Objectives: This study aimed at validating Voice Disorder Outcome Profile (V-DOP) adapted for Tamil speaking population and correlating the scores of Dysphonia Severity Index (DSI) with V-DOP.

Method: The study was carried out in three phases. Phase I: V-DOP developed by Konnai et al., 2010 (in Kannada & English for Indian population) was translated in Tamil and verified for content validity. Phase II: English and Tamil version of V-DOP was administered on forty eight subjects for validation. Phase III: Correlating scores from DSI and V-DOP was done on fifty subjects with voice concerns and identified vocal pathology. DSI was measured using LingWaves Phonetogram Pro signal analysis module (version 2.4).

Results: Phase I: V-DOP in Tamil was developed. Phase II: Overall Cronbach's coefficient $\alpha$ for V-DOP was 0.89 suggesting that V-DOP is a reliable measure to assess dysphonia in Tamil speaking population. Construct and concurrent validity measure revealed statistically significant correlation (P<0.01) within domains and between overall severity, domains and the total score of V-DOP. Phase III: Domains and the total V-DOP score did not correlate significantly with any of the parameters of acoustic analysis i.e. jitter %, $I_0$-low dB (A), $F_0$-high (Hz), Maximum Phonation Time (sec) and DSI except for physical domain. The physical domain showed a minimal but a significant negative correlation (P<0.05) with MPT.

Conclusion: V-DOP in Tamil evolved as a valid and reliable tool for measuring voice disorder outcome. V-DOP and DSI measure two distinct parameters and are complementary measures in a comprehensive voice assessment.

Key words: Voice Disorder Outcome Profile, Dysphonia Severity Index, and Comprehensive voice assessment.

Introduction

Voice is a multidimensional entity that can express emotions, artistic feelings and verbal communication 1. Earlier, voice disorders were reported as just deviations in voice parameters. According to this view, voice disorders were explained as: "When a person's vocal quality, pitch and loudness differ from those of similar age, sex, cultural background and geographic locations" 2. Later, the view of defining voice disorders was broadened to explain the effects of voice disorders on the individual’s daily living "The term 'voice disorder' is explicitly or implicitly defined as a condition of sufficient concern for the bearer to report it, register functional disruption because of it, and/or seek treatment because of it" Verdolini and Ramig 3 by this definition implies a greater role on subjective identification of the voice problem rather than the underlying pathology. Thus current trend in voice assessment includes patient history, visualization of larynx through stroboscopy, assessment of vocal behavior and function through multiparametric objective analysis, and self perception for providing insight about the individual.
Measuring Health Related Quality Of Life (HRQOL) by the clinician had paved way to document the impact of voice pathology on specified parameters. HRQOL measurements refer to self perception of impact of a disease on individual’s life under various parameters. Physical, psychological/ emotional and social functions of the individuals are assessed in HRQOL. It is a generic term referring to any health related measures that are caused due to illness or diseased condition. In voice disordered population, the impact on individual’s life is measured using Voice-Disordered Quality of Life (VDQOL). It is a disease construct that assess activity limitation and participation restriction due to voice disorders. These HRQOL measures provide information on the handicap that an individual experience in his/her personal and social life because of a diseased condition. Such quality of life measures has gained its importance in assessment and management of voice disorders in the last decade.

Various western normalized HRQOL had been developed to assess the subjective perception of the voice quantitatively and qualitatively. These measures are, Voice Handicap Index (VHI) by Jacobson et al4, Voice-Related Quality of Life (V-RQOL) by Hogikyan and Sethuraman5, Voice Activity and Participation Profile (VAPP) by Ma and Yu6, Pediatric Voice Outcome Survey by Hartrick7, and The Voice Symptom Scale (VoISS) by Deary, Wilson, Carding and MacKenzie8, Voice Handicap Index- 10 (VHI- 10) by Rosen, Lee, Osborne, Zullo and Murry9.

It was reported that the manner in which an individual experience a voice problem varies with the cultural background10. This suggested that there is a need for using the standardized rating scales according to the multicultural background. Measuring a specific disease related quality of life is still in its emerging stage in India 11. Thus Voice Disorder Outcome Profile (V-DOP) questionnaire emerged for assessing the quality of life in voice disordered population in India.

Voice Disorder Outcome Profile (V-DOP)

In India, a large number of individuals depend on the voice for their daily living 11. A survey on awareness of vocal hygiene practices was carried out in professional voice users in India12. The results revealed that the politicians and vendors had the highest point prevalence and frequency of voice problems. Lack of awareness among politicians and vendors regarding treatment of voice problems were also reported. The factors that increased individuals’ susceptibility to voice problems in Indian population were studied13. The factors were noise and dust pollution, lack of use of acoustic amplification in classrooms, dietary preference (spicy foods, excessive consumption of coffee, tea, & carbonated soft drinks), the tropical climate, and excessive voice use. Despite the individuals are highly prone to voice problems seeking professional help is always less. This may be due to various factors such as: lack of awareness of available voice therapy, financial issues, anticipation of getting better with home remedies, or a greater tolerance for the impact of a voice problem.

The Voice Disorder Outcome Profile (V-DOP) is a self assessed patient questionnaire developed by Konnai et al11 to assess the HRQOL in Indian population. It consisted of two parts: Part 1 included question on self perception of severity of the voice problem. Part 2 consisted of 32 items in three domains namely, physical, emotional and functional domains. There were 10 items in the physical domain that dealt with patients’ perceptions of problems concerning voice output and usage. The emotional domain (10 items) included items related to patients’ affective responses to the disorder. Finally, the functional domain included 12 items pertaining to daily living situations (6 items), job activities (3 items), and social activities (3 items). Konnai et al11 reported that V-DOP is a reliable and a valid tool for measuring voice disorder outcome in Indian population. Further, they also stated that there was no gender variation in V-DOP.

However, there is no single instrument or objective measure that correlates with the perceptual rating of the listener as well as the subjective analysis of health related quality of life. A combination of several objective parameters seemed to correlate better with perceptual analysis than single acoustic measures6. In order to compare subjective and objective analysis, a multiparametric approach of objective analysis would be an appropriate procedure.

Dysphonia Severity Index (DSI)

The multiparametric objective measures are essential in comparing the objective measures with the subjective measurement. Voice range profile and dysphonia severity index provides the multiparametric approach for assessing the voice in individuals with voice concerns.

The term “Voice Range Profile (VRP)” was proposed by the Voice Committee of the International Association of Logopedics and Phoniatrics (IALP) in 1992. It denotes the two-dimensional graphical display of an individual’s maximum phonational intensity range against his/her maximum phonational frequency range. Such VRP reflected the individual's physiological vocal limits or capacity and therefore, it is regarded as a test of maximum performance. Alternative terms that
have been used in the literature include phonetogram, phonetography, voice profile, phonational profiles and voice area.

Dysphonia Severity Index (DSI) is a quantitative correlate of voice quality. The DSI is based on the weighted combination of the following selected set of voice measurements: highest frequency (F0-high in Hz), lowest intensity (I0-low in dB), Maximum Phonation Time (MPT in seconds), and jitter (%). The DSI is derived from a multivariate analysis of 387 subjects with the goal of describing purely based on objective measures and the perceived voice quality. As it involved more than one voice characteristics for calculating dysphonia severity, it could be used to correlate with subjective rating. The equation is:

\[
DSI = 0.13 \times MPT + 0.0053 \times F0\text{-high} - 0.26 \times I0\text{-low} - 1.18 \times \text{jitter} + 12.4
\]

DSI was the weighted combination of variables that reflected best the degree of hoarseness as expressed by the grade G in GRBAS scale. The DSI scores for perceptually normal voice equals +5 and to severe dysphonic voices -5 indicating that more negative the values are, more severe was the voice problem.

Attempts were made to investigate the influence of age and gender on the DSI scores. They concluded that age had a significant impact on DSI and gender did not exhibit any significant difference in DSI scores. The highest frequency which was higher in females and maximum phonation time which was higher in males counteracted and resulted in no gender difference. Wuyts et al further stated that DSI was sufficient in a clinical setting to assess voices in a scientifically relevant way within a limited amount of time.

Hakkesteegt investigated the usefulness of DSI as an objective multiparametric measurement in dysphonics. They concluded that DSI is a useful instrument in measuring the severity of the voice problem in individuals with dysphonia. It was also found that DSI is useful in evaluating the therapeutic progress of dysphonic patients. Thus, DSI had been proved to be an effective and efficient tool in global assessment procedure.

Correlation between objective and subjective assessment:

Most of the studies investigated the relationship between subjective assessment with the isolated acoustic variables such as harmonics to noise ratio, jitter, and shimmer etc. It was concluded that no single variable can strongly correlate with the dysphonic ratings. Rather it should be a combination of various parameters for prediction of dysphonia. Thus the need for using a multiparametric analysis, paved way for focusing on correlating DSI and subjective self rating. High correlation between DSI and Voice Handicap Index (VHI) was obtained.

However, Hsuing concluded that Voice Laboratory Measurements (VLM) and VHI parameters showed a very poor reliability (p>0.05) proving that no objective parameter can be regarded as a definitive prognostic factor in a subjective evaluation of dysphonic patients. Woisard elucidated the relationship between VHI and several voice laboratory measurements. They concluded that VHI and the laboratory measurements gave independent information in practice. Similarly, Wheeler concluded that the acoustic measures cannot be a predictive for the overall VHI scores and no comparable pattern was observed with overall VHI or with any particular subscale.

Literature revealed variation in results obtained in correlating the objective and subjective self rating. Evidence on subjective rating stated that there was an inherent cultural effect on impact of the voice disorder. Thus, correlating the individual’s impact on voice disorder to the objective analysis of different ethnical groups in Indian population becomes essential.

The paucity of literature in HRQOL in individuals with voice concerns led to the inherent need for developing a self perception questionnaire in India. Many questions in subjective ratings were based on percepts of vocal loudness, vocal variability and vocal clarity. Thus it is reasonable to assume that the patient’s response to these questions would relate to measurable acoustic parameters in the patient’s voice. A correlation between the acoustic measures of severity of voice problem and the subjective self perception is essential for a comprehensive voice evaluation.

This study aimed at validating the self perception questionnaire (V-DOP) for measuring quality of life in Tamil speaking population and correlating Dysphonia Severity Index (DSI) and Voice Disorder Outcome Profile (V-DOP).

Method

The study was carried out in three phases and ninety eight subjects participated in this study. The three phases are:
Phase I: Translation of the Voice Disorder Outcome Profile (V-DOP) in Tamil.

Phase II: Validation of the V-DOP in Tamil.

Phase III: Correlation of DSI and V-DOP.

Phase I: Translation of the Voice Disorder Outcome Profile (V-DOP) in Tamil

The phase I of the study had two steps.

Step 1: Preliminary translation process

V-DOP developed by Konnai et al11 was translated into Tamil by the investigator. Two dictionaries were used to check the appropriateness of vocabulary used in the process of translation. Initially, to translate words from English to Tamil, Lifco dictionary (English- Tamil) was used. Later to verify the appropriateness of meaning of the translated words, Oxford dictionary was used.

For the purpose of this study, the V-DOP developed by Konnai et al11 in English was used with fewer modifications. Questions related to job performance in V-DOP would not be applicable for home makers, students etc. Thus, as suggested by Konnai et al11, an additional column of "NOT APPLICABLE" was added in the questionnaire (English & Tamil). This was essential to accommodate those subjects for whom job and its performance would not be applicable.

Step 2: Development of V-DOP in Tamil

Five experts (Professors & higher secondary school teachers) with Doctorate and M.Phil degrees with eight to fifteen years of experience in teaching Tamil literature participated. The purpose of the study was explained to them. They were instructed to verify the translated version of the investigator. The content validity of V-DOP was judged by giving the English and Tamil (translated version) of V-DOP to them individually. The experts were allowed to make any pertinent changes such as changing the words and rephrasing sentences that were inappropriate. Necessary and recommended changes by the Tamil experts were incorporated in the final version. This modified version was used for the study.

Phase II: Validation of the V-DOP in Tamil

In order to adjudge the construct validity of the questionnaire, the English11 and Tamil version (developed for the current study) of the V-DOP were administered to the clinical (individuals with dysphonia) and non clinical group (individuals with no known history and/or complaint of any voice change). The details of the subjects participated in phase II are given below in Table 1. (Table 1)

Phase III: Correlation of DSI and V-DOP

Subjects

Subjects reported to Sri Ramachandra medical centre with voice concerns and vocal pathologies between September, 2008 to February, 2009 were taken for the study (n= 50; Age range: 18 - 86 years). The subjects were recruited in the study based on the following inclusion and exclusion criteria:

Inclusion criteria:

Subjects should be above the age of 18 years.15

Subjects should be diagnosed to have vocal pathology.

Exclusion criteria:

Subjects attended any prior voice therapy.

Subjects diagnosed with malignant growth of larynx.

The diagnosis of subjects who participated in phase III is given in Table 2. (Table 2)

ADMINISTRATION OF V-DOP

V–DOP given by Konnai et al11 consisted of two parts: The first part included a question regarding the severity of the voice problem and the second part consists of 32 questions under three domains: physical, emotional and functional. In the first part, the subjects were instructed to
rate the severity of their voice problem as perceived by them, by marking a cross 'X' on a 10 cm line (visual analog scale) to reflect it. A cross 'X' towards the extreme left indicates 'normal' voice and to the extreme right indicates 'severe' problem.

Normal Severe

Similarly for the part two of the questionnaire, the subjects were instructed to answer the questions by marking an 'X' on the 10cm line depending on the extent of the problem. A cross towards the extreme left side indicates 'never' affected, while a cross towards the extreme right side indicates 'always' affected by the voice problem.

Never Always

Scoring: The distance (in centimeters) measured from the left end of the line to the individual's mark was used as the score for each question. The scores for all the items in each domain were acquired in this manner. The total V-DOP score was obtained by summing the scores of three domains. The total V-DOP score for an individual could be a maximum of 320 (as there were 32 items with a maximum score of 10 for each item) and a minimum of zero. Questions that are rated as "Not applicable" by the subjects were not included for analysis.

Based on the client’s linguistic preference, the English or Tamil version of the V-DOP was completed. The procedure to complete the questionnaire was explained. Further clarification and assistance were provided if subjects requested. The average time taken to complete the questionnaire was 10 minutes.

Measurement of DSI

Instrumentation

LingWaves Phonetogram Pro and Signal Analysis Module (version 2.4) was used to measure DSI. Recording was done using a condenser microphone attached to a sound pressure level [dB (A)] meter (Center 322) mounted on a tripod. It enabled adjustment of height and alignment of the mic to the subject’s mouth. The in-built mic was covered by wind screen to reduce the sensitivity of mic to surrounding noise.

Recording of voice sample

The recording was done at Speech science lab of Sri Ramachandra University.

Phonetogram

The subjects were instructed to sit in an upright, relaxed posture. Mouth to mic distance was maintained at 30 cm. Following steps were used to obtain a phonetogram:

1) Phonating /a/ at four levels: Low pitch- low intensity; low pitch- high intensity; high pitch-low intensity and high pitch- high intensity.

2) Reading a passage (Rainbow passage) or conversational speech sample in three different volume (soft, moderate & high) levels was recorded. DSI was computed automatically using the Wuyts et al's formula.

Reliability measure of V-DOP was computed using Cronbach alpha co-efficient correlation test. Validation of V-DOP and correlating DSI and V-DOP was done using Kendaul tau_b correlation test.

Results and Discussion

Phase I

Content validity

Content validity was established for V-DOP in English by Konnai et al11. Thus, in Phase I, the content validity of the Tamil version of V-DOP was done. The questions for the final Tamil version of V-DOP were selected based upon the exactness of meaning and its acceptability in usage and the same was used for the study.

Phase II
Reliability and Validation measures of the V-DOP

The V-DOP was administered on twenty normal individuals (non clinical group) and twenty eight individuals with dysphonia (clinical group). The scores of V-DOP were subjected to analysis for reliability and validation measures. The mean of each item of V-DOP for the non clinical group was zero. The mean and standard deviation of each domain and total V-DOP scores for clinical group are presented in Table 3. (Table 3)

Reliability of V-DOP

Internal consistency: The internal consistency of the V-DOP was estimated using Cronbach's alpha coefficient. Cronbach's coefficient $\alpha$ for V-DOP was 0.89. The results for the item-total correlation is presented in Table 4. Items within the V-DOP had a high item-total correlation ($\alpha < 0.5$) ranging from 0.49 to 0.85 except for items 8, 16, 31 and 32. However, deleting these items lead to insignificant decrease in overall $\alpha$ from 0.89 to 0.88. So the items were considered to be relatively homogenous and were thus included in V-DOP for phase III of the study. (Table 4)

The overall $\alpha$ for V-DOP was 0.89 which suggested the greater reliability of the questionnaire. Similarly, the high item-total correlation revealed that V-DOP is a reliable measure to assess dysphonia in Indian population.

Validity measures of V-DOP

Construct validity

The mean V-DOP scores for the non-clinical group (normal) and clinical group (individuals with dysphonia) were significantly different. The mean total V-DOP score for the dysphonia group was 90.93 (SD = 61.44), whereas the mean was zero for the non clinical group (there were no indications of any vocal difficulties for the non clinical group). The results indicated that the V-DOP can differentiate normal voice from dysphonia. Subjects in non clinical group (normal) rated the items to completely normal voice (zero score for all items).

To establish the construct validity of the V-DOP, the individual total scores of each domain (physical, emotional, & functional) were correlated across domains and with the total V-DOP score.

Correlation of domain and total V-DOP scores

A correlation matrix was obtained for the domain and the total V-DOP scores using Kendall's tau_b correlation. Results are shown in Table 5. Significant correlation was obtained across domains, the total V-DOP score with correlations ranging from 0.27 to 0.77. (Table 5)

The emotional and functional parameters showed high correlation (r= 0.77, 0.72 respectively) followed by the physical domain (r= 0.61). Similar results had been reported by Konnai et al11.

There was statistically significant correlation (at 0.01 level) among all the three domains of V-DOP ranging from 0.42 to 0.56. It is supported by previous studies4,11. If the correlation was high, then it indicated that a person's voice problem causes equal effect on all parameters. But, in the current study the smaller correlation indicated that the impact of voice problem on these domains was not equally distributed. Thus, each domain was affected at varied level and probably influenced by other environmental and personal factors.

Concurrent validity

To establish the concurrent validity of V-DOP, the individuals' V-DOP scores were compared to the self-perceived severity of dysphonia.

Correlation of domains and total V-DOP scores with self-perceived severity of voice disorder

The correlation between self-perceived severity of dysphonia and the total V-DOP score was 0.43 (at 0.01 significance level) as shown in Table 5. Also, the self-perceived severity of dysphonia correlated significantly (at 0.01 & 0.05 significance level) with each domain of V-DOP, but the correlations were low (0.27 for physical, 0.36 for functional & 0.46 for emotional). These findings supported meaningful concurrent validity of the instrument.
Phase III

Correlation between domains of V-DOP and acoustic measures:

Correlation between each item in V-DOP with parameters of acoustic measures was calculated using Kendall tau_b correlation test. Results are shown in Table 6. It was found that the all the items in V-DOP did not correlate significantly with DSI. Item 5 of physical domain correlated positively with jitter (%). Items 1, 3, 6, 8 and 9 in physical domain showed significant negative correlation with maximum phonation time. Item 2 in physical domain, items 16, and 17 in emotional domain, items 21, 26 and 27 in functional domain showed significant negative correlation with F0-high. Item 12 in emotional domain showed a positive correlation with I0-low. (Table 6)

The results revealed that the individual items in V-DOP did not correlate significantly with acoustic measures in any cohesive or predictable manner. Thus indicating that the V-DOP measured individual’s perception of voice problem which may be influenced by contextual factors such as environmental and personal factors. These factors may play a greater role in how an individual address his/her voice problem and how it affects his/her daily living.

Correlation between domains of V-DOP and acoustic measures

Correlation between domains, total score and self perceived severity of V-DOP with the parameters of acoustic measures was evaluated using Kendall tau_b correlation test. The results are tabulated in Table 7. The physical domain of V-DOP correlated negatively with the maximum phonation time indicating that lower maximum phonation time resulted in higher scores in physical domain. The other domains did not show significant correlation with the parameters of acoustic measures. (Table 7)

The results suggested that the domains and the total V-DOP score did not correlate significantly with any of the parameters of acoustic analysis i.e. jitter %, I0-low dB (A), F0-high (Hz), maximum phonation time (sec) and DSI except for physical domain. The physical domain showed a minimal but a significant negative correlation with MPT (r = -0.21). It is reasonable to link the self perceived severity to aerodynamic measures than to timbre parameters20.

The results of the present study are in coherence with Hsuing et al19 and Wheeler et al21. Therefore, it can be concluded from present study that V-DOP and DSI give independent information. Thus, obtaining information on client’s perception of his/her own voice is important in assessment of voice disorders. It would give indication of discrepancies between the client’s his/her own voice with the clinician’s perception of voice problem. Such information would be helpful directly addressing need of the population.

On the other hand, multiparametric measures are more suitable for evaluation of voice quality than single measure 14,22. Though, V-DOP and DSI are two distinct measures, however for comprehensive assessment of voice information from both the measures are essential.

This study represented an initial attempt that was made to understand the relationship between DSI and V-DOP across Indian population. Future work should focus on correlating these measures in a particular vocal pathology and in evaluating the therapeutic outcomes in voice disorders.

Conclusion

V-DOP evolved as a valid and reliable tool in measuring self perception of voice disordered population. V-DOP and DSI measure two distinct parameters and are complementary measures in assessment of voice. This study represented an initial attempt that was made to understand the relationship between DSI and V-DOP in Indian population speaking Tamil. Future work should focus on correlating these measures in a particular vocal pathology and in evaluating the therapeutic outcomes in voice disorders.

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