ISSN: 2083-389X
eISSN: 2084-3127

J Hear Sci, 2023; 13(1): 29–34
DOI: 10.17430/jhs/162074

VOICE QUALITY IN POLISH CHILDREN WITH VOCAL FOLD NODULES

Contributions:
A Study design/planning
B Data collection/entry
C Data analysis/statistics
D Data interpretation
E Preparation of manuscript
F Literature analysis/search
G Funds collection

Agata Szkiełkowska[A-G], Paulina Krasnodębska[EF], Karol Myszel[F]

Audiology and Phoniatrics, Institute of Physiology and Pathology of Hearing, Poland

Corresponding author: Paulina Krasnodębska, Audiology and Phoniatrics, Institute of Physiology and Pathology of Hearing, Mochnackiego 10, 02-042, Warsaw, Poland; email: p.krasnodebska@ifps.org.pl

Abstract

Background: Vocal fold nodules are a common cause of pediatric dysphonia. The aim of the study was to assess the acoustic structure of the voice in children with vocal fold nodules and investigate the relationship between objective and subjective measures.

Material and methods: The study group consisted of 223 children, aged 7 to 12 years with normal hearing. The control group included 213 children. All children underwent ENT and phoniatric examination including laryngovideostroboscopy (LVS), assessment of voice on the GRBAS perceptual scale, and acoustic analysis (spectrographic analysis using the Multi-Dimensional Voice Profile).

Results: In children with vocal fold nodules the average perceptual score for their voice was G1R1B0A0S2. No statistically significant effect of the child's sex or age on the values of the MDVP parameters was found. The acoustic structure of the voice of children with childhood dysphonia and vocal fold nodules differed significantly from the acoustic structure of those in the control group. A relationship between GRBAS features and MDVP analysis was found.

Conclusions: Voice acoustic analysis is a valuable tool for assessing voice quality in children. The analysis can identify deviations from normal values that the human ear is unable to pick up.

Key words: acoustic analysis • dysphonia • GRBAS • MDVP • vocal fold nodules • voice

JAKOŚĆ GŁOSU U DZIECI POLSKICH Z GUZKAMI GŁOSOWYMI

Streszczenie

Wprowadzenie: Guzki fałdów głosowych są częstą przyczyną dysfonii dziecięcej.

Cel: Celem pracy była ocena struktury akustycznej głosu dzieci z guzkami głosowymi oraz zbadanie zależności pomiędzy pomiarami obiektywnymi i subiektywnymi głosu.

Materiał i metody: Grupę badaną stanowiło 223 dzieci w wieku od 7 do 12 lat z prawidłowym słuchem. Grupę kontrolną stanowiło 213 dzieci. U wszystkich dzieci wykonano badanie laryngologiczne i foniatryczne obejmujące laryngowideostroboskopię (LVS), ocenę głosu w skali percepcyjnej GRBAS oraz analizę akustyczną (analiza spektrograficzna z zastosowaniem wieloparametrycznej oceny głosu – MDVP).

Wyniki: U dzieci z guzkami fałdów głosowych ocena percepcyjna głosu wynosiła średnio G1R1B0A0S2. Nie stwierdzono istotnego statystycznie wpływu płci i wieku dziecka na wartości parametrów MDVP. Struktura akustyczna głosu dzieci z dysfonią dziecięcą i guzkami fałdów głosowych różniła się istotnie od struktury akustycznej dzieci z grupy kontrolnej. Stwierdzono zależność między cechami GRBAS a analizą MDVP.

Wnioski: Analiza akustyczna głosu jest cennym narzędziem do oceny jakości głosu w populacji dziecięcej. Analiza identyfikuje odchylenia od wartości prawidłowych, których ucho ludzkie nie jest w stanie wychwycić.

Słowa kluczowe: analiza akustyczna • dysfonia • GRBAS • MDVP • guzki głosowe • głos

List of abbreviations

GRBAS	Scale of G-grade, R-roughness, B-breathiness, A-asthenia, and S-strain
LVS	laryngovideostroboscopy
MDVP	Multi-Dimensional Voice Profile

Introduction

Voice disorders in school children are often associated with abuse of the voice, e.g. speaking, singing, or shouting too loudly. Voice abuse occurs in about 45% of children [1]. The etiology of these disorders is not uniform, and sometimes children may produce their voice incorrectly because of psychogenic reasons [2,3].

Vocal fold nodules are a common cause of pediatric dysphonia. The authors believe that children 7–12 years old who have functional voice disorders usually have secondary changes in the form of vocal fold nodules, which give rise to chronic hoarseness [4]. The literature indicates that vocal fold nodules are common, occurring in nearly 60% of children [5–7], and changes in the voice are more often observed in boys than girls [2]. In childhood dysphonia, the way the voice is produced and its quality change [8,9]. To date, there has been little literature on voice disorders in Polish children. In this study, we aim to describe the characteristics of the most common pathology of children's voice – vocal fold nodules – in the Polish population.

The aim of this study was to assess the acoustic structure of voice in children with vocal fold nodules and examine its relationship to the GRBAS perceptual scale.

Material and methods

The study group consisted of 223 children, aged 7 to 12 years, with hyperfunctional dysphonia. There were 63 girls (28%) and 160 boys (72%). All children in the study group had normal hearing sensitivity and normal impedance audiometry. None were having voice therapy at the time of the study. The control group included 213 children, aged 7 to 12 years, with normal hearing and without voice or speech disorders; there were 120 girls (56%) and 93 boys (44%). None of the control group had present or past voice disorders. Children were included in the study only if their voice had not mutated.

In this prospective study, all children underwent otolaryngologic and phoniatric examination including laryngovideostroboscopy (LVS), assessment of the voice on the GRBAS perceptual scale, and acoustic analysis. Endoscopic examination of the larynx was performed through the nose using a Xion fiberscope of diameter 3.2 mm. Features of hyperfunctional dysphonia were recognized according to literature guidelines. Distinctive features of hyperfunctional dysphonia that can be observed by LVS are supraglottic hypertension, reduced open phase, reduced maximum amplitude, and elongated closed phase; similarly, a physical examination can reveal general muscle hypertension, thoracic breathing pattern, tight articulation pattern, and cervical tension [10,11]. The phoniatric examination included perceptive evaluation according to the GRBAS classification (G, grade; R, roughness; B, breathiness; A, asthenicity; S, strain) on a 4-step scale made independently by two practitioners (at least 2 of the authors) [2]. All patients underwent acoustic voice testing. Vocal samples were obtained during sustained emission of the vowel /a/ and analyzed using a KAY 4300B spectrograph and its multi-parametric voice analysis function (Multi-Dimensional Voice Profile, MDVP).

Statistical analysis was performed with Statistica 7.0 (Statsoft). Based on the collected qualitative data, the number and proportion of cases in the analyzed subgroups were determined. The variables were evaluated using a Pearson Chi-square independence test. If the expected number in each subgroup was less than 5, a Chi-square test with Yates correction was used. The quantitative variables were placed into tables giving means and standard deviations. A Shapiro–Wilk test was used to assess the homogeneity of variance in each subgroup. Depending on the results, further dependencies were tested using a Student's *t*-test for related and independent samples (if the results had a normal distribution), or a Wilcoxon pair order test or Mann–Whitney *U*-test (if the distribution was non-normal). When formulating conclusions from analyses using statistical tests, the threshold level of significance was $p < 0.05$.

This study received approval from the Bioethics Committee, document No. IFPS/KB/10/2010.

Results

In the LVS examination, excessively tense vocal folds were found in the study group, with visible bilateral vocal fold nodules located marginally in the middle third of the vocal folds. The nodules were edematous in all cases. The glottal gap during phonation in all children with vocal fold nodules was hourglass-shaped. In the LVS examination, a reduced amplitude of vocal fold vibrations was observed, with the regularity of vibrations disturbed. The mucosal wave was reduced and poorly visible in most of the examined children. The respiratory and phonation mobility of the vocal folds was preserved. The use of a flexible fiberscope for laryngoscopic and stroboscopic examination made it possible to assess the resting and phonation position at the level of the pharynx and ventricle of the larynx.

High muscle activity of the structures of the supraglottic region above the true vocal folds was observed, resulting in a reduction of space around the ventricle of the larynx and the inferior pharynx. In children with vocal fold nodules excessive adduction of ventricular folds dominated.

In the listening assessment conducted by the doctor during the examination, all children exhibited a mostly hoarse voice to a moderate degree. Most often the voice was formed with effort, had a hard vocal onset, and a high volume. The voice analysis on the GRBAS perceptual scale showed a statistically significant increase in the frequency of occurrence of each feature, with a severity greater than 0 observed for the voices of children with vocal fold nodules. **Table 1** shows the frequency of GRBAS parameter values in the group of children with vocal fold nodules compared with the control group. In terms of the severity of the disorders, it was most often light (degree 1), sometimes moderate (degree 2), and least often severe (degree 3) for each of the characteristics. The most distinguishing feature in the study group was the S-feature (strain), where severity 1, 2, or 3 was found in 97.4% of

Table 1. Incidence of GRBAS parameters in a group of 223 children with vocal fold nodules compared with a control group of 213 children

Parameter	Severity	Group with nodules		Control group	
		No	%	No	%
G	0	11	4.9	189	88.7
	1	179	80.3	24	11.3
	2	23	10.3	0	0
	3	10	4.8	0	0
R	0	45	20.2	148	69.5
	1	140	62.9	65	30.5
	2	30	13.5	0	0
	3	8	3.6	0	0
B	0	174	78.0	193	90.6
	1	48	21.5	19	8.9
	2	1	0.4	1	0.5
	3	0	0	0	0
A	0	182	81.6	201	94.4
	1	33	14.8	12	5.6
	2	8	3.6	0	0
	3	0	0	0	0
S	0	6	2.7	140	65.7
	1	64	28.7	72	33.8
	2	123	55.2	1	0.5
	3	30	13.5	0	0

the group. The G-feature (grade of hoarseness) was disturbed in 95.4%, and the R-feature (roughness) was non-zero in 80.0%. The average score for children with vocal fold nodules was G1R1B0A0S2.

From the acoustic tests, parameters and graphic images of the multi-parametric voice analysis (MDVP) were obtained. **Table 2** shows the acoustic parameters assessing the physical characteristics of the voice which are significant from a clinical point of view. Statistical analysis showed that the child's sex was not statistically significant for any parameter, and the same was true of age.

Next, the values of the DVB, DSH, and DUV parameters were compared. In healthy voices these values do not exceed 0 [12]. **Table 3** shows the number and percentage of normal and abnormal results for the DVB, DSH, and DUV tests. For each of these parameters, there was a statistically significant increase in the frequency of abnormal results (> 0) in the group of children with dysphonia and concomitant vocal fold nodules. The highest number of abnormal results was observed for the DSH parameter, which assesses the subharmonic components in the voice.

The results of the objective voice tests show that the acoustic structure of the voices of children with childhood dysphonia and vocal fold nodules differed significantly from that of children from the control group. The largest statistically significant differences concerned those parameters describing frequency disturbances (JitT, RAP, PPQ, sPPQ, vF0), which were notably higher in the study group, as shown in **Table 2**, where $p < 0.01$. Similar differences ($p < 0.01$) were found in the parameters NHR and VTI which describe the occurrence of noise in the analyzed signal. For FTRI, the voice tremor parameter, and APQ, the parameter that describes the short-term disturbance of the voice amplitude from cycle to cycle, p-values were < 0.05.

The next step was to look for relationships between GRBAS features and the voice acoustic parameters. For the G-feature, describing the grade of hoarseness, relationships ($r = 0.86$; $p < 0.05$) were found between the first degree of severity, G1, and the vF0 parameter, as well as between G1 and parameters describing amplitude disturbances (APQ, sAPQ, vAm). For the second degree of severity, G2, there was an even stronger relationship ($p < 0.01$) between it and all parameters describing the physical features of the voice. However, statistical significance was not observed for SPI (soft phonation index) or ATRI (amplitude tremor intensity index).

The R-feature, describing voice roughness, correlated ($r = 0.83$; $p < 0.05$) with parameters describing relative changes in frequency (Jitt, RAP, PPQ, sPPQ, vF0), with amplitude parameters (APQ, sAPQ), with the NHR noise parameter, and with the voice tremor parameter FTRI. Increases in severity of the R-feature did not affect the level of correlation.

Table 2. Average and standard deviation of acoustic parameters (MDVP) for the control group and the study group. Threshold of significance was $p < 0.05$

Voice parameter	Control group		Study group with nodules		*p*-value
	$\bar{X}$	SD	$\bar{X}$	SD	
Fo Average fundamental frequency (Hz)	265.87	22.99	263.62	26.72	> 0.05
Fhi Highest fundamental frequency (Hz)	266.36	21.25	293.45	39.17	< 0.01
Flo Lowest fundamental frequency (Hz)	257.98	22.97	240.84	30.66	< 0.01
STD Standard deviation (Hz)	4.19	1.47	5.49	2.71	< 0.01
Jita Absolute jitter	26.53	11.12	47.83	21.67	< 0.01
Jitt Jitter (%)	0.71	0.48	1.42	0.81	< 0.01
RAP	0.45	0.21	0.82	0.45	< 0.01
PPQ	0.39	0.21	0.82	0.48	< 0.01
sPPQ	0.56	0.19	0.91	0.50	< 0.01
vFo	1.95	0.79	2.10	0.90	> 0.05
ShdB	0.55	0.18	0.61	0.19	< 0.05
Shim	5.27	1.43	5.17	1.45	> 0.05
APQ	3.89	1.17	4.94	1.80	< 0.01
sAPQ	5.03	1.52	5.65	1.51	< 0.01
vAM	16.70	7.10	18.18	6.66	< 0.05
NHR	0.16	0.03	0.18	0.05	< 0.01
VTI	0.08	0.03	0.10	0.04	< 0.01
SPI	4.47	2.49	4.26	2.11	> 0.05
FTRI	0.54	0.36	0.75	0.49	< 0.05
ATRI	4.11	3.26	5.46	3.23	< 0.05

Table 3. Frequency (%) of normal and abnormal results for the control and research groups, divided according to whether the children had or did not have nodules. Bold figures indicate a statistically significant ($p < 0.05$) greater number of abnormal results

Test	Result	Control group		Group with nodules	
		No	%	No	%
DVB	normal	143	94.1	192	86.1
	abnormal	9	5.9	31	**13.9**
DSH	normal	126	82.9	140	62.8
	abnormal	26	17.1	83	**37.2**
DUV	normal	134	88.2	152	68.2
	abnormal	18	11.8	71	**31.8**

The B-feature, which describes a breathy voice resulting from exhalation of air through the opened glottis, showed no correlation with any parameter determining the physical characteristics of the voice, at least when the degree of severity was slight (B1). However, with an increase in the severity of the disorder to B2, there was a significant correlation ($r = 0.51$; $p < 0.05$) with parameters describing the relative change in frequency (Jitt, RAP, PPQ, sPPQ, vF0), amplitude (RAP, APQ, sAPQ, vAm), and the VTI parameter (an indicator of turbulence in the voice).

The A-feature, describing a weak, asthenic voice, showed a slight correlation ($r = 0.34$; $p \leq 0.01$) with an A1 level of severity in relation to the VTI parameter; however, with an increase in severity to A2, no correlation was observed with any acoustic parameter.

The S-feature, describing a strained, hyperfunctional voice showed a relationship with the SPI ($r = -0.81$; $p < 0.01$) and FTRI ($r = 0.79$; $p < 0.05$) parameters when there was a slight degree of severity (S1). Increasing the severity level to S2 gave a correlation ($r = 0.77$; $p < 0.05$) with all groups describing physical features of the voice (i.e., parameters assessing relative changes in frequency, amplitude, noise, tremor, pauses, irregularities, and subharmonics in the voice).

In summary, the features that correlated most strongly with the acoustic parameters in children with vocal fold nodules were the G-feature, which determines the degree of hoarseness, the R-feature, which assesses the roughness in the voice, and the S-feature, which describes a tense, spastic voice.

Discussion

The experience of many authors in everyday clinical practice, including ourselves, is that there is a growing problem of children with voice disorders [13]. A survey conducted in Poland has shown that 12.8% of children aged 7–12 had voice disorders [14]. This percentage represents a significant problem not only medically, but also socially and educationally. In the opinion of the authors, this problem requires screening and monitoring.

The novelty of this study is the characterisation of the voice of Polish children with vocal nodules from within a large group of early school-age children. The research conducted here, and in the literature, demonstrate that diagnosing and treating the voice of a child needs to be done differently than in an adult [15–17]. Children have different anatomical structures and environmental factors; they also differ in terms of maturation of the central nervous system and psychological profiles, and one must consider the huge role of emotional and cognitive factors at this age. Fundamentally, the acoustics of voice formation occur in children under different conditions than in adults. The results obtained in the present study show that acoustic parameters describing the physical features of the child's voice differ from the results standardized for adults. Therefore, normative results for school-age children are required; only then will we have a reliable basis for comparing children's voices in various types of pathology [18,19].

If one uses common values of acoustic parameters for children and adults, it is possible to misinterpret the acoustic structure of the voice, not only in the case of vocal nodules but also in other diseases. In the present work, differences for each age group within the studied age range were not statistically significant; therefore we averaged all values to establish normative values for healthy children aged 7 to 12. Our results of acoustic analysis for children from the control group accord with results from other researchers [20,21]. Moreover, the results for Polish children with dysphonia showed similar trends to those described in the literature for pediatric populations of other nationalities [22,23]. The children with dysphonia had significantly higher parameter values than those of healthy children, especially for parameters describing frequency and amplitude disturbances and parameters describing the presence of noise components.

The results of our work suggest that determining relationships between subjective and objective features of the voice might allow one to determine characteristic voice profiles for each childhood disease. Such conclusions were also reached by Fujiki [24]. We conclude that acoustic examination is a valuable tool in diagnosing voice disorders and a valuable supplement to subjective assessment of voice quality, especially during therapy and rehabilitation. In the authors' opinion, the assessment can also be useful in screening children's voices.

Conclusions

Hyperfunctional phonation in children with vocal fold nodules creates disturbance of their voice quality. The acoustic structure of the voice of school children with vocal fold nodules differs significantly from that of healthy children. The use of acoustic analysis in children requires reference values specific to the pediatric population. Development of references values for children is a valuable tool for assessing voice quality, especially in treatment and rehabilitation of the voices of Polish children. In the perceptual evaluation test, an increase in the degree of voice dysfunction is accompanied by a strong increase in acoustic features of the voice. Simultaneous objective and subjective assessment of the voice is a sensitive indicator of changes in voice quality in children with pathology of the larynx.

Conflicts of Interest

The authors report no conflicts of interest related to this research.

Compliance with Ethical Standards – Research Involving Human Participants and/or Animals

The experimenters received approval from the institutional bioethical committee before recruiting participants and beginning the study. Informed consent was obtained from a parent prior to data collection.

References

1. Szkiełkowska A, Miaśkiewicz B. Application of listening and auditory lateralization tests in dysphonic children. Otorynolaryngologia – przegląd kliniczny, 2014; 13(3): 139–46.
2. Krasnodębska P, Szkiełkowska A, Rosińska A, Skarżyński H. The Polish version of the Pediatric Voice Handicap Index (pVHI). J Pediatr ORL, 2020; 138: 110278. https://doi.org/10.1016/j.ijporl.2020.110278

3. Martins R, Ribeiro C, de Mello B, Branco A, Tavares E. Dysphonia in children. J Voice, 2012; 26(5): 674.e17–674.e20. https://doi.org/10.1016/j.jvoice.2012.03.004
4. Swain S, Nahak B, Sahoo L, Munjal S, Sahu M. Pediatric dysphonia: a review. Indian J Child Health, 2019; 6(1): 1–5. https://doi.org/10.32677/IJCH.2019.V06.I01.001
5. Rojas S, Kefalianos E, Vogel A. How does our voice change as we age? A systematic review and meta-analysis of acoustic and perceptual voice data from healthy adults over 50 years of age. J Speech Lang Hear Res, 2020; 63(2): 533–51. https://doi.org/10.1044/2019_JSLHR-19-00099
6. Schiff CS. Pediatricians' proficiency in the care of the dysphonic child. Laryngoscope, 2019; 129(8): 1756–62. https://doi.org/10.1002/lary.27577
7. Al-Kadi M, Alfawaz M, Alotaibi F. Impact of voice therapy on pediatric patients with dysphonia and vocal nodules: a systematic review. Cureus, 2022; 4(4): e24433. https://doi.org/10.7759/cureus.24433
8. Hoffmann CF, Cielo CA. Characteristics of the voice of dysphonic school children from 4:0 to 7:11 years old. J Voice, 2021; 35(4): 664.e11. https://doi.org/10.1016/j.jvoice.2019.12.004
9. Pribuisiene R, Pasvenskaite A, Pribuisis K, Balsevicius T, Liutkevicius V, Uloza V. Dysphonia screening in vocally trained and untrained children. Int J Pediatr Otorhinolaryngol, 2020; 129: 109776. https://doi.org/10.1016/j.ijporl.2019.109776
10. Hegazi M, Neumann K, Rosenfeld J. Prevention of developmental disorders of speech and language. In: Zehnhoff-Dinnesen A, Wiskirska-Woznica B, Neumann K, Nawka T, editors, Phoniatrics I. Berlin: Springer; 2020, 713–24.
11. Szkiełkowska A, Krasnodębska P, Mitas A, Bugdol M, Bugdol M, Romaniszyn-Kania P, et al. Electrophysiological predictors of hyperfunctional dysphonia. Acta Otolaryngol, 2023; 143(1): 56–63. https://doi.org/10.1080/00016489.2022.2162961
12. Christmann M, Brancalioni A, Freitas C, Vargas D, Keske-Soares M, Mezzomo C, et al. Use of the program MDVP in different contexts: a literature review. Revista CEFAC, 2015; 17(4): 1341–9. https://doi.org/10.1590/1982-021620151742914
13. Tavares E, Brasolotto A, Santana M, Padovan C, Martins R. Epidemiological study of dysphonia in 4–12-year-old children. Braz J Otorhinolaryngol, 2011; 77: 736–46. https://doi.org/10.1590/S1808-86942011000600010
14. Szkiełkowska A, Miaśkiewicz B, Gos E, Skarżyński P, Świerniak W. Voice disorders in children starting school education. Otolaryngol Pol, 2020; 74(6): 16–20. https://doi.org/10.5604/01.3001.0014.1613
15. Campisi P. Computer-assisted voice analysis: establishing a pediatric database. Arch Otolaryngol Head Neck Surg, 2002; 128(2): 156–60. https://doi.org/10.1001/archotol.128.2.156
16. Spazzapan EA, Cardoso VM, Fabron EMG, Berti LC, Brasolotto AG, Marino VCC. Acoustic characteristics of healthy voices of adults: from young to middle age. Codas, 2018; 30(5): e20170225. https://doi.org/10.1590/2317-1782/20182017225
17. Szkiełkowska A, Krasnodębska P, Miaśkiewicz B. Assessment of auditory processing in childhood dysphonia. Int J Pediatr Otorhinolaryngol, 2022; 155: 111060. https://doi.org/10.1016/j.ijporl.2022.111060
18. Lee Y, Kim G, Sohn K, Lee B, Lee J, Kwon S. The usefulness of auditory perceptual assessment and acoustic analysis as a screening test for voice problems. Folia Phoniatr Logop, 2021; 73(1): 34–41. https://doi.org/10.1159/000504220
19. Li G, Hou Q, Zhang C, Jiang Z, Gong S. Acoustic parameters for the evaluation of voice quality in patients with voice disorders. Ann Palliat Med, 2021; 10(1): 130–6. https://doi.org/10.21037/apm-20-2102
20. Kent RD, Eichhorn JT, Vorperian HK. Acoustic parameters of voice in typically developing children ages 4–19 years. Int J Pediatr Otorhinolaryngol, 2021; 10; 142: 110614. https://doi.org/10.1016/j.ijporl.2021.110614
21. Brockmann-Bauser M, Beyer D, Bohlender JE. Reliable acoustic measurements in children between 5;0 and 9;11 years: gender, age, height and weight effects on fundamental frequency, jitter and shimmer in phonations without and with controlled voice SPL. Int J Pediatr Otorhinolaryngol, 2015; 79(12): 2035–42. https://doi.org/10.1016/j.ijporl.2015.09.005
22. Aydinli F, Özcebe E, Incebay Ö. Use of cepstral analysis for differentiating dysphonic from normal voices in children. Int J Pediatr Otorhinolaryngol, 2019; 116: 107–13. https://doi.org/10.1016/j.ijporl.2018.10.029
23. Johnson C, Anderson D, Brigger M. Pediatric dysphonia: a cross-sectional survey of subspecialty and primary care clinics. J Voice, 2020; 34(2): 301.e1–301.e5. https://doi.org/10.1016/j.jvoice.2018.08.017
24. Fujiki R, Thibeault S. The relationship between auditory-perceptual rating scales and objective voice measures in children with voice disorders. Am J Speech Lang Pathol, 2021; 30(1): 228–38. https://doi.org/10.1044/2020_AJSLP-20-00188