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# Adaptation and validation of Mizo language version of Abbreviated Profile from Hearing Aids (APHAB)

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## Abstract

The Abbreviated Profile of Hearing Aid Benefit (APHAB) questionnaire was developed as a 24-item self-report outcome measure to evaluate the effectiveness of hearing aid fittings and to provide a standardized method for quantifying the disability associated with a patient's hearing impairment. The lack of standardized self-assessment questionnaires in the regional language in Mizoram, India has caused a lot of issues in measuring the benefit of amplification devices, monitoring of progress, lifestyle requirements especially amongst the Mizo population. The study is aimed to translate, adapt and validate of Abbreviated profile for the hearing aid benefit [APHAB] into Mizo language. Forward and backward translations of the questionnaire were made, and it was validated. Descriptive cross-sectional study was adopted. Fifty-six native post lingual deaf with Mizo language speakers aged >/=18 years, and minimum of a month of hearing aid usage experience, but with any degree of hearing loss were the respondents for the questionnaire. The APHAB v2.1 programme was used for data analysis. The sensitivity and reliability of the translated version of APHAB was carried out. The outcome of the responses APHAB-Mizo on different subscales was evaluated across its audiological factors such as hearing loss and hearing aid experience, usage, and style. The results suggested that APHAB-Mizo is a valid and reliable tool to evaluate the benefits of hearing aids of native Mizo language individuals.

**Keywords:** APHAB, Mizo, Psychometric Measures, Reliability, Validity.

## Introduction

The primary psychoacoustic dimensions affected by hearing loss include threshold sensitivity, dynamic range, frequency resolution, temporal resolution, and binaural hearing. The perceptual experience of hearing impairment is influenced by a combination of biological and pathophysiological mechanisms, social context, environmental conditions—particularly within the physical and acoustic domains—and individual factors, including psychological components. In audiological practice, both objective psychoacoustic assessments and the subjective experience of hearing loss are essential for informing the development of targeted and effective rehabilitation strategies (1). At the individual level, untreated hearing loss affects multiple aspects of life, including cognitive function, educational attainment, employment opportunities, social isolation, loneliness, and stigma. Additionally, hearing impairment in adults has been associated with at least a 50% increase in the prevalence of depression. Beyond the individual, hearing loss also poses broader implications for society and the economy (2). Two primary approaches are employed in hearing aid validation to assess the outcomes of the fitting process: subjective measures, which rely on patient-reported experiences, such as interviews and self-assessment questionnaires; and objective measures, which utilize empirical data to evaluate device performance and fitting accuracy (3). The effectiveness of hearing amplification is typically assessed through various measures, including improvement, acceptability, benefit, satisfaction, and reduction in handicap. Key factors influencing customer satisfaction include the individual's experience, expectations, personality, attitude, and usage patterns, as well as attributes such as hearing aid type, sound quality, listening environments, and practical issues related to the use of hearing aids. Additionally, aspects such as appearance, cost, acoustic benefit, comfort, and



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services have consistently been shown to impact overall satisfaction with the device (3-7). The benefit and satisfaction derived from hearing aid performance are commonly evaluated using self-assessment questionnaires. Without incorporating patient-reported outcomes in real-world listening situations, it becomes difficult to accurately assess effectiveness or make informed assumptions regarding the success of amplification (8). The benefit of any amplification device is usually measured in terms of technical perspective rather than the non-technical staffs [self-assessment measurements] which could give us more information on the satisfaction of the hearing aid (9). A previous study recommended the use of self-assessment outcome measures, emphasizing that while laboratory-based evaluations—such as speech recognition in quiet and noise, insertion gain, functional gain, aided gain, loudness and sound quality judgments, and the Speech Intelligibility Index—provide valuable data, they do not fully capture real-life hearing aid outcomes. These real-world experiences can only be effectively assessed through patient-reported measures in everyday listening environments (10). He opined that the main reason for client's seeking intervention is because of their limitations to carry out daily activities and engaging in social activity. Even if the real-world situation can be stimulated in the laboratory it often does not resemble the real-life experience of the client therefore, to quantify these self-report outcomes are necessary. Self-assessment questionnaires offer a unique perspective by providing clinicians with evidence of how users perceive hearing aid performance in everyday situations. They allow for the identification of specific listening environments where users experience benefit and help determine the most appropriate time frame for measuring hearing aid outcomes (11). Such responses also help clinicians assess the degree of benefit as perceived by both the user and their family members. Additionally, they allow audiologists to measure the reduction in self-perceived hearing handicap resulting from hearing aid use and to monitor the progression of benefit over time (12).

Patient-reported outcomes have been compared with traditional audio logical measures to evaluate the effectiveness and perceived benefit of hearing aids. Evidence suggests that these subjective outcomes provide a unique perspective on the patient's perceived value of amplification, which may inform hearing aid programming, user training, or appropriate referrals for alternative or supplementary hearing healthcare services (13). Several standardized inventories have been developed to assess various aspects of hearing loss and hearing aid outcomes. Some are designed to quantify the disability associated with hearing loss, such as the Hearing Handicap Inventory for the Elderly (HHIE), the Profile of Hearing Aid Performance (PHAP), and the Communication Profile for the Hearing Impaired (CPHI). Others focus on evaluating the efficacy of, or satisfaction with, hearing aid fittings, including the Abbreviated Profile of Hearing Aid Benefit (APHAB), the Client Oriented Scale of Improvement (COSI), the Glasgow Hearing Aid Benefit Profile (GHABP), and the Satisfaction with Amplification in Daily Life (SADL) (3, 8, 9, 14-17).

Listeners with high-frequency sensorineural hearing loss (HFSNHL) are more likely to experience speech recognition challenges, particularly in the presence of background noise (18-20). Both Behind-The-Ear (BTE) and Completely-In-The-Canal (CIC) hearing aids offer excellent amplification options. In a study, the Abbreviated Profile of Hearing Aid Benefit (APHAB), Satisfaction with Amplification in Daily Life (SADL), and Hearing Handicap for the Elderly-Screening Version questionnaires were administered to two separate groups: one with normal hearing up to 2000Hz and another with normal hearing up to 1000Hz. Both groups reported significant improvements in quality of life and reductions in hearing handicap following the use of hearing aids. However, no statistically significant differences were found between the two groups on any of the three measures. The study concluded that individuals with high-frequency sensor neural hearing loss perceived CIC hearing aids as both beneficial and satisfactory, suggesting they are viable candidates for amplification evaluation.

The APHAB has proven to be an effective tool for assessing the outcomes of hearing aid fittings and for identifying issues that hearing aid users may encounter with their devices (16, 21, 22). The APHAB's psychometric properties and norms are available for adaptation to different languages (5, 16, 23). It has been widely used to assess hearing aid benefits, compare settings, and evaluate fitting protocols (23-30).

The Swedish and Norwegian versions of this inventory have demonstrated APHAB's validity and reliability as a questionnaire (31, 32). For the retest period of two to four weeks, the test-retest correlations for the Chinese version of the questionnaire were 0.84 [intraclass correlation coefficient] and 0.73 [Spearman's rho, p = 0.01], showing good test reliability. A study was conducted on the efficacy of hearing aids for listeners with high-frequency hearing loss (33). Listeners with high-frequency sensor neural hearing loss if SNHL exceeding 2000 Hz are the only ones who experience issues with amplification. It is accessible in 22 different language including three that are spoken in India [Kannada, Hindi, Gujarati].

The APHAB (Abbreviated Profile of Hearing Aid Benefit) is composed of 24 items, systematically categorized into four subscales: Ease of Communication (EC), Reverberation (RV), Background Noise (BN), and Aversiveness of Sounds (AV). Each subscale contains six items, with EC focusing on communication strain in favorable conditions, RV on communication in reverberant rooms, BN on speech understanding in noisy environments, and AV on the unpleasantness of environmental sounds (1). Respondents rate each item using a seven-point scale ranging from "always" (99%) to "never" (1%), providing separate ratings for unaided and aided conditions. The benefit of the hearing aid is calculated by subtracting the unaided score from the aided score, reflecting the reduction in hearing-related difficulties. The subscale scores are derived from the mean ratings of the six items in each subscale, and the global APHAB score is the average of the EC, BN, and RV subscales (4).

Mizoram is a state in the north-eastern part of India with a population of 10, 97,206 as per 2011census Mizoram, Disability Census Data 2011. Mizo is a regional language spoken in the north eastern state of India, MIZORAM 'MIZO' language is believed to originate from Tibeto Burman region Self-assessment. This study aimed to evaluate the reliability and validity of a Mizo version of the APHAB, with the goal of determining its feasibility for adaptation and implementation in clinical settings within a Mizo-speaking population.

# Methodology

## Adaptation

The items in the original APHAB were translated into Mizo using the translation-back translation method (34). The translation process involved three individuals proficient in both English and Mizo: one linguist, one audiologist, and one individual with no professional background in audiology but with a high level of education. The Mizo version was subsequently back-translated into English by two independent bilingual groups, who were unaware of the original version, to ensure semantic equivalence. Following this, an expert panel of four audiologists, all experienced in working with hearing-impaired elderly populations, evaluated all three versions of the Mizo APHAB. The panel assessed each version for appropriateness and semantic accuracy relative to the original English version. The version that received the highest ratings was chosen as the final version.

## Validation

Once the adaptation process was completed, the translated Mizo version of the APHAB was subjected to several validity and reliability checks to ensure its suitability for use in the target population.

**Face Validity:** A group of four audiologists reviewed all the translations and rated them on a 5-point rating scale for the appropriateness and semantic equivalence.

**Criterion Validity:** The translated version of APHAB was administered on 20% of the subjects. The English version of APHAB was administered on the same subjects within one month of the first administration. The scores were compared using Spearman rank correlation to know whether they are similar or not.

**Test-Retest Reliability:** The translated version of APHAB was administered on 20% of the subjects. The same subjects retook the test after one month to know test-retest reliability. The two scores were compared using Spearman rank correlation.

**Construct Validity:** The final version of Mizo APHAB was administered on 56 adults with acquired hearing impairment. The participants in this study were native Mizo speakers diagnosed with sensor neural hearing loss (of any degree) and using hearing aids (either unilateral or bilateral) for at least six months. All participants' responses were recorded in a software platform containing all subscales, which were subsequently analyzed in relation to various audiological factors, including hours of usage per day, hearing aid experience, hearing aid style, and degree of hearing loss. Participants were classified into unilateral or bilateral hearing aid users, and their responses to the APHAB-Mizo were analyzed based on the following factors: hours of usage (< or > 8 hours per day), hearing aid style (BTE - Behind the Ear or ITC - In the Canal), degree of hearing loss (mild, moderate, moderately severe, or severe), and duration of hearing aid use (< or > 5 years). As shown in Table 1, the number of BTE users was larger than that of ITC users, with the majority of participants experiencing moderate hearing loss. Additionally, participants with more than five years of hearing aid experience were in the majority.

**Table 1:** Demographic Information of the Participants

| Characteristics | Unilateral Hearing Aid Users | Bilateral Hearing Aid Users |
|---|---|---|
| | Count (Percentage) | |
| Male | 9 (52.9) | 8 (47.0) |
| Female | 17 (43.5) | 22 (56.4) |
| <8hours of hearing aid usage daily | 14 (25) | 9 (16.1) |
| >8 hours of hearing aid usage daily | 17 (30.4) | 16 (28.6) |
| BTE users | 19 (33.9) | 22 (39.3) |
| ITC users | 12 (21.4) | 3 (5.4) |
| Mild hearing loss | 8 (14.3) | 2 (3.6) |
| Moderate hearing loss | 15 (26.8) | 1 (1.8) |
| Moderately severe hearing loss | 4 (7.1) | 9 (16.1) |
| Severe hearing loss | 4 (7.1) | 13 (23.2) |
| < 5 years of usage | 12 (21.4) | 7 (12.5) |
| >5 years of usage | 19 (33.9) | 18 (32.1) |

The minimum sample required was based on the number of hearing-impaired population within the age range of 18 – 80 years and the total number of disabled population in the state of Mizoram. According to 2011 census, the total number of disabled population in the state was 15160 and 2745 belonged to the age category of 18 – 80 years. The sample size formula used is as follows:

$$n = \frac{Z^2 p(1-p)}{d^2} \quad \text{.....................} [1]$$

Where z [z score] = 1.96 at 5% level of significance and 95% of confidence interval. d [margin of error] = 0.10 and p [estimated population proportion] = 0.18. Required minimum number of sample for the study was 56.

The data were tested for normality, and the results indicated a failure to meet the assumptions of normality. Consequently, non-parametric tests, specifically the Mann-Whitney U test and the Kruskal-Wallis test, were employed to evaluate significant differences between the groups for each subscale.

## Results

Data was collected from a number of 56 participants (17 males and 39 females) who belonged to the age range of 18 – 80 years (36.45 $\pm$ 12.3) and met all the criteria. All the participants' responses were recorded using the updated version of software. The subscales were as follows: Ease of communication [EC], Reverberation [RV], Background Noise [BN], Aversiveness [AV]. The expert panel reviewed the forward and backward translation. They compared the ratings of similarity and appropriateness given for the three APHAB Mizo versions, one by the Linguist and second one by the APHAB Mizo version by the audiologist and third by non-professional, and concluded that the translation with the most accuracy and close in meaning to the original version was the one translated by the Linguist. Therefore, the linguist version of Mizo APHAB was taken for further part of the study. Criterion validity was assessed by administering MIZO APHAB and original English APHAB to 20% of the original study participants. Criterion validity was determined by correlating the scores obtained using the untranslated version with the scores obtained using the translated version of the questionnaire. The correlation coefficient indicated a perfect correlation [r = 1.000, p < 0.0001]. Therefore, it can be interpreted that the translated version of the tool used in the study is highly valid. Test Retest reliability assessed by using Spearman's correlation test. Data recollected from 20% of the original participants one month after initial data collection. The correlation coefficient indicated a perfect correlation [r = 1.000, p < 0.0001] for all domains EV, AV, BN, RV. Therefore, it can be interpreted that the translated version of the tool used in the study is highly reliable. The participant data were analyzed for unilateral hearing aid wearers and binaural hearing aid wearers separately. Their audiological characteristics that can influence the benefits of wearing hearing aids, was determined to evaluate the efficacy of the amplification device, using the adapted version of 'APHAB'. The following demographic information was used to analyze their impact on the study variable. Demographic variables that were examined for their impact on the study outcomes included daily hearing aid usage, hearing aid style, degree of hearing loss, and duration of hearing aid use. Participants were categorized into two groups based on daily hearing aid usage: those using hearing aids for less than eight hours and those using them for more than eight hours, with comparisons of their APHAB scores conducted accordingly. Hearing aid style was classified into two categories: Behind-the-Ear (BTE) and In-the-Canal (ITC). The degree of hearing loss was categorized into four levels: Mild, Moderate, Moderately Severe, and Severe, which were used to analyze the APHAB scores. Additionally, the duration of hearing aid use was divided into two groups: less than five years and more than five years. Table 2 indicates the distribution of demographic details of the Unilateral & Bilateral Hearing Aid users.

**Table 2:** Demographic Information of Unilateral and Bilateral Hearing Aid Users

| Characteristics | Categories | Unilateral Users | Bilateral Users |
|---|---|---|---|
| | | Count (Percentage) | |
| Hours of Usage | < 8 hours | 14 (25) | 9 (16.1) |
| | > 8 hours | 17 (30.4) | 16 (28.6) |
| Style | BTC | 19 (33.9) | 22 (39.3) |
| | ITC | 12 (21.4) | 3 (5.4) |
| Degree of Loss | Mild | 8 (14.3) | 2 (3.6) |
| | Moderate | 15 (26.8) | 1 (1.8) |
| | Moderately Severe | 4 (7.1) | 9 (16.1) |
| | Severe | 4 (7.1) | 13 (23.2) |
| Years of Usage | < 5 Years | 12 (21.4) | 7 (12.5) |
| | >5 Years | 19 (33.9) | 18 (32.1) |

The APHAB consists of 24 items; each assessed on a 7-point rating scale, and is divided into four subscales: Ease of Communication (EC), Reverberation (RV), Background Noise (BN), and Aversiveness of Sounds (AV). The hearing aid benefit score is derived by subtracting the average scores of participants who do not receive assistance from those who do. For each subscale, scores are obtained for both unaided and aided conditions by having participants respond to each item for both 'without hearing aid' and 'with hearing aid'. The software incorporates two norm groups: one comprising individuals with mild to moderate, flat or sloping bilateral sensorineural hearing loss, predominantly elderly patients who had previously used linear hearing aids regularly, with approximately 50% being bilateral hearing aid users.

The benefit score is calculated based on the patient responses, with a minimum difference of 22 points between the unaided and aided conditions across the subscales (Ease of Communication [EC], Reverberation [RV], Background Noise [BN], and Aversiveness of Sounds [AV]) indicating a significant benefit. An evaluation is considered clinically meaningful when a difference of at least 10 points is observed on each subscale, Table 3.

**Table 3:** Descriptive Statistics for Each of the Subscales of APHAB Mizo

| Sub scales | Group | Unilateral Hearing Aid Users N = 31 | | Bilateral Hearing Aid Users N = 25 | |
|---|---|---|---|---|---|
| | | Min - Max | Mean ± SD | Min - Max | Mean ± SD |
| EC | Unaided | 71 - 87 | 78.55 ± 3.68 | 70.8 - 87 | 84.75 ± 4.62 |
| | Aided | 16 - 29 | 21.99 ± 3.45 | 10.2 - 24.8 | 13.82 ± 3.21 |
| | Benefit | 52.2 - 60.5 | 56.58 ± 2.68 | 58.3 - 75 | 71.03 ± 5.65 |
| RV | Unaided | 69 - 87.7 | 81.93 ± 4.13 | 79 - 87 | 85.8 ± 2.31 |
| | Aided | 19.2 - 33.3 | 25.59 ± 3.88 | 12 - 35.3 | 17.46 ± 5.87 |
| | Benefit | 51.2 - 64.2 | 56.71 ± 3.69 | 49.7 - 75 | 68.29 ± 6.87 |
| BN | Unaided | 10 - 87 | 70.46 ± 26.49 | 74.2 - 97 | 85.99 ± 5.05 |
| | Aided | 16.3 - 31.2 | 23.82 ± 3.6 | 12 - 29.2 | 16.37 ± 4.35 |
| | Benefit | -10.8 - 64.3 | 47.15 ± 26.11 | 47.8 - 75 | 68.8 ± 6.95 |
| AV | Unaided | 10 - 24.5 | 14.77 ± 5.13 | 12 - 24.5 | 13 ± 3.46 |
| | Aided | 21.2 - 22.8 | 22.7 ± 0.34 | 18.5 - 37.5 | 23.77 ± 3.45 |
| | Benefit | -11.2 - 1.7 | -7.91 ± 5.04 | -25.2 - 9 | -10.24 ± 5.92 |

Hours of Usage, Style of hearing aids, Degree of hearing loss, duration of hearing aid usage was considered as the audiological /non-audiological factors to assess the influence of these on APHAB Mizo Scores. APHAB scores of participants with Unilateral Hearing aids and bilateral hearing aids were calculated and assessed the impact of factors on APHAB score in unilateral hearing aid and bilateral hearing aid users separately.

## Hours of Usage

In Unilateral Hearing aid users, the results revealed a statistically significant difference in BN [Unaided]: U = 42.00, p = 0.002, AV [Unaided]: U = 67.00, p = 0.013 and in AV [Benefit] scores: U = 72.00, p = 0.020 across the groups of 'hours of usage' at 5% level of significance [Table 4]. Meanwhile in bilateral hearing aid users, no significant difference in parameter scores was observed in Table 5.

**Table 4:** Influence of Hours of Usage on APHAB Subscale Scores in Unilateral Hearing Aid Users

| Sub Scales | Hours | Unaided Mean ± SD | Unaided U test statistic | Unaided P-value | Aided Mean ± SD | Aided U test statistic | Aided P-value | Benefit Mean ± SD | Benefit U test statistic | Benefit P-value |
|---|---|---|---|---|---|---|---|---|---|---|
| EC | <8 Hours | 77.42±3.05 | 88 | 0.20 | 21.22±3.68 | 92 | 0.27 | 56.28±2.79 | 108.5 | 0.67 |
| | >8 Hours | 79.47±3.97 | | | 22.61±3.21 | | | 56.8±2.63 | | |
| RV | <8 Hours | 80.44±5.00 | 79.5 | 0.100 | 24.72±4.51 | 90.5 | 0.25 | 56.57±3.32 | 115.5 | 0.88 |
| | >8 Hours | 83.15±2,84 | | | 26.2±3.24 | | | 56.82±4.06 | | |
| BN | <8 Hours | 64.35±28.94 | 42 | 0.002 | 23.15±3.59 | 106 | 0.59 | 42.39±29.0 | 83 | 0.72 |
| | >8 Hours | 75.48±23.98 | | | 24.3±3.61 | | | 51.0±23.54 | | |
| AV | <8 Hours | 12.46±2.97 | 67 | 0.013 | 22.68±.42 | 114.5 | 0.72 | -10.07±2.81 | 72 | 0.02 |
| | >8 Hours | 16.67±5.79 | | | 22.70±.265 | | | -6.12±5.79 | | |

**Table 5**: Influence of Hours of Usage on APHAB Subscale Scores in Bilateral Hearing Aid Users

| | Hours | Unaided | | | Aided | | | Benefit | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean ± SD | U test statistic | P-value | Mean ± SD | U test statistic | P-value | Mean ± SD | U test statistic | P-value |
| EC | <8 Hours | 84.30±.4.7 | 62.0 | .450 | 13.6±.1.9 | 61.0 | .501 | 70.7±5.64 | 64.5 | .647 |
| | >8 Hours | 84.9±4.6 | | | 13.9±3.8 | | | 71.1±5.8 | | |
| RV | <8 Hours | 85.40±2.7 | 65.0 | .616 | 18.1±5.88 | 64.5 | .663 | 67.24±7.24 | 61.5 | .542 |
| | >8 Hours | 86.0±2.06 | | | 17.0±6.02 | | | 68.8±6.8 | | |
| BN | <8 Hours | 83.57±5.27 | 52.5 | .182 | 17.7±4.33 | 47.5 | .134 | 65.8±9.33 | 51.0 | .214 |
| | >8 Hours | 87.35±4.52 | | | 15.6±4.28 | | | 70.4±4.7 | | |
| AV | <8 Hours | 12.00±.00 | 63.0 | .279 | 24.4±4.98 | 69.5 | .876 | -12.4±4.91 | 60.0 | .443 |
| | >8 Hours | 13.5±4.26 | | | 23.38±2.3 | | | -9.01±6.22 | | |

**Table 6:** Influence of Style of Hearing Aids on APHAB Subscale Scores in Unilateral Hearing Aid Users

| Sub Scales | Category | Unaided | | | Aided | | | Benefit | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean ± SD | U test statistic | P-value | Mean ± SD | U test statistic | P-value | Mean ± SD | U test statistic | P-value |
| EC | BTE | 79.42±3.6 | 81.50 | .176 | 22.2±3,78 | 109.5 | .85 | 56.8±2.45 | 101.5 | .61 |
| | ITC | 77.6±3.01 | | | 21.5±2.94 | | | 56.1±3.06 | | |
| RV | BTE | 83.72±2.32 | 40.0 | .002 | 26.2±3.09 | 74.5 | .104 | 57.0±3.97 | 105 | .71 |
| | ITC | 79.1±4.8 | | | 24.2±4.73 | | | 56.11±3.2 | | |
| BN | BTE | 79.5±16.6 | 32.0 | .001 | 23.7±3.10 | 111.0 | .901 | 56.0±16.46 | 36.5 | .002 |
| | ITC | 56.1±33.09 | | | 23.8±4.42 | | | 32.99±32.5 | | |
| AV | BTE | 15.5±5.61 | 92.5 | .292 | 22.7±.36 | 102.0 | .343 | -7.1±5.5 | 99.0 | .44 |
| | ITC | 13.58±4.20 | | | 22.66±.311 | | | -9.05±4.08 | | |

**Table 7:** Influence of Style of Hearing Aids on APHAB Subscale Scores in Bilateral Hearing Aid Users

| Sub Scales | Category | Unaided | | | Aided | | | Benefit | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean ± SD | U test statistic | P-value | Mean ± SD | U test statistic | P-value | Mean ± SD | U test statistic | P-value |
| EC | BTE | 84.9±4.58 | 29.0 | .655 | 13.8±3.35 | 27.0 | .499 | 71.1±5.81 | 28.0 | .588 |
| | ITC | 83.6±5.77 | | | 13.5±2.40 | | | 70.1±5.1 | | |
| RV | BTE | 86.0±1.92 | 28.0 | .597 | 17.9±6.10 | 21.5 | .323 | 68.03±7.01 | 25.0 | .498 |
| | ITC | 84.33±4.61 | | | 14.1±2.15 | | | 70.1±6.55 | | |
| BN | BTE | 86.88±4.21 | 12.5 | .038 | 15.8±3.88 | 17.50 | .162 | 70.1±4.91 | 15.0 | .116 |
| | ITC | 79.4±6.72 | | | 20.5±6.25 | | | 58.96±12.7 | | |
| AV | BTE | 13.13±3.67 | 30.0 | .594 | 23.13±2.01 | 13.50 | .072 | -9.40±5.31 | 12.0 | .047 |
| | ITC | 12.0±.00 | | | 28.43±7.92 | | | -16.3±7.75 | | |

## Style of Hearing Aids

The results of Mann Whitney U test showed that largely style of hearing aid worn by unilateral hearing aid users influenced APHAB scores for unaided scores alone. A statistically significant difference in the scores across the groups of 'style of hearing aid' were observed in RV [Unaided]: U = 40.00, p = 0.002, BN [Unaided]: U = 32.00, p = 0.001 and in BN [Benefit]: U = 36.500, p =0.002 in Table 6. In bilateral hearing aid users, a statistical difference in score across the groups were observed in BN [Unaided]: U = 12.500, p = 0.038 and AV [Benefit]: U = 12.00, p = 0.047 in Table 7.

## Degree of Hearing Loss

The results of Kruskal Walli's test showed that largely degree of hearing loss of unilateral hearing aid users influenced APHAB scores for unaided scores alone. A statistically significant difference in the parameter scores across the level of severity were observed in EV [Unaided]: $\chi^2$ = 8.818, p = 0.032, BN [Unaided]: $\chi^2$ = 13.061, p = 0.005, AV [Unaided]: $\chi^2$ = 7.925, p = 0.048, and in AV [Benefit]: $\chi^2$ = 8.578, p = 0.35 at 5% level of significance.

However, at 10% level of significance, statistical difference in scores was observed for EV [Aided], BN [Aided] and RV [Aided] Table 8. For bilateral hearing aid users, no significant difference in scores across the groups at 5% level of significance was observed in Table 9.

**Table 8:** Influence of Degree of Hearing Loss on APHAB Subscale Scores in Unilateral Hearing Aid Users

| Sub Scale | Category | Unaided | | | Aided | | | Benefit | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean ± SD | $\chi^2$ test statistic | p-value | Mean ± SD | $\chi^2$ test statistic | p-value | Mean ± SD | $\chi^2$ test statistic | p-value |
| EC | Mild | 77.2±1.6 | 8.88 | .032 | 21.1±2.69 | 7.7 | 0.5 | 56.1±3.39 | .70 | .87 |
| | Moderate | 77.6±3.6 | | | 21.2±3.67 | | | 56.58±2.54 | | |
| | Moderately Severe | 79.0±1.6 | | | 22.1±2.5 | | | 56.7±1.99 | | |
| | Severe | 84.0±3.8 | | | 26.4±1.10 | | | 57.5±2.92 | | |
| RV | Mild | 80.7±1.9 | 5.12 | .163 | 24.6±3.66 | 6.9 | .07 | 55.9±3.30 | 3.5 | .31 |
| | Moderate | 81.6±5.5 | | | 24.4±3.9 | | | 57.±4.35 | | |
| | Moderately severe | 84.5±1.9 | | | 29.1±3.38 | | | 55.3±2.0 | | |
| | Severe | 83.0±.00 | | | 28.1±1.27 | | | 54.9±1.27 | | |
| BN | Mild | 70.8±23.8 | 13.0 | .005 | 22.7±3.46 | 7.2 | .06 | 48.1±24.09 | .80 | .84 |
| | Moderate | 62.5±32.0 | | | 23.1±3.62 | | | 40.4±32.2 | | |
| | Moderately Severe | 83.50±1.9 | | | 24.4±2.01 | | | 59.1±1.16 | | |
| | Severe | 86.5±1.00 | | | 28.05±2.1 | | | 58.4±2.00 | | |
| AV | Mild | 13.3±3.71 | 7.9 | .048 | 22.7±.28 | 1.1 | .77 | 9.4±3.71 | 8.5 | .03 |
| | Moderate | 14.5±5.0 | | | 22.6±.441 | | | -8.02±4.82 | | |
| | Moderately severe | 12.0±.00 | | | 22.8±.00 | | | -10.8±.00 | | |
| | Severe | 21.3±6.2 | | | 22.8±.00 | | | -1.42±6.25 | | |

**Table 9:** Influence of Degree of Hearing Loss on APHAB Subscale Scores in Bilateral Hearing Aid Users

| Sub Scale | Category | Unaided Mean ± SD | Unaided χ² test statistic | Unaided p-value | Aided Mean ± SD | Aided χ² test statistic | Aided p-value | Benefit Mean ± SD | Benefit χ² test statistic | Benefit p-value |
|---|---|---|---|---|---|---|---|---|---|---|
| EC | Mild | 82.0±7.01 | 1.76 | .623 | 12.1±.212 | 1.57 | .665 | 69.8±7.28 | 1.91 | .591 |
| | Moderate | 87.0 | | | 12.0 | | | 75.0 | | |
| | Moderately Severe | 84.5±4.44 | | | 14.0±2.0 | | | 70.5±5.17 | | |
| | Severe | 85.2±4.84 | | | 14.0±4.12 | | | 71.25±6.30 | | |
| RV | Mild | 83.0±5.65 | 1.7 | .62 | 15.25±1.48 | .371 | .946 | 67.7±7.14 | .196 | .978 |
| | Moderate | 87.0 | | | 16.3 | | | 70.7 | | |
| | Moderately severe | 85.6±2.23 | | | 17.7±6.21 | | | 67.9±7.46 | | |
| | Severe | 86.2±1.73 | | | 17.7±6.48 | | | 68.4±7.22 | | |
| BN | Mild | 82.7±7.07 | 3.09 | .378 | 17.45±4.59 | .65 | .885 | 64.55±11.6 | 1.10 | .776 |
| | Moderate | 87.0 | | | 14.3 | | | 72.7 | | |
| | Moderately Severe | 84.4±4.66 | | | 16.77±4.5 | | | 67.6±8.87 | | |
| | Severe | 87.6±4.99 | | | 16.0±4.62 | | | 69.9±5.08 | | |
| AV | Mild | 12.0±.00 | .336 | .947 | 30.15±10.39 | 2.16 | .538 | - 18.00±10.1 | 1.86 | .600 |
| | Moderate | 12.0 | | | 22.8 | | | -10.8 | | |
| | Moderately Severe | 13.3±4.6 | | | 22.9±1.27 | | | -8.85±6.82 | | |
| | Severe | 12.9±3.46 | | | 23.42±2.49 | | | -9.96±4.34 | | |

**Table 10:** Influence of Experience of Hearing Aids on APHAB Subscale Scores in Unilateral Hearing Aid Users

| Sub Scales | Experience | Unaided Mean ± SD | Unaided U test statistic | Unaided P-value | Aided Mean ± SD | Aided U test statistic | Aided P-value | Benefit Mean ± SD | Benefit U test statistic | Benefit P-value |
|---|---|---|---|---|---|---|---|---|---|---|
| EC | <5 years | 77.5±2.2 | 84.0 | .212 | 21.1±3.05 | 90.0 | .320 | 56.3±2.93 | 106.0 | .744 |
| | >5 years | 79.2±4.23 | | | 22.5±3.66 | | | 56.7±2.57 | | |
| RV | <5 years | 83.2±3.08 | 90.5 | .330 | 26.5±4.12 | 93.0 | .387 | 56.6±4.34 | 105.5 | .730 |
| | >5 years | 81.10±4.55 | | | 25.0±3.71 | | | 56.7±3.33 | | |
| BN | <5 years | 75.5±20.0 | 112.0 | .935 | 23.3±2.5 | 101.0 | .589 | 52.2±20.2 | 106.0 | .745 |
| | >5 years | 67.2±29.8 | | | 24.1±4.14 | | | 43.9±29.26 | | |
| AV | <5 years | 13.7±4.08 | 104.0 | .624 | 22.7±.230 | 111.0 | .813 | -9.05±4.08 | 99.0 | .446 |
| | >5 years | 15.4±5.70 | | | 22.6±.401 | | | -7.18±5.53 | | |

**Table 11:** Influence of Experience of Hearing Aids on APHAB Subscale Scores in Bilateral Hearing Aid Users

| Sub Scales | Experience | UNAIDED | | | AIDED | | | BENEFIT | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean ± SD | U test statistic | P-value | Mean ± SD | U test statistic | P-value | Mean ± SD | U test statistic | P-value |
| EC | <5 years | 84.4±6.04 | 59.0 | .747 | 12.5±1.68 | 42.0 | .170 | 71.9±5.24 | 56.0 | .64 |
| | >5 years | 84.88±4.14 | | | 14.3±3.55 | | | 70.6±5.90 | | |
| RV | <5 years | 85.8±2.26 | 63.0 | .1.00 | 16.9±4.8 | 61.0 | .901 | 68.8±5.70 | 62.5 | .97 |
| | >5 years | 85.77±2.39 | | | 17.65±6.33 | | | 68.066±7.40 | | |
| BN | <5 years | 85.5±3.77 | 61.5 | .913 | 14.4±2.30 | 40.5 | .142 | 71.0±4.32 | 47.0 | .31 |
| | >5 years | 86.1±5.55 | | | 17.1±4.77 | | | 67.9±7.6 | | |
| AV | <5 years | 13.7±4.72 | 57.5 | .479 | 23.5±2.33 | 53.0 | .505 | -8.8±5.27 | 44.0 | .19 |
| | >5 years | 12.6±2.94 | | | 23.8±3.85 | | | -10.7±6.02 | | |

## Duration of Hearing Aid Usage

In both Unilateral and Bilateral hearing aid users, no significant difference in parameter scores across the group was observed in Table 10 and 11. The Mann-Whitney U test was conducted to determine whether significant differences existed in the APHAB subscale scores between unilateral and bilateral hearing aid users across three conditions: unaided, aided, and benefit. The results indicated a statistically significant difference in the scores for all subscales, with the exception of the Aversiveness of Sounds (AV) subscale, Table 12.

**Table 12:** Comparison on the Benefit on Each of the in Both Unilateral and Bilateral Participants

| Sub Scales | Category | Unaided | | | Aided | | | Benefit | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean ± SD | U | P-value | Mean ± SD | U | P-value | Mean ± SD | U | P-value |
| EC | Unilateral | 78.5±3.67 | 21.0 | 0.000 | 21.9±3.4 | 38.5 | 0.000 | 56.5±2.67 | 17.0 | 0.000 |
| | Bilateral | 84.7±4.61 | | | 13.8±3.21 | | | 71.0±5.64 | | |
| RV | Unilateral | 81.9±4.13 | 156.5 | 0.000 | 25.5±3.8 | 93.5 | 0.000 | 56.7±3.68 | 71.0 | 0.000 |
| | Bilateral | 85.8±2.30 | | | 17..3±5.87 | | | 68.8±6.8 | | |
| BN | Unilateral | 70.4±26.4 | 132.0 | 0.000 | 23.8±3.6 | 72.0 | 0.000 | 47.1±26.1 | 79.0 | 0.000 |
| | Bilateral | 85.9±5.05 | | | 16.37±4.34 | | | 68.8±6.9 | | |
| AV | Unilateral | 14.7±5.12 | 346.5 | 0.346 | 22.6±.34 | 343.0 | 0.335 | -7.9±5.03 | 311.0 | 0.135 |
| | Bilateral | 13.0±3.4 | | | 23.7±3.44 | | | -10.24±5.9 | | |

# Discussion

This study aimed to evaluate the reliability and validity of a Mizo version of the APHAB, with the goal of determining its feasibility for adaptation and implementation in clinical settings within a Mizo-speaking population. The criterion validity test of the Mizo version of APHAB was conducted by collecting the data from participants using the translated version, and then again after a period of one moth using the original English version. The translated Mizo version of the APHAB tool was found to be highly valid and reliable, showing perfect correlation in both validity and test retest reliability tests conducted among 20% of the original participants. Literature evidence shows perfect test -retest validity and reliability of the translated version of APHAB into various languages. In a study evaluating the psychometric properties of a Swedish translation of the APHAB and the influence of demographic variables on outcomes in a clinical sample, although the Reverberation (RV) subscale exhibited some potential issues, the overall psychometric parameters demonstrated strong test-retest reliability (31). The Chinese translation of the Abbreviated Profile of Hearing Aid Benefit (APHAB) demonstrated strong internal consistency, similar to the original version (32).

The global mean score for APHAB-CH was 12.62 (SD = 19.34), with average subscale scores as follows: Ease of Communication (EC) 15.36 (SD = 29.84), Reverberation (RV) 8.08 (SD = 29.12), Background Noise (BN) 14.42 (SD = 23.37), and Aversiveness of Sounds (AV) -14.67 (SD = 23.70). Significant correlations were found between APHAB-CH scores, subjective assessments of hearing aid function, and overall satisfaction. Test-retest reliability was strong. Unpleasant background noise was reported more often with amplification. The results support that APHAB-CH is a valid and reliable measure of hearing aid outcomes. The APHAB primarily evaluates hearing aid effectiveness, with higher satisfaction linked to benefit scores of 25 or more in the EC, RV, and BN subscales (35). The Chinese version of the APHAB indicates that it can effectively assess satisfaction levels. Once the reliability and validity of the translated version was estimated which resulted in good outcome, the participants were then categorized based on the factors, such as style of hearing aids, degree of loss, type of usage [unilateral and bilateral], duration of daily use and experience [i.e., how long the participants have been using hearing aids]. The participants data was categorized into two - unilateral users and bilateral users, to evaluate the audiological factors. Scores of the subjects with unilateral hearing loss were evaluated for the hours of usage of hearing aid. Subjects were classified into two groups, <8 hours of usage and > 8 hours of usage. This comparison showed significant differences for the following subsections i.e BN [U = 42.00, p = 0.002], AV [U = 67.00, p = 0.013] for the unaided condition and again for AV- scores [U = 72.00, p = 0.020] for the benefit condition. Statistical difference was observed at 5% significance level. No significant differences were observed in other subscales [Table 4]. The aversiveness [AV] was not used for the analysis of benefit since there are no discernible patterns of response (16). A study suggested objective speech recognition in noise was not more strongly correlated with subscale BN, which quantifies communication in background noise (10). The relationship between audiological characteristics and APHAB scores was weakest for the Background Noise (BN) subscale. Specifically, BN scores showed a stronger correlation with threshold sensitivity and speech recognition. A systematic review found that while hearing aid use is linked to benefit and satisfaction, no dimension consistently correlates with the duration of use (36). Those with more severe hearing loss wore hearing aids longer than those with less severe loss (37, 38). Surprisingly, longer daily use was associated with better benefit (APHAB scores) and higher satisfaction (SADL scores) (39).

Participants were grouped by hearing aid style. Statistically significant differences were found in RV-UNAIDED (U = 40.00, p = 0.002), BN-UNAIDED (U = 32.00, p = 0.001), and BN-BENEFIT (U = 36.50, p = 0.002) for unilateral users. For bilateral users, differences were seen in BN-UNAIDED (U = 12.50, p = 0.038) and AV-BENEFIT (U = 12.00, p = 0.047) [Tables 6 & 7]. Most participants used BTE and ITC hearing aids due to cosmetic concerns and the cost of RIC models. Contradicting to the findings above there are certain literature evidence that results in otherwise. A study compared the benefits of open-fit with closed-fit hearing aids for both seasoned and novice users. The APHAB results showed no appreciable distinction between the groups with hearing aids with an open and closed fit, which is contradicting to the findings above. A study investigated the use of hearing aids and their relative benefits were examined, using both subjective and objective tests (40). All of the self-reported measures [GAS, SHAPIE, and HAUQ] had positive results, showing that ITE hearing aids are generally more beneficial, simpler to use, and more satisfying than BTE devices. To ascertain if receiver position affects subjective performance and/or listener preference, some investigators studied hearing aids with RITA [receiver in the aid] and RITE [receiver in the ear] receiver placements (24). APHAB showed, aside from aversiveness, the percentage of issues was substantially lower [better] for the RITE and RITA instruments than for the unaided version for all of the APHAB subtests. There was no statistically significant difference between the percentage of issues for the RITE and RITA instruments for any other APHAB subtest.

The RITE and RITA instruments provided participants with comparable levels of subjective benefit, according to the APHAB results, while satisfaction surveys revealed that people favoured the RITE over the RITA instrument. The degree of hearing loss significantly influenced unaided APHAB scores among unilateral users, particularly in the EV, BN and AV domains. Some of the aided scores also showed differences at the 10% significance level. No significant differences were observed among bilateral users [Table 8 and 9]. Not much literature evidence on APHAB outcome for individuals with unilateral user based on their degree of loss. Whereas for the bilateral user no significant difference in scores across the groups at 5% level of significance for bilateral users. Existing literature suggests that the Abbreviated Profile of Hearing Aid Benefit (APHAB) has been used to assess the outcomes of hearing aid fittings across various hearing impairments. In a study focusing on elderly individuals with severe sensorineural hearing loss (SNHL), significant benefits were observed in the subscales of Background Noise (BN), Reverberation (RV), and Ease of Communication (EC). However, no correlation was found between the benefit scores and the severity of hearing loss. A similar finding was reported in a study incorporating both pure sensorineural and mixed hearing losses with a primarily sensorineural component. This double-blind, randomized study utilized the Dutch version of the APHAB to measure self-reported hearing aid benefits and concluded that the degree of hearing loss did not influence the magnitude of these benefits (41).

Further research involving a Norwegian version of the APHAB categorized participants based on their most recent audiogram into three severity groups: mild to moderate, moderate to severe, and profound to severe. A one-way analysis of variance revealed that individuals in the more severe hearing loss categories scored significantly lower than those in the mild to moderate group. However, no significant differences were observed between the moderate and severe-to-profound hearing loss groups. These findings were similarly replicated in a study utilizing the Kannada-translated version of the APHAB.

In the present study, participants were classified based on their hearing aid usage experience into two groups: those with less than 5 years of usage and those with more than 5 years of usage. No statistically significant differences were observed between unilateral and bilateral users within either group (Tables 10 and 11). While the subscales and overall score of the Abbreviated Profile of Hearing Aid Benefit (APHAB) are influenced by daily hearing aid use, the extent of this impact remains insufficiently explored in existing literature. A comparison of the benefit and impact of the APHAB subscales between unilateral and bilateral hearing aid users revealed significant differences in the Ease of Communication (EC), Reverberation (RV), and Background Noise (BN) subscales, with no significant difference found in the Aversiveness (AV) domain. One study that utilized the APHAB to compare single versus bilateral hearing aid users reported that individuals using two hearing aids demonstrated improved speech understanding and fewer communication difficulties (42). Conversely, another study found that as the severity of hearing loss increased, the average satisfaction score decreased (43). Despite the observed differences in hearing aid configuration (unilateral vs. bilateral), no significant statistical difference was noted with respect to the degree of hearing loss. Notably, patient satisfaction was found to be notably higher among bilateral hearing aid users. A study reported wearing two hearing aids resulted in considerably higher subscale scores than wearing just one. Though their effect size was minor, the large sample size resulted in a statistically significant difference (44). Similar results were also observed in other literatures, where the respondents who chose two hearing aids scored higher on the advantages subscale, with an effect size d = 0.4.Although it was not significant when patients were divided into the two hearing loss groups, this result was statistically significant in the study when all subjects were combined. A study revealed contradictory findings (45), patients who chose two hearing aids as opposed to one saw a noticeably better real world benefit with one set of surveys. However, the IOI-HA results did not show a meaningful benefit for bilateral fittings. Contradicting to the findings above, a study that compared three methods for the initial fitting of Multi-channel compression hearing aids, used the APHAB as one of the tests and concluded as there was no statistically significant difference between the APHAB questionnaire results for the groups that received unilaterally fitted devices and those that received bilaterally fitted devices (46). Literature is positive in accepting that PROMs or questionnaires have a significant role in auditory habilitation. An investigation demonstrated that questionnaires provide insight about the benefits from amplification and also help identify aspects that need to be attended to in follow-up (47). But like many PROMs this too may be influenced by biases such as social desirability and unwillingness to accept in front of strangers their difficulties [self-esteem]. The present study acknowledges those limitations inherent to the survey design. It has been noted that certain biases may have influenced participant's responses to the APHAB questionnaire (48). Skipped responses, overestimating or underestimating their experiences, social stigma as well as social desirability were some of the factors that the authors considered relevant. The primary researcher belongs to the linguistic-social background of the subjects and to certain extent would have helped subjects to be as natural and realistic as possible in their answers. Largely this remains to be a limitation of the study as no specific procedure was incorporated into the study design to reduce these biases.

### Future Direction

Study can be conducted on subjects with different regions and dialects of Mizoram. Study may be conducted to know prevailing practices of Audiologists in hearing health care, inclusion of PROMs in their routine practice and influence of education and importance of these measures in change in their practice methods etc.

## Conclusion

For the translation and adapted version of the APHAB, 56 participants responded. The study aimed to evaluate the validity and reliability of the translated version of the APHAB. Criterion validity was assessed by correlating the scores obtained using the untranslated version with the scores obtained using the translated version of the questionnaire. The result suggested that the translated version of the tool was highly valid. The result of inter-rater reliability also indicated high reliability of the tool used. In the entire translated version APHAB's subscales and on the global scale, audiological factors, has an impact on all of the subscales, and the results were consistent with those of the Swedish APHAB version, and Korean version. For every APHAB subscale [translated version] and global scale benefit score, audiological characteristics such hearing aid experience, usage, and style did not significantly differ between groups or among groups. Aversiveness [AV] subscale was the only one where a parameter, such as the degree of hearing loss, showed a significant difference between the groups; the other subscales and the overall scale did not. With the exception of the Aversiveness [AV] subscale, the APHAB scores of bilateral and unilateral hearing aid fittings differed significantly in all subscales and the global scale.

The study also revealed that many participants had limited awareness of standard audiological evaluation procedures. Approximately 30% of the participants lacked access to services for fine-tuning their hearing aids, and financial constraints prevented them from purchasing bilateral hearing aids. As a result, considerable variability was observed among unilateral hearing aid users across all subscales. Furthermore, the availability of audiologists for adjustments and support was a significant factor influencing the participants' experiences. Many participants also reported concerns regarding the cosmetic appearance of Behind-the-Ear (BTE) hearing aids, leading to social stigma. These factors contributed to noticeable variation in the outcomes across the subscales.

Hearing aids like Receiver in the Canal are not very popular as reported by the audiologist it is due to lack of demands from hearing impaired individuals due to financial issues. In the canal hearing aids were reported to be very common even if it provides limit benefit due to cosmetic concerns, and easy accessibility especially amongst the younger individuals. Participants were also unaware, of the routine audiological evaluation to keep a tract of their hearing levels. Mizoram as a state still lacks very much in awareness of audiological services, and the importance of care and maintenance of amplification devices, also lacks in the variety of style of hearing aids to be provided to the people in need. The hearing aids provided by the Government reported to be lack in many features, which provided a limited benefit amongst the individuals.

### Abbreviations

APHAB: Abbreviated Profile of Hearing Aid Benefit, AV: Aversiveness of Sounds, BN: Background Noise, BTE: Behind The Ear, CIC: Completely In the Canal, COSI: Client Oriented Scale of Improvement, CPHI: Communication Profile for the Hearing Impaired, EC: Ease of Communication, GHABP: Glasgow Hearing Aid Benefit Profile, HF SNHL:

High-Frequency Sensorineural Hearing Loss, HHIE: Hearing Handicap Inventory for the Elderly, IOI-HA: International Outcome Inventory for Hearing Aids, ITC : In The Canal, Mizo: Refers to the Mizo language, Mizo APHAB: Mizo version of the Abbreviated Profile of Hearing Aid Benefit, PHAP: Profile of Hearing Aid Performance, RITA: Receiver-In-The-Aid, RITE: Receiver-In-The-Ear, RV: Reverberation, SADL: Satisfaction with Amplification in Daily Life, SNHL: Sensorineural Hearing Loss, U: Mann-Whitney U test statistic, WHO: World Health Organization.

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## Author Contributions

Lalrinfeli Sailo: Conceptualization, Data Collection, Writing – Original Draft, Suresh T: Supervision, Methodology, A. Srividya: Review, Editing, Praveena Babu: Statistical Analysis, Data Interpretation.

## Conflict of Interest

The authors of this work state that they have no conflicts of interest about this publication.

## Ethics Approval

The study received ethical clearance from the Institutional Ethics Committee of Dr. S. R. Chandrasekhar Institute of Speech and Hearing on March 5, 2023. [Approval No. BSHRF/RC/IEC/D/1 7/2023]

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