Voice Self-assessment Protocols: Different Trends Among Organic and Behavioral Dysphonias

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Summary: Objectives. This study aimed to correlate the results of five self-assessment instruments for patients with behavioral or organic dysphonia (OD), and to analyze their relationship with listeners' judgments of degree of voice severity and predominant type of voice deviation.

Study Design. This is a cross-sectional prospective study.

Methods. A total of 103 patients (77 with behavioral dysphonia, 26 with OD) completed the Brazilian validated versions of five instruments: Voice Handicap Index (VHI), Voice-Related Quality of Life, Vocal Performance Questionnaire, Voice Symptom Scale (VoiSS), and Vocal Tract Discomfort Scale. Voice samples were collected for auditory-perceptual analysis. Correlations were made among protocols, and between these instruments and the perceptual analysis.

Results. None of the instruments correctly identified 100% of the dysphonic individuals. The VoiSS identified 100 of the 103 subjects. Numerous correlations were found with variable strength. The strongest correlation was between frequency and severity scales of the Vocal Tract Discomfort Scale ($r = 0.946$) and the total score of the VHI and VoiSS ($r = 0.917$). Correlations between the instruments and the perceptual analysis achieved only moderate strength; the VHI, the Voice-Related Quality of Life, and the VoiSS showed the highest correlations with counting numbers task, particularly for OD. The predominant type of voice deviation did not influence the score of the protocols.

Conclusions. None of the self-assessment instruments is capable of identifying all cases of dysphonia. However, they are important in assessing the impact of voice problem on quality of life. Patient self-assessment and clinician perceptual evaluation share only moderate correlations, with higher strength for counting numbers task in comparison with sustained vowel.

Key Words: voice–dysphonia–protocols–quality of life–self-assessment.

INTRODUCTION

The World Health Organization defines health as a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.[1] The concept was recently broadened to include quality of life aspects, defined as the individual's self-perception about his or her role in life.[2] Questionnaires are standard instruments that assess the effects of health issues on quality of life. They also assist in quantifying the subject's self-perception of the negative social, professional, and financial impact.[1]

Dysphonia is defined as difficulty or deviation of voice production, which, in the majority of cases, does not result in an imminent risk of death. Typically, its treatment is elective. Because dysphonia is multidimensional, the voice assessment must include the history of the present complaint, an otolaryngologic evaluation, and an auditory-perceptual and acoustic evaluation by a speech-language pathologist.[3,4] The term for dysphonia that stems from inappropriate voice usage is behavioral dysphonia (BD). This type of disorder is highly prevalent in voice professionals.[5] The term for dysphonia resulting from injuries to the muscles or nerves that control phonation is organic dysphonia (OD).

Recent studies have used self-evaluation questionnaires to quantify the perceived impact of a voice disorder and to show the importance of these tools in identifying factors leading to the voice problem.[6] These questionnaires have also been used to identify key patient-related issues and consequently to address treatment options.[7,8] Development and validation of self-assessment questionnaires have gained momentum and are now adopted around the world.[4,6,9–12]

Many self-assessment questionnaires are available. The most referenced are the Voice Handicap Index (VHI),[9] validated into Brazilian Portuguese[11]; the Vocal Performance Questionnaire (VPQ),[13] validated into Brazilian Portuguese[14]; and the Voice Related Quality of Life (V-RQOL),[10] validated into Brazilian Portuguese,[4] which is the most commonly used language in Brazil.[3] The Vocal Tract Discomfort Scale (VTD)[15,16] and the Voice Symptom Scale (VoiSS),[17] validated into Brazilian Portuguese,[18] aim to quantify voice symptoms reported by patients with dysphonia. All of the above self-assessment scales (Brazilian versions) have cutoff values[7,8] separating subjects with no self-perceived vocal problem (called healthy voice subjects) from those with likely deviated voices that would require a full assessment (individuals at voice risk).

Numerous studies have shown that patients with dysphonia may vary in terms of the amount of self-perceived voice problem, which negatively impacts their quality of life,[6] as well as in terms of functional limitations and physical and socio-emotional concerns.[4,11,14,18,19] Age and gender may influence the perceived impact of these conditions.[20] However, little is known about age and gender's correlation with the different proposed instruments.

The literature shows only few studies that use more than one questionnaire within the same population for the sole purpose

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of investigating possible correlations among them. The majority of researchers have used the VHI,[9] the VHI-10,[21] and the V-RQOL,[10] either for a general dysphonic population,[22,23] for a specific pathologic population such as patients with cancer,[24,25] or for measurement of treatment effect.[26] High correlations have been reported between the VHI and the V-RQOL,[22–26] providing clinicians with a choice as to which questionnaire to use; however, in most cases, there is no clear process to guide this decision.[27] Although the content and psychometric properties of each test vary, the general findings of each of the above tests support their use in clinical settings related to voice disorders.[28–30]

Currently, only few studies have analyzed the relatedness of the aforementioned questionnaires. Little is known on how a dysphonia-specific group may perform on these different self-assessment tools. Also, little is known on the relationship between quality of life (the focus of the V-RQOL) and voice severity based on perceptual voice judgments, and between quality of life (V-RQOL) and patient handicap (VHI) due to their voice disorder. It also remains unknown whether the degree of voice deviation clinically determined by perceptual analysis corresponds to the degree of perceived loss on aspects of vocal performance (VPQ), voice symptom (VoiSS), or vocal tract discomfort (VTD). Lastly, it is also unknown whether the predominant type of voice deviation, ie, predominance of roughness, breathiness, or strain, is correlated with the impact perceived by the patient.

Therefore, the purposes of the current study are:

(1) To investigate the performance of subjects diagnosed with dysphonia on the following self-assessment protocols: VHI, V-RQOL, VPQ, VoiSS, and VTD, considering total scores and subscales, whereas existent.
(2) To compare all protocol scores of subjects with BD with all scores of subjects with OD.
(3) To compare self-assessment questionnaire scores with the degree of voice severity determined by perceptual analysis.
(4) To determine whether the predominant type of voice deviation (roughness, breathiness, or strained voice) is related to the perceived loss in quality of life, voice handicap, reduced performance, or voice symptoms.

METHOD

This research was approved by the Ethics in Research Committee of the *Universidade Federal de São Paulo* (CEP # 0911/11). All participants signed an informed consent. One hundred and three subjects participated in the study (27 men and 76 women, mean age 39.25 years, SD = 14.68). Participants were categorized into two groups according to the etiology of their voice problem: BD or OD. The BD group had 77 subjects (58 women and 19 men; mean age 40.31 years, SD = 15.53) and the OD group had 26 subjects (18 women and 8 men; mean age 36.11 years, SD = 11.49). All subjects were consecutively seen individuals with clinically determined dysphonia, who sought help because of a voice complaint. They were patients from the authors' associated institutions, invited to participate voluntarily in the research. No patient refused to take part in the study. Data were collected in the years 2013 and 2014. Individuals underwent Speech-Language Pathology (SLP) and Otolaryngology (otorhinolaryngologists) assessments to obtain a diagnosis of dysphonia, to provide them with a referral, and to categorize them into the two aforementioned groups. The BD group included patients with voice problems predominantly related to voice usage, including poor voice technique, muscle tension, and vocal abuse/misuse. The OD group, with OD defined as a systemic disorder, included patients with neurologic disease or laryngeal lesion, with no behavioral component to their dysphonia such as vocal abuse/misuse. Patients with BD presented with the following findings in their otolaryngologic assessment: vocal fold edema, functional aphonia, vestibular phonation, minor structural alterations, glottic gap, benign mass lesions, or normal examination in the presence of voice deviations. It is important to emphasize that the categorization of BD was obtained by analyzing the history of the problem and the patients' vocal habits and techniques; moreover, the presence of an organic lesion did not exclude patients from this group if the lesion was a clear consequence of the use of voice. Patients with OD presented with the following diagnoses: laryngeal cancer, laryngeal neurofibromatosis, vocal fold paralysis, laryngeal dystonia, postsurgical vocal fold scar, chronic laryngitis, laryngeal amyloidosis, laryngeal stenosis, and/or vocal fold atrophy due to continuous use of inhaled cortisone. No cases of acute dysphonia were included.

Inclusion criteria were adults older than 18 years of age, voice complaint of any degree or type, and BD group and OD group dysphonia as diagnosed by SLP and otorhinolaryngologists assessments. Exclusion criteria were not being available or interested in the research; the presence of neurologic, cognitive, and/or psychiatric disorders compromising the ability to answer the questionnaires; and/or lack of comprehension of the questionnaires' instructions determined by inability to answer the questions.

Patients underwent the following procedures: voice recording for perceptual analysis and completing self-assessment questionnaires presented in random order.

The voice recording was performed in a silent room, using a por computer (Dell Latitude 3440, DELL, Brazil), with an external sound card Andrea PureAudio USB (Andrea Electronics Corporation, USA) and headset Karsect Ht2 (Karsect, Brazil), placed at 45° and 2 cm from the patient's mouth. Sample rate was 44.1 KHz and the software used was *Fonoview* (version 4.5h, CTS *Informática*, Brazil). The subjects performed two tasks: sustaining the vowel /Ɛ/ and counting numbers from 1 to 10, in a comfortable pitch and loudness self-selected by the patient. Subjects were asked to sustain the vowel for as long as possible, after taking a deep breath; for the counting numbers task, patients were asked to maintain their regular speech rate. Both tasks were performed once, unless the patient made a mistake in counting, or accidently stopped vowel production because of coughing or any other atypical event. Audio samples were analyzed by a voice-specialized SLP with at least 20 years of clinical and research experience. Intra-judge reliability was high (random repetition index of 20% of all voice samples: alpha Cronbach coefficient 0.910, $P < 0.001$ for the sustained vowel production; 0.950, $P < 0.001$ for the counting numbers task, and 0.865, $P < 0.001$ for the predominant type of voice deviation).

The degree of auditory perceptual voice deviation was scored using a four-point numeric scale: 0 = absence of deviation,

Questionnaire	Number of questions	Subscales	Scores distribution	Sensitivity	Specificity	Cutoff value
Voice Handicap Index – VHI (Jacobson et al., 1997) *Índice de Desvantagem Vocal – IDV* (Behlau et al., 2011)	30	Functional Physical Emotional	Functional: 0-40 Physical: 0-40 Emotional: 0-40 Total: 0-120	Total: 1.000 (Behlau et al., 2015)	Total: 1.000 (Behlau et al., 2015)	Total: 19 (Behlau et al., 2015)
Voice-Related Quality of Life – V-RQOL Hogikyan et al., 1999) *Qualidade de Vida em Voz – QVV* (Gasparini et al., 2009)	10	Physical Socio-emotional	Physical: 0-100 Socio-emotional: 0-100	Total: 0.967 (Behlau et al., 2015)	Total: 0.860 (Behlau et al., 2015)	Total: 91.25 (Behlau et al., 2015)
Vocal Performance Questionnaire – VPQ (Carding et al., 1999) *Questionário de* Performance *Vocal – QPV* Paulinelli et al., 2012)	12	-----	Total: 12-60	Total: 0.831 (Behlau et al., 2015)	Total: 0.824 (Behlau et al., 2015)	Total: 20.5 (Behlau et al., 2015)
Voice Symptom Scale – VoiSS (Deary et al., 2003) *Escala de Sintomas Vocais – ESV* (Moreti et al., 2014)	30	Impairment Emotional Physical	Impairment: 0-60 Emotional: 0-32 Physical: 0-28 Total: 0-120	Total: 1.000 (Moreti et al., 2014; Behlau et al., 2015)	Total: 1.000 (Moreti et al., 2014; Behlau et al., 2015)	Total: 16 (Moreti et al., 2014; Behlau et al., 2015)
Vocal Tract Discomfort Scale – VTD (Mathieson et al., 2009) *Escala de Desconforto do Trato Vocal – EDTV* (Rodrigues et al., 2013	8	Frequency of occurrence Severity of symptoms	Frequency: 0-48 Severity: 0-48	Frequency: 0.875 Severity: 0.906 (Rodrigues et al., 2013)	Frequency: 0.767 Severity: 0.767 (Rodrigues et al., 2013)	Frequency: 1.188 Severity: 1.190 (Rodrigues et al., 2013)

FIGURE 1. Main characteristics of the self-assessment questionnaires VHI, V-RQOL, VPQ, VoiSS, and VTD: number of questions, subscales, score distribution, ROC curve sensitivity and specificity values, as well as cutoff value for the Brazilian population.

1 = mild deviation, 2 = moderate deviation, and 3 = severe deviation. This scale was adopted for both sustained vowel and counting task samples, singly assessed, for both categories of voice disorders: behavioral- and organic-based dysphonia. In addition to the voice deviation degree, the predominant type of voice deviation was identified from the sustained vowel: roughness, breathiness, or strained voice. Only the sustained vowel production was used to determine the predominant type of voice deviation because this task is less influenced by the vocal tract and vocal style, and the goal was to focus particularly on the laryngeal source.

The patients completed the following questionnaires in their Brazilian Portuguese versions, presented in random order: VHI (*Índice de Desvantagem Vocal*, Behlau et al[11]), V-RQOL (*Questionário de Qualidade de Vida em Voz*, Gasparini and Behlau[4]), VPQ (*Questionário de Performance Vocal*, Paulinelli et al[14]), VoiSS (*Escala de Sintomas Vocais*, Moreti et al[18]), and VTD (*Escala de Desconforto no Trato Vocal*, Rodrigues et al[16]).

Figure 1 summarizes the main characteristics of the questionnaires used in the present study, including number of questions, subscales, score distribution, Receiver Operating Characteristic (ROC) curve sensitivity (ability of a test to correctly identify individuals with the problem in question, ie, the ratio of true positives), and specificity (ability of a test to correctly identify individuals without the problem in question, ie, the ratio of true negatives) values, as well as cutoff values. The ROC curve represents the relationship between the sensitivity and the specificity of a test by determining the real value of these two categories.[31] In other words, the efficiency of a test is determined by its ability to correctly identify both the positive and the negative cases. The maximum value of 1.0 for sensitivity and specificity indicates a test of maximum efficiency to evaluate its purpose.

Patients were classified into individuals who either passed or failed the test, determined by the cutoff point of each questionnaire.[7,8] Although to use the words "pass" and "fail" may not be the best choices when considering self-assessment because commonly used to identify "positive" and "negative" aspects or actions, the selection of the same was based on the need to simplify argumentation in the present study. Statistical analyses were performed by comparing the total sample of patients with the subjects' passing or failing in each questionnaire, ie positively or negatively identified with perceived voice deviation. Scores for each questionnaire were cross-correlated. Groups passing and failing based on the cutoff points were assessed according to the category of dysphonia: BD or OD. Microsoft Excel (Microsoft Office 2010, Microsoft Corporation – One Microsoft Way, USA) was used to arrange and compute the data and to develop the database. IBM (USA) *SPSS Statistics* 22.0 was used to obtain the results. Statistical tests were Fisher exact test, Mann-Whitney *U* test, Spearman correlation analysis, and likelihood ratio test. Significance level was set at 5%. Correlation coefficient, which represents the strength of association between variables, was classified according to the following[32,33]: 0.90 to 1.00 = very high correlation; 0.70 to 0.90 = high correlation; 0.50 to 0.70 = moderate correlation; 0.30 to 0.50 = low correlation; and 0.00 to 0.30 negligible correlation.

RESULTS

No instrument was capable of identifying a voice problem in all individuals (Table 1) once it was known that all participants had a medically diagnosed dysphonia. The instrument that performed best at identifying dysphonia was the VoiSS (100 out of 103 dysphonic individuals); the VTD was the protocol that identified the least number of subjects with dysphonia (69 out of 103 dysphonic individuals). Total scores from all instruments performed better than any subscale in identifying dysphonic individuals.

Differences were noted between subjects of the two etiologic categories of dysphonia, BD and OD, as indicated by the VTD and the physical domain subscale of the VoiSS, which clearly pointed out the differences between these two etiologic categories. It is interesting to point out that none of the OD cases presented with symptoms of the physical subscale, and only 15.6% of BD cases failed at this subset of items ($P = 0.032$); the impairment subscale positively identifies the highest number of dysphonic subjects (83.10% of BD and 84.60% of OD cases), although it did not provide differentiation between the two etiologic categories. The VTD failed to identify almost 50% of individuals with OD, and the physical subscale of the VoiSS did not identify any subjects with OD.

The scores of the questionnaires (Table 2) identified more similarities than differences between the two etiologic categories of dysphonia. However, the score of the Physical subscale of the VoiSS questionnaire was statistically higher for BD (10.58 for BD and 8.00 for OD, $P = 0.034$), as well as for both scores of the VTD. The VTD values were presented according to its total mean frequency of occurrence and severity of symptoms, as this protocol does not have subscale items. Frequency of occurrence and severity of discomfort symptoms data were essentially identical for both BD (frequency 2.12 and severity 2.18) and OD (frequency 1.05 and severity 1.12). However, BD frequency of occurrence and severity of the manifestation were twice as high in comparison with OD ($P < 0.001$). Patients with BD not only have more chance of presenting with vocal tract discomfort symptoms (Table 1), but also have higher occurrence and severity (Table 2). Therefore, regardless of the etiology of the voice problem, the impact is higher in the VTD than in the other instruments.

Regarding gender, women presented statistically with higher perception of vocal tract discomfort (VTD), with more voice problem symptoms (total and impairment scales of the VoiSS instrument), with higher physical handicap (physical subscale of the VHI instrument), and with higher loss of quality of life (total and socio-emotional scales of the V-RQOL instrument), as presented in Table 3. The female group scores were consistently higher for all of the abovementioned scales, except for the V-RQOL because the interpretation of this instrument is reversed (lower values indicate reduced quality of life regarding aspects of voice). Men did not present with significantly higher

TABLE 1.
Numeric and Percentage Distribution of Subjects With Behavioral or Organic Dysphonia Passing or Failing each Questionnaire Subtest

	Dysphonia Type												
	Behavioral				Organic					Total			
	Pass		Fail		Pass		Fail			Pass		Fail	
Questionnaire	N	%	N	%	N	%	N	%	*P* Value	N	%	N	%
VHI													
Physical	27	35.10	50	64.90	13	50.00	13	50.00	0.177	40	38.80	63	61.20
Emotional	58	75.30	19	24.70	22	84.60	4	15.40	0.325	80	77.70	23	22.30
Functional	59	76.60	18	23.40	19	73.10	7	26.90	0.715	78	75.70	25	24.30
Total	10	13.00	67	87.00	4	15.40	22	84.60	0.758	14	13.60	89	86.40
V-RQOL													
Physical	9	11.70	68	88.30	3	11.50	23	88.50	0.984	12	11.70	91	88.30
Socio-emotional	24	31.20	53	68.80	11	42.30	15	57.70	0.300	35	34.00	68	66.00
Total	7	9.10	70	90.90	3	11.50	23	88.50	0.716	10	9.70	93	90.30
VPQ													
Total	4	5.20	73	94.80	1	3.80	25	96.20	0.782	5	4.90	98	95.10
VoiSS													
Impairment	13	16.90	64	83.10	4	15.40	22	84.60	0.859	17	16.50	86	83.50
Emotional	58	75.30	19	24.70	20	76.90	6	23.10	0.869	78	75.70	25	24.30
Physical	65	84.40	12	15.60	26	100.00	0	0.00	0.032*	91	88.30	12	11.70
Total	1	1.30	76	98.70	2	7.70	24	92.30	0.094	3	2.90	100	97.10
VTD													
Frequency	19	24.70	58	75.30	14	53.80	12	46.20	0.006*	33	32.00	70	68.00
Severity	19	24.70	58	75.30	15	57.70	11	42.30	0.002*	34	33.00	69	67.00

* Significant values ($P \leq 0.05$)—Fisher exact test.
Abbreviations: VHI, Voice Handicap Index; VoiSS, Voice Symptom Scale; VPQ, Voice Performance Questionnaire; V-RQOL, Voice-Related Quality of Life; VTD, Vocal Tract Discomfort Scale.

TABLE 2.
Questionnaire Scores for the Behavioral and the Organic Dysphonia Groups

Questionnaires and Groups	Mean	Standard Deviation	Minimum	Maximum	Median	*P* Value
VHI						
Physical						
BD	21.30	8.93	0.00	38.00	22.00	0.218
OD	18.92	8.37	4.00	32.00	19.00	
Total	20.70	8.81	0.00	38.00	21.00	
Emotional						
BD	12.36	10.06	0.00	38.00	9.00	0.790
OD	11.12	8.75	0.00	33.00	8.50	
Total	12.05	9.72	0.00	38.00	9.00	
Functional						
BD	12.18	9.23	0.00	35.00	11.00	0.670
OD	11.58	9.97	0.00	35.00	11.00	
Total	12.03	9.37	0.00	35.00	11.00	
Total						
BD	45.84	24.95	0.00	102.00	43.00	0.549
OD	41.62	23.24	4.00	100.00	37.50	
Total	44.78	24.49	0.00	102.00	41.00	
V-RQOL						
Physical						
DC	57.26	25.28	1.00	100.00	54.20	0.840
DO	58.02	26.55	12.50	91.70	58.30	
Total	57.45	25.48	1.00	100.00	58.30	
Socio-emotional						
BD	73.39	24.26	12.50	106.30	81.30	0.582
OD	75.03	27.55	18.80	100.00	84.40	
Total	73.81	25.00	12.50	106.30	81.30	
Total						
BD	63.16	23.53	1.00	100.00	65.00	0.670
OD	64.81	25.21	15.00	95.00	73.75	
Total	63.58	23.85	1.00	100.00	70.00	
VPQ						
Total						
BD	30.73	9.40	0.00	48.00	31.00	0.758
OD	32.19	8.10	20.00	48.00	31.50	
Total	31.10	9.07	0.00	48.00	31.00	
VoiSS						
Impairment						
BD	32.19	13.65	2.00	58.00	35.00	0.891
OD	32.50	13.92	6.00	58.00	34.50	
Total	32.27	13.65	2.00	58.00	35.00	
Emotional						
BD	9.70	7.77	0.00	31.00	9.00	0.510
OD	8.54	7.49	0.00	24.00	6.50	
Total	9.41	7.68	0.00	31.00	8.00	
Physical						
BD	10.58	4.92	1.00	22.00	11.00	0.034*
OD	8.00	4.31	0.00	15.00	8.50	
Total	9.93	4.88	0.00	22.00	10.00	
Total						
BD	52.48	22.39	4.00	102.00	53.00	0.600
OD	49.04	21.67	13.00	82.00	45.00	
Total	51.61	22.15	4.00	102.00	52.00	
VTD						
Frequency						
BD	2.12	1.24	0.00	5.00	2.00	<0.001*
OD	1.05	0.79	0.00	3.00	1.00	
Total	1.85	1.24	0.00	5.00	1.75	
Severity						
BD	2.18	1.25	0.00	5.25	2.13	<0.001*
OD	1.12	0.93	0.00	4.00	1.00	
Total	1.91	1.26	0.00	5.25	1.75	

* Significant values ($P \leq 0.05$)—Mann-Whitney *U* test.

Abbreviations: BD, behavioral dysphonia; OD, organic dysphonia; VHI, Voice Handicap Index; VoiSS, Voice Symptom Scale; VPQ, Voice Performance Questionnaire; V-RQOL, Voice-Related Quality of Life; VTD, Vocal Tract Discomfort Scale.

TABLE 3.
Questionnaire Scores According to Gender

Questionnaires and Gender	Mean	Standard Deviation	Minimum	Maximum	Median	*P* Value
VHI						
Physical						
Female	21.79	8.85	0.00	38.00	23.50	0.025*
Male	17.63	8.08	4.00	32.00	16.00	
Emotional						
Female	12.53	9.72	0.00	38.00	10.50	0.426
Male	10.70	9.77	0.00	38.00	8.00	
Functional						
Female	12.78	9.44	0.00	35.00	11.00	0.140
Male	9.93	9.01	0.00	34.00	6.00	
Total						
Female	47.09	24.49	0.00	100.00	46.00	0.130
Male	38.26	23.72	4.00	102.00	36.00	
V-RQOL						
Physical						
Female	54.72	24.82	1.00	100.00	54.20	0.057
Male	65.13	26.19	12.50	95.80	75.00	
Socio-emotional						
Female	70.75	25.48	12.50	106.30	75.00	0.027*
Male	82.42	21.79	25.00	100.00	87.50	
Total						
Female	60.61	23.57	1.00	100.00	63.75	0.020*
Male	71.94	23.02	17.50	97.50	75.00	
VPQ						
Total						
Female	31.95	9.01	0.00	48.00	32.00	0.051
Male	28.70	8.97	0.00	48.00	28.00	
VoiSS						
Impairment						
Female	34.16	13.03	2.00	58.00	38.50	0.012*
Male	26.96	14.20	9.00	58.00	25.00	
Emotional						
Female	10.01	7.79	0.00	31.00	8.50	0.168
Male	7.70	7.21	0.00	26.00	6.00	
Physical						
Female	10.28	5.09	1.00	22.00	10.50	0.261
Male	8.96	4.18	0.00	20.00	9.00	
Total						
Female	54.45	21.87	4.00	99.00	56.50	0.020*
Male	43.63	21.37	17.00	102.00	41.00	
VTD						
Frequency						
Female	2.03	1.24	0.00	5.00	1.88	0.008*
Male	1.34	1.10	0.00	5.00	1.00	
Severity						
Female	2.09	1.25	0.00	5.25	2.00	0.008*
Male	1.41	1.17	0.00	4.75	1.00	

* Significant values ($P \leq 0.05$)—Mann-Whitney *U* test.
Abbreviations: VHI, Voice Handicap Index; VoiSS, Voice Symptom Scale; VPQ, Voice Performance Questionnaire; V-RQOL, Voice-Related Quality of Life; VTD, Vocal Tract Discomfort Scale.

negative self-perceived voice problem than women for any of the instruments.

Correlations for both BD and OD subjects varied from negligible to very high. These results were expected because the questionnaires addressed both particular aspects as well as similar aspects related to quality of life, voice handicap, and voice disorders symptoms (Tables 4 and 5). All instruments were positively correlated, with higher scores indicating better quality of life

TABLE 4.
Correlation Between the Questionnaire Scores and the Subjects With Organic Dysphonia

Variable	Statistic	VTD Frequency	VTD Severity	VHI Physical	VHI Emotional	VHI Functional	VHI Total	VoiSS Impairment	VoiSS Emotional	VoiSS Physical	VoiSS Total	VPQ Total	V-RQOL Total	V-RQOL Physical
VTD severity	Coef. Correl. (*P*)	0.946												
	Sig. Calc. (*P*)	<0.001*												
VHI physical	Coef. Correl. (*P*)	0.078	0.068											
	Sig. Calc. (*P*)	0.706	0.741											
VHI emotional	Coef. Correl. (*P*)	–0.099	–0.122	0.519										
	Sig. Calc. (*P*)	0.630	0.553	0.007*										
VHI **functional**	Coef. Correl. (*P*)	0.061	–0.009	0.543	0.695									
	Sig. Calc. (*P*)	0.766	0.966	0.004*	<0.001*									
VHI total	Coef. Correl. (*P*)	–0.012	–0.049	0.808	0.837	0.864								
	Sig. Calc. (*P*)	0.954	0.813	<0.001*	<0.001*	<0.001*								
VoiSS impairment	Coef. Correl. (*P*)	–0.121	–0.093	0.871	0.681	0.695	0.885							
	Sig. Calc. (*P*)	0.557	0.652	<0.001*	<0.001*	<0.001*	<0.001*							
VoiSS emotional	Coef. Correl. (*P*)	–0.067	–0.121	0.549	0.894	0.802	0.853	0.706						
	Sig. Calc. (*P*)	0.743	0.557	0.004*	<0.001*	<0.001*	<0.001*	<0.001*						
VoiSS physical	Coef. Correl. (*P*)	0.311	0.236	0.301	0.294	0.438	0.435	0.377	0.344					
	Sig. Calc. (*P*)	0.122	0.246	0.135	0.146	0.025*	0.026*	0.057	0.085					
VoiSS total	Coef. Correl. (*P*)	–0.009	–0.027	0.830	0.737	0.784	0.917	0.950	0.799	0.534				
	Sig. Calc. (*P*)	0.967	0.895	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	0.005*				
VPQ total	Coef. Correl. (*P*)	–0.052	–0.016	0.753	0.596	0.563	0.763	0.786	0.573	0.134	0.747			
	Sig. Calc. (*P*)	0.800	0.938	<0.001*	0.001*	0.003*	<0.001*	<0.001*	0.002*	0.515	<0.001*			
V-RQOL total	Coef. Correl. (*P*)	0.171	0.155	–0.625	–0.713	–0.755	–0.823	–0.788	–0.696	–0.172	–0.765	–0.870		
	Sig. Calc. (*P*)	0.404	0.448	0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	0.401	<0.001*	<0.001*		
V-RQOL physical	Coef. Correl. (*P*)	0.177	0.170	–0.598	–0.636	–0.690	–0.749	–0.735	–0.605	–0.134	–0.689	–0.827	0.968	
	Sig. Calc. (*P*)	0.386	0.406	0.001*	<0.001*	<0.001*	<0.001*	<0.001*	0.001*	0.515	<0.001*	<0.001*	<0.001*	
V-RQOL socio-emotional	Coef. Correl. (*P*)	0.110	0.110	–0.508	–0.813	–0.777	–0.824	–0.704	–0.836	–0.333	–0.798	–0.752	0.834	0.705
	Sig. Calc. (*P*)	0.593	0.592	0.008*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	0.096	<0.001*	<0.001*	<0.001*	<0.001*

* Significant values ($P \leq 0.05$)—Spearman correlation test.
Abbreviations: VHI, Voice Handicap Index; VoiSS, Voice Symptom Scale; VPQ, Voice Performance Questionnaire; V-RQOL, Voice-Related Quality of Life; VTD, Vocal Tract Discomfort Scale.

TABLE 5.
Correlation Between the Questionnaire Scores and the Subjects With Behavioral Dysphonia

Variable	Statistic	VTD Frequency	VTD Severity	VHI Physical	VHI Emotional	VHI Functional	VHI Total	VoiSS Impairment	VoiSS Emotional	VoiSS Physical	VoiSS Total	VPQ Total	V-RQOL Total	V-RQOL Physical
VTD severity	Coef. Correl. (*P*)	0.950												
	Sig. Calc. (*P*)	<0.001*												
VHI physical	Coef. Correl. (*P*)	0.539	0.541											
	Sig. Calc. (*P*)	<0.001*	<0.001*											
VHI emotional	Coef. Correl. (*P*)	0.286	0.327	0.599										
	Sig. Calc. (*P*)	0.012*	0.004*	<0.001*										
VHI functional	Coef. Correl. (*P*)	0.278	0.329	0.685	0.727									
	Sig. Calc. (*P*)	0.014*	0.003*	<0.001*	<0.001*									
VHI total	Coef. Correl. (*P*)	0.400	0.435	0.867	0.858	0.905								
	Sig. Calc. (*P*)	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*								
VoiSS impairment	Coef. Correl. (*P*)	0.402	0.378	0.817	0.557	0.720	0.796							
	Sig. Calc. (*P*)	<0.001*	0.001*	<0.001*	<0.001*	<0.001*	<0.001*							
VoiSS emotional	Coef. Correl. (*P*)	0.326	0.334	0.544	0.727	0.583	0.692	0.624						
	Sig. Calc. (*P*)	0.004*	0.003*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*						
VoiSS physical	Coef. Correl. (*P*)	0.597	0.596	0.519	0.418	0.367	0.485	0.474	0.424					
	Sig. Calc. (*P*)	<0.001*	<0.001*	<0.001*	<0.001*	0.001*	<0.001*	<0.001*	<0.001*					
VoiSS total	Coef. Correl. (*P*)	0.451	0.451	0.793	0.693	0.736	0.838	0.919	0.832	0.626				
	Sig. Calc. (*P*)	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*				
VPQ total	Coef. Correl. (*P*)	0.457	0.443	0.649	0.495	0.537	0.636	0.706	0.520	0.496	0.689			
	Sig. Calc. (*P*)	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*			
V-RQOL total	Coef. Correl. (*P*)	−0.515	−0.528	−0.780	−0.703	−0.746	−0.834	−0.771	−0.633	−0.537	−0.810	−0.632		
	Sig. Calc. (*P*)	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*		
V-RQOL physical	Coef. Correl. (*P*)	−0.479	−0.476	−0.759	−0.576	−0.716	−0.769	−0.767	−0.539	−0.476	−0.760	−0.583	0.949	
	Sig. Calc. (*P*)	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	
V-RQOL socio-emotional	Coef. Correl. (*P*)	−0.476	−0.505	−0.666	−0.779	−0.650	−0.783	−0.620	−0.672	−0.489	−0.725	−0.598	0.880	0.722
	Sig. Calc. (*P*)	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*

* Significant values ($P \leq 0.05$)—Spearman correlation analysis.
Abbreviations: VHI, Voice Handicap Index; VoiSS, Voice Symptom Scale; VPQ, Voice Performance Questionnaire; V-RQOL, Voice-Related Quality of Life; VTD, Vocal Tract Discomfort Scale.

regarding aspects related to voice. The V-RQOL was the only exception as the correlation occurred in the opposite direction (inversely correlated).

The four protocols VHI, V-RQOL, VoiSS, and VPQ were strongly correlated for the OD group (Table 4), with strength varying from high to very high (VoiSS and VHI). The VTD did not show any statistically significant correlation with any of the other instruments (Table 4). Because of the high strength of correlations, the items listed in the protocols were highly associated or similar. The strongest correlation for OD occurred between the mean frequency and the severity of vocal tract discomfort (VTD frequency *vs.* VTD severity = 0.946). Correlation strength between total scores from all other protocols was also between high and very high. The highest correlation between instruments was found between the VoiSS and the VHI total scores (VoiSS total *vs.* VHI total = 0.917; very high strength). This finding was expected because in developing the VoiSS, the authors of the questionnaire included VHI questions.

Regarding the VPQ, the questionnaire with the lowest ability of identifying individuals with voice problems among all questionnaires used, a high correlation was found with the impairment subscale of the VoiSS instrument (0.786 for OD and 0.706 for BD) (Tables 4 and 5). This suggests that the higher the perceived voice impairment, the higher the loss in vocal performance. The physical subscale score of the VoiSS produced the lowest correlation among its four scores with the VPQ (0.496, $P < 0.001$) for BD (Table 5) and no statistically significant correlation for OD (0.134, $P = 0.515$; Table 4).

When comparing total scores of the instruments with its subscales, we found that the total scores of VHI, VoiSS, and V-RQOL for OD (Table 4) were correlated significantly high or very high respectively with functional, impairment, and physical sub-scores (Table 4). Neither the emotional nor the socio-emotional scores had high correlation with the total score. Taking into consideration the total scores of the instruments, we found that the strength of correlations was higher for OD (Table 4) than for BD (Table 5).

For the BD group, the total scores of all instruments, including the VTD, were significantly correlated among themselves, with strength varying from low to high (Table 5). Once again, the total VoiSS score and the total VHI score presented with the highest correlation (0.838, high strength). Between subscales of the same instrument, the frequency of occurrence and severity of manifestation of symptom from the VTD had almost a perfect correlation (0.950, very high correlation) and practically identical to what was seen with the OD group (0.946). Similar to the observation in OD, results for the BD group showed that the VHI, VoiSS, and V-RQOL total scores strongly correlated (very high strength) with the functional, impairment, and physical subscores, respectively, more than other scores. Similar to the OD group, none of the emotional or socio-emotional scores had high correlation strength with the total score.

Perceptual analysis showed that the majority of patients in both BD and OD cases (above 80%) presented with mild and moderate deviation degree. No statistical differences were found in the deviation degree distribution for both types of dysphonia according to the tasks (sustained vowel or counting numbers), as presented in Table 6.

TABLE 6.
Perceptual Voice Analysis According to the Task, Sustained Vowel, Counting Numbers, and the Etiologic Group of Dysphonia

Task and Deviation Degree	Group				
	BD		OD		
	Frequency	%	Frequency	%	*P* Value
Sustained vowel					
Absence	0	0.0	0	0.0	0.921
Mild	35	45.5	11	42.3	
Moderate	35	45.5	12	46.2	
Intense	7	9.1	3	11.5	
Counting numbers					
Absence	0	0.0	0	0.0	0.216
Mild	31	40.3	8	30.8	
Moderate	42	54.5	14	53.8	
Intense	4	5.2	4	15.4	

*Significant values ($P \leq 0.05$)—Fisher exact test.
Abbreviations: BD, behavioral dysphonia; OD, organic dysphonia.

Several correlations were found among dysphonia self-assessment and auditory perceptual voice deviation degree assessed by clinician with strength varying from negligible to moderate (Table 7). The correlation between counting task with V-RQOL, as expected, was negative. The highest correlation of moderate strength occurred between VHI total score and counting task in OD (0.606). There was no statistically significant correlation between vocal tract discomfort symptoms (VTD) and clinician-perceived deviations, regardless of the type of voice task analyzed (sustained vowel or counting numbers).

In analyzing the relationship among perceptual characteristics of vocal quality and the total scores of the instruments, we found that no predominant type of voice deviation, such as breathiness, roughness, or strain, contributed to the classification of the subject as being dysphonic. In other words, the presence of strain, roughness, or breathiness did not determine the categorization of subjects according to the cutoff values (dysphonic *vs.* healthy), as presented in Table 8.

DISCUSSION

Patient self-assessment of voice severity and handicap is a relatively recent approach to the understanding of voice disorders and how it may affect patient care. Patient self-assessment includes the modern vision of health and quality of life.[1] Voice disorder quality of life instruments were introduced in the late 1990s[9,10,13] and have developed international acceptance and use as a result of many validated translations and cultural adaptations.[34] The worldwide spread of these instruments identified a common ground for dysphonic patients regardless of the culture.[6,8,35] The current use of self-assessment protocols goes beyond its capability to identify presence or absence of a voice disorder and includes the patient's perspective in living with the problem.

Self-assessment protocols were originally developed for clinical diagnosis purposes, to obtain a more comprehensive picture of a patient with a voice disorder, but now they are considered

TABLE 7.
Correlation Among Questionnaire Scores and Voice Perceptual Analysis, Sustained Vowel, and Speech of Organic and Behavioral Groups

		Group					
		All Sample		OD		BD	
Variable	Statistic	Sustained Vowel	Counting Numbers	Sustained Vowel	Counting Numbers	Sustained Vowel	Counting Numbers
VHI total	Correlation	0.209	0.356	0.343	0.606	0.177	0.281
	P value	0.034*	<0.001*	0.086	0.001*	0.124	0.013*
V-RQOL total	Correlation	–0.090	–0.257	–0.237	–0.564	–0.064	–0.150
	P value	0.365	0.009*	0.243	0.003*	0.581	0.193
VPQ total	Correlation	0.175	0.307	0.240	0.386	0.146	0.281
	P value	0.078	0.002*	0.238	0.052	0.204	0.013*
VoiSS total	Correlation	0.265	0.380	0.242	0.530	0.277	0.333
	P value	0.007*	<0.001*	0.234	0.005*	0.015*	0.003*
VTD							
Frequency	Correlation	–0.018	–0.006	0.212	0.035	–0.038	0.065
	P value	0.861	0.952	0.299	0.864	0.745	0.577
Severity	Correlation	–0.041	–0.053	0.155	0.022	-0.043	0.028
	P value	0.679	0.596	0.448	0.916	0.713	0.808

* Significant values ($P \leq 0.05$)—Spearman correlation analysis.
Abbreviations: BD, behavioral dysphonia; OD, organic dysphonia; VHI, Voice Handicap Index; VoiSS, Voice Symptom Scale; VPQ, Voice Performance Questionnaire; V-RQOL, Voice-Related Quality of Life; VTD, Vocal Tract Discomfort Scale.

to be also beneficial for programming therapeutic management. The low correlation between the patient's perspective and the clinician's analysis[36,37] suggests that self-assessment offers an additional perspective in communicating with the patient.

Although these protocols are essential for clinical evaluation and can predict adherence to treatment,[38] they can be best used as screening tools for large populations, because they have defined cutoff points[7,8] and they are low cost, fast, and reliable. However, our results clearly indicated that these instruments cannot be used in isolation to determine whether a person presents with a dysphonia or not, because none of them were capable of identifying voice problems with 100% accuracy (Table 1).

Based on these findings, self-assessment instruments cannot be used in isolation to identify voice problems in patients with dysphonia. As such, it is recommended to use caution when adapting these instruments in isolation for screening purposes. In other words, although cutoff values offer great additional value to self-assessment voice instruments, it is still premature to argue that they provide a clear indication of the presence of dysphonia. Voice is a behavior and a patient's self-assessment in itself can be

TABLE 8.
Numerical and Percentage Distribution of the Predominant Deviation Type According to the Questionnaire Cutoffs

	Predominant Deviation Type												
	Breathiness				Roughness				Strain				
	Pass		Fail		Pass		Fail		Pass		Fail		
Questionnaire	N	%	N	%	N	%	N.	%	N	%	N	%	*P* Value
VHI													
Total	5	12.20	36	87.80	8	16.00	42	84.00	1	8.30	11	91.70	0.742
V-RQOL													
Total	4	9.80	37	90.20	5	10.00	45	90.00	1	8.30	11	91.70	0.985
VPQ													
Total	4	9.80	37	90.20	1	2.00	49	98.00	0	0.00	12	100.00	0.163
VoiSS													
Total	2	4.90	39	95.10	1	2.00	49	98.00	0	0.00	12	100.00	0.586
VTD													
Frequency	9	22.00	32	78.00	18	36.00	32	64.00	6	50.00	6	50.00	0.132
Severity	9	22.00	32	78.00	21	42.00	29	58.00	4	33.30	8	66.70	0.129

*Significant values ($P \leq 0.05$)—likelihood ratio test.
Abbreviations: VHI, Voice Handicap Index; VoiSS, Voice Symptom Scale; VPQ, Voice Performance Questionnaire; V-RQOL, Voice-Related Quality of Life; VTD, Vocal Tract Discomfort Scale.

different from a health professional team's clinical impression, such as the one provided by the otorhinolaryngologists and the SLP. It was expected that at least the VHI and the VoiSS protocols, both considered perfect classifiers,[7,8] would be able to identify all subjects from this study as having dysphonia; however, the VoiSS positively marked 100 out of 103 subjects and the VHI missed 14 patients (Table 1).

An assertive systematic review[29] evaluated many self-assessment instruments designed for the assessment of the impact of a voice problem, and none of them met all recommended criteria presented by the scientific advisory committee of the Medical Outcome Trust guidelines.[2] Interestingly, the study by Branski et al[29] suggested that the VoiSS protocol was the best developed instrument. The data from this current study confirmed the superiority of this questionnaire in identifying subjects with dysphonia (Tables 1 and 2). This may play a role in the consistency of the results. Moreover, partial scores or subscales of the instruments performed worse than total scores in identifying dysphonic patients (Table 1). Perhaps the subscale concept should be abandoned and the total score should be the only one used for evaluation.[29]

None of the instruments used in this research were designed for a particular diagnostic category. Actually, in the voice area, only the Voice Outcome Survey is specifically intended for patients with vocal fold paralysis.[39] However, this protocol was not used in the present study.

The literature comparing OD and BD cases is limited. Some studies revealed a higher loss in quality of life (V-RQOL) for patients with organic causes of dysphonia, such as vocal fold paralysis, benign neoplasia, and inflammations.[40] Other studies revealed a higher score on vocal symptoms (VoiSS) for patients with OD.[41] However, the use of several instruments and the comparison of organic- and behavioral-based dysphonia revealed new emerging trends. One recent trend in the field is discomfort.[15,16,42,43] Discomfort, or low level of pain, seems to be particularly important in BD cases; in our data, patients with BD presented with a much higher score than individuals with OD (Table 2). Voice disorders are complex and a low level of pain (ie, discomfort) in the vocal tract is a subjective experience; however, this subjective experience can be more important than any other voice quality deviation, such as hoarseness.[15]

VTD, which specifically identifies discomfort or low level of pain, was the protocol that identified the least number of subjects with dysphonia (Table 1). When considering the two etiologic categories, behavioral- and organic-based dysphonia, we found that VTD produced different results according to the type of dysphonia: 75.3% of patients with BD reported enough vocal tract frequency of discomfort symptoms to fail in this instrument, whereas only 46.2% of patients with OD presented with these complaints (Table 1). This finding was not at all surprising considering that not all subjects with dysphonia presented with discomfort symptoms during speech. It is interesting that the number of subjects (Table 1) and the scores (Table 2) were higher for BD. The frequency and severity of discomfort symptoms for OD (Table 2) were very similar to the normal population.[16] Therefore, discomfort symptoms seem to be more common and more intense in dysphonia from behavioral causes, such as incorrect vocal technique, than dysphonia from organic causes, such as vocal fold paralysis. The physiopathologic mechanisms associated with vocal tract discomfort are still not clear, but it is an important step to recognize the importance of these symptoms in patients with dysphonia, particularly in behavioral cases.[15] Mechanisms of associative learning, motivation, and emotion regulation are involved in the transition from acute to chronic discomfort and pain,[44] and these can play a role in the development and maintenance of dysphonia, which was not explored until now.

The VTD can be used not only to assess these specific types of symptoms, but also to monitor the change of negative sensations after vocal rehabilitation. It is interesting to observe that not only the number of positives (fail) and negatives (pass) for dysphonia were practically identical for both frequency of occurrence and severity of the manifestation (Table 1), but also the mean score for both measures and for both BD and OD cases was similar (Table 2). Therefore, it is possible to investigate frequency independently from the severity of the symptoms associated with vocal tract discomfort. Perhaps the frequency of occurrence and severity of the symptom may covariate; however, this would require further investigation. Finally, the physical subscale of the VoiSS presented with a similar trend to the VTD; more subjects with BD failed in this domain, ie, were considered dysphonic, and all individuals with OD passed this subscale, ie, were considered vocally healthy, as shown in Table 1.

When working with OD cases, we can use any of the four protocols, VHI, V-RQOL, VPQ, or VoiSS, because they all present with a good ability to identify vocal impact (Table 1). The VoiSS could be considered the first choice because of its higher sensitivity and in accordance to what was indicated in a previous study.[29]

One interesting point is that the conceptual development of all these self-assessment instruments was different. Some of the perspectives were the perceived handicap (VHI, Jacobson et al[9]), aspects of quality of life related to voice (V-RQOL, Hogikyan and Sethuraman[10]), perception of loss of vocal endurance (VPQ, Carding et al[13]), and a mix of disability and vocal symptoms (VoiSS, Deary et al[17]). The common ground was to measure the perceived impact of a voice problem and this has produced the highest number of correlations found in the present study (Tables 4 and 5).

Studies need to be performed on specific diagnostic categories to determine the most clinically useful questionnaire. The original population of these instruments was a mix of different dysphonias. However, no sample size calculation was performed by etiology of the dysphonia, ensuring that the sample size used was sufficient to establish the cutoff value. As such, sample size may have played a role in the results. For example, in an implemented classification of voice disorders, nine categories were presented, with more than 100 subdivisions.[45] Theoretically, to be truly representative of dysphonia, all categories should be included in the sample and include subjects with a variety of voice symptoms, degree of voice deviation, and length of voice symptoms, as well as professional and nonprofessional voice users, for both genders. This process would probably demand a long multicentric study with numerous

subjects. Therefore, sample size, not only in the present study but also in previous research,[7,8] may not have been sufficient to represent the entire population of dysphonic individuals desired to investigate. Moreover, individuals with and without a voice disorder might be too broad of a definition to adequately address clinically relevant questions; as such, the diagnoses of interest may have needed to be specified instead of using large categories of disorders.[46] The study by Romak et al[23] compared dysphonic patients with many diagnoses who had answered two instruments, the VHI-10 and the V-RQOL; the results oscillated according to the diagnostic category and patients with presbyphonia and muscle tension dysphonia presented with different areas under the ROC curve, which indirectly indicates different cutoff values for these two categories.

Regardless of the diagnostic category, the presence or absence of professional voice users may have played a role in relation to the voice problem and consequently affected the results.[47] A study that investigated subjects with BD (general population and teachers) revealed higher cutoff values for teachers.[48] Therefore, differences found in some correlations or even lack of correlations may be related to patient characteristics used as samples.

It must be considered that although the studies that established the cutoff values of the validated Brazilian instruments[7,8] belong to the same group of researchers, the subjects used were not the same; hence, a heterogeneity among the groups may have contributed to contrast the results.

The evolution of self-assessment tools for voice disorders developed in the last three decades has offered many possibilities to the clinician, but the decision process in selecting a protocol has not yet been defined. The current study aimed at comparing patients' information (self-assessment questionnaires) to physicians' dysphonia diagnosis (external evaluation). All patients were known to be positive for voice disorders and it was hypothesized that one or more instruments would categorize all individuals as having dysphonia. However, this hypothesis was rejected (Table 1). Dysphonia self-assessment instruments do not replace other dimensions of the evaluation, but may reveal additional new information related to the patient's perspective on living with a voice problem, and differences related to the etiologic category, behavioral *vs.* organic based (Tables 1, 2, 4 and 5).

Results in the literature have been conflicting on the relationship between gender and voice self-assessment. Some investigations showed similar scores for both genders,[3,4,20,40,49,50] whereas others showed a higher perceived impact for women[51] or more vulnerability to certain types of dysphonia.[52] In this study, results on gender were not consistent among the instruments. Women presented a higher number of vocal symptoms (VoiSS), higher loss in quality of life (V-RQOL), and more discomfort symptoms (VTD); however, no differences were present regarding disadvantage and loss of performance (Table 3). Sample size reflecting the presence of more women than men, partly due to the convenient method of recruiting subjects, which reflects the clinical presentation of patients with dysphonia,[53] may have interfered with these results; this needs further investigation.

The clinical selection of one or more questionnaires deserves some consideration. There are no specific recommendations regarding the use of one questionnaire over another, and the choice may depend more on clinical preference than on any other scientific-based reason. For example, for time administration purposes, the best options may be the VHI-10 and the V-RQOL, each with only 10 questions; however, the psychometric properties of the VHI are superior for specificity.[7,8] By analyzing the content of all questionnaires, we found that the VoiSS instrument presents with a larger list of vocal symptoms as well as several items on the impact of a voice problem; therefore, when patients report mainly laryngeal and vocal symptoms during the initial consultation, the VoiSS may be a good option, because it includes a mixed option of vocal symptom questions and impact of a voice problem on several aspects of quality of life. This instrument seems to be the most comprehensive of them all. Some questions appear only in this instrument and not in the VHI, V-RQOL, VPQ, or VTD, such as "Do you cough or clear your throat?," "Does it feel as if there is something stuck in your throat?," "Do you have swollen glands?," "Do you have a lot of phlegm in your throat?," "Do you have a blocked nose?," and "How often do you get throat infections?"

It seems that for OD, such as vocal fold paralysis or larynx focal dystonia, ie, voice problems with a clear moment in time where the difficulties started, VPQ may provide the best information related to reduced performance, as the patient is asked to compare the previous voice status with the current problem. Table 1 shows that 25 out of 26 patients with OD (96.2%) failed this protocol. Moreover, the correlations in OD between VPQ and all other instruments are higher (Table 4) than the ones obtained in BD (Table 5). Patients with behaviorally related voice disorders usually do not remember their voices before the problem occurred. For some patients with long-standing chronic dysphonia, self-vocal image can be less clear, which may impair the quality of the answers on the VPQ protocol.

It is interesting to analyze the high (BD) and the very high (OD) correlations between VHI and VoiSS protocols (Tables 4 and 5). The development of the VoiSS instrument included VHI questions[17]; 12 questions of the original 30-item VHI version or four questions of the VHI-10 version appear in the 30-item final VoiSS questionnaire, using the exact phrasing or similar wording.[54] As such, this statistically significant high correlation was expected. Therefore, if time is not a concern, the VoiSS protocol is recommended as the self-assessment protocol of choice because it provides more information regarding voice symptoms.

For BD, all protocols have significant statistical correlation, including the VTD; however, the correlation strength varied from moderate to high, which are lower results than the ones found for OD (Tables 4 and 5). The VTD produced correlations from low to moderate with all protocols indicating that the signs of vocal tract discomfort may follow the symptoms of handicap, quality of life loss, and performance restrictions in cases of BD. The VPQ has also produced correlations from low to moderate with all the instruments. The VoiSS, VHI, and VRQOL instruments presented moderate correlations among themselves.

The perception of the dysphonia impact on behavioral cases may arguably appear to be more variable and heterogenic for different protocols. A feasible suggestion may be to apply more than one instrument when assessing patients with BD once the

correlation values indicate variable association (Table 5). It is possible that the combined use of VTD and VHI on BD would provide more clinical information because they are the instruments with lower correlation. The instruments that likely do not provide more clinical information when used together are VoiSS, VHI, or V-RQOL at any combination because they have high correlation values (Table 5) indicating high association among the items surveyed.

Perceptual analysis was similar for both the BD and the OD groups (Table 6). The majority of cases presented with mild or moderate degree of deviation. This reflects the habitual clinical distribution of patients, where intense voice deviations are less commonly seen.[36] A relatively higher percentage of cases with intense deviation belong to the OD group; however, this does not produce a statistical difference between the groups. The voice samples collected in this study occurred according to patients' attendance in the clinic and not by equal distribution in all categories of voice deviation, ie, the predominant type of voice deviation. However, results of this current study reinforce the fact that the self-perception of the impact of the problem is not related to the degree of deviation itself, rather to the patient's experience in living with the voice disorder.[36,37,49] Patients' self-perception may also be dependent on the expectation of their own voice, level and type of vocal demand, and lifestyle.[36,49] It is hard to objectively measure these aspects; however, it is easy to assume that, for example, a teacher with BD and a retired individual with vocal fold paralysis after a thyroid cancer surgery, both with a moderate degree of voice deviation, can present with different self-perception of their voice, according to their needs, use of voice, and coping strategies involved in dealing with the problem.[55] Patient perception of the problem seems to be independent, not only from the perceived vocal deviation but also from many parameters commonly investigated in a clinical evaluation, such as glottic closure, type of lesion, characteristic of the mucosal wave,[49] and Dysphonia Severity Index, a multiparametric method of acoustic assessment.[40] As in many other diseases, patient perception on the severity of impact may vary considerably.[1]

The association between patients' self-assessment of the voice problem and the external rating by clinical perceptual evaluation is not easy to analyze. The correlations varied from negligible to moderate (Table 7) and no high strength association was found. The counting numbers task presented with a higher correlation in comparison with the sustained vowel. As such, it is possible that the use of any speech-like material (eg, words, paragraph reading, or automatic speech) may offer a more natural sample of the use of voice than a sustained vowel and should have priority.[56] It is interesting to point out that vocal tract discomfort symptoms are not associated with any deviations perceived by the clinician, regardless of the type of voice task analyzed (sustained vowel or counting numbers). In other words, the reported discomfort may be found in any overall severity of voice deviation, and should not be inferred by it. The most consistent results for all samples were found between counting numbers and the total scores of the four instruments: VHI, V-RQOL, VoiSS, and VPQ. The sustained vowel perceptual analysis is not an indicator of the perceived impact of the voice problem, even if it is the preferred stimulus for maximum phonation time measurement[57] and acoustic analysis.[58] In regard to the perceptual characteristics of vocal quality, it could be hypothesized that breathiness would cause more impact than roughness or strain, due to difficulties in projecting the voice in a noisy environment; however, this relationship was not found (Table 8). A limitation might have been that the sample size was not enough to explore this association, because the levels of deviation for each predominant type of voice have not been controlled.

The history of the dysphonia, patient complaint, and physician diagnoses allow the SLP to elect the best assessment tool to be included in the evaluation session and to prepare the treatment program. Moreover, the perceived impact can be a determining factor in predicting adherence and can help to preview prognosis.[38] The patient's perspective of his or her own problem should be mandatory for any clinical diagnosis, even if the patient's self-perception may differ from the clinician's perspective.

A systematic review[46] of 29 databases from 1930 to 2009 of studies related to voice measures, voice disorders, and diagnostic accuracy revealed evidence that selected acoustic, laryngeal imaging–based, auditory-perceptual, functional, and aerodynamic measures can be potentially effective components in a clinical voice evaluation, demonstrating the capability to detect the presence of a voice disorder; however, none of these assessments used in isolation proved to be a perfect diagnostic tool. Considering that selected acoustic measures were able to detect dysphonia in 78% of samples,[46] we conclude that the ability of self-assessment questionnaires to identify patients with dysphonia, as seen in the present study, is high, although not perfect.

CONCLUSION

Based on the data of this study, several considerations are suggested when selecting an instrument for voice self-assessment:

- Self-assessment protocols provide unique and useful information that cannot be determined by perceptual analysis of vocal quality
- Women may suffer larger impact than men in regard to a voice problem
- Auditory-perceptual analysis and self-assessment protocols share only a moderate correlation; therefore, the association between these two analyses should be verified and not inferred; deviation presented in counting numbers task correlate better with the perceived impact than deviation with sustained vowel task
- The type of voice deviation, ie, roughness, breathiness, or strain, is unrelated to the scores of the self-assessment protocols
- When dealing with large general populations, the use of the VoiSS questionnaire may be a better choice, if time is not a constraint; otherwise, shorter protocols can be used, such as the V-RQOL
- When individuals are professional voice users with possible behavioral etiologic voice problems, such as teachers

and telemarketers, the VTD should be administered to verify the role of discomfort

- VTD symptoms should be selected as an assessment tool when behavioral etiology is suspected; when a patient with OD presents with a high VTD score, behavioral aspects should be investigated and addressed in the rehabilitation program
- In organic cases, such as patients from surgical caseloads and neurologic dysphonias, the use of the VPQ is preferred as it clearly measures the amount of loss in vocal performance comparing two points in time
- The combined use of some of these protocols should be considered with difficult cases, particularly when etiologic factors are not clear or when previous failure on rehabilitation occurred
- Self-assessment protocols should not be used in isolation for diagnostic purposes

In summary, different voice self-assessment questionnaires are moderately to highly correlated, with the exception of the VTD, particularly in OD. The different instruments may offer complementary and additional information. The selection of one questionnaire over another should be a conscious clinical choice, by taking into consideration the specific aspects of the dysphonia, considering the complaint, physician diagnosis, and most importantly the etiologic factor. The correlation between the clinician's perceptual analysis and the patient's self-evaluation is weak; deviations observed in the counting numbers task are more related to the questionnaire scores, independent from the predominant type of voice deviation. No instrument categorized all dysphonia; therefore, a combined use of these questionnaires with other clinic assessment measures is advisable.

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