Correlation between the Arabic Pediatric Voice Related Quality of Life, the auditory perceptual assessment, and acoustic analysis of voice in dysphonic children

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Context
Dysphonia affects children's lives badly. An Arabic translation of Pediatric Voice Related Quality of Life (APVRQOL) was created. It is a reliable assessment questionnaire.
Aim
The aim was to determine the relationship among APVRQOL, subjective, and objective voice assessment in childhood dysphonia.
Settings and design
It is an observational case–control study.
Patients and methods
The study included 130 children divided into two groups: patient group: 65 dysphonic children and the control group: 65 children without vocal complaints. Auditory perceptual assessment of participant's voice and acoustic voice analysis was done in addition to an APVRQOL form to fill in.
Statistical analysis used
SPSS, version 20 was applied. Comparison tests were used: χ^2 test for categorical data and independent-sample *t* test for quantitative data. Correlation between the abnormally distributed data has been done by Spearman's correlation coefficient.
Results
The results showed that the control group has higher mean scores of all domains of APVRQOL than those of the patient group with more affected quality of life. Also, there was a significant negative correlation among the items of auditory perceptual assessment in addition to those of APVRQOL. Also, a significant negative correlation was observed between jitter and both the total APVRQOL and physical–functional domains.
Conclusions
APVRQOL form is an applicable tool for assessment of dysphonia's effect on quality of life of youngsters.

Keywords:
Arabic Pediatric Voice Related Quality of Life, children, Computerized Speech Lab, dysphonia, GRBAS scale

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Introduction

Dysphonia is any disruption of voice function [1]. The range of childhood dysphonia is between 6 and 23% [2]. Change of voice may negatively affect all aspects of a child's life [3]. An Arabic form of Pediatric Voice Related Quality of Life (APVRQOL) was developed for children with age range from 2 to 18 years [4]. The present study aims to assess the correlation between APVRQOL with subjective and objective voice-assessment measures in children. It is essential for examining the influence of dysphonia on children's lives and giving an effective treatment plan for them.

Patients and methods

Ethics

Before initiating the study, an approval from the Ethics Committee of Faculty of Medicine of Assiut University was obtained. IRB number 17100290.

Study design

An observational case–control study was carried out during the period from November 2017 to November 2018.

Patients

The study was conducted in two groups: patient group consisted of 65 dysphonic cases and the control group consisted of 65 children without vocal or any physical

complaints. They were recruited from the relatives of the studied children at Phoniatric Unit, Assiut University Hospital, attending a clinic as an outpatient and matched to the study group for age, sex, and socioeconomic state.

Individual selection criteria are:

(1) Inclusion criteria:
   (a) Age: from 6 to 18 years.
   (b) Sex: both sexes were involved in the work.
   (c) The patient group has dysphonia due to functional or minimal associated pathological lesions (MAPLs).
(2) Exclusion criteria:
   (a) Presence of other chronic illnesses affecting their quality of lives.
   (b) Mental retardation.
   (c) Dysphonia due to organic voice disorders.

Methods

All participants performed the next protocol of evaluation [1]:

(1) Elementary diagnostic procedure:
   (a) Personal history, complaints, and analysis of symptoms.
   (b) Auditory perceptual assessment (APA) of voice for spontaneous and automatic speech. A modified GRBAS scale by three expert phoniatricians was used for evaluation of the APA.
   (c) General and full ENT examination.
(2) Clinical diagnostic aids:
   (a) Visual documentation and augmentation: laryngoscopic examination was performed using a rigid 90° laryngoscope (Explorant Gyrus, ACMI, Tuttlingen, Germany) and a flexible fiber-optic laryngoscope (Karl Storz) connected to a monitor (STORZ tele pack X LED) and camera (telecam PAL).
(3) Additional instrumental aids:
   (a) Acoustic assessment: using Computerized Speech Lab (CSL) (version 4300; Kay Elemetric Corporation, Lincoln Park, New Jersey, USA) to get fundamental frequency, frequency perturbation, amplitude perturbation, and harmonic to noise ratio (HNR). Those measures had been receiving the usage of a microphone placed ~10 cm from the player's mouth at a suitable tone and loudness levels, he required to produce a sustained vowel/a

Usage of Arabic translation of Pediatric Voice Related Quality of Life

An APVRQOL questionnaire becomes applied to children aging 12 years and above or their parents before clinical voice assessment. It has 10 items and two domains with questions 4, 5, 8, and 10 for the social–emotional domain and questions 1, 2, 3, 6, 7, and 9 for the physical–functional domain. The total result of the APVRQOL was from 0 to 100, the higher the scores, the good VRQOL and vice versa [4].

Statistical analysis

Data analysis has been evaluated by SPSS model 20 IBM SPSS (IBM Corp., Armonk, New York, USA). Categorical data have been offered such as number and percent. Numerical data were offered like mean and SD. Comparisons were made using χ^2 test and independent-sample t test. The correlation tests were conducted using Spearman's correlation coefficient to correlate between an abnormally distributed data and different parameters. The statistical differences were considered significant when P was lower than 0.05.

Results

One hundred and thirty children with age ranges from 6 to 18 years were selected to participate in this work and were sectioned into two groups:

Patient group (total 65) consisted of 34 (52.3%) boys and 31 (47.7%) girls with mean age 10.95 years. Fifty-five of them (84.6%) were diagnosed with hyperfunctional childhood dysphonia and 10 (15.4%) were diagnosed with MAPLs. Control group (total 65) consisted of 35 (53.8%) boys and 30 (46.2%) girls with mean age 10.17 years.

On data analysis, we found that:

(1) On comparison between the patient and control groups regarding the APVRQOL for:
   (a) The total group: there have been highly statistically significant distinctions among them concerning the total APVRQOL, social, emotional, and physical–functional domains (Table 1).
   (b) Male and female subgroups: no statistical significant difference among them in both groups. By way of a closer observed data, the means of all domains of APVRQOL were higher in males than females in the dysphonic group; however, they were raised in females than males for the control group (Table 2).
(2) On comparison between the patient and control groups regarding APA for:
   (a) The total group: there have been highly statistically significant variations between them regarding the overall grade of

Table 1 Comparison between patient and control groups regarding Arabic translation of Pediatric Voice Related Quality of Life

	Patient group (*n*=65) (mean±SD)	Control group (*n*=65) (mean±SD)	*P**
Total APVRQOL	58.46±22.45	92±13.13	<0.001†
Social-emotional	27.27±11.5	38.19±5.44	<0.001†
Physical-functional	31.81±12.66	53.65±9.86	<0.001†

APVRQOL, Arabic translation of Pediatric Voice Related Quality of Life. **P* value for independent-samples *t* test. †Highly statistically significant difference (*P*<0.01).

Table 2 Comparison between males and females of patient and control groups regarding Arabic translation of Pediatric Voice Related Quality of Life

	Patient group (*n*=65) (mean±SD)			Control group (*n*=65) (mean±SD)		
	Male	Female	*P*	Male	Female	*P**
Total APVRQOL	60.96±19.52	55.73±25.32	0.352	90.14±15.46	94.17±9.54	0.221
Social-emotional	29.49±10.42	24.84±12.28	0.104	37.79±6.75	38.67±3.39	0.519
Physical-functional	32.06±11.6	31.53±13.91	0.869	52.07±11.83	55.5±6.64	0.164

APVRQOL, Arabic translation of Pediatric Voice Related Quality of Life. **P* value for independent-samples *t* test.

Table 3 Comparison between the patient and control groups regarding auditory perceptual assessment

	Patient group (*n*=65) (mean±SD)	Control group (*n*=65) (mean±SD)	*P**
Overall grade of dysphonia	2.03±0.68	0±0	0.000†
Strained	1.74±0.73	0±0	0.000†
Leaky	1.34±0.82	0±0	0.000†
Irregular	0.38±0.6	0±0	0.000†
Breathy	0.05±0.37	0±0	0.321

**P* value for independent-samples *t* test. †Highly statistically significant difference (*P*<0.01).

dysphonia, strained, leaky, and irregular characters (Table 3).

(b) Male and female subgroups of the patient group: a statistical significant difference among them concerning the leaky character of APA. The other parameters indicated that males had a higher degree of dysphonia and more strained voice than females, although the differences were not significant (Table 4).

(3) On comparison between patient and control groups concerning the acoustic characters for:

(a) Total group: a statistically considerable difference among the two groups regarding jitter. Moreover, regarding HNR, a greater statistically significant distinction was noticed (Table 5).

(b) Male and female subgroups: no statistically significant differences among sex subgroups of the patient group, but still males have a higher average pitch, jitter, and shimmer values with less HNR than females. However, there were highly statistically significant differences between sex subgroups of the control group regarding HNR (Table 6).

(4) On correlation between the APVRQOL and APA characters of the patient group: there has been a mild significant negative correlation among the overall grade of dysphonia in addition to each domain of APVRQOL (the total and social–emotional). Also, a moderate significant negative correlation between it and the physical–functional domain was found. As regards strained character, there was a mild significant negative correlation among it along with all domains of APVRQOL (Table 7).

(5) Correlation between the APVRQOL domains and acoustic parameters of the patient group: showed a mild negative significant correlation between jitter in addition to both total APVRQOL and physical–functional domains (Table 8).

Table 4 Comparison between males and females of the patient group regarding auditory perceptual assessment

	Patient group (mean±SD)		
	Male	Female	*P**
Overall grade of dysphonia	2.06±0.65	2±0.73	0.732
Strained	1.85±0.78	1.61±0.67	0.191
Leaky	1.56±0.75	1.1±0.83	0.021†
Irregular	0.29±0.52	0.48±0.68	0.215
Breathy	0±0	0.1±0.54	0.325

**P* value for independent-samples *t* test. †Statistically significant difference (*P*<0.05).

Discussion

This work aimed to find the correlation among APVRQOL, APA, and voice acoustic measures for childhood dysphonia because of the functional or MAPL causes. A greater proportion of our cases were diagnosed with hyperfunctional childhood dysphonia. Angelillo *et al*. [5] reported that hyperfunctional childhood dysphonia with vocal fold nodules is the majority of reasons of childhood

dysphonia [6], it was in line with the finding of our work.

Comparison between the patient and control groups regarding APVRQOL revealed a statistically widespread distinction among the two groups regarding all domains of APVRQOL. This significant difference occurred as a result of apparent physical alterations to the vocal mechanism, which means poor quality of life of the patient group. Zaki *et al.* [4] found highly significant differences in the score of all domains of APVRQOL in dysphonic cases compared with nondysphonic ones, which is harmonious with the finding of this study.

Table 5 Comparison between the patient and control groups regarding the acoustic parameters

	Patient group (mean±SD)	Control group (mean±SD)	*P**
Average pitch	260.39±328.97	223.4±43.06	0.370
Jitter	2.19±1.16	1.71±1.07	0.014†
Shimmer	1.2±1.32	1.06±1.42	0.565
HNR	−0.38±4.18	2±3.12	<0.001‡

HNR, harmonic to noise ratio. **P* value for independent-samples *t* test. †Statistically significant difference (*P*<0.05). ‡Highly statistically significant difference (*P*<0.01).

We noticed that the mean scores of the social–emotional domain of APVRQOL of the patient group were less than that of the physical–functional domain, indicating that children have a somewhat high perception of expressing the emotional effect of the voice more than the physical–functional effect. This finding was predicted as they are not vocational voice users [7]. Another explanation is that the parents have a propensity to overestimate the volume to which their youngsters may be emotional by their voice disorders.

The results of comparison between sex subgroups of both groups reflected no significant differences regarding all domains of APVRQOL. This was consistent with the observations by Sabir *et al.* [8] and by Blumin *et al.* [9]. A closer look at the data revealed that the mean scores of all domains of APVRQOL were higher in males than females in the dysphonic group, indicating better quality of life in males more than females.

This finding may be explained by differences in female and male physiology, sociology, and even philosophy. That is in step with the overall scientific literature, which points that females are much more likely to experience emotional troubles, especially when there

Table 6 Comparison between males and females of the patient and control groups regarding the acoustic parameters

	Study group (mean±SD)			Control group (mean±SD)		
	Male (*n*=34)	Female (*n*=31)	*P**	Male (*n*=35)	Female (*n*=30)	*P**
Average pitch	223.71±45.66	217.82±36.36	0.569	221.57±41.29	225.54±45.64	0.714
Jitter	2.33±1.27	2.04±1.02	0.324	1.88±1.33	1.5±0.62	0.157
Shimmer	1.31±1.57	1.08±1	0.499	0.94±1.09	1.20±1.74	0.4968
HNR	−0.59±3.82	−0.14±4.59	0.663	0.98±3.27	3.19±2.49	0.004†

HNR, harmonic to noise ratio. **P* value for independent-samples *t* test. †Highly statistically significant difference (*P*<0.01).

Table 7 Correlation between the Arabic translation of Pediatric Voice Related Quality of Life and auditory perceptual assessment characters of the patient group

	Total APVRQOL		Social-emotional		Physical-functional	
	r_s*	*P*	r_s*	*P*	r_s*	*P*
Overall grade of dysphonia	−0.373	0.002‡	−0.268	0.031†	−0.402	0.001‡
Strained	−0.372	0.002‡	−0.335	0.006‡	−0.333	0.007‡
Leaky	−0.196	0.118	−0.184	0.143	−0.201	0.108
Irregular	−0.137	0.276	−0.151	0.231	−0.068	0.592
Breathy	−0.093	0.459	−0.068	0.592	−0.137	0.277
Pitch	−0.144	0.251	−0.058	0.644	−0.173	0.168

APVRQOL, Arabic translation of Pediatric Voice Related Quality of Life. *r_s: Spearman coefficient. †Significant correlation at *P*<0.05. ‡Highly significant correlation at *P*<0.01.

Table 8 Correlation between the Arabic translation of Pediatric Voice Related Quality of Life and acoustic parameters of the patient group

	Total APVRQOL		Social-emotional		Physical-functional	
	r_s*	*P*	r_s*	*P*	r_s*	*P*
Average pitch	−0.155	0.219	−0.042	0.740	−0.011	0.933
Jitter	−0.308†	0.013	−0.241	0.054	−0.330‡	0.007
Shimmer	−0.035	0.781	−0.079	0.533	0.026	0.836
HNR	0.070	0.581	−0.032	0.800	0.159	0.206

APVRQOL, Arabic translation of Pediatric Voice Related Quality of Life; HNR, harmonic to noise ratio. *r_s: Spearman coefficient. †Significant correlation at *P*<0.05. ‡Highly significant correlation at *P*<0.01.

are different concurrent fitness issues [10]. This becomes steady with the study by way of Russell *et al*. [11] who stated that women are more susceptible to poor quality of life due to voice problems compared with men.

However, in the control group, the mean scores of all domains of APVRQOL were higher in females than males, indicating better quality of life in females more than males. This is regular with the study of Blumin *et al*. [9] who stated a diminished APVRQOL for boys as compared with girls in the control group, revealing that dysphonia may affect the excellence of lifestyles in girls more than men.

Comparison between the patient and control groups regarding APA characters confirmed that relatively statistically big differences were found between them in all scales of modified GRBAS, except the breathy scale. This finding was in agreement with Sabir *et al*. [8]. Moreover, Tamura *et al*. [12] noticed no substantial differences in grade of dysphonia of GRBAS measure between the patient and control groups. The inconsistencies in the results between the studies could be explained by the diversity in the chosen criteria of the study group, the listener's subjective standards and perceptual analysis can be affected by means of factors inclusive of the type of rating scale used, the voice sample being evaluated [13].

Our comparison between sex subgroups of the patient group regarding APA revealed a statistical giant difference between them in leaky scale in males. The other parameters, such as the degree of dysphonia and strained voice, were higher in males than females, however, they did not reach a significant difference. The higher degree of dysphonia and strained voice in males than females may be attributed to their vocally abusive behaviors such as screaming. Boltežar *et al*. [14] reported that girl's voices are steadier than boy's voices.

Comparison between patient and control groups regarding acoustic parameters confirmed that there had been statistically substantial differences between the two groups concerning jitter and HNR. The increased jitter value can be considered an objective and early sign of vocal fold dysfunction [15]. Our results are in agreement with studies described by Peppard *et al*. [16], who noticed that cases with nodules have remarkably more jitter grades than the normal group. Jiang *et al*. [17] also found a significant distinction among polyp and normal groups concerning jitter and HNR ratio. In contrast to our results, Rosen *et al*. [18] pointed a significant distinction between control and dysphonic groups regarding shimmer. The discrepancy in these findings of acoustic analysis possibly contributed to the variation in study-group selection criteria and using of different analysis programs and software [17].

Our comparison between males and females of the patient group showed no statistically enormous differences among them within the acoustic items although the acoustic parameter values were worse in males than females. This is inconsistent with Sabir *et al*. [8] who reported significant differences among dysphonic female and male groups in fundamental frequency. We can explain this difference in the results due to higher mean age (22 years) in their sample than our sample (10 years), in which there is near-equal pitch in children (boys and girls), but as age increases, male voices become more low.

This work stated a negative significant correlation between the overall grade of dysphonia and strained scales of the APA on one hand and all domains of APVRQOL on the other. This means that raising the grade of dysphonia and strained characters, all domains of APVRQOL were lowered with worse quality of life and high degree of dysfunction.

Our findings could be explained by the higher mean scores of the grade of dysphonia and strained characters of the patient group than other characters of APA. This is consistent with Ghandour and Kaddah [19] who found a positive correlation among the characters of APA and each functional and physical domains of APVHI. This means that raising the grades of the APA, the domains of APVHI were raised with worse quality of life and high degree of handicapping.

On correlation between the APVRQOL domains and acoustic parameters in the patient group, our data revealed mild negative significant correlations between the total APVRQOL and physical–functional domain on one hand and jitter on the other. This can be explained by the increased disarrangement of the normal vocal fold structure and function correlating to vocal fold pathology in this group. The physical–functional domain describes the sensation related to the vocal output, correlated with jitter. The social–emotional domain describes the sensation related to the emotional influence of the voice on the individual not correlated with any acoustic items.

Whereas Sabir *et al*. [8] observed a worthy correlation among all subscales of PVHI and jitter and shimmer. The differences in the methodological procedures in the two studies made it difficult to compare the results. This difference may be due to several reasons, of them, the standards of recording, the utilized microphone, and the way by which the systems calculate the data.

Also, the cultural versions should be taken into account as they have an effect on voice.

Conclusion

The dysphonic group has an affected quality of life more than the control group and this effect seems to be more on the social–emotional aspect than the physical–functional aspect. Dysphonia seems to affect the quality of life in females more than males. The APVRQOL form is a valuable and applicable tool for assessment of the degree of the impact of dysphonia in children. However, it must not be applied as an isolated clinical instrument. It should be incorporated in multidimensional voice assessment with auditory perceptual evaluation and voice-analysis measures to evaluate the influence of child's voice characteristics on goodness of life, which may go beyond the level of perceived voice change.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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