CoDAS
ISSN 2317-1782 (Online version)

Original Article
Artigo Original

Fatigue, effort and vocal discomfort in teachers after teaching activity

Fadiga, esforço e desconforto vocal em professores após atividade letiva

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Keywords

Voice
Teachers
Speech Therapy
Muscle Fatigue
Self-Evaluation

ABSTRACT

Purpose: Investigate vocal fatigue and its relationship with the sensation of phonatory effort and discomfort in the vocal tract of teachers after a week of activity. **Methods:** Cross-sectional, quantitative study, involving 40 teachers with complaints of vocal fatigue. Procedures performed at the beginning and end of the week, before the classes start were Vocal Fatigue Index, Borg Scale, Vocal Tract Discomfort Scale, and voice recording for perceptual analysis. **Results:** There were no changes in phonatory effort and in frequency and intensity of discomfort in vocal tract. In relation to the VFI, in the domains of fatigue and vocal limitation and physical discomfort associated with the voice, teachers started and ended the week with values compatible with dysphonia. In the vocal restriction domain, they started the week with values compatible with vocal healthy individuals and at the end of the week they had scores compatible with dysphonia. In recovery with vocal rest, the pre and post values were below the cut-off score, meaning less vocal recovery. The greater the sensation of vocal fatigue, the greater the perception of phonatory effort; more frequent is the sensation of tightness, dryness, sore, sensitive and irritated throat and more intense the sensations of discomfort in the vocal tract: tightness, dryness, itching, sensitive and irritated throat. **Conclusion:** Teachers perceive an increase in vocal fatigue, without changes in phonatory effort and vocal tract discomfort after one week of class. The greater the perception of vocal fatigue, the greater the sensation of effort and phonatory discomfort.

Palavras-chaves

Voz
Docentes
Fonoaudiologia
Fadiga Muscular
Autoavaliação

RESUMO

Objetivo: Investigar a fadiga vocal e sua relação com a sensação de esforço fonatório e desconforto no trato vocal de professores após uma semana de atividade letiva. **Método:** Estudo transversal, quantitativo, participando 40 professores com queixas de fadiga vocal. Procedimentos realizados no começo e final da semana, antes do início das aulas: Índice de Fadiga Vocal–IFV, Escala Borg, Escala de Desconforto do Trato Vocal–EDTV e registro de voz para análise perceptivo-auditiva. **Resultados:** Não houve mudanças no esforço fonatório e na frequência e intensidade do desconforto no trato vocal. Em relação ao IFV, nos domínios fadiga e limitação vocal e desconforto físico associado à voz, os professores iniciaram e terminaram a semana com valores compatíveis aos dos disfônicos. No domínio restrição vocal iniciaram a semana com valores compatíveis aos dos indivíduos vocalmente saudáveis e no final da semana tiveram escores compatíveis aos dos disfônicos. Na recuperação com repouso vocal os valores pré e pós foram abaixo da nota de corte, significando menor recuperação vocal. Quanto maior é a sensação de fadiga vocal, maior é a percepção de esforço fonatório; mais frequente é a sensação de aperto, secura, garganta dolorida, sensível e irritada, e mais intensas as sensações de desconforto no trato vocal: aperto, secura, coceira, garganta sensível e irritada. **Conclusão:** Professores percebem aumento de fadiga vocal, sem mudanças no esforço fonatório e desconforto de trato vocal após uma semana de aula. Quanto maior é a percepção de fadiga vocal, maior é a sensação de esforço e desconforto fonatório.

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Received: April 07, 2020

Accepted: July 21, 2020

Trabalho realizado na Universidade Estadual de Ciências da Saúde de Alagoas –UNCISAL, Maceió (AL), Brasil.

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Financial support: nothing to declare.

Conflict of interests: nothing to declare.

INTRODUCTION

The voice is one of the main forms of expression of the human being, however, a category group that highlight for the intense vocal demand, called voice professionals[1].

The professional voice is defined as "the form of oral communication used by individuals who depend on it to exercise their occupational activity"[1]. Teachers use their voice as the main work tool, often in adverse circumstances, which makes them more likely to have vocal problems[2].

The prolonged use of the voice associated with individual, environmental and work organization risk factors can contribute to increase the occurrence of vocal disorders in teachers[3], voice disorder being one of the main causes of absence from teaching[4]. Therefore, these aspects can trigger or intensify the symptoms, making this professional category more predisposed to vocal disorders[4].

The inappropriate use of the voice, which is frequent among teachers, is often the consequence of a lack of knowledge and training[1]. These professionals when exposed to inappropriate conditions of the voice uses or unfavorable work organization may have to increase the vocal effort[5]. Thus, there is often an association between increased workload and vocal alteration, with the consequent favoring of a picture of vocal fatigue[6]. In addition, the work-related voice disorder (WRVD) can be caused by several factors from the work context (environmental, organizational, vocal use factors), as well as the individuals predisposing factors[7].

Vocal fatigue is a perception that can be manifested by increased phonatory effort, usually associated with an increase in vocal demand[8]. In addition, when associated with negative behaviors, it may favor phonotrauma and the development of changes in the larynx[8].

It is still unclear whether vocal fatigue occurs independently of the vocal alteration or if it contributes to this alteration. There is still no consensus in the literature regarding its concept and universal definition, which may be confused with the concept of phonatory effort[9]. One of the first symptoms that vocal production is not being healthy, either due to individual factors or as a result of adverse environmental conditions is the presence of one or more symptoms of discomfort in the vocal tract, possibly resulting from excessive effort in relation to phonation[10].

The assessment of vocal fatigue is still a challenge, due to its multi-causality and the lack of specific instruments for this. Thus, it is believed that an instrument that measures the individual perception in relation to this aspect is important, especially for the development of prevention and treatment patterns for acquired vocal disorders[11].

Studies demonstrate that the most frequent vocal signs and symptoms in teachers have a little relation to the quality of the voice produced and are more frequently associated with physical perceptions related to vocal production, such as fatigue, effort and vocal tract discomfort[2,12].

Understanding the issues related to the perception of vocal tract discomfort is essential in the evaluation of individuals exposed to risk factors for the development of a voice problem, as these symptoms can often indicate the onset of a voice disorder[13]. Thus, it is necessary to identify through research the different symptoms of vocal disorders and promote prevention strategies in this population.

Thus, it is important to investigate whether there is a relationship between effort and feeling of discomfort in the vocal tract and vocal fatigue in teachers after a week of teaching activity.

METHOD

This study was approved by the Research Ethics Committee of the Universidade Estadual de Ciências da Saúde de Alagoas –UNCISAL under the number of CAAE: 11465119.4.0000.501.

Participants: recruitment and characterization

Initially, the subjects were approached in the teachers room and those who reported vocal fatigue complaints were invited to participate in the study. The participants received verbal and written information regarding the research objectives, as well as signed the Free and Informed Consent Form (FIC). Then, in the coordination room, all teachers responded to the protocols, as well as the recording of voices. All data were collected in the months of September and October 2019.

This is a cross-sectional, quantitative study, which included teachers with complaints of vocal fatigue, aged between 18 and 45 years, weekly workload of 20h (04h per day), with at least one year of teaching. Physical Education teachers were excluded, in addition to those who had an upper airway impairment on the day of collection, such as colds or flu.

Procedures

The questionnaire to characterize the sample was developed to outline the profile of the research participants, presenting questions referring to subjects and grades they teach, average number of students per room, time they teach, if there is noise in the room or if they have already consulted a doctor due to voice problems.

The Vocal Fatigue Index (VFI) protocol was developed to investigate the sensation of vocal fatigue, using the validated and adapted version for Brazilian Portuguese in this study, which, unlike the original English version[14], has 17 questions divided into four domains: vocal fatigue and limitation, vocal restriction, physical discomfort associated with the voice and recovery with vocal rest. Higher values mean increased symptoms, except for recovery with vocal rest, in which higher values mean greater vocal recovery[15]. The calculation of the total score was performed using the following formula: Total = Factor 1 + Factor 2 + Factor 3 + (12 - Factor 4). The cutoff values for each factor are 4.50 for fatigue and vocal limitation (factor 1), 3.50 for vocal restriction (factor 2), 1.50 for physical discomfort associated with the voice (factor 3) and 8.50 for recovery with vocal rest (factor 4). For the total score, the value that separates the dysphonic individuals from the healthy ones is 11.50[15].

It is noteworthy that higher scores for factor 4 represent improvement in vocal fatigue symptoms with rest, however this is different from what is observed in other factors[15].

The Borg scale measures the individual perception of effort by measuring a scale from 0 to 10[16]. The Voice Tract Discomfort Scale (VTDS) was developed as a tool for measuring the intensity and frequency of vocal tract discomfort symptoms, completed by the individual himself, using qualitative descriptors. It is a scale with 08 symptoms and sensations that can be felt in the throat.

The individual indicates the frequency and intensity with which the symptoms occur[17], on a scale ranging from 0 to 6 points. For the frequency of the sensation/symptom, the scale varies from (0) to never, (1-2) sometimes, (3-5) many times and (6) always, for the intensity of the sensation/symptom, the scale varies from (0) to none, (1-3) mild, (4-5) moderate and (6) extreme.

The voices were recorded on a portable computer, captured by a unidirectional head set microphone, brand Logitech 350®, placed laterally three centimeters (cm) from the subjects mouth in order to avoid interference from expiratory noise. For the purpose of cataloging and recording the voice, the records were processed in the Voxmetria® version 2.4h acoustic analysis programs, and for the perceptual-auditory analysis of the emissions. Before the procedure, there was a brief explanation about the importance of maintaining habitual phonation, so that the sample of the voices captured were as spontaneous as possible. The subjects were asked to emit the vowel /e/ in a sustained way, followed by counting numbers from 0 to 10. Subsequently, the voices were analyzed by 03 speech therapists who specialized in voice, who defined the degree of vocal deviation, through a scale 0= no deviation, 1= slight deviation, 2= moderate deviation, 3= intense deviation. For the analysis of intra-rater reliability, the Fleiss Kappa test was used, 20% of the voice samples were repeated and the speech therapists evaluation was used with greater reliability (76,2% reliability).

Collection steps

The development of the research consisted of two stages as presented in figure 1.

At the beginning of the week before the beginning of the class (Step 1) and after the end of the week, that is, after 20 hours of class (Step 2). This procedure was adopted in order to verify the frequency and intensity of symptoms of vocal fatigue, phonatory effort and vocal tract discomfort before and after a week of class in the same group composed of 40 teachers.

Stage 1 - Before starting the first class of the week, the teacher answered the questionnaire to characterize the sample in the coordination room. In addition, the VFI Protocol, the Borg Scale and VTDS were applied. Subsequently, the recording of the sustained emission of the vowel /e/ and counting of the numbers from 1 to 10 for later perceptual-auditory analysis of the vocal quality.

Stage 2 - At the end of the class week, the participants again answered the VFI protocol and the Borg and VTDS scales.

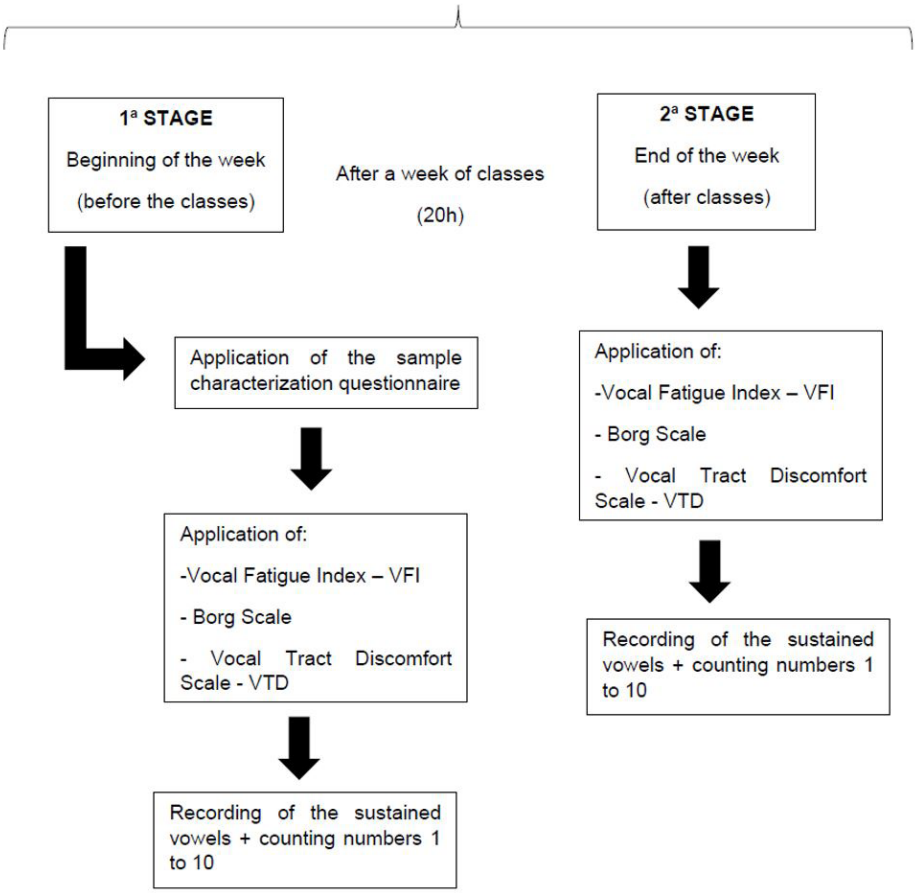

Figure1. Stages of collection development

In addition, the sustained emission of the vowel /e/ and the counting of the numbers from 1 to 10 voices were performed again to compare the vocal quality.

Statistical analysis

The data were analyzed in a descriptive and inferential manner. The SPSS 25.0 software was used. The description of the qualitative nominal variables was conducted by means of relative frequency and absolute frequency. Ordinal quantitative and qualitative variables were described using measures of variability (standard deviation), central tendency (mean and median) and position (minimum, maximum, first quartile and third quartile).

To perform the inferential analysis, the quantitative variables underwent an analysis of distribution homogeneity with the Shapiro Wilk test. All data demonstrated a non-normal distribution. Thus, the comparison of ordinal qualitative data and non-normal quantitative data between the two dependent groups was performed using the Wilcoxon Test. A significance level of 5% was considered in all inferential analyzes. The correlation between two qualitative ordinal or non-normal quantitative variables was performed utilizing the Spearman Correlation Test.

To verify the presence of correlation between the findings, Spearman Correlation test was used. To analyze the strength of the correlation, the values of r= 0.10 to 0.30 were considered as weak correlation; r= 0.40 to 0.6 as moderate and r= 0.70 to 1 as indicative of strong correlation[18].

RESULTS

Participated in the present study 40 female teachers of Kindergarten and Elementary School 1, from the Municipal Public education in the Municipality of Maceió, with an average age of 32 years and 11 months (SD = 7.70). The average number of students per classroom was 17.38 (SD = 4.48), the average teaching time was 9 years and five months (SD= 5.59), with teachers at the early childhood education level being more frequent (80%), who were exposed to noise (72.50%) and who did not use their voice in excess outside the classroom (77.50%).

Table 1 exposes that there was a significant increase in the scores for the domains of fatigue and vocal limitation (p= 0.004), vocal restriction (p<0.001), physical discomfort associated with the voice (p<0.001) and total (p= 0.004) and significant reduction in the scores of the recovery factor with vocal rest (p= 0.015) after a week of teaching activity.

Comparing the data from the two moments of the collection, there were no changes in the self-perception of phonatory effort and in the auditory-perceptual assessment before and after a week of teaching activity.

Comparing the data from the two moments of the collection, there were no changes in the frequency and intensity (Table 2) of discomfort in the vocal tract before and after a week of teaching activity.

Table 3 exposes the correlation between vocal fatigue and phonatory effort and vocal tract discomfort after teaching in teachers. Regarding the fatigue and vocal limitation domain, there was a positive correlation with phonatory effort (r= 0.435; p= 0.005). The vocal restriction domain was positively correlated with phonatory effort (r= 0,365; p= 0.020), while the physical discomfort domain associated with voice had a positive correlation with phonatory effort (r= 0.355; p= 0.025). The recovery domain with vocal rest demonstrated a negative correlation with the variable frequency of dryness (r= 0.318; p= 0.046). The total score, on the other hand, demonstrated a positive correlation with the phonatory effort variable (r= 0.462; p= 0.003).

With regard to the correlation strength, it is observed that the factors of fatigue and vocal limitation, vocal restriction and physical discomfort associated with the voice presented some moderate correlations of strength. In addition, the total VFI demonstrated moderate correlation with Borg Scale, frequency of dryness, frequency of sensitive throat, frequency of irritated

Table 1. Comparison of self-perceived vocal fatigue, phonatory effort and auditory-perceptual assessment before and after teaching activity

Variable	Moment	Mean	SD	Minimum	Maximum	Q25	Median	Q75	p-value
VFI Fatigue and vocal limitation	Pre	11.23	6.13	0.00	24.00	6.25	11.00	15.00	0.004*
	Post	13.30	6.35	0.00	26.00	8.50	13.00	18.50	
VFI Vocal Restriction	Pre	3.40	3.02	0.00	11.00	1.00	3.00	5.00	<0.001*
	Post	4.73	3.05	0.00	12.00	3.00	5.00	7.00	
VFI Physical discomfort associated with voice	Pre	3.95	3.50	0.00	13.00	1.25	3.00	6.00	<0.001*
	Post	5,60	3.56	0.00	13.00	3.00	6.00	8.00	
VFI Recovery with vocal rest	Pre	5.28	3.88	0.00	12.00	2.00	5.00	8.00	0.015*
	Post	3.83	3.43	0.00	12.00	1.00	3.00	6.00	
VFI Total	Pre	23.85	10.09	6.00	49.00	17.25	22.00	28.75	0.004*
	Post	27.45	11.14	1.00	52.00	20.00	25.50	34.00	
Borg scale (vocal effort)	Pre	3.49	1.73	0.00	9.00	3.00	3.00	4.00	0.916
	Post	3.49	2.12	0.00	9.00	2.00	3.00	4.75	
Sustained emission PAA	Pre	1.20	0.72	0.00	3.00	1.00	1.00	2.00	0.480
	Post	1.15	0.70	0.00	3.00	1.00	1.00	2.00	
PAA count	Pre	0.70	0.72	0.00	2.00	0.00	1.00	1.00	0.166
	Post	0.83	0.81	0.00	2.00	0.00	1.00	1.75	

*p<0.05 – Wilcoxon Test
Caption: SD = Standard Deviation; Q25 = First Quartile; Q75 = Third Quartile; IFV = Vocal Fatigue Index; APA = Perceptual-Auditory Assessment

Table 2. Comparison of frequency and intensity of discomfort in the vocal tract before and after teaching activity

Symptoms	Moment	Mean				Minimum		Maximum		Q25		Median		Q75		p-value	
		F	I	F	I	F	I	F	I	F	I	F	I	F	I	F	I
Dryness	Pre	2.98	2.75	1.94	1.68	0.00	0.00	6.00	6.00	2.00	2.00	3.00	3.00	5.00	4.00	0.91	0.28
	Post	2.98	2.98	1.78	1.75	0.00	0.00	6.00	6.00	2.00	2.00	3.00	3.00	4.00	4.00		
Sensitive throat	Pre	1.74	1.69	1.70	1.61	0.00	0.00	5.00	5.00	0.00	0.00	2.00	1.00	3.00	3.00	0.90	0.37
	Post	1.70	1.90	1.68	1.84	0.00	0.00	6.00	6.00	0.00	0.00	1.00	2.00	2.00	3.75		
Irritated throat	Pre	1.93	2.10	1.37	1.53	0.00	0.00	5.00	5.00	1.00	1.00	2.00	2.00	3.00	3.00	0.97	0.43
	Post	1.98	2.35	1.67	1.78	0.00	0.00	6.00	6.00	1.00	1.00	2.00	2.00	3.00	4.00		
Sore Throat	Pre	1.68	2.03	1.49	1.61	0.00	0.00	6.00	5.00	0.25	1.00	2.00	2.00	2.00	3.75	0.13	0.29
	Post	2.10	2.25	1.68	1.56	0.00	0.00	6,00	6.00	1.00	1.00	2.00	2.00	3.75	4.00		
Burning	Pre	1.25	1.35	1.63	1.75	0.00	0.00	5.00	6.00	0.00	0.00	0.00	0.00	2.75	2.75	0.06	0.07
	Post	1.78	1.88	1.79	1.81	0.00	0.00	6.00	6.00	0.00	0.00	2.00	2.00	3.00	3.00		
Tightening	Pre	1.55	1.83	1.50	1.55	0.00	0.00	6.00	5.00	0.00	0.00	1.50	2.00	2.00	3.00	0.26	0.57
	Post	1.78	1.93	1.49	1.65	0.00	0.00	6.00	6.00	0.00	0.00	2.00	2.00	3.00	3.00		
Ball in the throat	Pre	0.93	0.98	1.37	1.42	0.00	0.00	5.00	5.00	0.00	0.00	0.00	0.00	2.00	2.00	0.30	0.12
	Post	1.10	1.33	1.55	1.59	0.00	0.00	5.00	5.00	0.00	0.00	0.00	0.50	2.00	2.75		
Grip	Pre	0.98	1.15	1.37	1.56	0.00	0.00	4.00	5.00	0.00	0.00	0.00	0.00	2.00	2.00	0.08	0.42
	Post	1.28	1.35	1.36	1.49	0.00	0.00	4.00	5.00	0.00	0.00	1.00	1.00	2.00	2.00		
Total	Pre	1.62	1.73	1.08	1.10	0.00	0.00	4.38	3.88	0.66	0.78	1.50	1.88	2.22	2.72	0.09	0.08
	Post	1.83	1.99	1.17	1.26	0.00	0.00	4.13	5.00	0.81	0.91	1.94	1.94	2.59	3.06		

* p<0.05 - Wilcoxon test Legend: SD = Standard Deviation; Q25 = First Quartile; Q75 = Third Quartile; F = Frequency, I= Intensity;

Table 3. Correlation between vocal fatigue and phonatory effort and vocal tract discomfort after teaching activity

		VFI Fatigue and vocal limitation	VFI Vocal Restriction	VFI Physical discomfort associated with voice	VFI Recovery with vocal rest	VFI Total
Borg Scale (vocal effort)	r	0.435	0.365	0.355	0.058	0.462
	p-value	0.005*	0.020*	0.025*	0.724	0.003*
Burning Frequency	r	0.228	0.124	0.283	-0.153	0.226
	p-value	0.157	0.446	0.077	0.345	0.160
Tightening frequency	r	0.424	0.195	0.317	-0.098	0.387
	p-value	0.006*	0.228	0.046*	0.547	0.014*
Dryness Frequency	r	0.485	0.371	0.614	-0.318	0.476
	p-value	0.002*	0.019*	<0.001*	0.046*	0.002*
Sore throat Frequency	r	0.335	0.264	0.404	-0.286	0.322
	p-value	0.034*	0.099	0.010*	0.073	0.043*
Tightening Frequency	r	0.326	0.175	0.273	-0.164	0.309
	p-value	0.040*	0.280	0.088	0.311	0.052
Sensitive throat Frequency	r	0.452	0.462	0.364	-0.109	0.476
	p-value	0.003*	0.003*	0.021*	0.502	0.002*
Irritated throat Frequency	r	0.47	0.507	0.521	-0.132	0.528
	p-value	0.002*	0.001*	0.001*	0.418	<0.001*
Ball in the throat Frequency	r	0.332	0.070	0.178	-0.066	0.285
	p-value	0.036*	0.668	0.273	0.687	0.075
Total Frequency	r	0.520	0.399	0.561	-0.204	0.534
	p-value	0.001*	0.011*	<0.001*	0.206	<0.001*
Burning intensity	r	0.317	0.185	0.353	-0.183	0.307
	p-value	0.046*	0.253	0.026*	0.258	0.054
Grip intensity	r	0.392	0.118	0.239	-0.059	0.337
	p-value	0.012*	0.467	0.137	0.718	0.033*
Dryness intensity	r	0.443	0.260	0.516	-0.211	0.434
	p-value	0.004*	0.106	0.001*	0.191	0.005*
Sore throat intensity	r	0.286	0.183	0.328	-0.205	0.281
	p-value	0.073	0.258	0.039*	0.205	0.079

* p<0.05 - Spearman Correlation Test
Legend: r = correlation coefficient; VFI = Vocal Fatigue Index

Table 3. Continued...

		VFI Fatigue and vocal limitation	VFI Vocal Restriction	VFI Physical discomfort associated with voice	VFI Recovery with vocal rest	VFI Total
Tightening intensity	r	0.417	0.186	0.329	-0.235	0.372
	p-value	0.007*	0.251	0.038*	0.144	0.018*
Sensitive throat intensity	r	0.462	0.420	0.337	-0.208	0.445
	p-value	0.003*	0.007*	0.034*	0.197	0.004*
Irritated throat intensity	r	0.475	0.464	0.446	-0.104	0.509
	p-value	0.002*	0.003*	0.004*	0.522	0.001*
Ball in the throat intensity	r	0.382	0.120	0.215	-0.113	0.321
	p-value	0.015*	0.461	0.182	0.486	0.044*
Total intensity	r	0.545	0.351	0.500	-0.170	0.536
	p-value	<0.001*	0.026*	0.001*	0.295	<0.001*

* p<0.05 - Spearman Correlation Test
Legend: r = correlation coefficient; VFI = Vocal Fatigue Index

throat, total frequency, intensity of dryness, intensity of sensitive throat, intensity of irritated throat, total intensity. The other correlations were weak and there was no strong correlation.

DISCUSSION

Vocal fatigue is a frequent complaint among teachers, since they work in noisy environments, with a high workload, inadequate working conditions and reduced vocal rest time[11]. Many teachers perceive an increase in phonatory effort over time, which may be accompanied by a decrease in phonatory function[19]. In addition, these teachers have vocal symptoms, which can vary in frequency and intensity, compromising, in some cases, the individual well-being[20].

With regard to vocal fatigue, when comparing the results of the VFI presented by the investigated teachers with the cutoff values that separate vocally healthy individuals from the dysphonic ones of the protocol validation research for Brazilian Portuguese, it is possible to verify that in the fatigue domains and vocal limitation and physical discomfort associated with the voice, teachers started and ended the week with scores compatible with dysphonic[15]. In the vocal restriction domain, they started the week with values compatible with those of the vocal healthy individuals and at the end of the week started to demonstrate compatible scores for the dysphonic individuals[15]. Regarding the recovery domain with vocal rest, the pre and post values were below the cutoff score of the VFI protocol, which demonstrates that there was less vocal recovery, an aspect that may come to hamper the act of teaching and collaborating for the development of a vocal alteration[15]. Regarding the total score, it was observed that there was an increase in the total value of vocal fatigue after one week of teaching activity[15].

Another study with individuals with vocal complaints demonstrated different results, with high values in the domains of fatigue and vocal limitation, vocal restriction and physical discomfort associated with the voice[14], data that does not corroborate the present research, since reduced results were obtained in all domains. A survey demonstrated that teachers perceived less vocal recovery with rest at the end of the year than at the beginning, given that it is in line with the findings in the present study. The vocal fatigue of the teacher, in general, results from an overload of the voice in lectures and the lack of an adequate recovery after the vocal use[19], an aspect that can limit and compromise the vocal use of the teacher.

Regarding the perception of phonatory effort, it was observed that it was moderate and remained the same at the beginning and the end of the week of teaching activities. This data corroborates the study that investigated individuals with vocal hyperfunction after four weeks of treatment and demonstrated that the vocal phonatory effort decreased or did not change[20]. This result can be justified due to the difficulty of patients in estimating the vocal effort produced when applying the scale or by the lack of awareness to monitor their own voice[20].

Regarding vocal tract discomfort, no difference was observed in the comparison of frequency and intensity before and after teaching activity during the week. This data differs from studies that demonstrated a higher frequency and intensity of symptoms of discomfort in the vocal tract of teachers after teaching activity[21,22].

Teachers reported a lot of dryness at the beginning and end of the week. This data can be justified by insufficient hydration and excessive use of the voice, risky behaviors for vocal health[23]. In addition, in a survey of a population that investigated teachers with and without vocal complaints, it was found that teachers reported at least three symptoms of vocal tract discomfort, with dryness with the highest average, as corroborating the present study. A survey conducted in São Paulo found that teachers who self-report the presence of vocal discomfort, identify the occurrence of three or less symptoms of discomfort, demonstrating its high incidence from that profession[10].

Although there is no difference in the pre and post comparison, it is observed that teachers report high frequency and intensity in various symptoms of discomfort in the vocal tract throughout the week, with dryness being the most frequent. It is suggested that many dysphonic individuals have some discomfort in the vocal tract, which may be due to excessive effort, involving the perilaryngeal muscles, for example[10]. The presence of laryngeal symptoms, such as:

irritation, dryness, throat clearing and pain in the throat, cause discomfort that can interfere with speech, compromising good vocal production, which can cause disturbances at work, or in the individual social vocal use[24].

Elementary school teachers who are at vocal risk report higher frequency and intensity of vocal tract discomfort symptoms at the end of the day, and the worsening of discomfort may be related to occupational risks related to the work environment and organization, which may impair their vocal health[25]. Teachers are professionals who have moderate or high vocal risk, depending on their academic periods and work environment[26].

The greater the sensation of vocal fatigue, the greater the perception of phonatory effort; the most frequent is the sensation of tightness, dryness, sore throat, sensitive throat and irritated throat, and the most intense are the sensations of discomfort in the vocal tract: tightness, dryness, griping, sensitive throat, irritated throat and throat ball. The literature highlighted that teachers with vocal complaints have an average of 7,8 symptoms, the most common of which are hoarseness, dry throat and throat pain[10], demonstrating that these professionals have many vocal problems when compared to non-teachers. Thus, the presence of vocal fatigue increases phonatory effort and discomfort in the vocal tract, which can be a risk factor for the development of dysphonia in teachers. In this perspective, it is important for the teacher to recognize the symptoms of fatigue early, in addition to conditioning his voice to delay the appearance of these manifestations.

Furthermore, this result may be related to insufficient hydration, an aspect that was not investigated in the present study. It is noteworthy that the lack of hydration can alter the viscosity of the vocal folds and, consequently, favor vocal fatigue. In addition, the phonatory pressure threshold and the phonatory effort may increase according to the decrease in hydration[27].

Prolonged periods of phonation accompanied by a lack of hydration can lead to changes in the composition of the fluids of the vocal chords, resulting in increased viscosity and stiffness of the chords. The increase in tissue viscosity should result in proportionally greater friction and heat dissipation during vocal chords vibration, consequently generating greater vocal effort. This reduction in phonatory efficiency requires greater energy consumption to initiate and sustain the oscillation of the chords[27]. Therefore, it is essential that teachers are instructed on the importance of constant hydration.

Vocal fatigue can be influenced by excessive use of the voice or increased vocal intensity. In this context, it is highlighted that vocal health programs can act as important tools to inform and sensitize the teacher about the well-being of the voice and collaborate for the reduction of symptoms and vocal changes in this category[28]. Individualized vocal conditioning by means of warming up and cooling down the voice is extremely important to meet the demand for vocal use of this teacher with the least possible effort. Thus, teachers, who use their voice excessively, need basic guidance on their production, care and vocal techniques[29,30].

Thus, educational measures to raise awareness of the use of the voice and adequate vocal training can contribute to reducing vocal discomfort and effort, delay voice fatigue and provide greater vocal resistance. In addition, they can enable the teacher to recognize vocal symptoms early and seek medical and speech evaluation for an early diagnosis. In this way, the more the teachers know their working instrument, the more they will be able to make healthy choices to minimize the vocal symptoms and avoid a vocal alteration.

The study had some limitations, since it did not compare vocal fatigue between dysphonic and vocally healthy teachers. In addition, there was no control over the noise in the room in which the voices were recorded, as well as the impossibility of understanding vocal fatigue, effort and discomfort considering the working conditions and the use of the teachers voice in everyday situations that are outside school work. Thus, future research is needed that contemplates aspects not studied in the present study.

CONCLUSIONS

Teachers perceive an increase in vocal fatigue, but do not signal changes in phonatory effort and vocal tract discomfort after one week of school. The increase in the perception of vocal fatigue correlates with the increase in the sensation of effort and phonatory discomfort.

ACKNOWLEDGMENT

None.

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Contribution of authors

All authors contributed significantly to the development of the article. The contribution of each author was: VFAP was responsible for the collection, analysis and interpretation of data and organization of the study; FZC was co-supervisor, responsible for the study design, data analysis and manuscript review; TTB was responsible for data collection and study organization; MB participated, as a supervisor, responsible for the study design and final revision of the manuscript.