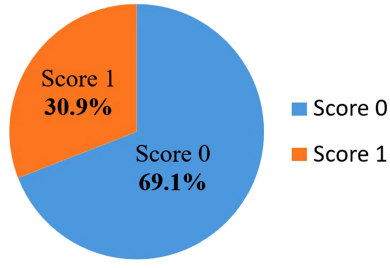

Figure 9. The data of recalling the names of 5 high school/college pals whom the participants have not encountered since graduation.

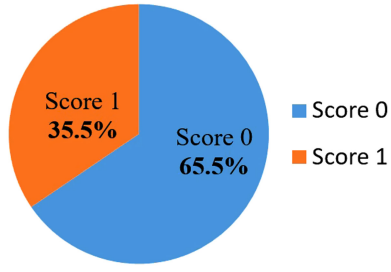

Figure 10. The data of longer time taken to answer when someone talks.

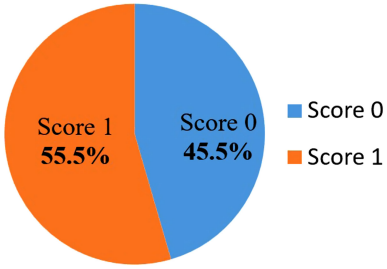

Figure 11. The data of difficulty in replying to people speaking simultaneously.

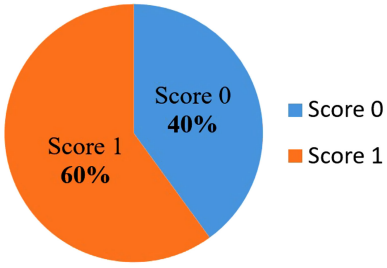

Figure 12. The data of difficulty in comprehending speech without facial cues.

Question 9

Figure 11 indicates that more than half of the participants (30) had difficulty in responding to 2 people talking at the same time, whereas 25 participants did not experience any difficulty with the task.

Question 10

Figure 12 illustrates that, 33 participants had difficulty to understand speech without any facial cues. Remaining 22 participants could perform the task adequately.

Question 11

Figure 13 illustrates that more than half of the participants (31) did not have difficulty in remembering numbers of their personal gadgets, etc., whereas 24 participants experienced difficulty with the task.

Question 12

Figure 14 indicates 45 participants did attend to someone speaking suddenly, whereas 10 participants did not attend to someone who suddenly started talking.

With a total of 26 participants exhibiting auditory processing difficulties in older adults with bilateral symmetrical sensorineural HL using SCAP-A, it can be understood that all the adults need to undergo screening using SCAP-A.

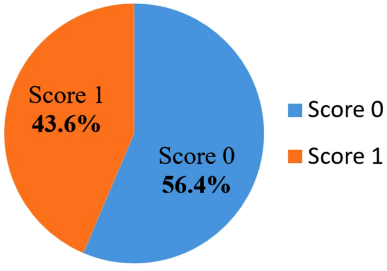

Figure 13. The data of difficulty recollecting numbers, particularly vehicle/telephone/bus numbers/door numbers/account numbers.

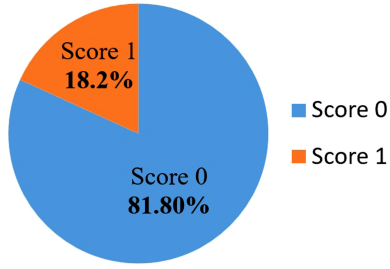

Figure 14. The data of not attending when someone suddenly starts talking.

DISCUSSION

Hearing loss is one of the utmost common sensory deficits in the older population, which results in reduction in quality of life. The test findings of this study reveal that almost 50% of the participants in the study experienced poor auditory processing skills.

Auditory memory, auditory attention, auditory separation/closure, and temporal ordering abilities require conscious behavioral and perceptual abilities. Findings of Jerger et al[8] state that processing at the level of auditory brainstem is not affected by aging. All the altered auditory processing findings of the study can be an effect of the underlying HI in both ears.

There is a general agreement in the literature regarding HL and its effect on the auditory processing abilities. The current study observed poor auditory memory, auditory attention, auditory separation/closure, and temporal ordering abilities in almost half of the considered participants of the study. Majority of the older adults experienced at least 2 symptoms of difficulty in auditory processing based on SCAP-A. A score of 1 in majorly all the participants in questions 3, 6, 4, and 1 of SCAP-A was observed. This highlights the need to use these questions on priority basis in daily audiological routine assessment to rule out the presence of auditory processing difficulties. The findings of the study are in concordance with the findings of the literature.

Auditory Separation/Closure Abilities

The observed poor auditory separation/closure abilities in the presence of background noise can be possibly explained by the complex process of segregating target speech from unwanted noise in the background. Understanding speech in noisy environments necessitates a complex combination of sensory and cognitive components.[9] This is especially true for the older adults, who must adjust for the loss of peripheral sensory function that comes with advancing age.[10] Three hypotheses involving peripheral, central, and cognitive processes have been presented to explain the mechanisms behind age-related HI in noise ability.[11] (a) Individuals with and without HL may experience changes in speech-in-noise perception and (b) central auditory processing as they age, (c) implying that aging can alter speech processing even when the signal is heard.[12] Furthermore, older adults use linguistic knowledge (i.e., the semantic and syntactic context of a sentence) to compensate for speech-in-noise perception deficiencies caused by slower processing, but failing fluid memory capacities limit the ability to apply this knowledge.[13]

The older adults with HI scored 1 (difficulty present) on questions focusing on auditory separation/closure. This is consistent with another study's findings, which found that older listeners have difficulties following a 2-person discourse.[14] Rather than an increase in cognitive demands, they attributed this difficulty to problems with spatial separation. As a result, listening to 2 people conversing at the same time most likely taps auditory integration, whereas listening in the presence of noise most likely taps auditory separation. To add on, poor speech comprehension is ascribed as damage to the anterior temporal region, which is further related to difficulties in auditory figure-ground discrimination.[15] The memory-related hippocampus and amygdala are located in the anterior temporal region.[16] Likewise, Tisserand et al[17] found a link between lower hippocampus activity or volume and verbal memory performance in nondemented elderly people.

Auditory Attention and Auditory Memory

The participants scored 1 on questions involving auditory memory and attention. This finding is in agreement with Larrabee and Levin's[18] findings. The authors discovered a link between self-reported memory loss and objective measures of attention and concentration. Park et al[19] found that older adults had more trouble remembering words when their attention was divided during the encoding stage rather than during the retrieval stage. Therefore, an older adult with HI may experience difficulties with auditory memory and attention abilities.

Also, the findings of the current study showcased majority of the participants scored 1 for question regarding frequent repetitions. This observation is against the findings of the study by Rogers et al.[20] The author quotes that older adults with HI have frequent convictions that they have accurately received information that they have in reality misperceived, particularly when relying on context; as a result, they are less likely to request repetition or clarification. Older adults have "false hearing" or "false seeing"[21] or "false memory."[22] This convergence, according to Jacoby and colleagues, implies a widespread decrease of frontal-lobe function.[21] Impairments in executive function (inhibitory control) may also affect hearing in noise, making older people more readily distracted by new auditory or visual stimuli and restricting their ability to selectively focus on the words said by a single speaker.[23] The study findings may simply be related to frequent repetition of the presence of underlying HI in both ears.

Auditory Temporal Processing

Literature quotes poor temporal processing abilities in older adults with HI. Fitzgibbons and Wightman[24] reported declines in temporal processing abilities using gap detection test (GDT). Authors related this to changes in cochlear mechanisms leading to HL[25] and the involvement of central auditory processes.[26] The GDT observed a rise in thresholds in individuals with HI.[27] In a similar study, Hall and Kreisman[28] assessed GDT scores in younger and older persons with and without HI. Hearing thresholds were lower in older persons with normal hearing, which was linked to age-related alterations in the central nervous system and central auditory processing. Therefore, reduction in peripheral sensitivity is likely to play a role in the temporal processing issues seen in older adults with HI.

The study findings are backed up by Vaidyanath and Yathiraj's[29] findings from a comparable investigation. They compared the SCAP-A with diagnostic test battery for auditory processes among elderly persons with normal hearing and those with mild to moderate HI above 2 KHz. Most older adults with HI failed the tests assessing temporal resolution and auditory integration. To compare, the recruited participants in our study had broader range of degree of HI from 250 Hz to 8 KHz. Similarly, the auditory processing difficulties were identified in auditory separation/closure, auditory integration, and temporal ordering, along with memory and attention. The presence of substantial HI appears to exacerbate poor auditory processing skills. This could explain why many senior citizens remark that wearing a hearing aid makes speech louder but does not necessarily increase their ability to understand it.

CONCLUSION

Incorporating SCAP-A will help the audiologist provide the best-needed rehabilitation/management option to the individual with APD such as hearing aids with recent technologies to enhance the signal-to-noise ratio. Further, SCAP-A can serve as a tool to record the improvement with auditory training. However, a large-scale study is warranted considering the limited sample size and unequal distribution of participants with varying degrees of HI ranging from mild to severe.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of Dr. S.R. Chandrasekhar Institute of Speech and Hearing (Approval No: Dr. SRC-BNGRC/T/IEC/139/2021).

Informed Consent: Informed consent was obtained from each patient included in the study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – T.D.D., R.J.B.; Design – T.D.D., R.J.B.; Supervision – T.D.D., R.J.B.; Funding – X.X., X.X.; Materials – A.A., T.D.D.; Data Collection and/or Processing – A.A.; Analysis and/or Interpretation – A.A., T.D.D.; Literature Review – A.A., T.D.D., R.J.B.; Writing – A.A., T.D.D.; Critical Review – A.A., T.D.D., R.J.B.

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Declaration of Interests: The authors declare that they have no competing interest.

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