Development and Validation of the Children's Voice Handicap Index-10 (CVHI-10)

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Summary: Objectives/Hypothesis. To develop and validate the self-administered Voice Handicap Index-10 for children (CVHI-10) in Italian and evaluate its internal consistency and reliability in normal and disordered children's voices.

Study Design. Cross-sectional survey study.

Methods. CVHI-10 was developed after a series of individual interviews with 20 children, aged 8–14 years to discuss the phrasing and wording of the original VHI-10. Subsequently, 66 dysphonic children (group 1) provided input to test internal consistency, external validity, and clinical validity. The voices of group 1 children were rated using the Grade, Roughness, and Breathiness parameters of the Grade, Roughness, Breathiness, Asthenia, Strain (GRBAS) scale. The test-retest results of 30 children (group 2) who successfully underwent voice treatment were also analyzed for test-retest reliability and responsiveness to treatment. Children of group 2 completed CVHI-10 twice, with an interval of 2 weeks. Additionally, 40 children without voice disorders (group 3) were included as a control group to obtain clinical validity. Each child included in the study completed CVHI-10 autonomously.

Results. Internal consistency measured with the Cronbach α coefficient was .85; test-retest reliability was 0.84. CVHI-10 positively correlated with G ($r = 0.62$) and B ($r = 0.34$) parameters of the GRBAS scale on Spearman rho test. The mean CVHI-10 score for group 2 was 12.4 ± 2.8 before treatment and 3.6 ± 1.6 after treatment; the difference was significant using the Wilcoxon sign test ($P = 0.0001$). The difference between CVHI-10 scores in groups 1 and 3 was significant using the Mann-Whitney U test ($P = 0.0001$).

Conclusions. CVHI-10 is easily administered, highly reproducible, exhibits good clinical validity, and responsiveness to treatment.

Key Words: Voice–Dysphonia–Quality of life–Voice Handicap Index.

INTRODUCTION

School-age children exhibit a wide variety of voice disorders; the most frequent diagnoses are vocal fold nodules, localized edema, and irregularity at the junction of the anterior and middle third of the vocal folds.[1,2] Other diagnoses such as laryngeal papillomatosis, subglottic stenosis, laryngeal cleft, and vocal fold paralysis are far less common but severely affect the voices of children.[3,4] Other diagnoses such as vocal fold polyps or cysts are less common in school-age children.

Multidimensional voice assessment, including perceptual voice evaluation using subjective scales, endoscopic examination, acoustics, aerodynamics, and a subjective self-assessment form,[5] has been recommended for voice assessment of adult patients; unfortunately, in pediatric dysphonia, multidimensional voice assessment is not yet the standard. Although office pediatric laryngeal examinations through the flexible endoscope is common in everyday practice,[6] and computer-assisted voice analyses as well as perceptual evaluations are becoming increasingly popular in pediatric dysphonia,[7,8] valid and reliable self-assessment ratings of voice severity have only recently been introduced.

Several self-assessments tools, such as the Voice Handicap Index (VHI),[9] Voice Outcome Survey,[10] Voice-Related Quality of Life,[11] and Outcome Scale[12] have been developed and are currently used throughout the world in adult populations.[13,14] VHI and VHI-10 are probably the most popular self-assessment tools. These have been translated into different languages, and they have been applied to various adult patient groups.[15–29]

Self-assessment of dysphonia severity for pediatric voice disorders is a recent development and the available tools are proxy measures that are based on adult assessment tools. The Pediatric Voice Outcome Survey (PVOS)[30] consists of four questions that are responded to by parents. PVOS has been validated in 108 children and normative data have been obtained from 385 parents. Recently, it has been validated in 120 parents of children with a variety of otolaryngologic diagnoses.[31,32]

A pediatric version of VHI, called pVHI, has also been developed, as the application of the adult VHI to children showed that an adaptation was necessary.[33,34] pVHI has been validated in Italian.[35] This version is a proxy measure and consists of 23 statements divided into functional (seven statements), emotional (seven statements), and physical domains (nine statements) to which the children's parents are asked to respond, using a five-point scale ranging from 0 (never a problem) to 4 (always a problem).

The Pediatric Voice-Related Quality of Life (PVRQOL)[32] is a reliable and valid tool; it is a 10-item instrument adapted from

Accepted for publication October 10, 2012.

Presented at the XLIV Congress of the Italian Society of Logopedics and Phoniatrics; June 22–26, 2010, Rome, Italy.

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Journal of Voice, Vol. 27, No. 2, pp. 258.e23-258.e28

0892-1997/$36.00

http://dx.doi.org/10.1016/j.jvoice.2012.10.006

the adult VRQOL[11] and is also a proxy instrument completed by a parent.

PVOS, pVHI, and PVRQOL are reported to be reliable and valid tools to measure a voice disorder's severity or impact on quality of life (QOL); however, these three assessment tools rely on the parents as source of information. Although parent proxy tools are applicable especially to young children, parents' reports may not necessarily reflect their children's opinions about their voices or their overall QOL.[36] Several advantages may arise from the record of children's view of their voice problem. First, because one of the main goals of voice therapy is to develop awareness of the problem in the patient, completion of a form identifying conditions of excessive voice use may directly lead the child to draw his/her attention to these behaviors. Second, awareness to such behaviors such as screaming or loud speaking[37] may best come from the child rather than from a parent. Third, motivation is an extremely important part of voice therapy, and answering statements about vocal behaviors may increase the child's awareness of his/her everyday difficulties and increase their motivation to improve his/her voice. Finally, it has been found that personality structure is very relevant in children with chronic hoarseness,[7] and the use of a self-assessment instrument may provide further insights to the clinician into some of the causes of voice abuse or misuse as perceived by the child.

The purpose of this study was to develop a pediatric version of VHI-10 to be completed by children aged 8–14 years and evaluate its internal consistency, reliability, validity, and responsiveness to treatment. This age range was selected because it includes children old enough to read and follow directions. Moreover, mucosal lesions are commonly seen in children of this age range.[1,2]

MATERIALS AND METHODS

The study was carried out according to the Declaration of Helsinki and approved by the Institutional Review Board. Both parents of each child included in the study gave written informed consent. All data were collected prospectively and entered into *SPSS*, Version 17.0 statistical software (SPSS, Inc. Chicago, IL). The study consisted of two separate phases: scale development (phase 1) and reliability and validity analysis (phase 2). One group of children was recruited for phase 1, whereas three additional groups of children provided the data for phase 2. The populations of these three groups are summarized in Table 1. Data from 66 dysphonic children (group 1) were used to test internal consistency, external validity, and clinical validity. Starting from these 66 children, a subgroup of 30 children with voice disorders (group 2) was selected to obtain test-retest reliability, construct validity, and responsiveness to treatment. Finally, a group of 40 children without voice disorders (group 3) were included in the study to investigate the differences in scores between the children with voice disorders and the normal control group of children without voice disorders.

Scale development

The original American version of VHI-10 and the data from the study by Connor et al[38] were used for scale development. Several statements in VHI-10 were not applicable to children because of the content of specific words in the statements such as "My voice causes me to lose income" or "My voice makes me feel handicapped." In addition, it was necessary to determine if children aged 8–14 years understood the meaning of other words in the statements such as "inferior, strain, and so forth" The Italian pVHI was also considered for language modification for the appropriate age. A preliminary version of a "Children Voice Handicap Index-10 (CVHI-10)" to be completed by the children was developed based on the interviews of 20 children with voice disorders. A heterogeneous group of 20 school-age children who were at least in the third year of school were recruited for preliminary analysis of the questions and the words within the questions. The criterion of third grade was selected because the children should be skilled enough to read and understand the 10 items of the survey. The children were aged 8–14 years and had vocal nodules, a vocal fold cyst, or muscle tension dysphonia. Each child was interviewed individually with one parent present to observe. The interview consisted of a discussion of the terms in each item in the newly developed CVHI-10. The interviewers developed a rapport with the children and encouraged them to provide appropriate

TABLE 1.
Age, Sex, and Diagnosis Characteristics of the three Groups of Children Recruited for Phase 2 of the Study

Group	Age, Mean ± SD (Range), Years	Male/Female	Diagnosis
Group 1 (n = 66)	11.4 ± 1.2 (8–14)	57/9	Vocal fold nodules (n = 32) Vocal fold edema (n = 10) Cyst (n = 4) Muscle tension dysphonia (n = 14) Sulcus (n = 6)
Group 2 (n = 30)	11.8 ± 1.6 (9–14)	26/4	Vocal fold nodules (n = 18) Vocal fold edema (n = 3) Cyst (n = 2) Muscle tension dysphonia (n = 7)
Group 3 (n = 40)	11.2 ± 3.2 (8–13)	33/7	No voice disorders

Abbreviation: SD, standard deviation.

responses. In addition, the interviewers specifically asked for descriptions of how each child felt about his/her voice disorder and how it affected their school performance. Notes from these discussions were reviewed by two investigators (A.R.M. and A.S.) to determine if they used the words that were similar to the words in the developing CVHI-10. The children were then asked to read each item of the questionnaire and then to explain and/or rephrase it.

Words within the self-assessment tool were modified on the basis of children suggestions and the reviewers' comments as well as on difficulty in understanding the items. Modifications were made according to the environmental, cultural, and language differences. The English translation of statement 7 was modified and "clear" (chiara) was replaced for light," and for statement 8, the closest English translation to "mi disturba" based on the responses from the children was "upsets me." Other words discussed included the Italian equivalents to "strain" and "inferior" but the children understood those words. Thus, two of the 10 statements (no. 7 and no. 8) were modified to meet age equivalency based on the interviews. Of significance in the interview was the finding that selecting a choice from the original 0–4 was difficult. Thus, the scoring was changed to 0 (never a problem) to 3 (always a problem). Thus, the maximum severity score is 30 (Appendix).

Participants

The demographics of the three groups of phase 2 are reported in Table 1. Group 1 consisted of 66 dysphonic children (57 males and nine females). The median age was 11.4 ± 1.2 years, with a range of 8–14 years. This group of patients was diagnosed with a variety of voice disorders by a phoniatrician and seen by a speech-language pathologist. Bilateral vocal fold nodules, vocal fold cyst, unilateral vocal fold edema, sulcus, and muscle tension dysphonia were found, respectively, in 32, four, 10, six, and 14 children. Group 2 included 30 dysphonic children (26 males and four females); these patients were selected for this study group based on the fact that each patient had been successfully treated for his or her voice problem. The median age of the participants was 11.8 ± 1.6 years, with a range of 9–14 years. Sixteen children underwent voice therapy, whereas the remaining 14 underwent surgical therapy followed by voice therapy. This group of patients was also diagnosed with a variety of voice disorders. Bilateral vocal fold nodules, vocal fold cyst, unilateral vocal fold edema, and muscle tension dysphonia were found, respectively, in 18, two, three, and seven children. Group 3 included 40 children, 33 males, and seven females seen in the Otorhinolaryngology Department, Bufalini Hospital for nasal or pharyngeal disorders but without dysphonia and with no history of voice disorder. The mean age was 11.2 ± 3.2 years, ranging from 8 to 13 years.

Internal consistency

Each child from group 1 completed CVHI-10 autonomously. The internal consistency of CVHI-10 was assessed using Cronbach alpha coefficient. A value greater than 0.8 is considered "good" and greater than 0.9 "excellent," whereas a value greater than 0.7 is often considered satisfactory.

Test-retest reliability analysis

For test-retest reliability, CVHI-10 was completed twice with a period of approximately 2 weeks between each administration by the children of group 2 before their treatment. This interval period was selected because no substantial change was expected to take place in the voice condition of the children within this period. When the children responded to the second CVHI-10, they had no access to their responses from the first CVHI-10.

Validity

To test criterion validity, the parents of group 2 children were asked to complete the Italian pVHI while the children completed CVHI-10. The two sets of scores were analyzed using the Spearman rho test. Children of group 2 were also asked to complete CVHI-10 after voice treatment.

The responsiveness to treatment was tested by comparing the CVHI-10 scores of group 2 children before and after treatment; the Wilcoxon sign test was used for this analysis.

To test whether CVHI-10 yields statistically reliable differences between groups of children with dysphonia and control speakers, group 3 children completed CVHI-10. The CVHI-10 scores of group 1 and group 3 children were compared through the Mann-Whitney *U* test. Finally, an experienced phoniatrician and a speech pathologist rated the voice of each child in group 1 on conversational speech and sustained vowels. The mean Grade, Roughness, and Breathiness (GRB) parameters of the Grade, Roughness, Breathiness, Asthenia, Strain (GRBAS) scale[39] were used for auditory perceptual analysis. The scores between CVHI-10 and the average GRB parameters of the GRBAS scale obtained for group 1 children were subjected to correlation analysis to assess external validity.

RESULTS

The children from groups 1, 2, and 3 managed to complete CVHI-10 without any need of assistance; the time required to respond to the statements never exceeded 10 minutes. CVHI-10 scores of group 1 children are reported in Table 2.

TABLE 2.
CVHI-10 Scores in Group 1 Children (n = 66); Mean ± SD and Range Are Reported for Each Diagnosis as well as for the Whole Group

Diagnosis	Mean ± SD CVHI-10 Scores	CVHI-10 Range
Vocal fold nodules (n = 32)	10.2 ± 2.9	6–20
Vocal fold edema (n = 10)	9.5 ± 3.1	6–15
Cyst (n = 4)	11.1 ± 4.3	7–20
Muscle tension dysphonia (n = 14)	8.2 ± 3.0	6–20
Sulcus (n = 6)	12.1 ± 4.5	12–24
Total (n = 66)	10.4 ± 3.2	6–24

Abbreviation: SD, standard deviation.

Internal consistency and reliability analysis

The overall Cronbach α coefficient value for CVHI-10 obtained from group 1 children was good ($\alpha = .85$). The mean CVHI-10 scores obtained for the test-retest reliability analysis in group 2 children were 11.8 ± 2.8 (range = 10–16) in the test condition and 11.7 ± 2.9 (range = 9–16) in the retest condition. A minor decrease of the mean CVHI-10 score in the retest condition was noted; however, the Pearson product-moment correlation score was good ($r = 0.84$; $P = 0.0001$).

Validity analysis

The mean scores of CVHI-10 and pVHI in group 1 were 10.4 ± 3.2 (range = 6–24) and 29.4 ± 12.6 (range = 16–58), respectively; the correlation between these two measures was statistically significant ($r = 0.74$, $P > 0.0001$).

In group 2, the CVHI-10 mean score was 12.8 ± 2.8 (range = 9–14) before treatment and 3.6 ± 1.6 (range = 0–6) after treatment, the difference was significant ($P > 0.0001$).

The mean scores obtained from group 1 and group 3 were 10.4 ± 3.2 (range = 6–24) and 2.4 ± 1.2 (range = 0–4), respectively. A significant difference on the Mann-Whitney U test between children of group 1 and group 3 was found for CVHI-10 ($P > 0.0001$).

The mean GRB values of the 66 dysphonic children were $G = 1.4 \pm 0.6$, $R = 0.7 \pm 0.1$, and $B = 1.2 \pm 0.5$. CVHI-10 showed positive correlations with G ($r = 0.62$), R ($r = 0.38$), and B ($r = 0.34$).

DISCUSSION

The psychometric properties of the assessment tool completed by children aged 8–14 years (CVHI-10) were studied in a group of 66 dysphonic children and in a control group of 40 children without voice disorders. The results show strong internal consistency, test-retest reliability, clinical validity, and external validity. These are the first data on a self-administered severity of voice assessment tool for children in this age group. CVHI-10 is quick to administer and worded in a manner that makes it easy for children to understand. There are no subscales and the clinician only needs to add the numbers. CVHI-10 may range from 0 to 30 and an elevated score indicates a higher self-perception of dysphonia. A total score of 4 or less suggests that the child perceives his or her voice as normal based on the data from group 3.

Specific findings related to CVHI-10 are noteworthy. First, the development of CVHI-10 was not an adaptation of an already existing adult voice handicap scale; on the contrary, data from the existing qualitative research and from patient interviews were used.[38] Second, the lexicon and scoring system were discussed with children to avoid inappropriate interpretation of words within the item before administering it to the experimental groups. Third, this is the first dysphonia self-assessment tool for children not based on parents' responses. This point is particularly important as proxy application violates the strict tenets of self-assessment tools.[40] To our knowledge, this is the first report on a self-administered assessment tool of children's voices. In particular, CVHI-10 was completed fully by all children, suggesting that all the children understood all the questions and were comfortable answering all of them. Therefore, it might be speculated that CVHI-10 is not a burdensome instrument as it is easily self-administered and requires no more than 10 minutes to complete.

The internal consistency of CVHI-10 was 0.85. A Cronbach α coefficient or this value is considered good. The scores obtained on CVHI-10 for the test-retest condition indicate that CVHI-10 has high stability and reproducibility over time. In fact, the Spearman rho correlation scores were higher than 0.80, a value considered optimal for group comparison and individual measurements over time.[41] Similar findings were reported for VHI-10[26–28] and the Italian pVHI.[34,35] The main difference between CVHI-10 and other self-assessment tools for children lies in the fact that although CVHI-10 is self-administered, the others are done by parent proxy. Criterion validity was assessed comparing CVHI-10 and pVHI scores. pVHI was chosen because it is the only voice self-assessment tool validated for children in Italian. Correlation between CVHI-10 and pVHI was satisfactory, supporting the validity of CVHI-10.

Data from the present study indicate that CVHI-10 may be a sensitive tool for identifying voice disorders. The overall CVHI-10 scores in the control group were significantly lower than those found in the voice-disordered group. These findings agree with those of several studies in adult patients, according to which the voice-disordered patients had significantly higher scores than the comparison control group.[16–18,20,42] Also in the studies on pVHI, the difference in the scores obtained from parents of dysphonic children and control was statistically significant.[34,35]

A weak-to-moderate correlation between auditory perceptual ratings of dysphonia and CVHI-10 was found. Similar findings were found in the Italian validation of pVHI.[35] These findings reflect the nature of the differences between what a clinician hears and what a patient feels or perceives about his/her voice. Conversely, the weak correlations between GRB and the CVHI-10 findings suggest that both measures provide independent, but complementary, information about the patient's voice.

We acknowledge the limitations of our study because of the small number of patients, their heterogeneity, and the possibility that other uncontrolled factors, such as reading skills, may impact on the future administration of CVHI-10 to other children in this age group. Future research is necessary to replicate these findings in a diverse sample of children where reading level is controlled and in groups both younger and older to determine the age range where the results of self-administered children's voice assessment is reliable and valid. Evaluation of CVHI-10 data across age groups is also necessary to establish normative data, which should be confirmed across categories of socioeconomic status, gender, and race. This initial effort intended to encourage studies on larger populations to investigate how dysphonia is perceived by children with a voice disorder and gain insight into new therapy techniques based on the child's perception of his or her voice problem. In particular, it would be useful to have more extensive data on CVHI-10 from groups of children with different voice disorders.

CONCLUSIONS

CVHI-10 is easily administered, highly reproducible, and exhibits excellent clinical validity in Italian children aged 8–14 years. Therefore, it appears to be a useful self-assessment tool of voice severity for the initial assessment of children in this age group as well as for evaluation of treatment outcomes. CVHI-10 provides additional information for the clinician to better understand the manner in which children perceive their voice and is recommended for inclusion as the standard protocol for voice assessment of children. Further assessment of this tool in other languages may contribute to a better understanding of how children perceive voice disorders.

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APPENDIX

Children Voice Handicap Index-10 (Italian version and English translation)

Instructions: These are statements that many children have used to describe their voices and the effects of their voices on their lives. Circle the response that indicates how frequently you have the same experience.

Istruzioni: queste sono affermazioni che molti bambini hanno usato per descrivere la loro voce e gli effetti della loro voce sulla propria vita. Fai un cerchio sulla risposta che indica la frequenza con cui si verificano.

0 = Never; 1 = Sometimes; 2 = Many times; 3 = Always.
0 = Mai; 1 = Qualche volta; 2 = Molte volte; 3 = Sempre.

1	People have difficulty hearing me because of my voice	Never	Sometimes	Many Times	Always
	La gente ha difficoltà a sentirmi a causa della mia voce	*Mai*	*Qualche Volta*	*Molte Volte*	*Sempre*
2	People have difficulty understanding me in a noisy room	Never	Sometimes	Many Times	Always
	La gente ha difficoltà a capirmi in una stanza rumorosa	*Mai*	*Qualche Volta*	*Molte Volte*	*Sempre*
3	My voice difficulties prevent me to stay with people	Never	Sometimes	Many Times	Always
	Le difficoltà della mia voce mi impediscono di stare con la gente	*Mai*	*Qualche Volta*	*Molte Volte*	*Sempre*
4	I feel left out of conversations because of my voice	Never	Sometimes	Many Times	Always
	Mi sento escluso/a dalle conversazioni a causa della mia voce	*Mai*	*Qualche Volta*	*Molte Volte*	*Sempre*
5	My voice difficulties reduce my school outcome	Never	Sometimes	Many Times	Always
	Le difficoltà della mia voce riducono i miei risultati a scuola	*Mai*	*Qualche Volta*	*Molte Volte*	*Sempre*
6	I feel I have to strain to produce voice	Never	Sometimes	Many Times	Always
	Sento che devo fare sforzo per fare uscire la voce	*Mai*	*Qualche Volta*	*Molte Volte*	*Sempre*
7	My voice is not light	Never	Sometimes	Many Times	Always
	La mia voce non è chiara	*Mai*	*Qualche Volta*	*Molte Volte*	*Sempre*
8	My voice problem upsets me	Never	Sometimes	Many Times	Always
	Il mio problema di voce mi disturba	*Mai*	*Qualche Volta*	*Molte Volte*	*Sempre*
9	My voice makes me feel inferior to other children or other boys	Never	Sometimes	Many Times	Always
	La mia voce mi fa sentire inferiore agli altri bambini o agli altri ragazzi	*Mai*	*Qualche Volta*	*Molte Volte*	*Sempre*
10	People ask me "what's wrong with your voice?"	Never	Sometimes	Many Times	Always
	La gente mi chiede "cosa c'è che non va nella tua voce?"	*Mai*	*Qualche Volta*	*Molte Volte*	*Sempre*
Score: _____		0	1	2	3