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Association between voice symptoms and college professors' home working conditions during online classes in times of COVID-19 pandemic

Asociación entre síntomas vocales y condiciones de trabajo en casa durante las clases online en tiempos de COVID-19 de docentes universitarios

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Abstract

Introduction. Due to the COVID-19 pandemic, teaching conditions changed around the world from in-person classes to online classes, which also determined changes on teachers' working conditions.

Method: Exploratory cross-sectional study with the aim of determining the association between two voice symptoms (vocal fatigue and throat pain) with home working conditions during online classes in times of COVID-19 pandemic. Professors answered an online survey including 27 questions about four components: sociodemographic factors, characteristics of home working, quarantine characteristics, and health conditions (including voice functioning).

Results: 177 college professors from Argentina, Colombia, and Chile participated in this study. First, incidence of vocal fatigue, during online classes in times of COVID-19 pandemic, represented around 50%. Although throat pain had a smaller incidence, it was also important (35%). Second, days in quarantine, number of classes per week, people living with during quarantine, and history of vocal fatigue before quarantine were important associated factors of vocal fatigue. Third, important associated factors of throat pain were number of classes per week, level of stress, years of experience, and history of throat pain before quarantine.

Conflicts of Interest
The authors have declared that no competing interests exist.

Data Availability Statement
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Author Contributions
Lady Catherine Cantor-Cutiva: conceptualization, investigation, methodology, writing – original draft, writing – review and editing.
Maria del Carmen Dalmasso: conceptualization, investigation, methodology, writing – original draft, writing – review and editing.
María Celina Malebrán Bezerra de Mello: conceptualization, investigation, methodology, writing – original draft, writing – review and editing.

Conclusion: Similar to pre-COVID-19, vocal fatigue and throat pain were frequently reported voice symptoms among college professors. Associated factors of these symptoms included years of experience, number of classes per week, stress, people living with during quarantine due to COVID-19, and history of voice symptoms. Workplace Health Promotion programs should include activities that facilitate a healthy occupational voice use during and post-COVID-19 pandemic, considering the implications of online teaching on teachers' health and safety.

Key words
Voice disorders; voice quality; vocal fatigue; throat pain; teachers; faculty; occupational risks; home working; online classes; COVID-19; Coronavirus Infections.

Resumen
Introducción: Debido a la pandemia del COVID-19, las condiciones de enseñanza-aprendizaje cambiaron alrededor del mundo, pasando de clases presenciales a clases virtuales, lo que también determinó cambios en las condiciones de trabajo docente.

Métodos: Estudio transversal exploratorio que tuvo como propósito determinar la asociación entre dos síntomas de voz (fatiga vocal y dolor de garganta) con las condiciones de trabajo docente durante las clases virtuales en tiempos de COVID-19. Los profesores diligenciaron una encuesta virtual que incluyó 27 preguntas sobre los siguientes cuatro componentes: factores sociodemográficos, características del trabajo en casa, características de la cuarentena, y condiciones de salud (incluyendo funcionamiento vocal).

Resultados: 177 profesores universitarios de Argentina, Colombia y Chile participaron en este estudio. Primero, la incidencia de la fatiga vocal durante las clases virtuales en tiempos de COVID-19 representó alrededor del 50%. Aunque el dolor de garganta tuvo una menor incidencia, también fue importante (35%). Segundo, los días en cuarentena, número de clases por semana, personas con las que vivió durante la cuarentena, y los antecedentes de fatiga vocal antes de la cuarentena estuvieron estadísticamente asociados a la fatiga vocal. Tercero, los factores asociados al dolor de garganta fueron el número de clases semanales, los niveles de estrés, los años de experiencia y los antecedentes de dolor de garganta antes de la cuarentena.

Conclusión: Similar a hallazgos previos al COVID-19, la fatiga vocal y el dolor de garganta son síntomas vocales frecuentemente reportados en docentes universitarios. Factores asociados de estos síntomas incluyen años de experiencia, número de clases semanales, estrés, personas con las que vivió durante la cuarentena y antecedentes de estos síntomas vocales antes del trabajo en casa. Los Programas de Promoción de la Salud en los Lugares de Trabajo deben incluir actividades que faciliten el uso ocupacional saludable de la voz durante y después del COVID-19, considerando las implicaciones de la enseñanza virtual en la salud y seguridad de los profesores.

Palabras clave
Desórdenes de la voz; calidad vocal; fatiga vocal; dolor de garganta; docentes; profesores; riesgos ocupacionales; trabajo en casa; clases virtuales; COVID-19; infecciones por Coronavirus.

Introduction

Vocal fatigue has been defined as the perceived measurable symptom that influences vocal task performance, may be a result of high vocal demand response, high vocal effort, or neuromuscular deficit [1], and it is one of the most common symptoms among teachers due to their high vocal demand at work (teaching to big groups of students for long periods of time without rest under noisy environments) [2]. Previous research has reported that work-related factors, such as background noise levels and reverberation times inside classrooms and schools, may lead to increased vocal loudness, which may increase vocal effort and, therefore, cause voice disorders [3–5].

In addition, it has been reported that voice disorders have important consequences on quality of life [6,7], and stress is an important psychosocial factor associated to an increased occurrence of voice disorders among teachers [8]. Moreover, until march 2020, most teachers were used to in-person teaching conditions, and moving to online classes could cause *coronateaching* (UNESCO, 2020), which is defined as the implications at psychological and emotional levels due to the frustration of not knowing-how to use digital resources during online teaching [9].

Although evidence is consistent on the association between working conditions and voice symptoms (including vocal fatigue) among teachers, there is a need for studies that analyze the association between voice symptoms and home working conditions during online classes in times of COVID-19 and identify the *home-working-related factors* associated with the occurrence of voice disorders among teachers.

On this regards, one study among Israelian college professors concluded that stress surrounding the transition to online classes was associated with elevated levels of vocal symptoms [10]. Another study among Finnish teachers reported a decreased proportion of voice symptoms during online teaching (44%) compared with in-person teaching (71%) [11]. A third study, among Colombian teachers, reported that teachers' perception of poor acoustic conditions (high echo) inside their homes/workplaces during online classes decreased their Voice-Related Quality of Life [12].

Considering this low number of publications, we designed a cross-sectional study among South American college professors (Argentina, Chile, and Colombia) to determine the association between two voice symptoms (vocal fatigue and throat pain) with home working conditions during online classes in times of COVID-19 pandemic, which is an important information to determine the characteristics of workplace vocal health promotion programs to decrease the occurrence of voice disorders among teachers when teaching online.

Method

Design and participants

This exploratory cross-sectional study was performed in May 2020. College professors located in three South American countries (Argentina, Chile, and Colombia), who worked in different fields (education, health, social sciences, basic sciences, arts, engineering, among others), were invited to fill in an online survey about voice symptoms and working conditions during home working in online classes in times of COVID-19 pandemic. Initial power calculations were based on results presented in previous research [3], and showed that considering a prevalence of voice disorders among teachers of 94% [13], with a power of 80% and a precision of 95%, 87 participants would be required to detect meaningful differences in the presence of voice symptoms across important associated factors. This study complied with the ethical principles outlined in the Declaration of Helsinki (IRB approval #006-21).

Data collection procedures

For this research, we designed a survey in Spanish to be filled in online through Google Forms. The three authors had several meetings for two months and discuss the main aspects to be included in the survey. After these meetings, we ended up with a 27 questions instrument to collect data regarding to sociodemographic conditions (n= 4), home-working conditions (online classes, extra time) (n= 14), quarantine characteristics (n= 4), and health conditions —including voice functioning— (n= 5). The first, second and fourth components were adapted from a previous instrument used in previous research with college professors [14]. The third component was included considering the pandemic situation and isolation/quarantine recommendations implemented worldwide. The first component included questions on sex, age, marital status, and country. The second component had 14 questions on hours of class per week, number of lectures per week, duration of lectures, occupational voice use, non-occupational voice use, tools used for online classes, years of experience, number of students per class, and stress. The third component included questions about days in quarantine, and people living with the professor during quarantine. The fourth component asked about current presence of voice symptoms and history of voice disorders.

In order to reduce response bias, we designed the survey to be anonymous, which prevented for demand characteristics bias. In addition, many of the questions were designed as open-ended questions to avoid acquiescence bias.

Statistical Analysis

Considering the objective of this study, two dependent variables and ten independent variables were defined. The dependent variables were continuous variables (Likert scale from 0 to 10): current presence of vocal fatigue and current presence of throat pain. Among the independent variables, two were dichotomous (biological sex and history of voice symptoms) and eight were continuous variables (days in quarantine, weekly classes hours, number of classes per week, people in quarantine with you, minutes per class, stress, years of experience, and students per class).

For the statistical analysis, normality of the data was first assessed by means of the Shapiro-Wilk test. Since data were not normally distributed, we used Generalized Linear Model (GLM) with a Poisson distribution to determine the association between working conditions during the COVID-19 pandemic with vocal fatigue and throat pain among college professors. The magnitude of the association was expressed as the Beta, and its standard error (SE). SPSS 21 software was used for statistical analysis.

Results

Participant characteristics

In total, 177 college professors from Argentina, Chile and Colombia participated in this study. Around 30% of the participants were male (n= 53), and most participants were married (35%). Table 1 shows the distribution of biological sex and marital status per country.

Table 1. Distribution of biological sex and marital status of participating professors per country

Variable	Parameters	Country		
		Argentina	Chile	Colombia
Biological sex	Male	7	21	25
	Female	38	32	53
Marital status	Married	22	15	24
	Divorced	4	7	5
	Separated	7	2	4
	Single	9	22	27
	Living with someone	3	6	17

Occurrence of vocal fatigue and throat pain during home working in times of the COVID-19 pandemic

As shown in Table 2, the incidence of vocal fatigue during home working in times of COVID-19 pandemic was 46%, and persistent vocal fatigue (before and during home working) was 94%, indicating the continuation of this complaints. Regarding throat pain, 54% of participating professors reported having felt throat pain when working at home during the COVID-19 pandemic. Incidence (new cases) was 35%, and recovery (throat pain before home working and not throat pain during home working) was 14%.

Table 2. Occurrence of voice symptoms among South American professors during the COVID-19 pandemic

Vocal fatigue	**N**	**%**
Incidence	43	46
Chronicity	78	94
Recovery	5	6
Throat pain	**N**	**%**
Incidence	39	35
Chronicity	56	86
Recovery	9	14

Association between vocal fatigue and home working during the COVID-19 pandemic

Table 3 shows the associated factors for the prevalence of vocal fatigue (n=121). In the univariate analysis, days in quarantine (B= 0.02), number of classes per week (B=0.04), number of persons you live with during quarantine (B= -0.09), stress (B=0.10), and history of vocal fatigue before quarantine (B=0.54) were associated with current vocal fatigue (during the

COVID-19 pandemic). The multivariate analysis (including all variables statistically significant in the univariate analysis) shows that professors with more days in quarantine (B=0.01), a greater number of classes per week (B= 0.06), less people living with in quarantine (B= -0.11), and history of vocal fatigue before quarantine (B=0.59) were more likely to report vocal fatigue during home working in times of the COVID-19 pandemic.

Table 3. Associated factors of vocal fatigue among South American professors during home working in times of the COVID-19 pandemic

Variable	Univariate analysis			Multivariate analysis		
	Beta	SE	p-value	Beta	SE	p-value
Female	-0,14	0,09	0,12			
Days in quarantine	0,02	0,01	0,00	0,01	0,01	0,05
Weekly classes hours	0,00	0,00	0,50			
Number of classes per week	0,04	0,01	0,00	0,06	0,01	0,00
Duration of classes (in minutes)	0,00	0,00	0,01	0,00	0,00	0,08
People in quarantine with you	-0,09	0,03	0,01	-0,11	0,03	0,00
Stress	0,10	0,02	0,00	0,09	0,02	0,00
Experience (in years)	-0,01	0,00	0,10			
Students	0,00	0,00	0,95			
Vocal fatigue before quarantine	0,54	0,09	0,00	0,59	0,09	0,00

Association between throat pain during and home working in times of the COVID-19 pandemic

Table 4 shows the associated factors for the prevalence of throat pain (n=95). In the univariate analysis, days in quarantine (B=0.02), number of classes per week (B=0.04), stress (B=0.12), experience in years (B= -0.02), and history of throat pain before quarantine (B=0.61) were statistically associated with current throat pain. The multivariate analysis (including all variables statistically significant in the univariate analysis) shows that professors with higher number of classes per week (B=0.07), higher level of stress (B= 0.11), less years of experience (B= -0.02), and history of throat pain before quarantine (B=0.64) were more likely to report throat pain.

Table 4. Associated factors of throat pain among South American professors during home working in times of the COVID-19 pandemic

Variable	analysis			Multivariate analysis		
	Beta	SE	p-value	Beta	SE	p-value
Female	0,16	0,12	0,17			
Days in quarantine	0,02	0,01	0,01	0,01	0,01	0,10
Weekly classes hours	0,00	0,00	0,84			
Number of classes per week	0,04	0,01	0,00	0,07	0,01	0,00
Duration of classes (in minutes)	0,00	0,00	0,01	0,00	0,00	0,09
People in quarantine with you	-0,01	0,03	0,85			
Stress	0,12	0,02	0,00	0,11	0,02	0,00
Experience (in years)	-0,02	0,01	0,01	-0,02	0,01	0,00
Students	0,00	0,00	0,28			
Throat pain before quarantine	0,61	0,10	0,00	0,64	0,11	0,00

Discussion

This cross-sectional study aimed to determine the association between two voice symptoms (vocal fatigue and throat pain) with home working conditions during online classes in times of COVID-19 pandemic. Three main results were found. First, incidence of vocal fatigue (new cases) represents around half of the participating college professors without history of vocal fatigue before home working due the COVID-19 pandemic (46%). Second, days in quarantine, number of classes per week, people living with during quarantine, and history of vocal fatigue before quarantine were important associated factors of vocal fatigue during home working in times of the COVID-19 pandemic. Third, number of classes per week, level of stress, years of experience, and history of throat pain before quarantine were statistically associated factors of throat pain during home working in times of COVID-19 pandemic.

Concerning the first result, studies before COVID-19 pandemic reported an occurrence of vocal fatigue between 17% among Indian primary school teachers [15] and 27% among Brazilian college professors [16]. In our study, current prevalence of vocal fatigue was 68%. Moreover, as shown in Table 2, the incidence of vocal fatigue during online classes in times of COVID-19 pandemic was 46%, which indicates a high occurrence of vocal fatigue among previously healthy professors. Regarding throat pain, studies before COVID-19 pandemic reported a prevalence between 3% among Indian teachers (17) and 24% among teachers in Lebanon (18), which is lower compared with our results (54%). Therefore, our findings suggest that home working in times of COVID-19 pandemic may cause a higher occurrence of vocal fatigue and throat pain among participating professors compared with the prevalence of these symptoms before online classes due to COVID-19. These results are in disagreement with Besser et al. [10], who found no significant differences between the perception of vocal symptoms during the online synchronous teaching compared to reported vocal symptoms before the COVID-19 pandemic [10]. One possible explanation for this disagreement is the "moment of

the pandemic", since professors in Besser´s study were closer to the beginning of the pandemic, whereas our participants had longer times in home working, and therefore, longer exposure to the "adjusted" working conditions. Our results are also in disagreement with Patjas et al. [11], who reported that teachers (primary and secondary school) experienced significantly fewer voice disorders during online teaching compared with in-person teaching before COVID-19. One possible explanation for this disagreement is the recall period, since Patjas et al. [11] asked for the immediately before period, whereas we asked about voice symptoms before quarantine (without defining the recall period), and as it has been reported that studies with long or undefined recall periods reported higher prevalence compared with studies that used shorter recall periods (12 months-prevalence) [3], it seems likely that we found higher prevalence compared with Patjas et al. [11]. Further studies are needed to confirm these results.

Regarding the associated factors of vocal fatigue during online classes in times of COVID-19, we found four important associated factors: 1) days in quarantine, 2) number of classes per week, 3) people living with in quarantine, and 4) history of vocal fatigue before home working. Previous studies have reported the effect of individual and work-related factors on the occurrence of voice disorders among teachers [4,5,16]. We would like to highlight some of these associations. First, the relationship between "days in quarantine" and "people in quarantine with you" with vocal fatigue. The multivariate analysis showed that professors with more days in quarantine and less people living with during quarantine were more likely to report vocal fatigue. One possible explanation for these associations is that expending more time in home working and online teaching without proper training and physical adjustments for a "healthy" occupational voice use may increase the odds of having voice symptoms because teachers use their voices under unknown or unconventional conditions. Moreover, if they have training in voice use, it is highly likely that it is not completely suitable for the online classes' conditions (for instance, they may have been trained in how using projected voice inside the classroom during in-person classes but not how to control the Lombard effect due to the low feedback caused by the headphones during online classes). In addition, being in quarantine with less people might mean being away from family and friends, which may increase stress, anxiety and even depression (especially when quarantines were very rigid due to COVID-19), and therefore the occurrence of voice symptoms related with these psychosocial conditions [19]. Moreover, many professors reported (anecdotally) an increased occupational voice use due to home working (online classes and meetings) because being online allowed to attend to more meetings, even to several meetings at the same time. This increased occupational voice use involves an increased *vocal demand response* (the response of the talker to the demands of the communicative context), and therefore the vocal fatigue. Another interesting result is related with the lack of association between biological sex and vocal fatigue among the participating professors, which is in disagreement with previous research [16,20]. According with our results, it seems likely that vocal fatigue during home working in times of the COVID-19 pandemic affects in a similar way male and female professors. Future research is advised to confirm our results.

Our result on the association between classes per week and throat pain is partially in agreement with Padilha et al. [21], who reported a significant association between dysphonia and weekly working hours, with teachers with dysphonia having around 36 hours per week and teachers without dysphonia with around 27 hours per week [21]. However, our results are in disagreement with Marçal and Peres, who reported no effect of number of classes on voice disorders [22]. Since during online classes (and meetings) in times of the COVID-19

pandemic, professors needed to use their voices for longer periods of time without rest and under not optimal conditions (noise and lighting designed for housing and not for working), it seems likely that teachers with longer working hours can feel throat pain associated with higher vocal effort. Nevertheless, this hypothesis is beyond the scope of this paper and will be explored in future studies.

On the other hand, we found a significant association between years of experience and throat pain (B= -0.02), which means that professors with more experience are less likely to report throat pain during home working in times of COVID-19 pandemic. This result is in disagreement with previous research that report no significant association between voice problems and years of experience in-person classes [21,22]. One possible explanation for this disagreement is the definition of voice disorders; Marçal and Padilha measured voice disorders in general, whereas we measured a specific symptom (throat pain). A second possible explanation is related with the change of working conditions. Since participating teachers in Padilha´s and Marçal´s studies were working inside schools (in-person classes), whereas our participants were home working, which may suggest that working environment may be more influenced by years of experience. A third explanation is related with the level of teaching, our participants were college professors with different working conditions compared with Padilha´s and Marçal´s, who included schoolteachers.

Finally, we would like to highlight the association between stress and history of voice symptoms with current voice symptoms (vocal fatigue and throat pain). Similar to previous studies [8], professors who reported higher levels of stress were more likely to report vocal fatigue and throat pain, which suggest that the association between stress and voice disorders during home working and online classes in times of COVID-19 pandemic remains. This result may also indicate that home working and online classes in times of COVID-19 increased stress levels among professors [10]. Concerning the effect of previous voice symptoms on current voice symptoms, we found that teachers with history of vocal fatigue and throat pain were more likely to report current symptoms. On this regards, previous research reported a high chronicity of voice complaints among schoolteachers [5], which highlight the persistence of voice disorders as a health problem among teachers.

This study had some limitations. First, we did not explain the concepts of fatigue or throat pain in advance to the participating teachers, which could bias participants' responses. However, since these symptoms are common among teachers, we consider this bias is likely but low. Second, our results are exclusively based on self-reports, which increase the likelihood of recall bias. Nevertheless, considering the COVID-19 restrictions at the time of the data collection, this was a suitable method for data collection. Third, the cross-sectional design does not allow to determine causality because we were not able to determine the natural course of voice symptoms during home working and online classes.

In conclusion, our results indicated that, similar to in-person classes, teachers' working conditions include different factors that may increase their likelihood to report voice symptoms. Among our participants, years of experience, number of classes per week, stress, people living with in quarantine, and history of voice symptoms were statistically associated with vocal fatigue and throat pain among college professors during home working in times of the COVID-19 pandemic. Workplace Health Promotion Programs are required to implement activities that facilitate a healthy occupational voice use during home working in times of the COVID-19 pandemic.

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