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SPEECH, SPATIAL AND QUALITY OF HEARING IN ADOLESCENCE, ADULT AND GERIATRICS

DISSERTATION

Gopika B Kumar, Satish Kumaraswamy, Vini Abhijith Gupta
Dr. M.V. Shetty College of Speech and Hearing
Maladi Court, Kavoor, Mangalore-05
bkumargopika@gmail.com
Phone: 9447926419
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CHAPTER – 1

INTRODUCTION

Audition is rooted in the Latin verb *audire*, meaning "to hear" and was first used in late 16th century to refer to the power or sense of hearing. Among the five senses 'Hearing' is one of the most valuable senses which helps in communication and orienting us to the environment. https://www.merriam-webster.com/dictionary/audition

Auditory system is responsible for detecting sounds, sensing intensity, discriminating sound patterns, perceiving distance, direction and location of the sound source and for determining the quality of sounds. These features enable the use of hearing in the real world which includes alertness to sounds, monitoring the environment, recognizing and locating auditory events, monitoring and controlling one's own voice, appreciating auditory experiences, but primarily to understand the speech of others and communicate verbally in an effective manner.

Sound occurs around us virtually all time, through multiple sources and locations at different point of time. When sound is of importance, listener shifts his/her attention by moving eyes and head towards the source of sound and listens carefully. Thus, comprehends the sound and participate in communication. The auditory system deficits

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are integral to cascade of hearing, listening, comprehending & communicating. Although cognitive aspects of hearing have a substantial influence on how listeners function in everyday settings. Tonnesen & Steinmetz (1993)

Binaural hearing is superior to monaural hearing because binaural hearing increases signal loudness & improves sound quality, speech intelligibility in noise, and localization ability compared to monoaural hearing. The improvement in auditory perception when a person is listening with both ears is called the binaural advantage or binaural summation. The most important effect of binaural hearing, which greatly improves spatial orientation.

Spatial hearing, the capacity of the auditory system to interpret or exploit different spatial paths by which sounds may reach the head and deals with how people localize sound sources using binaural and monaural cues and how they use echoes and reverberation to tell about the nature of the listening space (Emanuel, Letowski, 2009). Using spatial hearing, the auditory system can determine the location of a sound source and 'unmask' sounds otherwise obscured by noise. It can also orient attention towards or away from a sound source.

Spatial ability is the capacity to understand reason and remember the spatial relation among objects or space. Speech spatial ability is hearing speech in variety of competing context in simultaneous speech streams. The reality of hearing in everyday life is reflected by speech spatial ability. Gatehouse & Noble (2004)

Speech, Spatial, and Quality of Hearing Scale (SSQ) Gatehouse and Noble (2004) developed a questionnaire to measure listener's self-reported ability to hear in a variety of situations. The questionnaire helps in assessing mainly three aspects of hearing: 1) Speech hearing 2) Spatial hearing 3) Quality of hearing.

Veliyakath, Shany and Gupta (2017) compared and found better auditory performance for speech spatial ability and quality of hearing on moderate to severe symmetrical sensorineural hearing loss.

Arun, Shany and Kumaraswamy (2017) studied the speech, spatial abilities and qualities of hearing scale in tea factory workers of different groups and concluded that there is

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significant difference between the subjects with normal hearing sensitivity, unilateral hearing loss & bilateral hearing loss.

George and Kumaraswamy (2018) studied speech, spatial abilities and qualities of hearing scale in moderate to severe sensorineural hearing loss using hearing aid since 2 years, and found that subjects using hearing aid bilaterally are being mildly affected.

Speech, Spatial, Quality of hearing Scale Gatehouse and Noble (2004) designed to measure range of hearing disabilities across several domains. Age-related declines in cognitive processing may contribute to spatial errors. Such difficulties are reported even by those who have relatively good audiograms that could be considered "normal" for their age. Murman (2015)

Audiological evaluation in clinical setups concentrates on presence or absence of hearing loss. Whereas hearing disability is not focused. The speech, spatial and quality of an individual are often overlooked and will help clinician to analyze the hearing disability and obtain detail information of an individual hearing and also how to use it effectively in rehabilitation. Majority literatures are focused on western context and are exclusively studied. Introduction of electronic gadgets like mobile phones possess challenge in SSQ for adolescence as well as adults and literature is not exclusively studied in Indian context. The present study was taken up to compare the speech, spatial abilities and quality of hearing in adolescence, adult and geriatrics and provide needed support for the individual to improve the quality of life and performance in daily routine.

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CHAPTER -2

REVIEW OF LITERATURE

Hearing, or Auditory perception, is the ability to perceive sound by detecting vibrations, changes in the pressure of the surrounding medium through time. The ability of human auditory system is to extract three-dimensional entropy about their speech sound environs by analyzing the acoustic signal received at their sound environment.

Sound events and auditory events are distinct in terms of time, space and other attributes (Blauert, 1997); that is, they occur only at particular times, at particular place, and with particular attributes. The concept of "spatial hearing" acquires its meaning in this context. Spatial hearing embraces the relationships between the locations of auditory events and other parameters- particularly those of sound events.

Spatial hearing is almost-entirely underpinned by 'binaural' hearing, the comparison of the signal at one ear with the other ear (Culling & Akeroyd, 2010). These comparisons are reflected in terms of differences between time and level and are termed interaural time difference and interaural level difference and are the basis of all binaural processing and are fundamental to nearly all spatial hearing.

Spatial orientation is the act of determining the position of a sound source in space and relationship between this position and position of listener. To identify both relative positions, listener needs to determine the direction from which the sound is coming and the distance of the sound source (Emanuel & Letowski, 2009). These two activities are auditory localization and auditory distance estimation.

Auditory localization is the process of judging the direction of an incoming sound. This process depends on binaural cues and monoaural cues, head movements, and familiarity with the sound source. Judging distance to a sound source depends on the intensity of the sound and properties of the sound that result from sound reflection, absorption by the air etc., and familiarity with the sound. (Emanuel & Letowski, 2009)

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Binaural cues are the interaural difference in intensity and time (phase) of sounds arriving to both ears. The interaural intensity difference (IID), also called inter aural level difference (ILD), results from different intensities of sounds arriving to both ears. These results from different intensities of sounds arriving to the left and the right ear. It is mainly caused by direction- and frequency –dependent diffraction of sound around the listener's head. (Culling and Akeroyd, 2010)

Binaural cues aid sound localization mainly along left –right axis of the listener in the horizontal plane. In addition to listening to sound source in a sound field, the listener may listen to sounds are usually localized inside the head. In this case recorded ("phantom") sound sources are usually localized inside the head. By changing the ITD or IID between signals arriving to the left and right ear, the phantom sound source can be moved within the head on an imaginary connecting both ears. The act of identifying the location of a phantom sound source within the head is called lateralization. https://www.ncbi.nlm.nih.gov/books/NBK3885/

Ageing possess a myriad of issues regarding the spatial abilities. Spatial hearing, which deals with how people localize sound sources using binaural and monoaural cues, and how they use echoes and reverberation to tell about the nature of the listening space. As age increases there will be declination in cognition and thus results in the degradation of spatial hearing. (Dobreva, O'Neil & Paige, 2012). During the rehabilitation process only hearing impairment is taken into account. Various self-assessing questionnaires have been developed to measure the effect of speech recognition, spatial hearing and quality of hearing.

Among them short version of Speech Spatial Quality of hearing (SSQ12) was developed by Noble, Jensen, Naylor, Bhullar & Akeroyd (2013). The SSQ12 was designed to measure self-perception of auditory disability in three domains:

1. Speech recognition.
2. Spatial hearing.
3. Qualities of hearing.

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It is separated into subscales such as speech in noise, speech in speech, listening effort, multiple speech streams, distance and movement, localization, segregation, listening effort and quality and naturalness.

In real world, sound sources are likely to occur from multiple direction and overlaps with each other, the sounds are also dynamic in nature, where sounds sources, moves around and change rapidly, such environments are often challenging. In such environment, listeners effective functioning is required to focus and identify the sounds (Galvin & Noble, 2013).

Western Studies

Noble, Byrne and Ter-Horst (1997) documented auditory localization, detection, of spatial ability, and speech hearing in noise in individuals with sensorineural hearing loss and conductive & mixed hearing loss. Measurements were made for single source localization and speech intelligibility in both spatially separate and non-separate noise. Localization test result showed disruption of vertical plane ability and horizontal plane localization in the conductive- mixed hearing loss.

Byrne, Sinclair &Noble (1998) documented that persons with a high frequency steeply sloping audiogram configuration could experience relatively more difficulties with spatial hearing and speech understanding in noise than persons with flat audiogram configuration.

Mackersie, Pride & Stiles (2001) determined the role of frequency selectivity and sequential stream segregation in perception of simultaneous sentences by listeners with Sensorineural hearing loss and result suggested that the ability to perceptually separate pitch pattern and separate sentence spoken simultaneously by different talkers are mediated by underlying perceptual and cognitive factors.

Gatehouse and Noble (2004) designed the speech spatial and qualities of hearing scale (SSQ) to measure a range of hearing disabilities across several domains. Importance given to hearing speech in variety of competing context, and to directional, distance and movement components of spatial hearing. Results implicated that aspect of temporal and

spatial dynamics in the experience of handicap and hearing disability. The SSQ shows promise as an instrumental for evaluating interventions of various kinds.

Gatehouse and Noble (2004) documented the speech spatial and qualities of hearing scale (SSQ) on interaural asymmetry of hearing loss. Result showed that spatial hearing was severely disabled in the group with asymmetry across all domains. Hence SSQ shows promise in assessment of outcomes in case of bilateral versus unilateral amplification and implantation.

Noble and Gatehouse (2006) studied the effect of unilateral versus bilateral hearing aid fitting on abilities measured by speech spatial and qualities of hearing scale (SSQ) and the result showed that hearing speech in demanding context showed benefit with the one aid and further benefit with two in spatial domain, directional hearing showed some benefit with one aid , and particular benefit with one aid in quality domain and benefit with respect to listening effort was with bilateral fitting.

Douglas, Yeung, Daudia, Gatehouse, and Donoghue (2007) did a study where the objective was to use speech, spatial and qualities of hearing scale (SSQ), to characterize and quantify the auditory disabilities that profound unilateral hearing loss patients experience after acoustic neuroma removal. Result showed the greatest difficulty was speech in presence of noise, situations of multiple speech streams and switching location of unseen objects and increase listening efforts.

Litovsky, Parkinson and Arcaroli (2009) measured spatial hearing and speech intelligibility in bilateral cochlear implant users. Result revealed that during the early stages of bilateral hearing through cochlear implants in post lingually deafened adults, there is an early emergence of spatial hearing skills. Although nearly all subjects can discriminate source location to the right versus left, less than half are able to perform the more difficult task of identifying source locations in a multispeaker array. Benefits for speech intelligibility with one versus two implants improve with time, in particular when spatial cues are used to segregate speech and competing noise. Localization and speech-in-noise abilities in this group of patients are somewhat correlated.

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Noble, Jensen, Nayler, Buller and Akeroyd (2013) develop and evaluate 12 item versions of speech, spatial, and qualities of hearing scale for use in clinical rehabilitation setting and results revealed similar results to SSQ of 49 question version.

Banh, Jessica, Singh, Gurjit, Fuller and Kathleen (2012) investigated age affects response on speech spatial qualities of hearing by adults with minimal audiometric hearing loss and documented that younger adults scored better compared to older adults, these results provide clinicians with information that should assist them in setting realistic targets for interventions for adults of different ages.

Glyde, Cameron, Dillon, Hickson and Seeto (2013) investigated the effect of ageing and hearing impairment on spatial processing and thus revealed that some degree of spatial processing deficit will be present. This should be considered when counselling patients in regard to realistic background noise.

Dwyer, Firszt, and ruder (2014) did a study on unilateral listeners by using Speech, Spatial Qualities of hearing scale (SSQ) to evaluate effects of hearing mode in everyday communication. Results revealed adults irrespective of better ear hearing mode, including those with normal hearing ear, are at disadvantage in all aspects of everyday listening and communication.

Voss (2016) explained auditory spatial perception with late onset visual blind individuals and documented that early visual experience plays a role in the development of both spatial hearing enhancements and deficits.

Indian Studies

Veliyakath, Shany& Gupta (2017) assessed the speech, spatial and quality of hearing scale in moderate to severe symmetrical and asymmetrical sensorineural hearing loss of Kannada speakers and study revealed that no significant difference, but had better auditory performance on symmetrical sensorineural hearing loss.

Arun, Shany & Kumaraswamy (2017) studied the speech, spatial and quality of hearing scale in tea factory workers of different groups including normal hearing sensitivity, unilateral and bilateral mild to moderate hearing loss and documented that the disability measures majorly affected in individuals with bilateral hearing loss.

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George & Kumaraswamy (2018) studied speech, spatial and quality of hearing scale in Malayalam speaking individuals with bilateral moderate to severe sensorineural hearing loss using hearing aid since 2 years, and results documented that subjects using hearing aid bilaterally are mildly affected.

Need of the Study

Audiological evaluation in clinical setups concentrates on presence or absence of hearing loss. Whereas hearing disability is not focused. The speech, spatial and quality of an individual are often overlooked and will help clinician to analyze the hearing disability and obtain detail information of an individual hearing and also how to use it effectively in rehabilitation.

Majority literatures are focused on western context and are exclusively studied speech, spatial, quality in geriatric population. Introduction of electronic gadgets like mobile phones possess challenge in SSQ for adolescence as well as adults and literature is not exclusively studied in Indian context. The present study was taken up to compare the speech, spatial abilities and quality of hearing in adolescence, adults and geriatrics and provide needed support for the individual to improve the quality of life and performance in daily routine.

Aim of the Study

The aim of the study was to compare the speech, spatial ability and quality of hearing in different age groups i.e., adolescence, adults and geriatrics with normal hearing sensitivity.

Objectives

1. To compare the speech, spatial and quality of hearing in different age groups - i.e., Adolescence, adult and geriatrics with normal hearing sensitivity.
2. To compare across speech, spatial and quality of hearing in different age groups - i.e., Adolescence, adult and geriatrics with normal hearing sensitivity.

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CHAPTER-3

METHODOLOGY

The aim of the study was to compare the speech, spatial ability and quality of hearing in different age groups i.e., adolescence, adult and geriatrics with normal hearing sensitivity.

Subjects

A total of 90 typical Malayalam speakers with no history of hearing loss where further divided into three groups:

Group1: 30 Adolescence in the age range of 13 -18 years with mean of 15.5.

Group2:30 Adults in the age range of 19 – 59years with mean of 39.

Group3: 30 Geriatrics in the age range of 60-65 years with mean of 62.5.

Inclusion Criteria

- Subjects with age range 13 to 65 years.
- Subjects with normal hearing sensitivity.
- Subject with normal motor, sensory skills.
- Subjects with no history of tinnitus and vertigo.

Exclusion Criteria

- Subjects having either congenital or acquired hearing loss.
- Subjects with ear anomalies.
- Subject with neurological issues.
- Special population like intellectual disability

Materials

The Speech Spatial Quality questionnaire (SSQ12) given by Noble & Gatehouse (2013), with 12 questions based on speech in noise, speech in speech, hearing in multiple speech streams, localization, distance and movement, segregation, identification of sound, quality and naturalness, and listening effort. The questionnaire was translated into Malayalam by a Malayalam professor who is in teaching profession for more than 20

years and is proficient in Malayalam and English. Later, it was validated by 5 audiologists who were proficient in Malayalam and English and final questionnaire was used for the study.

Procedure

90 subjects were informed regarding aim and procedure of the study and prior consent was obtained. They were also given a short introduction on Speech, Spatial Quality of hearing (SSQ)-12 questionnaire and given a time period of 20 minutes to complete the questionnaire and were asked to rate each question between 0 to 10 on a visual analog scale, where 0 was difficulty and 10 was no difficulty.

Analysis

Self-rating score obtained from the individuals were analysed and the result are discussed in the next chapter.

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CHAPTER-4

RESULT AND DISCUSSION

The present study aimed to assess the disability associated with speech, spatial and quality of hearing in different age groups i.e., Adolescence, adult, geriatrics with normal hearing sensitivity. The obtained data was statistically analyzed by ANOVA taking age as a variant and group wise comparison was done by Bonferroni test to compare speech, spatial quality of hearing in three different age groups. The results are discussed below.

1. Comparison of Speech, spatial quality of hearing (SSQ) questionnaire in different age groups.

Q1.	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA test p value	
				Lower Bound	Upper Bound		
ADOLESCENCE	30	8.90	.803	8.60	9.20	.000	HS
ADULT	30	8.47	1.196	8.02	8.91		
GERIATRIC	30	6.93	.907	6.59	7.27		
Total	90	8.10	1.290	7.83	8.37		

Table 4.1 Showing the mean and standard deviation of SSQ questionnaire for question no: 1 in three different age groups.

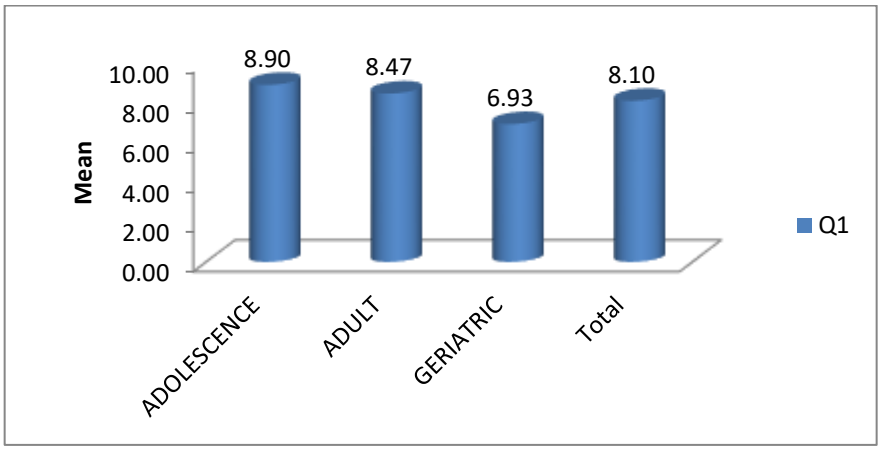

Fig 4.1 Showing the mean scores of SSQ questionnaire for question 1 in three different age groups.

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From Table 4.1 & Figure 4.1 it is clear that SSQ values for adolescence, adults, geriatrics was 8.90, 8.47 and 6.93 respectively. The ANOVA test reveals a highly significant difference for question 1(p= .000) among the three groups.

Q2	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA test p value	
				Lower Bound	Upper Bound		
ADOLESCENCE	30	8.27	.907	7.93	8.61	.000	HS
ADULT	30	7.47	1.074	7.07	7.87		
GERIATRIC	30	6.43	1.406	5.91	6.96		
Total	90	7.39	1.363	7.10	7.67		

Table 4.2 Showing the mean and standard deviation of SSQ questionnaire for question no: 2 in three different age groups.

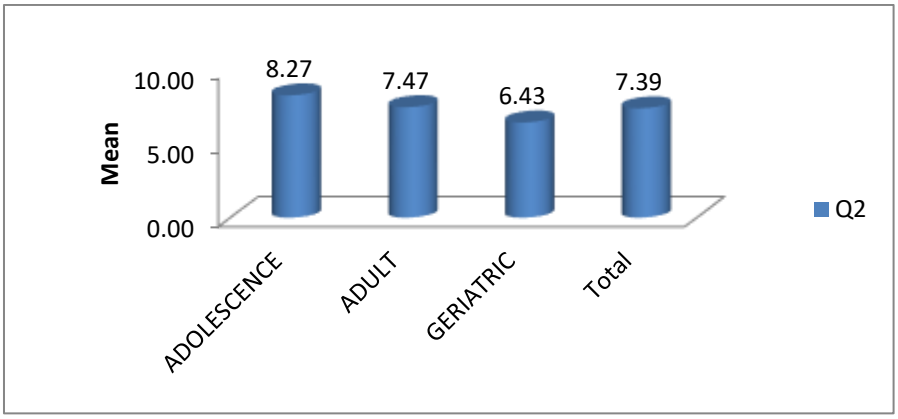

Fig 4.2 Showing the mean scores of SSQ questionnaire for question 2 in three different age groups.

From Table 4.2 & Figure 4.2 it is clear that SSQ values for adolescence, adult, geriatric was 8.27, 7.47 and 6.43 respectively. The ANOVA test reveals a highly significant difference for question 2(p= .000) among the three groups.

Q3	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA test p value	
				Lower Bound	Upper Bound		
ADOLESCENCE	30	8.87	.937	8.52	9.22	.000	HS
ADULT	30	8.17	1.177	7.73	8.61		
GERIATRIC	30	7.23	1.357	6.73	7.74		
Total	90	8.09	1.338	7.81	8.37		

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Table 4.3 Showing the mean and standard deviation of SSQ questionnaire for question no: 3 in three different age groups.

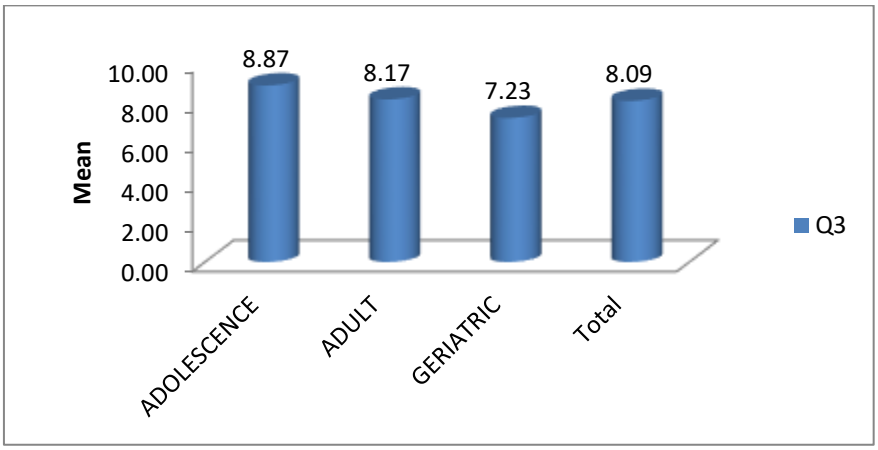

Fig 4.3 Showing the mean scores of SSQ questionnaire for question 3 three different age groups.

From Table 4.3 & Figure 4.3 it is clear that SSQ values for adolescence, adult, geriatric was 8.87, 8.17 and 7.23 respectively. The ANOVA test reveals a highly significant difference for question 3(p= .000) among the three groups.

Q4	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA test p value	
				Lower Bound	Upper Bound		
ADOLESCENCE	30	8.17	1.020	7.79	8.55	.000	HS
ADULT	30	7.63	.890	7.30	7.97		
GERIATRIC	30	6.20	1.730	5.55	6.85		
Total	90	7.33	1.507	7.02	7.65		

Table 4.4 Showing the mean and standard deviation of SSQ questionnaire for question no: 4 in three different age groups.

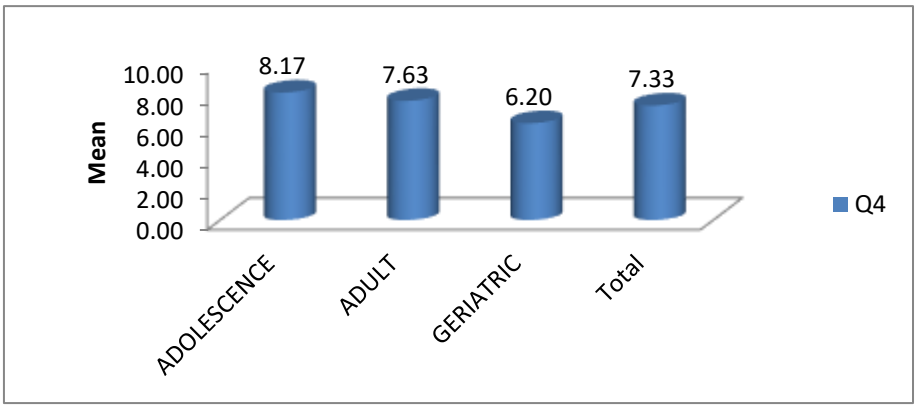

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Fig 4.4 Showing the mean scores SSQ questionnaire for question 4 three different age groups.

From Table 4.4 & Figure 4.4 it is clear that SSQ values for adolescence, adult, geriatric was 8.17, 7.63 and 6.20 respectively. The ANOVA test reveals a highly significant difference for question 4(p= .000) among the three groups.

Q5	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA test p value	
				Lower Bound	Upper Bound		
ADOLESCENCE	30	8.63	.999	8.26	9.01	.000	HS
ADULT	30	7.17	1.147	6.74	7.60		
GERIATRIC	30	6.37	1.520	5.80	6.93		
Total	90	7.39	1.548	7.06	7.71		

Table 4.5 Showing the mean and standard deviation of SSQ questionnaire for question no: 5 in three different age groups.

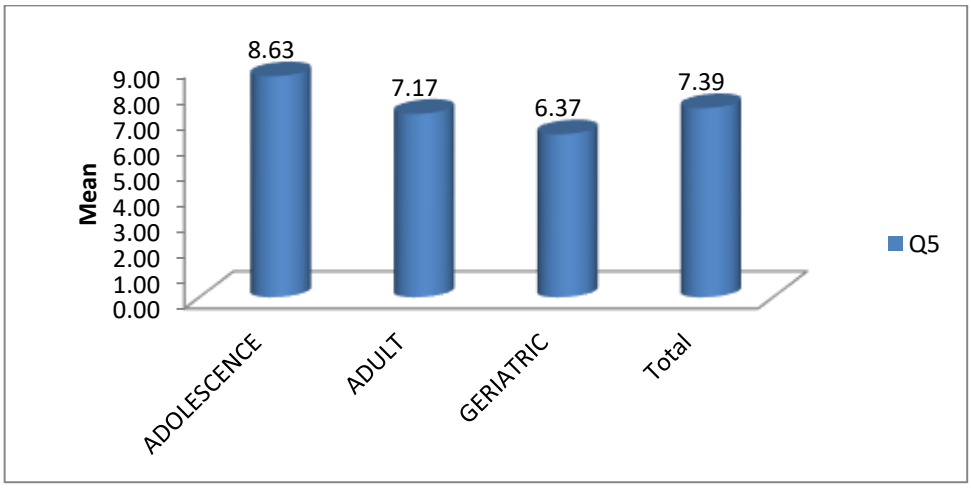

Fig 4.5 Showing the mean scores of SSQ questionnaire for question 5 three different age groups.

From Table 4.5 & Figure 4.5 it is clear SSQ values for adolescence, adult, geriatric was 8.63, 7.17 and 6.37 respectively. The ANOVA test reveals a highly significant difference for question 5(p= .000) among the three groups.

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Q6	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA test p value	
				Lower Bound	Upper Bound		
ADOLESCENCE	30	8.97	.928	8.62	9.31	.004	HS
ADULT	30	8.67	.959	8.31	9.02		
GERIATRIC	30	7.83	1.840	7.15	8.52		
Total	90	8.49	1.384	8.20	8.78		

Table 4.6 Showing the mean and standard deviation of SSQ questionnaire for question no: 6 in three different age groups.

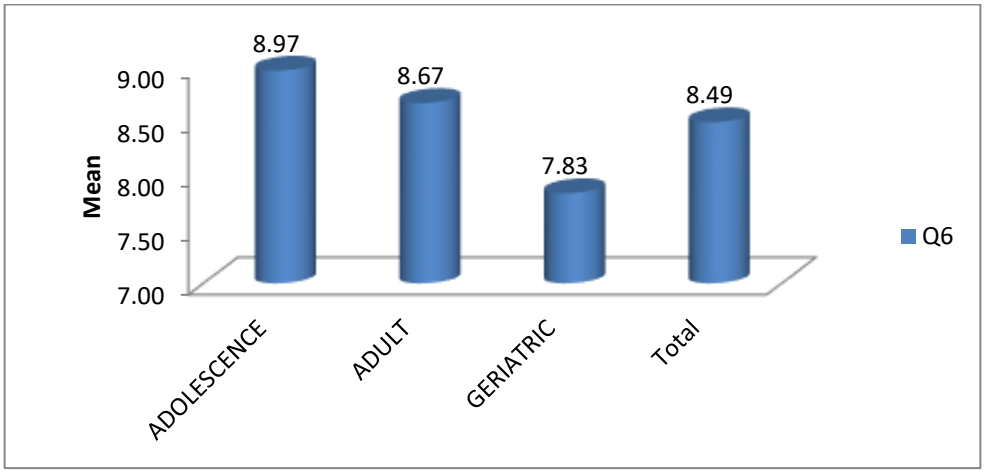

Fig 4.6 Showing the mean scores SSQ questionnaire for question 6 in three different age groups.

From Table 4.6 & Figure 4.6 it is clear SSQ values for adolescence, adult, geriatric was 8.97, 8.67 and 7.83 respectively. The ANOVA test reveals a highly significant difference for question 6(p= .000) among the three groups.

Q7	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA test p value	
				Lower Bound	Upper Bound		
ADOLESCENCE	30	8.90	.960	8.54	9.26	.000	HS
ADULT	30	8.40	1.163	7.97	8.83		
GERIATRIC	30	7.47	1.613	6.86	8.07		
Total	90	8.26	1.395	7.96	8.55		

Table 4.7 Showing the mean and standard deviation of SSQ questionnaire for question no: 7 in three different age groups.

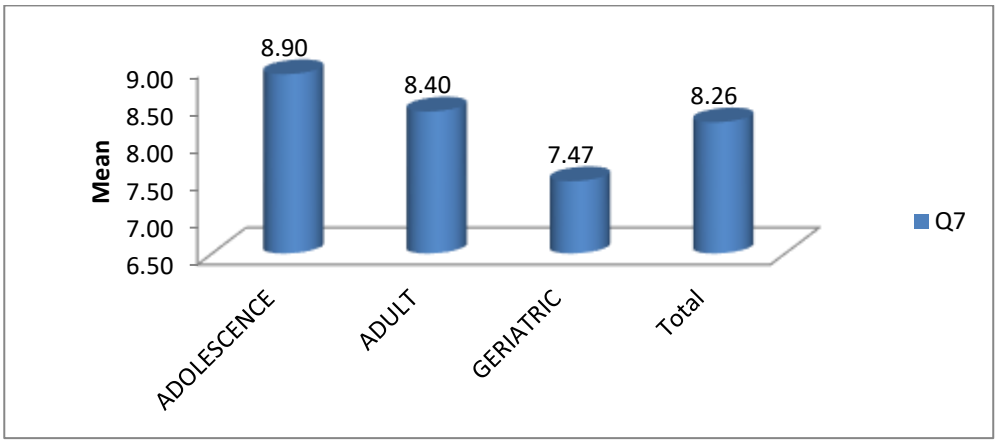

Fig 4.7 Showing the mean scores of SSQ questionnaire for question 7 in three different age groups.

From Table 4.7 & Figure 4.7 it is clear that SSQ values for adolescence, adult, geriatric was 8.90, 8.40 and 7.47 respectively. The ANOVA test reveals a highly significant difference for question 7(p= .000) among the three groups.

Q8	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA test p value	
				Lower Bound	Upper Bound		
ADOLESCENCE	30	8.90	.923	8.56	9.24	.007	HS
ADULT	30	8.73	1.202	8.28	9.18		
GERIATRIC	30	7.90	1.626	7.29	8.51		
Total	90	8.51	1.343	8.23	8.79		

Table 4.8 Showing the mean and standard deviation of SSQ questionnaire for question no: 8 in three different age groups.

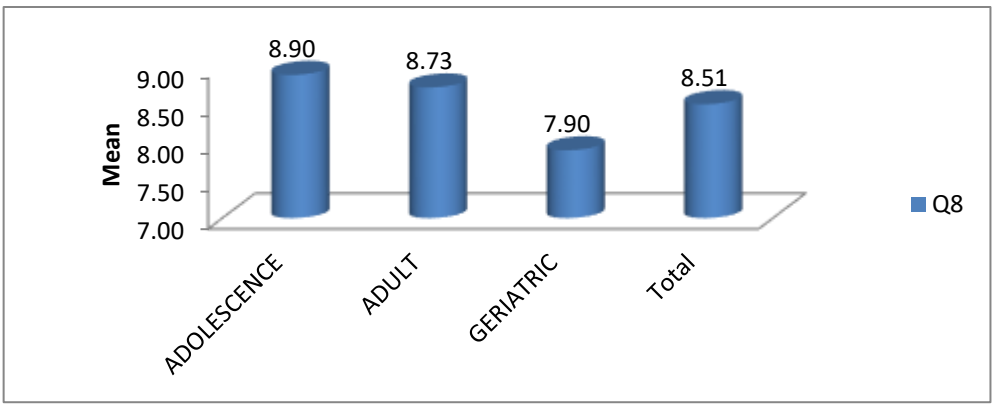

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Fig 4.8 Showing the mean scores SSQ questionnaire for question 8 in three different age groups.

From Table 4.8 & Figure 4.8 it is clear that SSQ values for adolescence, adult, geriatric was 8.90, 8.73 and 7.90 respectively. The ANOVA test reveals a highly significant difference for question 8(p= .000) among the three groups.

Q9	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA test p value	
				Lower Bound	Upper Bound		
ADOLESCENCE	30	8.93	.944	8.58	9.29	.000	HS
ADULT	30	8.67	1.155	8.24	9.10		
GERIATRIC	30	7.40	1.831	6.72	8.08		
Total	90	8.33	1.507	8.02	8.65		

Table 4.9 Showing the mean and standard deviation of SSQ questionnaire for question no: 9 in three different age groups.

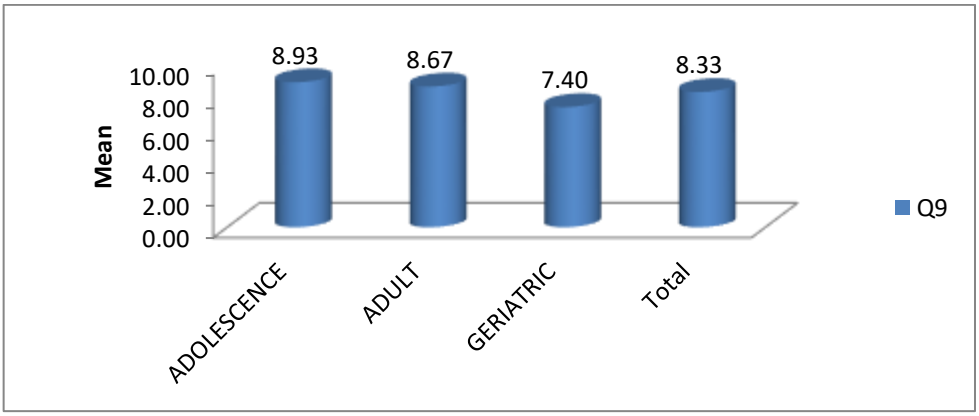

Fig 4.9 Showing the mean scores SSQ questionnaire for question 9 in three different age groups.

From Table 4.9 & Figure 4.9 it is clear that SSQ values for adolescence, adult, geriatric was 8.93, 8.67 and 7.40 respectively. The ANOVA test reveals a highly significant difference for question 9(p= .000) among the three groups.

Q10	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA test p value	
				Lower Bound	Upper Bound		
ADOLESCENCE	30	9.03	.765	8.75	9.32	.000	HS
ADULT	30	8.50	1.106	8.09	8.91		
GERIATRIC	30	7.43	1.455	6.89	7.98		
Total	90	8.32	1.314	8.05	8.60		

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Table 4.10 Showing the mean and standard deviation of SSQ questionnaire for question no: 10 in three different age groups.

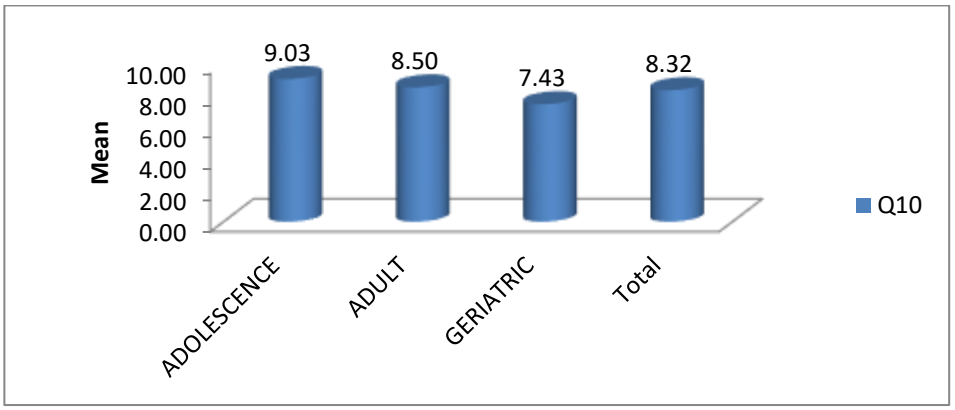

Fig 4.10 Showing the mean scores of SSQ questionnaire for question 10 in three different age groups.

From Table 4.10 & Figure 4.10 it is clear that SSQ values for adolescence, adult, geriatric was 9.03, 8.50 and 7.43 respectively. The ANOVA test reveals a highly significant difference for question 10(p= .000) among the three groups.

Q11	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA test p value	
				Lower Bound	Upper Bound		
ADOLESCENCE	30	9.00	.743	8.72	9.28	.000	HS
ADULT	30	8.73	.944	8.38	9.09		
GERIATRICS	30	8.03	1.033	7.65	8.42		
Total	90	8.59	.993	8.38	8.80		

Table 4.11 Showing the mean and standard deviation of SSQ questionnaire for question no: 11 in three different age groups.

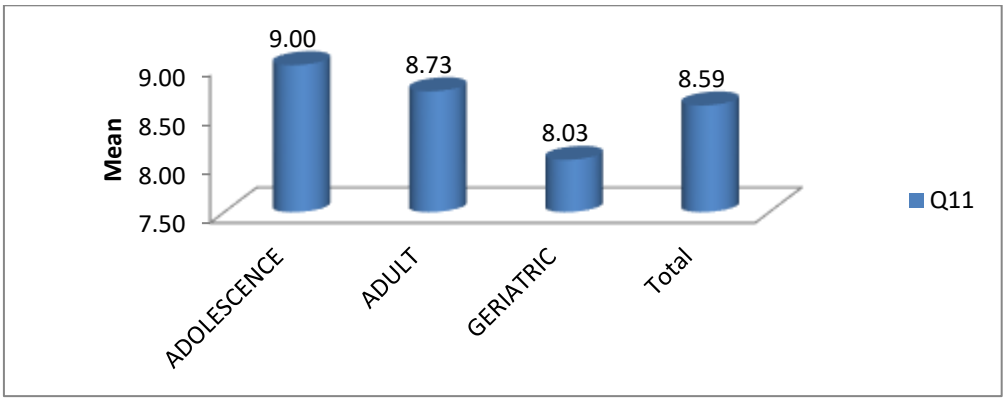

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Fig 4.11 Showing the mean scores of SSQ questionnaire for question 11 in three different age groups.

From Table 4.11 & Figure 4.11 it is clear that SSQ values for adolescence, adult, geriatric was 9.00, 8.73 and 8.03 respectively. The ANOVA test reveals a highly significant difference for question 11(p= .000) among the three groups.

Q12	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA test p value	
				Lower Bound	Upper Bound		
ADOLESCENCE	30	8.93	.740	8.66	9.21	.000	HS
ADULT	30	8.30	1.368	7.79	8.81		
GERIATRIC	30	7.67	1.269	7.19	8.14		
Total	90	8.30	1.258	8.04	8.56		

Table 4.12 Showing the mean and standard deviation of SSQ questionnaire for question no: 12 in three different age groups

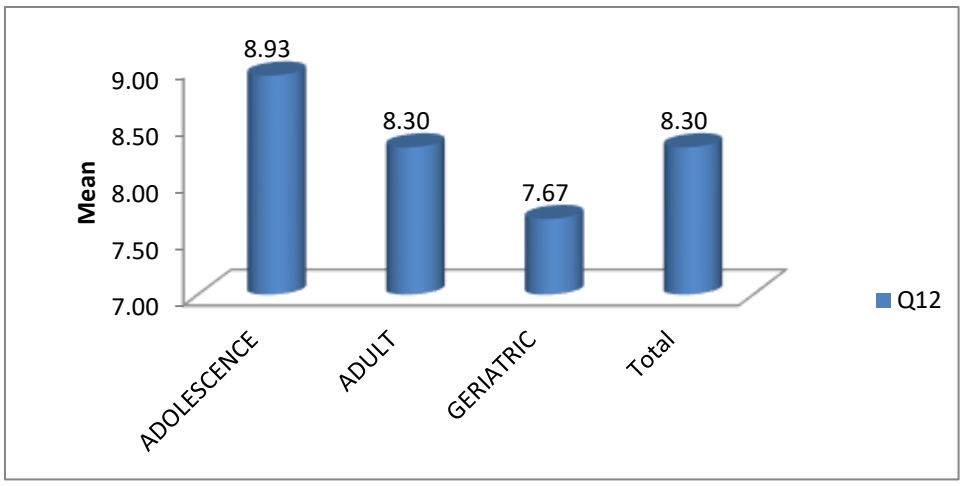

Fig 4.12 Showing the mean scores of SSQ questionnaire for question 12 in Adolescence, adult, geriatric.

From Table 4.12 & Figure 4.12 it is clear that SSQ values for adolescence, adult, geriatric was 8.93, 8.30 and 7.67 respectively. The ANOVA test reveals a highly significant difference for question 12(p= .000) among the three groups.

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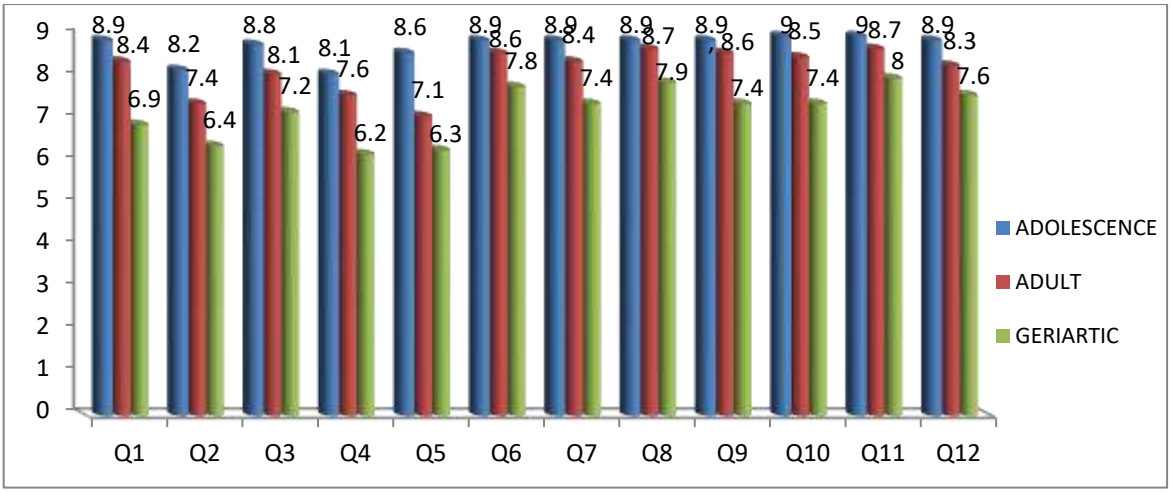

Figure 4.13: Showing the mean scores of SSQ questionnaire from question 1 to 12 in three different age groups.

Areas of SSQ	Mean		
	Adolescence	Adult	Geriatric
Speech in noise	8.5	8	8.2
Multiple speech streams	8.6	7.1	6.3
Speech in speech	8.8	8.1	7.2
Localization	8.9	8.6	7.8
Distance and movement	8.9	8.5	7.6
Identification of sound	9	8.5	7.4
Segregation	8.9	8.6	7.4
Quality and naturalness	9	8.7	8
Listening effort	8.9	8.3	7.6

Table 4.13: Showing the mean scores for areas of SSQ questionnaire in adolescence, adult and geriatric.

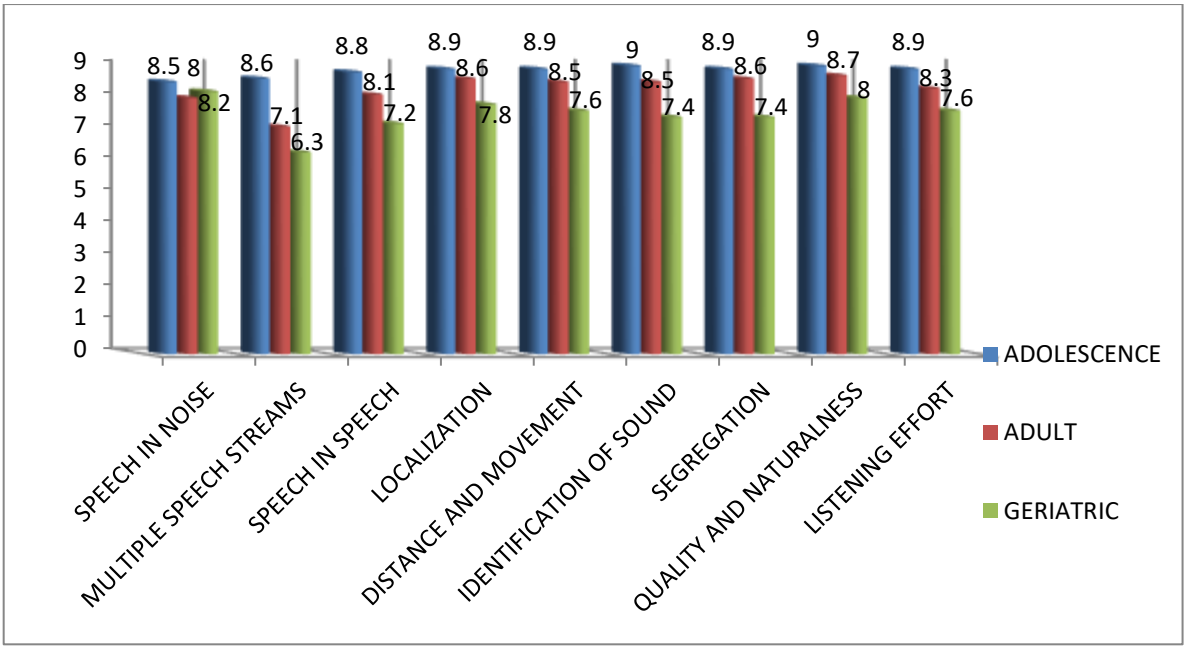

Fig4.14: Showing the mean scores for areas of SSQ Questionnaire in three different age groups.

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SSQ questionnaire			Mean Difference	Std. Error	p
Q1	ADOLESCENCE	ADULT	.433	.254	.274
		GERIATRIC	1.967	.254	.000
	ADULT	GERIATRIC	1.533	.254	.000
Q2	ADOLESCENCE	ADULT	.800	.296	.025
		GERIATRIC	1.833	.296	.000
	ADULT	GERIATRIC	1.033	.296	.002
Q3	ADOLESCENCE	ADULT	.700	.302	.068
		GERIATRIC	1.633	.302	.000
	ADULT	GERIATRIC	.933	.302	.008
Q4	ADOLESCENCE	ADULT	.533	.327	.321
		GERIATRIC	1.967	.327	.000
	ADULT	GERIATRIC	1.433	.327	.000
Q5	ADOLESCENCE	ADULT	1.467	.321	.000
		GERIATRIC	2.267	.321	.000
	ADULT	GERIATRIC	.800	.321	.043
Q6	ADOLESCENCE	ADULT	.300	.339	1.000
		GERIATRIC	1.133	.339	.004
	ADULT	GERIATRIC	.833	.339	.048
Q7	ADOLESCENCE	ADULT	.500	.329	.397
		GERIATRIC	1.433	.329	.000
	ADULT	GERIATRIC	.933	.329	.017
Q8	ADOLESCENCE	ADULT	.167	.331	1.000
		GERIATRIC	1.000	.331	.010
	ADULT	GERIATRIC	.833	.331	.041
Q9	ADOLESCENCE	ADULT	.267	.352	1.000
		GERIATRIC	1.533	.352	.000
	ADULT	GERIATRIC	1.267	.352	.002
Q10	ADOLESCENCE	ADULT	.533	.295	.223
		GERIATRIC	1.600	.295	.000
	ADULT	GERIATRIC	1.067	.295	.002
Q11	ADOLESCENCE	ADULT	.267	.236	.786
		GERIATRIC	.967	.236	.000
	ADULT	GERIATRIC	.700	.236	.012
Q12	ADOLESCENCE	ADULT	.633	.299	.111
		GERIATRIC	1.267	.299	.000
	ADULT	GERIATRIC	.633	.299	.111

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Table 4.14: Showing the mean scores for multiple comparison of SSQ in three different age groups.

DISCUSSION

The above results indicated that there is significant difference between adolescence, adult and geriatric. But the mean difference are higher in geriatric i.e.; highly significant difference compared to adolescence and adult. In speech, spatial and quality of hearing scale adolescence scored poorly for question speech in noise with a mean score of 8.5 followed by multiple speech streams (8.6), speech in speech (8.8), localization (8.9), distance and movement (8.9), segregation (8.9), listening effort (8.9) identification of sound (9) and quality of naturalness (9). Adult performed poorly in multiple speech streams with a mean score of 7.1 followed by speech in noise (8), speech in speech (8.1), listening effort (8.3), distance & movement (8.5), identification of sound (8.5), segregation (8.6), localization (8.6), and quality of naturalness (8.7). Geriatric performed poorly in multiple speech streams with a mean score of 6.3 followed by speech in speech (7.2), identification of sound (7.4), segregation (7.4), distance and movement (7.6), listening effort (7.6), localization (7.8) quality and naturalness (8) and speech in noise (8.2). Resulting that speech spatial and quality of hearing is more affected in geriatric.

The present study is in accordance with Banh, Jessica and Singh (2012) who studied age affects response on speech, spatial and quality of hearing with minimal audiometric hearing loss showed better SSQ score for younger adults compared to older adults.

Result suggests that disability measures provide additional information about hearing status compared to behavioural impairment measures. The speech, spatial and quality of an individual are often overlooked and will help the clinician to analyze the hearing disability and obtain detail information of an individual hearing and also how to use it effectively in rehabilitation.

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CHAPTER – 5

SUMMARY AND CONCLUSION

Auditory perception is the ability to identify, interpret and attach meaning to sounds. Auditory system serves other progeny besides hearing, such as localization of sound, identification of sound, sensing intensity, discriminating sound patterns, perceiving distance, direction and emplacement of the sound source, and for determining the quality of sounds.

Age related decline in cognitive functions such as "working memory" and "speed of processing" might affect auditory perception even the introduction of electronic gadgets like mobile phones possess challenge in speech spatial abilities and quality of hearing for adolescence as well as adults.

The need of the study is to compare the speech, spatial abilities and quality of hearing in adolescence, adults and geriatrics with normal hearing sensitivity and provide needed support for the individual to improve the quality of life and performance in daily routine.

Total of 90 subjects with age range of 13 to 65 with normal hearing sensitivity further divided into adolescence, adult, geriatric, were considered for the study. All the individuals were informed regarding aim and procedure of the study an asked to mark response between 0 – 10 on a visual analog scale and prior consent was obtained and were asked to complete SSQ-12 questionnaire given by Noble & Gatehouse (2004) which was translated and validated to Malayalam.

The results indicate that there is significant difference between adolescence, adults and geriatrics. The mean scores are lesser in geriatric when compared to adolescence and adult with normal hearing sensitivity. Overall results indicate that speech spatial and quality of hearing are majorly affected in geriatric. The most important changes in cognition with normal aging declines in performance on cognitive tasks that require one to quickly process or transform information to make a decision, including measures of speed of processing, working memory, and executive cognitive function may be the reason to affect speech, spatial and quality of hearing.

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In summary, disability measures offer additional information concerning hearing status compared to behavioural impairment measures. The speech, spatial and quality of life are typically unmarked and can facilitate the clinician to investigate the hearing disability and acquire detail data of an individual hearing and conjointly the way to use it effectively in rehabilitation.

Limitations of the Study

- Equal proportion of gender was not available.
- The number of participants for the study was less.

Future Implications

- The questionnaire can be translated to different languages.
- The study can be conducted on different type and degree of hearing loss.
- The study can be carried out across genders.
- The study can be conducted on people with central auditory processing disorders.
- The study can be conducted on visually handicap population.

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APPENDIX 1

Name :

Age :

Sex:

1. നിങ്ങൾ ടി.വി. കണ്ടുകൊണ്ടിരിക്കുമ്പോൾ മറ്റൊരാൾ നിങ്ങളോട് സംസാരിക്കുന്നു എന്നു വിചാരിക്കുക. അതേ സമയത്ത് ടിവിയുടെ ശബ്ദം കുറയ്ക്കാതെ ആ സംസാരം മനസിലാക്കാൻ സാധിക്കുമോ?

   (You are talking with one other person and there is a TV on in the same room, without turning the TV down, can you follow what the person you're talking to says?)

   1 2 3 4 5 6 7 8 9 10

2. നിങ്ങൾ മറ്റൊരാളോട് സംസാരിക്കുമ്പോൾ തന്നെ ടിവിയിലെ വാർത്ത ശ്രദ്ധിക്കുന്ന സാഹചര്യത്തിൽ രണ്ടും ഒരുപോലെ മനസ്സിലാക്കുവാൻ സാധിക്കുമോ?

   (You are listening to someone talking to you, while at the same time trying to follow the news on TV. Can you follow what both people are saying?)

   1 2 3 4 5 6 7 8 9 10

3. മുറിയിൽ കൂടെ പേരുടെ സംഭാഷണത്തിന്റെ ഇടയ്ക്ക് നിങ്ങൾ ഒരാളോട് മാത്രമായി ഏർപ്പെടുന്ന സംഭാഷണം മനസ്സിലാക്കാൻ സാധിക്കുമോ?

   You are in conversation with one person in a room where there are many other people talking. Can you follow what the person you are talking to is saying?)

   1 2 3 4 5 6 7 8 9 10

4. ഒരു തിരക്കുള്ള ഭക്ഷണ ശാലയിൽ നിങ്ങൾക്ക് എല്ലാവരുടെയും സംഭാഷണം ഒരുപോലെ മനസ്സിലാക്കുവാൻ സാധിക്കുമോ?

   (You are in a group of about five people in a busy restaurant. You can see everyone else in the group. Can you follow the conversation?)

   1 2 3 4 5 6 7 8 9 10

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5. നിങ്ങളും ഒരു കൂട്ടം ആളുകളുടെ സംഭാഷണത്തിൽ ഏർപ്പെടുന്നു എന്നു വിചാരിക്കുക. അതിൽ ഒരാൾ മറ്റൊരാളോട് സംസാരിക്കുന്നത് നിങ്ങൾക്ക് മനസ്സിലാക്കാൻ സാധിക്കുമോ?

(You are with a group and the conversation switches from one person to another. Can you easily follow the conversation without missing the start of what each new speaker is saying?

1 2 3 4 5 6 7 8 9 10

6. നിങ്ങൾ വീടിന്റെ പുറത്തുള്ളപ്പോൾ ഒരു നായ കുരയ്ക്കുന്ന ശബ്ദം കേൾക്കാൻ ഇടയാകുന്ന സാഹചര്യത്തിൽ നോക്കാതെ തന്നെ ആ ശബ്ദം എവിടെ നിന്നാണ് വരുന്നത് എന്ന് മനസ്സിലാക്കാൻ സാധിക്കുമോ?

(You are outside. A dog barks loudly. Can you tell immediately where it is, without having to look?)

1 2 3 4 5 6 7 8 9 10

7. ഒരു ബസിന്റെയോ ലോറിയുടെയോ ശബ്ദം കേട്ടാൽ എത്ര ദൂരത്ത് നിന്നാണ് അവ വരുന്നത് എന്ന് പറയുവാൻ സാധിക്കുമോ?

(Can you tell how far away a bus or a truck is from the sound ?)

1 2 3 4 5 6 7 8 9 10

8. ഒരു ലോറിയുടെയോ ബസിന്റെയോ ശബ്ദം കേട്ടാൽ അത് നിങ്ങളുടെ അടുത്തു വരിക ആണോ അതോ ദൂരെ പോവുകയാണോ എന്ന് മനസ്സിലാക്കാൻ സാധിക്കുമോ?

(Can you tell from the sound whether a bus or truck is coming towards you or going away?)

1 2 3 4 5 6 7 8 9 10

9. ഒരേ സമയം നിങ്ങൾ ഒന്നിൽ കൂടുതൽ ശബ്ദങ്ങൾ കേട്ടാൽ നിങ്ങൾക്ക് അവ എല്ലാം കൂടി ചേർന്ന് ഒറ്റ ശബ്ദമായി തോന്നുമോ?

(When you hear more than one sound at a time, do you have the impression that it seems like a single jumbled sound?)

1 2 3 4 5 6 7 8 9 10

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10. നിങ്ങൾ പാട്ടു കേൾക്കുമ്പോൾ ഏത് സംഗീത ഉപകരണത്തിൽ നിന്നാണ് ശബ്ദങ്ങൾ വരുന്നത് എന്ന് മനസ്സിലാക്കാൻ സാധിക്കുമോ?

(When you listen to music, can you make out which instruments are playing)

1 2 3 4 5 6 7 8 9 10

11. നിത്യം കേൾക്കുന്ന ശബ്ദങ്ങൾ നിങ്ങൾക്ക് വ്യക്തമായി ആയാസം കൂടാതെ കേൾക്കുവാൻ സാധിക്കുമോ?

(Do everyday sounds that you can hear easily seem clear to you (not blurred)?)

1 2 3 4 5 6 7 8 9 10

12. മറ്റൊരാളുടെ സംസാരം മനസ്സിലാക്കുവാൻ നിങ്ങൾ കൂടുതലായി ശ്രദ്ധ കേന്ദ്രീകരിക്കേണ്ടതുണ്ടോ?

(Do you have to concentrate very much when listening to someone or something?)

1 2 3 4 5 6 7 8 9 10

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