

Dysphonia in teachers: is it only a matter of voice misuse?

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Background

Teaching is considered among the most demanding tasks for voice;

Aim

This study investigated dysphonia in a sample of Egyptian teachers and determined the prevalence of dysphonia in the sample under study.

Patients and methods

The study was carried out by applying a questionnaire to 250 primary school teachers in Fayed city. The questionnaire included three main groups of questions that indicate the presence or absence of dysphonia, gastric reflux, and allergy, in addition to questions about personal and teaching data. The participants who reported that they suffer from dysphonia were transmitted to the second step of the study, which is acoustic analysis for their voices and laryngoscopic examination for their larynges.

Results

The present study revealed that the prevalence of dysphonia in the study sample is 23.2%. The dysphonia was based on the participants self-impression and was emphasized by the acoustic analysis; in addition, this study showed a significant correlation between dysphonia and both allergy and reflux.

Conclusion

The study revealed that prevalence of dysphonia in the sample under study which contains primary school teachers is 23.2%. A positive correlation between teaching hours/week, allergy and reflux with dysphonia with presence of pathological lesions and subclinical finding detected by acoustic analysis changes.

Keywords:

acoustic analysis, dysphonia, gastric reflux

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Introduction

Voice serves an important function of regulating social communication and interactions [1]. Dysphonia is expressed as any difficulty or change in voice emission that interferes with natural voice [2].

There has been growing interest during recent years in studying the relationship between dysphonia and teaching work. Prior research indicates that teachers represent a high-risk group with respect to the development of voice problems [3].

The vocal loading that occurs in the daily life of teachers has several causes; long teaching hours, poor room acoustics, and bad air quality are seen as the leading causes of voice problems in teachers. Psychological and emotional aspects may also contribute to voice disorders [4,5].

Allergies may cause excessive mucous and edema of the vocal folds; edema and excessive mucous on the vocal folds have a negative effect on the voice quality [6]. In addition, it causes an increased need for throat clearing and coughing [7]. Similarly, Issing *et al.* [8] has evaluated and reported negative

effects of pathological acid reflux on the mucosa of the larynx.

Aim

The aim of this study was to answer the study question whether dysphonia in teachers is due to voice misuse only or there are other underlying factors and to determine the prevalence of dysphonia in the study sample and laryngeal pathology underlying dysphonia in teachers.

Patients and methods

Patients

Population of study was 250 teachers working in primary schools in Fayed Educational Management, which are governmental schools. Both male and female teachers were included. They were involved in the active teaching process and had spent in this teaching process at least 1 year. Their age ranged from 22 to 50 years (mean age 36.12 years). In addition, 30 normal age-matched and sex-matched individuals were taken as the control group for acoustic measurements.

Inclusion criteria

- (1) Teachers with almost similar voice misuse during teaching hours/day (4–6 h), with a teaching period more than 1 year.
- (2) The same type of schools (governmental), the same teaching stage (primary schools), and nearly the same environmental conditions.

Exclusion criteria

- (1) Smokers.
- (2) Teachers with known autoimmune, endocrinal disease, neurological disorders, diabetes, hypertension, or under long medical treatment.

Methods

The study was a descriptive, cross-sectional study conducted in primary school teachers in Fayed city, Ismailia governorate (Governmental Primary Schools that belong to Fayed Educational Management at Ismailia governorate). The study was performed during the period between April 2012 and May 2013.

Study sample

Sample type: Simple random sample was selected by choosing teachers from a given list (every even number), obtained from records of directorate of upbringing and education of Ismailia, then the schools where they work were identified to reach them through school visits.

Sample size: A sample of 250 primary school teachers was included, 39 (15.6%) male teachers and 211 (84.4%) female teachers. The sample size was obtained through the following statistical equation:

$$S_s = (Z_{\alpha/2}/E) 2 \times P(1-P)$$

where $Z_{\alpha/2}$ is 1.96 for 95% confidence level, P is the prevalence of dysphonia (28.8%), and $E = SE \times P \times Z_{\alpha/2}$ [standard error (SE) = 0.1].

Data collection

Data were collected through the following:

- (1) Protocol of voice assessment applied in Kasr Al-Aini Hospital was carried out for those participants who reported that they are dysphonic by the applied questionnaire. It included:
 - (a) Elementary diagnostic procedures:
 - (1) Patient interview and thorough personal history taking, including age, sex, occupation, highlighting the duration of teaching experience in years and number of teaching hours/week.
 - (2) Searching for etiological factors: abuse and misuse of voice, exposure to dust

and fumes, allergy, reflux, medications, recurrent respiratory tract infection, and previous surgeries.

- (3) Complaint and analysis of symptoms by asking about the duration, onset, and course and by asking about phonathenic symptoms, which include throat dryness, soreness, tenderness, frequent throat clearing, difficulty in swallowing, and sticky throat mucous.
 - (4) Searching for etiological factors: abuse and misuse of voice, dust, fumes, allergy, reflux, medications, recurrent respiratory tract infection, and previous surgeries.
- (b) Use of questionnaire: These are questions related to allergic rhinitis symptoms that have been identified in the peer-reviewed literature as having the greatest diagnostic value. It will not produce a definitive diagnosis, but they are highly suggestive of allergic rhinitis [9]. Questions that indicate presence or absence of gastric reflux were obtained from the reflux symptom index (RSI) by Belafsky *et al.* [10] who consider an RSI greater than 13 to be abnormal. Hence, in the present study, the teacher is considered positive for reflux when he or she has a RSI score greater than 13.
- (c) Auditory perceptual assessment (APA) was performed by two phoniaticians using the 'modified GRBAS scale' [11] as following: Dysphonia: overall grade, character (strained, leaky, breathy, or rough), pitch (overall increase, overall decreased, or diplophonia), register (habitual register, register break, or tendency of vocal fry at the end of phrases), loudness (excessively loud, excessively soft, or fluctuating), glottal attack (normal, hard, or soft), associated laryngeal functions (cough, whisper, and laughter, which may be affected). The APA was documented by voice recording, which was carried out in a sound-treated room with a high fidelity computerized audio recording system.
- (2) Clinical diagnostic aids: A laryngeal videoendoscopy was carried out using 90° rigid endoscope of a Karl Storz endoscopic set (Germany). It was performed for dysphonic participants to find out why are they dysphonic.
 - (3) Additional instrumental measures: Acoustic analysis: the acoustic analysis was performed using the voice analysis software Praat version 5.3.40 (Paul Boersma and David Weenink, The University of Amsterdam, The Netherlands) [12]. [Praat (the Dutch word for 'talk') is a scientific computer software package] after optimizing it for voice analysis. Jitter (%), shimmer (dB), and harmonic-to-noise ratio were obtained.

Data management and statistical analysis

The collected data were revised, summarized, and then analyzed by statistical package for the social science (SPSS, version 16; SPSS Inc., Chicago, Illinois, USA).

Data were calculated and presented with corresponding 95% confidence intervals. Parametric data were expressed as mean \pm SD and nonparametric data were expressed as number and percentage of the total. The analyzed data were then presented into tables and graphs.

Ethical considerations

Our study was ethically approved by obtaining the agreement of the following:

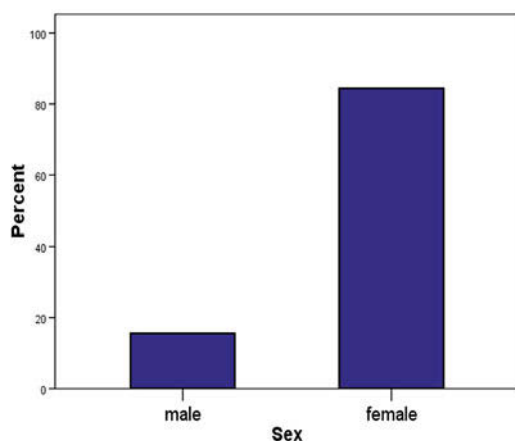
- (1) Postgraduate and ENT Department.
- (2) Ministry of Upbringing and Education.
- (3) Central Agency for Public Mobilisation and Statistics of Arab Republic of Egypt.
- (4) Directorate of Upbringing and Education of Ismailia.
- (5) Management of Upbringing and Education of Fayed.
- (6) Managers and teachers of the schools studied.

Results

Data of this study were analyzed statistically and they show the following results:

- (1) Data of the participants included age, sex (Fig. 1), teaching years, and teaching hours (Tables 1–7).
- (2) Dysphonia distribution and its relationship with age and sex (Tables 8–10).
- (3) Allergy distribution and its correlation with dysphonia (Tables 11 and 12).
- (4) Reflux distribution and its correlation with dysphonia (Tables 13 and 14).

Figure 1



Sex distribution among subjects

- (5) Videoscopic results of dysphonic participants: distribution and types of vocal fold pathology among examined participants (Tables 15 and 16 and Figs 2–5).

Table 1 Statistical description of age of participants

Item	Minimum	Maximum	Mean	SD
Age (years)	22.00	50.00	36.12	7.68

Table 2 Statistical description of teaching years among participants

Item	Minimum	Maximum	Mean	SD
Teaching years	1.00	28.00	13.56	7.102

Table 3 Comparison of mean and SD of teaching years between male and female teachers

Sexes	Mean of teaching years	SD of teaching years	<i>P</i>
Male	18.00	6.42	0.000
Female	12.73	6.92	

P < 0.01, highly significant.

Table 4 Statistical description of teaching hours/week among participants

Item	Minimum	Maximum	Mean	SD
Teaching (h/week)	7.00	30.00	20.14	5.64

Table 5 Comparison of teaching hours/week between male and female participants

Sexes	Mean of teaching hours/week	SD of teaching hours/week	<i>P</i>
Male	28.58	1.31	0.000
Female	18.57	4.66	

P < 0.01, highly significant.

Table 6 Comparison of teaching hours/week between dysphonic and nondysphonic participants

Dysphonia	Mean of teaching hours/week	SD of teaching hours/week	<i>P</i>
Dysphonic	18.67	5.48	0.024
Not dysphonic	20.58	5.63	

P < 0.05, significant.

Table 7 Comparison of teaching years between dysphonic and nondysphonic participants

Dysphonia	Mean of teaching years	SD of teaching years	<i>P</i>
Dysphonic	14.20	6.81	0.430
Nondysphonic	13.36	7.19	

Table 8 Distribution of dysphonia (according to self-impression of participants)

Dysphonia	Frequency (%)
Dysphonic	58 (23.2)
Not dysphonic	192 (76.8)

(6) Comparison between acoustic analysis results of the control and dysphonic groups (Table 17).

Discussion

Voice function is a complex phenomenon and has an undisputable relationship with the voice load and occupational demands [13].

Table 9 Correlation between dysphonia and sex

Correlation	Value	P
Pearson's χ^2	0.71	0.398

Table 10 Comparison of age between the dysphonic and nondysphonic groups

Dysphonia	Mean of age	SD of age	P
Dysphonic	35.65	6.38	0.74
Not dysphonic	35.31	6.97	

Table 11 Distribution of allergy (according to self-impression of participants)

Allergy	Frequency (%)
Allergic	38 (15.2)
Not allergic	212 (84.8)

Table 12 Correlation between dysphonia and allergy

Correlation between dysphonia and allergy	Value	P
Pearson's χ^2	8.989	0.003

$P < 0.01$, highly significant.

Table 13 Distribution of reflux (according to self-impression of participants)

Distribution of reflux	Frequency (%)
Positive for reflux	104 (41.6)
Negative for reflux	146 (58.4)

Table 14 Correlation between dysphonia and reflux

Dysphonia and reflux	Value	P
Pearson χ^2	10.923	0.001

$P < 0.01$, highly significant.

Table 15 Distribution of vocal fold pathology among examined participants

Laryngoscopic examination	Frequency (%)
Pathological vocal folds	50 (86.21)
Free vocal folds	8 (13.79)

Table 16 Description of the pathological lesions

Sex	Vocal fold nodules	Vocal fold erythema and arytenoid edema	Phonatory gap (phonatory gap)	Vocal fold polyp	Vocal fold hemorrhage
Male	0	2	1	2	1
Female	37	5	2	0	0

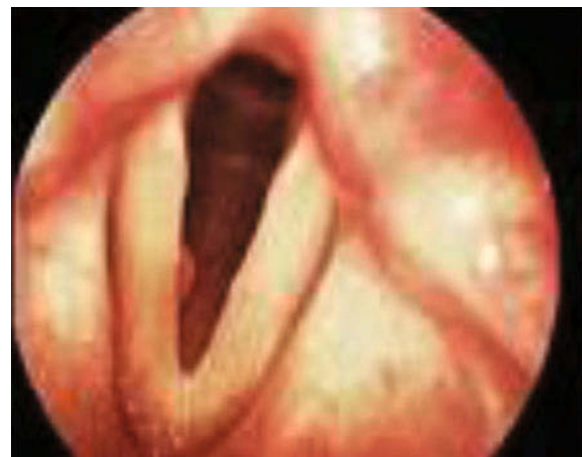
In this study, there were 250 teachers in total, consisting of 84.4% female teachers and 15.6% male

Figure 2



Vocal fold nodules

Figure 3



Vocal fold polyp

Figure 4



Vocal fold hemorrhage

teachers (Fig. 1), which is in agreement with the study by Laukkanen and colleagues who stated that female teachers are a majority in the teaching profession.

This study shows that the prevalence of dysphonia in the sample under study — according to self-subjective impression of teachers — is 23.2%, which is a relatively high prevalence (Table 8). The reason is because teachers often spend a long time talking loudly in noisy environments and in stressful situations [14]. In addition, there is a general agreement that vocal load is the major cause of voice problems in the teaching staff [2].

Different studies conducted have shown that the prevalence of voice fatigue in teachers varies from 18 to 32% [3,15,16]. The prevalence of dysphonia is quite close to that of the present study.

The prevalence in other studies ranges from 50 to 88% [17]. This is so far much higher than that of the present study. Varying results in these papers may be explained by differences in defining duration of the condition, frequency of symptoms, and differences in sample size.

APA of teachers with complaint of dysphonia revealed variable degrees of dysphonia. Acoustic analysis confirmed APA finding by abnormal jitter, shimmer, and mean harmonic-to-noise ratio values as compared with the control group (Table 17).

Table 17 Comparison between the jitter, shimmer, and harmonic-to-noise ratio () of the control and dysphonic group

Items	Mean \pm SD		P
	Control group	Dysphonic participants	
Jitter	0.54 \pm 0.29	2.44 \pm 0.28	0.000
Shimmer	2.62 \pm 0.31	4.67 \pm 0.38	0.000
HNR	22.013 \pm 1.66	16.12 \pm 2.74	0.003

HNR, harmonic-to-noise ratio; $P < 0.01$, highly significant.

Figure 5



Phonatory gap

Videolaryngoscopic examination was performed in those participants who consider themselves to be dysphonic — by questionnaire — to find out why are they dysphonic. It shows that 86.2% of dysphonic patients show pathological lesions in their vocal folds, whereas 13.8% of them show free vocal folds (Figs 2–6 and Table 16).

The presence of acoustic analysis changes even without the presence of structural pathology could be explained by that dysphonia in the absence of laryngeal structural pathology may precede laryngeal structural pathology [18]. In addition, what may seem to be functional dysphonia on evaluation has been suggested by some studies to possibly be secondary to microorganic disease instead (organic disease not detectable on examination) [19].

The explanation for this dysphonia is because teachers often spend a long time talking loudly in noisy environments and in stressful situations [14]. These talking styles lead to increased glottal closure, which elevate vocal fold impact stress resulting in functional voice problems and vocal fold pathologies, especially vocal fold nodules [20].

These are the same reasons for Tavares and Martins [21], who stated that vocal overuse or misuse during teaching over a period of time is a primary cause of voice disorders and vocal fold pathologies. This result is in concordance with another study, which showed that teachers are more susceptible to aphonia, edema, polyps, and nodules than nonvocal professionals [22].

This study revealed that teaching years has no relationship with the development of dysphonia (Table 7). This could be explained by that younger teachers reported greater vocal difficulties due to working longer hours

Figure 6



Arytenoid edema and vocal fold erythema

and having poorer vocal hygiene techniques than their older, more experienced peers [23]. This result agrees with the study conducted by Simberg *et al.* [24], who reported that length of teaching experience has little correlation with the frequency of voice disorders. In addition, other studies reported that old age is not a risk factor for dysphonia [22]. However, this result disagrees with studies showing that one of the risk factors for the development of dysphonia is being older or having more years of teaching experience [3,25].

This study revealed that there is a positive correlation between teaching hours/week and presence or absence of dysphonia (Table 6). This could be because of cumulative voice use [16]. As the vocal loading that occurs in the daily life of teachers has several causes, one of them is long teaching hours [4].

Concerning sex, this study revealed that there is no correlation between sex and development of dysphonia, which is unexpected (Table 9), as women have some physiological factors that predispose them to the development of voice problems, such as a glottic configuration favoring bowing, hormonal influence on vocal qualities, and higher incidence of endocrinological diseases; in addition, women have shorter vocal folds and produce voice at a higher fundamental frequency. In addition, there is less tissue mass to dampen a larger amount of vibrations and lower levels of hyaluronic acid in the superficial layers of lamina propria, which decreases the tissue viscosity of the vocal folds and their shock-absorbing capabilities [21]. This result may be due to difference between male and female teachers included in this study with respect to number of teaching hours/week and number of teaching years.

This result disagrees with the study conducted by Smith *et al.* [22], who reported female sex as one of the risk factors for dysphonia, in addition to the study conducted by Laukkanen *et al.* [26], who revealed that female individuals have about twice as many voice problems as male individuals.

It also disagrees with previous studies that have been consistently reporting that female teachers have significantly more voice problems than their male colleagues [17,27].

With respect to allergy, this study shows that there is a positive correlation between allergy and dysphonia (Table 12). It can be explained by that the mucous is heavier and more tenacious in allergic persons than in persons without allergy and interferes with the mucosal wave in the vocal folds [28]. This result agrees with the results of a survey by Roy *et al.* [3], who showed that the patients who had voice disorders reported respiratory

allergies significantly more often than those who did not have voice disorders. In addition, the results of two questionnaire studies showed that allergic patients have more frequently occurring vocal symptoms than patients in the control group [24,29]. However, this disagrees with the study by King *et al.* [6], who reported that the larynx of allergic patients is often normal.

This study showed that reflux also has positive correlation with dysphonia (Table 14). This table shows that 60.3% of dysphonic patients are positive for reflux. The explanation is that the delicate ciliated respiratory epithelium of the posterior larynx that normally functions to clear mucus from the tracheobronchial tree is altered by the gastric refluxate, and the resultant ciliary dysfunction causes mucus stasis. The subsequent accumulation of mucus produces postnasal drip sensation and provokes throat clearing [30].

In addition, the direct refluxate irritation can cause coughing and choking (laryngospasm) because of sensitivity inflammation [30]. This combination of factors can lead to vocal fold edema, contact ulcers, and granulomas that cause laryngopharyngeal reflux (LPR)-associated symptoms such as sore throat, globus pharyngeus, and dysphonia [31].

This result agrees with the results of Ross *et al.* [32] who reported that all patients with suspected LPR had significantly increased abnormal perceptual voice characteristics in the form of musculoskeletal tension, hard glottal attack, glottal fry, restricted tone placement, and dysphonia.

In addition, Pribuisiene *et al.* [33] had reported that parameters including jitter, shimmer, normalized noise energy, voice handicap index, and phonetogram parameters were significantly different in patients with LPR.

In contrast, different authors have shown that laryngeal findings commonly attributed to reflux laryngitis can be visualized in up to 64–86% of normal controls [34,35]. In addition, a structured review of randomized controlled trials has failed to detect a significant advantage of proton pump inhibitors over placebo in the treatment of patients with reflux laryngitis, which indirectly make the role of reflux in dysphonia questionable [36].

Acknowledgements

Conflicts of interest

None declared.

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