

Prevalence and factors associated to dysphonia and laryngeal lesions: a study among teachers in a region of the Brazilian Legal Amazon

Prevalência e fatores associados à disfonia e lesões laríngeas: um estudo entre professores de uma região da Amazônia Legal Brasileira

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Abstract

Objective: to investigate the prevalence and factors associated with dysphonia and laryngeal lesions at elementary public school teachers in a region of the Amazonian region. **Methodology:** cross-sectional study with collection of sociodemographic, occupational, environmental, and clinics variables. Dysphonia and laryngeal lesions were evaluated using three methods: self-perceptions, diagnostic criteria and video-assisted laryngoscopy. Logistic regression was used to determine factors associated. **Results:** the prevalence of self-reported dysphonia was 68.9%, diagnosed dysphonia was 59.1% and laryngeal lesions, 53.3%. There was association between self-reported dysphonia and respiratory problems (OR=3.00; CI95%=1.25-7.22), use of drugs (OR= 2.31, CI95%= 1.19-4.49) and noise in the internal environment (OR= 2.43; CI95%=1.24-4.73). Easy access to water was a protection factor against self-reported dysphonia (OR=0.09; CI95%: 0.01-0.79). We found a significant association between dysphonia diagnosed and digestive problems (OR= 5.35; CI95%=2.39-11.96), external noise (OR=4.89, CI95%=1.87-12.78) and inadequate ventilation (OR=3.56; CI95%=1.46-8.62). The variables associated with higher chance of laryngeal lesions in dysphonic teachers were lighting (OR=3.74; CI95%=1.15-12.14%), acoustics (OR= 4.14; CI95%=1.32-12.95) and inadequate room size (OR= 3.76; CI95%=1.29-10.91). The use of drugs (OR=0.34; CI95%=0.12-0.92), respiratory problems (OR=0.21; CI95%=0.06-0.76) and easy access to water (OR= 0.12; CI95%=0.04-0.38) were protection factors for laryngeal lesions. **Conclusion:** occupational environmental factors aggravated the vocal health of this professional category. Access to water in the work impacted positively.

Keywords: Faculty. Dysphonia. Occupational Health. Risk Factors.

Resumo

Objetivo: investigar a prevalência e fatores associados à disfonia e lesões laríngeas em professores do ensino fundamental de um município da Amazônia Legal. **Metodologia:** estudo transversal com coleta de variáveis sociodemográficas, ocupacionais, ambientais e clínicas. Disfonia e lesões laríngeas foram avaliadas com a utilização de três métodos: autopercepção, critérios diagnósticos e laringoscopia assistida por vídeo. Utilizou-se modelo de regressão logística para determinação dos fatores associados. **Resultados:** a prevalência da disfonia autorreferida foi 68,9%, da disfonia diagnosticada foi 59,1% e das lesões laríngeas, 53,3%. Houve associação entre disfonia autorreferida e problemas respiratórios (OR=3,00; IC95%=1,25-7,22), uso de medicamentos (OR=2,31; IC95%=1,19-4,49) e ruído interno no ambiente (OR=2,43; IC95%=1,24-4,73). Teve associação protetora entre disfonia autorreferida e facilidade de acesso à água (OR=0,09; IC95%=0,01-0,79). Encontrou-se associação significativa entre disfonia diagnosticada e problemas digestivos (OR=5,35; IC95%=2,39-11,96), ruído externo (OR=4,89; IC95%=1,87-12,78) e ventilação inadequada (OR=3,56; IC95%=1,46-8,62). As variáveis associadas à maior chance de lesões laríngeas em docentes disfônicos foram iluminação (OR=3,74; IC95%=1,15-12,14), acústica (OR=4,14; IC95%=1,32-12,95) e tamanho da sala inadequados (OR=3,76; IC95%=1,29-10,91). Uso de medicação (OR=0,34; IC95%=0,12-0,92), problemas respiratórios (OR=0,21; IC95%=0,06-0,76) e facilidade de acesso à água (OR=0,12; IC95%=0,04-0,38) mostraram-se fatores de proteção para lesões laríngeas. **Conclusão:** fatores ambientais ocupacionais agravaram a saúde vocal desta categoria profissional. O acesso à água no ambiente de trabalho impactou positivamente.

Palavras-chave: Docentes. Disfonia. Saúde do Trabalhador. Fatores de Risco.

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INTRODUCTION

The teaching profession is of utmost importance to society and the teaching-learning process involves creativity and innovation¹. However, teaching is frequently related to musculoskeletal, vocal, and mental disorders². Compared to the general population, teachers are at greater risk for the development of dysphonia, which is a voice disorder due to a functional and/or organic alteration of the larynx and/or vocal tract³ associated with hoarseness, vocal fatigue, and a burning sensation in the throat⁴. These signs and symptoms lead to a reduction in quality of life associated with psychological problems and emotional restrictions, poor professional performance, absenteeism, reductions in social activities as well as financial costs to the health and education systems⁵.

Different prevalence rates of vocal disorders in this occupation are found in national and international studies, depending on the concepts and methods adopted in different investigations, such as self-perceptions, vocal signs and symptoms and video-assisted laryngoscopy⁶, with rates ranging from 4.4 to 90%⁷⁻⁹. An American epidemiological study found that teachers have a greater prevalence rate of vocal disorders throughout their professional lives (58%) in comparison to the general population¹⁰. A study evaluating the vocal cords of French teachers using laryngoscopy found that 20.8% had laryngeal lesions, the most frequent of which were vocal nodules¹¹. In South Korean, the prevalence of voice disorders was significantly higher among individuals with vocal nodules (8.1% and 27.7%, respectively)⁶.

In Brazil, a study among in the private elementary and secondary school teachers, identified the prevalence of current voice problems and voice problems at some point in lifetime, with variation between 11.6% and 63%¹². In the city of São Paulo, an investigation involving educators in the municipal public system found that 60% reported vocal changes related to environmental and organizational aspects of the work, with frequent reports of mental and respiratory disorders¹³. In another study conducted with elementary public schools' teachers in a city in the state of São Paulo, the most prevalent vocal problems were dry throat (30.4%), hoarseness (52.0%), vocal fatigue (53.9%) and shortness of breath while speaking (81.4%)¹⁴. Vocal changes can occur as a result of the interaction between hereditary, individual, behavioral, lifestyle and occupational factors. The female sex, voice use pattern, high workload, environment with excessive noise and large number of students^{15,16}, inadequate school infrastructure, absence of prior voice and communication training and how to cope with stressful situations¹⁷.

Data from the [Pesquisa Nacional por Amostra de Domicílios – PNAD], prepared by the [Instituto Brasileiro de Geografia e Estatística – IBGE], show that between 2002 and 2013, the number the number Brazilian school-teachers' in the country, increased by 32.9%¹⁸. According to [Instituto Nacional de Estudos e Pesquisas – INEP],

in basic education alone there are 2.2 million teachers. considering the number of these professionals and the wage floor, it is estimated that public spending on leave, licenses and readaptations of teaching staff are R\$ 1.66 billion/year^{19,20}. This is a serious public health problem, and the Brazilian Ministry of Health recognizes it as work-related voice disorder (WRVD), through the official publication of the WRVD Protocol¹⁹, which it establishes in the International Classification of Diseases, the following code (ICD-10 J04.2, J37.1, J-38, J38.2, R-49)²¹.

Therefore, it is important to investigate the prevalence of vocal disorders among educators with a broader vision that considers the relationship between health and work and is based on environmental and organizational conditions²². Despite the importance of this issue, there are few studies in developing countries about vocal evaluations involving video-assisted laryngoscopy to obtain a better diagnosis^{5,10,23,24}. In this perspective, the aim of the present study was to estimate the prevalence of dysphonia and laryngeal lesions and identify factors associated with these vocal problems in a municipality located in Brazilian Legal Amazon.

METHODOLOGY

An observational cross-sectional study was conducted between November 2017 and April 2018 at elementary schools in the public education system of the county of Imperatriz, state of Maranhão, which is located in the eastern region of Brazilian Amazonia. The state of Maranhão is located in the northeastern region of the country and occupies an area of 329,642.182 Km²²⁵. It is necessary to emphasize that, although the county of Imperatriz is to the west of the 44° meridian, in the Legal Amazon, the state of Maranhão is located in the northeast of Brazil. The data were furnished by the Municipal Secretary of Education, which reported a total of 2619 teachers working at 159 schools in the municipality, 40 of which were exclusively nurseries, daycare centers and preschools. The remaining 119 establishments were related to elementary schools with 2221 teachers, which was the universe used to calculate the sample size. These 119 elementary schools were subdivided among five districts in the urban zone and two in the rural zone. The sample size was calculated using the following formula:

$$n = \frac{N \cdot Z^2 \cdot p \cdot (1 - p)}{Z^2 \cdot p \cdot (1 - p) + e^2 \cdot (N - 1)}$$

in which:

n – calculated sample size;

N – population (2221);

Z – determined by confidence interval [CI = 95% (1.96)];

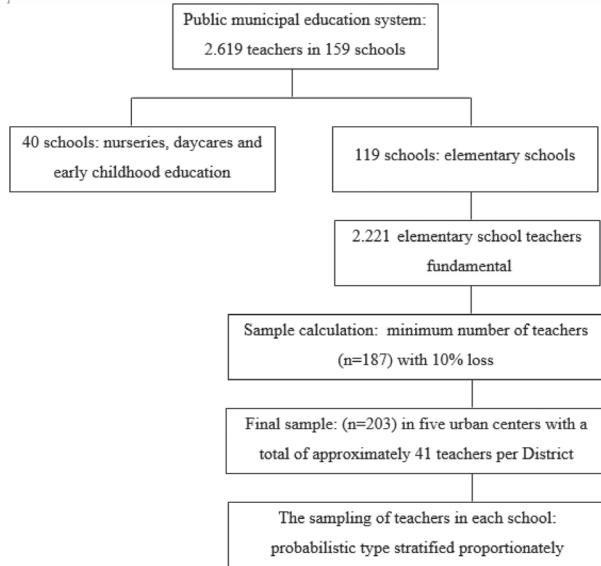
p – estimated prevalence of dysphonia: 50.0%;

e – sampling error of 7%.

As the literature does not offer a clear prevalence rate for dysphonia⁹ 50% was used in the calculation of the sample size. The application of the formula described

above determined a minimum sample of 187 individuals, which was increased to 203 to compensate for a possible 10% dropout rate. Therefore, 41 teachers were selected from each of the five urban districts of county (Figure 1).

Figure 1 – Flowchart of the study steps



Source: Authorship

Stratified probabilistic sampling proportional to the total number of teachers per school was performed. The teachers were randomly selected from a total of four schools per district to ensure greater representativeness of the sample, this means that the total number of schools was 20 (Table 1). This process determined the number of questionnaires to be sent to each school. The questionnaires were duly coded with numbers corresponding to the probabilistic calculation and delivered to the teachers during intervals between classes. The teachers had the option of taking the questionnaires to answer at home and return on a different occasion.

Table 1 – Probabilistic sampling stratified proportionally with presentation of the four schools drawn in each District, the total number of teachers in each school and the number of questionnaires to be applied per school

District	Number of schools	School	Total teachers (n/%)	Number of samples (n)
Bacuri	1	Bacuri 1	22 (24.2)	10
	2	Bacuri 2	24 (26.3)	11
	3	Bacuri 3	25 (27.5)	11
	4	Bacuri 4	20 (22.0)	9
New Village	5	New Village 1	23 (24.7)	10
	6	New Village 2	26 (28.0)	11
	7	New Village 3	23 (24.7)	10
	8	New Village 4	21 (22.6)	9

Lobão Village	9	Lobão Village 1	41 (32.5)	13
	10	Lobão Village 2	40 (31.7)	13
	11	Lobão Village 3	21 (16.7)	7
	12	Lobão Village 4	24 (19.1)	8
Santa Rita	13	Santa Rita 1	36 (31.0)	12
	14	Santa Rita 2	23 (19.8)	8
	15	Santa Rita 3	34 (29.3)	12
	16	Santa Rita 4	23 (19.8)	8
Center	17	Center 1	24 (22.4)	9
	18	Center 2	25 (23.4)	10
	19	Center 3	30 (28.0)	11
	20	Center 4	28 (26.2)	11

Source: Research data

Male and female teachers in the active phase of working at the time of the study and pertaining to the municipal public elementary school system were included in the study. Substitute teachers, assistant teachers, interns, those who had less than one year of experience teaching, those who did not make up part of the municipal public school system and those who worked in other sectors of the school and did not practice classroom teaching daily were excluded from the study. Schools in the rural zone, daycare centers and nurseries were also excluded.

Prior to the data collection process, meetings and educational lectures were held to raise the awareness of the teachers and administrators at each school. Two hundred five questionnaires were delivered and 203 were returned (99% response rate). The study was conducted in two steps. The first step consisted of the use of an adapted self-administered questionnaire²⁶. The following data were collected: identification (code of interviewee, school/institution, date and initials of respondent); sociodemographic characteristics (sex, age, date of birth, marital status and schooling); professional activity (teaching experience, number of schools at which the respondent was working at the time of the interview, weekly workload with students, number of students per class, grade taught, whether the respondent exercised another professional activity outside the school, type of employment tie, type of working environment [calm or not], whether interval between classes was sufficient to rest, whether the workplace offered a place for teachers to rest and number of classes the respondent taught); work environment (physical space, lighting, acoustics, ventilation, chalk, dust, external noise, internal noise [by students in the classroom] and relationship with co-workers); and general health conditions: (1) individual vocal characteristics (raising voice, shouting or using singsong voice while teaching, voice loss or failure, fatigue while speaking or at the end of the day, hoarseness, throat clearing and feeling of a lump or foreign body in throat/oropharynx); (2) lifestyle characteristics (smoking, alcohol use, use of medications in previous two weeks, daily water

intake and ease of access to water at school); (3) symptoms related to the respiratory system (rhinitis, sinusitis, tonsillitis, pharyngitis, laryngitis, bronchitis, asthma and colds); (4) gastric symptoms (heartburn, acid reflux and gastritis); (5) problems related to hearing system (difficulty hearing, earache, tinnitus, dizziness and/or vertigo); and (6) sleep quality.

Dysphonia and laryngeal lesions were evaluated using three methods: self-perceptions, diagnostic criteria, and video-assisted laryngoscopy. Self-reported dysphonia was assessed by reference to some general health characteristics (vocal aspects, vocal complaints, self-reported voice disorder)²⁷. The diagnostic criteria were assessed at the time of the interview with the identification of vocal characteristics compatible with 04 or more laryngopathies (cough, throat clearing, sore throat, foreign body sensation, excess mucus in the larynx, other symptoms related to the respiratory system, gastric and auditory signs, and symptoms)¹².

In the second step, all teachers with self-reported dysphonia and those with vocal characteristics compatible with laryngopathy (4 or +) were invited to participate in a specialized medical examination involving rigid video-assisted laryngoscopy performed by a head and neck surgeon and otolaryngologist. The laryngoscopic exams were scheduled through the schools using the codes of the interviewees. However, only 60 of the teachers with dysphonia underwent the exams. Laryngoscopy is an exam of the upper air ways performed with a flexible fiberoptic endoscope, which enables observing the interior of the nasal and laryngeal organs. Video-assisted laryngoscopy was performed at a private medical office during previously scheduled appointments at no cost to the 60 participants who underwent this procedure. For such, a rigid 70^o optic scope with a magnification field was used, with a video camera coupled to an image capturing system of the MDmed program.

Spreadsheets on Microsoft Office Excel 2010 were used for the creation of the database. All data were entered twice for the analysis of external consistency. The items on the questionnaires were categorized in a code

book. The data were expressed as absolute and relative frequencies and presented in tables. Analysis of variance was performed using the chi-squared test (χ^2) and Fisher's exact test for the comparison of categorical variables and the Student's t-test for the comparison of continuous variables with normal distribution.

Univariate logistic analysis was used for the selection of the main factors associated with the outcome. All variables with a p-value <0.20 in the univariate analysis were incorporated into the multivariate logistic regression analysis for the estimation of odds ratios (OR) and respective 95% confidence intervals (CI). The level of significance was set to 5% ($p \leq 0.05$). Simple and multiple regression models were used to quantify the association between exposure (explanatory variable) and outcome (response variable), given that the responses were binary (having or not having dysphonia; having or not having laryngeal lesions). The Statistical Package for the Social Sciences (SPSS, version 21.0, IBM Corp., Armonk, NY, USA) was used for all statistical analyses.

This study received approval from the Human Research Ethics Committee of Ceuma University (certificate number: 2.378.153/2017). All volunteers who agreed to participate in the study signed a statement of informed consent.

RESULTS

The sample was composed of 203 teachers from elementary school public system of Imperatriz, state of Maranhão, Brazil. One hundred forty exhibited dysphonia, which corresponds to a prevalence rate of 68.9%, all of whom were invited to undergo video-assisted laryngoscopy, but only 60 appeared for the exams (42.8%).

Table 2 displays the sociodemographic, professional, and environmental characteristics of the sample. One hundred twenty-five (61.6%) considered the internal noise excessive and 84 (41.6%) reported that the external noise was harmful; these results were statistically significant ($p = 0.002$ and $p = 0.027$, respectively).

Table 2 – Distribution of sociodemographic, professional, and work environment characteristics according to presence/absence of dysphonia among teachers from elementary school public system of Imperatriz, MA, Brazil, 2017 (n = 203).

Variables	DYSPHONIA						p-value
	Yes		No		Total		
	n %	%	n %	%	n %	%	
Age group (n=193)**							
< 30	7	5.1	2	3.6	9	5.3	0.088
30-39	25	18.2	12	21.4	37	21.8	
40-49	54	39.4	11	19.6	65	38.2	
50-59	43	31.4	26	46.4	69	40.6	
60 or more	8	5.8	5	8.9	13	7.6	
Sex (n=202)**							

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Variables	DYSPHONIA						p-value
	Yes		No		Total		
	n %	%	n %	%	n %	%	
Male	19	13.7	13	20.6	32	15.8	0.209
Female	120	86.3	50	79.4	170	84.2	
Marital status							
Unknown	4	2.9	2	3.2	6	3.0	
Married	73	52.1	29	46.0	102	50.2	0.419
Divorced	13	9.3	6	9.5	19	9.4	
Single	48	34.3	22	34.9	70	34.5	
Widowed	2	1.4	4	6.3	6	3.0	
Schooling							
Teaching	1	0.7	0	0.0	1	0.5	
High school	2	1.4	1	1.6	3	1.5	
Master's degree	2	1.4	0	0.0	2	1.0	0.861
Specialist	46	32.8	22	34.9	68	32.9	
Higher level	87	62.1	39	61.9	126	62.1	
Unknown	2	1.4	1	1.6	3	1.5	
Teaching experience (years) (n=200)**							
1 – 5	14	10.2	9	14.3	23	11.5	
6 – 10	24	17.5	4	6.3	28	14.0	
11 – 15	8	5.8	2	3.2	10	5.0	
16 – 20	33	24.1	19	30.2	52	26.0	0.322
21 – 25	30	21.9	18	28.6	48	24.0	
26 – 30	18	13.1	6	9.5	24	12.0	
> 30	10	7.3	5	7.9	15	7.5	
Nº of schools (n=200)**							
1	72	52.6	30	47.6	102	51.0	
2	61	44.5	32	50.8	93	46.5	0.828
3	2	1.5	1	1.6	3	1.5	
4	1	0.7	0	0.0	1	0.5	
10	1	0.7	0	0.0	1	0.5	
Other activities							
Yes	32	22.9	7	11.1	39	19.2	0.049
No	108	77.1	56	88.9	164	80.8	
Work tie							
Contracted	11	7.9	5	7.9	16	7.9	0.143
Effective	122	87.1	57	90.5	179	88.2	
Coordinator	7	5.0	0	0.0	7	3.4	
Other	0	0.0	1	1.6	1	0.5	
Weekly workload (hours)							
< 10	1	0.7	2	3.2	3	1.5	
10 – 20	50	35.7	24	38.1	74	36.5	
20 – 30	6	4.3	5	7.9	11	5.4	0.498
30 – 40	73	52.1	28	44.4	101	49.8	
> 40	8	5.7	4	6.3	12	5.9	
Unknown	2	1.4	0	0.0	2	1.0	
Tranquility work environment							
Never	16	11.4	6	9.5	22	10.8	

Variables	DYSPHONIA						p-value
	Yes		No		Total		
	n %	%	n %	%	n %	%	
Rarely	45	32.1	16	25.4	61	30.0	0.765
Sometimes	67	47.9	34	54.0	101	49.8	
Always	10	7.1	5	7.9	15	7.4	
I don't know	2	1.4	2	3.2	4	2.0	
Classroom size (number of students)							
Unknown	1	0.7	0	0.0	1	0.5	
<15	2	1.4	0	0.0	2	1.0	0.569
15-30	37	26.4	19	30.2	56	27.6	
> 30	100	71.4	44	69.8	144	70.9	
Adequate place for rest							
No	70	50.0	38	60.3	108	53.2	0.173
Yes	70	50.0	25	39.7	95	46.8	
Adequate break							
No	90	64.3	37	58.7	127	62.6	0.449
Yes	50	35.7	26	41.3	76	37.4	
Number of classes							
1 – 5	71	50.7	34	54.0	105	51.7	
6 – 10	40	28.6	22	34.9	62	30.5	0.252
> 10	13	9.3	5	7.9	18	8.9	
Unknown	16	11.4	2	3.2	18	8.9	
Ventilation							
Adequate	62	44.3	23	36.5	85	41.9	0.299
Inadequate	78	55.7	40	63.5	118	58.1	
Lighting							
Adequate	86	61.4	40	63.5	126	62.1	0.779
Inadequate	54	38.6	23	36.5	77	37.9	
Acoustics							
Adequate	64	45.7	32	50.8	96	47.3	0.655
Inadequate	76	54.3	31	49.2	107	52.7	
Classroom size (n=201)**							
Adequate	104	75.4	45	71.4	149	74.1	0.556
Inadequate	34	24.6	18	28.6	52	25.9	
Dust (n=202)**							
No	53	38.1	33	52.4	86	42.6	0.058
Yes	86	61.9	30	47.6	116	57.4	
External noise (n=202)**							
No	74	53.2	44	69.8	118	58.4	0.027
Yes	65	46.8	19	30.2	84	41.6	
Internal noise							
No	44	31.4	34	54.0	78	38.4	0.002
Yes	96	68.6	29	46.0	125	61.6	
Good relationship with co-workers							
No	1	0.7	0	0.0	1	0.5	0.501
Yes	139	99.3	63	100.0	202	99.5	
Chalk dust							

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Variables	DYSPHONIA						p-value
	Yes		No		Total		
	n %	%	n %	%	n %	%	
No	139	99.3	60	95.2	199	98.0	0.055
Yes	1	0.7	3	4.8	4	2.0	

*multiple answers; **n differs from 203 due responses that were crossed out, leading to the exclusion of questionnaires only for the topic in question; Chi-squared (χ^2) test with $p \leq 0.05$, with presence/absence of dysphonia.

Source: Research data

Table 3 displays the general and vocal health characteristics of the sample. The prevalence of self-reported dysphonia was 68.9% ($n = 140$). The prevalence of diagnosed dysphonia was 59.1% ($n = 120$). One hundred fifty-one (74.4%) teachers reported some type of digestive problem, 175 (86.2%) reported respiratory problems and 95 (46.8%) reported using medications; these latter two results were statistically significant ($p = 0.005$ and $p =$

0.023, respectively). Water consumption was a routine practice among 194 (95.6%) teachers and 185 (91.1%) reported having easy access to water at the workplace; this result was statistically significant ($p = 0.003$). The statistically significant vocal characteristics were voice loss or failure ($p < 0.001$), fatigue when speaking ($p < 0.001$) and hoarseness ($p < 0.001$).

Table 3 – Distribution of general and vocal health characteristics among teachers from elementary school public system of Imperatriz, MA, Brazil, 2017 ($n = 203$).

General health aspects	DYSPHONIA						p-value
	Yes		No		Total	%	
	n %	%	n %	%			
Dysphonia (Self-reported)	140	68.9	63	31.1	203	100	–
Dysphonia (Diagnosed)	120	59.1	83	40.9	203	100	–
Digestive problems							
Negative	32	22.9	20	31.7	52	25.6	0.180
Positive	108	77.1	43	68.3	151	74.4	
Respiratory problems ($n=200$)**							
Negative	13	9.3	15	23.8	28	13.8	0.005
Positive	127	90.7	48	76.2	175	86.2	
Hearing problems							
Negative	35	25.0	15	23.8	50	24.6	0.855
Positive	105	75.0	48	76.2	153	75.4	
Use of medication							
No	67	47.9	41	65.1	108	53.2	0.023
Yes	73	52.1	22	34.9	95	46.8	
Smoking							
No	134	95.7	61	96.8	195	96.1	0.707
Yes	6	4.3	2	3.2	8	3.9	
Alcoholic beverages							
No	100	71.4	47	74.6	147	72.4	0.640
Yes	40	28.6	16	25.4	56	27.6	
Daily water consumption							
No	8	5.7	1	1.6	9	4.4	0.186
Yes	132	94.3	62	98.4	194	95.6	
Easy access to water at school							
No	18	12.9	0	0.0	18	8.9	0.003
Yes	122	87.1	63	100.0	185	91.1	

General health aspects	DSYPHONIA				Total	%	p-value
	Yes		No				
	n %	%	n %	%			
Sleeps well							
No	51	36.4	15	23.8	66	32.5	0.076
Yes	89	63.6	48	76.2	137	67.5	
Raises voice							
Never	3	2.1	0	0.0	3	1.5	0.173
Rarely	8	5.7	7	11.1	15	7.4	
Sometimes	39	27.9	24	38.1	63	31.0	
Often	58	41.4	23	36.5	81	39.9	
Always	32	22.9	9	14.3	41	20.2	
Shouts							
Never	11	7.9	12	19.0	23	11.3	0.071
Rarely	27	19.3	17	27.0	44	21.7	
Sometimes	74	52.9	23	36.5	97	47.8	
Often	22	15.7	9	14.3	31	15.3	
Always	6	4.3	2	3.2	8	3.9	
Sings (n=202)**							
Never	12	8.6	12	19.0	24	11.9	0.304
Rarely	39	28.1	15	23.8	54	26.7	
Sometimes	61	43.9	26	41.3	87	43.1	
Often	21	15.1	7	11.1	28	13.9	
Always	6	4.3	3	4.8	9	4.5	
Voice loss or failure							
Never	7	5.0	21	33.3	28	13.8	0.000
Rarely	28	20.0	16	25.4	44	21.7	
Sometimes	68	48.6	26	41.3	94	46.3	
Often	26	18.6	0	0.0	26	12.8	
Always	11	7.9	0	0.0	11	5.4	
Fatigue while speaking (n=202)**							
Never	18	12.9	22	34.9	40	19.8	0.001
Rarely	16	11.5	11	17.5	27	13.4	
Sometimes	58	41.7	20	31.7	78	38.6	
Often	31	22.3	9	14.3	40	19.8	
Always	16	11.5	1	1.6	17	8.4	
Hoarseness							
Never	4	2.9	16	25.4	20	9.9	< 0.001
Rarely	21	15.0	21	33.3	42	20.7	
Sometimes	72	51.4	22	34.9	94	46.3	
Often	33	23.6	4	6.3	37	18.2	
Always	10	7.1	0	0.0	10	4.9	

**n differs from 203 due responses that were crossed out, leading to the exclusion of questionnaires only for the topic in question; Chi-squared (χ^2) test with $p \leq 0.05$, with presence/absence of dysphonia.

Source: Research data

All variables were analyzed using logistic regression methods, with self-reported dysphonia by the teacher as well as dysphonia diagnosed based on clinical vocal

characteristics and the presence of laryngeal lesions. Self-reported dysphonia was associated with respiratory problems (OR=3.00; CI95%=1.25-7.22) and internal noise

(OR=2.43; CI95%=1.24-4.73). The use of medications (OR=2.31; CI95%= 1.19-4.49) was risk factor for self-reported dysphonia. Easy access to water (OR=0.09; CI95%= 0.01-0.79) was a protection factor for self-reported dysphonia (Table 4).

Table 4 – Multivariate and adjusted association with self-reported dysphonia among teachers from elementary school public system of Imperatriz, MA, Brazil, 2017.

Independent variable	p-value ^a	OR	95% CI of OR		p-value ^b	OR*	95% CI of OR	
			Lower	Upper			Lower	Upper
Sex (woman)	0.439	1.48	0.55	3.99				
Age group (>30)	0.543	0.89	0.62	1.28				
Digestive problems (Yes)	0.841	1.10	0.45	2.67				
Respiratory problems (Yes)	0.034	3.02	1.09	8.37	0.014	3.00	1.25	7.22
Hearing problems (Yes)	0.764	0.87	0.35	2.14				
Use of medication (Yes)	0.070	2.00	0.94	4.23	0.014	2.31	1.19	4.49
Smokes (Yes)	0.616	1.65	0.23	11.58				
Drinks alcoholic beverages (Yes)	0.670	0.83	0.36	1.94				
Daily water intake (Yes)	0.451	0.50	0.08	3.00				
Easy access to water at school (Yes)	0.074	0.12	0.01	1.23	0.030	0.09	0.01	0.79
Sleeps well (Yes)	0.300	0.64	0.28	1.48				
Dust (Yes)	0.455	1.35	0.61	2.99				
External noise (Yes)	0.299	1.56	0.67	3.64				
Internal noise (Yes)	0.031	2.33	1.08	5.05	0.009	2.43	1.24	4.73
Good relationship with co-workers (Yes)	0.124	8.40	0.56	126.49	0.145	5.29	0.56	49.81
Chalk dust (Yes)	0.056	0.06	0.00	1.07	0.109	0.12	0.01	1.60
Ventilation (Inadequate)	0.089	2.20	0.89	5.48	0.320	1.41	0.71	2.80
Lighting (Inadequate)	0.261	1.66	0.69	4.02				
Acoustics (Inadequate)	0.850	1.08	0.47	2.51				
Room size (Inadequate)	0.087	2.08	0.90	4.82	0.198	1.63	0.77	3.44
Lesion	0.374	1.76	0.51	6.07				

*Adjusted logistic regression; ^a p-value <0.20; ^b p-value ≤ 0.05.

Source: Research data

Diagnosed dysphonia was associated with digestive problems (OR=5.35; CI95%= 2.39 – 11.96), external noise (OR=4.89; CI95%=1.87-12.78) and inadequate ventilation (OR=3.56; CI95%=1.46-8.62) (Table 5).

Table 5 – Multivariate and adjusted association with diagnosed dyphonia (based on clinical vocal characteristics) among teachers from elementary school public system of Imperatriz, MA, Brazil, 2017.

Independent variable	p-value ^a	OR	95% CI of OR		p-value ^b	OR*	95% CI of OR	
			Lower	Upper			Lower	Upper
Sex (woman)	0.774	1.19	0.37	3.85				
Age group (>30)	0.352	1.23	0.79	1.91				
Digestive problems (Yes)	0.000	6.43	2.29	18.06	0.000	5.35	2.39	11.96
Respiratory problems (Yes)	0.486	1.60	0.43	5.95				
Hearing problems (Yes)	0.501	1.43	0.51	4.00				
Use of medication (Yes)	0.649	1.23	0.50	3.01				
Smokes (Yes)	0.854	1.24	0.13	12.13				
Drinks alcoholic beverages (Yes)	0.929	0.96	0.35	2.62				
Daily water intake (Yes)	0.184	0.22	0.02	2.07	0.750	0.77	0.154	3.85
Easy access to water at school (Yes)	0.938	1.07	0.19	6.06				
Sleeps well (Yes)	0.886	1.08	0.39	2.95				
Dust (Yes)	0.676	0.82	0.31	2.12				
External noise (Yes)	0.017	3.71	1.27	10.88	0.001	4.89	1.87	12.78
Internal noise (Yes)	0.347	1.58	0.61	4.06				
Good relationship with co-workers (Yes)	0.873	0.77	0.03	19.89				
Chalk dust (Yes)	0.780	0.67	0.04	10.97				
Ventilation (Inadequate)	0.004	6.01	1.79	20.23	0.005	3.56	1.46	8.62
Lighting (Inadequate)	0.219	1.96	0.67	5.72				

Independent variable	p-value ^a	OR	95% CI of OR		p-value ^b	OR*	95% CI of OR	
			Lower	Upper			Lower	Upper
Acoustics (Inadequate)	0.063	2.63	0.95	7.28	0.078	2.15	0.91	5.05
Room size (Inadequate)	0.029	3.30	1.13	9.64	0.429	0.70	0.29	1.69
Lesion	0.998	1.00	0.00					

*Adjusted logistic regression; ^a p-value <0.20; ^b p-value ≤ 0.05.

Source: Research data

Laryngeal lesions were positively associated with the inadequate lighting (OR=3.74; CI95%= 1.15-12.14), inadequate acoustics (OR=4.14; CI95%=1.32-12.95) and inadequate room size (OR=3.76; CI95%=1.29-10.91).

Respiratory problems (OR=0.21; CI95%=0.06-0.76), easy access to water (OR= 0.12; CI95%=0.04-0.38) and use of medication (OR=0.34; CI95%= 0.12-0.92) were protection factors against laryngeal lesions (Table 6).

Table 6 – Multivariate and adjusted association with laryngeal lesions among teachers in the municipal education system of Imperatriz, MA, Brazil, 2017.

Independent variable	p-value ^a	OR	95% CI of OR		p-value ^b	OR*	95% CI of OR	
			Lower	Upper			Lower	Upper
Sex (woman)	0.080	23.17	0.69	777.17	0.056	4.15	0.96	17.84
Age group (>30)	0.632	0.88	0.52	1.49				
Digestive problems (Yes)	0.152	3.12	0.66	14.80	0.193	2.58	0.62	10.73
Respiratory problems (Yes)	0.102	0.30	0.07	1.27	0.017	0.21	0.06	0.76
Hearing problems (Yes)	0.124	0.38	0.11	1.30	0.089	0.39	0.13	1.15
Use of medication (Yes)	0.093	0.40	0.14	1.16	0.033	0.34	0.12	0.92
Smokes (Yes)	0.999	0.00	0.00					
Drinks alcoholic beverages (Yes)	0.814	0.87	0.27	2.78				
Daily water intake (Yes)	0.377	0.44	0.07	2.74				
Easy access to water at school (Yes)	0.052	0.23	0.05	1.01	0.000	0.12	0.04	0.38
Sleeps well (Yes)	0.921	0.95	0.31	2.85				
Dust (Yes)	0.055	3.10	0.98	9.87	0.182	1.96	0.73	5.26
External noise (Yes)	0.505	0.68	0.21	2.14				
Internal noise (Yes)	0.044	3.65	1.04	12.84	0.107	2.39	0.83	6.88
Good relationship with co-workers (Yes)	0.243	0.15	0.01	3.70				
Chalk dust (Yes)	0.999	0.00	0.00					
Ventilation (Inadequate)	0.798	1.16	0.37	3.65				
Lighting (Inadequate)	0.089	3.08	0.84	11.26	0.028	3.74	1.15	12.14
Acoustics (Inadequate)	0.060	3.26	0.95	11.18	0.015	4.14	1.32	12.95
Room size (Inadequate)	0.048	3.17	1.01	9.98	0.015	3.76	1.29	10.91

*Adjusted logistic regression; ^a p-value <0.20; ^b p-value ≤ 0.05.

Source: Research data

Among the 60 participants who underwent video-assisted laryngoscopy, 53.3% (n=32) has some type of laryngeal lesion and 43.3% (n=26) had no lesions but had other findings. Moreover, 3.3% (n=2) were unable to do the exam due to feelings of nausea. During the performance of video-laryngoscopies, the entire oral and laryngeal cavity of the teachers was evaluated, and thus other findings located outside the vocal folds were identified. However, as the objective of the study was to study changes that fit dysphonia, only laryngeal lesions were considered among the findings. Among these videolaryngoscopic findings, the laryngeal lesions found were as follows: micronodules (21.7%), vocal nodules (8.3%), vascular dysgenesis (8.3%), vocal sulcus (5%), thickening of free edge of the left vocal fold (1.7%) and right vocal fold (3.3%), leukoplakia (3.3%) and aryepiglottic fold cyst (1.7%). The prevalence of laryngeal lesions among the participants who underwent

laryngoscopy was 53.3% (data not presented in table).

DISCUSSION

The main findings of the present study were the high prevalence of dysphonia among teachers and the fact that environmental factors related to the workplace can lead to occupational health problems.

It is necessary to understand the context of worker health among teachers in order to achieve significant improvements in the working conditions of these professionals as well as in the context of Brazilian Public Health. The present findings suggest the need to investigate services offered to teachers in the public education system in different regions of Brazil and determine factors associated with vocal disorders in this occupation.

This study shows high prevalence rates of self-reported dysphonia (68.9%), of diagnosed dysphonia (59.1%)

and laryngeal lesions in teachers with dysphonia (53.3%) who work in the basic education system in a municipality in Amazonia. Multicausality was found for vocal disorders, with an increased chance of self-reported or diagnosed (based on four or more clinical vocal characteristics or video-assisted laryngoscopy) dysphonia in teachers with respiratory and digestive problems and those who teach in an inadequate work environment. However, the use of medications, respiratory problems and easy access to water had protective effects.

The prevalence of vocal disorders was higher than rates reported in developed countries such as Europe and the United States of America^{7,10,16}, as well as other national studies^{12,28,29}, although literature describes extreme variability regarding disorders in this occupation⁹.

In the present study, vocal problems were more frequent among the female teachers, who accounted for 86.3% of the individuals with such problems. The literature³⁰⁻³³ also reports that women are more vulnerable to vocal problems due to anatomical-physiological aspects of the larynx specific to the female sex³⁴, the vocal frequency similar to that found in children, double-work shifts³⁵ and level of schooling⁵. In elementary education, the proportion of women largely prevails. While the male gender has a greater participation in secondary and higher education. This can be a good example that the higher the educational level, the greater the number of men involved³⁶.

Age merits particular attention. In the present study, the large portion of the sample was between 50 and 59 years of age (40.6%), followed by the 40-to-49-year-old age group (38.2%), who were precisely those most affected by vocal problems (31.4 and 39.4%, respectively). Studies on the voice report that 24 to 45 years is considered the age group with the best vocal efficiency and the chances of structural laryngeal changes that affect vocal quality increase with the advance of age²⁸.

No statistically significant associations were found between dysphonia and sociodemographic variable (age group, sex, marital status, schooling and teaching experience), which agrees with findings described in previous studies^{26,31}. A high percentage of teachers had a complete university education (62.1%). This finding may be related to education guidelines stipulated in legislation in Brazil (Law nº 9.394/1996), which establishes that educators with an undergraduate or graduate degree can teach on all levels of the education system, including basic education³².

The internal noise in the work environment was pointed out by most of the dysphonic teachers (68.6%), and our work showed that the presence of noise in the classroom had a significant association with voice problems. Previous studies report a similar finding^{31,37,38}. A survey conducted in Dublin identified that 71.3% of elementary school teachers worked in classes with more than 30 students, and among this group, 69.4% had vocal disorders, also highlighted that the working conditions of these teachers need to be fully adapted to promote vocal health³⁹. In this

sense, we suggest the use of amplifiers and microphones as important aspects of individual protective equipment⁵ in environments that are considered aggravating to the vocal health of teachers as a way to minimize speech effort and vocal fatigue^{40,41}. Nebulization with 0.9% NaCl (NEB) to protect the teacher's voice in the workplace⁴², as well as vocal warm-up/cool-down and the semi-occluded vocal tract exercise with commercial straw, are also low-cost strategies, with positive effects on the teacher's voice in the workplace⁴³.

External noise was also positively associated with vocal symptoms, which agrees with a study conducted in 12 public schools in Colombia (OR=1.83; CI95%=1.12-2.99)³⁵. School noise is present in different forms both inside and outside the classroom, but internal noise is more perceptible to students and teachers than external noise³⁹⁻⁴¹. Brazilian Norm NBR 10152 of the Brazilian Association of Technical Standards stipulates a noise level of 35 to 45 dB as acceptable for the classroom⁴⁴. A study conducted in a city in the state of São Paulo⁴⁵ portrays this situation well, as the mean environmental noise in the classroom ranged from 40 and 51 dB without the students and from 45 to 65 dB with the students, accompanied by an intensity of the voice of the teacher ranging from 52 to 68 dB, reaching 7.8 dB above the environmental noise. In the study, 90% of the schools investigated had noise levels above those recommended by NBR 10152. Another study highlights the reference to noise as something that can be subjective and this aspect should ideally be evaluated in an objective manner, correlating it with the degree of intelligibility of the teacher's speaking¹⁶. In the present study, other environmental factors (inadequate lighting, acoustics, ventilation and classroom size) associated with vocal disorders concomitantly to exposure to noise further aggravated the working environment of teachers. These factors can also have consequences for the respiratory system, thereby exerting an impact on vocal production.

The municipality of Imperatriz is located in the state of Maranhão, which has the second worst Human Development Index in the northeastern region of the country²⁵. The region is characterized by a wet tropical climate with high temperatures as well as environmental pollution and the burning of biomass in the second semester of the year³¹. Classroom infrastructure is precarious, and many urban streets are unpaved, which have impacts on the working and health conditions of the entire school community. These data are compatible to those reported in a study conducted in Nigeria¹⁰.

A significant association was found between dysphonia and digestive problems. Among the participants in the present study, 74.4% had some type of complaint related to the gastrointestinal tract. The most common symptoms were heartburn (60.1%) and acid reflux (41.8%). Moreover, signs of laryngopharyngeal reflux were found in 86.7% of the teachers who were submitted to video-assisted laryngoscopy, despite being an atypical form of gastroesophageal reflux disease, this fact may be related

to the environmental exposures in the workplace, such as: "burning" and dust from the existing unpaved streets. The literature also reports high prevalence rates of acid reflux, with 70 to 90% of vocal problems in professionals who rely on their voices due to both vocal activity and living habits, such as smoking, alcohol use and a sedentary lifestyle^{26,27,46}.

A significant association was also found between dysphonia and respiratory problems. Approximately, 86.2% of the teachers reported a history of respiratory conditions, such as rhinitis, sinusitis, pharyngitis, laryngitis, bronchitis/asthma and colds, the most prevalent of which were colds (66.9%), sinusitis (45.8%), rhinitis (36.9%) and tonsillitis (36.9%), which is similar to data reported in previous studies^{10,47}. Among allergic disorders, rhinitis occurs repeatedly and its main cause is inhaled allergens, such as dust mites, mold dust and chalk dust; moreover, allergic rhinitis is an aggravating factor of dysphonia and teachers are advised to seek specific treatment to avoid a worsening of the condition^{32,48}.

The use of medications in the previous two weeks was also positively associated with vocal problems. This practice was common among 46.8% of the teachers evaluated and 52.1% of those with dysphonia. No detailed investigation was made regarding what medications were used or the duration of treatment (acute or continuous). Therefore, information bias may have occurred. It should also be pointed out that the use of medication does not necessarily mean that these individuals sought a physician, as they may have been self-medicating. The question about drug treatment refers to the use of general medication. Perhaps, this association is related to the increase in the use of psychotropic drugs by teachers and the association between voice problems and mental disorders⁴⁹, mainly among teachers who work in various schools⁵⁰.

Another finding was that teachers with dysphonia and respiratory problems had a lower chance of exhibiting vocal lesions. It is possible that the symptoms of a laryngopathy emerge more rapidly and more intensively in the presence of an aggravating factor among individuals with a previously established laryngeal problem, making them quickly diminish the demands on their voice, which may explain the protective effect found in this study. Another question, maybe this finding in our study may be explained by the fact of use of medication also being a protective factor for vocal lesions, taking into consideration that some of these medicines have been used to treat respiratory problems of the teachers. However, this hypothesis should be investigated later.

The consumption of water during work was frequent among the teachers, with 95.6% drinking water during their activities on daily basis and 91.1% reporting having easy access to water in the work environment. Easy access to water was also a vocal protection factor, which agrees with findings describe in previous studies⁵⁰, demonstrating the importance of water to the maintenance and im-

provement of vocal health. Therefore, facilitating access to water is a simple, low-cost measure that should be performed and encouraged in all vocal health policies.

The present study has limitations that should be considered. In the cross-sectional design, exposure and outcome factors are determined simultaneously, which does not enable the determination of causality between vocal disorders and associated factors. Therefore, one cannot discard the possibility of measurement and recall bias. Most teachers did not undergo video-assisted laryngoscopy and the extrapolation of the data to all teachers in basic education should be performed with caution. Moreover, the prevalence of vocal problems may have been underestimated due to the non-perception of such problems or a lack of knowledge regarding one's own voice³⁴.

CONCLUSION

The present study reveals a high prevalence of vocal disorders among elementary school teachers of Imperatriz, state of Maranhão, located in Brazil's Legal Amazon (BLA). Dysphonia and laryngeal lesions were evaluated using three methods: self-perceptions, diagnostic criteria, and video-assisted laryngoscopy. Vocal disorders were associated with aspects related to the working environment, such as internal noise, external noise, respiratory problems, digestive problems, and the use of medications. Among the teachers with dysphonia, respiratory problems, use of medication and easy access to water during work activities were protection factors. The results of this study underscore the need for the combined effort of worker health, education and public health administrators for the establishment of public policies aimed at the promotion of occupational health that prioritize actions on different levels, such as awareness regarding the voice as an instrument of work and an important teaching tool, investment in regular vocal improvement programs for teaching staff and the drafting of strategies that can minimize factors associated with risk to the vocal health of teachers. Moreover, there is an urgent need to implement public policies that promote vocal health, to prevent morbidities, and to improve working conditions in this occupation.

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