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Short Communication

Cultural adaptation and validation of "aging voice index" in Bengali

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ABSTRACT

Changes in voice due to aging impact the ability to use one's voice to communicate in all situations and can decrease their quality of life. The primary objective of this study was to transadapt the aging voice index (AVI) in Bengali (AVI-B) for the Bengali population to help in better comprehension by the patient rating the AVI scale. Ten older adults with voice disorder were asked to fill the AVI-E and AVI-B simultaneously to check the homogeneity of AVI-B. Establishment of kappa co-efficient between AVI-E and AVI-B was done. Wilcoxon test was done to evaluate the differences between pre and post therapeutic results. Kappa correlation for content validity was 0.81. The parameters of doctor speech, grade of grade, roughness, breathiness, asthenia, strain, and instability (GRABASI) scale and voice handicap index (VHI)-10 scale were mild to moderately correlated to the AVI-B ($p>0.05$). Inter class correlation for test-retest reliability was 0.933. Pre to post AVI-B scores were reduced when the participants were given a period of straw phonation therapy treatment. The AVI-B is a valid and reliable quality of life assessment for older adults with voice disorder and with native language as Bengali.

Keywords: Presbyphonia, Perturbation, Aging voice

INTRODUCTION

Voice is produced as air from the lungs passes through the vocal folds in the larynx (voice box) causing the vocal folds to vibrate. Then the sound produced by the vibration is modified and shaped by the vocal tract causing speech. (throat, mouth and nasal passages).

Laryngeal muscles are divided into two parts the external and internal muscles. The main intrinsic muscles which help in voice production are posterior cricothyroid muscles that abducts the vocal folds, is solely responsible for optimal respiration and the thyroarytenoid, interarytenoid, and the lateral cricoarytenoid muscles which adducts the vocal folds are responsible for phonation, providing optimal sound quality. As people age, the larynx become stiff, and the vocal folds can lose muscle tone, elasticity and moisture. This is known as vocal fold atrophy. Vocal atrophy interferes with the precise actions and positioning of the vocal folds that are needed for vocalizations. Thus, this can result in vocal tones that are thin, rough or hoarse, as well as the cracking voice.

Age-related changes to the body, such as decreased lung capacity and loss of strength and muscle tone, can result in a breathy or hoarse voice. A loss of volume, as well as vocal fatigue too can be common. The laryngeal cartilages calcify with ageing and the cricoarytenoid joints involved in opening and closing the vocal folds become stiffer affecting the quality of voice.

Men and women are differently affected towards the end of middle age ageing changes. In women, due to menopause the hormonal changes associated with it alter the vocal folds in a number of ways. They become stiffer and slightly thickened/swollen. Decrease in number of glands reduces the mucus secretion that lubricates the vocal folds, causing dryness, also the quality of the mucus

alters becoming thicker and more difficult to clear. Such changes result in significantly lower pitch of the voice and the vocal quality will be rougher and breathier. In men the vocal pitch rises after middle age which is more noticeable.

Thinning and stiffing of vocal folds occur due to losing of muscle its bulk. Straight edges of vocal folds may be lost, making it difficult to meet at the midline during phonation. As a result, spindle-shaped gap develops between them, through which breath can escape, making the voice sound weak and breathy. This condition is usually referred to by the doctors as "presbylarynx".[1] Presbylarynx is most common in elderly men, but it can also occur in women in their later years. Diplophonia is often associated with presbylarynx.

The weak, voice is harder to maintain and is physically very effortful. Speaking is usually more tiring and it may feel uncomfortable and strained. Also changes in the neurological system may result in a tremor which will make the voice sound shaky, tight and strained. Mostly the age-related changes are gradual, but for some the deterioration associated with ageing occurs early and does impact on their communication and social activities. When this happens, they should seek medical intervention.

Parameters of aging voice

F0 SD, jitter, and shimmer are important parameters for the evaluation of pitch variation during sustained phonation, and it discriminates between voice disorders. Acoustic analysis is an objective and non-invasive modality for the evaluation of voice quality in people with voice disorders.[2] Perturbation parameters (jitter and shimmer), reflects the perturbations in the frequency of the neighbouring vibration cycles, are sensitive to phonatory deviations.[4] In contrast to jitter and shimmer, which are perceived as voice roughness, F0 SD represents the F0 variation that is captured by measuring the SD in voice pitch. Therefore, F0 SD captures the amount of within-utterance variation in pitch, and low values of F0 SD are perceived as monotony.[2]

In elderly population, the fundamental frequency is seen to be greater in elderly males than in young males and vice versa in case of females. Also, both shimmer and jitter were significantly greater in elderly speakers than in the young and middle-aged speakers. In addition, the harmonics-to-noise ratio was significantly greater for young and middle-aged males and females than for elderly males and females.[3]

Three cross-cultural adaptations of the aging voice index (AVI) have also been developed for non-English-speaking populations, including Korean, Persian, and Arabic versions. The Korean version examine the validity and reliability of Korean aging voice index (K-AVI), which assesses the quality of life related to the voice of the elderly. The Persian version was developed for the Persian-speaking older adults with voice disorders. The Arabic version of the AVI (A-AVI), assess the psychometric aspects in Arabic-speaking elderly persons with voice disorders.[4-6]

Need

Cultural adaptation of any instrument is important when an instrument is used in different language and setting. Thus, transadaptation of AVI in Bengali improves the comprehension of the questions in the rating scale and hence the outcome becomes more reliable when used in a population where people's native language is Bengali. Other scales like quality-of-life rating scale for population with voice disorders is already present like voice handicap index (VHI-10), voice-related quality of life (V-RQOL) are present, but these rating scales does not solely focus on the quality of life of the aging population with voice disorders which will be markedly different compared to younger population with voice disorders. Hence, aging voice is an important area to explore because of dearth of literature in India regarding aging voice till date. The Bengali speaking population is also in surge in Bangladesh where Bengali is the official, national, and most widely spoken language of Bangladesh, with 98% of Bangladeshis using Bengali as their first language. Thus, trans adapting AVI in Bengali will increase its efficacy in determining the quality of life of the elderly population whose native language is Bengali.

Aim

The aim of the study was to transadapt and validate the AVI in Bengali for the older adults with voice disorders in clinical settings.

Objectives

The objectives of the study were: to transadapt the AVI in Bengali language in the cases of older adults with voice pathology; to measure linguistic and construct validity of AVI in clinical settings; to measure content validity of AVI in Bengali; to assess concurrent validity of AVI in Bengali; to reveal discriminant validity of AVI in Bengali language; and to check test-retest reliability of the developed AVI in Bengali language for using in the clinical settings in the cases of voice pathology of older adults.

METHODS

Study place

The study was conducted at Ali Yavar Jung National Institute of Speech and Hearing Disabilities, Eastern Regional Center, Kolkata, Bonhooghly, West Bengal.

Study duration

The duration of the study was of 3 months from September 2023 to December 2023.

Sample size

In order to meet the objectives of tool development Sample size was calculated as per statistical data using G power software.[10] Presbyphonic subjects with hoarse voice were recruited with mean age of 61.8±1.42.

Inclusion criteria

Older adults of age range 62-79 who were professional voice users (male), fluent in both English and Bengali were recruited. They were diagnosed with primary muscle tension dysphonia (MTD type 1) by ENTs and SLPs. They showed symptoms of large interarytenoid and posterior glottal chink. They did not have pachydermia. Strobovideolaryngoscopy (Kay Pentax, Model 9400) was performed in all the participants for the diagnoses made above. Mild hoarseness component was also perceived in all the participants. Also, objective assessment in these subjects using Doctor's speech software revealed they had more of a hoarse component in their voice with their mean fundamental frequency to be 107.9 Hz. All of them had a history of laryngopharyngeal reflux and took Proton pump inhibitor medications prescribed by ENT surgeon.

Exclusion criteria

The older adults of age range 62-79 with hearing loss, cognitive impairment, underlying neurogenic pathology or memory deficits and visual impairment.

Tools

For performing this study, the following tools were used.

Aging voice index

AVI in English language has been given by has been used which has 23-item, self-administered questionnaire that asks individuals about the effects of their voice on their lives. Here each item is based on a scale of 0 to 4, and the sum of all items is the total score. The AVI's maximum score is 92. A higher total score indicates that the subject's voice impairment has a greater impact on the quality of life.[7]

Voice handicap index

VHI-B is also present in Bengali language which measures the patient's perception of the impact of his or her voice-disorder. It is a validated self-assessment tool that quantifies the functional, physical, and emotional impact of a voice disorder on an individual's quality of life. The tool consists of 30 questions that are equally distributed across 3 domains: functional, physical, and emotional aspects. It also measures the changes of the patient's perception following treatment for four different voice disorders which are unilateral vocal fold paralysis, vocal cyst/polyp, and muscle tension dysphonia. Scores for the VHI-B range from zero-to-40, with higher scores indicating a greater voice-related handicap. Here a score greater than 11 is considered abnormal, whereas scores ranging from zero-to-10 are considered normal, or nearly normal.[8,9]

Doctor's speech software (ve4.0)

This software is used for acoustic (perturbation) assessment of voice which is designed to use to guide diagnostic assessments for speech disorders by measuring respiration, phonation, and resonance. It provides us with a comprehensive report for voice quality assessment using acoustic parameters – jitter, shimmer, fundamental frequency tremor, amplitude tremor, normalized noise energy (NNE), harmonic-to-noise ratio (HNR), signal-to-noise ratio (SNR) reflecting how much deviated it is from the normative values for each parameter. Normative values of each parameter is different in males and females. It's useful for patients with moderate hoarseness, mild roughness, and severe breathiness. It is uses precise signal detection and processing and easily edit and store your collected data.

GRBASI

It is a perceptual rating scale which includes 6 components: G - overall grade of hoarseness, R - roughness, B - breathiness), A – asthenia (weakness), S (strain) and I (instability). Each component is rated on an integer four-point scale, in which 0 is normal, 1 slight, 2 moderate, and 3 severe. The administration of the scale is done by three speech-language pathologists (SLPs) who rates the voice from normal to severe in the respective parameters and consensus to one rating was done.[10]

Procedure to develop AVI in Bengali

Step 1: approval of the study

Written consent was taken from all the 10 participants. Prior ethical and technical clearance was taken from Institute ethics committee. Necessary permission was obtained from the holder of the intellectual property rights relating to the test before carrying out any adaptation. Permission was granted on 03.08.2023 via mail.

Step 2

The transadaptation of AVI-B was carried out as per the International Test Commission, 2013 guidelines for translating and adapting tests. A linguist with experience in translation and trans-adaptation processes helped ensure the linguistic validation of the AVI in Bengali. Appropriate modifications were made by reviewing available Bengali literature from books, online sources, journals, and existing tools within India. The process involved several key steps. Initially, the original English version of the AVI was provided to five native SLPs proficient in both Bengali (first language) and English. Each SLP independently translated the English version

into Bengali, ensuring conceptual equivalence. Finally, an experienced speech-language pathologist, specializing in voice disorders, compiled the translations to create the final Bengali version of the scale.

Another five native SLPs (who did not participate in the forward translation process), proficient in both Bengali and English and with no prior knowledge of the AVI questionnaire, were tasked with back-translating the Bengali version of the AVI into English. This step was essential to assess the consistency of the Bengali version with the original English version. An additional experienced SLP was responsible for finalizing the back-translated English version of the tool. Three highly proficient English-speaking SLPs were then asked to compare the original English AVI with the back-translated version. The two English versions were compared using Cronbach's α test, which yielded a score of 0.933, confirming the validity of the Bengali AVI. The final tool was prepared by organizing the translated Bengali version of the AVI accordingly.

Step 3: validation measures

Construct validity

To measure the construct validity appropriateness of the AVI-B was rated by 5 SLPs on a scale of 1 (not appropriate) to 5 (most appropriate). One SLP rated it 5 and the rest rated it 4. Inter rater validity has been evaluated using Cronbach's alpha (0.933), which implied AVI-B is well equipped to assess the quality of life of the elderly population with Bengali as their native language having voice disorders as it claims and can be generalized to the wider intended population.

Content validity

Content validity estimates anyways a test is representative of all aspects of the contents of the tool under study. For measuring the content validity both the tools, one English version of AVI (original) and other one translated Bangla AVI was given to the ten elderly bilingual subjects with voice disorders and their scores were correlated.

Concurrent validity

Concurrent validity is a type of evidence that shows how well a new test compares to an existing, validated test. For measuring the concurrent validity, the AVI-B was correlated with grade of GRABASI scale. The parameters of Dr speech which included fundamental frequency, jitter, shimmer and the VHI-B scale using Spearman correlation.

Discriminant validity

Discriminant validity is a research method that assesses whether a test measures a concept accurately and separately from other concepts. For measuring the discriminant validity, the participants were given therapy using straw phonation technique 5 sessions a week and total 10 sessions of 30 mins was given to each participants. Then pre and post therapy AVI-B mean scores were compared using Wilcoxon signed-rank test.

Step 4: reliability measures

Test-retest reliability was measured to evaluate the reproducibility of the AVI-B. After one week, the participants who were studied were asked for same activity. The participants were asked to fill up the AVI-B questionnaire like before. The retest was done without informing the participants their score of the previous test. There was no intervening treatment between test and retest conditions.

Statistical analysis

The obtained data was analysed using statistical package for the social sciences (SPSS) version 16.0 software. Data were subjected to Shapiro Wilk test to check normal distribution of the data. The test revealed the data were sparsely distributed at p=0.05. Hence non- parametric statistics were implemented. Descriptive statistics were used using mean, percentage, standard Deviation. Co relational measures were used using Cronbach's alpha, kappa and spearman correlation. For discriminant validity Wilcoxon sign rank test were used to check the differences between pre and post therapeutic conditions and to determine the effect size.

RESULTS

The first objective of the study was to translate and culturally adapt the AVI in Bangla language. The procedure of translation and trans adaptation has been discussed in the method section.

The second objective of present study was to measure the linguistic validation of translated AVI in Bengali. AVI-E was forwardly and backwardly translated with the help of native Bengali SLPs, recruited at its different stages. Preparation of final AVI-B was achieved after observing significant values in appropriate measurement (Cronbach's α=0.933). Final tool was completed by arranging accordingly the translated AVI-B. Construct validity was obtained by rating of the AVI-B by SLPs. AVI-B was rated by 5 SLPs on a scale of 1 (not appropriate) to 5 (most appropriate). The first step towards this was to measure the values of inter-judge agreement by Cronbach α coefficient, which was found 0.933. This is suggestive of high agreement between the judges in all 23 items. The third objective was to establish content validity. The high Cohen's Kappa value (0.83) (Table 1) indicated a strong agreement between the Bangla (AVI-B) and English (AVI-E) versions of the test. This suggested that the transadaptation process was successful, achieving the objective, with participants' performance being highly consistent across both versions. The fourth objective was to find out the concurrent validity. Table 2 presents the

Spearman rank correlation results between various parameters and the AVI-B (Bangla version of the test), which seemed to be part of the analysis for the transadaptation from AVI-English to AVI-Bangla. The table compared mean scores and evaluates the correlation (r-value) of AVI-B with the parameters related to speech (e.g., habitual F0, jitter, shimmer, grade, and VHI-B) and their respective p-values. It was found that while the correlation between some parameters (like shimmer and grade) and AVI-B showed moderate positive relationships, none of the correlations reach statistical significance ($p>0.05$). This suggested that while there were some positive associations between these speech-related parameters and the Bangla version (AVI-B), these results do not strongly support a significant relationship in this sample size (n=10). This indicated that further analysis with a larger sample size is needed to confirm these trends and achieve the objective more accurately. The fifth objective was to find out the discriminant validity. Table 3 presents the results of a Wilcoxon signed-rank test to evaluate the difference in mean scores of AVI-B (Bangla version) before and after therapy, aiming to establish discriminant validity for the transadaptation of AVI-English to AVI-Bangla. In the mean difference, there was a noticeable reduction in the mean score from 48.2 (pre-therapy) to 43.4 (post-therapy), suggesting that participants showed improvement after therapy, as reflected in the AVI-B scores. The p value of 0.019 suggested that this reduction is statistically significant, meaning the therapy had a measurable effect on AVI-B scores. The significant difference in scores pre- and post-therapy supported the discriminant validity of the transadapted AVI-B version. This demonstrated that the test can distinguish between different states (pre- and post-therapy), showing that the Bangla version is sensitive to changes in participants' conditions after therapy. Overall, this test result confirmed that AVI-B effectively differentiates between pre- and post-therapy performance, reinforcing the validity of the transadapted version for Bangla-speaking participants. Table 4 presents the results of Cronbach's alpha to assess the test-retest reliability of the AVI-B (Bangla version) in the transadaptation process from AVI-English. Test-retest reliability evaluates how consistently a test measures a variable over time, ensuring that the test results are stable and reliable when administered at different points. The alpha value of 0.933 suggests that the AVI-B is highly reliable, meaning that the participants' scores were consistent across different testing occasions (pre-test, 7-day follow-up, and post-test). The high Cronbach's alpha value of 0.933 indicated that the Bangla version of the test (AVI-B) demonstrates strong test-retest reliability. This meant that the transadaptation from English to Bangla was successful in producing a version of the test that yields stable and consistent results over time, further validating the reliability of the Bangla version for repeated assessments. Above mentioned results were critically and elaborately explained in discussion part by relating interactive impacts on different variables AVI-B established as robust tool as AVI-E.

Table 1: Agreement of AVI-B with AVI-E using Cohen's Kappa coefficient.

Variables	N	Number of items	Mean	K
AVI B	10	23	48.20	0.83
AVI E	10	23	48.20	

Table 2: Correlation between AVI-B versus parameters of doctor's speech, VHI-B and grade of GRABASI scale (n=10): Spearman rank correlation.

Parameters	Mean	AVI-B (mean)	R value	P value
Habitual F0 (Hz)	199.76	48.2	0.33	0.34
Jitter (%)	0.77	48.2	0.29	0.40
Shimmer (%)	7.06	48.2	0.55	0.09
Grade	2.2	48.2	0.44	0.20
VHI-B	29	48.2	0.11	0.74

Table 3: Difference in mean scores of AVI-B pre-post therapy using Wilcoxon signed rank test.

Variable	Pre therapy	Post therapy	R value	P value
AVI-B mean	48.2	43.4	0.9844	0.019

Table 4: The reliability between pre, 7 days and post-test: Cronbach's alpha.

N	Number of items	Cronbach's alpha
10	23	0.933

DISCUSSION

The ability to use one's voice for communication is essential in daily life, particularly for many older adults who rely on it as the primary means of verbal interaction. Research conducted by Smith and colleagues revealed that older individuals with voice disorders experience a greater impact on their quality of life.[11] These individuals reported more significant social, psychological, and communication challenges compared to younger adults with similar voice issues. This study aimed to transadapt and validate AVI-E to AVI-B to accommodate cultural and linguistic differences. Several validation procedures were applied to ensure the reliability and accuracy of the translation. The results of the AVI-B were compared with the original AVI-E, showing comparable outcomes in both versions. The primary goal was to systematically translate the AVI-E into Bangla using validated methods. The findings demonstrated that AVI-B is a reliable instrument with strong internal consistency and test-retest reliability, making it an effective tool for assessing vocal aging in Bangla-speaking populations. Further the results were discussed as follows. The first objective of the study involved translating and culturally adapting the AVI to ensure its suitability for Bangla-speaking individuals. The

process of forward and backward translation, carried out by native Bengali SLPs, was critical in ensuring that both linguistic and cultural nuances were accurately reflected in the final version. The high Cronbach's alpha value of 0.933, indicative of excellent internal consistency, demonstrates that the translated items retained their reliability after adaptation. This highlights that the translated AVI-B is a reliable tool, similar to the English version (AVI-E). For the second objective, linguistic validation was established by measuring inter-judge agreement using Cronbach's alpha (also 0.933), which shows a high degree of agreement among the five SLPs who rated the appropriateness of the Bangla version of the AVI on a 5-point scale. This finding is highly significant, as it demonstrates that the translated items are linguistically appropriate, consistent, and effectively capture the constructs of the original AVI. The strong inter-rater agreement confirms that the adapted tool meets the linguistic requirements of the Bangla-speaking population and suggests the accuracy of the transadaptation. Content validity, was established by the Cohen's Kappa value of 0.83 (Table 1). This high value indicates a strong agreement between the Bangla (AVI-B) and English (AVI-E) versions. A Cohen's Kappa value greater than 0.80 typically suggests an excellent level of agreement, which confirms that the transadaptation process has successfully maintained the content integrity of the original test. The findings suggest that participants performed consistently across both language versions, underscoring that the Bangla version retains the original test's intended meaning and functionality. In the fourth objective, the study assessed the concurrent validity of AVI-B by comparing the Bangla version with various parameters related to speech (such as habitual F0, jitter, shimmer, grade, and VHI-B) (Table 2). The Spearman rank correlation analysis showed moderate positive correlations between some parameters (like shimmer and grade) and the AVI-B, but these correlations were not statistically significant ($p>0.05$). This indicates that while there are some positive associations between AVI-B scores and certain speech-related metrics, the sample size ($n=10$) may have been insufficient to detect stronger or significant relationships. Therefore, it would be valuable for future studies to use a larger sample size to further examine these correlations. Despite the lack of statistical significance, the moderate correlations provide a foundation for further exploration. The AVI-English was also highly correlated to the VRQOL ($p<0.0001$).[13] The fifth objective involved establishing the discriminant validity of AVI-B through a Wilcoxon signed-rank test (Table 3) to compare pre- and post-therapy scores. Straw phonation techniques were provided to clients for 5 sessions per week, each lasting 30 minutes. The results revealed a significant reduction in mean scores, from 48.2 pre-therapy to 43.4 post-therapy, with a p value of 0.019, indicating that this difference was statistically significant. This finding was crucial as it demonstrated that the AVI-B was sensitive to changes in participant's vocal performance following therapy. The ability of AVI-B to distinguish between pre- and post-therapy conditions suggested that the test accurately reflected participants' progress, thereby supporting its discriminant validity. This result also suggests that the Bangla version is as effective as the original English version in assessing vocal changes over time. In a similar study it also states that straw phonation has shown positive effects in aging voice.[12] Finally, the study assessed the test-retest reliability of the AVI-B using Cronbach's alpha, which was again high at 0.933 (Table 4). This value indicates that the test yields consistent results over time, confirming that AVI-B is a stable and reliable tool for repeated assessments. This high test-retest reliability further strengthens the validity of the transadapted AVI-B, ensuring that it can be used confidently for follow-up evaluations or longitudinal studies within the Bangla-speaking population. In overall the AVI-B is a valid and reliable tool to understand dysphagia related quality of life and its severity in Bangla context.

Limitations

Population based study must be done for the data got from the AVI-B. Doing such study would be much more liable.

CONCLUSION

The results of the study suggest that the AVI-B is a robust and reliable tool for assessing voice handicap in the Bangla-speaking population. The AVI-E has been adapted in many other languages like Mandarin Chinese, Arabic, Persian, which has been validated with high internal consistency and high interclass correlation coefficient. All of these have high reliability and validity in Chinese speaking and Arabic speaking and Persian speaking elderly population respectively. AVI-B is also validated with a high test-retest reliability and is as par with global standards. Thus, AVI -B is a standardized tool. Hence, it may be used for our elderly population with voice disorder whose native language is Bengali, to assess their quality of life. It can also be used in checking the progress of the therapy by taking post therapy ratings of the AVI-B and help us plan the next goal towards the betterment of their quality of life.

Recommendations

The AVI-B must be converted in many other Indian languages for a better comprehension of the scale by the older adults with respective native languages.

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