Original Article

https://doi.org/10.1590/2317-6431-2022-2636en

Audiology Communication Research
ISSN 2317-6431

Impact of the COVID-19 pandemic on vocal self-perception and predictive factors in teachers

Impacto da pandemia da Covid-19 na autopercepção vocal e fatores preditivos em professores

Eliane Cristina Pereira[1], *Regiane Máximo da Silva*[1], *Ana Paula Dassie-Leite*[1], *Roxane de Alencar Irineu*[2], *Vanessa Veis Ribeiro*[3], *Perla do Nascimento Martins*[1]

ABSTRACT

Purpose: This study aims to analyze the self-perception of vocal effort, vocal signs and symptoms, and vocal fatigue in teachers before and during the COVID-19 pandemic; and factors related to sociodemographic and occupational data that could predict self-perception during the pandemic **Methods**: Participants were 263 Brazilian teachers working from in-home office during the pandemic. They answered a questionnaire on sociodemographic and occupational data, adapted Borg CR10-BR for vocal effort ratings, Vocal Signs and Symptoms List, and Vocal Fatigue Index. The vocal self-assessment questionnaires were answered twice, considering the period before and during the pandemic. **Results**: The self-perception of vocal effort, vocal signs and symptoms, and vocal fatigue during the pandemic in teachers was lower than before the pandemic. In comparing outcomes due to vocal complaints, teachers with no vocal complaints presented lower values than those with vocal complaints. Teachers with vocal complaints during the pandemic showed greater self-perception of vocal fatigue. Teachers at early education, elementary, and high schools self-reported more vocal signs and symptoms before than during the pandemic. **Conclusion**: In general, teachers report decreased vocal effort and vocal signs and symptoms during the COVID-19 pandemic. Teachers with vocal complaints have a higher perception of vocal effort, vocal signs and symptoms, and vocal fatigue. The presence of vocal complaints and the variables related to vocal demand during the pandemic are related to the perception of vocal effort, vocal signs and symptoms, and vocal fatigue.

Keywords: COVID-19; Pandemic; Teacher; Voice; Voice disorders

RESUMO

Objetivo: Analisar a autopercepção de esforço vocal, sinais e sintomas vocais e fadiga vocal em professores antes e durante a pandemia da COVID-19; e os fatores relacionados a dados sociodemograficos e ocupacionais que pudessem prever a autopercepção durante a pandemia. **Métodos**: Participaram do estudo 263 professores brasileiros que estavam trabalhando em home office durante a pandemia. Eles responderam um questionário sobre dados sociodemográficos e ocupacionais, escala de Borg CR10-BR adaptada para classificação de esforço vocal, Lista de Sinais e Sintomas Vocais e Índice de Fadiga Vocal. Os questionários de autoavaliação vocal foram respondidos duas vezes, considerando antes e durante a pandemia. **Resultados**: A autopercepção de esforço vocal, sinais e sintomas vocais e fadiga vocal durante a pandemia em professores foi menor do que antes da pandemia. Na comparação dos desfechos por queixa vocal, os professores sem queixa vocal apresentaram valores menores do que aqueles com queixa vocal. Professores com queixas vocais durante a pandemia apresentaram maior autopercepção de fadiga vocal. Professores de educação infantil, ensino fundamental e ensino médio relataram mais sinais e sintomas vocais antes do que durante a pandemia. **Conclusão**: Em geral, os professores relatam diminuição do esforço vocal e dos sinais e sintomas vocais durante a pandemia de COVID-19. Professores com queixas vocais apresentam maior percepção de esforço vocal, sinais e sintomas vocais e fadiga vocal. A presença de queixas vocais e as variáveis relacionadas à demanda vocal durante a pandemia estão relacionadas à percepção de esforço vocal, sinais e sintomas vocais e fadiga vocal.

Palavras-chave: COVID-19; Pandemia; Professor; Voz; Distúrbios da voz

Study carried out at Universidade Estadual do Centro Oeste – UNICENTRO – Irati (PR), Brasil and Universidade Federal de Sergipe – UFS – Lagarto (SE), Sergipe.

[1]Departamento de Fonoaudiologia, Universidade Estadual do Centro–Oeste – UNICENTRO – Irati (PR), Brasil.

[2]Departamento de Fonoaudiologia, Universidade Federal de Sergipe – UFS – Lagarto (SE), Brasil.

[3]Departamento de Fonoaudiologia, Universidade de Brasília – UNB – Brasília (DF), Brasil.

Conflict of interests: No.

Authors' contribution: ECP was responsible for the conception of the study, data collection, data analysis, preparation of the writing of the manuscript, final revision of the manuscript and editing. RMS: data collection, data analysis, preparation of manuscript writing; RMS: data collection, data analysis, preparation of manuscript writing; APDL: data collection, data analysis, preparation of manuscript writing and review; RAI: data collection, data analysis, preparation of manuscript writing; VVR: data collection, data analysis, preparation of manuscript writing, PNM: data collection, data analysis, preparation of manuscript writing and final review.

Funding: none.

Corresponding author: Eliane Cristina Pereira. E-mail: ecpereira@unicentro.br

Received: February 13, 2022; **Accepted:** September 16, 2022

INTRODUCTION

Coronavirus disease (COVID-19) caused by the SARS-Cov-2 virus has spread rapidly worldwide. WHO has advised on protective measures to control the spread of the disease as it spreads mainly through contact between people[1].These guidelines include hygiene measures, social distancing norms, and isolation strategies[2] .

Some professionals had to adapt to their workplace because of the measures to contain the disease transmission. While some professionals continued their activities from workplaces with adaptations to security measures, some began to perform their activities from in-home offices and some initially worked from in-home offices and eventually from their workplaces. The teachers were one of the professionals who had to readapt their activities[3].

Teachers are essential in the educational process, and their voice is a fundamental instrument and one of the main teaching and learning resources[4]. In usual working conditions, teachers are considered as professionals who are at risk to develop voice disorders[5-7] .

The main risk factors to teachers' voice include high vocal demand, working conditions, vocal behavior, general health, and individual predisposition[8].Teachers under usual working conditions often experience vocal effort (VE), vocal symptoms, and vocal fatigue, which are generally related to the risk factors mentioned above[6].

During the pandemic, teachers had to modify their work to adapt to the home office modality. In this modality, teachers had to adapt to the environment, planning strategies, and activities that contribute to the teaching and distance learning process[9]. Classes were held in a digital (synchronous and asynchronous) environment[3].

Adaptation to the home office occurred without providing training on vocal use in the online modality and without an ergonomic structure suitable at home for the performance of the function. Some teachers presented vocal symptoms in the transition from face-to-face teaching to online synchronous teaching[10]. These symptoms include hoarseness, vocal fatigue, VE, pain or ardor in the throat, weakening of the voice, irritation or dryness of the larynx, frequent need to clear the throat or cough, and frequent need to drink water[10].

Given the adaptations made by teachers during the pandemic, it is necessary to understand the changes in self-perception of VE, vocal signs and symptoms, and vocal fatigue; and analyze the factors that influence this self-perception. These data will allow us to understand the current needs of this professional class, and can be used to propose actions to improve the vocal health of teachers.

The research had the following objectives: a) to analyze the self-perception of VE, vocal signs and symptoms, and vocal fatigue in teachers before and during the pandemic; and b) to analyze the factors related to sociodemographic and occupational data that could predict self-perception during the pandemic

METHODS

Design

This research is an observational and analytical study.

Ethics Approval

The Research Ethics Committee of the Universidade Estadual do Centro-Oeste approved this study (CAAE 32190820.4.1001.8967; n. 4,059,026), and all subjects digitally signed the Free and Informed Consent Form.

Sample

The participants were recruited via email and social networks in Brazil. Data were collected online during the COVID-19 pandemic (June and July 2020) via Google Forms. The participants answered only once the survey, which consisted of two answers for each instrument, being that in the first response they should consider the pre-pandemic period (school year 2019); and in the second they should consider the current moment, during the pandemic (from school year 2020 to the date of data collection).

The inclusion criteria were as follows: They must be Brazilian citizens who were teachers performing teaching activities exclusively at home/home office and aged between 18 and 59 years, irrespective of gender. The exclusion criteria were as follows: participants who reported previous hearing complaints and upper airway diseases (such as sinusitis, pharyngitis, or laryngitis) on the day of completion of the study, and teachers who did not live or work in Brazil during the COVID-19 pandemic. For the selection, the participants answered a questionnaire on the eligibility criteria.

The sample size was calculated using a dependent t-test. The parameters adopted for the test were α 5%, β 10%, and K 90%. The total VFI scores before and during the pandemic were used for the calculation. The following parameters were used: standard deviation of 12.72 points and mean difference of 3.72. The sample size was 124 participants.

An online questionnaire on sociodemographic and occupational data, the adapted Borg CR10-BR for VE ratings[11], the SSL, and the VFI were employed for data collection. The vocal self-assessment questionnaires were answered twice: a) considering the pre-pandemic period (school year 2019); and b) considering the period during the pandemic (from school year 2020 to the date of data collection). Data were collected in a single session.

In the questionnaire on sociodemographic and occupational data, participants answered questions on the following: age, working time (years), weekly workload (hours), weekly vocal workload (hours), gender (female or male), school type (public, private, both), vocal complaints (before the pandemic, during the pandemic, both before and during the pandemic, and no vocal complaints), workplace during the pandemic (home office and preferably at home), education level they work in (Level l - Early Education and Elementary School, Level ll - Upper Elementary and High School, Level lll - Higher Education), and professional activities (face-to-face classes, preparing

classes, preparing activities for students, face-to-face meetings, recording videos of classes, giving online classes, virtual meetings, and taking questions over phone). The selection of variables was performed through a mapping of risk factors for voice in scientific publications with teachers.

The adapted Borg CR10-BR for VE ratings[11] translated and adapted for Brazilian Portuguese was used to measure the self-perception of VE teachers. For this, participants should grade the VE level between 0 "no VE" and 10 "maximum VE." A response value between 1 and 10 was considered for data analysis.

The SSL[6], translated into Brazilian Portuguese, was used to measure the self-assessment of vocal signs and symptoms[5]. The SSL contains 14 items and contemplates the presence of the symptom[5,6]. The total score of the questionnaire was calculated by simple summation, according to the authors' instructions. The present study did not analyze the relationship between symptoms and work. The range of the instrument is between 0 and 14 points.

The VFI validated in the Brazilian Portuguese version was used to analyze the perception of vocal fatigue symptoms[12]. The VFI consists of 17 items divided into the following factors: fatigue and vocal limitation, vocal restriction, physical discomfort associated with voice, and recovery of symptoms with vocal rest. The total domain of the instrument was also considered. The questions were marked according to the frequency of their occurrence, between (0) never and (4) always. Scores were calculated based on the authors' recommendations. The range of the instrument is between 0 and 68 points.

Data analysis

The dependent variables were the self-perception of VE, vocal signs and symptoms, and vocal fatigue symptoms. The independent variables were sociodemographic and occupational data.

The data were analyzed descriptively and inferentially. SPSS 25.0 software was used. Further, a significance level of 5% was used for all inferential analyses.

The variables were described using measures of frequency, variability, central tendency, and position.

To verify the influence of the independent variables that is, education level the teachers' work in, vocal complaint, and time—on the scores of the dependent variables, a repeated-measures ANOVA was conducted. In cases where there was a statistical difference, Tukey's test was performed for multiple comparisons.

Multiple linear regression analysis was used to analyze the association between the independent variables and each of the dependent variables. The total score of the three self-assessment instruments was used as the dependent variables. Thus, the nominal qualitative variables with multiple categories were transformed into dummy variables, with the absence of the characteristic as a reference. The stepwise method was employed to select the independent variables.

RESULTS

Two hundred and seventy-six teachers answered the survey, of which 263 were selected for the study. They had a mean age of 39 years and 11 months, and consisted of 32 (12.17%) males and 231 (87.83%) females. Of the teachers studied, 21.29% had vocal complaints during the pandemic.

The average working time (years) was 13.83 (SD: 9.31), the weekly workload (hours) average was 30.54 (SD: 13.22), and the weekly vocal workload average was 16.92 hours (SD: 16.09). Regarding the type of school, 63.12% (n=166) worked in public schools, the others worked in a private school. Regarding the education level they work in, 54.37% (n=143) worked in Level l, 20.91% (n=55) in Level ll, and 24.71% (n=65) in Level lll.

Regarding professional activities, 4.94% (n=3) delivered classes, 92.02% (n=242) prepared classes, 93.92% (n=247) prepared activities for the students, 13.31% (n=35) conducted face-to-face orientations, 10.27% (n=27) held face-to-face meetings, 78.33% (n=206) recorded videos of classes, 25.86% (n=68) gave online/live classes, 84.79% (n=223) held virtual meetings, and 91.63% (n=241) took students' questions (over phone, email, WhatsApp, etc.).

The mean score of the self-perception of VE was 1.92 (SD: 2.07) and that of vocal signs and symptoms was 3.02 (SD: 3.49). The average self-perception score of vocal fatigue symptoms was 15.09 (SD: 7.48) in the tiredness and voice impairment factor, 6.80 (SD: 7.76) in the avoidance of voice use factor, 7.76 (SD: 4.08) in the physical discomfort factor, 9.28 (SD: 4.43) in the improvement of voice symptoms with rest factor, and 32.37 (SD: 12.72) in the total factor.

The perceived VE of teachers during the pandemic was lower than that before the pandemic (p<0,001) (Table 1). In the comparison of effort due to vocal complaints, it was observed that teachers with no vocal complaints before and after the pandemic presented lower VE values than teachers with vocal complaints before, during, or before and after the pandemic. Further, teachers with vocal complaints before and after the pandemic self-reported greater VE than those who reported vocal complaints only before the pandemic.

When the intersection between the time and the education level the teachers work in was analyzed, it was observed that teachers of Levels l and ll self-reported VE before than during the pandemic (p<0.001 and p = 0.002, respectively). In the analysis considering the intersection between the time and the presence of vocal complaints, teachers without vocal complaints (p=0.009), complaining before the pandemic (p<0,001), and complaining before and after the pandemic (p=0.002) self-reported greater VE in the period before the pandemic than during the pandemic. Teachers with vocal complaints only during the pandemic reported greater VE during the pandemic compared to the period before the pandemic (0.033).

The outcome of self-reported vocal signs and symptoms were also analyzed according to the education level the teachers work in, presence of vocal complaint, and time (before the pandemic or during the pandemic) (Table 2).

Regarding the time, it was observed that the perception of vocal signs and symptoms of teachers during the pandemic was lower than that before the pandemic (p=0.001). Regarding the presence of vocal complaints, teachers without vocal complaints before and after the pandemic reported fewer signs and symptoms than teachers with vocal complaints before the

Table 1. Analysis of self-assessment of vocal effort as a function of level, vocal complaints, and time

Outcome	Level	VC	N	Time				Effect	F	Df	p-value	post-hoc
				BP		DP						
				Mean	SD	Mean	SD					
Adapted Borg CR10-BR for vocal effort ratings (teaching activity)	Level I	No	73	2.66	2.04	1.61	1.66	Time	21.72	1	<0.001	BP > DP (p<0.001)
		BP	44	5.45	2,85	0.86	0.97					
		DP	8	2.25	2.24	3.31	2.22					
		BM	18	5.19	3.04	3.33	2.28	Level	0.26	2	0.768	
		Total	143	3.81	2.80	1.69	1.80					
	Level I	No	20	2.48	1.57	1.63	1.53					
		BP	19	4.74	2.16	0.84	0.87	VC	15.50	3	<0.001	No < BP (p=0.020) = DP (p<0.001) = Both (p<0.001); Both > BP (p=0.019)
		DP	9	3.50	2.76	4.61	2.74					
		BM	7	4.71	3.72	3.79	3.41					
		Total	55	3.71	2.48	2.12	2.35	Time * Level	4.60	2	0.011	Level I BP >Level I DP (p<0.001); Level II BP >Level II DP (p=0.002)
	Level III	No	43	1.74	1.51	1.73	1.90					
		BP	8	4.00	2.67	1.19	1.03					
		DP	7	2.93	2.65	5.57	2.82	Time * VC	28.54	3	<0.001	No VC timeBP > No VC timeDP (p=0,009); VC-BP time BP > VC-BP time DP (p<0,001); VC-DP time BP < VC-DP time DP (p=0.002); VC-BM time BP > VC-BM time DP (p=0.033)
		BM	7	3.79	2.51	3.50	2.02					
		Total	65	2.37	2.09	2.27	2.30					
	Total	No	136	2.35	1.86	1.65	1.71	Level * VC	0.95	6	0.461	
		BP	71	5.10	2.67	0.89	0.94					
		DP	24	2.92	2.51	4.46	2.65					
		BM	32	4.78	3.05	3.47	2.43	Time * Level * VC	0,20	6	0.976	
		Total	263	3.44	2.64	1.92	2.07					

Repeated measures ANOVA p<0.05; Level of Education at wort: Level I - Early Education and Elementary School, Level II - Upper Elementary and High School, Level III - Higher Education; BP: before pandemic; DP: during a pandemic; Time: situation considering BP, DP or both; *: intersection

Subtitle: N: number; SD: Standard deviation; VC: Vocal complaints; df: degrees of freedom

pandemic (p<0.001), during the pandemic (p<0.001), and before and after the pandemic (p<0.001). Further, teachers with vocal complaints before and after the pandemic self-reported more signs and symptoms than those who had vocal complaints only before (p<0<01) or during the pandemic (p<0,001).

When the intersection between the time and the education level the teachers work in was analyzed, it was observed that teachers of Levels l and ll self-reported more vocal signs and symptoms before the pandemic than during the pandemic (p<0.001 and p = 0.002, respectively). In the analysis considering the intersection between the time and vocal complaints, it was observed that teachers without vocal complaints (p<0.001) and with vocal complaints before the pandemic (p<0.001) self-reported more symptoms before the pandemic than during the pandemic. Teachers with vocal complaints during the pandemic self-reported more vocal symptoms during the pandemic time than the pre-pandemic time (p <0.001).

The self-perception of vocal fatigue symptoms showed a difference due to vocal complaints and the intersection between time and vocal complaints (Table 3).

Teachers with vocal complaints during the pandemic reported more vocal fatigue symptoms than those without vocal complaints (p=0.002) and with vocal complaints before the pandemic (p=0.012). Further, teachers with vocal complaints before and after the pandemic self-reported more vocal fatigue symptoms than those without vocal complaints (p<0.001) and those with vocal complaints only before the pandemic (p=0.001).

The intersection between the time and the presence of vocal complaints showed that teachers without vocal complaints (p<0.001) and with vocal complaints before the pandemic (p<0,001) self-reported more vocal fatigue symptoms before than during the pandemic. Teachers with vocal complaints during the pandemic (p=0.001) and vocal complaints before and after the pandemic (p=0.001) self-reported more vocal fatigue symptoms during than before the pandemic.

The following independent variables were predictors of the self-perception of VE during the pandemic [F (4, 258) = 23.126; p<0.001 ; R2 = 0.264]: vocal complaints during the pandemic (β = 0.292; t = 5.231; p<0.001), weekly vocal workload at work (β = 0.228; t = 4.055; p<0.001), public school (β = -0.142; t = -2.566; p=0.011), and giving online/live classes (β = 0.140, t = 2.522, p=0.012) - (Table 4).

Vocal complaints during the pandemic (β = 0.295; t = 5.075; p<0.001), weekly vocal workload at work (β = 0.197; t = 3.331; p=0.001), and giving online/live classes (β = 0.117, t = 2.049, p=0.041) were predictors of the self-perception of vocal signs and symptoms during the pandemic [F (3, 259) = 19.706; p<0.001; R2 = 0.186] - (Table 4).

The independent variables vocal complaints during the pandemic (β = 0.250; t = 4.192; p<0.001) and weekly vocal complaints at work (β = 0.219, t = 3.676, p<0.001) were predictors of the self-perception of vocal fatigue symptoms during the pandemic [F (2, 260) = 20.982; p<0.001; R2 = 0.139] - (Table 4).

Table 2. Analysis of self-perception of vocal symptoms as a function of level, vocal complaints, and time

Outcome	Level	VC	N	Before pandemic		During pandemic		Effect	F	Df	p-value	post-hoc
				Mean	SD	Mean	SD					
Sign and symptoms	Level I	No	73	3.68	3.05	1.90	2.87	Time	11.52		0.001	BP > DP (p=0.001)
		BP	44	8.41	3.58	1.75	2.84			1		
		DP	8	1.50	1.60	5.75	4.40					
		Both	18	8.83	3.35	6.94	3.95	Level	0.35		0.70	
		Total	143	5.66	4.09	2.71	3.58			2		
	Level II	No	20	2.80	2.33	1.50	1.61					
		BP	19	7.68	3.77	1.63	1.83	VC	39.71		<0.001	No < BP (p<0.001) = DP (p<0.001) = Both (p<0.001); Both > BP (p<0.001) = DP (p<0.001)
		DP	9	4.67	3.77	7.78	2.73			3		
		Both	7	8.43	3.05	7.29	3.68					
		Total	55	5.51	3.92	3.31	3.50	Time * Level	5.43		0.005	Level I BP >Level I DP (p<0.001); Level II BP >Level II DP (p=0.002)
	Level III	No	43	2.09	2.29	2.05	2.29			2		
		BP	8	7.38	2.62	3.88	3.27					
		DP	7	2.86	2.73	7.29	1.38	Time * VC	54.73		<0.001	No VC timeBP > No VC timeDP (p<0.001); VC-BP time BP > VC-BP time DP (p<0.001); VC-DP time BP < VC-DP time DP (p<0.001)
		Both	7	7.43	2.23	8.00	2.65					
		Total	65	3.40	3.21	3.48	3.26			3		
	Total	No	136	3.05	2.81	1.89	2.53	Level * VC	1.23		0.29	
		BP	71	8.10	3.52	1.96	2.71			6		
		DP	24	3.08	3.09	6.96	3.13					
		Both	32	8.44	3.04	7.25	3.57	Time * Level * VC	0.53		0.782	
		Total	263	5.07	3.96	3.02	3.49			6		

Level of Education at wort: Level I - Early Education and Elementary School, Level II - Upper Elementary and High School, Level III - Higher Education; *intersection
Subtitle: N: number; SD: Standard deviation; df: degrees of freedom; VC: vocal complaints; BP: before pandemic; DP: during a pandemic; Time: situation considering BP, DP or both

Table 3. Analysis of self-perception of vocal fatigue symptoms as a function of level, vocal complaints, and time

Outcome	Level	VC	N	Before pandemic		During pandemic		Effect	F	Df	p-value	post-hoc
				Mean	SD	Mean	SD					
VFI Total	Level I	No	73	34.47	10.34	29.47	10.54	Time	0.992		0.320	
		BP	44	37.07	11.47	28.30	13.41			1		
		DP	8	35.50	7.45	39.63	13.54					
		Both	18	38.61	8.27	41.17	13.67	Level	0.915		0.402	
		Total	143	35.85	10.36	31.15	12.77			2		
	Level II	No	20	37.20	12.20	30.30	8.36					
		BP	19	38.58	14.07	30.05	11.40	VC	7.117		<0.001	DP > No (p=0.002) = BP (p=0.012); Both > No (p<0.001) = BP (p=0.001)
		DP	9	32.11	10.94	48.56	10.01			1		
		Both	7	34.00	7.68	48.57	13.07					
		Total	55	36.44	12.18	35.53	13.15	Time * Level	1.860		0.158	
	Level III	No	43	37.49	11.32	29.16	10.40			2		
		BP	8	39.00	7.91	29.63	12.30					
		DP	7	31.86	10.17	45.43	7.41	Time * VC	15.610		<0.001	No VC timeBP > No VC timeDP (p<0.001); VC-BP time BP > VC-BP time DP (p<0.001); VC-DP time BP < VC-DP time DP (p=0.001); VCBoth time BP > No VC timeDP (p=0.002)
		Both	7	30.57	12.54	42.29	11.83					
		Total	65	36.32	11.09	32.38	11.96			1		
	Total	No	136	35.82	10.95	29.49	10.15	Level * VC	0.319		0.927	
		BP	71	37.69	11.77	28.92	12.64			2		
		DP	24	33.17	9.40	44.67	10.95					
		Both	32	35.84	9.53	43.03	13.10	Time * Level * VC	1.102		0.362	
		Total	263	36.09	10.90	32.37	12.72			2		

Level of Education at wort: Level I - Early Education and Elementary School, Level II - Upper Elementary and High School, Level III - Higher Education *intersection
Subtitle: N: number; SD: Standard deviation; df: degrees of freedom;VC: vocal complaints; VFI: Vocal Fatigue Index; BP: before pandemic; DP: during a pandemic; Time: situation considering BP, DP or both

Table 4. Association between independent variables and self-perception of vocal effort, of vocal signs and symptoms and of vocal fatigue symptoms

Association between independent variables and self-perception of vocal effort					
Model	**b**	B	**T**	**p-value**	**VFI**
(Constant)	1.130		3.717	<0.001	
Vocal complaints during pandemic	2.094	0.292	5.231	<0.001	1.095
Weekly vocal workload at work	0.029	0.228	4.055	<0.001	1.113
Public school	-0.608	-0.142	-2.566	0.011	1.077
Giving online/lives classes	0.661	0.140	2.522	0.012	1.086
$r^2 = 0.264$					
Association between independent variables and self-perception of vocal signs and symptoms					
Model	**b**	B	**T**	**p-value**	**VIF**
(Constant)	1.281		3.124	0.002	
Vocal complaints during pandemic	3.572	.295	5.075	<0.001	1.075
Weekly vocal workload at work	.043	.197	3.331	0.001	1.110
Giving online/lives classes	.935	.117	2.049	0.041	1.045
$r^2 = 0.186$					
Association between independent variables and self-perception of vocal fatigue symptoms					
Model	**B**	B	**T**	**p-value**	**VIF**
(Constant)	28.434		26.784	<0.001	
Vocal complaints during pandemic	11.015	.250	4.192	<0.001	1.073
Weekly vocal workload at work	.173	.219	3.676	0.002	1.073
$r^2 = 0.139$;					

Multiple linear regression, stepwise method
Subtitle: VFI: Vocal Fatigue Index

DISCUSSION

The social distancing norms due to the COVID-19 pandemic have caused a change in the lifestyle of people. Teachers had to adapt to the virtual environment and home office, which resulted in changes in their vocal use[10].

The majority of teachers were female, confirming that this profession has been historically more female-oriented[13]. Gender data should be considered when considering the vocal health of teachers because there is a greater chance of developing lesions due to the laryngeal structure and the higher concentration of fibronectin and lower hyaluronic acid in the female vocal folds[14]. Moreover, women have greater exposure to responsibilities and workloads resulting from the accumulation of roles at work and in the family[15]. The general burden deserves to be valued during the pandemic, as females have experienced more psychological risks[16].

The average weekly workload of teachers was 30.54 hours, which is consistent with the findings of similar studies[17,18]. During the pandemic, teachers reported a weekly vocal workload of approximately 16.92 hours. It is believed that in the period of social distancing, teachers may have had a reduced vocal workload due to the rules of regulation and the difficulty of access to the synchronous system by students, especially public education.

As for professional activities, most teachers did not participate in classes and face-to-face meetings, but prepared classes and activities for students, recorded videos of classes, gave online/live classes, held virtual meetings, and took questions from students/guardians (over phone, email, WhatsApp, among others). These findings agree with those of other studies on teachers[19] following the WHO guidelines on social isolation and distancing[1].

All domains for the VFI had scores of the risk for dysphonia[12]. Therefore, teachers continued to present vocal fatigue symptoms in reality, even with lower vocal demand and in a different teaching environment. The values obtained for the VFI in the present study are similar to those of dysphonic teachers who seek vocal therapy[20]; and the teachers at the end of the school year[21].

The SSL protocols and adapted Borg CR10-BR for VE ratings are not validated and do not present cutoff values for their scores. Studies using the SSL to investigate vocal signs and symptoms concluded that the general population in Brazil has, on average, 1.7 symptoms[6], and Brazilian teachers have, on average, 3.7 symptoms[5]. The present study obtained values of signs and symptoms similar to those of Brazilian teachers under normal conditions.

No national studies using the adapted Borg CR10-BR for VE ratings were found, probably because of its recent adaptation to the Portuguese language[11]. Moreover, no studies that used this scale with teachers were found at the international level. An international study with the general population obtained an average score of 1.48 points on the adapted Borg CR10-BR for VE ratings for participants with voice disorders and 1.41 for healthy controls[22]. Therefore, the mean scores of the self-perception of VE in the present study are higher than those obtained for individuals with vocal disorders in the general population. These results reinforce the need to pay attention to the voice of Brazilian teachers, even during the pandemic.

The perception of VE, vocal signs and symptoms, and vocal fatigue of teachers during the pandemic were lower than those before the pandemic for teachers without vocal complaints, with vocal complaints before the pandemic, and with vocal complaints before and during the pandemic. An exception was teachers with vocal complaints only during the pandemic, who had higher self-perception scores during the pandemic

than before the pandemic. These data corroborate another study that showed no increase in vocal symptoms with the change from face-to-face to synchronous classes during the COVID-19 pandemic[10].

This may have occurred because there have been significant changes, mainly related to the environment and other historically unfavorable working conditions to the teacher[4], such as excessive number of students per room, elevated environmental noise, causing use of voice at a high intensity level[23,24].

Moreover, there was also a reduction in the vocal workload since some Brazilian public educational institutions did not implement synchronous classes, and those they implemented reduced the workload in relation to what was usually taught synchronously. VE is known to be closely related to vocal demand[24]. Thus, it is hypothesized that the virtual environment may have minimized the vocal risks related to the work environment and the demand for vocal use, specifically for this professional group, even in the face of possible challenges related to the ergonomic conditions of work at home and adaptation to virtual communication. In the Brazilian professors studied, there was little workload of synchronous activities, which may justify this finding.

In the present study, teachers with vocal complaints presented higher scores for VE, vocal signs and symptoms, and vocal fatigue compared to teachers without vocal complaints. An exception was the self-perception of vocal fatigue: teachers who had complaints only during the pandemic had more symptoms of vocal fatigue during than before the pandemic. Vocal complaints are described in the literature as a condition often observed in teachers, usually associated with inappropriate vocal behavior[25]. However, the fact that the self-perception of vocal fatigue is higher in individuals who have vocal complaints during the pandemic may be related to the large occurrence of self-reference of general fatigue that involves tiredness, exhaustion, weakness, decreased energy, and functional capacity, among other aspects[26]. Moreover, the symptoms of vocal fatigue commonly improve with rest[20,21]; however, with the accumulation of activities resulting from the overlap of professional and domestic activities,associate a context of psychological insecurity, they may have led to a deficit of recovery[21,27] and increased vocal fatigue symptoms.

Teachers of Levels l and ll self-reported greater VE and vocal signs and symptoms before than during the pandemic, which did not happen to Level lll teachers. Early education, elementary and high school teachers have a higher demand for vocal use and higher vocal risk due to environmental and structural issues in teaching profession. In contrast, higher education teachers, although they also carry a risk of dysphonia, have a lower workload of weekly classes since they work in the triad of teaching, research, and extension, which minimizes some potentiating effects[28]. Moreover, the factor mentioned above related to the absence of synchronous classes in public educational institutions, except in higher education, may have contributed to this reduction only in these educational networks.

Further, it was found that the increase in the weekly vocal workload and the presence of vocal complaints during the pandemic were related to an increase in the self-perception of VE, vocal signs and symptoms, and vocal fatigue symptoms. Additionally, teachers who taught through online classes and lives during the pandemic had a higher self-perception of VE and vocal signs and symptoms. Factors related to vocal demand such as increased hourly load and online classes, associated with the probable performance of inappropriate vocal behaviors by individuals with vocal complaints, can lead to an overload in the phonatory apparatus of teachers, and consequently to an increase in the self-perception of perceived VE[24]. It is known that the feeling of effort leads to a decrease in the performance of the vocal task, which may be due to a neuromuscular inefficiency resulting from the reduction of oxygenation due to inadequate vocal behavior and inefficient muscle recruitment. This increases the energy demand for functional performance, which may or may not be related to the recovery deficit[21,27]. In this case, it is inferred that both increased demand and the presence of vocal complaints that indicate possible inappropriate vocal behaviors may compromise teachers' vocal use and lead to a greater sensation of VE, developing vocal fatigue symptoms possibly due to neuromuscular inefficiency.

Teachers in public schools had a lower self-perception of VE during the pandemic. As already mentioned, this is believed to have occurred because public institutions, except for universities, did not offer synchronous classes. In contrast, private institutions have opted mainly for synchronous and asynchronous teaching by recording classes and other materials[29].

The findings of the present study show that scores of the self-perception of teachers remain high despite a reduction in the self-perception of VE, vocal signs and symptoms, and vocal fatigue during the pandemic, which points to the need for vocal health care in this population. Moreover, even differently, traditional factors related to possible inappropriate vocal behaviors and vocal demands were predictive of the self-perception of VE, vocal signs and symptoms, and vocal fatigue during the COVID-19 pandemic. The data presented in this study refer only to self-perception. Future studies should perform clinical evaluations of teachers' voice in the context of the pandemic. It is also suggested to analyze the relationship between vocal self-perception and variables related to the type of technology that teachers use for teaching.

The present study is limited in that it has a risk of memory bias since pre-pandemic period data were collected retrospectively.

CONCLUSION

Teachers at the early education, elementary, and high schools report decreased symptoms of VE and vocal signs and symptoms during the COVID-19 pandemic. Teachers with vocal complaints have a higher perception of VE, vocal signs and symptoms, and vocal fatigue; specifically for vocal fatigue, the presence of vocal complaints only during the pandemic lead to a greater self-perception of symptoms. The increase in the weekly vocal load at work and the presence of vocal complaints during the pandemic worsened vocal self-perception; being teaching online/live classes during the pandemic worsened the self-perception of VE and vocal signs and symptoms during the pandemic; and being a private school teacher worsened VE self-perception during the pandemic

REFERENCES

1. WHO: World Health Organization. (2020). *Novel Coronavirus – China* [Internet]. Geneva: WHO [citado em 2022 Fev 13]. Disponível em: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/

2. Farias HS. The advancement of Covid-19 and social isolation as a strategy to reduce vulnerability. Espaço e Economia. 2020;17. http://dx.doi.org/10.4000/espacoeconomia.11357.

3. Camacho ACLF, Joaquim FL, Menezes HF, Sant' Anna RM. A tutoria na educação à distância em tempos de COVID-19: orientações relevantes. Soc Dev. 2020;9(5):e30953151. http://dx.doi.org/10.33448/rsd-v9i5.3151.

4. Behlau M, Dragone MLS, Nagano L. A voz que ensina: o professor e a comunicação em sala de aula. Rio de Janeiro: Revinter; 2004.

5. Behlau M, Zambon F, Guerrieri AC, Roy N. Epidemiology of voice disorders in teachers and nonteachers in Brazil: prevalence and adverse effects. J Voice. 2012;26(5):665.e9-18. http://dx.doi.org/10.1016/j.jvoice.2011.09.010. PMid:22516316.

6. Roy N, Merrill RM, Thibeault S, Gray SD, Smith EM. Voice disorders in teachers and the general population: effects on work performance, attendance, and future career choices. J Speech Lang Hear Res. 2004;47(3):542-51. http://dx.doi.org/10.1044/1092-4388(2004/042). PMid:15212567.

7. Zambon F, Moreti F, Behlau M. Coping strategies in teachers with vocal complaint. J Voice. 2014;28(3):341-8. http://dx.doi.org/10.1016/j.jvoice.2013.11.008. PMid:24495425.

8. Pizolato RA, Mialhe FL, Cortellazzi KL, Ambrosano GMB, Cornacchioni Rehder MIB, Pereira AC. Avaliação dos fatores de risco para distúrbios de voz em professores e análise acústica vocal como instrumento de avaliação epidemiológica. Rev CEFAC. 2013;15(4):957-66. http://dx.doi.org/10.1590/S1516-18462013000400025.

9. Xia J. Practical exploration of school-family cooperative education during the covid-19 epidemic: a case study of zhenjiang experimental school in Jiangsu Province, China. Best Evid Chin Edu. 2020;4(2):521-8. https://doi.org/10.15354/bece.20.rp003.

10. Besser A, Lotem S, Zeigler-Hill V. Psychological stress and vocal symptoms among University Professors in Israel: Implications of the Shift to Online Synchronous Teaching During the COVID-19 Pandemic. J Voice. 2022 Mar;36(2):291.e9-16. http://dx.doi.org/10.1016/j.jvoice.2020.05.028. PMid:32600872.

11. Camargo MRMC, Zambon F, Moreti F, Behlau M. Tradução e adaptação cultural e linguística da Adapted Borg CR10 for Vocal Effort Ratings para o português brasileiro. CoDAS. 2019;31(5):e20180112. http://dx.doi.org/10.1590/2317-1782/20192018112. PMid:31691744.

12. Zambon F, Moreti F, Ribeiro VV, Nanjundeswaran C, Behlau M. Vocal Fatigue Index: Validation and Cutoff Values of the Brazilian Version. J Voice. 2020;2020(20):30235-6.

13. Vianna CP. O sexo e o gênero da docência. Cadernos Pagu. 2001;2(17-18):81-103. http://dx.doi.org/10.1590/s0104-83332002000100003.

14. Behlau M. (2001). Voz: o livro do especialista. Rio de Janeiro: Revinter; 2001.

15. Grillo MHMM, Penteado RZ. The impact of voice on the quality of life of elementary school teachers. Pro Fono. 2005;17(3):321-30. http://dx.doi.org/10.1590/S0104-56872005000300006. PMid:16389789.

16. Vindegaard N, Benros ME. COVID-19 pandemic and mental health consequences: systematic review of the current evidence. Brain Behav Immun. 2020;89:531-42. http://dx.doi.org/10.1016/j.bbi.2020.05.048. PMid:32485289.

17. Alves LP, Araújo LTR, Xavier Neto JA. Prevalência de queixas vocais e estudo de fatores associados em uma amostra de professores de ensino fundamental em Maceió, Alagoas, Brasil. Rev Bras Saúde Ocup. 2010 Jun;35(121):168-75. http://dx.doi.org/10.1590/S0303-76572010000100018.

18. Ceballos AGC, Carvalho FM, Araújo TM, Reis EJFB. Avaliação perceptivo-auditiva e fatores associados à alteração vocal em professores. Rev Bras Epidemiol. 2011 Jun;14(2):285-95. http://dx.doi.org/10.1590/S1415-790X2011000200010. PMid:21655695.

19. Murdaugh K, Hausknecht JB, Herbst CT. In-Person or Virtual? - Assessing the Impact of COVID-19 on the Teaching Habits of Voice Pedagogues. J Voice. 2022 Set;36(5):735.e19-25. http://dx.doi.org/10.1016/j.jvoice.2020.08.027. PMid:33243666.

20. Abou-Rafée M, Zambon F, Badaró F, Behlau M. Fadiga vocal em professores disfônicos que procuram atendimento fonoaudiológico. CoDAS. 2019;31(3):2-7. PMid:31188907.

21. Cercal GCS, Paula AL, Novis JMM, Ribeiro VV, Leite APD. Vocal fatigue in professors at the beginning and end of the school year. CoDAS. 2020;32(1):e20180233. http://dx.doi.org/10.1590/2317-1782/20192018233. PMid:31851210.

22. Ford Baldner E, Doll E, Van Mersbergen MR. A review of measures of vocal effort with a preliminary study on the establishment of a vocal effort measure. J Voice. 2015;29(5):530-41. http://dx.doi.org/10.1016/j.jvoice.2014.08.017. PMid:26186811.

23. Roy N, Gray SD, Simon M, Dove H, Corbin-Lewis K, Stemple JC. An evaluation of the effects of two treatment approaches for teachers with voice disorders: a prospective randomized clinical trial. J Speech Lang Hear Res. 2001;44(2):286-96. http://dx.doi.org/10.1044/1092-4388(2001/023). PMid:11324651.

24. Sampaio MC, dos Reis EJ, Carvalho FM, Porto LA, Araújo TM. Vocal effort and voice handicap among teachers. J Voice. 2012;26(6):820.e15-8. http://dx.doi.org/10.1016/j.jvoice.2012.06.003. PMid:23177755.

25. Servilha EAM, Arbach MDP. Queixas de saúde em professores universitários e sua relação com fatores de risco presentes na organização do trabalho. Distúrb Comun. 2011;23(2):181-91.

26. Mota DDCF, Cruz DALM, Pimenta CAM. Fadiga: uma análise do conceito. Acta Paul Enferm. 2005;18(3):285-93. http://dx.doi.org/10.1590/S0103-21002005000300009.

27. Nanjundeswaran C, VanSwearingen J, Abbott KV. Metabolic mechanisms of vocal fatigue. J Voice. 2017;31(3):378.e1-11. http://dx.doi.org/10.1016/j.jvoice.2016.09.014. PMid:27777059.

28. Dassie-Leite AP, Cercal GCS, de Paula AL, Novis JMM, Ribeiro VV. Vocal symptoms in brazilian professors: self-perception and relationship factors. J Voice. 2021 Set;35(5):806.e15-20. http://dx.doi.org/10.1016/j.jvoice.2020.01.028. PMid:32088066.

29. Souza GHS, Jardim WS, Marques YB, Lopes G Jr, Santos APS, Liberato LP. Educação remota emergencial (ere): um estudo empírico sobre capacidades educacionais e expectativas docentes durante a pandemia da COVID-19. Res Soc Dev. 2021;10(1):e37510111904. http://dx.doi.org/10.33448/rsd-v10i1.11904.