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Adaptation, Reliability, and Validity of the Auditory Skills Checklist (ASC) for Bengali Speaking Children with Severe to Profound Sensorineural Hearing Loss with Hearing Aids

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Adaptation, Reliability, and Validity of the Auditory Skills Checklist (ASC) for Bengali Speaking Children with Severe to Profound Sensorineural Hearing Loss with Hearing Aids

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Abstract

Background: The audiologic assessment guidelines of the American Speech-Language-Hearing Association (ASHA) encouraged functional auditory skills assessment, appropriate for age. The Auditory Skills Checklist (ASC) assessment tool was developed from the necessity to assess the auditory skills of young children with Sensorineural Hearing Loss (SNHL). The aim of this study was to adapt a Bengali version of the ASC checklist from the original English version and then to test its reliability and validity.

Methods: The method of forward-backward translation and cognitive debriefing was employed to produce a culturally sensitive Bengali version of the checklist. The data was analyzed for the internal consistency of items, inter-rater agreement of items, temporal reliability, and convergent validity.

Results: The adapted Bengali version of the ASC produced excellent internal consistency (Checklist total = Cronbach's alpha 0.980 and domain specific Cronbach's alpha of 0.958, 0.921, 0.908 and 0.932 respectively), substantial level of inter-rater agreement (κ = 0.668 to 0.845 and $p < 0.01$), excellent temporal reliability (ICC 0.974 and $p < 0.01$) and convergent validity (AVE > 0.5).

Conclusion: The adapted version of the ASC showed excellent reliability and validity to facilitate functional auditory skills assessment and intervention.

Keywords: Bangladesh, children, hearing loss, psychometrics

INTRODUCTION

Hearing Loss (HL) in the form of a congenital disability is most common, and it adversely affects several aspects of life when left unaddressed during the critical period of communication needs.[1,2] In such a case, gradual worsening of HL in early childhood and school years is often observed.[3] HL has perpetuating effects on adulthood education as well as employment, as a functional disability in childhood.[4] Interestingly, 4.43% of the children with HL exhibited intellectual disability, while 35% exhibited borderline capacity in this regard in a particular study in Bangladesh.[5]

Recent developments in science and technology have made it feasible to identify hearing loss early and treat it, reducing its effects.[6] To address the necessity for greater precision of protocols as well as exact processes to help children from the beginning of the post-natal period to age 5 with HL in all environments, the American Speech-Language-Hearing Association (ASHA) working group devised guidelines regarding hearing assessment for young children that included age-appropriate functional auditory assessment.[7] Children who struggle to complete standardized testing, such as extremely young children and kids with extra challenges, should have functional tests more often.[8]

The evaluation of hearing threshold can be conducted using objective tests, whereas subjective tests can assist in determining the progression of hearing status using hearing technology in the habilitation process as a part of periodic evaluation.[9] A variety of rehabilitation decisions require accurate descriptions of a child's unique auditory behavior. Considering the adverse effect of HL on the global development of children, speech therapists require tools to conduct an analysis of individuals' hearing and to measure expected progress in hearing.[10] It may be useful to evaluate the listening skills and behaviors related to communication of a child using scales based on observational reports.[11] Complete standardized assessment tools allow assessing and monitoring habilitation programs, such as the evolution of therapeutic intervention, comparison between peer groups, signaling progress, and deviations in hearing skill development for families and professionals.[12] When other objective measures could be employed with confidence, with increasing recognition of the importance of combining subjective and objective measures, the subjective data

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would complement them.[13] For early detection of changes in central auditory processing function, information gathered through appropriately formulated checklists/ questionnaires regarding children's listening or hearing behaviors from individuals other than professionals, including parents, caregivers, as well as teachers, might be of great help.[14] As listening behaviors can vary depending on settings, conditions, and speakers, questionnaire-based functional assessment tools assess hearing in real-world settings, capturing these variations.[13] When parents are questioned regarding their child's present capabilities vs parental knowledge of developmental goals, studies exploring this form of data obtaining reveal that they are more correct.[15]

In addition to being reasonably priced and simple to use, report-based measures (scales, checklists, and questionnaires) have the potential to be extremely effective instruments for assisting clinical assessment.[14] Such instruments save resources and time, also. Application time is essential, as it is important to use tools that are quick to use in the outpatient system.[16] The Functional Auditory Performance Indicator (FAPI), Meaningful Auditory Integration Scale (MAIS), Infant Toddler-MAIS (IT-MAIS), and LittlEARS are just a few of the questionnaire-based tools that have been successfully converted and adapted to various languages and have demonstrated significant reliability.[16–18] In comparison with the widely applied IT-MAIS, an instrument which was also formulated for the purpose of measuring listening/hearing skills in kids using the implanted device, the ASC has great interrater reliability and excellent validity.[8]

The prevalence of HL in Bangladesh ranges from 6.97% to 9.7% according to studies with the number reaching up to 16% for children below 15 years of age for bilateral HL.[19,20] This prevalence ranges from 11.4% for the age range of 5-15 years and 10.4% for the 0-5 age group.[21] According to the literature, 25% of the population with HL in Bangladesh have SNHL, and the tendency to have SNHL increases with age progression.[21,20] South Asian countries contribute 28.2% of the global disabling HL, with childhood prevalence of HL ranging from 6.62% to 16.47%, where Nepal exhibits the highest prevalence.[22,23] Surprisingly, in an Indian regional study, 35.1% of school-going children exhibited different forms of HL, suggesting the prevalence to be diverse depending on geographical differences.[24] Moreover, lack of access to healthcare and rehabilitation facilities, as well as the presence of stigmatization, adversely affect the lives of individuals with disabilities in the South Asian Region.[25]

However, in Bangladesh, there is no available assessment or screening tool for the purpose of assessing functional/ practical hearing skills of young children experiencing any kind of HL. As a result, a comprehensive auditory profile of the hearing-impaired population, especially children, has not been produced till now. Therefore, this study aims to adapt ASC in the Bangladeshi context and evaluate/test its reliability and validity as a Bengali-adapted form to assess Bengali-speaking children experiencing severe to profound SNHL using HAs.

METHODS

Following the ethical approval of the Department of Communication Disorders' approval committee, 405 children in total, along with their parents, participated in the study. Hearing schools were approached to request the participation of the children along with their parents. Written consent was provided by the parents (either father or mother) to engage in the study, on behalf of the participating children. The following criteria were mandatory for inclusion: Bangla as first language, severe to profound sensorineural hearing loss, no other significant medical or neurological condition other than hearing loss, hearing loss in both ears, hearing aids of any kind except cochlear implant, and age within 6 years.

The ASC is composed of audiological skills arranged in four domains: sound detection, discrimination, identification, and comprehension. The detection domain contains 9 questions, the discrimination and identification domains contain 7 questions each, and the comprehension domain contains 12 questions. Frequencies are recorded as: Often (Has skill), Sometimes (Emerging skill), Never or Rarely (Does not have skill). A three-point rating scale is administered (0 = Does not have skill, 1 = Emerging skill, 2 = Has skill). One can obtain a maximum of 70 possible points. The higher the score one achieves, the more developed his/her auditory skill is.

The processes of translation and adaptation were based on commonly accepted standard guidelines.[26] The technique of forward translation and backward translation was used, where the translation of the original checklist in Bengali was translated back to the original English language. In the process of translating the checklist, several kinds of equivalence of the checklist were searched, which included cultural, conceptual, semantic, as well as content equivalents. Two different translators were assigned who had fluency in English and the subject matter. One of the translators was responsible for forward translation, and the other was responsible for backward translation. A dilemma regarding example stimuli was present among translators, which was further resolved through revision and cognitive debriefing. A two-member revision task consisted of one Speech and Language pathologist and one Audiologist to revise both translated versions. Steps were undertaken in choosing the best translation of the questions, and changes were made by employing cognitive debriefing on a short sample in terms that are more appropriate in the Bengali language. Changes reflected the accommodation of the

understanding of the Bengali population. In the process, a new Bengali version of the checklist was obtained.

The extent to which the questions were understood comfortably was verified by presenting them to a small group of parents in a pilot study. It was evident that, for item 4 of the sound detection domain, the example stimuli failed to fulfill their intended task as perceived by participants. Difficulties in perceiving the example items of the sound identification domain were also evident. Finally approved and accepted culturally equivalent alternatives of example items were "sound of a microwave bell", an example of the sound detection domain, to "sound of pressing a switch", which fulfilled the intended task. Alternatives of the example items of sound identify-cation domain included "train goes choo choo" to "cring cring sound of a bicycle bell" for question number 18, difference between syllable length in item number 19 from "ball, hotdog, computer" to "ball, football, calendar" in Bengali form, familiar songs of item number 23 to the national anthem of Bangladesh. All these changes were comfortably understood in consecutive piloting.

Parental observation of the auditory skill of the participants was obtained by applying the final adapted Bengali version of the ASC checklist to collect data in an institutional setting. Parents were interviewed for data collection. The interviewers were trained in the administration and rating of the questionnaire in a 1-hour-long session.

The data obtained from the parental interview was quantitatively analyzed by using SPSS version 20. The questionnaire, with its 35 questions, was tested for its overall and domain-specific consistency or internal reliability by measuring the Cronbach's alpha score. In assessing inter-rater reliability, Cohen's Kappa value was measured to determine how two different raters interpreted the ASC checklist in the same manner. Temporal reliability was tested by calculating the Intraclass Correlation Coefficient (ICC) for a cumulative score by an interval of one week. Internal reliability depicts the tendency of responding to questions in a consistent manner, interrater reliability depicts the consistency of replicability when incorporated by different respondents, and temporal reliability depicts a reliable replicability in time intervals. Convergent validity was measured by calculating Average Variance Extracted (AVE) of factors determined by Exploratory Factor Analysis (EFA). EFA assists in discovering the factor structure and consistent construct. Convergent validity confirms that the items are consistently capturing the intended behaviors or information.

RESULTS

Among the 405 participants, 66.7% (N = 270) were males and 33.3% (N = 135) were females. The minimum chronological age of participants was four years (Mean: 5.5 years, Median: five years, Standard Deviation: 0.9), and the maximum chronological age was six years. The age of HL identification ranged between two and four years of age. The mean age of HL identification as well as the hearing age was 3.4 years, the median age was 3.5 years, with a standard deviation of .63 for the participants. The Mean ASC scores by Gender: The total mean score of the ASC checklist for males was 48.75, and for females was 47.77. Domain-specific mean scores are given in Table 1.

The average inter-item correlation (AIC) was found to be 0.454, and the measurement value of Cronbach's alpha for the 35-item scale was 0.980. Domain-specific inter-item correlation was found to be 0.455, 0.466, 0.426, 0.464, respectively, and the measurement value of Cronbach's alpha was found to be 0.958, 0.921, 0.908, 0.932. The AIC needs to fall between the values of 0.15 and 0.50, and a value above 0.50 may indicate a narrow focus.[27] A Cronbach's alpha of 0.8 or higher is considered good reliability.[28] Results are presented in Table 2.

The kappa value of agreement of the observers ranged between 0.668 and 0.845 ($p < .001$). The range of Kappa from 0.6 to 0.8 indicates substantial agreement between raters.[29] Both raters agreed on at least 30 questions of the checklist for a specific case out of 35 questions. The result of the inter-rater reliability suggests substantial agreement. The average measure of the Intraclass Correlation Coefficient (ICC) was 0.979 with a significance level of 0.00 ($p < 0.01$). For excellent reliability, the intraclass correlation coefficient value must exceed 0.90.[30]

Principal Component Analysis (PCA), along with varimax rotation, was used to test the internal structure of the Bengali version of the ASC scale. The measurement value of the Kaiser-Meyer-Olkin (KMO) index (0.845) exceeded the reference value of 0.6.[31] Statistical significance was achieved by Bartlett's test of sphericity ($X^2 = 1439.899$, $p < 0.0001$), which indicated the suitability of the data for factor analysis. Four factors for the scale explained 74.521% of the variance with an eigenvalue greater than 1. Communalities exceeded a value of greater than 0.5 for each item. Factor loadings of each item on every factor exceeded a value of 0.6. However, item 1 of the scale (sound detection subsection) did not load on any factor due to the absence of variance.

Convergent validity for the checklist was measured by calculating the Average Variance Extracted (AVE) of each factor based on Exploratory Factor analysis. The AVE value of the four factors for the checklist was 0.74 (factor 1), 0.67 (factor 2), 0.65 (factor 3), and 0.65 (factor 4). All those values exceeded the reference value of greater than 0.5 to have an acceptable convergent validity.[32] Factor loadings are presented in Table 2.

TABLE 1. Mean ASC scores by domains according to Gender

Domains	Male		Female	
	Mean	SD	Mean	SD
Sound detection	12.32	1.3	11.89	1.1
Sound discrimination	9.74	1.2	9.56	1.3
Sound identification	9.47	1.4	9.35	1.3
Sound comprehension	17.23	0.8	16.98	0.9
Total mean score	48.75	1.2	47.77	1.1

*SD = Standard Deviation

DISCUSSION

This study was undertaken to adapt the ASC checklist, a questionnaire-based assessment instrument for the assessment of functional hearing/auditory skills of Bengali-speaking children with severe to profound SNHL with hearing aids. Cognitive debriefing played a pivotal part in the cultural adaptation of the checklist questions. When a minimum of 80% of respondents do not face or show any difficulty while answering the questions of material, it is assumed that the terms used in them, as well as the questions, are understood by the population under study without difficulties.[33] Most of the participants in cognitive debriefing felt uncomfortable and alienated with the stimuli presented in question numbers 4, 19, and 23. The typical Bengali population does not use those terms in daily conversation, and those are very much influenced by the level of education. Dilemmas and differences between translators regarding the adaptation of stimuli that exhibited potential linguistic and cultural difficulties were evident in the cognitive debriefing process. They were successfully substituted by culturally equivalent alternatives in successive piloting by cognitive debriefing.

TABLE 2. Factor loadings, Item deleted Cronbach's alpha values and corrected item–total correlations

Items	Component (Factor Loadings)				Cronbach's Alpha if Item Deleted	Corrected Item-Total Correlation
	1	2	3	4		
Item 7	0.912				0.931	0.935
Item 9	0.908				0.928	0.879
Item 17	0.908				0.941	0.855
Item 18	0.906				0.913	0.716
Item 8	0.888				0.924	0.935
Item 6	0.886				0.942	0.881
Item 2	0.875				0.930	0.651
Item 23	0.790				0.931	0.847
Item 21	0.779				0.922	0.932
Item 22	0.757				0.927	0.789
Item 3		0.903			0.902	0.838
Item 4		0.876			0.910	0.705
Item 5		0.864			0.906	0.789
Item 20		0.787			0.912	0.663
Item 19		0.778			0.885	0.753
Item 33		0.695			0.916	0.760
Item 13			0.898		0.921	0.755
Item 10			0.877		0.926	0.825
Item 12			0.867		0.914	0.621
Item 11			0.835		0.917	0.802
Item 14			0.798		0.913	0.861
Item 30			0.786		0.899	0.824
Item 32			0.746		0.916	0.668
Item 15			0.731		0.917	0.737
Item 16			0.695		0.921	0.873
Item 27				0.895	0.935	0.676
Item 25				0.885	0.937	0.609
Item 26				0.879	0.943	0.669
Item 24				0.861	0.935	0.657
Item 31				0.794	0.939	0.831
Item 34				0.789	0.932	0.864
Item 28				0.751	0.943	0.899
Item 29				0.693	0.938	0.663
Item 35				0.661	0.935	0.666

The results of the study suggest an excellent level of consistency of the questions on the checklist and a high level of replicability of drawing results in repeated measures conducted by different people while assessing the same participant. The results comply with a previous study where the overall Cronbach's alpha for the checklist was 0.98, and the value remained high for the coefficient when measured for each domain, ranging from 0.91 to 0.96 when studying a population with cochlear implants.[8] Inter-item correlation suggested that there was no negative correlation among items, and the item total correlation also suggested excellent reliability of items. This suggests that the domains are excellently correlated to measure the specific auditory skills of the participants. The inter-rater agreement observed by measuring the kappa value did not differ significantly among the participants' profiles. These values ranged between 0.668 and 0.845. The initial study for the development of the ASC checklist exhibited substantial inter-rater reliability and excellent temporal reliability, where most cases had Kappa values over 0.75 and an ICC value of 0.99 between raters.[8] The current study also exhibits excellent temporal reliability. With this level of consistency among items, there exists a greater chance of agreement between raters on most questions in repeated measurement. The results of both analyses established an excellent level of reliability and a substantial level of agreement between raters for the Bengali adapted version of the ASC checklist.

The intraclass correlation coefficient value of the current study indicates a high level of temporal reliability in terms of cumulative scores of the adapted version of the ASC checklist. The skills are presented in a hierarchical manner, and items capture those skills based on observation with great reliability. Residual hearing regarding severe to profound sensorineural HL is significantly small, and difficulties are faced by these populations in the perception of environmental sounds due to limited dynamic range. For the children of this group, responses observed on sound detection, discrimination, sound recognition, and comprehension skills that are reflective of basic auditory skills were low and needed to be recorded for the appropriate type of intervention required.[34] Exploratory factor analysis suggested a 4-factor solution for the checklist. Factors 1 and 2 included items related to sound detection and identification, apart from item 33 (understand frequently heard phrases/sentences) in factor 2, which represents sound comprehension. Factor 3 included items related to sound discrimination, except for items 30 (understand the question forms: W+H questions) and 32 (understand the use of negatives in phrases and sentences), representing sound comprehension. Items related to sound comprehension were included in factor 4. Convergent validity of the ASC scale was achieved for each factor of both domains as it was greater than the reference value of > 0.5.[32] Interestingly, no significant difference was found in the domain-specific and total score of the ASC checklist between gender groups. Potential parental biases could influence the scoring of the checklist, as a relatively uniform outcome was evident.

Limitations of the study could be attributed to potential parental bias and the recruitment of respondents. Though respondents were recruited based on the representation of diverse educational, economic, and regional characteristics, a uniform point of contact could contribute to the outcome of the study. Future studies can be undertaken to observe the nature of the association of the outcome of the ASC checklist to objective assessment methods, such as applying Otoacoustic Emission testing, Auditory Brainstem Response, and Pure Tone testing in periodic evaluation of performance. Evidence suggests that questionnaire-based performance is not always positively associated with objective tests.[32] Regardless, both reliability and validity measures of the adapted version of the ASC suggested the newly adapted version of the checklist to be clinically relevant and valid as well as easy to employ tool with less chances of disagreement between raters while evaluating the functional hearing skills of children with severe to profound SNHL with hearing aids.

CONCLUSIONS

The ASC checklist has been proven to be relevant to measuring basic functional auditory skills of the participants and is easy to administer. Acceptance of this type of assessment instrument will facilitate improved under-standing of auditory behaviors of children with severe to profound SNHL with hearing aids and to develop the auditory skills profile of this population to monitor development, Furthermore, it is hoped and believed that the result of the study will assist speech-language pathologists and audiologists working with this population in Bangladesh to make better judgement of the amplification system and to formulate and undertake effective interventional procedures while working with this population. However, with the satisfactory outcome of the study, the importance of objective physiological assessments of auditory skills is not denied. Rather, the outcomes have provided an opportunity to complement the existing assessment procedures with the information that can be obtained by employing the adapted instrument.

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CONFLICT OF INTEREST

None declared.

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