DEVELOPMENT AND CONTENT VALIDATION OF LISTS OF URDU MONOSYLLABLE WORDS FOR WORD RECOGNITION SCORES TESTING

MUHAMMAD ZUBAIR *

PhD Student, Lincoln University College, Malaysia.
*Corresponding Author Email: mzubair@licoln.edu.my

SATHEESH BABU NATARANJAN

Associate Professor, Lincoln University College, Malaysia. Email: satheeshbabu@lincoln.edu.my

WAQAR AHMED AWAN

Professor, Riphah International University, Islamabad Pakistan. Email: waqar.ahmed@riphah.edu.pk

Abstract

Background: Developing a standardized set of Urdu words and validating their efficacy allows Urdu-speaking people to get more accurate and reliable speech audiometry evaluations. **Objective:** The purpose of the study was to develop and validate the list of Urdu monosyllable words for speech recognition scores testing **Methodology:** This cross sectional study was done at Avicenna Medical Complex, Islamabad, during 1st June 2023 to 31st December 2023. There were n=60 adult Urdu speakers with age from 15 to 60 years, belong to different regions of Pakistan, were included in the study. Initially we collected 180 monosyllabic Urdu words form Urdu newspapers, magazines, Books. Culturally and religiously sensitive words and homogenous or misunderstood words were excluded. Then familiarity rating on 5-point likert scale was done by using Google forms. Words with familiarity rating more than 70% were included. Content validation was completed by 9 experts by using 3 scales of appropriateness, relevance and familiarity. Inter rater reliability was measured by using Kappa statistics. The only words that obtained CVI scores above 0.78 were included. **Results:** Familiarity rating of 180 words was done among 60 Urdu speakers and 32 words found less familiar excluded from the list. Content validation by 9-expert was done on 148 words and only 7 words found below the criteria. Four words were not repeated correctly in pilot testing result a valid list of 137 Urdu monosyllabic words for speech discrimination scores testing. **Conclusion:** A word bank of 137 Urdu monosyllabic words was created, with adequate evidence of content validity based on word familiarity, appropriateness and Relevance.

Keywords: Speech Audiometry, Word Recognition Scores, Content Validation, Urdu Monosyllable words, Audiometry, Hearing test, Speech Discrimination Scores.

INTRODUCTION

Speech perception and comprehension are essential for normal human communication. In everyday life, many people with hearing loss find it difficult to understand spoken language.[1] When assessing hearing of patients in a clinical setting, pure tone audiometry alone is insufficient. Therefore, speech audiometry must be a part of the regular audiological evaluation. [2]. The word recognition score [WRS] is the component of speech audiometry that is the most essential and frequently performed test. This test includes listening to a number of monosyllabic words that are either phonetically or phonemically balanced to the patient at a comfortable supra-threshold level. The patient

is then asked to repeat the words as they hear them. When the individual accurately repeats each phoneme in a word, consider the word is correct. The WRS is determined by the examiner as the percentage of words that were correctly repeated, ranging from 0% to 100%. [3]

During the evaluation of speech recognition ability of a patient, a number of different stimuli can be used. These stimuli can range from meaningless syllables to monosyllabic phrases and even sentences[4]. Monosyllable words are the most frequently used stimuli in speech recognition evaluations, as they allow for the assessment of an individual's ability to identify speech stimuli through auditory perception. These words ensure the sensitivity of the test by offering limited clues [5]. Patients with conductive hearing loss and normal hearing individuals typically have excellent word recognition scores [WRSs], patients with sensory hearing loss typically have reduced WRSs with mild roll over and patients with neural hearing loss typically have poor WRSs with significant roll over.[6]

The testing of the WRS is most significant in determining the location of the lesion, as well as in determining the neurological integrity of the auditory system and in the comprehension processes that occur at the brain level.[7],[8] Furthermore, WRS is highly useful for predicting the degree of brain degeneration [9], evaluating the benefit of fitting hearing aids [10] and assessing the suitability and performance of patients undergoing cochlear implants.[11]

It is essential for each language to have its own speech audiometry materials with psychometrically valid and reliable stimuli. [12]. Many languages have standardized speech audiometry word lists. [13], [17] Many monosyllabic word lists for native English speakers are frequently used in the US, such as the Central Institute of the Deaf's W-22 list[8] and North Western University's NU-6 CNC list.[13]. Many other languages also make use of the WRS material, these include Arabic,[14], Turkish,[15], Spanish,[16] and Japanese [17]

Hence, this study was designed with an objective to develop and validate Urdu monosyllable words list for Urdu speaking adults. There is no standardized and linguistically appropriate word recognition score test stimuli for Urdu speakers. This research fills the gap in Urdu-speaking audiological testing tools with a comprehensive, culturally appropriate approach. Creating a standardized set of Urdu words and validating their efficacy allows Urdu-speaking people to receive more accurate and reliable speech audiometry evaluations.

METHODOLOGY

This cross sectional study was carried out at Avicenna Medical Complex Islamabad, Pakistan, during 1st June 2023 to 31st December 2023. Written informed consent from all participants including healthy individuals and expert was obtained and confidentiality was maintained. The data was collected from healthy individual and expert by their direct observation.

There were n=60 male and female participants aged from 15 to 60 years. The entire participant belongs to different regions of Pakistan, with different mother tongues and education levels. Initially collected 180 monosyllable words, and more appropriate words were selected and their familiarity among general population was evaluated. More professional experts were asked to obtain the expert validation. Following steps were taken for this study.

Selection of words: The monosyllabic Urdu words were collected from national Urdu newspapers, magazines, Articles and books. [5] The most spoken and easily understandable words were selected. The words that were culturally or religiously sensitive, misunderstood and homophonic words were excluded from the word corpus[18]

Familiarity Rating: To ensure the selected words are common and understandable among Urdu speaking population the familiarity assessment was performed. This step excluded the less familiar words and aligned the list. A familiarity assessment survey was carried out among Pakistani individuals with various native language origins to develop the word list. To obtain familiarity scores for each of the 180 words, the Google forms survey was used. Binary outcomes were established using the Likert scale for familiarity ratings (1 to 5). Most familiar and very familiar scores were regarded as "Agreed," but average familiar, rarely familiar, and very rarely familiar scores (scored 3 to 5) were regarded as "Not Agreed."[19] The percentage of each word was determined. Words with familiarity ratings of less than or equal to 70% were eliminated.

Content Validation: This step was done on three essential scales, appropriateness, relevance and familiarity. Expert opinions were important for refining the list and enhancing the content validation. A panel of 9 experts including 3 audiologists, 2 Urdu linguists and 4 speech and language pathologists, evaluated the remaining 148 words. Experts ranked each word on 5-point Likert scale, assessing the relevance, appropriateness and familiarity. Evaluations of experts were analyzed. The Likert scale ratings (1–5) translated into binary outcomes: 1 and 2 (Highly Appropriate and Appropriate, Highly Relevant and Relevant, Most Familiar and very Familiar) were regarded as "Agreed," while 3–5 were regarded as "Not Agreed. Words were removed from the corpus which had Content Validity Index (CVI) scores below 0.78.[20] This expert validation ensured linguistically and culturally appropriateness of words for speech discrimination testing.

Pilot Testing: A pilot study was carried out to validate the rest of 141 words. Pure tone audiometry, tympanometry, and acoustic reflex assessments performed on 10 participants to confirm normal hearing thresholds (better than 20 dB HL). The selected words were presented at 40 dB SL. The responses of participants were recorded as either repeated correctly or not. . The words made with more than one error were omitted

Final Word List: The final list of Urdu monosyllabic words for adult speech discrimination testing was created by combining the findings of the familiarity rating, content validity assessment and pilot testing.

Statistical analysis: The demographic data of the participants were described through mean, standard deviation, frequency and percentages. The study's descriptive statistics and content validation index (CVI) scores were calculated in MS Excel 2010. Likert scale ratings (1–5) were converted into binary outcomes: as "Agreed," and "Not Agreed." The CVI was calculated by dividing the number of experts who agreed that the item is valid by total number of experts. The words with CVI values below 0.78 were removed. Kappa statistics assessed inter-rater agreement. Excellent inter-rater reliability was indicated by Kappa scores above 0.75.

RESULTS

The present study developed tool called Urdu monosyllable words list. Primarily 180 words collected from resources and analyzed. Individuals n=60 participated in the familiarity rating with different linguistic backgrounds. Gender distribution was 1:1.2 and mean age was 32.5 ± 8.6 years. Most participants had bachelor or master degrees. Additionally, majority of experts were postgraduates with over 5 years of experience.

The familiarity assessment for a list of 180 Urdu monosyllable words was completed, that indicate the perceived understanding of participants for these words. It consists of a lowest rating of 42% and a highest rating of 100%. Due to low familiarity scores, 32 words were removed. The remaining 148 words show a wide range of everyday jargon. Some words rated remarkably high, such as "لوگ" (100%) and "خوش" (100%), representing common recognition, while others, such as "میخ" (42%) and "فکر" (50%), rated poorly, indicating less familiarity. This result provides valuable insights into the linguistic structure of Urdu, presenting the various levels of familiarity associated with different words.

Table No. 1: Familiarity rating by 60 participants by their different mother tongue

Mother tongue	Most Familiar %	Very Familiar %	Average Familiar %	Rarely Familiar %	Very Rarely Familiar %
Pashto n=5	27.1	42.1	23	7.4	0.3
Saraiki n=11	60.2	28.3	9.5	1.4	0.4
Punjabi n=14	45.1	34.8	12.2	6.0	1.7
Sindhi n=2	26.9	42.7	14.7	7.5	8.0
Balochi n=3	32.9	54.8	8.3	3.1	0.7
Urdu n=23	51	29.7	12.8	4.8	1.5
Pahari n=1	73.3	15	6.6	4.4	0.5
Balti n=1	78.3	8.8	5	2.7	5
Average	49.3	32	11.5	4.6	2.2

The findings of the familiarity ratings as in table no. 1 show interesting patterns according to native languages of participants. The participants with Pashto mother tongue show a range of familiarity from most familiar to very rarely familiar words. Saraiki participant's show high level of familiarity considering the more than 60% of words most familiar. The Punjabi participants represent moderate familiarity rating with most familiar words. Balochi, Urdu, Sindhi, Balti and Parahi also show varying degree of familiarity within their particular group. On average, 81.7 % of words were most familiar and very familiar that

were consider as familiar. These findings provide valuable insights into the cross-linguistic aspects of language familiarity by highlighting the effect of participants' native dialects on their perception of the familiarity with Urdu monosyllabic words.
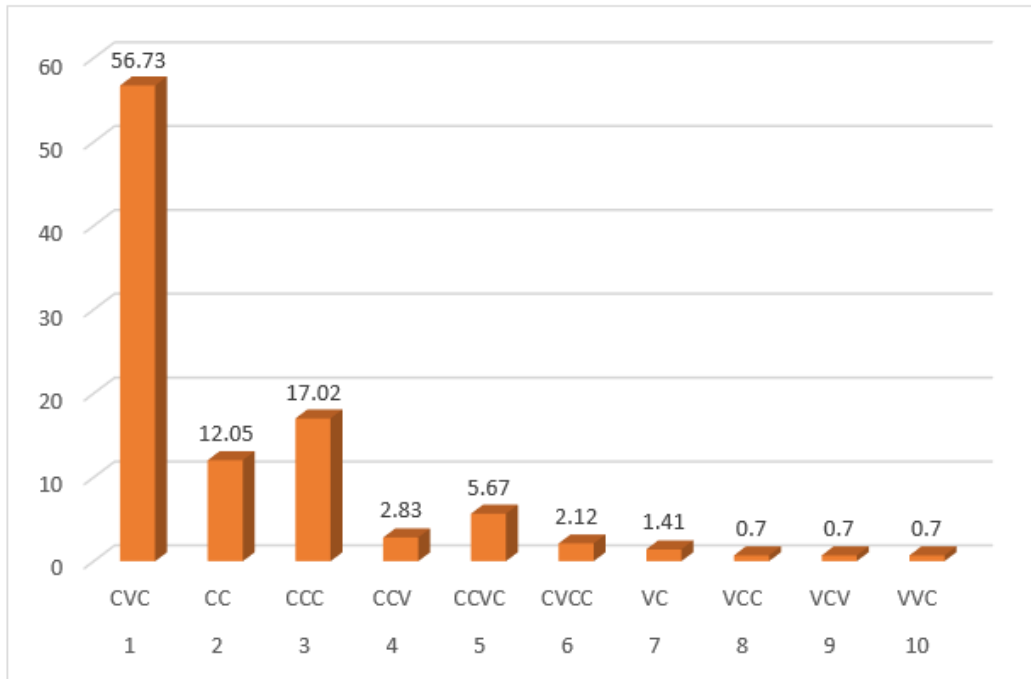

Fig 1: Syllable Structures and Percentages of Urdu Monosyllable Words

*CVC =consonant vowel consonant, CCVC= consonant consonant vowel consonant; CCC= consonant consonant consonant; VCC= vowel consonant consonant; CVCC= consonant vowel consonant consonant; CCV= consonant consonant vowel; CC=consonant consonant; VCV= vowel consonant vowel; VVC=vowel vowel consonant; VC=vowel consonant

The syllable structures in Urdu monosyllabic words shows a diverse linguistic patterns. Most words have Consonant-Vowel-Consonant syllables. It appears that most Urdu monosyllabic words follow this structure. Structures such as Consonant-Consonant and Consonant-Consonant-Consonant show that Urdu allows very complex consonant clusters in its monosyllabic words. A lot of the words shows such patterns. Although consonant-leading syllables are more common in Urdu, vowel-initial structures such as Vowel-Consonant (VC) and Vowel-Consonant-Consonant (VCC) are less common. This analysis shows complex syllable patterns and phonological system of Urdu monosyllabic words.

The list was narrow down by Seven words were from the list as their CVI score was less than 0.78. The words with higher CVI scores demonstrate significant agreement among experts. The words with high CVI value such as "سچ" (1.00), "نان" (1.00), and "شام" (1.00) demonstrate universal agreement among experts, indicating these words as widely

accepted and suitable for inclusion and Kappa statistics remarks show excellent content validation. On the other hand, words like "نقد" (0.73), "ديس" (0.70) and "موم" (0.65) achieved lower CVI scores, indicating certain level of disagreement in expert opinions about their acceptance. This validation process ensures that remaining words have achieved significant level of agreement among the experts in term of relevance, appropriateness and familiarity. Finally, at the stage of pilot testing, four words didn't satisfy the criteria and removed from the list. This resulted a final compilation of 137 monosyllable Urdu word list.

DISCUSSION

The aim of current study was to develop and validate the Urdu monosyllable words list for speech discrimination scores testing. A list of 137 words concluded based on familiarity rating, content validation and pilot testing.

Content validation is very important during the process of development and adaptation of tools for measurement.[21] It is planning for development of test in which a set of representative and appropriate items to be evaluated. Thus for speech comprehension tests, it is first required to plan word selection because each language has unique characteristics and words should be standardized and evaluated in the sequences.[22]

The familiarity of the word is associated with its frequency of usage in the language and can also lead to an improvement in the intelligibility of word. Selection of familiar words would reduce educational differences between the subjects, validating and reinforcing words selection criteria [23]. According to researches, phonetic balance is secondary as most used and important words provide better speech recognition which reinforces the need of inclusion of familiar words.[24], [25]. In current study words familiarity was prioritized over phonetic balancing.

A speech discrimination test, unlike a threshold test, must have few redundant items. Otherwise, the patients have a lot of clues that could hide his inability to tell the difference between consonants and vowels correctly. Therefore monosyllabic words were selected rather than conversational sentences or multisyllabic words like spondees.[24]

The content validity index confirmed that the lists are very valid, means they are significant and accurate to the scale construct.[26] The Brazilian research validated the lists of disyllabic words using both expert and lay raters. Content validation was done with familiarity and appropriateness scores.[5] Only two linguistic experts in the Macedonian study showed that people were familiar with words.[27] In this study, nine professionals rated familiarity, appropriateness, and relevance of test items to verify monosyllable words.

Vaucher in a study measured the Content Validity Ratio (CVR) to look the familiarity words and found that all of them had CVR values ≥ 0.529 and he considered all the words significant, and their level of familiarity varied from extremely familiar, very familiar and

familiar.[21] While in current study, most familiar and very familiar words were included and CVR value > 0.78 was considered significant based on number of participants.

A syllable pattern is made by the sequence of consonant and vowel. The phonological features of language can be better understood by examining its syllable patterns.[28] Most common syllable pattern noted in current study was "CVC". Ghazali and Nazar found eleven syllable templates (CV, CVV, CVC, CVCC, CVVCC, CVVC, V, VC, VVC, VV, VCC,) in their research. The syllable patens in current study matched with 6 templates of these studies. Both researchers agreed that CVV is the most common syllable, whereas VC, CVVCC, and V are the least common syllables.[29],[30]

Speech audiometry's first tests were made in English. Each language possesses unique characteristics that the authors of the test must consider when developing it.[31] It is credited to Egan, who worked in the Psychoacoustics Laboratory at Harvard University in 1948, that monosyllabic words were first used for speech recognition testing. The PAL PB-50 word lists are the result of his dividing his initial 1000-word pool into 20 sets of 50 words each. It was thought that every list was balanced phonetically.[13], [27] Ira Hirsh and colleagues from the Central Institute for the Deaf created four 50-word lists called CID W-22 in 1952. They used 120 of the most common words from the original PAL PB-50 and 80 additional words to ensure phonetic balance.[8], [32]

Current study is an attempt to develop an instrumental tool of words list for speech audiometry testing. Inter-rater reliability by Kappa statistics was excellent and content validity index scores were more than 0.78 for expert opinions. This is the only tool available for speech recognition scores testing in Urdu language. This words list is clinically very significant, as Urdu is national language and very well understood across the country. Hence this tool will help audiologist in better assessment of hearing disorders. It will be useful for future research.

Limitations and suggestions

Although this study has reported high reliability of developed tool, it is limited to small number of participants with different mother tongue. Further research is required to include more participants with more different local languages in Pakistan to increase the generalizability

CONCLUSION

A word bank of 137 Urdu monosyllabic words was created, with adequate evidence of content validity based on word familiarity, appropriateness and Relevance. Urdu speakers can benefit from using this list as an evaluation tool for their hearing.

Ethical Considerations: This study followed to ethical guidelines that protection of participant confidentiality and privacy was maintained throughout the research process. Informed consent was taken from all participants.

Conflict of Interest: The authors declare no conflict of interest.

Author's contribution:

MZ: Data collection, Methodology, Data analysis

SBN: Conception of work, Critical Revision

WAA: Interpretation of data, Literature Review, Manuscript writing

References

1) Goossens T, Vercammen C, Wouters J, van Wieringen A. Masked speech perception across the adult lifespan: Impact of age and hearing impairment. Hearing research. 2017;344:109-24.

2) Hemakom A, Jitwiriyanont S, Rugchatjaroen A, Israsena P. The development of Thai monosyllabic word and picture lists applicable to interactive speech audiometry in preschoolers. Clinical Linguistics & Phonetics. 2021;35(9):809-28.

3) Najem FJ, Marie B. Phonemically balanced Arabic monosyllabic word lists for speech audiometry testing in Jordan. Journal of the American Academy of Audiology. 2021;32(04):246-53.

4) Winn MB, Wright RA. Reconsidering commonly used stimuli in speech perception experiments. The Journal of the Acoustical Society of America. 2022;152(3):1394-403.

5) Hennig TR, Vaucher AVdA, Costa MJ. Development and validation of lists of disyllabic words for speech audiometry testing. Audiology-Communication Research. 2018;23.

6) Grant KJ, Parthasarathy A, Vasilkov V, Caswell-Midwinter B, Freitas ME, de Gruttola V, et al. Predicting neural deficits in sensorineural hearing loss from word recognition scores. Scientific reports. 2022;12(1):8929.

7) MD S. Studies in speech reception testing. The Journal of Speech Disorders. 1951;16(2):132-9.

8) Hirsh IJ, Davis H, Silverman SR, Reynolds EG, Eldert E, Benson RW. Development of materials for speech audiometry. Journal of speech and hearing disorders. 1952;17(3):321-37.

9) Canty P. Speech audiometry in acoustic neuroma. The Journal of Laryngology & Otology. 1978;92(10):843-51.

10) Arlinger SD. How to assess outcome of hearing aid fitting in children. Scandinavian Audiology. 2001;30(2).

11) Moberly AC, Bates C, Harris MS, Pisoni DB. The enigma of poor performance by adults with cochlear implants. Otology & Neurotology: Official Publication of the American Otological Society, American Neurotology Society [and] European Academy of Otology and Neurotology. 2016;37(10):1522.

12) Carhart R. Basic principles of speech audiometry. Acta oto-laryngologica. 1951;40(1-2):62-71.

13) Lehiste I, Peterson GE. Linguistic considerations in the study of speech intelligibility. The Journal of the Acoustical Society of America. 1959;31(3):280-6.

14) Soliman S. Speech discrimination audiometry using Arabic phonetically balanced words. Ain Shams Med J. 1985;27:27-30.

15) Kemaloğlu YK, KAMIŞLI GŞ, Mengü G. Phonemic analysis of Turkish monosyllabic word lists used for speech discrimination word recognition tests. The Turkish Journal of Ear Nose and Throat. 2017;27(4):198-207.

16) Weisleder P, Hodgson WR. Evaluation of four Spanish word-recognition-ability lists. Ear and hearing. 1989;10(6):387-93.

17) Sakamoto S, Yoshikawa T, Amano S, Suzuki Y, Kondo T, editors. New 20-word lists for word intelligibility test in Japanese. Ninth International Conference on Spoken Language Processing; 2006.

18) Lee GJC, Lee SLH. Development of SC-10: A psychometrically equivalent Singapore Mandarin disyllabic word list for clinical speech audiometry use. World Journal of Otorhinolaryngology-Head and Neck Surgery. 2021;7(03):247-56.

19) Jeong HJ, Lee WC. The level of collapse we are allowed: Comparison of different response scales in Safety Attitudes Questionnaire. Biom Biostat Int J. 2016;4(4):00100.

20) Yusoff MSB. ABC of content validation and content validity index calculation. Education in Medicine Journal. 2019;11(2):49-54.

21) Vaucher AVdA, Costa LD, Moraes ABd, Menegotto IH, Costa MJ, editors. Lists of monosyllables for logoaudiometric tests: elaboration, content validation and search for equivalence. CoDAS; 2022: SciELO Brasil.

22) Wilson RH, McArdle R. The homogeneity with respect to intelligibility of recorded word-recognition materials. Journal of the American Academy of Audiology. 2015;26(04):331-45.

23) Owens E. Intelligibility of words varying in familiarity. Journal of Speech and Hearing Research. 1961;4(2):113-29.

24) Carhart R. Problems in the measurement of speech discrimination. Archives of otolaryngology. 1965;82(3):253-60.

25) Martin FN, Champlin CA, Perez DD. The question of phonetic balance in word recognition testing. Journal of the American Academy of Audiology. 2000;11(09):489-93.

26) Mekki SA, Hassan EM, Dayhum AFA, Galhom DH. Development and Validation of Libyan Accent Bi-Syllabic and Monosyllabic Speech Perception Test in Adults: Data from Zagazig University. The Egyptian Journal of Hospital Medicine. 2023;90(1):1731-6.

27) Ristovska L, Jachova Z, Kovačević J, Hasanbegovic H. Development of Macedonian monosyllabic and disyllabic tests for speech audiometry. Human Research in Rehabilitation (HRR). 2022;12(1):27-35.

28) Ranjha MI. Urdu syllable: Templates and constraints. LANGUAGE & TECHNOLOGY. 2012;29.

29) Ghazali MA. Urdu syllable templates. Annual Report of Center for Research in Urdu Language Processing (CRULP). 2002.

30) Nazar N. Syllable templates in Urdu language. Annual Report of Center for Research in Urdu Language Processing (CRULP). 2002.

31) Kruger EL. Samoan speech audiometry: Developing word recognition materials for native speakers of Samoan: Brigham Young University; 2010.

32) Margolis RH, Wilson RH. Evaluation of binomial distribution estimates of confidence intervals of speech-recognition test scores. The Journal of the Acoustical Society of America. 2022;152(3):1404-15.