

ASSESSMENT OF SELF REPORTED SPATIAL HEARING MEASURES TO EVALUATE HEARING AID BENEFIT

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Abstract-

Spatial Hearing helps us to locate sound source and continue the communication in noisy environment. Hearing loss can cause reduction of spatial hearing and appropriate hearing aid selection and fitting must be done to enhance spatial hearing in Hearing impaired people. The aim of this study was to adapt and standardize the Spatial Hearing Questionnaire (SHQ) in Bengali Language. This study was carried out in different phases. The questionnaire was trans-adapted in Bengali by translation and back translation process. The questionnaire was administered along with the original English questionnaire and APHAB-Bengali in three different phases on sixty hearing impaired subjects, having bilateral moderate to severe sloping sensorineural hearing loss and who have undergone hearing aid fitting by digitally programmable multichannel hearing aids binaurally. The data obtained was analysed statistically. One way ANOVA was done for comparison between SHQ-B and SHQ-E. There was no significant difference between SHQ-B and SHQ-E in pre-fitting, immediate after fitting and 21 days after fitting. The correlation between the three conditions was significantly high. The score for SHQ-B in these three conditions showed a significant difference that is there is improvement in spatial hearing after amplification. Earwise comparison was also assessed in three different conditions. The study concludes that this is a reliable and valid test to measure spatial hearing benefit after fitting of hearing aids.

KeyWords: Questionnaire(SHQ), transadapted, APHAB- Bangla, multi channel hearing aids, Face validity, Concurrent validity, Discriminant Validity, Criterion Related Validity

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INTRODUCTION

Communication is the process to share the individual's thought, ideas, or feelings by various means. The day to day life communication is mainly verbal for which hearing is very crucial.

The Interaural Time difference(ITD) tells about time delay in the perception of sounds between two ears, when the source is at one side of head. The interaural level differences(ILD), tells about the difference of sounds in terms of pitch and loudness, between two ears, when source is on one side of head(Middlebrooks and Green,1999).The hearing impaired persons get a significant benefit by using appropriate amplification devices and if the devices can be fitted binaurally, the benefit will be much more both in terms of communication and sound localization. The most common form of amplification devices,—used to rehabilitate the adult patient, is the hearing aid(Dillon,2001).Studies reveal that over two thirds of the hearing impaired population is benefitted by using hearing aids(Richards and Gleeson,1990). hearing plays very crucial role in communication and is very important for auditory perception. The spatial hearing is a complex mechanism which includes the participation and coordination of both ears, depending upon the source of sound. Thus hearing impaired patients have problems in localizing the sound source, thus affecting quality of life-

NEED OF THE STUDY

In view of the fact that hearing loss can cause the reduction of spatial hearing; appropriate hearing aid selection and fitting should be able to enhance the spatial hearing in hearing impaired people hearing impairment have difficulty in localizing sound than those with normal hearing. Subjects with hearing loss also have significantly poorer speech understanding, especially in group conversations and competing noise contexts. There are many standardized hearing aid satisfaction questionnaires like abbreviated profile of hearing aid benefit(APHAB)developed by Cox and Alexander,1995, Hearing Handicap Inventory for elderly screening developed by Ventry and Weinstein,1982 (HHIE-S), Kozlowski, Almeida, and Ribas(2015), International Outcome Inventory for Hearing Aids Outcome Inventory for hearing Aids Outcome Inventory(IOI- HA) questionnaire, etc. have been adapted in Bangla but there is no correct self reported important questionnaire for spatial hearing available in Bangla. So there is a need to standardize Hearing aid Outcome measure in Bangla.This study was aimed to adapt and standardize the Spatial Hearing Questionnaire (SHQ) in Bangla.

OBJECTIVES

- 1) To adapt and standardize the Spatial Hearing Questionnaire in Bangla.
- 2) To measure the validity of the Bangla version of Spatial Hearing Questionnaire (SHQ- B).
- 3) To administer the questionnaires in different conditions, i.e., before hearing aid fitting; after hearing aid fitting; and after 21 days of hearing aid fitting.
- 4) To correlate the SHQ- B scores with pure tone average of each ears measures with respect to frequencies. To obtain reliability of SHQ- B.

METHODOLOGY

The present study was conducted over 3 months to transadapt and standardize the Spatial Hearing Questionnaire in Bangla language. This was carried out in different phases. First, the questionnaire was transadapted in Bangla by translation- back translation process. Then, the questionnaire was administered along with the original English questionnaire (Tyler, Perreau and Haihong, 2009) APHAB- Bangla in three different phases on 60 hearing impaired subjects, having bilateral moderate to severe sloping sensorineural hearing loss and having undergone hearing aid fitting by digitally programmable multi channel hearing aids binaurally and finally, the obtained data was analysed statistically and thus the transadaptation and standardization took place.

Inclusion Criteria: 60 participants who were diagnosed with bilateral moderate

to severe sloping sensorineural hearing loss, irrespective of gender, with the age range of 30 to 70 years (mean 51.95, SD 11.58). All subjects were fitted with digitally programmable multichannel hearing aids binaurally. All the participants were native speakers of Bangla, residing at district of Kolkata and sub- urban areas, having good proficiency in English with at least 10+2 (higher secondary) educational background. All the participants had moderate to severe sensorineural hearing loss that was measured of four frequency average (500Hz, 1 KHz, 2 KHz, and 4 KHz with the mean pure tone average was 69.76dBHL (SD- 5.95) and 69.83dBHL (SD 6.25) for right ear and left ear respectively) The hearing aid features were same for all the hearing aid models.

Hearing aid features

FEATURES	
Hearing Aid Style	Behind The Ear (BTE)
Channel	3-5 channels
Microphone	Directional
Processor	Digital Signal Processing (DSP)
Noise reduction system	Present
Fitting Strategy	NAL-NL2

Dual channel audiometer with free field arrangement was used in the study. Hi-Pro was used for connecting and programming of hearing aids. Hearing aid programming software was used based on the different manufacturer of hearing aids. Different questionnaires were administered to measure the satisfaction level of hearing aid users, as follows; SHQ-E, SHQ-B, APHAB-B. All the questionnaires were being administered to the subjects for three times, i.e. first, before hearing aid fitting, then just after hearing aid fitting and finally after 21 days of hearing aid fitting. For the Spatial Hearing Questionnaire, the participants were instructed to read each questions thoroughly and to rate each questions with the likert rating scale, 0 to 10 where 0 means the situation is too easy and 10 means the situation is too difficult. The instruction was same for both the English and Bangla questionnaire. For APHAB-B, the instruction was that the

subject has to rate each questions with 7 point rating scale, where certain percentages have been given. The participants have to read each questions thoroughly and have to rate it by the given points. The scale is such: A- Always (99%), B- Almost Always (87%), C- Generally (75%), D- Half- the- time (50%), E- Occasionally (25%), F- Seldom (12%), G- Never (1%). The Procedure was divided into Phase- I constituting of a) Permission and Consent taken of author and participants, b) Adaptation of questionnaire in which first the English questionnaire was taken and translated in Bangla by five English and Bangla speaking bilinguals and made into a format. The translated Bangla questionnaire was again back- translated into English and was formatted again. This format was then matched to the Bangla format and finally the master format was made. c) In item analysis a total score was also obtained by combining scores from all 24 questions. Phase- II constituted of a) Administration of the Questionnaire b) **Face validity** : For judging the item

validity of the questionnaire it was given to 3 speech language pathologists and 3 audiologists, having a minimum five years of experience in field of teaching and in clinical practice with assessing inter-rater agreement. **c) Concurrent validity** The Bangla trans- adaptation of Abbreviated Profile of Hearing Aid Benefit (Cox and Alexander, 1995) by Murmu (2008) was administered along with the SHQ- E and SHQ- B, to judge the questionnaire's concurrent validity. **d) Discriminant Validity** For judging the Discriminant validity of the questionnaire, it was administered among participants, during aided and unaided conditions. **e) Criterion Related Validity** For judging the Criterion related validity of the questionnaire, the scores of three different conditions, such as, pre fitting, immediately after fitting and 21 days after fitting condition were correlated with the pure tone average of each ear for individual subjects.

Phase- III constituted **a) Hearing Evaluation** Pure tone thresholds of both ears were calculated using Intracoustic AD 229 E diagnostic clinical audiometer.. Middle ear function was checked using Immittance Audiometer. Subjects with "A" type tympanogram were included. **b)** Hearing aid selection and fitting was done depending upon the degree of the hearing loss of the participants. The administration of the questionnaires was first done before hearing aid fitting. Then hearing aid fitting was done, using Hi- Pro and other software. **Phase- IV** included **a) Hearing Aid Fitting** was done followed by hearing aid trial. In hearing aid trial, three different hearing aids with same technologies and features were used and after determining the most efficient hearing aids for individual patients, the hearing aid fitting

was done and all the three questionnaires were administered for the second time. **Phase- Va) Retest** After the fitting was done, all the participants were administered with the three questionnaires after 21 days of fitting when the fine tuning and troubleshooting assessment were done. **Phase- VI Data processing** The obtained data was entered in an excel spread sheet and further analyzed. **Phase- VII Test retest reliability** was checked by administering the questionnaire on binaural hearing impaired patients, using hearing aids, the consistency of the data was checked on within the group of same patients, first, before hearing aid fitting, second, just after hearing aid fitting and third, after three weeks of hearing aid fitting.

Statistical analysis

It was done using SAS software 9.2 version to check significance of SHQ-B tool. One way ANOVA was used to compare scores of SHQ-B and SHQ-E in all three conditions. Paired t-test was done for checking the difference in scores between pre-fitting and after 21 days after fitting conditions for SHQ-B scores. Similarly for checking difference between the scores of three test conditions of APHAB-B, paired t-test was administered. To check test – retest reliability Pearson correlation was done among three conditions of SHQ-B scores and also to check pure tone averages of each ear with three different test conditions

RESULTS

To investigate the objectives of the current study, statistical analysis was done, which is shown under following phases.

Phase 1: Comparison between SHQ-B and SHQ-E in all three test conditions the result of one way ANOVA which was done to see the comparison between the SHQ-B and SHQ-E scores in pre fitting condition. The p value is 0.774491795 which is >0.05 , therefore, there is no significant difference between the scores of SHQ-B and SHQ-E in pre fitting condition. The p value is 0.88886 which is >0.05 , therefore, there is no significant difference between the scores of SHQ-B and SHQ-E in immediate after fitting condition. There is no significant difference in mean scores of two set of data which shows that these two questionnaires are highly correlated. There is no significant difference in mean scores of two set of data which shows that these two questionnaires are highly correlated. There is no significant difference in mean scores of two set of data which shows that these two questionnaires are highly correlated. The p value is 0.398789 which is >0.05 , therefore, there is no significant difference between the scores of SHQ-B and SHQ-E in 21 days after fitting condition. There is no significant difference in mean scores of two set of data which shows that these two questionnaires are highly correlated.

Phase 2: Calculation of test retest reliability of SHQ-B .The mean scores of SHQ-B score in pre fitting and immediately after fitting condition are 199.56667 and 198.73333 and the standard deviation is 3.21736 and 30314 respectively. The Pearson correlation value of SHQ-B score in pre fitting and immediately after fitting condition is 0.96818 and p value is <0.0001 , (shown in table 5.5) which suggested there is

significant correlation between these test conditions. The mean scores of SHQ-B score in pre fitting and 21 days after fitting condition are 199.56667 and 160.33333 and the standard deviation is 3.21736 and 5.72140 respectively (shown in table 5.6). The Pearson correlation value of SHQ-B score in pre fitting and 21 days after fitting condition is 0.65159 and p value is <0.0001 , (shown in table 5.7) which suggested there is significant correlation between these test conditions.

Phase 3: Comparison between SHQ-B scores in three different conditions. The mean score, standard deviation and standard error between SHQ-B score in pre fitting and immediately after fitting conditions are 0.8333, 0.7008 and 0.1067 respectively (shown in table 5.8.). The result of paired t- test (shown in table 5.9.) between the scores of pre fitting and immediately after fitting condition of SHQ-B for all subjects which showed the p value is <0.0001 , that is <0.05 . Thus, there is significant difference between the scores of pre fitting and immediately after fitting condition of SHQ-B for all the subjects. The mean score, standard deviation and standard error between SHQ-B score in pre fitting and 21 days after fitting conditions are 39.233, 4.37 and 0.5642 respectively (shown in table 5.10). The result of paired t- test (shown in table 5.11) between the scores of pre fitting and immediately after fitting condition of SHQ-B for all subjects which showed the p value is <0.0001 , that is <0.05 . Thus, there is significant difference between the scores of pre fitting and 21

days after fitting condition of SHQ-B for all the subjects.

Phase 4: Correlation of SHQ-B data for three test conditions with pure tone average of each ear. The mean scores of right ear PTA and SHQ-B score in pre fitting condition are 69.76250 and 199.56667 and the standard deviation is 5.95346 and 3.21736 respectively (shown in table 5.12). The Pearson correlation value of right ear PTA and SHQ-B score in pre fitting condition is 0.53320 and p value is <0.0001 , (shown in table 5.13) which suggests there is significant correlation between these test conditions. The Pearson correlation value of right ear PTA and SHQ-B score in 21 days after fitting condition is 0.34384 and p value is 0.0071, (shown in table 5.17.) which suggested that there is significant correlation between these test conditions.

Phase 5: Comparison between APHAB-B scores in three different conditions. The result of paired t- test (shown in table 5.24.) between the scores of pre fitting and immediately after fitting condition of APHAB-B for all subjects which showed the p value is 0.057, that is <0.05 . Thus, there is no significant difference between the scores of pre fitting and immediately after fitting condition of APHAB-B for all the subjects.

SUMMARY AND CONCLUSION

The satisfaction levels of a person with his/ her hearing aids, can be assessed by administering different hearing aid satisfaction questionnaires which are very much subjective in nature. Thus there is a huge need to develop the

hearing aid satisfaction questionnaires on different aspects of hearing. The Spatial Hearing Questionnaire was adapted in Bengali language with proper procedure. Along with these two, APHAB- Bangla was also administered to assess the perceived benefit from hearing aids in terms of quality of life. All the participants completed the questionnaires in a structured interview format. After getting the data for all the three conditions, the correlation was measured with the pure tone average of each ear for individual participants to assess the contribution of hearing thresholds in hearing aid programming. On the basis of subjects' responses, the following conclusions were drawn: The SHQ-B Scores: The results of SHQ-B indicated that there were significant benefits in terms of spatial hearing on using binaural hearing aids. There was marked difference in scores between pre fitting and 21 days after fitting results for all the participants, although there was very little difference between the pre fitting and immediately after fitting data. Thus it is clear that the participants did not get any benefit immediately after the hearing aid fitting but when they got acquainted with the hearing aid, they were benefitted. Therefore, we can say that hearing aid satisfaction is improving with the duration of hearing aid use. The SHQ-E Scores: The SHQ-E scores showed significant benefit in 21 days after fitting conditions for each participant, than immediately after fitting condition. The scores of SHQ-B and SHQ-E were significantly correlated. The APHAB-B Scores: The APHAB-B scores indicated that there was marked improvement in overall scores along

with the score of four subscales such as ease of communication, reverberation, background noise and **aversiveness** in post fitting data as compared to pre fitting data.

The Pure Tone Average of each ear indicated high correlation with SHQ-B scores in three different test conditions, which shows that the effectiveness of hearing aid selection and programming is entirely dependent upon the Pure Tone Average of each ear. This study entails that the hearing aid plays an active role in improving the hearing related quality of life in the elderly population by improving the residual hearing in all aspects. The spatial hearing also got improved in the hearing impaired person after hearing aid use for a period of time. The advanced technologies of digital hearing aids also play an important role to get more benefit of the aural rehabilitation. Another point to be considered here was the binaural fitting of hearing aid. The use of hearing aid in both ears also improved the spatial hearing of the hearing impaired persons. Thus, with advanced technologies and with appropriate programming strategies, the spatial hearing can be significantly improved and the hearing impaired person can get optimum benefit from the hearing aid. In today's scenario digital hearing aids are very popular and advantageous for hearing impaired person in terms of advanced technology when it is fitted binaurally. But in India monaural hearing aids are being used by most of the hearing impaired population due to lack of awareness, socioeconomic status, literacy level, etc. Therefore, more awareness should be created in terms of binaural hearing aid usage so

that one can get optimum benefit from aural rehabilitation. The Spatial Hearing Questionnaire may be adapted in different Indian languages for clinical practice. There may be comparative study on monaural versus binaural hearing aid fitting by administering SHQ-B. There may be comparative study on analog versus digital hearing aid fitting by administering SHQ-B. The SHQ-B may be administered to Cochlear Implant population to evaluate the spatial hearing after implantation. A similar study may be carried out with hearing impaired children. Similar kind of study may be done for other audiogram configuration (i.e. shape of audiogram). Similar kind of study may be considered on the basis of different hearing aid style like In The Canal (ITC), Completely In the Canal (CIC), Invisible In the Canal (IIC), etc. There may be comparative study on monaural versus binaural Cochlear Implant by administering SHQ-B.

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