Auditory vocal analysis and factors associated with voice disorders among teachers

Avaliação perceptivo-auditiva e fatores associados à alteração vocal em professores

Abstract

Teachers are professionals who demand much of their voices and, consequently, present a high risk of developing vocal disorders during the course of employment. **Objective:** To identify factors associated with vocal disorders among teachers. **Method:** An exploratory cross-sectional study, which investigated 476 teachers in primary and secondary schools in the city of Salvador, Bahia. Teachers answered a questionnaire and were submitted to auditory vocal analysis. The GRBAS was used for the diagnosis of vocal disorders. **Results:** The study population comprised 82.8% women, teachers with an average age of 40.7 years, teachers with higher education (88.4%), with an average workday of 38 hours per week, average 11.5 years of professional practice and average monthly income of R$1.817.18. The prevalence of voice disorders was 53.6%. (255 teachers). The bivariate analysis showed statistically significant associations between vocal disorders and age above 40 years (PR = 1.83; 95% CI; 1.27-2.64), family history of dysphonia (PR = 1.72; 95% CI; 1.06-2.80), over 20 hours of weekly working hours (PR = 1.66; 95% CI; 1.09-2.52) and presence of chalk dust in the classroom (PR = 1.70; 95% CI; 1.14-2.53). **Conclusion:** The study concluded that teachers, 40 years old and over, with a family history of dysphonia, working over 20 hours weekly, and teaching in classrooms with chalk dust are more likely to develop voice disorders than others.

Keywords: Occupational health. Dysphonia. Voice disorders. Education. Teaching. Teacher.

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Resumo

O professor é um profissional que exige muito de sua voz e, consequentemente, apresenta elevado risco de desenvolver alteração vocal durante o exercício do seu trabalho. **Objetivo**: Identificar fatores associados à alteração vocal em professores. **Método**: Estudo exploratório do tipo corte transversal que investigou 476 professores do ensino fundamental e médio de escolas municipais da cidade de Salvador, BA. Os professores responderam a um questionário e foram submetidos à avaliação fonoaudiológica perceptivo-auditiva da voz. Para diagnóstico de alteração vocal utilizou-se a escala GRBAS. **Resultados**: A população do estudo foi composta por 82,8% de mulheres. Os professores do estudo tinham média de idade igual a 40,7 anos, escolaridade superior (88,4%), jornada de trabalho média de 38 horas semanais, média de 11,5 anos de atuação profissional e renda média mensal de R$ 1.817,18. A prevalência de alteração vocal foi de 53,6% (255 professores). A análise bivariada evidenciou associações estatisticamente significantes entre alteração vocal e idade maior que 40 anos (RP = 1,83; IC 95%; 1,27-2,64), histórico familiar de disfonia (RP = 1,72; IC 95%; 1,06-2,80), carga horária semanal maior que 20 horas (RP = 1,66; IC 95%; 1,09-2,52) e presença de pó de giz na sala de aula (RP = 1,70; IC 95%; 1,14-2,53). **Conclusão**: O estudo realizado concluiu que os professores com 40 ou mais anos de idade, com histórico familiar de disfonia, com carga horária semanal maior que 20 horas e que lecionam em salas de aula com pó de giz têm maior chance de ter alteração vocal do que os demais.

Palavras-chave: Saúde do trabalhador. Disfonia. Distúrbios da Voz. Educação. Ensino. Docente.

Introduction

The voice is the main form of interaction between the speaker and their listeners. The integration among gestures, body and voice transmits the human emotions and desires. When produced in a complex way, the voice is sensitive to emotional disharmony and organic or functional lack of adjustment of the speech system.

Once the voice is unique to each speaker, the conceptualization of vocal quality and normality depends on an individual's cultural and temporal patterns. If the voice cannot fulfill its role of verbal or emotional message transmission, it is said there is a vocal disorder[1].

In addition to the vocal demand, sociodemographic, medical and individual factors and certain occupational and work environment characteristics have been described in the literature as factors that contribute to vocal disorder[2-9]. The teacher is one of the professionals who most use their voice, because they depend on it in the learning-teaching process, thus having higher risks of development of such disorders.

Studies conducted in several parts of Brazil, as observed in other countries, have sought to find the frequency of vocal disorders in teachers. In the city of Belo Horizonte, Minas Gerais, a study evidenced that 61% of teachers reported vocal strain, 56% reported worsening of voice quality and 30% had already been absent from work due to vocal problems[10]. In the city of Mogi das Cruzes, São Paulo, a similar study showed that 57% of teachers reported occasional dysphonia, while 15.5% mentioned frequent dysphonia[5]. In the city of São Paulo, day care center teachers reported vocal disorders (80%) from a mild to moderate level (74%) during a period equal to or longer than four years (39%)[11], and in Vitória da Conquista, Bahia, 59.2% of teachers mentioned hoarseness[9]. A study [12], which reviewed 15 studies on vocal disorder in teachers showed that hoarseness, vocal fatigue, and pain and strain when speaking are the most frequen-

tly reported symptoms in epidemiological studies on this theme. With regard to the working conditions of teachers, a review study[3] showed that teachers reported high level of physical effort, exposure to dust or chalk dust, inadequate ventilation, standing for long periods of time, insufficient time to perform activities and studies and accelerated pace of work.

In view of the high prevalence of vocal problems in this professional category, as evidenced in the previously mentioned studies, the present study aimed to identify factors associated with vocal disorders in teachers.

Methods

An exploratory cross-sectional study was conducted with primary and secondary teachers of municipal public schools of the city of Salvador, in the state of Bahia, Brazil, between March 2006 and March 2007.

The *Secretaria Municipal de Educação e Cultura* (SMEC – Municipal Department of Education and Culture) includes 422 primary and secondary schools, distributed in 11 educational areas that cover 139 districts of the city.

As a convenience criterion, sample selection for this study was performed in two stages. First, for operational purposes, the four educational areas selected were those closest to the *Hospital Universitário Professor Edgard Santos da Universidade Federal da Bahia* (Bahia Federal University Professor Edgard Santos University Hospital). In each area selected, based on a list of professionals per school provided by the SMEC, all schools with 20 or more teachers were chosen. All 24 schools that met these criteria were included in this study. They were spread around 54 districts of the city and included a total of 611 teachers. All teachers from the selected schools were considered eligible for this study and, consequently, invited to participate in it.

There were three formal refusals to participate in the study (0.49%); 25 teachers were on a sick leave during data collection (4.10%) and 107 teachers were not found in the school after three attempts to contact them, being considered losses in this study (17.51%). The final sample totaled 476 individuals (77.9% of those initially expected).

Data collection was performed in two stages, in the schools selected: questionnaire application and auditory-vocal analysis. In these two stages, data collection was conducted by two professionals, graduated in Speech Therapy.

The questionnaires used were as follows: the Portuguese version of the Job Content Questionnaire (JCQ), translated by Araujo (1999)[13] to observe the perception of social support, control and demand in the work environment; the Portuguese version of the Medical Outcome Study Question – Social Support Survey (MOS-SSS), translated by Chor et al (2001)[14] to observe social support out of the work environment; and questions about general health, vocal complaints and professional performance, adapted from the instrument developed by Ferreira et al (2007) [15]. Questionnaires and the Informed Consent Form (ICF) were directly delivered to teachers in a sealed envelope. After delivery, a date was set to return this material. When returned, the envelope with the questionnaires and ICF received a code and the teacher immediately underwent speech therapy analysis. Teachers who reported having a cold/the flu during analysis were excluded from it. Teachers were identified by their code in the questionnaire during this analysis.

Auditory-vocal analysis was conducted in a classroom, with the lowest level of noise possible. During analysis, a sample of the voice was recorded in a digital recorder, with the use of a dynamic professional microphone for quality control. This quality control consisted in another professional's analyzing a sample of analyses. The stage of vocal analysis in the school involved the use of the GRBAS scale[16], which enables the classification of vocal quality according to values that vary from 0 to 3 (absence of disorder, mild disorder, moderate disorder and extreme disorder), based on certain

parameters. These parameters are the following: G= Grade, R= Roughness, B= Breathiness, A= Astheny and S= Strain. The G parameter was used to characterize the presence of vocal disorder in this study, representing the speech therapists' general impression of the vocal quality of teachers, as they conducted the analysis. According to this analysis, teachers were considered "without vocal disorder" (G=0) or "with vocal disorder" (G≠0). The speech material used was the expiratory phonation of the sustained vowel /e/, the connected speech of the months of the year and counting from 1 to 20.

Parameters of analysis for the JCQ were proposed by its authors[13]. The cut-off point of the MOS-SSS was defined in tertiles, according to the variation in score possible in the test[17].

Double data entry was performed in the SPSS software, version 9.0. Bivariate data analysis was made in the Stata software, version 9.0. First, descriptive analysis of variables was performed, followed by bivariate analysis, when the prevalence ratio and confidence interval (α=5%) for the association between the vocal disorder variable and the predictive variables were calculated. The predictive variables were divided into groups of socio-demographic variables, behavioral variables, organizational variables, work environment-related variables, violent situation/indiscipline-related variables, medical condition variables and descriptive variables of vocal abuse.

Taking into consideration the fact that this study had an exploratory nature, where no hypotheses are tested and no main association is analyzed, multivariate analysis processes were found to be unnecessary.

The research project that originated this study did not result in conflict of interests and it was approved by the Bahia Federal University Professor Edgard Santos University Hospital Ethics Committee. All participants signed an informed consent form, according to the *Conselho Nacional de Saúde/Ministério de Saúde*'s (Brazilian Health Ministry/National Health Council) Resolution 196 of 10/10/1996. At the end of the study, each participating teacher received a report on their analysis and was informed about services for speech therapy and otorhinolaryngological care.

Results

The population studied was comprised of teachers, most of whom were females (82.8%), with a mean age of 40.7 years and a higher education level (88.4%). The mean monthly income reported was R$ 1,817.18 (US$ 780.00) mean weekly number of working hours was 38.23 hours and mean length of time working as teacher was 11.5 years.

Prevalence of vocal disorder in the 476 teachers studied was 53.6% (n=255).

Table 1 shows the description of the study population, according to vocal disorder. The same table shows the prevalence ratio (PR) and confidence intervals (CI) for the socio-demographic variables and vocal disorder. There was a positive and statistically significant association between age (PR=1.83 CI95% 1.27-2.64)/family history of dysphonia (PR=1.72 CI95% 1.06-2.80) and vocal disorder. The "social support out of the work environment" variable, resulting from the MOS-SSS, did not have a statistically significant association with the "vocal disorder" outcome.

Table 2 shows the result of the investigation of the association between the teachers' work environment and organization characteristics and vocal disorder, where it can be observed that the "weekly working hours" (PR=1.66 CI95% 1.09-2.52) and "chalk dust in the classroom" variables (PR=1.70 CI95% 1.14-2.53) are associated with vocal disorder in a positive and statistically significant way, unlike the association with the variables originated from the JCQ: control, demand, social support from work colleagues, and social support from the boss.

None of the aspects related to situations of violence or indiscipline in the teachers' work environment was associated with vocal disorder (Table 3). The same occurred

Table 1 - Description of population, prevalence ratio (PR) and respective 95% Confidence Intervals (95% CI) for voice disorders according to sociodemographic and behavioral characteristics of teachers from the City of Salvador, Brazil, 2007.
***Tabela 1** - Descrição da população, razões de prevalência (RP) e respectivos intervalos de confiança (IC 95%) para alteração vocal segundo variáveis sociodemográficas e comportamentais em professores de Salvador, Bahia, 2007.*

Variable	Without vocal disorder	With vocal disorder	PR	CI95%
Age (years)				
20 to 39	119	99		
40 or more	102	156	**1.83**	**1.27-2.64**
Sex				
Male	39	42		
Female	181	213	1.09	0.67-1.76
Marital status				
Without a partner	110	147		
With a partner	111	108	0.72	0.50-1.04
Children				
Does not have children	91	99		
Has children	124	149	1.10	0.76-1.60
Level of education				
Higher education	201	220		
Secondary education	20	35	1.59	0.89-2.86
Ethnicity				
Not black	159	184		
Black	62	71	0.99	0.66-1.47
Family history of dysphonia				
No	182	187		
Yes	31	55	**1.72**	**1.06-2.80**
Common mental disorders				
Not suspected	164	192		
Suspected	57	63	0.94	0.62-1.42
Satisfied with one's profession				
No	28	32		
Yes	187	216	1.01	0.58-1.74
Has thought about abandoning profession				
No	125	135		
Yes	96	120	1.15	0.80-1.66
Social support in the relationships out of the work environment				
High	198	226		
Low	23	29	1.10	0.61-1.97
Smoking habit				
No	204	232		
Yes	13	15	1.01	0.47-2.18
Alcohol consumption				
No	123	150		
Yes	89	94	0.86	0.59-1.26

Table 2 - Description of population, prevalence ratio (PR) and respective 95% Confidence Intervals (95% CI) for voice disorders according to work organization and environmental variables of teachers from the City of Salvador, Brazil, 2007.

Tabela 2 *- Descrição da população, razões de prevalência (RP) e respectivos intervalos de confiança (IC 95%) para alteração vocal segundo variáveis organizacionais e do ambiente de trabalho em professores de Salvador, Bahia, 2007.*

Variable	Without vocal disorder	With vocal disorder	PR	CI95%
Control over work				
Low	81	85		
High	101	108	1.01	0.67-1.53
Psychological demand				
Low	111	120		
High	81	91	1.05	0.70-1.55
Social support from work colleagues				
Low	90	117		
High	131	138	0.81	0.56-1.16
Social support from boss				
Low	31	29		
High	190	226	1.27	0.74-2.18
Weekly number of working hours				
Up to 20	66	52		
More than 20	155	203	**1.66**	**1.09-2.52**
Number of classes one teaches				
Up to 3	124	164		
More than 3	97	91	0.70	0.49-1.02
Number of students per class				
Up to 30	134	147		
More than 30	87	108	1.13	0.78-1.63
Teaching pre-school				
No	189	206		
Yes	28	43	1.40	0.84-2.35
Teaching in primary school (grades 1 to 4)				
No	95	93		
Yes	122	154	1.30	0.91-1.89
Teaching in primary school (grades 5 to 8)				
No	127	151		
Yes	90	98	0.91	0.63-1.32
Teaching in secondary school				
No	176	216		
Yes	40	33	0.67	0.40-1.11
Teaching in university preparation courses				
No	194	219		
Yes	7	6	0.75	0.25-2.29
Performing extra-class activities				
No	18	22		
Yes	200	222	0.90	0.47-1.74
Resting place for teachers				
No	128	158		
Yes	90	89	0.80	0.55-1.16
Satisfactory acoustics in the classroom				
No	147	166		
Yes	69	82	1.05	0.71-1.55

Table 2 - Description of population, prevalence ratio (PR) and respective 95% Confidence Intervals (95% CI) for voice disorders according to work organization and environmental variables of teachers from the City of Salvador, Brazil, 2007. (cont.)
***Tabela 2** - Descrição da população, razões de prevalência (RP) e respectivos intervalos de confiança (IC 95%) para alteração vocal segundo variáveis organizacionais e do ambiente de trabalho em professores de Salvador, Bahia, 2007. (cont.)*

Variable	Without vocal disorder	With vocal disorder	PR	CI95%
Noisy classrooms				
No	52	49		
Yes	166	197	1.25	0.81-1.95
Chalk dust in the classroom				
No	161	154		
Yes	57	93	**1.70**	**1.14-2.53**
Humidity in the classroom				
No	139	160		
Yes	77	85	0.95	0.65-1.40
Adequate classroom size				
No	75	76		
Yes	144	173	1.18	0.80-1.74
Space for the teacher to move in the classroom				
No	56	63		
Yes	162	185	1.01	0.66-1.54
Chair for the teacher in the classroom				
No	25	30		
Yes	192	214	0.92	0.52-1.63
Adequate furniture in the classroom				
No	67	90		
Yes	151	156	0.76	0.52-1.13
Adequate lighting				
No	58	81		
Yes	158	163	0.73	0.49-1.10

The variable "microphone available in the classroom" was excluded from the analysis, due to very low frequency of positive responses (0.6%). *Foi excluída da análise a variável "Dispõe de microfone na sala de aula" devido à quase ausência de respostas positivas (0,6%).*

with the variables related to medical conditions and vocal abuse of teachers (Table 4).

Discussion

Several factors pose a risk to teachers' vocal health. These professionals use their voice to influence, to convince, to give emphasis and to pass on knowledge. Changes in the teacher's voice can lead to stress and frustration, negatively affect their ability to teach and cause social and economic losses[2].

The present study found a prevalence of 53.6% of vocal disorders in teachers, according to the auditory-vocal analysis performed by speech therapists, a lower result than that found by Simões and Latorre, who observed 79.6% of change in the voice quality of the teachers studied.[11] Other studies based on the reports of participants showed data that were similar to those of Araújo et al [9], who found a prevalence of 59.2%, and those of Fuess and Lorenz [5], with 57%. The similarity of results, in contrast to the difference in methods, can indicate that teachers are aware of their vocal problem, as shown in a study conducted by Simões and Latorre[11].

By analyzing the association between

Table 3 - Description of population, prevalence ratio (PR) and respective 95% Confidence Intervals (95% CI) for voice disorders according to stress-producing events among teachers from the City of Salvador, Brazil, 2007.

Tabela 3 *- Descrição da população, razões de prevalência (RP) e respectivos intervalos de confiança (IC 95%) para disfonia segundo aspectos relativos a situações de violência/indisciplina em professores de Salvador, Bahia, 2007.*

Variable	Without vocal disorder	With vocal disorder	PR	CI95%
Situations of violence in the school				
No	29	23		
Yes	190	225	1.56	0.86-2.80
Depredation				
No	126	148		
Yes	72	78	0.92	0.61-1.37
Threat to teacher				
No	142	153		
Yes	56	73	1.21	0.79-1.83
Aggression against teacher				
No	158	187		
Yes	40	39	0.82	0.50-1.34
Insults				
No	107	108		
Yes	91	118	1.28	0.87-1.88
Manifestations of racism				
No	169	179		
Yes	29	47	1.53	0.92-2.52
Indiscipline in the classroom				
No	35	35		
Yes	163	191	1.17	0.70-1.95
Fights and physical aggression among students				
No	38	33		
Yes	160	193	1.38	0.83-2.31
Drug problems in the school				
No	179	194		
Yes	19	32	1.55	0.85-2.84
Thefts of personal objects				
No	111	108		
Yes	87	118	1.39	0.95-2.04
Graffiti in the school				
No	162	171		
Yes	36	55	1.44	0.90-2.32

factors of several natures and vocal disorders, the present study found that being aged 40 years or more (PR=1.83 CI95% 1.27-2.64), having a family history of dysphonia (PR=1.72 CI95% 1.06-2.80), working more than 20 hours per week (PR=1.66 CI95% 1.09-2.52) and teaching in classrooms with the presence of chalk dust (PR=1.70 CI95% 1.14-2.53) are associated with vocal disorders in a positive and statistically significant way.

The association between age and vocal disorders is not supported by studies conducted by Fuess and Lorenz [5], Simões [18] and Alves [19]. These three studies, among others, point to age not being associated with vocal disorders in teachers. Vocal strain resulting from continuous exposure

Table 4 - Description of population, prevalence ratio (PR) and respective 95% Confidence Intervals (95% CI) for voice disorders according to variables related to recurrent medical conditions and vocal abuse among teachers from the City of Salvador, Brazil, 2007.
Tabela 4 *- Descrição da população, razões de prevalência (RP) e respectivos intervalos de confiança (IC 95%) para a alteração vocal segundo variáveis relacionadas a condições médicas recorrentes e abuso vocal em professores de Salvador, Bahia, 2007.*

Variable	Without vocal disorder	With vocal disorder	PR	CI95%
Medical conditions				
Asthma				
No	207	227		
Yes	12	22	1.67	0.80-3.46
Rhinitis				
No	133	133		
Yes	86	116	1.34	0.93-1.94
Sinusitis				
No	155	178		
Yes	64	71	0.96	0.64-1.44
Bronchitis				
No	207	228		
Yes	12	21	1.58	0.76-3.30
Laryngitis				
No	188	206		
Yes	31	43	1.26	0.76-2.09
Pharyngitis				
No	189	206		
Yes	30	43	1.31	0.79-2.18
Tonsillitis				
No	169	184		
Yes	50	65	1.19	0.78-1.82
Flu/colds				
No	147	177		
Yes	72	72	0.83	0.56-1.23
Pyrosis				
No	140	164		
Yes	79	85	0.91	0.62-1.34
Gastroesophageal reflux				
No	184	203		
Yes	35	45	1.16	0.71-1.89
Hormonal disorder				
No	194	215		
Yes	25	34	1.22	0.70-2.13
Vocal abuse				
Speaks loudly during classes				
No	8	10		
Yes	213	245	0.92	0.35-2.34
Shouts during classes				
No	80	67		
Yes	141	188	1.59	0.98-2.35
Sings during classes				
No	72	70		
Yes	149	185	1.27	0.86-1.89
Saves one's voice between classes				
No	104	143		
Yes	110	106	0.70	0.48-1.01

to harmful factors for voice health could be hypothesized to explain the association found in this study.

The association between family history of dysphonia and vocal disorder in teachers is not clear in the literature. Although there may be cases of hereditary malformation of the laryngeal structure that compromise voice quality, it is believed that the association found in the present study is mostly due to individuals' emotional and relational aspects and factors in the domestic environment. In other words, the same social (speaking loudly, shouting, clearing the throat, frequently drinking cold beverages etc.) and physical environments (allergens and others), which cause a family member's vocal disorder, can contribute to teachers' vocal disorders.

The association between the number of working hours and vocal disorders is in agreement with a study conducted by Fuess and Lorenz[5] and another by Provenzano and Sampaio[20]. In the latter, the authors pointed out that 78% of teachers going on sick leaves in the state of Rio de Janeiro work 40 hours per week or more. The association analyzed can be explained, considering the fact that the higher the number of working hours, the greater the use of one's voice and the resulting strain, which may cause vocal fatigue[21].

With regard to the teachers' work environment, the association between chalk dust and voice disorders was also mentioned in a study conducted by Silvany Neto et al [22]. Such association can be explained by nasal and laryngeal mucosa irritation due to inhalation of chalk dust.

Although the present study have limitations, such as the cross-sectional design of the data collection method and the lack of acoustic treatment in the environment where teachers' voice quality assessment was performed, it can be concluded that voice disorders are multi-causal in terms of their etiology and that factors out of the work environment contribute to the onset or aggravation of such disorders.

Conclusion

The present study concluded that teachers aged 40 years or more, with a family history of dysphonia, working more than 20 hours per week and teaching in classrooms with the presence of chalk dust have a higher risk of developing vocal disorders than others.

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