Validity and Reliability of the Dutch Children's Voice Handicap Index-10

Anke Adriaansen [1,*], Kristiane Van Lierde [2], Iris Meerschman [3], Charlot Everaert [3], Evelien D'haeseleer [4]

[1] Center for Speech and Language Sciences (CESLAS), Department of Rehabilitation Sciences, Ghent University, Ghent, Belgium. Electronic address: Anke.adriaansen@ugent.be.

[2] Center for Speech and Language Sciences (CESLAS), Department of Rehabilitation Sciences, Ghent University, Ghent, Belgium; Department of Speech-Language Pathology and Audiology, University of Pretoria, Pretoria, South-Africa.

[3] Center for Speech and Language Sciences (CESLAS), Department of Rehabilitation Sciences, Ghent University, Ghent, Belgium.

[4] Center for Speech and Language Sciences (CESLAS), Department of Rehabilitation Sciences, Ghent University, Ghent, Belgium; Department of Otorhinolaryngology, Ghent University Hospital, Ghent, Belgium.

*Address correspondence and reprint requests to Anke Adriaansen, Corneel Heymanslaan 10, 9000 Ghent, Belgium. Email: Anke.adriaansen@ugent.be

Summary

Objectives: Voice-related quality of life (Qol) questionnaires provide the clinician with information regarding the impact of voice disorders on the patient's well-being. The available voice-related QoL tools for Dutch-speaking children are parent-proxy in nature. However, the use of proxy measurements has been debated in the literature. The Children's Voice Handicap Index-10 (CVHI-10) is a self-reported QoL tool for dysphonic children. Therefore, the aim of this study is to develop and validate a Dutch version of the CVHI-10.

Study design: Observational, prospective, cross-sectional study.

Methods: The original version of the CVHI-10 was translated and adapted to Dutch according to the recommendations of the Quality of Life Special Interest Group - Translation and Cultural Adaptation group. Subsequently, the questionnaire was individually completed by 77 children (dysphonic group: n = 30, control group: n = 47) between eight and 14 years. In order to investigate test-retest reliability, 50% of the participants were asked to complete the questionnaire twice with an interval of 2 weeks. Internal consistency, test-retest reliability and construct validity were calculated. A receiver operating characteristic (ROC) analysis was conducted to check the sensitivity and specificity levels of the instrument.

Results: Internal consistency measured with Cronbach's alpha coefficient was 0.745. Test-retest reliability measured with intraclass correlation coefficients was 0.718. Mean total CVHI-10 score was 6.17 ± 2.7 in the dysphonic group and 2.68 ± 2.6 in the control group. The difference in total score between the groups was statistically significant ($P < 0.001$), suggesting that the tool has good construct validity. ROC analysis demonstrated moderate diagnostic accuracy (area under the curve = 0.869) and suggested a cut-off score of 3.5.

Conclusions: The Dutch CVHI-10 is the first self-reported voice-related QoL tool for dysphonic Dutch-speaking children. It is a valid, reliable and sensitive tool to assess the impact of a voice disorder on the child's well-being.

Key Words: Voice disorders; Self-assessment; Children; Quality of life; Children's Voice Handicap Index

INTRODUCTION

Pediatric dysphonia is defined as a clinician-recognized impaired voice production in children.[1] Pediatric dysphonia is a common disorder with reported prevalence rates ranging from 3.9% to 53.2%.[2, 3, 4, 5, 6, 7, 8, 9] According to the protocol for the functional assessment of pathological voices, a voice assessment should be multidimensional in nature and consist of the five following types of measurements: a perceptual, videolaryngostroboscopic, aerodynamic, acoustic, and subjective (self-)evaluation.[10] Firstly, perceptual evaluation is considered as the 'gold standard' in a clinical voice assessment because of the perceptual nature of vocal quality.[11] The most commonly used perceptual evaluation tool is the GRBAS scale, which was proposed by Hirano[12] and supplemented with the parameter 'instability' by Dejonckere, Crevier-Buchman, Marie, Moerman, Remacle, Woisard.[13] Secondly, videolaryngostroboscopy is a widely used technique to visualize the vocal folds. As noted by Mortensen, Schaberg, Woo,[14] videolaryngostroboscopy has some specific diagnostic advantages: "Videolaryngostroboscopy elucidates subtle features of different disease processes; clarifies the differences between benign mucosal disorders that might require surgical intervention; and helps identify inflammatory processes that contribute to dysphonia." Several protocols are available to assess the videolaryngostroboscopic recordings. Basic videolaryngostroboscopic parameters are glottal closure, regularity, mucosal wave, symmetry, amplitude and supraglottic activity.[10,15] The feasibility of videolaryngostroboscopy depends on the tolerance and cooperation of the child.[16,17] Thirdly, aerodynamic measures are an important part of a voice evaluation since voice production is an aerodynamic process. These measures provide information regarding respiratory capacity and glottal competency.[18] The American Speech-Language-Hearing Association recommends average glottal airflow rate and average subglottal air pressure as aerodynamic measures in their protocol for instrumental assessment of vocal function.[19] Fourthly, acoustic parameters are essential because they are objective, easily reproducible and non-invasive.[20] There is increasing evidence that the cepstral peak prominence is the strongest acoustic predictor of overall voice quality and breathiness.[19,21, 22, 23] Lastly, subjective (self-)evaluations or patient-reported outcome measures (PROMs) are an indispensable part of voice evaluations because PROMs are the sole instruments to investigate the patient's views on their symptoms, functional status and health-related quality of life (QoL) without an observer bias.[24,25] Moreover, PROMs could improve patient involvement in clinical decision-making.[25] When patients do not experience negative health consequences, it is difficult to justify further interventions.[26]

The development of pediatric voice-related QoL tools is described below. For many years, validated voice-related QoL tools were not available for the pediatric population. In 2002, Hartnick[27] developed the first pediatric voice-related QoL tool that was called the Pediatric Voice Outcome Survey (PVOS). The PVOS consists of four questions addressing the parents. This survey originally focused on children with tracheotomies and subsequently validated in a broader pediatric otolaryngologic population.[28] Moreover, Boseley, Cunningham, Volk, Hartnick[29] adapted the Voice-Related Quality-of-Life instrument for a pediatric population,

resulting in the Pediatric Voice-Related Quality-of-Life instrument (PVRQOL). The PVRQOL consists of ten statements that parents score using a six-point rating scale. Furthermore, Zur, Cotton, Kelchner, Baker, Weinrich, Lee[30] developed and validated a pediatric version of the Voice Handicap Index (pVHI). The pVHI consists of 23 items that parents complete using a five-point rating scale to gain insight into the physical, functional and emotional impact of the voice disorder on their child.

So far, research focused on parent-proxy instead of self-reported tools for various reasons. Most importantly, children are believed to lack the necessary language skills to interpret the questions as well as the cognitive ability to reflect on the consequences of their voice disorder.[27] Moreover, parents have more internalized standards to judge the level of QoL.[31] Parental motivation and concern are also the main reasons to consult a voice therapist or an otolaryngologist with a dysphonic child, which indicates the importance of assessing the view of the parents.[28] Despite these reasons, the use of parent-proxy tools has been debated to measure children's health-related QoL. The World Health Organization (WHO) defined QoL as "individuals' perceptions of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns."[32] This definition emphasizes the importance of self-reporting in the assessment of QoL. Proxy ratings may be not valid, especially for symptom experience, peer relationships, and future worries.[33] Specifically in the field of pediatric dysphonia, Cohen, Wynne[34] pointed out that parents tend to overestimate the emotional impact of a voice disorder on their children. By contrast, Ricci-Maccarini, De Maio, Murry, Schindler[35] found that children report a more severe impact of their voice disorders compared to their parents.

Recently, more attention has been paid to the importance of self-reported QoL tools for pediatric populations. Verduyckt, Morsomme, Remacle[36] developed and validated in 2012 the first voice-related QoL tool addressing children, which was called the Pediatric Voice Symptom Questionnaire (PVSQ). The PVSQ is a 31-item questionnaire consisting of two parallel child- and parent-versions. The second self-reported QoL tool for dysphonic children was originally developed in Italian by Ricci-Maccarini, De Maio, Murry, Schindler[37] in 2013. They adapted the Voice Handicap Index-10 (VHI-10) to use in a pediatric population, resulting in the Children's Voice Handicap Index-10 (CVHI-10). Presently, the CVHI-10 has already been translated into Turkish and Hong Kong Chinese.[38,39] The characteristics of the different versions of the CVHI-10 are summarized in Table 1. The CVHI-10 is proved to be a reliable and valid self-assessment tool for dysphonic children between eight and 14 years in these languages.[37, 38, 39] The tool consists of ten statements using a four-point Likert scale (0 = "never", 1 = "sometimes", 2 = "many times" and 3 = "always"). A higher score implies that children experience a higher impact from their voice disorder, with a maximum total score of 30. A total score of four or less on the original CVHI-10 indicates that children experience their voice as normal.[37]

TABLE 1.
Characteristics of CVHI-10 Versions

Parameter	Ricci-Maccarini et al.(2013); Italian (original version)	Tadihan Özkan et al. (2017); Turkish	Kwong (2020); Hong Kong Chinese
Mean score (/30)			
Dysphonic children	10.4 ± 3.2	12.5 ± 6.7	5.57 ± 4.417
Control group	2.4 ± 1.2	3.5 ± 3.5	1.69 ± 1.728
Consistency analysis			
Internal consistency	Cronbach's α: 0.85	Cronbach's α: 0.87	Cronbach's α: 0.787
Reliability analysis			
Test-retest reliability	Pearson's r: 0.84	Pearson's r: 0.973	/
Discrimination of dysphonic group			
Cut-off score	> 4	> 9	2.5
Intrinsic accuracy (area under the curve)	/	0.882	0.808
Sensitivity	/	68.97%	75%
Specificity	/	93.23%	77.1%

Despite the recent initiatives to develop and validate pediatric self-reported QoL tools, an appropriate self-reported tool has been missing for the (Flemish) Dutch area. The aim of this study is to develop and validate a Dutch version of the CVHI-10 for children between eight and 14 years.

MATERIALS AND METHODS

This cross-sectional study was approved by the Ethics Committee of Ghent University Hospital (registration number: B6702020000306).

Participants

Two groups of children were included in this study. Both groups consisted of Dutch-speaking children aged between 8 and 14 years, without cognitive impairment or a history of hearing problems as reported by the parents.

The first group consisted of treatment-seeking children with a current diagnosis of dysphonia. They were diagnosed by a voice therapist with experience in pediatric dysphonia and an otolaryngologist using flexible videolaryngostroboscopy. The dysphonic children were recruited during their appointment in the voice clinic of Ghent University Hospital between November 18, 2020, and November 2, 2021. The second group (control group) consisted of children without a current vocal pathology or a history of voice problems. These non-dysphonic children were recruited via social media between November 18, 2020, and January 2, 2021.

Procedures

The first part of the research process was the development of the Dutch CVHI-10. The CVHI-10 was translated and adapted according to the recommendations of the Quality of Life Special Interest Group - Translation and Cultural Adaptation group.[40] This group was established by the professional society for health economics and outcomes research (ISPOR), the leading organization dedicated to improving healthcare decision-making worldwide.[41] The following steps were taken during the developmental phase. Firstly, permission to use the original CVHI-10 (Appendix A) was obtained from the developers.[37] Secondly, the English version of the CVHI-10 was translated into Dutch by two independent native

speakers of Dutch who have professional knowledge of English and expertise in pediatric dysphonia (Appendix B and C). Both translations were merged by a third, independent native speaker of Dutch who had a degree in English linguistics and was not previously involved in the translation process (Appendix D). This merged version was back-translated into English by a fourth native speaker of Dutch with a degree in applied English language (Appendix E). A comparison was made between the back-translated English version and the original English version by a fifth person with professional knowledge of English. Afterwards, the merged Dutch CVHI-10 was individually completed and orally discussed by three dysphonic participants (8-14 years) to ensure that the translation is comprehensible and to highlight all issues causing confusion. Lastly, the suggestions of these three participants were implemented and typographical and grammatical errors were corrected (Appendix F).

The second part of the research process was the validation of the newly developed Dutch CVHI-10. The parents of all included children gave written informed consent to participate in the study. Each participant independently completed the Dutch CVHI-10. Children in the dysphonic group answered the paper questionnaire during the consultation at Ghent University Hospital. Dysphonia severity index (DSI), acoustic voice quality index (AVQI) and GRBASI were determined during this consultation.[12,42,43] Children in the control group received an online version of the questionnaire, which was created using Google Forms. In order to identify the test-retest reliability, the link to the online version was (re)sent after two weeks to 50% of the participants, with no access to their previous anwers.

Statistical analysis

All statistical tests were performed using IBM SPSS Statistics 26 software (SPSS, Inc. Chicago, IL) and the significance level was set at $\alpha = 0.05$. Assumption of normality was checked for age and total CVHI-10 score using the Shapiro-Wilk test. The non-parametric Mann-Whitney *U* test was used to check for statistically significant differences in age between the dysphonic and control group. The chi-square test was used for the comparison of sex between the dysphonic and the control group.

Internal consistency was calculated using the Cronbach's alpha coefficient and interpreted following the classification proposed by Terwee, Bot, de Boer, van der Windt, Knol, Dekker, Bouter, de Vet,[44] with a value between 0.70 and 0.95 considered good. Test-retest reliability was evaluated using intraclass correlation coefficients (ICC) and their 95% confident intervals based on a single measurement, absolute-agreement and two-way mixed-effects model. The ICC values were interpreted following the classification of Koo, Li[45] (> 0.9 ‘excellent’; $0.9 \geq ICC > 0.75$ ‘good’; $0.75 \geq ICC > 0.5$ ‘moderate’; ≤ 0.5 ‘poor’). Additionally, a non-parametric paired-samples Wilcoxon Test was used to determine whether there was a statistical significant difference in total CVHI-10 score between the test and retest condition.

Construct validity was checked by comparing the mean total CVHI-10 score between the dysphonic group and the control group with the Mann-Whitney *U* test. Effects of sex and age on total CVHI-10 score in both groups were evaluated using the Mann-Whitney *U* test and Spearman correlation respectively.

In order to evaluate the diagnostic accuracy of the Dutch CVHI-10, sensitivity and specificity were estimated by constructing the ROC curve. Area under the curve (AUC) results were interpreted as follows: $AUC \geq 0.90$ ‘high diagnostic accuracy’; $0.90 \geq AUC > 0.70$ ‘moderate

diagnostic accuracy'; AUC ≤ 0.70 'low diagnostic accuracy').[46] Based on this ROC curve, the optimal cut-off score could be determined to distinguish whether children perceive their voice as normal.

RESULTS

Demographic characteristics

In total, 77 children (37 boys and 40 girls) participated in this study. Mean age was 11.30 years (SD: 1.8) with a range of 8.0-14.5 years. The demographic characteristics of the dysphonic and the control group are shown in Table 2. Characteristics of vocal quality (grade (G) of GRBASI, DSI and AVQI) among the dysphonic participants (n = 30) are shown in Table 3. Almost all participants (90%, 27/30) in the dysphonic group were diagnosed with vocal fold nodules, except for one boy who was diagnosed with unilateral vocal fold paralysis, another boy with vocal fold edema and glottal insufficiency and one girl with muscle tension dysphonia. There was a significant difference in age between the dysphonic and the control group [U = 430; $P = 0.004$]. Children in the dysphonic group were younger than those in the control group. The chi-square test revealed a statistical significant difference in sex between the dysphonic and the control group [$c^2(1) = 12.584$; $P < 0.001$], with more boys in the dysphonic group.

TABLE 2.
Demographic Characteristics of the Dysphonic and Control Group

	Dysphonic group (n=30)	Control group (n=47)
age (years)		
mean (SD*)	10.53 (1.5)	11.79 (1.8)
median (IQR†)	10.53 (9.41-11.23)	11.96 (10.27-13.23)
min-max	8.1-13.9	8.0-14.5
sex (n)		
boys	22 (73%)	15 (32%)
girls	8 (27%)	32 (68%)

* standard deviation.
† interquartile range.

TABLE 3.
Characteristics of Vocal Quality Among Dysphonic Participants (n=30)

	G	DSI	AVQI
mean (SD)	1.60 (0.7)	-2.65 (2.9)	4.81 (1.5)
median (IQR)	2.00 (1.00-2.00)	-2.45 (-4.65-(-0.95))	4.93 (3.70-5.91)
min-max	1-3	-9.20-3.40	3.70-7.73

Reliability analysis

Concerning the internal consistency, a Cronbach's alpha coefficient of 0.745 was obtained for the ten items of the Dutch CVHI-10. To assess test-retest reliability, the questionnaire was completed twice with an interval of two weeks by 37,7% (29/77) of the children (22 children in the control group (22/47; 47%) and five children in the dysphonic group (5/30; 17%)). The ICC for the total group was 0.718 with a 95% confidence interval from 0.482 to 0.857. The ICC was 0.828 (95% CI [0.646, 0.922]) for the control group and -0.625 (95% CI [-1.471, 0.378]) for the dysphonic group. Mean total CVHI-10 score of the children who completed

the questionnaire twice was 2.72 (SD: 2.5) in the test condition and 2.52 (SD: 2.6) in the retest condition. The paired-samples Wilcoxon test did not show a significant difference in total CVHI-10 score between these two test moments [Z = -0.448; $P = 0.654$].

A closer look at the data revealed that the total CVHI-10 score for one dysphonic participant differed substantially between the test condition (total score: 11) and the retest condition (total score: 4). For two items, the answers changed from 'many times' to 'never' over a two-week period. A change in response that differed by more than one option was not observed in another participant. Exclusion of this participant resulted in an ICC of 0.810.

Validity analysis

Total CVHI-10 scores are presented in Table 4. A significant difference on the Mann-Whitney *U* test was found between the dysphonic goup and the control group for total CVHI-10 score in the test condition. Dysphonic children obtained significantly higher scores than non-dysphonic children [U = 1255.5; $P < 0.001$].

TABLE 4.
Total CVHI-10 Scores of the Dysphonic and Control Group

	Dysphonic group (n=30)	Control group (n=47)
mean (SD)	6.17 (2.7)	2.68 (2.6)
median (IQR)	6.0 (4.0-7.0)	2.0 (1.0-3.0)
min-max	3-15	0-13

Mann-Whitney *U* tests showed that there was no statistical significant difference in total CVHI-10 scores between boys and girls in the dysphonic group [U = 59.0; $P = 0.169$] or control group [U = 207.5; $P = 0.449$]. Spearman's correlations demonstrated that there was no statistical significant relationship between total CVHI-10 score and age in the dysphonic group [$\rho = -0.288$; $P = 0.123$] or control group [$\rho = 0.086$; $P = 0.567$].

Sensitivity and specificity

The ROC curve is illustrated in Figure 1. The AUC of total CVHI-10 score was calculated to be 0.869 ($P < 0.001$). The optimal cut-off score was determined to be 3.5 or above, with a sensitivity level of 86.7% and a specificity level of 76.6%.

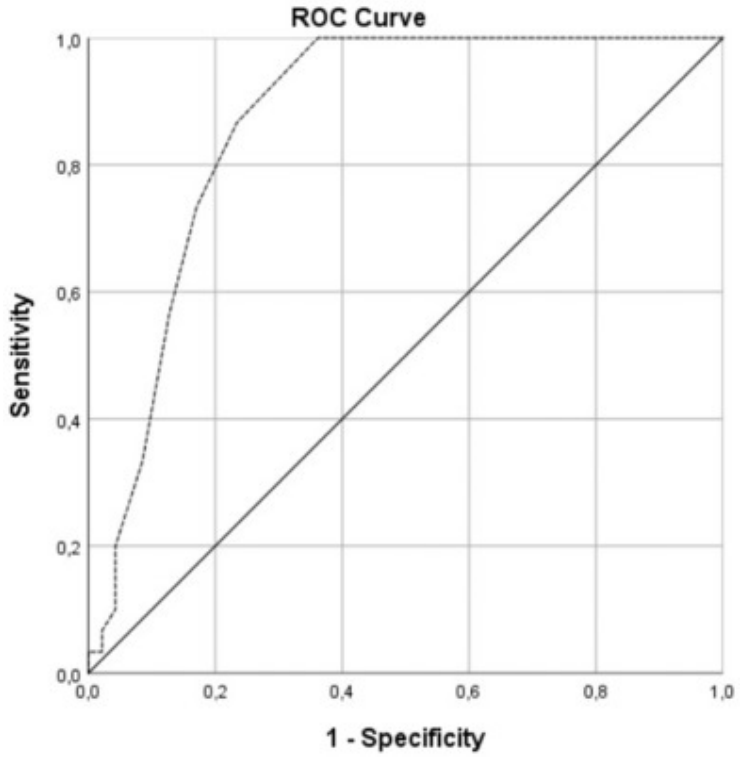

FIGURE 1. ROC curve analysis of Dutch CVHI-10.

DISCUSSION

The purpose of this study was to develop a Dutch version of the CVHI-10 and to check the validity and reliability of this translated tool. This is the first self-reported QoL tool for dysphonic children in the Dutch language area. The internal consistency of the Dutch CVHI-10 is good (Cronbach's $\alpha = 0.745$). This indicates that the different items on the CVHI-10 are likely to measure the same intended concept, which is the impact of the voice on children's well-being from their own perspective.[44] The internal consistency is slightly lower than in the original ($\alpha = 0.85$) and Turkish ($\alpha = 0.87$) version of the CVHI-10 and comparable to the Hong Kong Chinese version ($\alpha = 0.787$).

The test-retest reliability is moderate (ICC = 0.718) and no significant difference could be found between the test and retest condition, indicating that the Dutch CVHI-10 is a rather stable and repeatable tool. The test-retest reliability is good in the control group (ICC = 0.828) and poor in the dysphonic group (ICC = -0.625). However, the sample size of the dysphonic group that completed the questionnaire twice was very small (n = 5). Low sample sizes can result in negative reliability scores, so this result should be interpreted with caution.[47] It is also possible that dysphonic children experience an actual change in voice-related QoL over a 2 week period, due to varying voice requirements, the fluctuating nature of vocal symptoms, changes in lifestyle or the effects of voice therapy. It may be assumed that the voice-related QoL is more stable in the control group. In this group, test-retest reliability was good. For one participant, total CVHI-10 score differed substantially between the test and retest condition. This child may have experienced actual changes in his voice-

related QoL due to the reasons mentioned above. It is also possible that the child was unable to reliably reflect on the voice disorder. The test-retest reliability cannot be compared to the other versions of the CVHI-10 since they used a Pearson's r instead of an ICC (Italian version: Pearson's r = 0.84, Turkish version: Pearson's r: 0.973). The response rate for the retest was remarkably lower in the dysphonic group compared to the control group. One possible explanation is that children in the dysphonic group felt less involved in the study since they were recruited during a clinical consultation.

A significant difference in total CVHI-10 score is found between the dysphonic and the control group. This could be expected because pediatric dysphonia may have a negative impact on children's psychosocial well-being, like social and educational development, self-esteem, self-image and participation in school group activities.[48,49] This significant difference has also been reported in several studies on the VHI, pVHI and other versions of the CVHI-10.[30,38,39,50, 51, 52, 53, 54, 55, 56, 57] Furthermore, there was no significant age-effect or gender-effect in the dysphonic and control group, which is consistent with the findings for the Turkish CVHI-10.[39] It can be concluded that the Dutch CVHI-10 has a good construct validity, which is defined by Terwee, Bot, de Boer, van der Windt, Knol, Dekker, Bouter, de Vet[44] as "the extent to which scores on a particular instrument relate to other measures in a manner that is consistent with theoretically derived hypotheses concerning the concepts that are being measured."

The Dutch CVHI-10 seems to be a sensitive tool to identify voice disorders. The AUC (AUC = 0.869) showed that the Dutch CVHI-10 has a moderate diagnostic accuracy. A total score of 3.5 is determined as the optimal cut-off value in discriminating dysphonic and non-dysphonic children. However, a total score of 3.5 is not clinically possible so we recommend 'total score ≥ 4' as a clinical guideline. This cut-off score is slightly higher than that of the Turkish CVHI-10 (cut-off score = 2.5), comparable to the original CVHI-10 (cut-off score = 4) and remarkably lower than the Hong Kong Chinese CVHI-10 (cut-off score = 9). The difference in cut-off score could possibly be attributed to cultural differences in the perception towards or reporting of voice problems.[58,59] Similar to the other translations of the CVHI-10, no scaling for severity is provided in this study. Future research should determine anchors for severity of the CVHI-10.

This study makes an important contribution to the clinical care of Dutch pediatric voice patients. Until now, no Dutch instrument was available to investigate children's views on the consequences of their voice disorder. The Dutch CVHI-10 is the first self-reported tool to assess voice-related QoL in a Dutch pediatric population. It would be interesting to administer the CVHI-10 and the pVHI simultaneously because the comparison of these questionnaires may provide additional information and the perceptions of both children and parents may be taken into account when making clinical decisions. The CVHI-10 is a clinical useful instrument: it is easy to administer, not time-consuming and fast to interpret. Since the questionnaire takes no more than five minutes to complete and does not require adult supervision, it can be administered during a clinical consultation when a parent completes the pVHI. Although changes in CVHI-10 scores after the initiation of voice therapy were not examined in the current study, the CVHI-10 may also provide insight in the evolution of voice-related QoL after a period of voice therapy. Ideally, the score on the CVHI-10 decreases as therapy progresses, meaning that the child experiences less impact of the voice problem.

This study has some limitations. Firstly, almost all children in the dysphonic group were diagnosed with vocal fold nodules. Other vocal pathologies were not adequately represented in the study group.This is only a partially accurate representation of clinical reality, as vocal fold nodules account for 35% to 78% of all cases of pediatric dysphonia.[60, 61, 62, 63] Secondly, there was a significant difference in age and gender between the dysphonic and the control group. More boys were included in the dysphonic group, which is consistent with the prevalence rates of vocal fold nodules and dysphonia in general in a pediatric population.[4,61] This limitation could have been overcome by sex- and age-matching between the dysphonic and the control group. A further study with focus on balanced gender and age ratios and more variation in vocal pathologies is therefore suggested. Moreover, other uncontrolled factors may have influenced the results, such as reading skills, personality traits and the severity and duration of the voice problem. Finally, children in the control group were recruited via mail so their vocal quality was not tested by a clinician. It is possible that not all children in the control group had a perceptually normal voice.

Further research should be undertaken to investigate other types of validity. A comparison of the results on the pVHI and the CVHI-10 should be made in order to assess criterion validity. To test external validity, the correlation between CVHI-10 scores and a perceptual assessment should be calculated.

CONCLUSION

The Dutch CVHI-10 is the first self-reported voice-related QoL tool for Dutch-speaking children between eight and 14 years. The findings suggest that the CVHI-10 is a valid, reliable and sensitive tool to assess children's views on the impact of their voice disorder. A cut-off score of 3.5 was determined to distinguish between dysphonic and non-dysphonic children. Moreover, the questionnaire is easy to administer and quick to interpet. Therefore, it appears to be a user-friendly and useful tool for the self-assessment of dysphonic children.

DECLARATIONS OF INTEREST

None.

ACKNOWLEDGMENTS

This project was funded with the support of the Research Fund Flanders (3G069319).

REFERENCES

1. Stachler RJ, Francis DO, Schwartz SR, et al. Clinical practice guideline: hoarseness (dysphonia) (update). Otolaryngology−Head and Neck Surgery: Official Journal of American Academy of Otolaryngology-Head and Neck Surgery. 2018;158(1_suppl): S1–S42.

2. Duff MC, Proctor A, Yairi E. Prevalence of voice disorders in African American and European American preschoolers. Journal of Voice: official journal of the Voice Foundation. 2004; 18:348–353.

3. Mohammadzadeh A, Sandoughdar N. Prevalence of voice disorders in Iranian primary school students. Journal of Voice: official journal of the Voice Foundation. 2017;31. 263 e213-263 e218.

4. Carding PN, Roulstone S, Northstone K, Team AS. The prevalence of childhood dysphonia: a cross-sectional study. Journal of Voice: official journal of the Voice Foundation. 2006; 20:623–630.

5. Silverman E, Zimmer C. Incidence of chronic hoarseness among school-age children. Journal of Speech and Hearing Disorders. 1975; 40:211–215.

6. Kallvik E, Lindstrom E, Holmqvist S, et al. Prevalence of hoarseness in school-aged children. Journal of Voice: official journal of the Voice Foundation. 2015; 29:260. e261-219.

7. Pribuisiene R, Pasvenskaite A, Pribuisis K, et al. Dysphonia screening in vocally trained and untrained children. International journal of pediatric otorhinolaryngology. 2020;129: 109776.

8. Johnson CM, Anderson DC, Brigger MT. Pediatric dysphonia: a cross-sectional survey of subspecialty and primary care clinics. Journal of Voice: official journal of the Voice Foundation. 2020; 34: 301.e301−301.e305.

9. Tavares ELM, Brasolotto A, Santana MF, et al. Estudo epidemiológico de disfonias em crianças de 4 a 12 anos. Brazilian Journal of Otorhinolaryngology. 2011; 77:736–746.

10. Dejonckere P, Bradley P, Clemente P, et al. A basic protocol for functional assessment of voice pathology, especially for investigating the efficacy of (phonosurgical) treatments and evaluating new assessment techniques Guideline elaborated by the Committee on Phoniatrics of the European Laryngological Society (ELS). European Archives of Oto-Rhino-Laryngology. 2001; 258:77–82.

11. Oates J. Auditory-perceptual evaluation of disordered voice quality: pros, cons and future directions. Folia Phoniatrica et Logopaedica: official organ of the International Association of Logopedics and Phoniatrics (IALP). 2009; 61:49–56.

12. Hirano M. Clinical Examination of Voice. New York: Springer; 1981.

13. Dejonckere P, Crevier-Buchman L, Marie J-P, et al. Implementation of the European Laryngological Society (ELS) - Basic protocol for assessing voice treatment effect. Revue de laryngologie - otologie - rhinologie. 2003; 124:279–283.

14. Mortensen M, Schaberg M, Woo P. Diagnostic contributions of video-laryngostroboscopy in the pediatric population. Archives of Otolaryngology - Head and Neck Surgery. 2010;136(1):75–79.

15. Poburka BJ, Patel RR, Bless DM. Voice-vibratory assessment with laryngeal imaging (VALI) form: reliability of rating stroboscopy and high-speed video-endoscopy. Journal of Voice: official journal of the Voice Foundation. 2017; 31: 513.e511−513.e514.

16. Mornet E, Coulombeau B, Fayoux P, et al. Assessment of chronic childhood dysphonia. European Annals of Otorhinolaryngology, Head and Neck Diseases. 2014; 131:309–312.

17. Ramos PH, Alvarez ML, Leon NI, et al. Voice disorders in children: experience in the voice unit at universidad catolica clinical hospital. Journal of Voice: official journal of the Voice Foundation. 2022;36(2): 293.e1–293.e5.

18. Incebay O, Kose A, Esen Aydinli F, et al. The effects of age and gender on laryngeal aerodynamics in the children population. Journal of Voice: official journal of the Voice Foundation. 2020; 34:300. e327-300 e346.

19. Patel RR, Awan SN, Barkmeier-Kraemer J, et al. Recommended protocols for instrumental assessment of voice: American speech-language-hearing association expert panel to develop a protocol for instrumental assessment of vocal function. American journal of speech-language pathology. 2018; 27:887–905.

20. Campisi P, Tewfik T, Manoukian J, et al. Computer-assisted voice analysis. Archives of Otolaryngology - Head and Neck Surgery. 2002;128(2):156–160.

21. Heman-Ackah YD, Michael DD, Goding GS. The relationship between cepstral peak prominence and selected parameters of dysphonia. Journal of Voice. 2002; 16:20–27.

22. Demirci AN, Kose A, Aydinli FE, et al. Investigating the cepstral acoustic characteristics of voice in healthy children. International journal of pediatric otorhinolaryngology. 2021;148: 110815.

23. Maryn Y, Roy N, De Bodt M, et al. Acoustic measurement of overall voice quality: a meta-analysis. The Journal of the Acoustical Society of America. 2009; 126:2619–2634.

24. Black N. Patient reported outcome measures could help transform healthcare. BMJ (Clinical research ed). 2013; 346: f167.

25. Slavych BK, Zraick RI, Ruleman A. A systematic review of voice-related patient-reported outcome measures for use with adults. Journal of Voice: official journal of the Voice Foundation. 2021. In press.

26. Francis DO, Daniero JJ, Hovis KL, et al. Voice-related patient-reported outcome measures: a systematic review of instrument development and validation. Journal of Speech, Language, and Hearing Research: JSLHR. 2017; 60:62–88.

27. Hartnick C. Validation of the pediatric voice-related quality-of-life survey. Archives of Otolaryngology - Head and Neck Surgery. 2002; 128:919–922.

28. Hartnick CJ, Volk M, Cunningham M. Establishing normative voice-related quality of life scores within the pediatric otolaryngology population. Archives of Otolaryngology−Head & Neck Surgery. 2003; 129:1090–1093.

29. Boseley M, Cunningham M, Volk M, et al. Validation of the pediatric voice-related quality-of-life survey. Archives of Otolaryngology – Head and Neck Surgery. 2006; 132:717–720.

30. Zur KB, Cotton S, Kelchner L, et al. Pediatric Voice Handicap Index (pVHI): a new tool for evaluating pediatric dysphonia. International journal of pediatric otorhinolaryngology. 2007; 71:77–82.

31. Theunissen N, Vogels T, Koopman H, et al. The proxy problem: child report versus parent report in health-related quality of life research. Quality of Life Research. 1998; 7:387–397.

32. WHO. Programme on Mental Health: WHOQOL User Manual.1998.

33. Eiser C. Children's quality of life measures. Archives of Disease in Childhood. 1997; 77:350/354.

34. Cohen W, Wynne DM. Parent and child responses to the pediatric voice-related quality-of-life questionnaire. Journal of Voice: official journal of the Voice Foundation. 2015; 29:299–303.

35. Ricci-Maccarini A, De Maio V, Murry T, et al. Development and validation of the children's voice handicap index-10 for parents. Journal of Voice: official journal of the Voice Foundation. 2016; 30:120–126.

36. Verduyckt I, Morsomme M, Remacle M. Validation and standardization of the Pediatric Voice Symptom Questionnaire: a double-form questionnaire for dysphonic children and their parents. Journal of Voice: official journal of the Voice Foundation. 2012;26: e129–e139.

37. Ricci-Maccarini A, De Maio V, Murry T, et al. Development and validation of the children's voice handicap index-10 (CVHI-10). Journal of voice: official journal of the Voice Foundation. 2013; 27:258. e223-258 e228.

38. Kwong E. Cross-cultural adaptation and validation of the hong kong-chinese version of children's voice handicap index. Journal of voice: official journal of the Voice Foundation. 2020. In press.

39. Tadihan Ozkan E, Tuzuner A, Ciyiltepe M, et al. Reliability and validity of the Turkish children's voice handicap index-10 (TR-CVHI-10). International journal of pediatric otorhinolaryngology. 2017; 96:131–134.

40. Wild D, Grove A, Martin M, et al. Principles of good practice for the translation and cultural adaptation process for patient reported outcomes (PRO) measures: report of the ISPOR task force for translation and cultural adaptation. Value in Health. 2005; 8:94–104.

41. International Society for Pharmacoeconomics and Outcomes Research I. Available at: https://www.ispor.org/about/our-mission. Published 2022. Accessed.

42. Wuyts FL, De Bodt MU, Molenberghs G, et al. The dysphonia severity index: an objective measure of vocal quality based on a multiparameter approach. (2000) Journal Of Speech Language And Hearing Research.2000.

43. Maryn Y, Corthals P, Van Cauwenberge P, et al. Toward improved ecological validity in the acoustic measurement of overall voice quality: combining continuous speech and

sustained vowels. Journal of voice: official journal of the Voice Foundation. 2010; 24:540–555.

44. Terwee CB, Bot SD, de Boer MR, et al. Quality criteria were proposed for measurement properties of health status questionnaires. Journal of clinical epidemiology. 2007; 60:34–42.

45. Koo TK, Li MY. A guideline of selecting and reporting intraclass correlation coefficients for reliability research. Journal of Chiropractic Medicine. 2016; 15:155–163.

46. Swets J. Signal Detection Theory and ROC Analysis in Psychology and Diagnostics in: Collected Paperq. NY: Psychology Press; 1996.

47. Liljequist D, Elfving B, Skavberg Roaldsen K. Intraclass correlation - A discussion and demonstration of basic features. PloS one. 2019;14: e0219854.

48. Ma EP, Yiu EM, Abbott KV. Application of the ICF in voice disorders. Seminars in speech and language. 2007; 28:343–350.

49. Connor NP, Cohen SB, Theis SM, et al. Attitudes of children with dysphonia. Journal of voice: official journal of the Voice Foundation. 2008; 22:197–209.

50. Schindler A, Tiddia C, Ghidelli C, et al. Adaptation and validation of the Italian Pediatric Voice Handicap Index. Folia Phoniatrica et Logo-paedica: official organ of the International Association of Logopedics and Phoniatrics (IALP). 2011; 63:9–14.

51. Park SS, Kwon TK, Choi SH, et al. Reliability and validity of the Korean version of Pediatric Voice Handicap Index: in school age children. International journal of pediatric otorhinolaryngology. 2013; 77:107–112.

52. Shoeib RM, Malki KH, Mesallam TA, et al. Development and validation of the Arabic pediatric voice handicap index. International journal of pediatric otorhinolaryngology. 2012; 76:1297–1303.

53. Nawka T, Wiesmann U, Gonnermann U. [Validation of the German version of the Voice Handicap Index]. HNO. 2003; 51:921–930.

54. Hsiung M, Lu P, Kang B, et al. Measurement and validation of the voice handicap index in voice-disordered patients in Taiwan. The Journal of Laryngology & Otology. 2003;117(6):478–481.

55. Guimaraes I, Abberton E. An investigation of the Voice Handicap Index with speakers of Portuguese: preliminary data. Journal of voice: official journal of the Voice Foundation. 2004; 18:71–82.

56. Verdonck-de Leeuw IM, Kuik DJ, De Bodt M, et al. Validation of the voice handicap index by assessing equivalence of European translations. Folia Phoniatrica et Logopaedica: official organ of the International Association of Logopedics and Phoniatrics (IALP). 2008; 60:173–178.

57. Barsties B, De Bodt M. Assessment of voice quality: Current state-of-the-art. Auris, Nasus, Larynx. 2015; 42:183–188.

58. Krischke S, Weigelt S, Hoppe U, et al. Quality of life in dysphonic patients. Journal of Voice. 2005; 19:0–137.

59. Behlau M, Madazio G, Oliveira G. Functional dysphonia: strategies to improve patient outcomes. Patient Related Outcome measures. 2015; 6:243–253.

60. Hartnick C, Ballif C, De Guzman V, et al. Indirect vs direct voice therapy for children with vocal nodules: a randomized clinical trial. JAMA Otolaryngology− Head & Neck Surgery. 2018;144:

156–163.

61. Mudd P, Noelke C. Vocal fold nodules in children. Current opinion in otolaryngology & head and neck surgery. 2018; 26:426–430.

62. Van Houtte E, Van Lierde K, D'haeseleer E, et al. The prevalence of laryngeal pathology in a treatment seeking population with dysphonia. Laryngoscope. 2010; 120:306–312.

63. Martins RH, Ribeiro CBH, Mello BMZ, et al. Dysphonia in children. Journal of voice: official journal of the Voice Foundation. 2012; 26:674.

Appendices

A. Original English and Italian version of the CVHI-10[37]

1. People have difficulty hearing me because of my voice.

   La gente ha difficoltà a sentirmi a causa della mia voce.

2. People have difficulty understanding me in a noisy room.

   La gente ha difficoltà a capirmi in una stanza rumorosa.

3. My voice difficulties prevent me to stay with people.

   Le difficoltà della mia voce mi impediscono di stare con la gente.

4. I feel left out of conversations because of my voice.

   Mi sento escluso/a dalle conversazioni a causa della mia voce.

5. My voice difficulties reduce my school outcome.

   Le difficoltà della mia voce riducono i miei risultati a scuola.

6. I feel I have to strain to produce voice.

   Sento che devo fare sforzo per fare uscire la voce.

7. My voice is not light.

   La mia voce non è chiara.

8. My voice problem upsets me.

   Il mio problema di voce mi disturba.

9. My voice makes me feel inferior to other children or other boys.

   La mia voce mi fa sentire inferiore agli altri bambini o agli altri ragazzi.

10. People ask me ‘‘what's wrong with your voice?’’.

    La gente mi chiede ‘‘cosa c’è che non va nella tua voce?’’.

B. Forward translation 1 (IM)

1. Mensen hebben moeite om mij te horen omwille van mijn stem.

2. Mensen hebben moeite om mij te verstaan in een lawaaierige kamer.

3. Mijn stemproblemen verhinderen dat ik bij mensen blijf.

4. Ik voel me buitengesloten uit gesprekken omwille van mijn stem.

5. Door mijn stemproblemen verzwakken mijn schoolresultaten.

6. Ik heb het gevoel dat ik me moet inspannen om mijn stem te gebruiken.

7. Mijn stem is zwaar.

8. Mijn stemprobleem maakt me van streek.

9. Door mijn stem voel ik me minder dan andere kinderen.

10. Mensen vragen me: 'Wat is er mis met je stem?'

C. Forward translation 2 (ED)

1. Mensen horen me moeilijk door mijn stem.

2. Mensen begrijpen me moeilijk in een rumoerige ruimte.

3. Mijn stemproblemen verhinderen me om bij mensen te blijven.

4. Ik heb het gevoel dat ik buiten gesprekken gehouden word door mijn stem.

5. Mijn stemproblemen verslechteren mijn schoolresultaten.

6. Ik heb het gevoel dat ik me moet inspannen om mijn stem te gebruiken.

7. Mijn stem is niet helder.

8. Mijn stemprobleem stoort me.

9. Door mijn stem voel ik me minder dan andere kinderen.

10. Mensen vragen me "wat is er mis met je stem".

D. Merged Dutch version

1. Door mijn stem kunnen mensen mij moeilijk horen.

2. Mensen kunnen mijn moeilijk begrijpen in een lawaaierige kamer.

3. Mijn stemproblemen verhinderen dat ik bij mensen blijf.

4. Door mijn stem voel ik me buitengesloten uit gesprekken.

5. Door mijn stemproblemen verslechteren mijn schoolresultaten.

6. Ik heb het gevoel dat ik me moet inspannen om mijn stem te gebruiken.

7. Mijn stem is niet helder.

8. Mijn stemprobleem maakt me van streek.

9. Door mijn stem voel ik me minder waard dan andere kinderen.

10. Mensen vragen me: ‘Wat is er mis met je stem?’.

E. Backward translation

1. Because of my voice, people have difficulty hearing me.

2. People have difficulty understanding me in a noisy room.

3. My voice problems stop me from staying with people.

4. Because of my voice, I feel left out of conversations.

5. Because of my voice problems, my school results are getting worse.

6. I feel like I have to strain to use my voice.

7. My voice is not clear.

8. My voice problems make me upset.

9. Because of my voice, I feel less worthy than other children.

10. People ask me: “What is wrong with your voice?”

F. Final Dutch version of the CVHI-10

1. Door mijn stem kunnen mensen mij moeilijk horen.

   Nooit Soms Vaak Altijd

2. Mensen kunnen mij moeilijk begrijpen in een lawaaierige kamer.

   Nooit Soms Vaak Altijd

3. Mijn stemproblemen verhinderen dat ik bij mensen blijf.

   Nooit Soms Vaak Altijd

4. Door mijn stem voel ik me buitengesloten uit gesprekken.

   Nooit Soms Vaak Altijd

5. Door mijn stemproblemen verslechteren mijn schoolresultaten.

Nooit Soms Vaak Altijd

6. Ik heb het gevoel dat ik moeite moet doen om mijn stem te gebruiken.

Nooit Soms Vaak Altijd

7. Mijn stem is niet helder.

Nooit Soms Vaak Altijd

8. Mijn stemprobleem stoort me.

Nooit Soms Vaak Altijd

9. Door mijn stem voel ik me minder dan andere kinderen.

Nooit Soms Vaak Altijd

10. Mensen vragen me: ‘Wat is er mis met je stem?”

Nooit Soms Vaak Altijd