

**PERCEIVED DISABILITY IN CHILDREN AND ADULTS WITH
SINGLE SIDED DEAFNESS AT TWO TERTIARY INSTITUTIONS**

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DECLARATION

I, Balgeis Elfallah, declare that this thesis is based on a research study conducted by me, except where I have quoted or referenced the sources. To the best of my knowledge, this work has not been previously submitted for a degree in my university or any other institution, neither has it previously been submitted for publication to another journal.

Signature:

Date: 01/02/2021

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CHAPTER 1

LITERATURE REVIEW

INTRODUCTION

Binaural hearing is the ability to hear with two ears which provides many advantages to the brain such as speech understanding, speech clarity, sound localization, sound identification and better hearing in a noisy environment.^[1] Moreover, binaural squelch phenomena are the ability of the brain to suppress any interfering noise and focus on the targeted sound to permit better communication in the presence of a noisy background. ^[1] According to the characteristics of the sound produced by the source, a sound can be localized in space. On one side of a listener, the sound reaches the ear closer to the source first; then it arrives at the ear which is further from the source. This time arrival difference is known as the interaural time difference. There is also an interaural loudness difference which indicates that the sound will be louder in the ear nearer to the sound source. Both these differences are important to identify the location of the sound source.^[2] People with unilateral deafness lose all the advantages of binaural hearing especially in case of unilateral severe-to-profound hearing loss which is referred to as single-sided deafness.

Single-sided deafness (SSD) applies to unilateral hearing loss that is highly asymmetric. SSD has been defined by an international consensus statement as a severe-to-profound hearing loss in one ear (pure-tone average threshold ≥ 60 dB HL) and almost normal or normal hearing in the contralateral ear (pure-tone average threshold < 30 dB HL).^[3] The hearing loss cannot be aided with conventional means of amplification. Single-sided deafness affects 12-27 patients in every 100,000 of the general population.^[4]

Single-sided deafness has to be distinguished from asymmetrical hearing loss which is defined as an average difference in air conduction threshold between the ears of ≥ 15 dB at 500, 1000, 2000, 3000 Hz according to the American Academy of Otolaryngology-head and Neck Surgery criteria. Patients with asymmetrical hearing loss have hearing loss in both ears but with different severity between the two ears.

There are several causes for SSD. These include but are not limited to: idiopathic sudden sensorineural hearing loss, congenital cytomegalovirus, mumps, acoustic neuroma,

meningitis, Meniere's disease, head trauma, cochlear nerve aplasia, auditory neuropathy, chronic otitis media, and perilymphatic fistulae.^[5]

Individuals with profound SSD have difficulty in understanding speech especially with background noise, as well as difficulty in sound localisation due to the head shadow effect where the head acts as an acoustic barrier and reflects all sounds that have short wavelengths.^[6,7] The other major sequelae of SSD are mainly associated with social consequences like activity limitations and participation restrictions; increased psychological stress like worrying about losing the hearing in the other normal ear; embarrassment due to the social stigma related to the hearing loss, which results in loss of confidence in certain situations. This, in turn, leads to social withdrawal and individuals feeling separated from society.^[3] Unilateral hearing loss or SSD in children was previously thought to be of little consequence in relation to language development due to the opposite ear having normal hearing.^[8] Many studies, however, showed that children with SSD have behavioural problems in the class and high rates of grade failure.^[8] Some of them also need more educational support.^[8]

There are many options to manage patients with SSD e.g. contralateral routing of sound (CROS), bone anchored hearing aids (BAHA), and more recently cochlear implants (CI). These options have been used in well-resourced centers. Some of these options are expensive and inaccessible, especially in a resource-limited setting. Also, there is a lack of consensus regarding audiological management, particularly in the paediatric population. While many studies look at audiological characteristics (e.g. word recognition scores), this may not necessarily correlate with patients' perception of their hearing loss and whether they feel they require intervention. Therefore, this study examines the perceived disability of children and adults with SSD and to enable effective counselling, rehabilitation, and overall management in our institutions.

LITERATURE SEARCH

This study aims to determine the perceived disability of individuals with SSD and its effect on the quality of life of those patients. Articles were reviewed through the PubMed central library by using the search words “single-sided deafness”, “quality of life in SSD patients” and “disabilities in patients with SSD”. Articles reporting on disabilities in patients with SSD and their quality of life, written in English were selected.

SUMMARY AND INTERPRETATION OF LITERATURE

Although several studies evaluate the handicap level in patients with SSD, few of them were conducted in developing countries.

A study conducted by Wie et al.^[9] looked at 30 adults with unilateral profound deafness and found that patients felt excluded in conversations with multiple people. Furthermore, they avoided social interactions especially with significant background noise and used multiple strategies to improve hearing such as head turning or speech reading.^[9]

Lieu et al.^[10] performed a case-control study of 6- to 12-year old children with unilateral hearing loss (UHL) and compared them to their siblings as a control group (n = 148). Their results indicated that school-aged children with UHL showed worse scores in the oral language than their normal hearing siblings did. The authors suggested re-evaluating the common practice of deferring the referral of children with UHL for further evaluation and management. In addition, Lieu et al.^[8] reported that school-aged children with UHL tended to have higher grade failure rates, needed extra educational support, and experienced some behavioural problems in the classroom.

Chang et al.^[11] included 52 patients with SSD in semi-structured interviews to assess the social as well as communication challenges of patients with SSD. Their results showed that patients with SSD had increased dependence on family members, a low sense of autonomy, and a change of communication quality with their families. Chang et al.^[11] concluded that SSD patients require proper counselling and explanation of their challenges and aural rehabilitation to improve their listening skills. In a retrospective survey of 51 adults with SSD, Meehan et al.^[12] found that patients with SSD noticed major changes in their appreciation of music, where the UHL resulted in patients listening to music less frequently. Patients found listening to music less enjoyable as the sound was found to be blurrier (81%), less pleasing (71%), and more artificial (75%) than before the hearing loss.^[12]

By employing the *Hearing in Noise Test*, Mondelli et al.^[13] concluded that people with UHL showed improved performance in speech perception by using hearing aids both in conditions with competing noise as well as in silence.

By applying the Hearing Handicap Inventory for Adults (HHIA) questionnaire for 50 patients with SSD in India, Augustine et al.^[14] found significantly poorer scores in patients with SSD

compared to the control group. They also found that localization of sounds in the horizontal plane was consistently influenced in all patients with SSD compared to a control group.

CONCLUSION

The literature reviewed strongly suggests that patients with SSD experience social, emotional as well as educational difficulties as a result of a loss of binaural hearing advantages. This is particularly the case in children where these difficulties appear to be more marked. Most of these studies were conducted in well-resourced countries. However, there was a paucity of studies done in resource-restricted places where the management options of SSD are either expensive or inaccessible.

AREAS FOR FUTURE RESEARCH

Speech and language delays may occur in some children with SSD, but it is not known if these children "catch up" as they grow older. It is still not clear whether these children should be treated as normal-hearing children where one would expect normal development for speech and language or whether they should be provided with amplification as soon as possible while in that critical period of language acquisition. Also, more studies need to be done on the effects of SSD in patients in developing countries where resources are limited.

REFERENCES

1. Prasad BK. Binaural hearing: Physiological and Clinical View. *Arch Otolaryngol Rhinol* 2020;6(2):033-036. <http://dx.doi.org/10.17352/2455-1759.000118>
2. Noble W, Tyler R, Dunn C, Witt S. Binaural hearing has advantages for cochlear implant users also. *The Hearing Journal* 2005;58(11):56-57. <https://doi.org/10.1097/01.hj.0000286407.49683.14>
3. Lucas L, Katiri R, Kitterick PT. The psychological and social consequences of single-sided deafness in adulthood. *International journal of audiology* 2018;57(1):21-30. <https://doi.org/10.1080/14992027.2017.1398420>
4. Cabral Junior F, Pinna MH, Alves RD, Malerbi AFDS, Bento RF. Cochlear implantation and single-sided deafness: a systematic review of the literature. *International archives of otorhinolaryngology* 2016;20(1):69-75. <https://doi.org/10.1055/s-0035-1559586>
5. Usami SI, Kitoh R, Moteki H, Nishio SY, Kitano T, Kobayashi M, Shinagawa J, Yokota Y, Sugiyama K, Watanabe K. Etiology of single-sided deafness and asymmetrical hearing loss. *Acta oto-laryngologica* 2017;137(S565):S2-S7.
6. Fogels J, Jönsson R, Sadeghi A, Flynn M, Flynn T. Single-Sided Deafness—Outcomes of Three Interventions for Profound Unilateral Sensorineural Hearing Loss: A Randomized Clinical Trial. *Otology & Neurotology* 2020;41(6):736-744.
7. Cire G. Understanding Single Sided Deafness: Evaluation and Treatment for Professionals. *Audiology*, 2012. <https://www.audiologyonline.com/articles/understanding-single-sided-deafness-evaluation-6829> (accessed 5 November 2020).
8. Lieu JEC. Speech-language and educational consequences of unilateral hearing loss in children. *Archives of Otolaryngology–Head & Neck Surgery* 2004;130(5):524-530. <https://doi.org/10.1001/archotol.130.5.524>
9. Wie OB, Hugo Pripp A, Tvette O. Unilateral deafness in adults: effects on communication and social interaction. *Annals of Otology, Rhinology & Laryngology* 2010;119(11):772-781
10. Lieu JE, Tye-Murray N, Karzon RK, Piccirillo JF. Unilateral hearing loss is associated with worse speech-language scores in children. *Pediatrics* 2010;125(6):1348-1355. <https://doi.org/10.1542/peds.2009-2448>
11. Chang PF, Zhang F, Schaaf AJ. Deaf in one ear: Communication and social challenges of patients with single-sided deafness post-diagnosis. *Patient Education and Counseling* 2020;103(3):530-536. <https://doi.org/10.1016/j.pec.2019.10.009>

12. Meehan S, Hough EA, Crundwell G, Knappett R, Smith M, Baguley DM. The impact of single-sided deafness upon music appreciation. *Journal of the American Academy of Audiology* 2017;28(5):444-462. <https://doi.org/10.3766/jaaa.16063>
13. Mondelli MF, Santos MD, José MR. Speech perception in noise in unilateral hearing loss. *Brazilian journal of otorhinolaryngology* 2016;82(4):427-432.
14. Augustine AM, Chrysolyte SB, Thenmozhi K, Rupa V. Assessment of auditory and psychosocial handicap associated with unilateral hearing loss among Indian patients. *Indian Journal of Otolaryngology and Head & Neck Surgery* 2013;65(2):120-125. <https://doi.org/10.1007/s12070-012-0586-6>
15. Kurz A, Grubenbecher M, Rak K, Hagen R, Kühn H. The impact of etiology and duration of deafness on speech perception outcomes in SSD patients. *European Archives of Oto-Rhino-Laryngology* 2019;276(12):3317-3325. <https://doi.org/10.1007/s00405-019-05644-w>

CHAPTER 2

PUBLICATION READY MANUSCRIPT

TITLE PAGE

PERCEIVED DISABILITY IN CHILDREN AND ADULTS WITH SINGLE SIDED DEAFNESS AT TWO TERTIARY INSTITUTIONS

MMed Dissertation in Otorhinolaryngology

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ABSTRACT

Background: Single-sided deafness is defined as a severe-to-profound hearing loss in one ear and normal or near-normal hearing in the other ear. The handicap experienced by patients with bilateral sensorineural hearing loss is well known, but the consequences of single-sided deafness are often underestimated based on the assumption that a person with normal hearing in the contralateral ear is not likely to face a major handicap.

Objectives: To determine the handicap level in patients with single-sided deafness, and compare the handicap between employed and unemployed patients. Also, to investigate the relationship between perceived disability and noise in the workplace. The effect of age and duration of hearing loss on the perceived disability of single-sided deafness was also examined.

Methods: Two validated questionnaires (1) *Speech, Spatial and Qualities of Hearing Scale* (SSQ12); and (2) *Hearing Handicap Inventory for adults* (HHIA) were handed to participants with SSD. This research was conducted in two tertiary hospitals in Cape Town, namely, Groote Schuur Hospital and Red Cross War Memorial Children's Hospital, over the period from November 2018 to August 2020.

Results: Fifty-four participants were included in the study, 44 adults and 10 children. Employing the HHIA questionnaire, the results show that 39% of adult participants have a significant handicap compared to 32% who have a moderate handicap and 30% who have no handicap. Also, there was no significant difference in the total handicap scores between the employed and unemployed groups, and the presence of noise in the workplace did not influence the total handicap score in the employed group. There was no influence on age or duration of hearing loss on the total handicap score. The mean of the responses in the SSQ12 questionnaire was between 3.42 and 7; thus, some participants experience major hearing difficulties, while others have minor difficulties. Most of the participants are struggling to follow a conversation with background noise and have difficulty localizing sounds. They also struggle to identify the sound distance. They report increased effort when listening to someone or something.

Conclusions: A majority of the patients with single-sided deafness in our population either have a severe or a mild-moderate handicap. A good assessment of the individual's degree of

handicap is required to adequately counsel the patient and assist in the decision regarding treatment options.

Keywords: Single-sided deafness (SSD), HHIA, SSQ12.

ABBREVIATIONS:

BAHA: Bone Anchored Hearing Aid.

CI: Cochlear Implant.

CROS: Contralateral Routing of Sound.

dB: Decibel.

HHIA: Hearing Handicap Inventory for adults.

SSD: Single-Sided Deafness.

SSQ12: Speech, Spatial and Qualities of Hearing Scale.

UHL: Unilateral Hearing Loss.

GSH: Groote Schuur Hospital.

RCCH: Red Cross War Memorial Children's Hospital.

INTRODUCTION

Binaural hearing is the ability to hear with two ears. It provides many advantages to the brain such as speech understanding, sound localization, and better hearing in a noisy environment.^[1] Binaural squelch phenomena are the ability of the brain to suppress any interfering noise and to focus on the targeted sound. This permits better communication in the presence of a noisy background.^[1]

Both interaural time difference and interaural loudness are used to locate the source of a sound, where the interaural time difference is the time interval between when a sound enters one ear and when it enters the other ear.^[2] Essentially, a sound coming from the right side will enter the right ear a split second before it enters the left. The auditory system can detect this millisecond time delay. This interaural time difference is used to localise the direction the sound is coming from. Interaural loudness refers to the phenomenon that sound loudness is different between the two ears, this is also used to determine the location of a sound source.^[2]

A patient with single-sided deafness loses the advantages of both interaural time difference and interaural loudness compared to their binaural counterparts.

Single-sided deafness (SSD) applies to unilateral hearing loss (UHL) which is highly asymmetric. SSD has been defined by an international consensus statement as a severe-to-profound hearing loss in one ear (pure-tone average threshold ≥ 60 dB HL) and almost normal or normal hearing in the contralateral ear (pure-tone average threshold < 30 dB HL).^[3] The hearing loss cannot be aided with conventional means of amplification. SSD affects 12-27 patients in every 100,000 of the general population.^[4] SSD must be distinguished from asymmetrical hearing loss which is defined as an average difference in air conduction threshold between the ears of ≥ 15 dB at 500, 1000, 2000, 3000 Hz according to the American Academy of Otolaryngology-Head and Neck Surgery criteria. Patients with asymmetrical hearing loss have hearing loss in both ears but with different severity between the two ears. There are several causes for SSD. These include but are not limited to: idiopathic sudden sensorineural hearing loss, congenital cytomegalovirus, acoustic neuroma, meningitis, Meniere's disease, head trauma, cochlear nerve aplasia, and perilymphatic fistula.^[5]

Individuals with SSD have difficulty in understanding speech especially with background noise, as well as difficulty in sound localisation. This is due to the head shadow effect where the head acts as an acoustic barrier and reflects sounds that have short wavelengths.^[6,7] The other major sequelae of SSD are mainly associated with social consequences like participation restrictions, and increased psychological stress, like worrying about losing the hearing in the normal ear as well as embarrassment due to the social stigma related to the hearing loss. This results in a loss of confidence in certain situations and in turn, lead to social withdrawal.^[3]

SSD in children was previously thought to be of little consequence on language development due to the opposite ear which has normal hearing.^[8] Lieu et al found that children with SSD have behavioural problems in the classroom, a high rate of grade failure with some needing more educational support.^[8]

There are many options used to manage patients with SSD especially in well-resourced centers e.g. contralateral routing of sound (CROS), bone-anchored hearing aids (BAHA), and recently cochlear implants (CI). Some of these options are expensive and inaccessible, especially in a resource-limited setting. Also, there is a lack of consensus regarding audiological management, particularly in the paediatric population.

Although many studies looked at audiological characteristics (e.g. word recognition scores), this may not necessarily correlate with patients' perception of their hearing loss and whether they feel intervention is required. This study examines the perceived disability of children and adults with SSD to guide management at our institution.

OBJECTIVES OF THE STUDY

1. Examine the perceived disability of children and adults with SSD.
2. Investigate the differences in perceived disability of SSD between employed patients and unemployed patients.
3. Investigate the effect of noisy and non-noisy environments in the workplace on the perceived disability of SSD in the employed group of patients.
4. Investigate the effect of patients' age and duration of hearing loss on the perceived disability of SSD.

MATERIALS AND METHODS

A prospective qualitative study was conducted using two validated questionnaires, the *Hearing Handicap Inventory for Adults* (HHIA) and the *Speech, Spatial and Qualities of Hearing Scale* (SSQ12). Data was collected on patients diagnosed with SSD from November 2018 to August 2020 at two tertiary hospitals in Cape Town, namely (1) Groote Schuur Hospital (GSH), and (2) Red Cross War Memorial Children's Hospital (RCCH). Groote Schuur Hospital treats adolescent patients (between ages 14-18 years) and adults (older than 18 years), whereas RCCH only treats children younger than 13 years. Both HHIA and SSQ12 questionnaires were handed to adolescents and adult patients at GSH. While only the SSQ12 questionnaire was used at RCCH. These questionnaires were administered to patients following their hearing assessment which entailing auditory threshold detection (pure tone audiometry) by air conduction (250-8000 Hz) and bone conduction (500-4000 Hz), speech audiometry tests, and immittance measurements.

The HHIA questionnaire is a self-assessment questionnaire that is designed to assess the effects of hearing impairment on the emotional and social aspects of adults. There are 25 questions, divided into two subscales: (1) a 13-item subscale identifies the emotional consequences of hearing impairment; and (2) a 12-item subscale identifies both social and situational effects. The responses are "No/Sometimes/Yes". "No" scores 0 points, "Sometimes" scores 2 points, and "Yes" scores 4 points. A total score between 0-16%

indicates no handicap, a score between 18-42% indicates a mild-moderate handicap and a score >44% indicates a severe handicap. The total points of 17% and 43% are not included in the HHIA questionnaire.

The SSQ12 questionnaire is a self-rating scale that was developed using a clinician-patient interview design to assess hearing disability with particular attention to hearing speech in different competing situations. The 12 questions comprising the SSQ12 are derived from version 5.6 of the SSQ 49 (49 items) and encompass its main factors, including questions involving the three core domains (speech hearing, spatial hearing, and qualities of hearing). Participants rated their communication performance in each situation with a score of 0 to 10. All subjects were explained that 10 indicated they were able to perform the situation in the question perfectly, whereas 0 indicated they were unable to perform the situation at all. The SSQ12 questionnaire consists of 12 questions which are divided into subscales as shown in Table 1.

Table 1 SSQ12 Subscales

Pragmatic Subscale	SSQ12 Questions
Speech in Noise subscale	SSQ12-1 SSQ12-3 SSQ12-4
Multiple Speech Streams subscale	SSQ12-2 SSQ12-5
Localization of sounds subscale	SSQ12-6
Sound Distance and Movement subscale	SSQ12-7 SSQ12-8
Segregation of sounds subscale	SSQ12-9
Identification of Sounds subscale	SSQ12-10
Quality & Naturalness of sounds subscale	SSQ12-11
Listening Effort subscale	SSQ12-12

The SSQ12 was found to be appropriate for this study which looks at perceived disability in patients with SSD as the questionnaire includes everyday situations where patients with monaural hearing may struggle e.g. the presence of background noise.

The two questionnaires were handed to 44 patients attending the ENT department at GSH (older than 13 years). Patients were recruited by the audiologist after an audiogram had been performed, and SSD was identified. Ten patients were recruited by the audiologist from the ENT department at RCCH after an SSD had been identified. The questionnaires were self-administered for those participants who were English speaking. For non-English speaking participants, the questionnaires were conducted in the form of an interview where the audiologist translated the questions in the participant's first language. For young children, the SSQ 12 questionnaire was completed by the primary caregiver or parent

Inclusion criteria

Patients with confirmed SSD including:

- Children between the ages of 5 and 13 years.
- Adolescents (between ages 14-18 years) and adults.

Exclusion criteria

- Patients who due to mental illnesses could not complete the questionnaire.
- Patients with asymmetrical hearing loss, where there is bilateral hearing loss, but the hearing loss in one ear is worse when compared to the other ear because those patients are actively managed in our institution.
- Children below the age of 5 years since the SSQ12 is adapted for children of 5 years and older.
- Patients who have received intervention for their hearing loss.

Statistical analysis

Data were entered into a Microsoft Excel sheet and analysed using Statistica 13.5. Descriptive statistics were presented with means, medians, histograms, and frequency tables. ANOVA was used for testing means scores between groups and cross-tabulation with the Chi-square test for relationships between categorical variables. For testing relationships between variables, Pearson correlation test was used. The reliability for the two questionnaires was testing separately by applying Cronbach's alphas test. If the Cronbach

Alpha value is between 0.84 and 0.90, it is considered reliable, while if it is between 0.91 and 0.93, it is considered strong.^[9] P values of < 0.05 were considered statistically significant.

ETHICAL CONSIDERATIONS

The study was approved by the Departmental of Surgery Research Committee at the University of Cape Town, and ethical approval was granted by the Research Ethics Committee, Faculty of Health Sciences, and University of Cape Town HREC REF: 696/2018.

RESULTS

Fifty-four participants with confirmed SSD were included in the study, 29 were male and 25 were female. Forty-four participants were >18 years and 10 participants <18 years old. The mean age of participants was 38 years (range 6-75 years). The duration of hearing loss was between 1 and 58 years (mean= 21 years).

The reliability of the questionnaires is tested by employing Cronbach's alpha test. The higher the alpha value, the higher the reliability of the questionnaire. Table 2 displays the value of Cronbach Alpha for each questionnaire.

Table 2 Internal Consistency Reliability

Questionnaire	Number of questions	Cronbach Alpha
HHIA	25	0.910
SSQ12	12	0.876

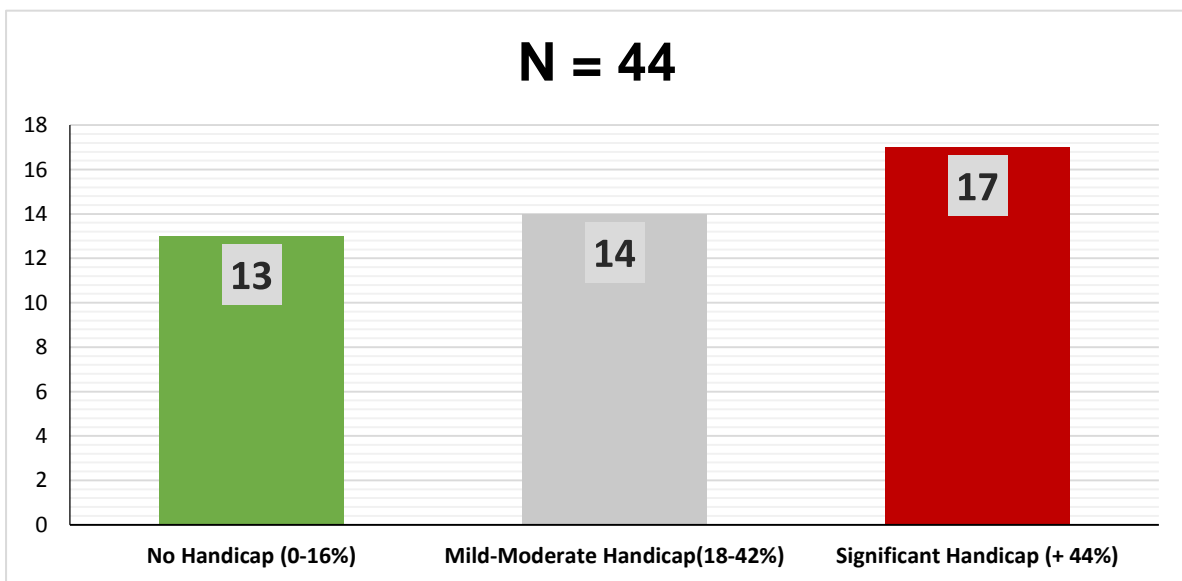
As it is noted in Table 2, the results of Cronbach alpha are 0.910 and 0.876. Thus, the results indicate that the internal consistency for the two questionnaires is strong and reliable, respectively.

1. Hearing Handicap Inventory for Adults Questionnaire (HHIA)

1.1 Total Handicap Score

The total handicap score for forty-four participants' responses in the HHIA questionnaires is illustrated in Figure 1.

Figure 1 Total Handicap Score for the Responses



As shown in Figure 1, the number of responders with no handicap, mild-moderate handicap, and severe handicap were fairly equally distributed. Thirteen out of 44 (30%) participants had no handicap, 14 (32%) participants had a mild-to-moderate handicap, while 17 (39%) participants had a severe handicap.

The above total score was calculated from the responses of the HHIA questionnaire for both categories (social and emotional) which are presented in Tables 3 and 4, respectively.

Table 3 Responses to the Social Questions.

HHI Social Questions	Total Responses		
	Yes	Sometimes	No
S-1: Does a hearing problem cause you to use the phone less often than you would like?	13 (30%)	7 (16%)	24 (55%)
S-3: Does a hearing problem cause you to avoid groups of people?	14 (32%)	9 (20%)	21 (48%)
S-6: Does a hearing problem cause you difficulty when attending a party?	19 (44%)	9 (21%)	15 (35%)
S-7: Does a hearing problem cause you difficulty hearing /understanding coworkers, clients, or customers?	20 (49%)	11 (27%)	10 (24%)
S-9: Does a hearing problem cause you difficulty when visiting friends, relatives, or neighbors?	7 (16%)	12 (27%)	25 (57%)
S-11: Does a hearing problem cause you difficulty in the movies or theater?	13 (31%)	8 (19%)	21 (50%)
S-13: Does a hearing problem cause you to visit friends, relatives, or neighbors less often than you would like?	8 (18%)	5 (11%)	31 (70%)
S-15: Does a hearing problem cause you difficulty when listening to TV or radio?	11 (25%)	16 (36%)	17 (39%)
S-16: Does a hearing problem cause you to go shopping less often than you would like?	8 (18%)	5 (11%)	31 (70%)
S-19: Does a hearing problem cause you to talk to family members less often than you would like?	5 (11%)	8 (18%)	31 (70%)
S-21: Does a hearing problem cause you difficulty when in a restaurant with relatives or friends?	13 (30%)	15 (34%)	16 (36%)
S-23: Does a hearing problem cause you to listen to TV or the radio less often than you would like?	11 (25%)	4 (9%)	29 (66%)

Table 3 shows that most of the participants answered ‘No’ to all questions, except for questions S-6 and S-7 where most of the participants answered ‘Yes’. This indicates that most of the participants tended to have some difficulty with these two questions.

Table 4 Responses to the Emotional Questions

HHI Emotional Questions	Responses		
	Yes	Sometimes	No
E-1: Does a hearing problem cause you to feel embarrassed when meeting new people?	14 (32%)	12 (27%)	18 (41%)
E-4: Does a hearing problem make you irritable?	14 (32%)	15 (34%)	15 (34%)
E-5: Does a hearing problem cause you to feel frustrated when talking to members of your family?	8 (18%)	13 (30%)	23 (52%)
E-8: Do you feel handicapped by a hearing problem?	10 (23%)	12 (28%)	21 (49%)
E-10: Does a hearing problem cause you to feel frustrated when talking to coworkers, clients or customers?	13 (32%)	11 (27%)	17 (41%)
E-12: Does a hearing problem cause you to be nervous?	10 (23%)	9 (21%)	24 (56%)
E-14: Does a hearing problem cause you to have arguments with family members?	10 (23%)	10 (23%)	24 (55%)
E-17: Does any problem or difficulty with your hearing upset you at all?	14 (32%)	13 (30%)	17 (39%)
E-18: Does a hearing problem cause you to want to be by yourself?	8 (18%)	8 (18%)	28 (64%)
E-20: Do you feel that any difficulty with your hearing limits or hampers your personal or social life?	12 (27%)	11 (25%)	21 (48%)
E-22: Does a hearing problem cause you to feel depressed?	8 (18%)	8 (18%)	28 (64%)
E-24: Does a hearing problem cause you to feel uncomfortable when talking to friends?	11 (25%)	10 (23%)	23 (52%)
E-25: Does a hearing problem cause you to feel left out when you are with a group of people?	11 (25%)	10 (23%)	23 (52%)

Table 4 concur with Table 3 as the majority of responders answering “No” for the majority of questions, except for question E-4 where numbers of responses with ‘No’, 15 (34%), ‘Sometimes’ 15 (34%), and ‘Yes’, 14 (32%) were equally distributed.

1.2 HHIA and Employment Status / Noisy Work Environment

To determine whether employment status and working in a noisy environment were confounding factors, the researchers compared the total handicap score between the employed and unemployed participants, and also between participants who were working in

noisy places and non-noisy places by applying the Chi-square test. Two extra questions were asked to participants:

1. Are you employed?
2. If employed, do you work in a noisy environment?

- **HHIA and Employment Status**

Thirty-two participants were included in this study and of these, 17 were employed and 15 were unemployed. Table 5 shows the total handicap score of employed and unemployed participants. The mean of the handicap score for the employed participants (41.21) and unemployed participants (38.4), indicated mild-moderate handicap for both groups.

Table 5 Hearing Handicap Score of Employed and Unemployed Participants

Are you working now	Marked cells have counts > 10. Chi-square(df=2)=0.38, p=.82519 Fisher Exact(r x c) p=0.90			Row Totals
	HEARING HANDICAP(cat) <17	HEARING HANDICAP(cat) 17-43	HEARING HANDICAP(cat) >=43	
No	4	5	6	15
Row %	26.67%	33.33%	40.00%	
Yes	5	4	8	17
Row %	29.41%	23.53%	47.06%	
Totals	9	9	14	32

As Table 5 displays, 4/15 unemployed participants (33.3%) had no handicap and 5/15 participants (33.3%) had mild to moderate handicap. Of note, 6/15 (40%) of the unemployed participants had a severe handicap. Five out of 17 (29.4%) employed participants had no handicap, 4/17 (23.5%) had a mild-to-moderate handicap, while 8/17 (47.06%) had a severe handicap. There was no statistically significant difference in the hearing handicap scores between unemployed and employed participants ($p > 0.05$).

- **HHIA and Noisy Work Environment**

Table 6 shows the hearing handicap scores of employed participants working in noisy and non-noisy environments. Nine of the 17 employed participants worked in noisy environments

(mean total handicap score was 31.78) while 8 worked in non-noisy environments (mean total handicap score of 52.25).

Table 6 Difference in Responses between Working in Noisy Environment and Non-Noisy Environment

Working in noisy environment	Marked cells have counts > 10. Chi-square(df=2)=5.01, p=.08175 Fisher Exact(r x c) p=0.13			Row Totals
	HEARING HANDICAP(cat) <17	HEARING HANDICAP(cat) 17-43	HEARING HANDICAP(cat) >=43	
No	1	1	6	8
Row %	12.50%	12.50%	75.00%	
Yes	4	3	2	9
Row %	44.44%	33.33%	22.22%	
Totals	5	4	8	17

Six of 8 (75%) participants working in a non-noisy environment had a severe handicap, with the remaining 2 participants having a mild-moderate handicap and no handicap. Two of 9 (22.22%) participants working in a noisy environment had a severe handicap, 3 had a mild-moderate handicap and the remaining 4 participants had no handicap. Statistical analysis showed no difference between noisy environments in the workplace and the hearing handicap scores ($p > 0.05$).

1.3 Correlation Analysis for Participants' Responses

The Pearson test was applied to investigate the relationship between the total handicap score of the HHIA questionnaire and 1) age of the participant and 2) duration of hearing loss. The results are reflected in Table 7.

Table 7 Correlation between Participants' Responses with the Age and Duration of Hearing Loss

Correlation test			
Variable 1	Variable 2	Pearson	Sig. 5%
Age	Hearing Handicap	-0.27	0.11
Duration of hearing loss (years)	Hearing Handicap	-0.21	0.26

Table 7 show that while there is a weak negative relationship between the total handicap score of the participants and their age and the duration of hearing loss, these results are not statistically significant (P-values 0.11 and 0.26 respectively).

2. Speech, Spatial and Qualities of Hearing Scale (SSQ12) Results.

The ANOVA test and correlation test were used to analyze the responses to the SSQ12 questionnaire.

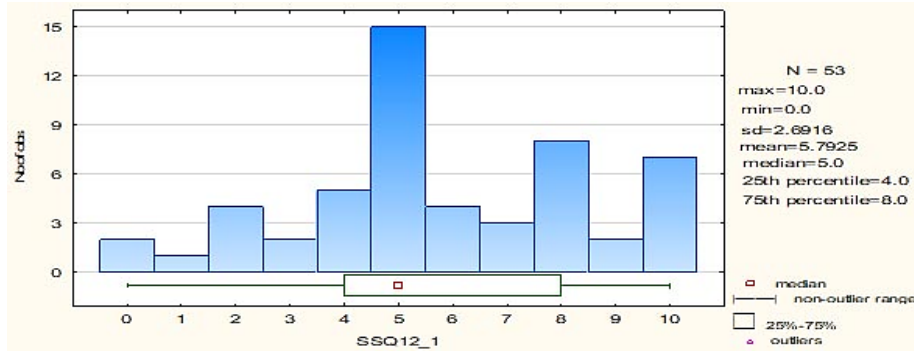
2.1 Descriptive Analysis for Participants' Responses

Figure 2 through Figure 9 show the descriptive analysis for the participants' responses of the SSQ12 sub-scales, namely (1) speech in noise subscale; (2) multiple speech streams subscale; (3) localization of sounds subscale; (4) distance and movement of sounds; (5) segregation of sounds subscale; (6) identification of sounds subscale; (7) quality and naturalness of sounds subscale; and (8) listening effort subscale, respectively.

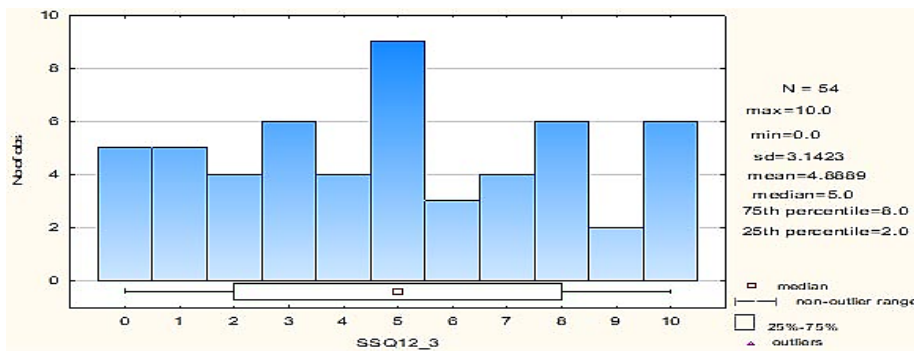
Figure 2 represents the three questions regarding speech in noise (SSQ12-1, SSQ12-3, and SSQ12-4).

Figure 2 **Speech in Noise Results**

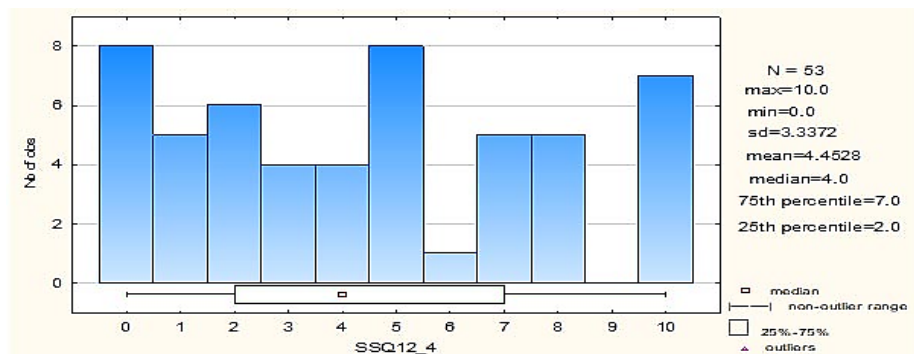
- SSQ12-1 You are talking with one other person and there is a TV on in the same room. Without turning the TV down, can you follow what the person you're talking to says?



- SSQ12-3 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?



- SSQ12-4 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?



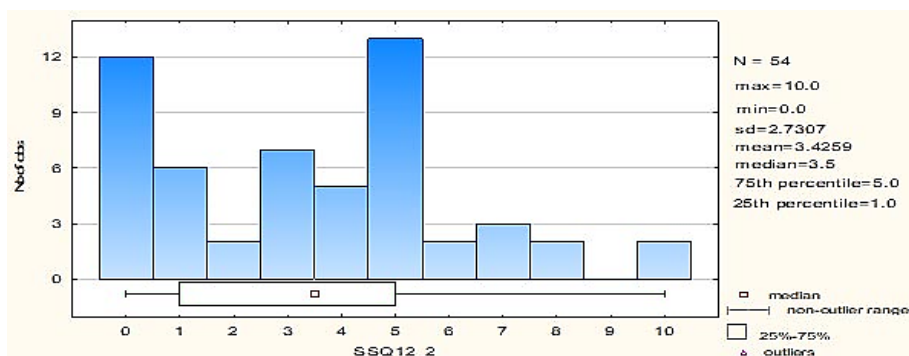
For SSQ12-1 in Figure 2, 50% of the participants' answers ranged between 4 and 8 with a median of 5 (right skew on the scale). This suggests that they tended to have no difficulty following a conversation with background noise. For SSQ12-3, 50% of the participants'

answers ranged between 2 and 8 (median: 5), reflecting that some have difficulty following a conversation with a person in a room full of people. For SSQ12-4, 50% of the participants' answers ranged between 2 and 7 (a left skew on the scale). Of note, 8 participants reported an answer of 0 and another eight reported an answer of 5 (median: 4) reflecting that some participants tended to have difficulty following a group conversation in busy places.

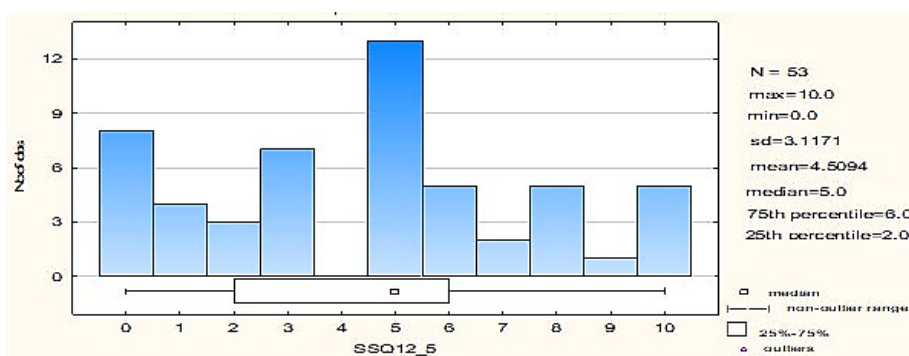
Figure 3 represents the two questions regarding the multiple speech streams (SSQ12-2 and SSQ12-5).

Figure 3 Multiple Speech Stream Results

- SSQ12-2 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?



- SSQ12-5 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?



For SSQ12-2 half of the participants' responses ranged between 1 and 5 (left skew on the scale, median:3.5), suggesting that most of them have difficulty in following multiple speech streams. For SSQ12-5, the range of the responses was between 2 and 6 (skewed to the left on the scale, median:6) for 50% of the participants, reflecting that half of the participants had

some difficulty following multiple speech streams. Of note, 13 out of 53 participants chose the answer 5.

The descriptive analysis of question six (SSQ12-6) which addresses the ability to localize the sounds is demonstrated in Figure 4.

Figure 4 Localization of Sounds Results

- SSQ12-6 You are outside. A dog barks loudly. Can you tell immediately where it is, without having to look?

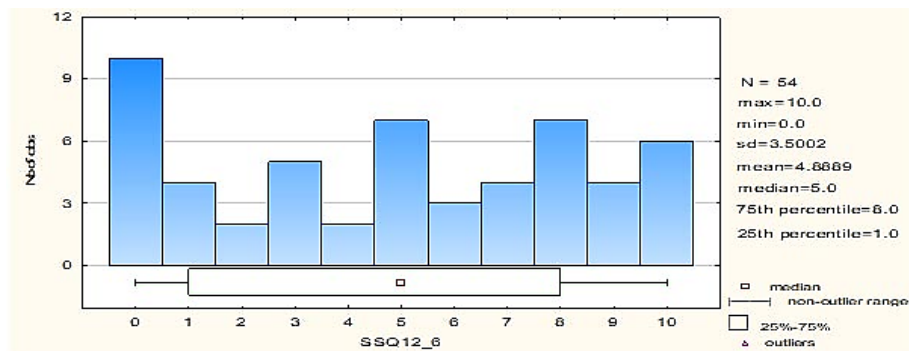
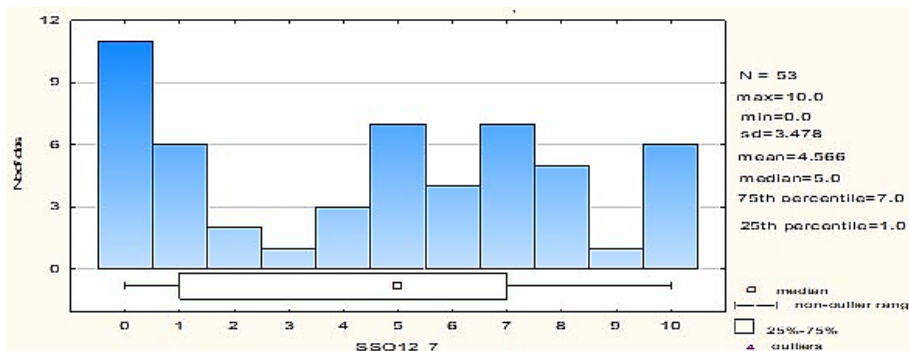


Figure 4 shows that the range of the answers was between 1 and 8 for half of the participants (median: 5) suggesting that they tended to have some difficulty localizing the sound. Of note, 10 of 53 participants chose the answer 0, reflecting a major difficulty for those participants in localizing sound.

The findings of the descriptive analysis for the sound distance and movement questions (SSQ12-7 and SSQ12-8) are presented in Figure 5.

Figure 5 Distance and Movement of Sounds Results

- SSQ12-7 Can you tell how far away a bus or a truck is, from the sound?



- SSQ12-8 Can you tell from the sound whether a bus or truck is coming towards you or going away?

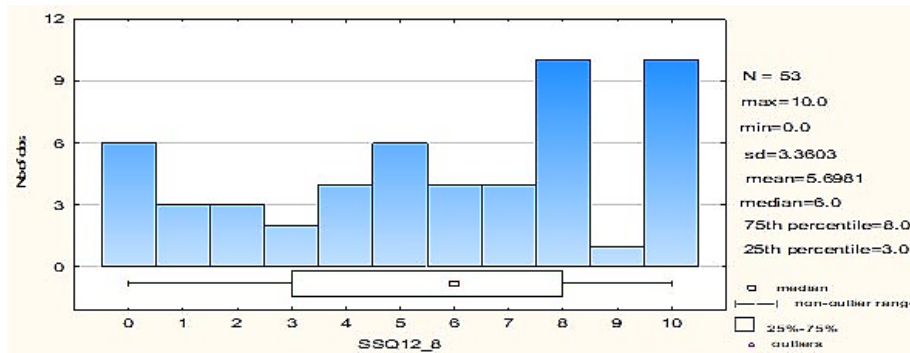


Figure 5 shows that half of the responses were between 1 and 7 (median:5) for SSQ12-7, with 11 participants answering 0 on the scale. This indicates that 50% of the participants are to some extent facing a problem with estimating sound distance. For SSQ12-8 there is a right skew on the scale (range between 3 and 8, median:6), suggesting that 50% of participants tend to be able to determine the sound movement. Of note here is that 10 respondents chose number 8 on the scale and a further 10 respondents chose number 10, reflecting that these participants had very little or no difficulty estimating sound distance.

Figure 6 displays the responses to the segregation of sounds question (SSQ12-9).

Figure 6 Segregation of Sounds Results

- SSQ12-9 When you hear more than one sound at a time, do you have the impression that it seems like a single jumbled sound?

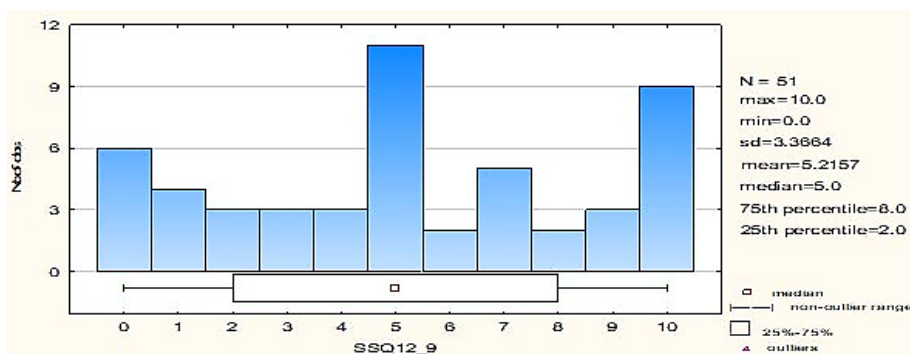


Figure 6 indicates that 50% of the participants' responses ranged between 2 and 8 (median: 5) where 11 participants chose 5, indicating, they have some issues regarding sound segregation.

Figure 7 displays the descriptive analysis for the participant's responses to SSQ12-10 which addresses the identification of sounds.

Figure 7 Identification of Sounds Results

- SSQ12-10 When you listen to music, can you make out which instruments are playing?

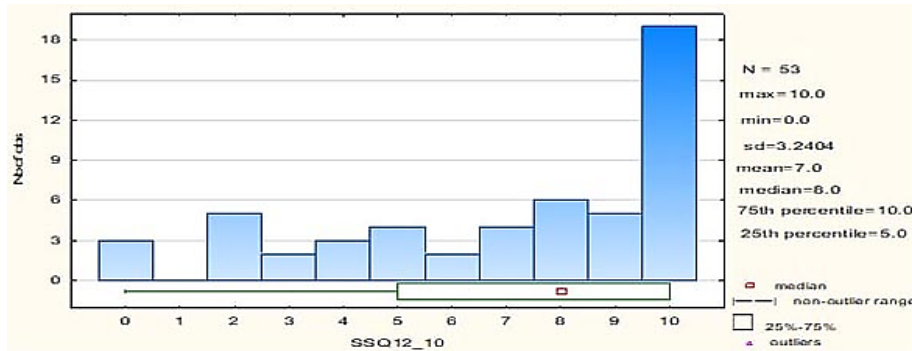


Figure 7 shows a right skew on the scale (range between 5 and 10, median:8) for 50% of the participants, with 19 participants choosing 10 on the scale. This indicates that most of them have minimal or no difficulty identifying different sounds at the same time.

The results of the quality and naturalness of sounds question (SSQ12-11) are presented in Figure 8.

Figure 8 Quality and Naturalness of Sounds Results

- SSQ12-11 Do everyday sounds that you can hear easily seem clear to you (not blurred)?

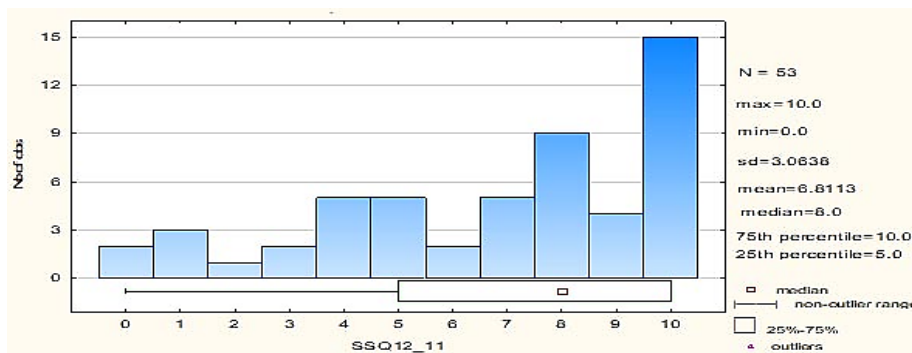


Figure 8 reveals a right skew on the scale with responses ranging between 5 and 10 (median:8) for half of the participants. Fifteen out of 53 responders chose 10 on the scale. Thus, the participants are able, to some degree, to hear everyday sounds clearly.

Figure 9 displays the results and its descriptive analysis for the listening effort in question (SSQ12-12).

Figure 9 Listening Effort Results

- SSQ12-12 Do you have to concentrate very much when listening to someone or something?

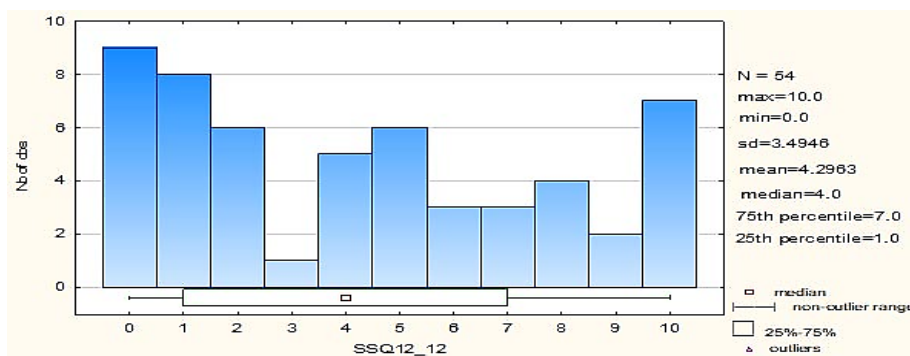


Figure 9 shows a left skew with responses ranging between 1 and 7 (median:4) which indicates that 50% of the participants had to use effort to concentrate when listening to someone or something.

2.2 Mean Differences in the Responses for the Employment Status

The employment status of participants was included to determine whether employed individuals had a greater handicap score. Only thirty-seven of the adult participants answered the question regarding employment status. The mean of the responses for all questions in SSQ12 was compared between the employed and unemployed groups. This study also examines the effect of a noisy work environment on the employed participants' responses to the SSQ12 questionnaire by comparing the mean of the responses between participants working in noisy environments and non-noisy environments.

Table 8 shows the mean of the answers for the SSQ12 questionnaire for the 19 employed participants vs. the 18 unemployed participants, and for the 11 participants who were working in a noisy environment vs. the 8 participants who were working in a non-noisy

environment. The table also shows the results of the ANOVA test which was used to determine if there was a statistically significant difference between the mean responses of each group.

Table 8 Mean Differences in the Responses for Employment Status

Questions	Working and non-working responses			Working in Noise or non-noisy Environment		
	Yes/No	Mean	Sig. 5%	Yes/No	Mean	Sig. 5%
SSQ12-1	Yes	5.11	0.40	Yes	6.00	0.38
	No	6.00		No	5.22	
SSQ12-2	Yes	2.53	0.38	Yes	3.55	0.29
	No	3.44		No	2.70	
SSQ12-3	Yes	4.32	0.44	Yes	4.73	0.81
	No	5.11		No	4.96	
SSQ12-4	Yes	3.89	0.69	Yes	5.09	0.24
	No	4.53		No	3.77	
SSQ12-5	Yes	4.32	0.68	Yes	5.00	0.70
	No	4.89		No	4.61	
SSQ12-6	Yes	3.53	0.19	Yes	5.18	0.43
	No	5.39		No	4.22	
SSQ12-7	Yes	3.94	0.44	Yes	5.20	0.52
	No	4.89		No	4.17	
SSQ12-8	Yes	4.89	0.48	Yes	6.10	0.32
	No	5.78		No	4.74	
SSQ12-9	Yes	5.28	0.69	Yes	5.50	0.65
	No	4.88		No	4.91	
SSQ12-10	Yes	6.94	0.90	Yes	8.20	0.10
	No	6.56		No	5.70	
SSQ12-11	Yes	6.47	0.40	Yes	6.82	0.74
	No	7.11		No	6.52	
SSQ12-12	Yes	3.53	0.25	Yes	3.91	0.83
	No	5.22		No	4.26	

The results in Table 8 can be divided into two groups:

- **Mean Differences in the Responses between Employed and Unemployed Participants**

There was a trend towards lower scores in the mean responses in the employed participants for most of the SSQ12 questions except for SSQ-9 and SSQ-10. This suggests that employed participants seem to be struggling more with SSD. However, the differences between the two groups were not statistically significant for all questions ($P < 0.05$).

- **Mean Differences in the Responses between Participants’ who are Working in Noisy and Non-noisy Environments**

Similarly, there was a trend towards lower scores for the SSQ12 questionnaire (except for SSQ12-3 and SSQ12-12) in participants who were working in non-noisy environments, suggesting once again that these participants were struggling more than their counterparts who were working in noisy environments. However, there were no statistical differences in the results between the two groups ($p < 0.05$).

2.3 Correlation Analysis for Participants’ Responses

The Pearson correlation test was used to examine the relationship between the participants’ responses and 1) the age of the participants and 2) the duration of hearing loss. Panel (a) in Table 9 shows the results for SSQ12 compared to the age, while Panel (b) in the same table presents the results for SSQ12 compared to the duration of hearing loss.

Table 9 Correlation between Participants’ Responses with the Age and Duration of Hearing Loss

Panel (a)

Correlation test			
Variable 1	Variable 2	Pearson	Sig. 5%
Age	SSQ12-1	0.29	0.04**
Age	SSQ12-2	0.18	0.20
Age	SSQ12-3	0.17	0.21
Age	SSQ12-4	-0.01	0.97
Age	SSQ12-5	0.06	0.68
Age	SSQ12-6	0.29	0.03**
Age	SSQ12-7	0.25	0.07
Age	SSQ12-8	0.17	0.21
Age	SSQ12-9	-0.11	0.45
Age	SSQ12-10	0.07	0.62
Age	SSQ12-11	0.12	0.38
Age	SSQ12-12	0.12	0.37

**significant at a 5% level

Panel (b)

Correlation test			
Variable 1	Variable 2	Pearson	Sig. 5%
Duration of hearing loss (years)	SSQ12-1	0.16	0.35
Duration of hearing loss (years)	SSQ12-2	0.22	0.19
Duration of hearing loss (years)	SSQ12-3	0.03	0.85
Duration of hearing loss (years)	SSQ12-4	0.04	0.80
Duration of hearing loss (years)	SSQ12-5	0.07	0.66
Duration of hearing loss (years)	SSQ12-6	0.29	0.08
Duration of hearing loss (years)	SSQ12-7	0.41	0.01**
Duration of hearing loss (years)	SSQ12-8	0.14	0.43
Duration of hearing loss (years)	SSQ12-9	0.10	0.59
Duration of hearing loss (years)	SSQ12-10	0.14	0.43
Duration of hearing loss (years)	SSQ12-11	0.28	0.10
Duration of hearing loss (years)	SSQ12-12	-0.02	0.92

**significant at a 5% level

- **Correlation between the SSQ12 Responses and the Age of the Participants.**

As observed from the results in Panel (a), there is a weak positive correlation between the age and the participants' responses in all the SSQ12 questions, with exception of questions SSQ12-4 and SSQ12-9 where it shows a weak negative correlation, meaning that the older the age the lower the score on the scale. However, the correlation was only statistically significant ($P \leq 0.05$) for SSQ12-1 ($p=0.04$) and SSQ12-6 ($p=0.03$).

- **Correlation between the SSQ12 Responses and the Duration of Hearing Loss.**

There is a weak positive correlation between the duration of hearing loss and the responses in the SSQ12 questionnaire except for SSQ12-7, where there is a moderately positive correlation, and SSQ12-12 where there is a weak negative correlation. There were however no statistically significant differences ($P < 0.05$) between most of the responses to the SSQ12 questionnaire and the duration of hearing loss, except for question SSQ12-7 ($P = 0.01$).

DISCUSSION

Just as human beings require two eyes to see in three dimensions, we require two ears for spatial hearing. The development of spatial hearing is important in developing communication and speech and language skills.^[1] Using two ears to hear enables us to locate the source of a sound, and to separate a single voice from surrounding background noise.^[1] Therefore, in a person with binaural hearing, the brain is better able to focus on the conversation it wants to hear which improves sound and speech discrimination and enhances speech intelligibility.^[1] This is particularly important in challenging environments with background noise. The binaural hearing also enables a better sense of balance in hearing sounds and improves sound quality.^[1]

In a patient with SSD, the benefits of binaural hearing and therefore spatial hearing are lost. The functional deficits associated with SSD have a profound impact on socialization, learning in children, and work productivity.^[6,7,8] While there are many options available to individuals with SSD i.e. CROS hearing aids, BAHAs, and finally CIs, but they are expensive. In developing countries, many of these options are simply not available due to the high cost. At our institution, the current approach to the treatment of SSD has been very pragmatic (and mainly determined by cost).

Disabilities associated with SDD, continue to be under-recognized. Few studies have looked at the effects of SSD in a developing world setting. The main objective of this study was to identify the perceived disabilities in patients with SSD. The effects of age, duration of hearing loss, employment status, and noisy workplace environments on perceived disability in SSD were also analysed.

HHIA Questionnaire:

The HHIA specifically addresses both the auditory as well as the non-auditory aspects of UHL such as the emotional, functional, and social handicap. The findings of the HHIA showed that most of the participants (71%) either have moderate (32%) or significant handicaps (39%). It is worth noting that when looking at the social questions which involved interactions with friends and family (S9, S13, S21), the participants tended to struggle less compared to when they had to interact with colleagues or clients (S7). Chang et al looked at the communication and social challenges in 52 patients following their diagnosis with SSD and identified several challenges which included an increased reliance on family members, a

decreased sense of autonomy as well as communication quality changes with family members.^[10] Chang et al. utilised semi-structured interviews that were digitally recorded and transcribed verbatim.^[10] One of the limitations of the HHIA questionnaire is that it does not particularly address the question of decreased autonomy and increased reliance on others.

Our study also found that patients with SSD have difficulty in listening to conversations in background noise such as busy places. This concurs with Canete et al. study, which included a group of 13 adults with UHL and a control group with normal binaural hearing.^[11] Their study concluded that UHL affected speech detection in noise as well as sound localization and patients' self-perceived hearing disability.^[11] Canete et al. also looked at the effect of UHL on speech-evoked cortical auditory evoked potentials (CAEP).^[11] It revealed that CAEPs elicited by speech sounds in patients with UHL are sensitive enough to evidence changes within the auditory cortex. Newman et al.^[12] indicated that social and emotional functions in patients with SSD are below average using the HHIA questionnaire. In contrast to a study by Newman et al., our study found that patients with SSD, in general, tended not to be struggling emotionally such as being embarrassed, isolated, or feeling depressed.

As mentioned, there is a prevailing misperception that one normal hearing ear is sufficient for daily communication, and in many instances, the disabling effect of SSD is underestimated as it is less overt. Increased effort is required to compensate for the loss of spatial hearing with SSD in complex listening environments and this eventually results in auditory fatigue^[13] and reduced performance at work.^[14]

Our study examined the perceived disability of SSD in both employed as well as unemployed individuals and found that both groups have a severe handicap. However, there is no statistically significant difference in the total handicap score between the two groups ($p > 0.05$). Employment status, therefore, did not have an impact on patients' perception of the disability of their SSD. One of the challenges with the loss of spatial hearing in SSD is that patients struggle with listening to speech in the presence of background noise. One would expect therefore that individuals who have SSD would struggle more when working in noisy environments. While the total handicap score for responders working in noisy environments was lower than those working in a non-noisy environment, but the results were not statistically significant ($p > 0.05$).

This study also examined the relationship between the total handicap score on the one hand and the age of the participants and the duration of hearing loss on the other hand. The results

for both demonstrate a negative relationship between the age and the handicap scores (-0.27; $p=0.11$), and between the duration of the hearing loss and the handicap score (-0.21; $p=0.26$). Essentially, the older the age of the individual and the longer the duration of the hearing loss, the lower the handicap score. These findings were not also statistically significant ($p>0.05$). A study done by Augustine et al. assessed the auditory and psychosocial handicap associated with UHL in 50 adult patients.^[15] The findings conclude that age, duration, side, and occupation did not affect HHIA total score. These findings contrast with the findings of a study done by Firszt et al. which showed that individuals with UHL who lost hearing as children were better at sound localization than those who had recently lost hearing as adults, but this was not the case for speech recognition. The authors suggested that experience plays an important role in learning to use monaural localization cues but perhaps not speech understanding.^[16]

SSQ12 Questionnaire:

Besides the numerous negative consequences, there is also considerable variation in how individuals perceive their handicap. The mean of the responses in the SSQ12 questionnaire varied considerably and was between 3.42 and 7 (median between 3.5 and 8) indicating that while some responders experienced major difficulties in listening and hearing in different situations, others have only minor difficulties. Our study found that overall, participants with SSD find following a conversation with background noise challenging, and have difficulty localizing sounds. Regarding the ability to follow multiple speech streams, most of the participants struggle to follow multiple conversations at the same time. The participants also struggle to identify the distance of the sound source and need to exert extra effort when listening. Conversely, participants seem to have less difficulty with recognition of sound movement, sound segregation, sound identification as well as sound quality and naturalness.

The findings of the SSQ12 and HHIA total scores were comparable concerning employment status and perceived disability. There were no statistically significant differences ($p>0.05$) in the mean answers between the employed and unemployed responders (p -values test were between 0.19 and 0.90). The results for the SSQ12 questionnaire and HHIA for employed responders working in noisy and non-noisy environments were also comparable in that there were no statistically significant differences ($p>0.05$) between the 2 groups (p -values were between 0.10 and 0.83). Therefore, working in what patients' environment did not seem to impact the perceived disability in patients with SSD.

The study also compared the age of the participants and their responses to the SSQ12 questionnaire. No statistically significant difference could be found for most of the responses except for SSQ12-1 and SSQ12-6, where there was a significant relationship (p-values 0.04 and 0.03 respectively) between the age of the participants and their responses. Older patients were able to follow a conversation with background noise and had less difficulty localizing sounds. This has implications for individuals in the younger age group and particularly in children. Studies have shown that children generally had more difficulty understanding speech in background noise and more trouble with localization ability than their normal-hearing peers.^[17,18] These children were also more likely to have academic difficulties than their normal-hearing peers.^[18]

When the duration of the SSD was factored into the responses of the SSQ12, no statistically significant differences were found for most questions except for SSQ12-7 which looked at the sound distance. Individuals with a longer duration of SSD had less difficulty detecting sound distance (e.g. able to tell how far a truck is from the sound) and this was found to be statistically significant (p=0.01).

CONCLUSIONS

This study concurs with findings in the literature that individuals with SSD are a heterogenous group when one looks at perceived difficulty. Additional tools like functional surveys and questionnaires should be used to identify and assess specific risk areas of concern such as localization ability, speech in noise, and listening effort (e.g. SSQ12) as well and the effect on social and emotional well-being (HHIA). This enables an individualised approach when assessing patients with SSD when considering treatment options, rehabilitation, and counselling.

LIMITATION OF THE STUDY

One of the limitations is that very few children compared to adults participated in the study. Another limitation is the fact that for non-English speaking participants the questionnaires were conducted in an interview format and translated in the participant's first language. This may of course present a threat to the validity of the questions. In this study however the audiologist conducting the interview had the linguistic ability and is trained in the research

field and so was aware of those potential risks. was not available to the researcher at the time of obtaining the data, especially with the spread of COVID-19 which negatively affected the work of the audiological department.

REFERENCES

1. Prasad BK. Binaural hearing: Physiological and Clinical View. *Arch Otolaryngol Rhinol* 2020;6(2):033-036. <http://dx.doi.org/10.17352/2455-1759.000118>
2. Noble W, Tyler R, Dunn C, Witt S. Binaural hearing has advantages for cochlear implant users also. *The Hearing Journal* 2005;58(11):56-57. <https://doi.org/10.1097/01.hj.0000286407.49683.14>
3. Lucas L, Katiri R, Kitterick PT. The psychological and social consequences of single-sided deafness in adulthood. *International journal of audiology* 2018;57(1):21-30. <https://doi.org/10.1080/14992027.2017.1398420>
4. Cabral Junior F, Pinna MH, Alves RD, Malerbi AFDS, Bento RF. Cochlear implantation and single-sided deafness: a systematic review of the literature. *International archives of otorhinolaryngology* 2016;20(1):69-75. <https://doi.org/10.1055/s-0035-1559586>
5. Usami SI, Kitoh R, Moteki H, Nishio SY, Kitano T, Kobayashi M, Shinagawa J, Yokota Y, Sugiyama K, Watanabe K. Etiology of single-sided deafness and asymmetrical hearing loss. *Acta oto-laryngologica* 2017;137(S565):S2-S7.
6. Fogels J, Jönsson R, Sadeghi A, Flynn M, Flynn T. Single-Sided Deafness—Outcomes of Three Interventions for Profound Unilateral Sensorineural Hearing Loss: A Randomized Clinical Trial. *Otology & Neurotology* 2020;41(6):736-744.
7. Cire G. Understanding Single Sided Deafness: Evaluation and Treatment for Professionals. *Audiology*, 2012. <https://www.audiologyonline.com/articles/understanding-single-sided-deafness-evaluation-6829> (accessed 5 November 2020).
8. Lieu JEC. Speech-language and educational consequences of unilateral hearing loss in children. *Archives of Otolaryngology–Head & Neck Surgery* 2004;130(5):524-530. <https://doi.org/10.1001/archotol.130.5.524>
9. Taber KS. The use of Cronbach’s alpha when developing and reporting research instruments in science education. *Research in Science Education* 2018;48(6):1273-1296. <http://dx.doi.org/10.1007/s11165-016-9602-2>
10. Chang PF, Zhang F, Schaaf AJ. Deaf in one ear: Communication and social challenges of patients with single-sided deafness post-diagnosis. *Patient Education and Counseling* 2020;103(3):530-536. <https://doi.org/10.1016/j.pec.2019.10.009>

11. Canete OM, Purdy SC, Brown CR, Neeff M, Thorne PR. Impact of unilateral hearing loss on behavioural and evoked potential measures of auditory function in adults. *Am Acad Audiol* 2019;30(7):564-578.
12. Newman CW, Sandridge SA, Wodzisz LM. Longitudinal benefit from and satisfaction with the Baha system for patients with acquired unilateral sensorineural hearing loss. *Otology & Neurotology* 2008;29(8):1123-1131.
13. AlHanbali S, Dawes P, Lloyd S, Munro K.J. Self-Reported Listening-Related Effort and Fatigue in Hearing-Impaired Adults. *Ear and hearing* 2017;38(1):e39–e48.
14. Mohr PE, Feldman JJ, Dunbar JL, McConkey-Robbins A, Niparko JK, Rittenhouse RK, Skinner MW. The societal costs of severe to profound hearing loss in the united states. *International journal of technology assessment in health care* 2000;16(4):1120–1135. <https://doi.org/10.1017/s0266462300103162>
15. Augustine AM, Chrysolyte SB, Thenmozhi K, Rupa V. Assessment of auditory and psychosocial handicap associated with unilateral hearing loss among Indian patients. *Indian Journal of Otolaryngology and Head & Neck Surgery* 2013;65(2):120-125. <https://doi.org/10.1007/s12070-012-0586-6>
16. Firszt JB, Reeder RM, Holden LK. Unilateral Hearing Loss: Understanding Speech Recognition and Localization Variability-Implications for Cochlear Implant Candidacy. *Ear and hearing* 2017;38(2):159-173. <https://doi.org/10.1097/aud.0000000000000380>
17. Bess FH, Tharpe AM, Gibler AM. Auditory performance of children with unilateral hearing loss. *Ear and hearing* 1986;7(1):20–26. <https://doi.org/10.1097/00003446-198602000-00005>
18. Bovo R, Martini A, Agnoletto M, Beghi A, Carmignoto D, Milani M, Zangaglia AM. Auditory and academic performance of children with unilateral hearing loss. *Scand Audiol Suppl* 1988;30:71-4. PMID: 3227285.

APPENDICES

APPENDIX (A): ACKNOWLEDGEMENTS

I thank Almighty for giving me the patience, strength, and guidance to complete this research project. I am also grateful to my supervisor Dr. Tashneem Harris for her support and outstanding guidance. My special thanks to Professor Johannes Fagan for his unlimited support and motivation. I would also thank all my family members; especially my husband Dr. Hani Nuri Rohuma, my father-in-law Nuri Rohuma and my two sons Aws and Ayhm for their patience and non-stop support throughout this journey.

APPENDIX (B): HHIA QUESTIONNAIRE

HEARING HANDICAP INVENTORY FOR ADULTS (HHIA)

NAME: _____ DATE: _____

Folder No, _____ Age: _____

INSTRUCTIONS: The purpose of the scale is to identify the problems your hearing loss may be causing you. Check YES, SOMETIMES, or NO for each question. DO NOT skip a question if you avoid a situation because of your hearing problem. If you use a hearing aid, please answer the way you hear **WITHOUT** your aid.

		YES (4)	SOME- TIMES (2)	NO (0)
S-1.	Does a hearing problem cause you to use the phone less often than you would like?			
E-2.	Does a hearing problem cause you to feel embarrassed when meeting new people?			
S-3.	Does a hearing problem cause you to avoid groups of people?			
E-4.	Does a hearing problem make you irritable?			
E-5.	Does a hearing problem cause you to feel frustrated when talking to members of your family?			
S-6.	Does a hearing problem cause you difficulty when attending a party?			
S-7.	Does a hearing problem cause you difficulty hearing/understanding coworkers, clients, or customers?			
E-8.	Do you feel handicapped by a hearing problem?			
S-9.	Does a hearing problem cause you difficulty when visiting friends, relatives, or neighbors?			
E-10.	Does a hearing problem cause you to feel frustrated when talking to coworkers, clients or customers?			
S-11.	Does a hearing problem cause you difficulty in the movies or theater?			
E-12.	Does a hearing problem cause you to be nervous?			
S-13.	Does a hearing problem cause you to visit friends, relatives, or neighbors less often than you would like?			
E-14.	Does a hearing problem cause you to have arguments with family members?			
S-15.	Does a hearing problem cause you difficulty when listening to TV or radio?			
S-16.	Does a hearing problem cause you to go shopping less often than you would like?			
E-17.	Does any problem or difficulty with your hearing upset you at all?			
E-18.	Does a hearing problem cause you to want to be by yourself?			

		YES (4)	SOME- TIMES (2)	NO (0)
S-19.	Does a hearing problem cause you to talk to family members less often than you would like?			
E-20.	Do you feel that any difficulty with your hearing limits or hampers your personal or social life?			
S-21.	Does a hearing problem cause you difficulty when in a restaurant with relatives or friends?			
E-22.	Does a hearing problem cause you to feel depressed?			
S-23.	Does a hearing problem cause you to listen to TV or the radio less often than you would like?			
E-24.	Does a hearing problem cause you to feel uncomfortable when talking to friends?			
E-25.	Does a hearing problem cause you to feel left out when you are with a group of people?			

NO = 0 points Sometimes = 2 points YES = 4 points

Total # of points _____ / 100

Total # of points for SOCIAL _____ / 48 = _____

Total # of points for EMOTIONAL _____ / 52 = _____

0 (no handicap) to 100 (total handicap)

0-16% = No handicap

18-42% = Mild-Moderate Handicap

44%+ = Significant Handicap

APPENDIX (C): SSQ12 QUESTIONNAIRE

SSQ12 Instructions

The following questions inquire about aspects of your ability and experience hearing and listening in different situations.

For each question, put a mark, such as a cross (x), **anywhere** on the scale shown against each question that runs from 0 through to 10. Putting a mark at **10** means that you would be **perfectly** able to do or experience what is described in the question. Putting a mark at **0** means you would be quite **unable** to do or experience what is described.

As an example, question 1 asks about having a conversation with someone while the TV is on at the same time. If you are well able to do this then put a mark up toward the right-hand end of the scale. If you could follow about half the conversation in this situation put the mark around the mid-point, and so on.

We expect that all the questions are relevant to your everyday experience, but if a question describes a situation that does not apply to you, put a cross in the "not applicable" box. Please also write a note next to that question explaining why it does not apply in your case

Your name:

Today's date

Your age

Please check one of these options:

I have **no** hearing aid/s

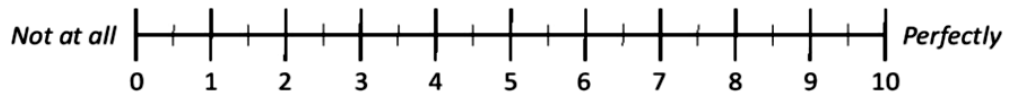
I use **one** hearing aid (**left ear**)

I use **one** hearing aid (**right ear**)

I use **two** hearing aids (**both ears**)

Folder Number

1. 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?



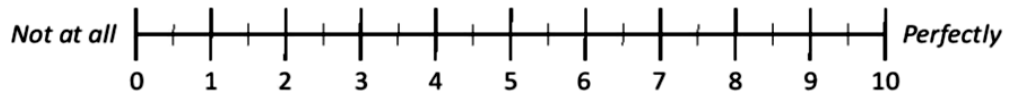
Not applicable

2. 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?



Not applicable

3. 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?



Not applicable

4. 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?



Not applicable

5. 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?



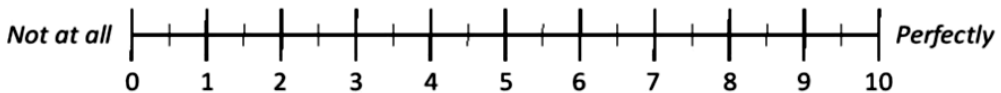
Not applicable

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



Not applicable

7. Can you tell how far away a bus or a truck is, from the sound?



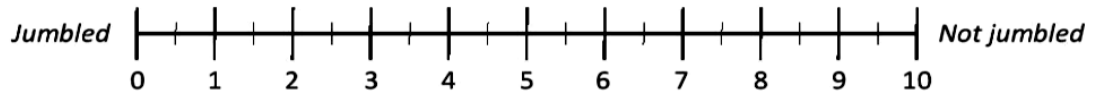
Not applicable

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



Not applicable

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



Not applicable

10. When you listen to music, can you make out which instruments are playing?



Not applicable

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



Not applicable

12. Do you have to concentrate very much when listening to someone or something?



Not applicable

**APPENDIX (D): DEPARTMENTAL RESEARCH COMMITTEE APPROVAL
LETTER**



UNIVERSITY OF CAPE TOWN



**Department of Surgery
Departmental Research Committee
Dr Timothy Pennel
D24 Office, Groote Schuur Hospital
Observatory 7925
South Africa
Tel (021) 404 9430
Email: tim.pennel@uct.ac.za**

11 Oct 2018

Dr D Elfallah
Department of Surgery
University of Cape Town

Dear Dr Elfallah

RE: Project 2018/041

PROJECT TITLE: Perceived Disability In Children And Adults With Single Sided Deafness At Two Tertiary Institutions

The above protocol has been reviewed by the Department of Surgery Research Committee. I am pleased to inform you that the committee approved the scientific merit of the study, and endorse the protocol for submission to the relevant ethics committee.

Although this letter serves as confirmation that the above protocol has successfully passed through the surgical DRC, respective ethics committees still require DRC chair signature before submission.

Please use the above project number in all future correspondence.

Yours sincerely

Signature Removed

**DR TIMOTHY PENNEL
CHAIRMAN: RESEARCH COMMITTEE**

"OUR MISSION is to be an outstanding teaching and research university, educating for life and addressing the challenges facing our society."

APPENDIX (E): HUMAN RESEARCH ETHICS APPROVAL LETTER AND ETHICS RENEWAL



UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee



Room B53-46 Old Main Building
Grootte Schuur Hospital
Observatory 7925
Telephone (021) 405 6625
Email: shuretta.thomas@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

13 November 2018

HREC REF: 696/2018

Dr T Harris
Otolaryngology
H53-79
OMB

Dear Dr Harris

PROJECT TITLE: PERCEIVED DISABILITY IN CHILDREN AND ADULTS WITH SINGLE SIDED DEAFNESS AT TWO TERTIARY INSTITUTIONS (Masters Candidate - Dr B Elfallah)

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30 November 2019.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.

(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

The HREC acknowledge that the student, Dr Balgeis Elfallah will also be involved in this study.

Yours sincerely

Signature Removed

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE
Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938

HREC 696/2018

Ethics Renewal



FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee



FHS017: Annual Progress Report / Renewal

Record Reviews/Audits/Collection of Biological Specimens/Repositories/Databases/Registries

HREC office use only (FWA00001637; IRB00001838)			
This serves as notification of annual approval, including any documentation described below.			
<input checked="" type="checkbox"/> Approved	Annual progress report	Approved until/next renewal date	30/05/21
<input type="checkbox"/> Not approved	See attached comments		
Signature Chairperson of the HREC/ Designee	Signature Removed	Date Signed	13/5/20

Note: Please note that incomplete submissions will not be reviewed. Please email this form and supporting documents (if applicable) in a combined pdf-file to hrec-enquiries@uct.ac.za.

Please clarify your plan for research-related activities during COVID-19 lockdown

Principal Investigator to complete the following:

1. Protocol Information

Date (when submitting this form)	04/5/2020		
HREC REF Number	696/2018	Current Ethics Approval was granted until	30/11/2019
Protocol title	Perceived disability in children and adults with single sided deafness at two tertiary institutions		
Principal Investigator	Tashneem Harris		
Department / Office Internal Mail Address	farhana.hassan@uct.ac.za		
1.1 Does this protocol receive US Federal funding?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

2. Protocol status (tick ✓)

<input type="checkbox"/>	Research-related activities are ongoing
<input checked="" type="checkbox"/>	Data collection is complete, data analysis only
Please indicate (in the block below) the titles and HREC reference numbers of any projects currently making use of the Database/registry/repository.	

3. Protocol summary

Total number of records or specimens collected, reviewed or stored since the original approval	30
Total number of records or specimens collected, reviewed or stored since last progress report	60
Have any research-related outputs (e.g. publications, abstracts, conference presentations) resulted from this research? If yes, please list and attach with this report.	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

4. Signature

HUMAN RESEARCH ETHICS COMMITTEE

11 MAY 2020

HEALTH SCIENCES FACULTY

UNIVERSITY OF CAPE TOWN



Signature of PI	Tashneem Harris	Date	04/5/2020
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APPENDIX (F): CONSENT FORM

Consent to participate in questionnaire regarding perceived disability of single sided deafness study

Invitation

You are invited to participate in a research study for patients who have single sided deafness (hearing loss in one ear). The study will include about 100 participants and your participation is completely voluntary.

Prior to your participation the audiologist will perform a hearing test and document the extent of your (or your child's) hearing loss.

After confirming that you (or your child) have a significant hearing loss in one ear, the audiologist will explain the nature of the study and will give you a list of questions to be answered.

You are encouraged to ask the audiologist any questions that you may have regarding this study.

An important aspect of this study is determining whether people who have significant hearing loss in one ear feel that it affects their quality of life and interferes with their ability perform certain tasks.

Potential Benefit

There is no direct benefit to you/ your child, however knowledge gained from this research may benefit others in the future. The information gained from this study will allow ear surgeons to determine whether patients with hearing loss in one ear need treatment or not.

Potential risks

There are no extra risks associated with this study.

Voluntary nature of the study

You do not have to participate in this study to get treatment. Your decision not to take part in this study, will not change your current or future relationship with the doctor or department or affect your treatment. If you decide not to participate, you will not be penalized in any way. If you wish to no longer participate in this study, you may withdraw at any stage.

Cost and compensation

There will be no remuneration for participating in this study. Many of the tests and follow-up clinic visits are part of standard medical care and you are therefore responsible for the costs related to the treatment of your condition.

Confidentiality

Your privacy is important. All the information gathered during this study will be kept private. The results of this study will be published or presented at a medical meeting, however no information will be included that will make it possible for you to be identified.

Whom to contact with questions

If you would like to have more information or you have questions regarding this study you may contact your doctor (the principal investigator), Dr. T Harris at (021) 404-5052 or (021) 404-5286 and Silva Kuschke (Audiologist) at 021 658 5406.

Participant's authorization

I have read the information provided above. I have had the opportunity to ask questions and am satisfied with the answers and explanations I have received. By signing this form I am giving permission for data related to my/ my child's medical condition to be used in the research described above. A copy of this authorisation form will be given to me after signing.

I understand that my participation is completely voluntary. I now understand all of the information and consent to participate in the study.

Subject signature: _____ Date: _____

Subject name: _____

In case of minor

Signature of legal guardian: _____ Date: _____

Witness signature: _____ Date: _____

Witness name: _____

APPENDIX (G): SAMJ INSTRUCTIONS FOR AUTHORS



Submissions

Author Guidelines

Conflicts of interest

We require that both authors and reviewers declare all sources of support for their research, any personal or financial relationships (including honoraria, speaking fees, gifts received, etc) with relevant individuals or organisations connected to the topic of the paper, and any association with a product or subject that may constitute a real, perceived or potential conflict of interest..

Research ethics committee approval

Authors must provide evidence of Research Ethics Committee approval of the research where relevant. Ensure the correct, full ethics committee name and reference number is included in the manuscript.

If the study was carried out using data from provincial healthcare facilities, or required active data collection through facility visits or staff interviews, approval should be sought from the relevant provincial authorities. For South African authors, please refer to the guidelines for submission to the National Health Research Database. Research involving human subjects must be conducted according to the principles outlined in the Declaration of Helsinki.

Protection of rights to privacy

Copyright notice

Copyright remains in the Author's name. The work is licensed under a Creative Commons Attribution - Non-commercial Works License. Authors are required to complete and sign an Author Agreement form that outlines Author and Publisher rights and terms of publication. The Author Agreement form should be uploaded along with other submissions files and any submission will be considered incomplete without it.

Material submitted for publication in the SAMJ is accepted provided it has not been published or submitted for publication elsewhere. Please inform the editorial team if the main findings of your paper have been presented at a conference and published in abstract form, to avoid copyright infringement. The SAMJ does not hold itself responsible for statements made by the authors. |

Ethnic/race classification

Use of racial or ethnicity classifications in research is fraught with problems. If you choose to use a research design that involves classification of participants based on race or ethnicity, or discuss issues with reference to such classifications, please ensure that you include a detailed rationale for doing so, ensure that the categories you describe are carefully defined, and that socioeconomic, cultural and lifestyle variables that may underlie perceived racial disparities are appropriately controlled for. Please also clearly specify whether race or ethnicity is classified as reported by the patient (self-identifying) or as perceived by the investigators. Please note that is not appropriate to use self-reported or investigator-assigned racial or ethnic categories for genetic studies.

General article format/layout

Accepted manuscripts that are not in the correct format specified in these guidelines will be returned to the author(s) for correction, which will delay publication.

General:

- Manuscripts must be written in UK English.
- The manuscript must be in Microsoft Word format. Text must be single-spaced, in 12-point Times New Roman font, and contain no unnecessary formatting (such as text in boxes).
- Please make your article concise, even if it is below the word limit.
- Qualifications, full affiliation (department, school/faculty, institution, city, country) and contact details of ALL authors must be provided in the manuscript and in the online submission process.
- Abbreviations should be spelt out when first used and thereafter used consistently, e.g. 'intravenous (IV)' or 'Department of Health (DoH)'.
- Include sections on Acknowledgements, Conflict of Interest, Author Contributions and Funding sources. If none is applicable, please state 'none'.
- Scientific measurements must be expressed in SI units except: blood pressure (mmHg) and haemoglobin (g/dL).
- Litres is denoted with an uppercase L e.g. 'mL' for millilitres).
- Units should be preceded by a space (except for % and °C), e.g. '40 kg' and '20 cm' but '50%' and '19°C'.
- Please be sure to insert proper symbols e.g. μ not u for micro, α not a for alpha, β not B for beta, etc.
- Numbers should be written as grouped per thousand-units, i.e. 4 000, 22 160.
- Quotes should be placed in single quotation marks: i.e. The respondent stated: '...'
- Round brackets (parentheses) should be used, as opposed to square brackets, which are reserved for denoting concentrations or insertions in direct quotes.
- If you wish material to be in a box, simply indicate this in the text. You may use the table format –this is the only exception. Please DO NOT use fill, format lines and so on.

SAMJ is a generalist medical journal, therefore for articles covering genetics, it is the responsibility of authors to apply the following:

- Please ensure that all genes are in italics, and proteins/enzymes/hormones are not.
- Ensure that all genes are presented in the correct case e.g. TP53 not Tp53.

****NB:** Copyeditors cannot be expected to pick up and correct errors ~~wrt~~ the above, although they will raise queries where concerned.

- Define all genes, proteins and related shorthand terms at first mention, e.g. '188del11' can be glossed as 'an 11 bp deletion at nucleotide 188.'

- Use the latest approved gene or protein symbol as appropriate:

Preparation notes by article type

Research

Guideline word limit: 4 000 words

Research articles describe the background, methods, results and conclusions of an original research study. The article should contain the following sections: introduction, methods, results, discussion and conclusion, and should include a structured abstract (see below). The introduction should be concise – no more than three paragraphs – on the background to the research question, and must include references to other relevant published studies that clearly lay out the rationale for conducting the study. Some common reasons for conducting a study are: to fill a gap in the literature, a logical extension of previous work, or to answer an important clinical question. If other papers related to the same study have been published previously, please make sure to refer to them specifically. Describe the study methods in as much detail as possible so that others would be able to replicate the study should they need to. Results should describe the study sample as well as the findings from the study itself, but all interpretation of findings must be kept in the discussion section, which should consider primary outcomes first before any secondary or tertiary findings or post-hoc analyses. The conclusion should briefly summarise the main message of the paper and provide recommendations for further study.

Select figures and tables for your paper carefully and sparingly. Use only those figures that provided added value to the paper, over and above what is written in the text.

Do not replicate data in tables and in text .

Structured abstract

- This should be 250-400 words, with the following recommended headings:
 - Background: why the study is being done and how it relates to other published work.
 - Objectives: what the study intends to find out
 - Methods: must include study design, number of participants, description of the intervention, primary and secondary outcomes, any specific analyses that were done on the data.
 - Results: first sentence must be brief population and sample description; outline the results according to the methods described. Primary outcomes must be described first, even if they are not the most significant findings of the study.
 - Conclusion: must be supported by the data, include recommendations for further study/actions.
- Please ensure that the structured abstract is complete, accurate and clear and has been approved by all authors.
- Do not include any references in the abstracts.

Main article

All articles are to include the following main sections: Introduction/Background, Methods, Results, Discussion, Conclusions.

The following are additional heading or section options that may appear within these:

- Objectives (within Introduction/Background): a clear statement of the main aim of the study and the major hypothesis tested or research question posed
- Design (within Methods): including factors such as prospective, randomisation, blinding, placebo control, case control, crossover, criterion standards for diagnostic tests, etc.
- Setting (within Methods): level of care, e.g. primary, secondary, number of participating centres.
- Participants (instead of patients or subjects; within Methods): numbers entering and completing the study, sex, age and any other biological, behavioural, social or cultural factors (e.g. smoking status, socioeconomic group, educational attainment, co-existing disease indicators, etc) that may have an impact on the study results. Clearly define how participants were enrolled, and describe selection and exclusion criteria.
- Interventions (within Methods): what, how, when and for how long. Typically for randomised controlled trials, crossover trials, and before and after studies.
- Main outcome measures (within Methods): those as planned in the protocol, and those ultimately measured. Explain differences, if any.

Results

- Start with description of the population and sample. Include key characteristics of comparison groups.
- Main results with (for quantitative studies) 95% confidence intervals and, where appropriate, the exact level of statistical significance and the number need to treat/harm. Whenever possible, state absolute rather than relative risks.
- Do not replicate data in tables and in text.
- If presenting mean and standard deviations, specify this clearly. Our house style is to present this as follows:
- E.g.: The mean (SD) birth weight was 2 500 (1 210) g. Do not use the \pm symbol for mean (SD).
- Leave interpretation to the Discussion section. The Results section should just report the findings as per the Methods section.

Discussion

Please ensure that the discussion is concise and follows this overall structure – sub-headings are not needed:

- Statement of principal findings
 - Strengths and weaknesses of the study
 - Contribution to the body of knowledge
 - Strengths and weaknesses in relation to other studies
 - The meaning of the study – e.g. what this study means to clinicians and policymakers
 - Unanswered questions and recommendations for future research
-

Conclusions

This may be the only section readers look at, therefore write it carefully. Include primary conclusions and their implications, suggesting areas for further research if appropriate. Do not go beyond the data in the article.

References

NB: Only complete, correctly formatted reference lists in Vancouver style will be accepted. Reference lists must be generated manually and not with the use of reference manager software. Endnotes must not be used.

- Authors must verify references from original sources.
 - Citations should be inserted in the text as superscript numbers between square brackets, e.g. These regulations are endorsed by the World Health Organization,^[2] and others.^[3,4-6]
 - All references should be listed at the end of the article in numerical order of appearance in the Vancouver style (not alphabetical order).
 - Approved abbreviations of journal titles must be used; see the List of Journals in Index Medicus.
 - Names and initials of all authors should be given; if there are more than six authors, the first three names should be given followed by et al.
 - Volume and issue numbers should be given.
 - First and last page, in full, should be given e.g.: 1215-1217 not 1215-17.
 - Wherever possible, references must be accompanied by a digital object identifier (DOI) link). Authors are encouraged to use the DOI lookup service offered by CrossRef:
 - On the Crossref homepage, paste the article title into the 'Metadata search' box.
 - Look for the correct, matching article in the list of results.
 - Click Actions > Cite
 - Alongside 'url =' copy the URL between { }.
 - Provide as follows, e.g.: <https://doi.org/10.7196/07294.937.98x>
-