COMPARISON OF SCAP-A OUTCOMES BETWEEN YOUNG AND ELDERLY ADULTS WITH NORMAL HEARING SENSITIVITY

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AUGUST, 2022

CERTIFICATE

This is to certify that this dissertation entitled "**Comparison of SCAP-A outcomes between Young and Elderly Adults with Normal Hearing Sensitivity**" is a bonafide work submitted as a part for the fulfillment for the degree of Master of Science (Audiology) of the student with Registration Number 20AUD040. This has been carried out under the guidance of the faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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This is to certify that this dissertation entitled "**Comparison of SCAP-A outcomes between Young and Elderly Adults with Normal Hearing Sensitivity**" has been prepared under my supervision and guidance. It is also being certified that this dissertation has not been submitted earlier to any other University for the award of any Diploma or Degree.

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DECLARATION

This is to certify that this dissertation entitled "**Comparison of SCAP-A outcomes between Young and Elderly Adults with Normal Hearing Sensitivity**" is the result of my own study under the guidance of Dr. Sandeep M., Professor of Audiology, Department of Audiology, All India Institute of Speech and Hearing, Mysore and has not been submitted earlier to any other University for the award of any Diploma or Degree.

Mysuru **Registration No: 20AUD040**

August, 2022

To my father, Mr. Manoj Sharma, and my mother, Mrs. Deepa Sharma

Khalil Gibran said that parents are like a bow and children like arrows. The more the bow bends and stretches, the farther the arrow flies. I fly, not because I am special, but because they stretched for me.

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CHAPTER 1

INTRODUCTION

Auditory inputs from the periphery are turned into brain activities through a hierarchy of processing stages known as central auditory processing (Fujioka et al., 2020). At the cortical level, the ascending auditory pathway extracts spectral, temporal, and spatial sound information in order to further integrate sound patterns and construct a perceptual representation of auditory objects (Scott, 2005; Fujioka et al., 2020). Auditory processing, in simple terms, is the efficiency and effectiveness with which the central auditory nervous system uses auditory information and it is the foundation for complex actions such as understanding spoken language. It is not a closed process, as it interacts intimately with other neural systems and is influenced by experience, environment, and active training; its alteration has a negative impact on people's quality of life. Auditory discrimination, temporal processing, binaural processing, and auditory performance with competing or degraded acoustic inputs, as well as dichotic listening are some of the auditory processes (ASHA, 2005).

Central auditory processing disorder (CAPD) is defined as the "difficulties in the central nervous system's perceptual processing of auditory information" (ASHA, 2005). In this, normal peripheral auditory function is present, but the central auditory nerve system, which includes the auditory pathways from the cochlear nucleus in the brainstem to the auditory cortex, is impaired (Bamiou, 2001). According to Jerger and Musiek (2000), auditory processing impairments are produced entirely by an auditory-specific defect. The American Speech and Hearing Association (ASHA) acknowledges that people with auditory processing disorder have more difficulty in the auditory modality (Vaidyanath & Yathiraj, 2014). However, because most regions

of the brain are responsible for numerous sensory modalities, total modality specificity is rare (Poremba et al., 2003). The prevalence of APD is reported to be 7% in the general population (Musiek et al., 1990).

Both the peripheral and central auditory systems have been shown to demonstrate physiologic changes with age (Willott, 1992). These alterations have the potential to have a direct impact on a wide variety of auditory and cognitive processing abilities that are critical for speech comprehension (Humes & Dubno, 2009). In a top-down, concept-driven fashion, reductions in higher-order processes (i.e., cognition) can impact changes in the perceptual processing of auditory information (Roberts, 1997). Changes in many aspects of memory and attention are evidence of this. Reduced speed of information (sensory & mental) processing with increasing age is one of the general results in cognitive ageing research (Salthouse, 1996). Listening comprehension is known to be affected by a reduction in the speed with which information is processed, as well as a reduction in cognitive skills in adults (Akeroyd, 2008; Holt & Lotto, 2008; McCoy et al., 2005; Ronnberg et al., 2008, 2010; Tun et al., 2010).

Central auditory processing deficits have also been found in the absence of severe cognitive decline and peripheral hearing impairment (Rodriguez et al., 1990; Jerger et al., 1989). According to Musiek et al. (1990), without the use of screening tests of CAPD, problems would either go unnoticed or would be discovered too late. In the literature, screening for auditory processing is primarily described in children (Lovett & Johnson, 2010; Smoski et al., 1992; Smith & Dittmann, 1983). To detect persons at-risk for auditory processing problems, the American Academy of Audiology (AAA, 2010) and the Canadian Inter-organizational Steering Group for

Speech–Language pathology and audiology (Canadian Inter-organizational Steering Group for Speech-Language Pathology & Audiology, 2012) suggested using checklists or inventories filled out by individuals or others associated with them (parents, employers, spouses, or significant others) (Vaidyanath & Yathiraj, 2021; (Vaidyanath & Yathiraj, 2014)). These checklists are meant to probe information on the individual's auditory impairments and their impact on day-to-day activities, thereby quickly detect those with higher probability of having auditory processing disorders (APD).

In many nations, including India, the population of older individuals is gradually increasing. According to Veron et al. (2002), the global population over the age of 65 is predicted to double from 7% to almost 14% by 2040, rising from 506 million in 2008. With an increase in the number of elderly people, it is expected that the number of people with auditory processing problems will rise in lockstep. Early detection of these people will aid in making appropriate referrals, which will aid in early diagnosis and management of the problem. This in turn will result in better quality of life in such persons.

According to the studies (for example, Musiek et al., 1990), screening for APD raises awareness, makes it possible to develop efficient management techniques, and enables making suitable social suggestions. Researchers have shown that both questionnaire-based and performance-based screening techniques are useful in identifying people who are at-risk for APD. Screening for APD has been done using questionnaires or checklists (Muthuselvi & Yathiraj, 2009) as well as screening tests (Dawes & Bishop, 2010; Wilson, 2014; Yathiraj & Maggu, 2012). The screening tests examine how the person performs in situations such as listening to music, silence, and

multiple auditory inputs, whereas the questionnaires gather information on how the person performs in various challenging listening conditions. Because the former are process-specific and latter asks the parent/guardian or educator to score their general view of the person's conduct, correlation between the two kinds of evaluation is found to be poor (Shaikh, 2020).

"Buffalo Model Questionnaire Revised" (BMQ-R) and "Screening Checklist of Auditory Processing in Adults" (SCAP-A) are a few commonly used checklists in adult and elderly population. BMQ covers a wide range of auditory behaviours that are affected by CAPD that include speech perception in noise and dichotic listening. Pavlick et al. (2010) stated that although the BMQ score has strong correlation with Buffalo model test battery, it cannot be used solely as a diagnostic tool. Kaul et al. (2016) reported that BMQ can also demonstrate treatment-related changes in different auditory processing areas, and is in agreement with behavioural auditory processing test.

According to Emerson et al. (1997), screening checklists may result in excessive referrals. Schow and Seikel (2007) noted that screening tests had higher sensitivity and specificity than screening checklists, which was positive evidence of their application. To check for APD, Chermak and Musiek (1997) advised using a battery of tests. The Screening Test for Central Auditory Processing Disorders for Adults (SCAN-A), Hearing in Noise Test (HINT) and SCAN-3 for adults are a few of the screening tests. Wilson (2011) discovered a limited association between the diagnostic tests for APD and the screening instruments (checklists & tests) for APD.

According to Lessler (1972), the aim of screening is to gather preliminary data on an individual's characteristics, particularly those that may have a big impact on

their health or quality of life. The author also underlined the need for the screening process to be resource-, time-, and money-efficient. By definition, screening would include more people than a complete evaluation. The length of time that is required to administer the screening task has been highlighted in the research as a crucial demerit (Lessler, 1972). According to the literature, SCAN-A and MAPA take 20 minutes (Keith, 1994) and 30 minutes (Domitz & Schow, 2000), respectively, whereas SCAN-A screener only takes 10-15 minutes (Keith, 2009).

SCAP-A developed by Yathiraj and Vaidyanath (2014) has two screening checklists; one for the participant and the other for the family member. The checklists have 12 questions, and are available in English and Kannada. The auditory processes investigated by the checklist include auditory separation and closure, auditory memory, auditory integration, temporal ordering, and attention. When Yathiraj and Vaidyanath (2021) assessed the correlation between SCAP-A and diagnostic test battery for APD, they discovered that the older people's responses to the checklist had a sensitivity and specificity of 69.05 % and 71.43 %, respectively. On the other hand, in the family members' response sensitivity and specificity were 33.33 % and 77.78 %, respectively. Both the versions of the checklist were found to have high test-retest reliability.

1.1 Justification for the Study

Subclinical auditory impairment seems to be more common in the elderly population. This can occur in either the central or peripheral auditory system, resulting in deviant central auditory processing. Although they may have normal hearing, they can show aberrant central auditory processing that is based in the peripheral auditory system or is present solely in the central auditory system.

Nagaraj et al. (2015) reported that structural and functional changes occur in the central nervous system with advancing age due to which the processing gets affected. This may be further influenced by hearing loss and cognitive decline, such as reduction in mental processing speed, working memory and attention. These in turn are likely to impact the auditory processing ability (Salthouse, 1996). Aging adults are known to experience difficulty with speech perception (especially in presence of noise) and discrimination (Humes, 2007; Murphy et al., 2018) supporting the notion that aging induces auditory processing deficits. The common difficulties faced by older people include difficulty following conversations in meetings, difficulty in understanding speech from telephones, hearing strangers, TV shows, movies etc (Heine & Slone, 2018). Such difficulties can have negative impact on the quality of life of the individual. Heine and Slone (2018) found that the individuals with CAPD show low confidence levels and symptoms of depression.

APD screening techniques make it possible to early identify those at-risk for the disorder and intervene. Additionally, these screening techniques reveal the need for additional diagnostic testing and lower the proportion of erroneous referrals of people with higher order cognitive or linguistic deficiencies (Martin & Dell, 2019). A checklist can provide information on the person's symptoms and complaints, which would be documented and examined. Deficits in one or more processes may be present in APD, and each individual may experience it differently. Due to the lack of screening or diagnostic tests for APD in all languages, persons at risk for the condition should at the very least undergo a questionnaire-based evaluation utilising a checklist, which will offer information about the symptoms as well as some extra case history details (Shaikh, 2020).

The bulk of checklists available in the literature are designed to detect children at-risk for APD; there aren't many available for the adult population. The SCAP-A is a questionnaire designed for adults that include questions about speech perception in noisy environments, auditory memory and sequencing, and other aspects of hearing. It also includes two checklists, one for the participants and the other for the participant's family. Because the family members' level of specificity was much lower than that of the older participants', information gleaned from the older persons at-risk for APD might be supplemented by the family members' answers to the checklist when the older adults are unable to provide meaningful feedback (Yathiraj & Vaidyanath, 2021).

In the pandemic like situations, where social distancing is to be practiced, it is very difficult to conduct comprehensive assessment for all the individuals to assess auditory processing deficits. Hence, in such situations, screening through checklist serves the purpose to at least reduce the over-referral, save time and money, and also for the safety of the individual as well as the examiner. Studies have been done to compare or find the relation between screening and diagnostic tests for children as well as adults but in any event, no study has been conducted to compare the results of SCAP-A in elderly individuals to those in young adults. The findings of this study can help us get an estimate of the risk of APD in elderly persons.

1.2 Aim of the Study

The aim of the study is to determine whether the probability of APD increases with advancing age.

1.3 Objectives of the Study

1) To compare the referral rate of SCAP-A across young, mid-aged and elderly participant groups
2) To compare the total score of SCAP-A across young, mid-aged and elderly participant groups
3) To compare the item-wise score of SCAP-A across young, mid-aged and elderly participant groups.

CHAPTER 2

REVIEW OF LITERATURE

The effective and efficient use of auditory information through the central nervous system is referred to as auditory processing (CNS). Auditory discrimination, temporal processing, binaural processing, and auditory performance with competing or degraded acoustic inputs are all based on auditory processing mechanisms (ASHA, 2005). In a nutshell, it's the efficient use of aural input.

2.1 Definition of Central Auditory Processing Disorder (CAPD)

The ASHA Task Force (1996) defined central auditory processing as the mechanism and process in the auditory system that is responsible for the following behavioural phenomena: sound localization and lateralization; auditory discrimination; auditory pattern recognition; temporal aspects of audition, such as temporal resolution, temporal marking, temporal integration, and temporal ordering; auditory performance decrement with completing acoustic signals; and auditory performance decrement with incomplete acoustic signals. Deficits in one or more of these skills are referred to as central auditory processing disorders (CAPD).

"Difficulty in processing auditory information perceptually in the central nervous system and underlying neurobiological activity that gives rise to electrophysiological auditory potentials" is the characteristics of Central Auditory Processing Disorder (ASHA, 2005). CAPD is a term used to describe deficiencies in the processing of audio information that are not caused by hearing loss or mental illness (ASHA, 1990).

When there's a lot of noise around, it's harder for older people to grasp what's being said (CHABA Working Group on Speech Understanding and Aging, 1988).

Although peripheral sensitivity reductions, particularly at high frequencies, may account for some of these difficulties, other factors such as changes in the central auditory nervous system and/or senescent changes in cognition may also play a role in reduced speech understanding in noise among older adults (CHABA Working Group on Speech Understanding and Aging, 1988).

2.2 Incidence and Prevalence of CAPD

The frequency and demographic characteristics of CAPD are primarily published in western countries, and there are a few researches that provide information on CAPD prevalence in India (Hind et al., 2011). Understanding the occurrence of CAPD is critical for developing appropriate infrastructure, intervention techniques, and evaluation protocols for CAPD. The prevalence rate ranges from 0.5 percent to nearly 7 percent of the population (Chermak & Musiek, 1997).

Hind et al. (2011) discovered that even individuals with normal hearing sensitivity to have hearing related complaints. They noted the prevalence for adults and children in UK and found that both adults and school-aged children were most typically referred for speech production issues by primary care physicians. They stated that the prevalence of CAPD was 5.1 percent among children and 0.9 percent among all the adults in the study. It was also shown that younger adults had a prevalence of 4% for auditory processing disorders. CAPD is expected to affect 0.5-1 percent of the general population in children and adults, according to the researchers (Hind et al., 2011).

2.3 Signs and Symptoms of CAPD

The main complaint of older persons with CAPD is difficulty understanding spoken language in noisy environments: there was frequent co-occurrence of

peripheral and central auditory impairments (Stach et al., 1991). The clinical profile of an adult or older adult with CAPD differs from that of children with CAPD. In the majority of children with CAPD, especially those with learning impairments, a neuro-morphological disease is suspected; however, CAPDs in adults are most frequently the result of well-defined and detectable lesions of the central auditory nervous system (Musiek & Gollegly, 1988; Musiek et al., 1990). CAPD in older persons is caused by accumulated damage or degeneration of the central auditory nerve system due to ageing, neural injury, and/or neurodegenerative illness (Baran & Musiek, 1991). Elderly adults lose previously intact processing functions, but children with CAPD may never have developed efficient processing skills.

Changes in cognitive abilities caused by age can impact the processing outcomes. Craig et al. (1993), for example, found that older persons needed longer duration segments to accurately identify monosyllabic word targets. They concluded that older persons may exercise more lexical restraint than younger adults, and that their lexical searching behaviour is less flexible. Differences in decision-making techniques and a decline in total speech processing in older persons can worsen problems with spoken language resolution (Craig et al., 1993).

2.4 Evaluation of CAPD

In order to detect lesions and describe functional auditory abnormalities in the central auditory nerve system, the CAPD evaluation incorporates a battery of tests. Prior to evaluating central auditory processes, routine audiological evaluation should be performed (Chermak & Musiek, 1997). APD in the elderly can be evaluated using a plethora of methods that can either be diagnostic or screening in nature.

2.4.1 Diagnostic evaluation of CAPD

Merten et al. (2020) assessed the temporal relations of decline in hearing sensitivity, higher-order auditory processing, and cognition in 1,274 middle-aged adults in 3 examinations (baseline, 5 year and 10 year follow up). Hearing sensitivity, higher order auditory processing assessed using word recognition in competing message in the better ear using the North-western University 6 word set, and cognition via trail-making test performance were all assessed. While hearing sensitivity may influence higher-order auditory processing, the study found that in midlife, connections between hearing and cognition are bidirectional and weak.

Rodriguez et al. (1990) tested central auditory and language capabilities in a sample of 25 older persons who had essentially normal hearing and were cognitively intact. In order to be included in the study, participants had to pass the Mini-Mental State Examination. Monosyllabic word lists, the synthetic sentence identification-ipsilateral competing message (SSI-ICM) test, the dichotic digits tests, and the staggered spondaic word test were all employed to assess central auditory performance. The Revised token test and subtests of the Boston diagnostic aphasia test were used to assess linguistic skills. The results demonstrated that central auditory involvement does not have to be accompanied by a loss of peripheral hearing sensitivity, cognitive function, or linguistic competency. The SSI-ICM appeared to be the most sensitive measure of changes in central auditory processing capacities with advancing age for the type of persons included in this investigation, according to the findings.

Rasmus and Blachnio (2021) looked into the symptoms of CAPD in the elderly, as well as the link between these deficits and emotional and linguistic prosody perception. The Brain-Boy Universal Professional and the Right Hemisphere Language Battery were employed. The functions associated to frequency

differentiation, recognition of the temporal pattern, the process of distinguishing between relevant sounds, and reaction speed were all reduced in the examined samples. They concluded that the de-automation of basic auditory central processing capabilities, which is seen in elderly persons, reduces the sense of both emotional and linguistic prosody, lowering the quality of communication.

Martin and Jerger (2005), from earlier researches, summarized behavioural and event-related potential findings on the effects of ageing on dichotic listening skills and reviewed a major site for deficiencies in temporal processing. They concluded that aspects of central auditory aging independent of peripheral hearing sensitivity underlie some of the temporal processing deficits as observed in the gap-detection measures (Schneider & Hamstra, 1999).Similar conclusions were made from the other studies where the investigators examined the duration-discrimination abilities between young and older adults with simple noise and tonal stimuli (Abek, Krever & Alberti, 1990; Fitzgibbons, Gordon & Fitzgibbons, 1994). The findings suggest that age-related deficiencies in inter-hemispheric information processing may be at the root of some listening issues in elders.

2.4.2 Screening tests for CAPD

It is possible to assess CAPD using a variety of screening tools, including checklists, tests, behavioural and physiological evaluations. Variety of tests that evaluate various aspects of auditory processing are included in the behavioural assessments. These tests evaluate binaural separation (Competing sentence test), binaural interaction (Masking level difference, Binaural fusion, and Dichotic digit test, among others), and temporal processing (Duration pattern test, Gap detection test). The majority of studies strongly recommend that a test battery rather than a

single behavioural measure be used to determine an APD diagnosis (ASHA, 1996; Bellis, 2003; Jerger & Musiek, 2000).

Parents and teachers can utilize one of the various screening checklists that are available to identify CAPD. The Screening Test for Auditory Processing Disorders for adults and adolescents (SCAN-A) by Keith (1994); SCAN-3 by Keith (2009) and; Hearing in Noise Test (HINT) by Nilson, Soli and Sullivan (1994) are popular audiological tests that are used to screen for CAPD and to recommend whether further testing for the condition is required. Some of the often used checklists are the Buffalo Model Questionnaire Revised (BMQ-R) developed by Katz and Zaleswski (2011), and the Screening Checklist of Auditory Processing in Adults (SCAP-A), developed by Vaidyanath and Yathiraj (2014).

SCAP-A encompasses two screening checklists; one for the participant and the other for the family member and have 12 questions available in English and Kannada languages. It assesses several auditory processes such as auditory separation and closure, auditory memory, auditory integration, temporal ordering, and attention. Their investigation findings showed that older persons experienced at least one memory-related auditory processing difficulties symptom. They found that more family members than the older persons reported no signs of impaired auditory processing. This suggests that the family members were unaware of the participants' modest issues. The most prevalent reported conditions were auditory closure and numeric sequences, whereas the most minor significant reported circumstances involved auditory attention. When memory and perception in the presence of noise were compared with attention, the latter two were more heavily reported by the participants. The authors of SCAP-A in 2021 examined the correlation between the SCAP-A and the diagnostic test battery for APD and found that the sensitivity and

specificity of older people's responses to the checklist had a was 69.05 % and 71.43 %, respectively whereas, the family members' responses to the checklist were 33.33 % and 77.78 %, respectively (Vaidyanath & Yathiraj, 2021). Both the versions of the checklist were found to have high test-retest reliability.

2.5 Management of CAPD

Due to the limited plasticity of their mature central nervous system, interventions for adults and older persons mainly focus on compensation rather than recovery of function (ASHA, 1996).A senior citizen with aphasia is less likely to benefit from CAPD treatment than a senior citizen with presbycusis who is experiencing CAPD as a result of the ageing central auditory nerve system (ASHA, 1996). Treatment outcomes will be influenced by group and individual variances resulting from disparities in intellectual, cognitive, linguistic, and psychosocial states. Peripheral deficiencies and cognitive decline or differences, without a doubt, could increase the effects of CAPD. Hearing aids, for example, are less effective in older persons with peripheral and central auditory impairments (Stach, Loiselle & Jerger, 1991). Amplification, particularly a personal frequency-modulated (FM) system, should be considered first in the treatment of CAPD in older persons. The FM system’s remote microphone technology is more successful than hearing aids at reducing background noise, which interferes with the capacity of older adults to perceive spoken language (Stach et al., 1991).

CHAPTER 3

METHOD

The study used cross-sectional design to study the effect of age on the findings of Screening Checklists of Auditory Processing for Adults (SCAP-A). The checklist was administered on normal hearing adults as well as their family members through personal and telephonic interviews. The responses were compared across the age groups, and also between participants and the family members.

3.1. Participants

A total of 170 normal hearing adults participated in the study. They were in the age range of 20 to 70 years. They were divided into 3 groups based on their age: 'Young', in age range of 20 to 30 years; 'Middle-aged', in the age range of 35 to 50 years, and 'Elderly', in the age range of 55 to 70 years. In case of every participant, a questionnaire meant for care taker was also administered on the respective care taker. The care taker was a family member who had known the participant for at least 5 years prior to the experiment. There were 170 care takers on whom the questionnaire was administered.

An informed consent was taken from each participant prior to their participation and the study conformed to the institutional ethical guidelines prescribed for bio-behavioural research (Basavaraj & Venkatesan, 2009). The participation in the study was completely voluntary, and the confidentiality of the demographic and individual response data was ensured.

All the participants were speakers of Kannada (n= 42) or English (n= 128). A detailed case history was obtained from all the participants and the participants having

any history of neurological, speech and language, otological problems (such as any past or present history of ear infection, ear pain, and giddiness or hearing loss), developmental delay and associated deficits were excluded from the study. They had to pass hearing screening test for them to be included in the study.

3.2. Test Material/ Tool

3.2.1. Hearing Screening App

The participants were screened for the hearing sensitivity using AIISH Hearing Screening App. It is a free app for mobile devices developed by AIISH that allows people to check their hearing on a regular basis. The app is for people who are at-risk for hearing loss or who are already experiencing some of the symptoms of hearing loss. It is compatible with iOS and Android phones and is available on Google Play Store and Apple App Store. The app presents common words in the presence of white noise and the participants need to select the picture of the word presented out of the four pictures shown on the mobile screen. The app takes the details of the participants such as contact number and address.

3.2.2. Screening Checklist for Auditory Processing in Adults (SCAP-A)

SCAP-A is a collection of two screening checklists developed by Ramya Vaidyanath and Asha Yathiraj (2016). It is meant to identify the at risk individuals for auditory processing deficits in adults. Among the two checklists, one is for the individual and the other is for the family. The checklists are given in Table 3.1 and Table 3.2. Kannada versions of the questionnaire are given in the Appendix 1. There are 12 questions in the checklists and they probe into various processes such as auditory separation/closure, auditory integration, temporal ordering, auditory

memory, and attention. A cut-off score of 4 is set and those who lie in the category of 4-12 score, need to get a detailed audiological evaluation done to confirm auditory processing deficits. According to the authors, the participants themselves or the audiologist can administer the checklists.

Table 3.1: *Screening Checklist of Auditory Processing for Adults meant for the person being screened*

Sl. No.	Question
1.	Do you require frequent repetitions while listening to someone who does not have a speech problem?
2.	Can you pay attention to someone speaking continuously for more than 10 minutes? E.g. Listening to a conversation
3.	Do you find it difficult to attend to speech in the presence of background noise? E.g. Television at normal volume/fan at high speed.
4.	Do you have trouble recalling what was said in the correct order? E.g. 5 different (non-routine) things in the order you have done them.
5.	Do you forget what was told to you within a short span of time (within a minute)? E.g. To buy a particular item from a shop.
6.	Do you have difficulty in understanding speech in the presence of background noise (when the television/fan at full speed)?
7.	Can you recall the names of 5 of your school/ college friends, who you have not met after you left school/college?
8.	Have you been told that you take longer than others to respond when your friends or family talk to you?
9.	Do you have difficulty in responding to two people talking at the same time? E.g. In a group, when two people answer/ask a question at the same time.
10.	Do you feel it is difficult to understand someone's speech when you cannot see his or her face? E.g. When the person's face is turned away from you.
11.	Do you have difficulty in remembering numbers, especially telephone/vehicle/ door numbers, bus numbers, account numbers?
12.	Do others report that you do not attend to them when they suddenly start talking to you?

Table 3.2: *Screening Checklist of Auditory Processing for Adults meant for the family members*

Sl. No.	Question
1.	Does she/he require frequent repetitions while listening to you or someone who speaks clearly?
2.	Can she/he attend to someone speaking continuously for more than 10 minutes?
3.	Does she/he find it difficult to attend to speech in the presence of background noise?
4.	Does she/he have trouble recalling what was said in the correct order? E.g. 5 different (non-routine) things in the correct order.
5.	Does she/he forget what was told very quickly within a short span of time (within a minute)? E.g. To buy a particular item from a shop.
6.	Does she/he have difficulty in understanding in the presence of background noise (when the television/fan at full speed)?
7.	Can she/he recollect the names of 5 friends whom they have not met over 30 years?
8.	Does she/he take much longer (almost double the time) to respond to what was said compared to others in the family/friends?
9.	Does she/he have difficulty in responding to two people talking almost at the same time?
10.	Does she/he have difficulty in understanding speech when the face of the speaker cannot be seen?
11.	Does she/he have difficulty in recalling digits, especially telephone/vehicle/door numbers, bus numbers, account numbers?
12.	Does she/he not attend to you or others when you or others suddenly start talking to her/him?

3.3.Test Procedure

3.3.1 Hearing Screening

The potential participants were adults in the age range of 20 to 70 years who reported that they have normal hearing and no history of neurological, speech and language problems, otological problems, developmental delay and associated deficits. They were chosen on a purposive sampling basis. They were approached through a phone call and a personal interview or telephonic interview was arranged for those who showed the willingness to participate. There were two modes of interview in view of the pandemic situation in the country.

For the hearing screening, the participants were asked to download the app in their cell phones or in the cell phones of the family member. The application was available on Google Play Store for Android phones and on iOS for Apple products.

Trial Phase: The participants were made to wear the 3mm jack earphones which were plugged into the mobile phone which had the application installed in it. Each ear was stimulated separately through the earphones. In the test, they heard a list of words in each ear separately, one after the other, along with background noise. In the trial phase minimum of 2 test items are presented to the participant for familiarization. They were asked to ignore the background noise and identify the word heard and respond by touching the corresponding picture displayed on the mobile screen out of the four pictures displayed on the screen.

Test Phase: After the participant got familiarized with the test procedure, actual screening test started. The stimuli were presented monoaurally at most comfortable level for the participant. The screening test is available in three languages: English, Hindi and Kannada. A total of 20 test items were presented in the preferred language of the participant. The level of background noise remained constant throughout the

screening. At the end of the test, the results were displayed on the screen for both ears respectively as 'Pass' or 'Refer'.

3.3.2 Administration of SCAP-A

In most of the participants, a personal interview was arranged to administer the two checklists in a household setting. However, due to the pandemic situation in the country, the personal interview was not feasible in all the cases. The first preference for the experiment was personal interview but due to hike in the number of Covid-19 positive cases, telephonic interviews were carried out. The investigator administered the checklists for all the participants. During the direct interview, the examiner was seated in front of the participant. The instructions remained same for both mode of interviews, that is *"I will pose 12 questions to you one after the other. After each question, you have to tell me whether you have any difficulty while performing the task which is mentioned in the question, by saying yes or no."* The participants were asked to respond in 'Yes' or 'No' mode for all the 12 questions which the examiner asked and could request for repetitions if not understood.

The responses for each question were scored and reported as Yes and No in a tabular format. The cumulative score of 'Yes' response was calculated. A score of 4 and above was considered deviant and designated as 'Refer' for detailed evaluation of auditory processing. The administration of the checklist took 5-7 minutes in each participant.

3.4. Statistical Analysis

The data was statistically analysed using Statistical Package for the Social Sciences (SPSS) version 20 software. The three groups of participant were compared for their total score and item-wise score.

CHAPTER 4

RESULTS

The study aimed to compare the responses of Young, Mid-aged and Elderly adults for their scores of Screening Checklists of Auditory Processing for Adults (SCAP-A). A total of 170 individuals with normal hearing sensitivity participated in the study. There were 33 Young (19.41%), 72 Mid-aged (42.35%) and 65 Elderly (38.23%) adults. Among the 170 participants, 77 (45.29%) were males and 93 (54.70%) were females.

The participants were administered with the checklist either in English or Kannada using the respective version of the questionnaire as per their language of preference: 128 were screened with English and 42 were screened with Kannada versions. Among the 170 caretakers, 98 (57.64%) were males and 72 (42.35%) were females. The mean age of the participants was 46.68 years (SD=13.88), whereas the mean age of the caretakers was 24.45 years. Table 4.1 shows mean and standard deviation of age in the three groups of participants.

Table 4.1: *Mean and Standard deviation of age in the three groups of participants*

Groups	Mean Age (Years)	Standard Deviation
Young	24.52	3.27
Mid-aged	45.24	4.98
Elderly	60.56	5.17

The age group (Young, Mid-aged & Elderly) was the independent variable of the study while the outputs of the questionnaire (overall score & the item-wise score) were the dependent variables. Initially, the agreement between participants and

caretaker responses was tested using Kappa coefficient. The Kappa coefficient ranged between 0.74 and 1.00 ($p<0.05$) for the 12 questions. The results are shown in Appendix II.

The data of the three groups of participants were tested for the distribution using Shapiro-Wilk test of normality. It was found that the data in the 3 groups were not normally distributed. Therefore, for the between-group comparisons, non-parametric tests were used.

4.1 Results of the Total Scores

Total score was the sum of the scores obtained for the 12 questions. The total score for the participants varied from 0 to 12 and the criteria for referral was '4' and above. The percentage of participants who scored ≥4 was taken as the referral rate and pass rate was the percentage of the participants who had a total score of less than 4.

4.1.1 Results of the Referral rate

Out of the 170 participants, 94 (55.9%) participants passed the screening checklist among which 28 (84.8%) were Young, 33 (45.8%) were Mid-aged and 34 (52.3%) were Elderly adults. Figure 4.1 shows the referral rate of the 3 groups.

Although not part of the study, we attempted comparing the referral rate between males and females. Among the 77 males, 43 (55.8%) were found at-risk for APD and among the 93 females, 32 (34.4%) were found at-risk for APD. The dependency of referral rate on the gender was tested using Chi square test and the results showed that there was a significant difference between the referral rates of males and females [$\chi^2(1) = 7.851$, $p=0.005$].

The referral rate between English and Kannada versions of SCAP-A was also compared. Among the 128 participants who were screened with English version, 56 were found at-risk for APD, whereas among the 42 participants screened with Kannada version, 19 were found at-risk for APD. The dependency of referral rate on the language of SCAP-A was measured using Chi square test and the results showed no significant association between the referral rates and the language [χ^2 (1) = 0.028, p=0.866].

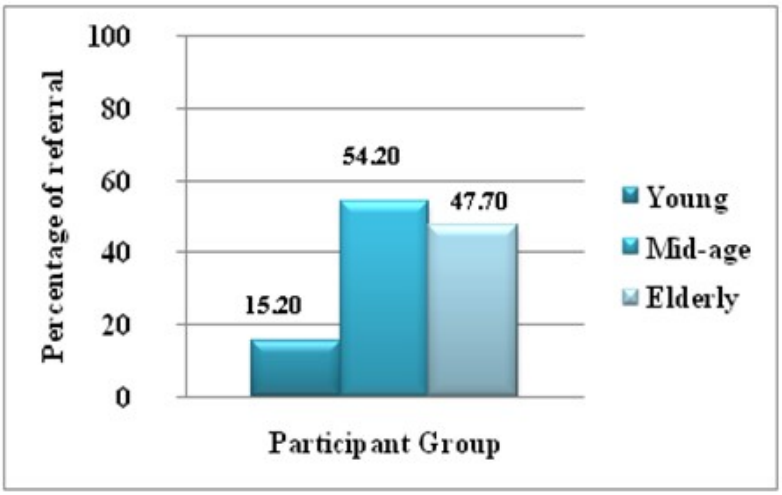


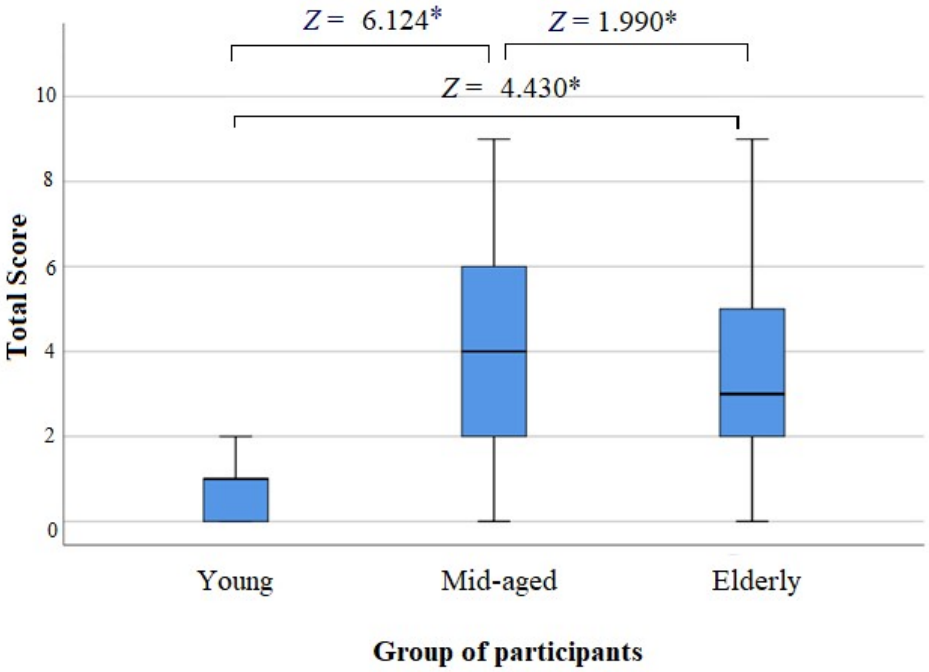
Figure 4.1: *The percentage of 'refer' in the 3 groups of participants*

The dependency of referral rate on age of the participant was tested using Chi-square test and the results showed a significant association between referral rate and age [χ^2(2)= 14.517, p<0.01]. The proportion across groups (Column proportion) was compared using Bonferroni's adjustment. The results showed that the referral rate in Young group was significantly lesser than the other two groups, while there was no significant difference between Mid-aged and Elderly group in their referral rate.

4.1.2 Comparison of total scores across the three groups

Table 4.2 shows the median and inter-quartile range of the total score obtained in the three groups of participants. The median score was highest in the Mid-aged

group followed by Elderly and Young groups. The groups were statistically compared using Kruskal-Wallis test and the results showed a significant group effect [χ^2 (2) = 37.673, $p<0.01$] on the median total score. Subsequently, the three groups were compared pair-wise using Mann-Whitney U test and it was found that the three groups were significantly different from each other ($p<0.05$).



Maximum Score= 12

Note: ** = Statistically significant*

Figure 4.2: *Median and IQR of the 3 groups of participants*

4.2 Results of the Question-wise Scores

Table 4.2 shows the referral rate of each group in each question. Among the 12 questions, in questions 1, 2, 3, 5, 7 and 10, the referral rate was highest in Mid-aged group; in questions 9 and 12, referral rate was highest in Young group and; in questions 4, 8, 9 and 11, and referral rate was highest in the Elderly group.

In each question, the groups were compared using Chi-square test. The results showed a significant group effect in question 2, 3, 5, 6, 7, and 11. The proportion across groups (Column proportion) was compared using Bonferroni's Adjustment. The results (depicted in Table 4.2) showed that in questions 1, 4, 8, 9, 10 and 12, there was no significant difference in the referral rate across the groups, while the referral rate varied significantly across groups in questions 2, 3, 5, 6, 7 and 11. The results can be summarized as follows:

a) In questions 2 and 7, the referral rate in Mid-aged group was significantly higher compared to that of Young and Elderly groups. The referral rate in Elderly groups was significantly higher than that in Young group.
b) In questions 3, 5, 6, and 11, the referral rate in Mid-aged and Elderly was significantly higher than that in Young group, while there was no significant difference between Mid-aged and Elderly groups in the referral rates.

Table 4.2: *Referral rate in the three groups of participants and the statistical results of group comparison of referral rates*

Question No.	Group	Referral Rate	χ^2
Question 1	Young	0.0[a]	6.542
	Mid-aged	11.1[a]	
	Elderly	3.1[a]	
Question 2	Young	3.0[a]	49.354*
	Mid-aged	76.4[b]	
	Elderly	56.9[c]	
Question 3	Young	0.0[a]	17.561*
	Mid-aged	38.9[b]	
	Elderly	34.4[b]	
Question 4	Young	6.1[a]	5.095
	Mid-aged	22.2[a]	
	Elderly	24.6[a]	
Question 5	Young	6.1[a]	12.141*
	Mid-aged	36.1[b]	
	Elderly	20[a,b]	
Question 6	Young	0.0[a]	27.983*
	Mid-aged	50[b]	
	Elderly	50[b]	
Question 7	Young	3.0[a]	43.359*
	Mid-aged	72.2[b]	
	Elderly	49.2[c]	
Question 8	Young	0.0[a]	3.152
	Mid-aged	8.3[a]	
	Elderly	9.2[a]	
Question 9	Young	24.2[a]	3.006
	Mid-aged	11.1[a]	
	Elderly	16.9[a]	
Question 10	Young	0.0[a]	7.550
	Mid-aged	13.9[a]	
	Elderly	4.6[a]	
Question 11	Young	0.0[a]	23.551*
	Mid-aged	44.4[b]	
	Elderly	46.2[b]	
Question 12	Young	6.1[a]	1.815
	Mid-aged	1.4[a]	
	Elderly	4.6[a]	

Note: **= $p<0.05$*
Each subscript letter denotes a subset of age groups whose column proportions do not differ significantly from each other at the 0.05 level.

CHAPTER 5

DISCUSSION

The study aimed to determine the effect of advancing age on the outcome of SCAP-A, which would in turn give an insight into the effect of age on central auditory processing abilities. The hypothesis of the study was that the Elderly group will have more deficits in the auditory processing compared to the Young and Mid-aged groups, therefore there would be higher referral rates in that group compared to the other groups. Different processes are tapped by SCAP-A, such as auditory separation/closure, auditory integration, temporal ordering, auditory memory, and attention. Each question taps on different processes. Hence, by comparing the questions it was expected that the deficits in the particular process will be indicated by the questions.

5.1 Agreement between Participant and Care Taker Responses

There were two different checklists of SCAP-A: one for the participants and the other for the care takers. But the questions were same. The purpose of administering questionnaire for care taker is that the information gleaned from the older adults at-risk for APD can be supplemented by the family members' opinions when the older adults are unable to provide meaningful feedback. We found significant agreement between responses of the participants and the care takers. The level of agreement ranged between 0.74 and 1.00 ($p<0.05$) for the 12 questions. This reflects that there are no discrepancies in the opinion of the two groups and the care takers have the similar thinking to the self perceptions of participants about their abilities to listen. A good agreement suggests that, if the responses of the participants

could not be reliably recorded, the responses of the care taker can serve as a reliable indicator.

5.2 Comparison of Referral Rate between the Two Genders

Krizman, Bonacina and Kraus (2021) compared adult males and females for their subcortical auditory processing, assessed using auditory evoked potentials elicited by a simple tone and a speech sound. They found that the auditory processing abilities of males were more affected than females and the findings hinted at males being more susceptible or at-risk for APD than females. Therefore, although not the objective of the study, the scores of SCAP-A were compared between the two genders to see the gender effect on the outcomes. An attempt was made to compare the referral rate between males and females. It was observed that there was a significant difference in the referral rates between the two genders: more in males than females. This suggests that males have higher probability of having APD than the females.

5.3 Comparison of Referral Rate between English and Kannada Version of SCAP-A

The outcome of SCAP-A in the two versions was compared to check the effect of language, if any on the responses of the participants. The two versions were compared for their referral rates. The results revealed that there was no significant difference between the two versions of SCAP-A (English & Kannada) in terms of the referral rate. This signifies that there was no language effect on the scores of the participants. This suggests that the language of administration doesn't influence the outcomes of SCAP-A. Therefore, SCAP-A can be administered in either language, based on the preference. In the current study, a subgroup of participants preferred Kannada version while the others preferred English versions. The absence of

significant difference between the two versions suggests that the data can be treated as that from a single cohort.

5.4 Effect of Advancing Age on Referral Rate

As the age advances, changes in the auditory processing are observed by the researchers, especially in acoustically complex conditions (Winglfield, 1996; van Rooij & Plomp, 1992). The other studies that compared the temporal resolution of older and younger adults reported that temporal processing was more affected in the older groups (Moore et al., 1992; Schneider et al., 1994; Snell, 1997). Based on these findings, in the current study it was hypothesized that the Elderly group will have more referral rate compared to the Young and Mid-aged groups. To verify the hypothesis, the outcome of SCAP-A was compared across the three participant groups.

A high referral rate would suggest higher probability of having APD. Results showed that the Young group had the lowest referral rate, but the Mid-aged and Elderly groups had high referral rates. This shows that, with advancing age the risk of APD may increase. These findings call for regular screening of older individuals for the presence of APD.

In adults, APD is most often the result of well-defined and detectable lesions of the central auditory nerve system (Musiek & Gollegly, 1988; Musiek & Hoffman, 1990). APD in older persons can also be caused by accumulated damage or degeneration of the central auditory nervous system due to ageing, neural injury, and/or neurodegenerative illness (Baran & Musiek, 1991). Elderly adults lose or get their previously intact processing functions disrupted due to the occurrence of central auditory processing disorder. Several studies have demonstrated that elderly adults

have more difficulty in understanding time compressed speech (Bergman, 1971; Winglfield et al., 1985), identifying the order of brief sounds (Humes & Christopherson, 1991) and discriminating the frequency of puretone as well as complex tones (Abel et al., 1990; Moore & Peters, 1992). The findings of current study although suggests higher risk of APD in elderly individuals, does not confirm APD, as the checklist is only a screening measure.

The study also compared the median total score of the three groups of participants. The findings showed that the median total score was different among the three groups and was high in Mid-aged group and Elderly group, indicating higher risk of APD in these groups. It is important to note that higher risk was found in mid-aged along with elderly group. The Mid-aged group had participants starting from 35 years of age. The findings suggest that there is higher risk of APD even at this age.

5.5 Relationship between Age and Each Question of SCAP-A

SCAP-A encompasses 12 questions and the effect of age on each question was assessed in the study. Question 1 assesses auditory memory and sequencing; 2 assesses auditory attention; 3 focuses on binaural separation; 4 examines temporal ordering, auditory memory and sequencing; 5 checks auditory memory; 6 assesses binaural separation; 7 throws light on auditory memory where the long term memory is assessed; 8 verifies auditory integration; 9 tests binaural separation and integration; 10 checks closure; 11 confirms auditory memory, temporal ordering and sequencing and the last question (12) assesses auditory attention of the participant. Question 1, 3, 4, 8, 9, 10 and 12 showed no age effect on the responses whereas there was a significant difference observed for question 2, 7, 5, 6 and 11. This means that auditory attention, auditory memory and sequencing, binaural separation and temporal

ordering showed the more referral rates in the elderly group compared to the other processes such as binaural integration and auditory closure.

The second question was regarding the attention of the participants; whether they can attend to a person speaking continuously for 10 or more minutes for example, listening to a conversation. For this question, there were 93 individuals (54.7%) who reported to have difficulties whereas remaining 77 could pay attention for more than 10 minutes to a person speaking continuously with them. The Young group was significantly different from the two groups and had the least referral rate (3%) whereas the Elderly group had 56.9% of referral rate and the Mid-aged had the highest referral rate of 76.4%. This question taps on auditory memory and attention processes and hence indicates that the Mid-aged and Elderly group faced significant difficulty in those two domains. These findings are supported by the findings of earlier studies, where they evaluated the effect of age on auditory brainstem response as a function of level, temporal modulation detection as a function of level, and background noise and spectral modulation as a function of level. They found a reduced wave I amplitudes and reduced amplitude ratios of Wave I and Wave V in older group **(**Grose, Buss & Elmore, 2019). Tun et al. (2010) manipulated the cognitive demands by presenting sentences of equivalent length and the response latencies for the two groups were noted down. They concluded that the response latencies to the correct comprehension judgments was more for the older participants than the young participants.

The fifth question of SCAP-A had a significantly high referral rate in Mid-aged and Elderly groups when compared with Young group and the difference was not significant between Mid-aged and Elderly groups. Question 5 talks about whether the participant forgets what was told to them within a short span of time, which means

that the question focuses on the auditory attention of the participant. The referred participants were more from Mid-aged and Elderly group. The findings reflect self-perception of the participants. Participants in Mid-aged and Elderly group feel they have short memory span.

The question 6 taps about the perception of speech in the presence of background noise and it was found that the Mid-aged group and the Elderly group had a higher referral rate than the Young group. Speech perception in noise is ability to understand speech in presence of background noise and it occurs with the help of process of auditory closure. India is a highly populated as well as noise polluted country. Majority of the listening situations contains presence of noise with the speech signal like the one in restaurants or in road traffic. Different listening environments such as office meeting, friend and family gatherings, parties, shopping, talking on telephone etc. will need auditory closure and separation to be highly active as the presence of noise will make the situation more demanding for the elderly population. They will have issues in separating the speech signal from the noise signal. The findings reflect the self-perception of adult and elderly about their auditory closure abilities.

Question 7 focuses on recollecting and recalling, which indirectly talks about memory of the participant. The question asked was whether they can recollect any 5 names of their school/ college friends whom they have not met in the last 30 years. Majority of the Mid-aged and Elderly group participants reported difficulty for this task. The referral rate was significantly different in each group and the rate was higher for Mid-aged (72.2%) followed by Elderly group (49.2%).

The 11th question of the checklist was that whether they have difficulty recalling the digits, for example: mobile numbers, vehicle numbers or account numbers. Here also, the question tapped on the auditory memory and sequencing ability of the participant and it was noticed that Mid-aged and Elderly group had a high referral rate compared to the Young group. The processes with more referrals are:

a. Auditory memory and sequencing
b. Binaural Separation
c. Attention
d. Closure

The processes with normal performance are auditory integration and temporal ordering.

Each question taps on different auditory processes mentioned above and whenever any of the questions show affected results, it is indicated that there might be some deficit in that particular process and the consequent condition is suspected. The study concluded that the Elderly and the Mid-aged groups had more referral rate than the Young group and the processes which showed more referrals for the Mid-aged and Elderly groups were binaural separation/closure, auditory memory and sequencing and attention.

Auditory processing deficits leave a big impact on the health and quality of life of the individual as it reduces the processing speed for the auditory stimuli and also affects the working memory and attention of the individual (Humes, 2007; Murphy et al., 2018). Persons with APD face difficulties with perception of speech as talking on telephones, talking to strangers, watching movies or TV shows, attending

meetings, shopping etc. (Heine & Slone, 2018). They also face problems such as depression and low confidence levels due to affected auditory processing abilities. Overall, it may impact the quality of life of the individual.

SCAP-A is a screening checklist for auditory processing disorder and can only suggest the risk for APD. It doesn't confirm APD. Yathiraj and Vaidyanath (2021) assessed the relationship between SCAP-A and the diagnostic test battery for APD. They found that the older people's responses to the checklist had a sensitivity and specificity of 69.05 % and 71.43 %, respectively. This hints at the accuracy of the current findings.

CHAPTER 6

SUMMARY AND CONCLUSIONS

In the elderly population, subclinical auditory impairment is known to be more prevalent. This can happen in the central or peripheral auditory systems, leading to deviant processing of the sensory input. By employing a checklist for screening auditory processing disorders (APD), one can learn more about the risk of APD, the possible signs and symptoms, and accordingly determine whether a comprehensive audiological evaluation is required or not. There are several checklists that have been established all around the world, but only a few of them are meant for adults; SCAP-A is one of them. A lot of research has been done to compare the findings of screening tests or checklists with outcomes of diagnostic evaluation, but relatively little research has been done to determine how age affects the results of screening tests. Therefore, the present study attempted to determine the effect of age on the results of SCAP-A, using a cross-sectional approach. This in turn would hint at the effect of advancing age on central auditory processing.

The checklist was administered on 170 adults with normal hearing either through direct and telephonic interviews. The participants belonged to one of the three age groups; Young, Mid-Aged, and Elderly. The checklist was also administered on one family member of each participant. The participants independently responded to each of the 12 questions in the checklist. The outcome measure was the referral rate in each group and for each question. The groups were also compared for their median rating. The AIISH hearing screening app was used to initially screen the participants, and those who passed the hearing screening were administered with SCAP-A. The

responses were recorded and using the Statistical Package for the Social Sciences (SPSS) version 20 software, the data was statistically analysed.

The results showed that referral rate was higher in Mid-aged and Elderly group compared to young group. The trend was similar in the median score. The item-wise analysis indicated that auditory memory and sequencing, binaural separation, attention, and auditory closure were the susceptible processes in the mid-aged and elderly. Whereas, processes like auditory integration and temporal ordering were unaffected. The referral rate was greater for men than for women, but when the English and Kannada versions of the SCAP-A were compared, there was no significant difference in the participants' performances. This suggests that there is no language effect on the outcome of SCAP-A. Considering that the sensitivity of SCAP-A is around 70%, higher referral rate and higher median score suggests that mid-aged and elderly groups are at higher risk for APD, warranting regular screening after the age of 35 years.

Implications of the Study

The findings of the study suggest higher risk of APD with advancing age. It suggests that individuals above 35 years have a significant risk of APD.

Limitations of the Study

The screening checklist only finds out the at-risk individuals and doesn’t confirm APD. Diagnostic testing of auditory processing in individuals identified as at-risk based on SCAP-A could have resulted in confirmatory findings and stronger inferences. However, it was not feasible due to pandemic situation.

Future Directions

1) One can attempt to explore the link between the results of SCAP-A and the psychological well-being of the individual.
2) Future studies can compare outcomes in SCAP-A and other screening tests and checklists to see the correlation among them.

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APPENDIX I

Kannada Version of Screening Checklist of Auditory Processing for Adults meant for the person being screened

Sl. ಸಂ.	ಪ್ರಶ್ನೆ
1.	ಮಾತಿನ ಸಮಸ್ಯೆ ಇಲ್ಲದವರ ಮಾತನ್ನು ಕೇಳುವಾಗ ನಿಮಗೆ ಪದೇ ಪದೇ ಪುನರಾವರ್ತನೆಗಳ ಅಗತ್ಯವಿದೆಯೇ?
2.	ಯಾರಾದರೂ 10 ನಿಮಿಷಗಳಿಗಿಂತ ಹೆಚ್ಚು ಕಾಲ ನಿರಂತರವಾಗಿ ಮಾತನಾಡುವುದನ್ನು ನೀವು ಗಮನಿಸಬಹುದೇ? ಉದಾ .ಸಂಭಾಷಣೆಯನ್ನು ಆಲಿಸುವುದು
3.	ಹಿನ್ನೆಲೆ ಶಬ್ದದ ಉಪಸ್ಥಿತಿಯಲ್ಲಿ ಭಾಷಣಕ್ಕೆ ಹಾಜರಾಗಲು ನಿಮಗೆ ಕಷ್ಟವಾಗುತ್ತಿದೆಯೇ? ಉದಾ .ಸಾಮಾನ್ಯ ಧ್ವನಿಯಲ್ಲಿ ದೂರದರ್ಶನ/ಅಧಿಕ ವೇಗದಲ್ಲಿ ಫ್ಯಾನ್.
4.	ಸರಿಯಾದ ಕ್ರಮದಲ್ಲಿ ಹೇಳಿದ್ದನ್ನು ನೆನಪಿಸಿಕೊಳ್ಳುವಲ್ಲಿ ನಿಮಗೆ ತೊಂದರೆ ಇದೆಯೇ? ಉದಾ .ನೀವು ಮಾಡಿದ ಕ್ರಮದಲ್ಲಿ 5 ವಿಭಿನ್ನ) ವಾಡಿಕೆಯಲ್ಲದ (ವಿಷಯಗಳನ್ನು
5.	ಸ್ವಲ್ಪ ಸಮಯದೊಳಗೆ) ಒಂದು ನಿಮಿಷದಲ್ಲಿ (ನಿಮಗೆ ಹೇಳಿದ್ದನ್ನು ನೀವು ಮರೆತುಬಿಡುತ್ತೀರಾ? ಉದಾ .ಅಂಗಡಿಯಿಂದ ನಿರ್ದಿಷ್ಟ ವಸ್ತುವನ್ನು ಖರೀದಿಸಲು.
6.	ಹಿನ್ನೆಲೆ ಶಬ್ದದ ಉಪಸ್ಥಿತಿಯಲ್ಲಿ) ಟೆಲಿವಿಷನ್/ಫ್ಯಾನ್ ಪೂರ್ಣ ವೇಗದಲ್ಲಿದ್ದಾಗ (ಭಾಷಣವನ್ನು ಅರ್ಥಮಾಡಿಕೊಳ್ಳಲು ನಿಮಗೆ ತೊಂದರೆ ಇದೆಯೇ?
7.	ನೀವು ಶಾಲೆ/ಕಾಲೇಜು ಬಿಟ್ಟ ನಂತರ ನೀವು ಭೇಟಿಯಾಗದ ನಿಮ್ಮ 5 ಶಾಲಾ/ಕಾಲೇಜು ಸ್ನೇಹಿತರ ಹೆಸರನ್ನು ನೀವು ನೆನಪಿಸಿಕೊಳ್ಳಬಹುದೇ?
8.	ನಿಮ್ಮ ಸ್ನೇಹಿತರು ಅಥವಾ ಕುಟುಂಬದವರು ನಿಮ್ಮೊಂದಿಗೆ ಮಾತನಾಡುವಾಗ ಪ್ರತಿಕ್ರಿಯಿಸಲು ನೀವು ಇತರರಿಗಿಂತ ಹೆಚ್ಚು ಸಮಯ ತೆಗೆದುಕೊಳ್ಳುತ್ತೀರಿ ಎಂದು ನಿಮಗೆ ಹೇಳಲಾಗಿದೆಯೇ?
9.	ಒಂದೇ ಸಮಯದಲ್ಲಿ ಇಬ್ಬರು ಮಾತನಾಡುವವರಿಗೆ ಪ್ರತಿಕ್ರಿಯಿಸಲು ನಿಮಗೆ ತೊಂದರೆ ಇದೆಯೇ? ಉದಾ .ಒಂದು ಗುಂಪಿನಲ್ಲಿ, ಇಬ್ಬರು ಒಂದೇ ಸಮಯದಲ್ಲಿ ಪ್ರಶ್ನೆಗೆ ಉತ್ತರಿಸಿದಾಗ/ಕೇಳಿದಾಗ.
10.	ನೀವು ಯಾರೊಬ್ಬರ ಮುಖವನ್ನು ನೋಡದಿದ್ದಾಗ ಅವರ ಭಾಷಣವನ್ನು ಅರ್ಥಮಾಡಿಕೊಳ್ಳುವುದು ಕಷ್ಟ ಎಂದು ನೀವು ಭಾವಿಸುತ್ತೀರಾ? ಉದಾ .ವ್ಯಕ್ತಿಯ ಮುಖವು ನಿಮ್ಮಿಂದ ದೂರವಾದಾಗ.
11.	ಸಂಖ್ಯೆಗಳು, ವಿಶೇಷವಾಗಿ ದೂರವಾಣಿ/ವಾಹನ /ಡೋರ್ ಸಂಖ್ಯೆಗಳು, ಬಸ್ ಸಂಖ್ಯೆಗಳು, ಖಾತೆ ಸಂಖ್ಯೆಗಳನ್ನು ನೆನಪಿನಲ್ಲಿಟ್ಟುಕೊಳ್ಳಲು ನಿಮಗೆ ತೊಂದರೆ ಇದೆಯೇ?
12.	ಅವರು ಇದ್ದಕ್ಕಿದ್ದಂತೆ ನಿಮ್ಮೊಂದಿಗೆ ಮಾತನಾಡಲು ಪ್ರಾರಂಭಿಸಿದಾಗ ನೀವು ಅವರಿಗೆ ಹಾಜರಾಗುವುದಿಲ್ಲ ಎಂದು ಇತರರು ವರದಿ ಮಾಡುತ್ತಾರೆಯೇ?

Kannada Version of Screening Checklist of Auditory Processing for Adults meant for the family members

Sl. ಸಂ.	ಪ್ರಶ್ನೆ
1.	ನೀವು ಅಥವಾ ಸ್ಪಷ್ಟವಾಗಿ ಮಾತನಾಡುವ ಯಾರಾದರೂ ಕೇಳುತ್ತಿರುವಾಗ ಅವಳು/ಅವನಿಗೆ ಪದೇ ಪದೇ ಪುನರಾವರ್ತನೆಗಳ ಅಗತ್ಯವಿದೆಯೇ?
2.	10ನಿಮಿಷಗಳಿಗಿಂತ ಹೆಚ್ಚು ಕಾಲ ನಿರಂತರವಾಗಿ ಮಾತನಾಡುವ ಯಾರಿಗಾದರೂ ಅವಳು / ಅವನು ಹಾಜರಾಗಬಹುದೇ?
3.	ಹಿನ್ನೆಲೆ ಶಬ್ದದ ಉಪಸ್ಥಿತಿಯಲ್ಲಿ ಭಾಷಣಕ್ಕೆ ಹಾಜರಾಗಲು ಅವಳು/ಅವನಿಗೆ ಕಷ್ಟವಾಗುತ್ತದೆಯೇ?
4.	ಸರಿಯಾದ ಕ್ರಮದಲ್ಲಿ ಹೇಳಿರುವುದನ್ನು ನೆನಪಿಸಿಕೊಳ್ಳುವಲ್ಲಿ ಅವಳು/ಅವನಿಗೆ ತೊಂದರೆ ಇದೆಯೇ? ಉದಾ 5 .ವಿಭಿನ್ನ) ವಾಡಿಕೆಯಲ್ಲದ (ವಿಷಯಗಳು ಸರಿಯಾದ ಕ್ರಮದಲ್ಲಿ.
5.	ಸ್ವಲ್ಪ ಸಮಯದೊಳಗೆ) ಒಂದು ನಿಮಿಷದಲ್ಲಿ (ಹೇಳಿದ್ದನ್ನು ಅವಳು / ಅವನು ಬೇಗನೆ ಮರೆತುಬಿಡುತ್ತಾನಾ? ಉದಾ .ಅಂಗಡಿಯಿಂದ ನಿರ್ದಿಷ್ಟ ವಸ್ತುವನ್ನು ಖರೀದಿಸಲು.
6.	ಹಿನ್ನೆಲೆ ಶಬ್ದದ ಉಪಸ್ಥಿತಿಯಲ್ಲಿ) ಟೆಲಿವಿಷನ್/ಫ್ಯಾನ್ ಪೂರ್ಣ ವೇಗದಲ್ಲಿದ್ದಾಗ (ಅರ್ಥಮಾಡಿಕೊಳ್ಳಲು ಅವಳು/ಅವನಿಗೆ ತೊಂದರೆ ಇದೆಯೇ?
7.	ಅವರು 30 ವರ್ಷಗಳಿಂದ ಭೇಟಿಯಾಗದ 5 ಸ್ನೇಹಿತರ ಹೆಸರನ್ನು ಅವಳು / ಅವನು ನೆನಪಿಸಿಕೊಳ್ಳಬಹುದೇ?
8.	ಕುಟುಂಬ/ಸ್ನೇಹಿತರೊಂದಿಗೆ ಹೋಲಿಸಿದರೆ ಹೇಳಿದ್ದಕ್ಕೆ ಪ್ರತಿಕ್ರಿಯಿಸಲು ಅವಳು/ಅವನು ಹೆಚ್ಚು ಸಮಯ ತೆಗೆದುಕೊಳ್ಳುತ್ತದೆಯೇ) ಬಹುತೇಕ ದುಪ್ಪಟ್ಟು ಸಮಯ (?
9.	ಬಹುತೇಕ ಒಂದೇ ಸಮಯದಲ್ಲಿ ಇಬ್ಬರು ವ್ಯಕ್ತಿಗಳು ಮಾತನಾಡುವುದಕ್ಕೆ ಪ್ರತಿಕ್ರಿಯಿಸಲು ಅವಳು/ಅವನಿಗೆ ತೊಂದರೆ ಇದೆಯೇ?
10.	ಮಾತನಾಡುವವರ ಮುಖ ಕಾಣದಿದ್ದಾಗ ಆಕೆ/ಅವನಿಗೆ ಭಾಷಣವನ್ನು ಅರ್ಥಮಾಡಿಕೊಳ್ಳಲು ತೊಂದರೆ ಇದೆಯೇ?
11.	ಅಂಕಿಗಳನ್ನು, ವಿಶೇಷವಾಗಿ ದೂರವಾಣಿ/ವಾಹನ/ಡೋರ್ ಸಂಖ್ಯೆಗಳು, ಬಸ್ ಸಂಖ್ಯೆಗಳು, ಖಾತೆ ಸಂಖ್ಯೆಗಳನ್ನು ನೆನಪಿಸಿಕೊಳ್ಳುವಲ್ಲಿ ಅವಳು/ಅವನಿಗೆ ತೊಂದರೆ ಇದೆಯೇ?
12.	ನೀವು ಅಥವಾ ಇತರರು ಇದ್ದಕ್ಕಿದ್ದಂತೆ ಅವಳ/ಅವನೊಡನೆ ಮಾತನಾಡಲು ಪ್ರಾರಂಭಿಸಿದಾಗ ಅವಳು/ಅವನು ನಿಮ್ಮೊಂದಿಗೆ ಅಥವಾ ಇತರರಿಗೆ ಹಾಜರಾಗುವುದಿಲ್ಲವೇ?

APPENDIX II

Agreement (Kappa Coefficient) between responses of participants and family members

Question	Young	Mid-aged	Elderly
Question 1	1.00#	0.93**	0.8*
Question 2	1.00#	1.00#	1.00#
Question 3	1.00#	0.94**	1.00#
Question 4	1.00#	0.96**	0.96**
Question 5	1.00#	0.84**	0.95**
Question 6	1.00#	1.00#	1.00#
Question 7	1.00#	1.00#	1.00#
Question 8	1.00#	1.00#	1.00#
Question 9	1.00#	1.00#	1.00#
Question 10	1.00#	1.00#	1.00#
Question 11	1.00#	0.74**	0.88**
Question 12	1.00#	1.00#	1.00#

Note: ***= p is <0.01; #= 100% agreement between the participants and caretakers*