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Keywords

Speech, Language and Hearing Sciences
 Voice
 Noise
 Faculty
 Occupational Health
 Working Conditions

Descritores

Fonoaudiologia
 Voz
 Ruído
 Docentes
 Saúde do Trabalhador
 Condições de Trabalho

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Received: February 18, 2015

Accepted: June 30, 2015

Teacher's voice: vocal tract discomfort symptoms, vocal intensity and noise in the classroom

Voz do professor: sintomas de desconforto do trato vocal, intensidade vocal e ruído em sala de aula

ABSTRACT

Objective: To identify a possible correlation between teachers vocal intensity and the noise in the classroom, as well as between vocal intensity and the symptoms of vocal tract discomfort before and after classes. **Methods:** 27 Elementary School I teachers participated in the study. We used the questionnaires “Vocal Production Condition of the Teacher” and “Vocal Tract Discomfort Scale - VTD” which were applied before and after the class. A properly calibrated noise meter was used for measuring noise in the classroom and the teachers' vocal intensity. **Results:** There was a moderate positive correlation between vocal intensity and noise and also a significant difference between the VTD and the teachers with and without vocal complaint before and after classes. When compared separately on both occasions, there was an increase in the group's scores for both groups and with and without complaints. We found association of the vocal tract symptoms before and after classes, frequency of burning, itching, sore throat and sensitive throat were observed. The intensity of symptoms was significant for sore throat, itching and feeling of lump in the throat. We observed significant values of vocal intensity and frequency and intensity of symptoms for sensitive throat and lump in the throat before the class, and sore throat and lump in the throat after the. **Conclusion:** The increase in teacher's vocal intensity correlates to high noise levels in the classroom. The evidence suggests correlation between vocal intensity and discomfort of the vocal tract, with most of the symptoms reported in greater frequency and intensity after the class.

RESUMO

Objetivo: Identificar se existe correlação entre a intensidade vocal das professoras e o ruído em sala de aula, assim como entre a intensidade vocal e os sintomas de desconforto do trato vocal, antes e após a aula. **Métodos:** Participaram 27 professoras do Ensino Fundamental I. Foram utilizados os questionários Condição de Produção Vocal do Professor e Escala de Desconforto do Trato Vocal, aplicados antes e após a aula. Para medição do ruído dentro da sala de aula e da intensidade vocal das professoras foi utilizado decibelímetro. **Resultados:** Houve correlação positiva moderada entre a intensidade vocal e o ruído. Observou-se diferença significativa entre a EDTV e as professoras com e sem queixa vocal antes e após a aula. Quando comparadas separadamente nos dois momentos, verificou-se aumento nos escores tanto para as professoras com queixa vocal quanto para as que não apresentaram queixa. Ocorreram associações dos sintomas do trato vocal antes e após a aula, da frequência de queimação, coceira, garganta irritada e garganta sensível. A intensidade dos sintomas foi significativa para garganta dolorida, coceira e bola na garganta. Observaram-se valores significativos sobre intensidade vocal e frequência e intensidade dos sintomas para garganta sensível e bola na garganta antes da aula e garganta irritada e bola na garganta após a aula. **Conclusão:** O aumento da intensidade vocal das professoras correlaciona-se aos altos níveis de ruído. Constata-se correlação entre intensidade vocal e sintomas de desconforto do trato vocal, sendo a maioria dos sintomas relatados com maior frequência e intensidade após a aula.

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Financial support: none.

Conflict of interests: nothing to declare.

INTRODUCTION

Teaching is one of the professions with the highest incidence of voice disorders, mostly due to the poor working conditions⁽¹⁾ related to the excessive vocal demand and the elevated voice intensity, often as a result of the presence of intensive noise in the classroom⁽²⁾.

This multifactorial nature of teachers' work environment can cause various symptoms^(3,4), constituting a risk factor for the development of voice disorders, impacting work performance⁽⁵⁻⁷⁾.

One of the main risk factors for the development of voice disorders is the increase in vocal intensity in the classroom⁽⁸⁾. In general, the intensity of the teacher's voice rises from 10 to 30 dB(A) above the intensity of ambient noises^(9,10).

Thus, the noise assessment objectively performed with the sound level meter at different times and school sites⁽¹¹⁾ as well as the self-assessment of symptoms reported by teachers⁽¹²⁾ contribute to understanding the noise-voice relationship and the environmental and organizational aspects.

In general, the symptoms reported by the patient with vocal complaints, whether they are teachers or not, can be sensory, when they involve unpleasant sensations in the body, specifically in the area of shoulders and neck at the time of vocal emission, or auditory, when the patient perceives auditorily that their voice quality has changed^(4,13,14). Moreover, these symptoms may continuously vary in terms of both frequency and intensity, affecting, in some cases, the individual's well-being^(4,13).

In this context, the Vocal Tract Discomfort Scale (VTD) was developed as a measurement tool for the intensity and frequency of symptoms of discomfort of the vocal tract, filled by the individual, through the use of qualitative descriptors⁽¹³⁾.

The understanding of issues related to the symptoms of discomfort of the vocal tract is essential in the evaluation of individuals exposed to risk factors for the development of voice disorders, because often these symptoms may indicate the onset of a voice disorder⁽¹⁵⁾.

In this study, we start from the hypothesis that the symptoms of discomfort can be exacerbated by poor working conditions, with constant exposure to noise, which can lead to increase in intensity of the teacher's voice and, consequently, burden the vocal tract⁽¹⁶⁻¹⁸⁾, predisposing to the development of voice disorders.

In this context, this study aimed at identifying whether there is a correlation between teachers' vocal intensity and the noise in the classroom, as well as correlation between vocal intensity and symptoms of vocal tract discomfort referred to by teachers before and after classes.

METHODS

This is a descriptive, transversal, quantitative study. The Human Research Ethics Committee of the home institution, under protocol no. 091/13, approved it and the participating teachers signed an informed consent.

The study was conducted in four public schools that participated in an extension project of a federal educational institution, whose purpose was to deploy a Vocal Health Consultancy Program (ASSEVOX) for elementary school teachers.

Inclusion criteria were being female and participating in all the steps proposed in this study. The gender criterion aimed at avoiding the influence of male and female anatomical and physiological variables on the search results. The teachers who presented auditory complaints were excluded from the study, as well as the teachers of physical education, as their work is conducted in a different environment from that of the conventional classroom, such as sports fields, not fitting in the design of this research.

Thus, the sample consisted of 27 teachers, with an average age of 43 years (SD = 9.42), with an average time of experience of 19 years and average workload of 20 hours per week in the classroom. This sample was composed in a non-probabilistic approach, and by convenience.

In order to avoid the vocal fatigue acquired by teachers along a working week, data collection occurred only on Mondays. In addition to this reason, we chose this day in order to eliminate other variables that could influence the outcome of the research, such as physical education class, which could generate higher noise levels when they occur.

The survey consisted in the application of two self-perception questionnaires. The first was the Teachers' Vocal Production Condition-CPV-P⁽⁷⁾, in which the participants responded to questions related to personal identification, functional status, physical characteristics of the workplace, and vocal aspects. The other questionnaire completed by the participants was the Vocal Tract Discomfort Scale-VTD. This scale was applied in two stages: before the beginning of a class and after its completion, that is, after 4 hours of class. This procedure was adopted in order to verify the frequency and intensity of symptoms of vocal tract discomfort before and after classes. In addition, the noise level in the classroom and teachers' vocal intensity at the time of the class were measured.

Teachers' Vocal Production Condition – CPV-P

The CPV-P⁽⁷⁾ consists of 79 questions related to the following aspects: identification of the respondent, identification of the school, functional status, school environment, organization of work, vocal aspects, and lifestyle. For this study, the following data on variables were used: date of birth, sex, time of profession, working hours, noisy school, noise site, loud noise, unpleasant noise, history of voice problems, and the causes most often cited for this change. The answers to the questions regarding the workplace environment in the CPV-P questionnaire are presented in a Likert scale of four points (never, rarely, sometimes, always).

Vocal Tract Discomfort Scale – VTD

The VTD scale⁽⁴⁾ is a self-assessment questionnaire that seeks to identify the perception of discomfort in the vocal tract using eight qualitative descriptors according to the frequency and intensity of symptoms on a scale from 0 (never) to 6 (always). In this questionnaire, the subject can choose the number that best represents the frequency and intensity of each following item: burning in the throat, throat tightness, dry throat, sore throat, itchy throat, sensitive throat, throat irritation and lump in the throat.

The answers to the questions are presented in a Likert scale of six points: never, rarely, a few times, sometimes, often, almost always, and always to the frequency of symptoms; and none, almost none, mild, almost moderate, moderate, strong, and extreme to the intensity of symptoms.

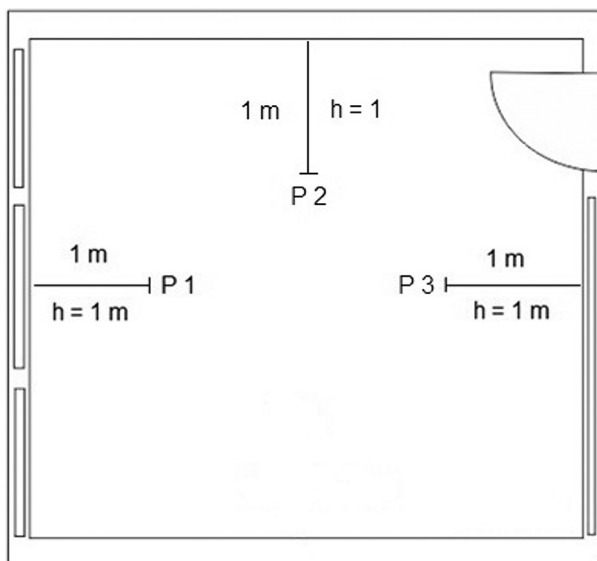
Procedures for the collection of noise level in the classroom and vocal intensity of teachers

The measurement of noise inside the classroom was made with an Akso brand sound pressure level meter, model AK814, 201208154893 series, with calibration certificate n. 6508/2013. For the measurement, the weighting scale (A) was used, for presenting the closest response to the human ear's, and a slow response circuitry, due to large fluctuation of values and for readability. The equipment was turned to the center of the room at 1 meter from the floor and 1 meter from the walls, in order to avoid standing waves.

The measurement of the noise level held during the class was recorded by the sound level meter on three points: next to the windows (P1), next to the chalkboard (P2), and next to the door (P3) for a period of 5 minutes, as shown in Figure 1. The lowest (minimum measure) and the highest (maximum measure) sound pressure levels were considered in each classroom (Figure 1).

The measurement intended to verify if the noise level was within the limits recommended by NBR 10.152⁽¹⁹⁾ – Noise levels for acoustic comfort, for indoor environments, which provides that for the classroom, the noise must be between 40 and 50 dB(A).

Subsequently, the level of vocal intensity of the teachers at the time of the class was measured for a 5-minute period, and the minimum and maximum sound pressure measures found during this period were considered. To this end, the equipment was placed in front of the teacher and 1 meter away from her and from the ground. The positioning was established aiming at favoring the main sound source, which is the voice of the teacher.



Caption: m = meter; h = height; P1 = point 1; P2 = point 2; P3 = point 3
Figure 1. Room layout with three noise measurement points

Data analysis

The data found in the two questionnaires and the measurements of minimum and maximum levels of vocal intensity of teachers and the noise in the classroom were tabulated in Microsoft Excel 2010.

For registration into the database, the questions from the CPV-P questionnaire whose responses were I don't know, never, and rarely were considered as absence, and the responses sometimes and always, as presence.

The VTD scale was tabulated according to the frequency and severity of symptoms on a scale from 0 (never) to 6 (always) before and after classes.

The data related to noise were grouped from the maximum and minimum levels found in each of the three points.

The Cronbach's alpha coefficient was used to measure the reliability of the CPV-P and VTD questionnaires. Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS), version 20.0, using the Pearson correlation test, to correlate the vocal intensity of the teachers and the average noise level in the classroom. The significance level was 5% ($p < 0.05$).

To relate the data from the VTD scale before and after classes, the chi-square test was used, in which the categories never, almost never, a few times, sometimes, often, almost always, and always were considered for the frequency of symptoms; and none, almost none, mild, almost moderate, moderate, strong, and extreme for the intensity of symptoms. Chi-square test allowed concluding if there are discrepancies between the observed and expected frequencies. The significance level was 5% ($p < 0.05$).

To identify the degree of correlation between the VTD scale variables and the vocal intensity of the teachers, Spearman coefficient was used, which indicates the correlation between the points, ranging from -1 (negative correlation) to +1 (positive correlation), adopting a significance level of 5% ($p < 0.05$).

In this study, to classify the correlation coefficients, values from 0.1 to 0.3 were considered to represent a weak correlation; values between 0.4 and 0.6 indicated moderate correlation; and values above 0.7 represented a strong degree of correlation between the variables.

To compare the scores obtained in the VTD scale by teachers who did or did not report complaints of voice disorders in CPV-P, the Mann-Whitney test was used. The analysis of before and after the VTD of teachers within their respective groups (with or without voice disorder complaint) was performed using the Wilcoxon test for paired samples.

RESULTS

By analyzing the Cronbach's alpha coefficient, values found were 0.843 for the CPV-P questionnaire and 0.971 for the VTD scale.

With regard to the noise issue in the school environment, from the 27 study participants, 24 (89.9%) reported that the school is noisy, 17 (63%) reported that the noise comes from within the classroom, 23 reported being loud (85.2%), and 21 as unpleasant (77.8%).

Regarding the vocal aspects, 17 (63%) reported that they have had some voice disorder and 8 (29.6%) reported they are currently facing it. By comparing these data with the symptoms of vocal tract discomfort, it was observed that there was significant difference between teachers with and without voice disorder complaints prior to ($p = 0.033$) and after classes ($p = 0.038$) and higher scores in the group that claimed to have voice disorders. Furthermore, when compared separately the two moments, there was a significant increase in scores both in the group with no voice disorder ($p < 0.001$) and in the group that presented voice disorders ($p = 0.040$) (Table 1). The causes most frequently cited for this disorder were the intensive use of

voice (20/74.1%), exposure to noise (15/55.6%), and allergy (13/48.1%).

The minimum and maximum noise measures collected within the classrooms of the four schools ranged between 55.5 and 85.9 dB(A), with an overall mean of 70.7 dB(A). The minimum and maximum average values of the teachers' voice intensity ranged between 54.3 and 86.6 dB(A), with an overall mean of 71.4 dB(A) (Table 2).

The distribution of the mean values of noise in each classroom and of the vocal intensity of each teacher (Figure 2) was performed.

The level of noise and vocal intensity of the teachers showed moderate positive correlation ($p = 0.041$).

Table 1. Comparison between groups of teachers on the VTD scores before and after class, according to the presence or absence of voice disorder complaints reported in CPV-P

VTD	Absence			Presence			P-value*
	Mean	SD	Standard error	Mean	SD	Standard error	
VTD before	1.21	1.30	0.30	2.33	1.16	0.41	0.033
VTD after	1.94	1.54	0.35	3.07	0.92	0.33	0.038
P-value**	<0.001			0.040			

* Significant values ($p < 0.05$) – Mann-Whitney test

** Significant values ($p < 0.05$) – paired Wilcoxon's test

Caption: VTD = Voice Tract Discomfort Scale; CPV-P = Teachers' Vocal Production Condition; SD = standard deviation

Table 2. Distribution of mean values of noise levels in the classroom and vocal intensity of teachers, per school

	Mean noise levels in the classroom dB(A)		Average vocal intensity of teachers dB(A)
	Min.	Max.	
School 1	Min.	55.5	59.4
	Max.	84.3	84.7
School 2	Min.	55.8	59.1
	Max.	85.3	86.6
School 3	Min.	57.2	54.3
	Max.	85.9	83.6
School 4	Min.	63.6	64.7
	Max.	84.2	80.8

Caption: Min. = minimum; Max. = maximum; dB = decibels

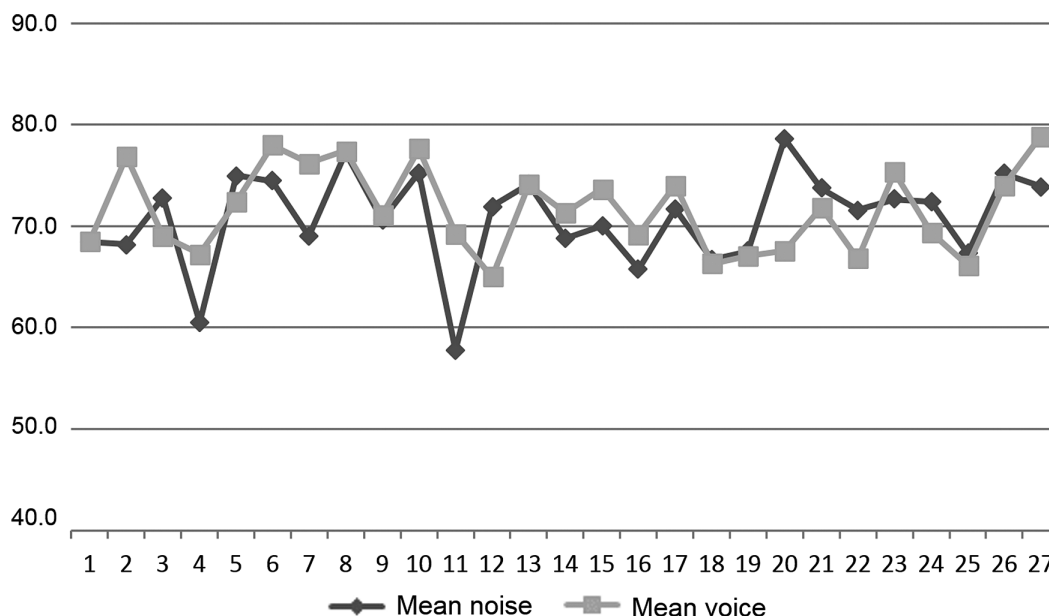


Figure 2. Distribution of the values (mean) of noise in the classroom and vocal intensity (mean) of the teachers during class

With regard to symptoms of vocal tract discomfort, there was an increase in the mean frequency and intensity of the majority of symptoms after class (Table 3).

There was an association of symptoms before and after classes with frequencies of burning in the throat ($p = 0.001$), itchy throat ($p = 0.001$), sensitive throat ($p = 0.029$), and throat irritation ($p = 0.001$). Regarding the intensity of the symptoms, there was difference between the moments before and after classes for sore throat ($p = 0.001$), itchy throat ($p = 0.001$), and lump in the throat ($p = 0.001$) (Table 3).

By correlating the frequency and the intensity of symptoms of vocal tract discomfort to the vocal intensity of teachers, there was a moderate positive correlation between vocal intensity and the frequency and intensity of symptoms of sensitive throat and lump in the throat before class and throat irritation and lump in the throat after class (Table 4).

DISCUSSION

This study consisted of the application of two questionnaires (CPV-P and VTD scale) to active teachers in four primary education schools in a public network, as well as the measurement of the vocal intensity of teachers and noise in the classroom.

The results found by Cronbach's alpha test for the CPV-P self-perception questionnaire showed good reliability, which means a high level of internal consistency. The VTD scale showed excellent level of reliability, higher than that found in a study of the same population and scale⁽⁴⁾.

The composition of this study's sample is similar to other related studies, which presented participants with an average age close to the end of the vocal efficiency period^(8,11,20). The average time of profession found was higher than in other studies^(2,8,21), and the workload was lower when compared to

Table 3. Mean, standard deviation, and standard error of the scores of symptoms, according to the frequency and intensity observed before and after class

	VTD scale before			VTD scale after			P-value
	Mean	SD	Standard error	Mean	SD	Standard error	
FREQUENCY							
Burning	1.11	1.67	0.32	2.11	1.93	0.37	0.001*
Tightness	0.67	1.44	0.28	1.63	1.88	0.36	0.096
Dryness	2.19	1.94	0.37	3.56	1.97	0.38	0.067
Sore throat	1.59	1.76	0.34	2.33	2.00	0.38	0.062
Itchiness	1.41	1.95	0.37	2.07	2.20	0.42	0.001*
Sensitive throat	1.78	2.04	0.39	2.63	2.12	0.41	0.029*
Throat irritation	1.85	1.94	0.37	2.56	1.89	0.36	0.001*
Lump in the throat	1.22	1.55	0.30	1.11	1.37	0.26	0.063
Subtotal	1.48	1.36	0.26	2.25	1.51	0.29	
INTENSITY							
Burning	1.07	1.47	0.28	1.85	1.70	0.33	0.083
Tightness	0.70	1.07	0.21	1.56	1.70	0.33	0.081
Dryness	2.44	2.06	0.40	3.41	1.82	0.35	0.064
Sore throat	1.63	1.86	0.36	2.41	1.89	0.36	0.001*
Itchiness	1.48	1.95	0.38	1.93	2.04	0.39	0.001*
Sensitive throat	2.07	2.27	0.44	2.82	2.11	0.41	0.074
Throat irritation	2.00	2.02	0.39	2.85	1.92	0.37	0.067
Lump in the throat	1.37	1.78	0.34	1.52	1.91	0.37	0.001*
Subtotal	1.60	1.44	0.28	2.29	1.44	0.28	
Total	3.08	2.69	0.52	4.54	2.94	0.56	

*Significant values ($p < 0.05$) – chi-square test

Caption: VTD scale = Voice Tract Discomfort Scale; SD = standard deviation

Table 4. Correlation between vocal intensity and symptoms of vocal tract discomfort, before and after class

	FREQUENCY		INTENSITY	
	BEFORE CLASS			
Correlation value	Sensitive throat	Lump in the throat	Sensitive throat	Lump in the throat
P-value	0.45	0.40	0.41	0.47
	0.021*	0.046*	0.038*	0.017*
	AFTER CLASS			
Correlation value	Throat irritation	Lump in the throat	Throat irritation	Lump in the throat
P-value	0.60	0.46	0.46	0.48
	0.001*	0.020*	0.019*	0.014*

*Significant values ($p < 0.05$) – Spearman correlation test

some studies^(2,21,22), which may be related to the fact that most of the primary education teachers in this study only teach classes in one period per day.

As for the noise in the school environment being loud and unpleasant, similar results were shown in other studies^(16,18,23). It was also found that the noise originated in the classroom was more noticeable for the teachers than that generated externally, which is in line with studies reporting that the internal noise is more noticeable by teachers than the external, which is perceived randomly^(13,24).

The reports of voice disorders by the teachers were equal to the national research and similar to the international research⁽²⁰⁾. Risk factors most often cited as the cause of this disorder were also reported in another study⁽²⁵⁾. Authors⁽²⁶⁾ point out that the main factor for the emergence of a voice disorder is the intensive use of voice related to harmful environmental factors such as exposure to noise. In this sense, it is known that the intensive use of voice can burden the vocal tract of teachers, influencing the configuration of the vocal tract and the operation of the vocal folds⁽⁸⁾.

We found that before the beginning of class, the teachers who reported voice disorder complaints at the time of the survey already had significantly higher scores on the VTD scale than teachers without complaints. After class, the VTD scale scores remained higher in teachers with voice disorder complaints; however, when compared separately the two periods, there was a significant increase in the scores of both the group without voice disorders and the one that presented them (Table 1).

From the above, we can infer that poor working conditions, with constant exposure to noise at high levels, as measured in the classrooms, may have generated a high intensity of voice in the teachers involved in this study, thus burdening the vocal tract, with decrease in the length of the vocal tract, predisposing to the development of auditory and sensory vocal symptoms or even indicating voice disorders⁽⁸⁾.

One study revealed, among other things, discomfort in the vocal tract of teachers with and without vocal complaints; it was found that the symptoms in teachers with complaints are more frequent and the intensity of discomfort in the vocal tract is greater when compared to teachers without complaints, and throat irritation and dry throat were the more frequent and intense symptoms⁽⁴⁾.

The average noise found in this study was 20.7 dB(A), above the ideal limit of acoustic comfort for classrooms, established by NBR 10.152⁽¹⁹⁾, which must not exceed 50 dB(A) (Table 2). It appears that even with the existence of this standard, the noise levels are above the maximum value suggested in the legislation for indoor environments, which can have negative effects for both the teacher and the student⁽¹⁶⁾.

The vocal intensity of the teachers was slightly higher than the noise in the classroom. Studies show that the auditory masking generated by high noise levels leads to increased voice intensity in normal individuals⁽²⁷⁾, a phenomenon known as the Lombard effect, which is the individual's natural tendency of increasing vocal intensity, such as when there is exposure to noise, which prevents the subjects from listening to and understanding the message accordingly (Table 2).

By correlating the vocal intensity of teachers and the measurements of noise in the classroom, a moderate positive value was observed, i.e., the higher the noise in the classroom, the more vocal intensity, leading to sound competition and increasing the vocal efforts made during class.

A moderate positive correlation between noise and vocal intensity has been observed in other studies^(16,23) that show the noise exposure along with excessive vocal demand and high voice intensity as risk factors that can lead to burden the vocal tract of teachers, influencing the configuration of the vocal tract (decrease of supraglottic cavities) and glottal mechanisms, both in terms of greater glottal adduction and of the modification of vocal folds vibration, with a tendency to elevate fundamental frequency and vocal intensity⁽⁸⁾.

With regard to symptoms of vocal tract discomfort, it is observed that, after 4 hours of classes, teachers had a higher frequency and intensity of the majority of symptoms. This may be related to vocal fatigue caused by the exposure to risk factors that are detrimental to the health of the voice, such as the high levels of noise measured in classrooms and the voice intensity of the surveyed teachers.

The teachers' vocal fatigue consists of an overload of glottal mechanisms with the decrease in the extent of resonator cavities, resulting in auditory and sensory vocal symptoms or even voice disorders⁽⁸⁾.

The surveyed teachers presented a higher frequency of burning throat, itchy throat, sensitive throat, and throat irritation after class, as well as greater intensity of symptoms of sore throat, itchy throat, and lump in the throat after class (Table 3).

Often, the first symptoms reported in a voice disorder are throat irritation, itchy throat, dry throat, and lump in the throat^(28,29). In addition, teachers often have hoarseness, dry cough, vocal fatigue, and decrease in their vocal projection capabilities, especially in vocal stress situations⁽³⁰⁾.

The initial study⁽¹⁴⁾ carried out for the creation of the VTD scale noted that there are qualitative differences between the symptoms of discomfort. The most common symptoms in patients with voice disorders are throat irritation and sore throat. The symptoms of dry throat, itchy throat, throat irritation, sensitive throat, and burning throat relate more to the presence of inflammatory changes and/or changes in the tissue in the larynx and hypopharynx, while the symptoms of tightness in the throat, sore throat, and lump in the throat have a greater relationship with muscle tension in the larynx and hypopharynx region.

Thus, in the population studied in the present study, an increase was observed in the frequency and intensity of the sensation of lump in the throat before and after teaching classes (Table 4). Considering that this symptom has a higher correlation with the presence of muscle tension in the vocal tract⁽¹⁴⁾, it can be inferred that teachers who use greater vocal intensity perform an improper adjustment to increase in intensity, with excessive tension in the vocal tract and laryngeal elevation, and they probably maintain this adjustment even outside of the professional environment⁽⁵⁾.

The sensitive throat and sore throat symptoms, which are positively related to the vocal intensity in the periods before and after class, respectively (Table 4), are usually referred to

by individuals with tissue injury and/or inflammation of the larynx and/or hypopharynx⁽¹⁴⁾. Thus, teachers who use greater vocal intensity in their work activities can present a major risk for developing lesions in the laryngeal mucosa.

In this research, the increased frequency and intensity of symptoms of vocal tract discomfort in teachers who use greater vocal intensity during classes can underline the role of this variable in the genesis of a voice disorder in that professional category. A positive correlation between the intensity of the symptoms of vocal tract discomfort and vocal changes was also observed⁽⁴⁾.

The above discussion highlights the importance of this study to support the planning and development of educational health promotion actions, such as voice health campaigns for teachers and awareness of the need to reduce the noise inside and outside the classrooms.

CONCLUSION

There is a correlation between the vocal intensity of the teachers and the noise in the classroom. The vocal intensity measures also relate to the symptoms of vocal tract discomfort before and after classes. A greater number of symptoms of discomfort was observed after 4 hours of class, and there is a correlation between this increase and the use of greater vocal intensity in the classroom.

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Author contributions

All authors participated in the study, including ALFM in the conception, study design, data collection, tabulation, and interpretation; BTLL in the statistical analysis; AMGDA in the collaboration for data collection; LWL and LPFM were responsible for revising the article and MFBLs in guidance and final review of this research.