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Factors associated with vocal fold pathologies in teachers

ABSTRACT

OBJECTIVE: To analyze factors associated with the prevalence of the medical diagnosis of vocal fold pathologies in teachers.

METHODS: A census-based epidemiological, cross-sectional study was conducted with 4,495 public primary and secondary school teachers in the city of Salvador, Northeastern Brazil, between March and April 2006. The dependent variable was the self-reported medical diagnosis of vocal fold pathologies and the independent variables were sociodemographic characteristics; professional activity; work organization/interpersonal relationships; physical work environment characteristics; frequency of common mental disorders, measured by the Self-Reporting Questionnaire-20 (SRQ-20 ≥ 7); and general health conditions. Descriptive statistical, bivariate and multiple logistic regression analysis techniques were used.

RESULTS: The prevalence of self-reported medical diagnosis of vocal fold pathologies was 18.9%. In the logistic regression analysis, the variables that remained associated with this medical diagnosis were as follows: being female, having worked as a teacher for more than seven years, excessive voice use, reporting more than five unfavorable physical work environment characteristics and presence of common mental disorders.

CONCLUSIONS: The presence of self-reported vocal fold pathologies was associated with factors that point out the need of actions that promote teachers' vocal health and changes in their work structure and organization.

DESCRIPTORS: Faculty. Voice Disorders. Working Conditions. Occupational Health. Cross-Sectional Studies.

INTRODUCTION

Professionals whose voice is their work instrument, such as singers, fitness club instructors, salespeople, telemarketing operators, receptionists, actors and teachers, are at a higher risk of developing voice disorders. Teachers have a high prevalence of voice changes when compared to other professional categories.²⁵ Voice disorders affect work performance and effectiveness and they can lead to working days missed, leaves of absence and even abandonment of work.

Voice disorders can result from the interaction among hereditary, behavioral, lifestyle and occupational factors. Excessive voice use in the workplace is a relevant factor for vocal fold pathologies.⁷ Disorders caused by voice use are characterized as being chronic, which distinguishes them from other disorders that change voice sound quality, such as laryngitis, flu, colds and acute inflammatory processes. The dividing line between these two groups of pathologies is estimated to be 15 days.⁵

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The prevalence of “vocal fold nodules” in teachers, as recorded in medical diagnoses, varied between 12% and 13%^{1,6} and it is associated with the length of time working as a teacher, working in two or more schools, performing another paid job apart from teaching, making an effort to speak, being female, shouting/ speaking loudly and weekly working time ≥ 20 hours.²

Among Spanish teachers, the prevalence of voice disorders measured by laryngeal exam was 57.3%, of which 20.2% were organic lesions, 8.1% were laryngitis, and 28.8% were functional lesions.¹⁹

The present study aimed to analyze the factors associated with the prevalence of the medical diagnosis of vocal fold pathologies reported by teachers.

METHODS

A cross-sectional study was conducted in preschool and primary school teachers in the city of Salvador, Northeastern Brazil, between March and April 2006. Data came from the census conducted with the support of the City of Salvador Department of Education and Culture.

A self-administered questionnaire was used, including socio-demographic aspects, teaching practice aspects, work environment characteristics, general health conditions, vocal health and habits associated with voice use. Questionnaires were sent to all municipal schools in Salvador. Of all 4,697 municipal public school teachers, 4,495 (95.7%) responded to the questionnaire.

The dependent variable was the self-reported medical diagnosis of vocal fold pathologies. The term “vocal cords” was used in the questionnaire, as it is more popular than “vocal folds”. The expression “vocal cord pathologies” included lesions such as nodules, polyps, edemas, minor structural changes of vocal fold mucosa and glottal chinks. The self-reported medical diagnosis was used as a more accurate framework than the indication of voice changes made by individuals themselves, because the identification of vocal fold pathologies depends on a clinical evaluation.

Factors more frequently associated with voice disorders in teachers were selected as independent variables: socio-demographic characteristics (sex, age, ethnicity, marital status, level of education and having children); professional activity characteristics (length of time working as a teacher, weekly working hours in municipal public schools, mean number of students per class, number of work shifts, performance of other professional activities, working as a teacher outside the municipal public school network and excessive voice use – speaking loudly and shouting – during classes); factors associated with interpersonal relationships/ work organization (specific location for teachers’

rest, continuous inspection of teachers’ performance, school management pressure, decreased teacher-student relationship quality, good relationship with colleagues, sufficient time between classes for rest, performance of activities without adequate materials and equipment, satisfaction in the performance of activities) and with the work environment (ventilation, furniture, humidity, chalk dust, microphone, excessive external noise, excessive noise, acoustics, classroom size adequacy, dust, excessive number of students); and self-reported diagnoses of diseases (respiratory tract diseases – rhinitis, pharyngitis, sinusitis –, gastritis, hearing loss and common mental disorders).

The following codes were adopted: 0 (negative response to up to four factors) and 1 (negative response to more than four factors) for factors associated with the work organization/interpersonal relationships; and 0 (negative response to up to five factors) and 1 (negative response to more than five factors) for factors associated with the work environment. Common mental disorders were evaluated with the Self-Reporting Questionnaire-20 (SRQ-20), developed by Harding et al¹⁰ and validated in Brazil by Mari & Williams.¹⁴ This version is comprised of 20 questions to detect common mental disorders. Individuals with seven or more positive responses were considered to be cases.

Variables were statistically described and the prevalence of self-reported diagnosis of vocal fold pathologies was estimated and compared among variables of the exposure groups, using the prevalence ratio (PR) as a measure of association and respective 95% confidence intervals (95%CI). A logistic regression model was proposed, adjusted for covariables of interest.

The odds ratio can overestimate the PR when the dependent variable shows a high prevalence.⁴ For this reason, the PR between exposed and non-exposed individuals was estimated for each independent variable, adjusting for the effect of the remaining variables. The 95%CI of the PR was defined according to the natural logarithm variance estimate of the PR estimator, using the delta method and with the covariance matrices being generated by logistic regression.¹⁷

The conditional prediction method¹² was used to adjust the prevalence estimated by regression, i.e. standardized reference values were selected for the covariables to obtain an estimate of prevalence from the model which is adjusted for each group of interest. In this case, the mean of each covariable was used as standard value. As a result, the prevalence of vocal fold pathologies and PR among teachers per category of each independent variable was specific for one category of the remaining covariables.²⁴

Pearson’s χ^2 statistics, the Hosmer-Lemeshow, Osibus-Rojek, Le Cessie-van Houwelingen and Stukel tests, Pearson’s quadratic correlation and verisimilitude ratio

coefficients, and the area under the ROC (Receiver Operating Characteristic) curve¹¹ were used in the analysis of the logistic regression model adjustment to the data analyzed. Goodness-of-fit assessment was considered in a set of adjusted values determined by the combination of values of model covariables (covariable patterns). A covariable pattern is a combination of values of each variable of exposure.¹¹ If, for instance, the model included the “sex” and “hearing loss” dichotomous variables exclusively, there would only be four possible covariable patterns: women with hearing loss; women without hearing loss; men with hearing loss; and men without hearing loss.

The influence diagnostic value ($\Delta\hat{\beta}$), measure of the covariable pattern elimination effect on the estimate of parameters, and Pearson's χ^2 reduction ($\Delta\chi^2$) and log-likelihood diagnoses (ΔD) were used to diagnose the logistic regression model¹⁰ by eliminating the covariable pattern. Data were analyzed with the “R” software, version 2.6.1, and the SPSS® software, version 13.0.

The study was approved by the Universidade Federal da Bahia Institute of Collective Health Research Ethics Committee (Official Opinion 047/07). Each teacher received an envelope with the questionnaire and informed consent form, with information about the research and way to contact researchers, in addition to a letter from the head of the City of Salvador Department of Education requesting the participation of teachers and informing about the volunteer nature and data confidentiality of the study. Teachers were instructed to return the signed informed consent form and completed questionnaire in a sealed envelope.

RESULTS

The majority of individuals in the population studied were females (92.0%); with a mean age of 40 years (standard deviation, SD: 9.4); with a higher education level (69.5%); mean length of time working as a teacher of 14.3 years (SD: 8.45); and a total of 20 working hours per week (53.3%).

The medical diagnosis of vocal fold pathologies was reported by 851 teachers (prevalence of 18.9%).

The bivariate analysis showed that the self-reported medical diagnosis of vocal fold pathologies was closely associated with being female, black (Table 1), having worked as a teacher for more than seven years, working more than one shift, excessive voice use (Table 2), reporting more than four negative factors of work organization/interpersonal relationships, more than five negative work environment characteristics (Table 3), one or more respiratory tract diseases, gastritis, hearing loss and positive result for common mental disorders (Table 4).

The following variables remained associated with the medical diagnosis of vocal fold pathologies in the logistic regression: being female, having worked as a teacher for more than seven years, excessive voice use, reporting more than five negative work environment characteristics, one or more respiratory tract diseases, hearing loss and common mental disorders (Table 5).

In the analysis of the logistic regression model adjustment to the data analyzed, statistics showed that this model was a good fit to the data, with a high level of agreement between the frequencies observed and those expected from the dependent variable.

The value of the area under the ROC curve of the model tested showed that this model adequately distinguished individuals with vocal fold pathologies from those without such pathologies.

Table 1. Association between self-reported medical diagnosis of vocal fold pathologies and sociodemographic characteristics of municipal public school teachers. Salvador, Northeastern Brazil, 2006.

Characteristic	Self-reported medical diagnosis of vocal fold pathologies		
	n	%	PR (95%CI)
Gender			
Male	348	8.6	
Female	3,994	19.9	2.31(1.63;3.27)
Age (years)			
18 to 39	2,241	18.7	
40 to 69	2,061	19.5	1.04(0.92;1.17)
Ethnicity			
Non-black	3,037	17.9	
Black	1,320	21.3	1.19(1.05;1.35)
Marital status			
Single	1,678	19.1	
Married	2,048	18.8	0.98(0.85;1.12)
Widowed	126	18.3	0.95(0.65;1.39)
Separated/divorced	474	18.8	0.98(0.79;1.21)
Level of education			
Secondary education	717	19.2	1.54(0.82;2.88)
Incomplete higher education	554	21.3	1.70(0.90;3.20)
Complete higher education	3,054	18.7	1.49(0.81;2.77)
Master's degree/ Ph.D.	72	12.5	
Children			
No	1,612	18.3	
Yes	2,832	19.3	1.05(0.92;1.19)

Table 2. Association between self-reported medical diagnosis of vocal fold pathologies and professional activity characteristics of municipal public school teachers. Salvador, Northeastern Brazil, 2006.

Characteristic	Self-reported medical diagnosis of vocal fold pathologies		
	n	%	PR (95%CI)
Length of time working as a teacher (years)			
Up to 7	1,093	15.8	
More than 7	3,024	20.6	1.30 (1.11;1.52)
Weekly working hours in municipal schools (hours)			
Up to 20	1,945	17.9	
More than 20	2,219	20.1	1.12 (0.98;1.27)
Mean number of students per class			
Up to 30	2,125	18.6	
More than 30	1,817	20.1	1.08 (0.95;1.22)
Work shifts			
One	2,034	17.6	
More than one	2,345	20.1	1.14 (1.01;1.29)
Performs another professional activity			
No	3,460	19.1	
Yes	438	18.9	0.99 (0.80;1.22)
Works as a teacher outside the municipal school network			
No	2,765	19.2	
Yes	1,297	18.7	0.97 (0.85;1.11)
Excessive voice use			
No	3,100	16.3	
Yes	1,395	24.8	1.52 (1.34;1.71)

There were 107 covariable patterns, totaling 3,993 individual records. The losses of this study totaled 15.0% [(4,697 - 3,993)/4,495 x 100]. In the logistic regression model diagnosis, none of the covariable patterns showed an influence diagnostic value higher than 0.3, far from the critical value which, according to Hosmer and Lemeshow,¹¹ is equal to 1.0. Some covariable patterns showed Pearson's χ^2 and log-verisimilitude values higher than 4 for covariable pattern elimination. The value of 4 is an approximation of the 95 percentile of χ^2 distribution with a degree of freedom. The covariable patterns studied in terms of the impact of their exclusion on the coefficients of final model covariables did not show relevant differences.

DISCUSSION

The prevalence of vocal fold pathologies was 18.9%, slightly higher than 13.3%, as observed in another study⁶ conducted in the state of Bahia. This difference is possibly due to the more far-reaching question in the investigation. Teachers were asked whether they had the medical diagnosis of "vocal fold pathologies",

Table 3. Association between self-reported medical diagnosis of vocal fold pathologies and factors related to work organization/interpersonal relationships and work environment of municipal public school teachers. Salvador, Northeastern Brazil, 2006.

Variable	Self-reported medical diagnosis of vocal fold pathologies		
	n	%	PR (95%CI)
Work organization/interpersonal relationships (unfavorable factors)			
Up to 4	3,150	17.3	
More than 4	1,341	22.8	1.32 (1.16;1.49)
Work environment (unfavorable characteristics)			
Up to 5	2,330	16.2	
More than 5	2,165	21.9	1.35 (1.19;1.52)

Table 4. Association between self-reported medical diagnosis of vocal fold pathologies and conditions that interfere with the voice quality of municipal public school teachers. Salvador, Northeastern Brazil, 2006. (N = 4,495)

Variable	Self-reported medical diagnosis of vocal fold pathologies		
	n	%	PR (95%CI)
Self-reported diagnosis of respiratory tract diseases			
No	3,025	15.4	
Yes	1,470	26.1	1.69 (1.50;1.90)
Self-reported diagnosis of gastritis			
No	3,998	17.3	
Yes	497	31.8	1.83 (1.58;2.12)
Self-reported diagnosis of hearing loss			
No	4,259	17.9	
Yes	236	38.1	2.13 (1.79;2.54)
Common mental disorders			
No	3,616	16.0	
Yes	879	31.2	1.95 (1.72;2.21)

while the other study⁶ questioned about the presence of "vocal fold nodules".

Studies that used clinical evaluation of the larynx through the inspection of this organ pointed to a high prevalence of visible changes in teachers' vocal folds. A study²³ conducted in 1,046 teachers found a prevalence of vocal fold pathologies of 20.8%, similar to that observed in the present study, according to the self-reported medical diagnosis. Nodules, polyps, edemas and cysts were found, among others. Glottal chinks were observed in 70% of the teachers studied.²³

A study⁷ conducted in 492 Spanish teachers using a video-laryngo-stroboscopic assessment found an estimated prevalence of 20.2% of organic lesions and of 13.8% of vocal fold nodules (20.5% in women and 3.2% in men).

Table 5. Adjusted prevalence ratios for the association between self-reported medical diagnosis of vocal fold pathologies and independent variables that remained in the final logistic model in municipal public school teachers. Salvador, Northeastern Brazil, 2006. (N = 3,993)

Variable	PR (95%CI)
Being female	2.18 (1.52;3.11)
Having worked as a teacher for more than seven years	1.35 (1.14;1.59)
Unfavorable work environment	1.25 (1.10;1.44)
Excessive voice use	1.40 (1.22;1.60)
Respiratory tract diseases	1.50 (1.32;1.72)
Hearing loss	1.88 (1.53;2.32)
Common mental disorders	1.65 (1.43;1.90)

Variations in the methodologies used in different studies could contribute to the variation in the prevalence found.¹⁶ Comparisons among studies in the area of voice are restricted to the variation in the definition of voice disorder and in the measurement criterion adopted.²¹

The profile of teachers in the city of Salvador school network was similar to that observed in other studies,^{2,3,6} i.e. there was a predominance of females who were married, had children, were middle-aged, had a complete higher education level and did not perform other professional activities.

The self-reported diagnosis of vocal fold pathologies was more prevalent in female teachers than in male ones. Teaching is an activity primarily performed by women. Despite the growing inclusion of women in the job market, their historical role in the family has not changed yet, i.e. their responsibility for housework. The resulting multiple roles create the so-called double shift: the professional activity and the domestic tasks (as mother and housewife). This double shift translates into an excessive number of working hours for women, contributing to the development of diseases, especially those related to stress.³ General health problems and vocal symptoms in particular are more prevalent in female teachers. This higher prevalence is associated with a lower level of education, compared to men; a greater proportion of high housework overload; and a lower level of participation in the decision-making process.¹

In addition to social aspects, biological factors may contribute to the higher prevalence of voice disorders in women. The hyaluronic acid, for instance, a protein that attracts water to the vocal fold lamina propria, leading to a reduction in surface trauma during sound emission, is more abundant in males. This could partly explain the lower frequency of vocal nodules in men.⁵

Preciado et al¹⁹ reported that the clinical form in which voice disorders occur differs according to sex. Nodular

lesions were predominantly diagnosed in women who suffer from major vocal trauma, as they have a smaller larynx and higher frequency of vibration.

Vocal fold pathologies were more prevalent in teachers with more than seven years of teaching experience. This finding is similar to what was observed in another study³ with teachers in the state of Bahia, in which the self-reported diagnosis of vocal fold nodules was more frequent from the fifth year of teaching practice on.

Excessive voice use was associated with the presence of self-reported diagnosis of vocal fold pathologies. This behavior includes speaking loudly and shouting.^{2,13} Higher voice demand and the corresponding effort made to speak can be the main causes for the onset of the first vocal symptoms, which would gradually shift from temporary to permanent, leading to laryngeal organic lesions.¹⁹ Excessive voice use is characterized by an extrinsic muscular tension of the larynx and repetition of vocal fold movements. Teachers are required to use their voice frequently and intensely, due to the need to maintain classroom discipline.¹⁶

Excessive voice use, when maintained for many years of teaching practice, can increase the prevalence of vocal fold pathologies.

The work environment may contribute to the development of voice disorders.⁷ The environmental characteristics analyzed in this study included excessive noise, temperature, humidity and dust, among others. Variations in temperature and humidity interfere with the pharyngeal and laryngeal mucosa hydration, causing the level of irritation to be higher. The high level of background noise forces teachers to raise their voices and increases their speech effort.²²

Special attention must be paid to environmental noise in classrooms. Case-control studies¹⁶ on occupational deafness showed a proportion of hearing loss of 25% in teachers and 10% in non-teachers. Among teachers, the audiometric configuration of hearing loss induced by high levels of sound pressure prevailed. Teachers reported excessive noise and auditory complaints with frequencies of 94% and 65%, respectively. Classrooms showed noise levels of approximately 87dBA.

The noise emission sources in the classrooms are the students themselves, when they speak or move their feet or chairs and desks.¹⁹

The association between vocal fold pathologies and respiratory tract diseases was significant in the present study. These diseases result from individual predispositions and environmental conditions. Larynx exposure to mucosa-irritating factors can change the delicate vocal mechanism. For this reason, it is important to evaluate the environment of professionals who use their voice

to prevent this situation from being aggravated, due to the presence of dust or mildew.⁸

Work overload is characterized by the excessive working hours and the several activities that teachers are required to perform simultaneously: teaching, correcting homework, completing report cards and class planning, among other activities, in addition to the work they have to take home. Multiple responsibilities cause teachers to experience physical and mental fatigue, which threatens their health. In view of the pressures existing in the work organization, teachers can feel anguish, dissatisfaction, anger, hopelessness, lack of motivation, tiredness and stress. The presence of these feelings causes teachers to experience psychological suffering in the teaching practice.²⁰ Common mental disorders, whether temporary or permanent, can lead to absence from work.^{18,20}

The association between common mental disorders and voice disorders was similar to that found in studies with teachers.¹ Gotaas & Starr⁹ reported that teachers with vocal fatigue showed higher levels of stress and anxiety than teachers without vocal fatigue. In a study conducted by Medeiros et al,¹⁶ teachers with common mental disorders showed 5.8 times more dysphonia than those without such disorders. These studies suggest that stress influences the occurrence of voice disorders. However, the mechanisms that measure this association have not been clearly established.

As the studies mentioned^{9,16} had a cross-sectional design, the possibility of reverse causality must be

considered: the presence of voice disorders could influence the occurrence of common mental disorders.

One of the limitations of the present study is the way how the dependent variable was assessed, because the self-reported medical diagnosis is a subjective fact. However, this measure must be reasonably close to the actual phenomenon studied, as this is a large-scale epidemiological survey.

In addition, there are limitations inherent in cross-sectional studies. It is not possible to determine the chronological order between exposure and effect. Data on the teachers who were on a leave of absence could not be obtained, underestimating the actual prevalence of the phenomenon studied, something known as healthy worker effect. The possibility of occurrence of information bias should not be disregarded either, because teachers who had experienced health problems tended to associate more symptoms or characteristics studied with their work. The relevance of selection bias cannot be fully evaluated, although the proportion of losses was relatively low (15.0%) in the simultaneous analysis of all factors included in the assessment made.

More in-depth studies on factors associated with voice disorders in teachers are required, aiming to promote vocal health, especially structural changes in the work environment and its form of organization. The legislation on occupational accidents' recognition of work-related voice disorders could promote voice change prevention control, the identification of initial symptoms and early diagnosis of these changes.

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