

Singing Voice Symptomatology Following Presumed SARS-CoV-2 Infection

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Summary: The impact of continued COVID-19 sequelae on singers' vocal function has yet to be determined. An online survey of singers who have contracted SARS-CoV-2 infection was designed and administered globally. Participants (n = 1,153) were recruited in Africa, the Americas, Asia, Australia, and Europe. Survey questions included demographics, peri- and post-SARS-CoV-2 infection symptoms, and self-reported sequelae attributed to long-COVID. The survey was made available in English, Portuguese, Spanish, and Traditional and Simplified Mandarin Chinese. Data were statistically analyzed to provide a useful summary of the sample and to evaluate associations between long-COVID and singers' vocal function. We found that age, gender, and vaccination status were not significantly correlated to a change in singing voice in our sample. However, severity of infection was statistically correlated with a change in singing voice. Of the 34 signs and symptoms presented, lingering cough, shortness of breath, and chronic fatigue were significantly correlated with a change in singing voice. These data and their analyses have added to our understanding of this growing population's unique vocal needs, and may inform strategies for singing voice habilitation in COVID-19 survivors.

Keyword: COVID—Long-COVID—Sequelae—Voice teacher—Singer—Symptom—Singing pedagogy.

INTRODUCTION

As of May 2022 an estimated 517 million people globally have been infected with Severe Acute Respiratory Syndrome-CoV-2.¹ Page et al reported that approximately 14% of those infected will likely experience long-COVID,² resulting in at least an estimated 72 million long-COVID infections. After 3 years of the COVID-19 pandemic, data on long-COVID or 'long haulers' syndrome are emerging. The definition of Long-COVID was consistent with the Centers for Disease Control and Prevention (CDC) guidelines³ at time of publication. Of these long-COVID patients, thousands are likely singers whose ongoing sequelae could negatively impact vocal function. The impact of these sequelae on singers' vocal function has yet to be determined. Pulmonary changes are a primary concern⁴ as singers rely on optimal respiratory function to power the voice, but other sequelae (eg, chronic fatigue, cognitive impairments, viral neuropathy, and others) may present ongoing vocal handicaps. The current study investigated singers who have contracted and survived SARS-CoV-2 infection to help the singing voice community to better understand the ongoing symptomatology of these singers.

METHODS

Survey tool

An online questionnaire was designed and administered internationally using the SurveyMonkey platform.

Responses were collected between March 28, 2022, and May 12, 2022. All potentially identifying responses were de-identified, and participation was both voluntary and anonymous. The investigation was conducted in full compliance with the Shenandoah University Institutional Review Board, IRB #1071. The survey design allowed participants to skip questions they did not want to answer, and questions near the end of the survey were often unanswered. Accordingly, null responses were not included in the individual question response percentages.

This cross-sectional survey (see [Appendix 1](#)) consisted of 23 questions: demographic data (questions 2-4, 6-8), singing activities (questions 5, 9), and singer health and symptomatology (questions 10-23). Respondents were also invited to elaborate on COVID-19 sequelae and vocal function in two short-answer questions (question 19 and 23). The survey was generated in English and reviewed by a psychometrician and an inclusivity consultant to reduce research bias and maximize global participation. Following psychometric, inclusivity, and epidemiological reviews, the survey was translated into Portuguese, Spanish, and Simplified and Traditional Mandarin Chinese.

Signs and symptoms of COVID-19 both during initial infection and 4 weeks out were queried in a manner consistent with an ongoing study by the Johns Hopkins Bloomberg School of Public Health.⁵ Before beginning the survey, respondents were presented with a brief paragraph reviewing several common COVID-19 symptoms and the various ways in which COVID-19 can be diagnostically determined to ensure they were COVID patients. After the demographic questions were presented, respondents were shown another paragraph, indicating they should answer the remaining set of questions based on their first infection with COVID-19 had they been infected more than once. The official diagnosis of long-COVID consists of a negative polymerase chain reaction (PCR) test following a SARS-CoV-2 infection indicating

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microbiological recovery and one or more of the following sequelae lasting at least 4 weeks from initial infection: fatigue, breathlessness, cough, chest pain, palpitations, headache, joint pain, myalgia and weakness, insomnia, pins and needles, diarrhea, rash or hair loss, impaired balance and gait, and neuro-cognitive issues including memory and concentration problems and worsened quality of life.^{6,7}

Singing population

Singers were invited to participate via social media, email, and word of mouth. Inclusion criteria included: 1) self-identified singer status (avocational or professional), 2) age ≥ 18 years, and 3) COVID-19 status that was confirmed by positive rapid, antibody, or PCR COVID-19 tests. Exclusion criteria included: 1) negative singer status, 2) those under 18 years of age, and 3) unconfirmed COVID-19 status. Unfortunately, testing opportunities were limited for many persons.⁸ Those who were infected before testing was widely available may have had equally debilitating experiences with COVID-19, but to ensure methodological rigor these persons were excluded from participation.

Data analysis

Chi-square test (non-parametric Fisher's exact test) was used to evaluate demographic data associations. Three preliminary generalized linear mixed effects models were used to analyze the demography of respondents more likely to experience a change in their singing voice. Each of these three models assumed a binomial distribution with reported change in singing voice (yes/no) as the outcome variable (y). Variables were included in the model if they had a biologic association with the reported changing in singing ability (informed selection). Odds ratios (OR) and 95% confidence limit (CI) were constructed and reported for each variable of interest. Odds ratios reported accounted for the increased odds or likelihood of reporting a change in singing ability. Statistical significance was considered for *P*-values less than or equal to 0.05. Correlation between a variable and the outcome was determined using chi-square tests to compare group proportions (Fisher's exact test was used for proportions less than 5).

Qualitative analysis of the two open-ended (short answer) questions consisted of standard narrative analysis. Responses were read, categorized, and quantifiably coded by two investigators. Disputes in categorization were resolved through discussion. Subsequently, comprehensive themes were identified collaboratively, with the assistance of an otolaryngologist when applicable.

RESULTS

As seen in [Figure 1](#), a total of 1,153 participants from six continents (Africa, Asia, Australia, Europe, North America, and South America) completed the online survey. Of these, 172 did not meet inclusion criteria. This group included those who did not report having COVID

($n = 102$), those who did not test positive for the SARS-CoV-2 virus ($n = 52$), those under 18 years of age ($n = 17$), and one respondent who did not identify as a singer. Of the remaining participants ($n = 981$), 75 reported experiencing their first COVID-19 infection less than a month before completing the survey (see [Figures 2](#) and [3](#)). These respondents were included in the demography questions, but not included in the evaluation of the long-term effects. Therefore, 906 were included in the study of the long-term effect of COVID.

Singing activities

13.5% of those who responded self-identified as avocational singers and 86.5% indicated that they made their living at least occasionally from singing. Of those who revealed their vaccination status, 18.2% reported being unvaccinated at the time of the survey. 64.4% reported they feel at least 76% recovered and can do "most or all" of their usual singing.

Respondents were asked how long they could comfortably sing in one session both before and after their initial COVID-19 infection. As shown in [Figure 4](#), all respondents were able to sing longer than 15 minutes before their COVID-19 infection and 79.7% of respondents could sing an hour or more. Responses to the same question posed after a COVID-19 infection are telling: 6.8% of respondents were unable to sing longer than 15 minutes after their COVID-19 infection while only 32.1% could sing an hour or more, suggesting a COVID-19 infection can result in a toll on vocal stamina. Notably, the frequency of respondents in the stamina pre-COVID-19 group by maximum time able to sing was significantly different from the frequency of respondents in the stamina post-COVID-19 group (*P*-value < 0.001).

Of those who responded, 60.3% reported lingering symptoms lasting 4 weeks or more following their initial infection. The three most commonly reported recurring symptoms were fatigue (62.8%), shortness of breath (40.8%), and brain fog (32.8%).

[Table 1](#) lists the respondents' demographic information (age, sex, and other variables) stratified by those who did and did not report a change in their singing. Using informed selection, the mixed effects models focused on illness severity, vaccination status, and singing vocation. While holding other variables constant, variables were correlated with a change in singing voice. "Reference" represents the constant that other variables were calculated against. Acute COVID-19 severity was the only demography variable significantly associated with a change in one's ability to sing. Participants who reported experiencing moderate acute COVID-19 symptoms had a 1.72 increased odds (*P*-value = 0.02) of reporting a change/reduction in their singing ability compared to participants with mild acute COVID-19 symptoms. Participants with severe acute COVID-19 symptoms had a 5.21 increased odds (*P*-value = 1.51×10^{-5}) of reporting a change/reduction in their singing ability compared to participants with mild acute COVID-19. All other demographic

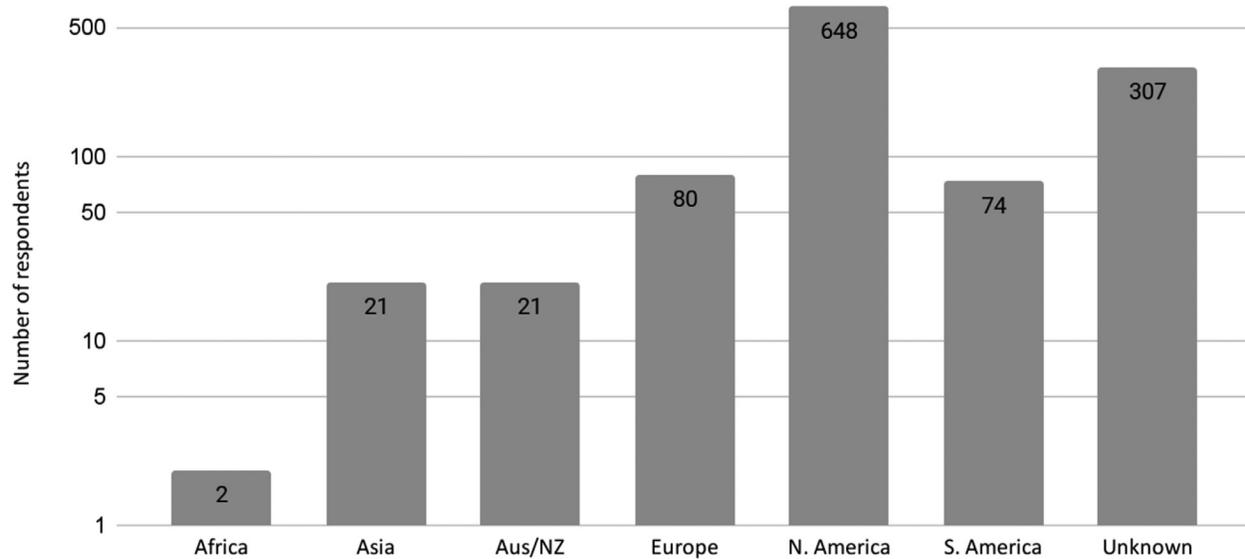


FIGURE 1. Respondent location (logarithmic scale).

variables were not significantly correlated with a change in ability to sing.

At the time of infection, signs and symptoms that were significantly associated with increased odds of a reported change in singing voice (see [Table 2](#)) were as follows: cough (OR: 3.7, 95% CI: 1.61-8.60, P -value = 0.002), sore throat (OR: 2.36, 95% CI: 1.03-5.36, P -value = 0.004), shortness of breath (OR: 0.58, 95% CI: 0.36-0.92, P -value = 0.02), and fatigue (OR: 1.77, 95% CI: 1.03-3.05, P -value = 0.039). The odds of reporting a change in singing ability when assessing the interaction between a cough and a sore throat were 0.24, suggesting a protective relationship between the two variables. Likewise, runny nose/congestion as correlated with a

change in singing ability (OR: 0.58) suggests a protective relationship. No other signs and symptoms at time of infection were significantly associated with an increased odds of reporting a change in their singing voice.

Four weeks after initial infection, the signs and symptoms that were significantly associated with increased odds of a reported change in singing voice were as follows (see [Table 3](#)): cough (OR: 1.81, 95% CI: 1.04-3.13, P -value = 0.035), shortness of breath (OR: 3.31, 95% CI: 2.15-5.10, P -value = 6.14×10^{-8}), and chronic fatigue (OR: 1.53, 95% CI: 1.03-2.29, P -value = 0.036). No other COVID-19 signs and symptoms experienced 4 weeks out were associated with an increased odds of reporting a change in their singing voice.

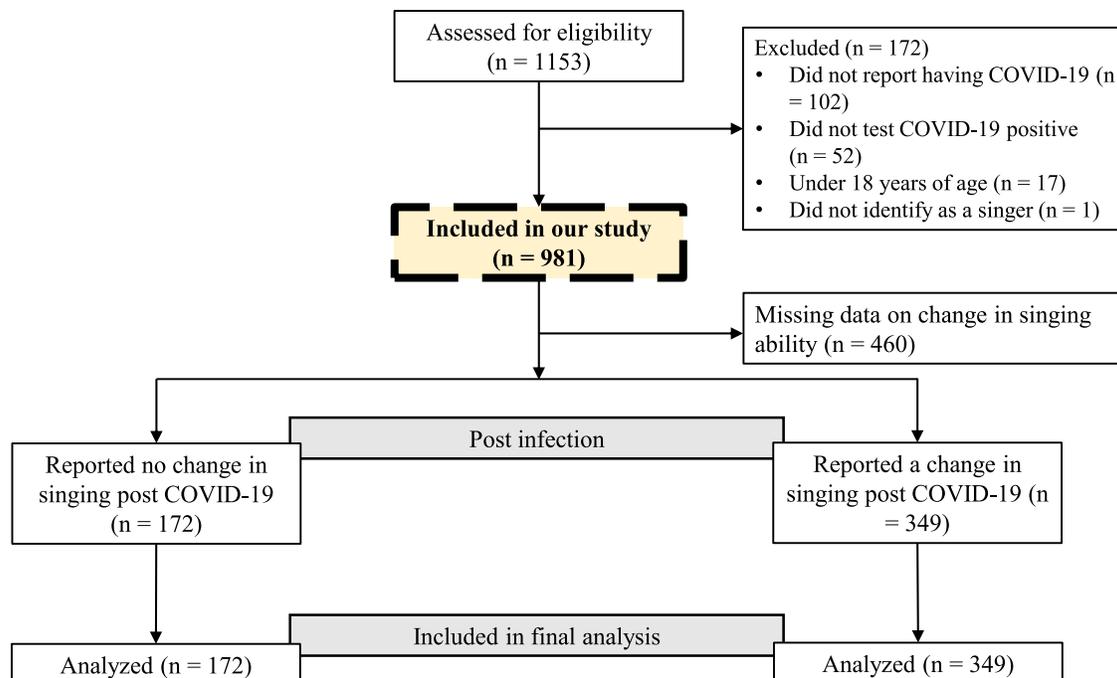


FIGURE 2. CONSORT diagram showing participant enrollment.

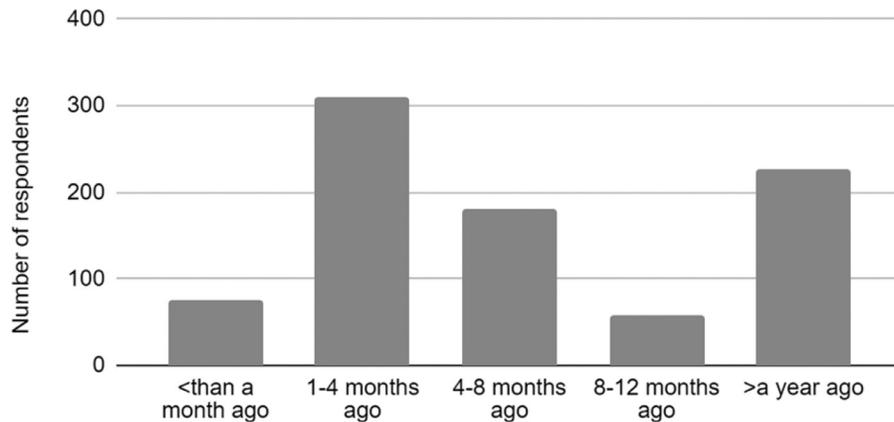


FIGURE 3. Onset of infection.

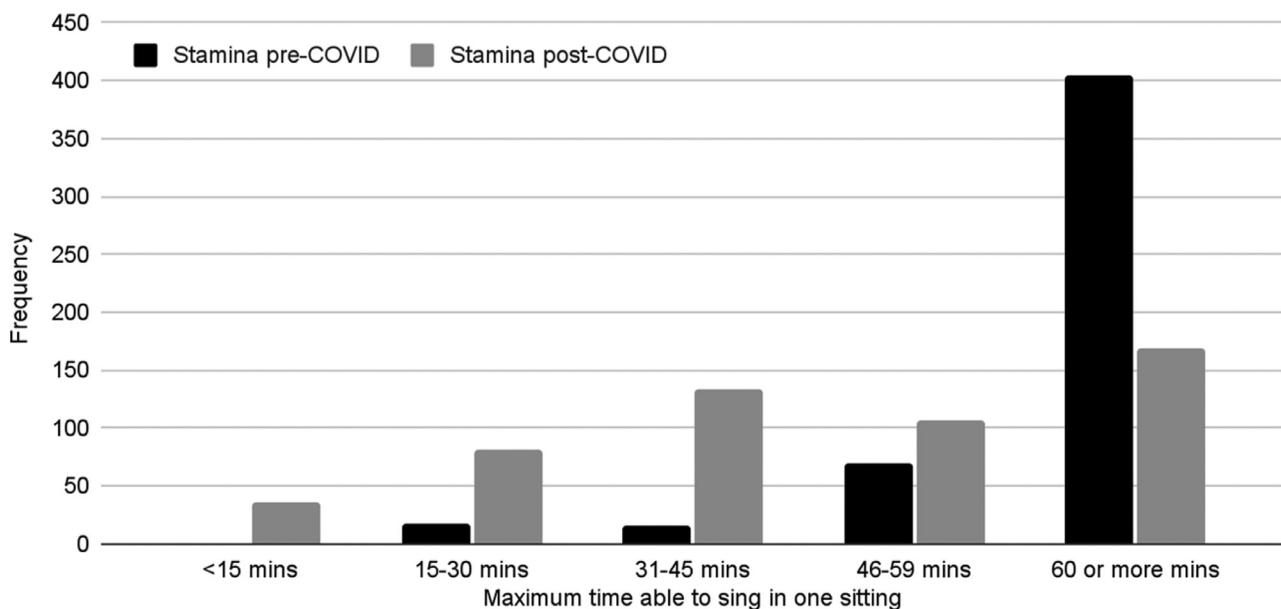


FIGURE 4. Stamina pre- and post-COVID.

Short answer question analysis

Two short-answer questions were included in the survey. In question 19, respondents were asked, “What are the main ways COVID-19 has affected your singing?” Themes were identified in the responses, as shown in Figure 5. Of the aggregated written concerns, those who responded reported more phonatory concerns (42.2%) than pulmonary (34%). The most common phonatory (dysphonia) concern was vocal fatigue (24.3%), while the most common pulmonary (dyspnea) concern was changes to breath support or control (40.8%). A selection of representative responses to this query grouped by theme may be found in Table 4.

Question 23 was the second open-ended question, and the last question of the survey. It asked, “Would you like to share any additional concerns about singing following COVID-19?” 28.2% of survey respondents chose not to answer this question, but the remaining responses mentioned additional breathing, mental health, registration, neurological, and stamina concerns (see Figure 6).

As in question 19, themes in question 23 were identified and examples of responses grouped by theme may be found in Table 5. While they were similar to responses for question 19, the investigators noted that mental health concerns were reported more frequently (17.2%). It should be noted that 43.2% of those who reported one or more concerns specified that they were yet ongoing.

DISCUSSION

This is the first known international multi-language study that evaluated the signs and symptoms of COVID-19 in adult singers. As shown in Table 1, beyond a moderate or severe COVID-19 infection, no other demographic variables were significantly associated with an increased odds of reporting a change in singing. Essentially, severity of disease can be used to understand who will experience a change in their singing ability. There were no significant interactions between demographic variables such as age and sex on the

TABLE 1.
Demography Variable vs Change in Singing Ability

Variable	Odds Ratio	95% Confidence Limit	P-value
COVID severity			
Mild	Reference	Reference	Reference
Moderate*	1.72	1.09-2.70	0.020
Severe†	5.21	2.47-11.00	1.51 × 10 ⁻⁷
Age range:			
Less than 30 years	Reference	Reference	Reference
30-59 years	1.00	0.68-1.51	0.96
60 years and greater	0.64	0.26-1.58	0.33
Vaccination status:			
Vaccinated	Reference	Reference	Reference
Not Vaccinated	0.78	0.48-1.27	0.32
Gender:			
Female	Reference	Reference	Reference
Male	0.65	0.41-1.03	0.07
Other	5.34	0.65-43.60	0.12
Singing classification:			
Non-professional singer	Reference	Reference	Reference
Professional singer	0.91	0.45- 1.74	0.78
Race			
White	Reference	Reference	Reference
Non-white	1.56	0.94-2.61	0.087

* P-value < 0.05.

† P-value < 0.01.

TABLE 2.
Symptom at Time of Infection vs Change in Singing Ability

Variable at Time of Infection	Odds Ratio	95% Confidence Limit	P-Value
COVID symptoms:			
Cough†	3.7	1.6-8.60	0.002
Sore throat†	2.36	1.31-4.26	0.004
Runny Nose/ Congestion*	0.58	0.36-0.92	0.02
Shortness of breath†	2.57	1.63-4.07	4.75 × 10 ⁻⁵
Headache	1.07	0.70-1.65	0.75
Fatigue*	1.77	1.03-3.05	0.039
Interaction terms:			
Cough by Sore throat†	0.24	0.09-0.63	0.004

* P-value < 0.05.

† P-value < 0.01.

TABLE 3.
Symptom 4 Weeks Postinfection vs Change in Singing Ability

Variable 4 Weeks Postinfection	Odds Ratio	95% Confidence Limit	P-Value
COVID symptoms:			
Cough*	1.81	1.04-3.13	0.035
Shortness of breath†	3.31	2.15-5.10	6.14 × 10 ⁻⁵
Chronic Fatigue*	1.53	1.03-2.29	0.036
Tightness or pressure on the chest	1.88	0.96-3.68	0.066
Headache	1.55	0.81-2.95	0.19
Buzzing ears or tinnitus	0.73	0.30-1.78	0.49

* P-value < 0.05.

† P-value < 0.01.

prediction of a change in singing voice. This finding differs from previous studies where such interactions were identified. Increasing age and male sex have both been independently shown to be a predictor of COVID-19 severity.^{9,10} One possible explanation for this difference from the literature is the very nature of this population. It is known that singers are more sensitive than non-singers to changes in their phonatory and respiratory systems due to the athletic nature of their voice use.¹¹ Previous studies have suggested that professional voice users tend to be more concerned about how the pandemic may impact them than non-singers.¹² Vaccination status (partial, full, and boosted) was surveyed, as well as the interaction between the timeline of infection, the onset of long-COVID symptoms, and time of vaccination. Due to the high proportion of vaccinated individuals in this data set (81.8%), the number reported being unvaccinated was not large enough to complete statistical analyses.

A total of 60.3% of our respondents reported experiencing long-COVID according to CDC guidelines. However, this does not imply that most singers who get COVID will experience long-COVID, as those who took the time to complete the survey may have been motivated by their own lingering signs and symptoms, thus representing a sampling bias in this study.

The signs and symptoms data were collected in a manner similar to other studies. Lechien et al surveyed 1,420 European patients in early 2020 for COVID-19 signs and symptoms upon initial infection.¹³ Lopez-Leon et al conducted a meta-analysis of 47,910 global patients' signs and symptoms that lasted over 2 weeks after initial infection.¹⁴ It should be noted that Lechien et al and Lopez-Leon et al examined populations that did not self-identify as singers. Table 6 presents these comparative data.

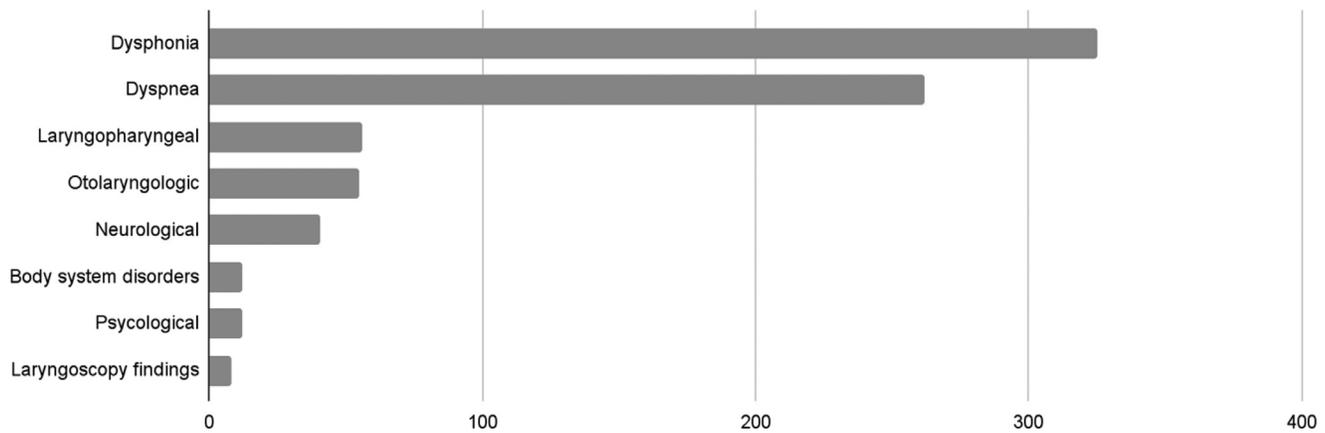


FIGURE 5. Themes of question 19 written answers by frequency.

TABLE 4.

Q. 19 Short Answer Themes: "What are the Main Ways COVID-19 has Affected Your Singing?"

Dysphonia concerns

"Shortness of breath and difficulty with breathing support, all the right sensations were there but I got very tired, dizzy and the effort was too much with little result"

"No more breath support! I can hardly do a full phrase and forget it if I'm singing softly! It's everything I have to get through 3 measures [of] legato. Never in my life before COVID did singing get me out of breath. Sometimes I find myself panting."

"Getting a full singer's breath still takes more effort than I think it should after 4 months since recovery"

"For 2 months after my other symptoms went away, I struggled to get a full breath in general and could not make it through easy phrases without extra breaths."

"Acute respiratory failure with hypoxia. Severe oxygen deprivation. I stayed awake in the ICU for 5 days and nights, kicking open my ribs to breathe"

Dyspnea concerns

"My voice didn't even feel like my own. My range was drastically decreased"

"Overall speaking pitch lowered, continued raspiness"

"I lost about an octave and transitioning into falsetto is a lot harder than it used to be as well"

Laryngopharyngeal concerns

"Constantly getting [a] tickle in my throat forcing me to cough. When there is tickle in my throat I have a hard time speaking or making a sound"

"Throat soreness, phlegm, throat tension increased"

"I was able to sing whistle tone regularly before COVID; now whistle tone is not accessible due to a dry cough"

Otolaryngological concerns

"My cough lasted for 2 months following my COVID infection, it was a deep chest cough and I completely lost my voice for those 2 months. It is still recovering and there are still about 5-7 notes in my mid-range that are just gone"

"Developed small nodules "

"I still wake up congested sometime, there is a heaviness in my throat and my chords feel constantly tired and like they are swollen and strained"

Neurological concerns

"Anxiety and fast heart rate affect breath management, and fatigue has led to decrease in muscle mass which has impacted my body and instrument as a whole"

"The foggy brain symptom has mad[e] it harder for me to concentrate"

"Feeling dizzy, cognitive fatigue"

Psychological concerns

"It's like learning to sing all over again, very disheartening"

"Since I've been unable to work due to this sickness, paying for voice lessons again... well, it's like going into debt all over again"

"Lots of long term anxiety mostly from having no clue what was happening"

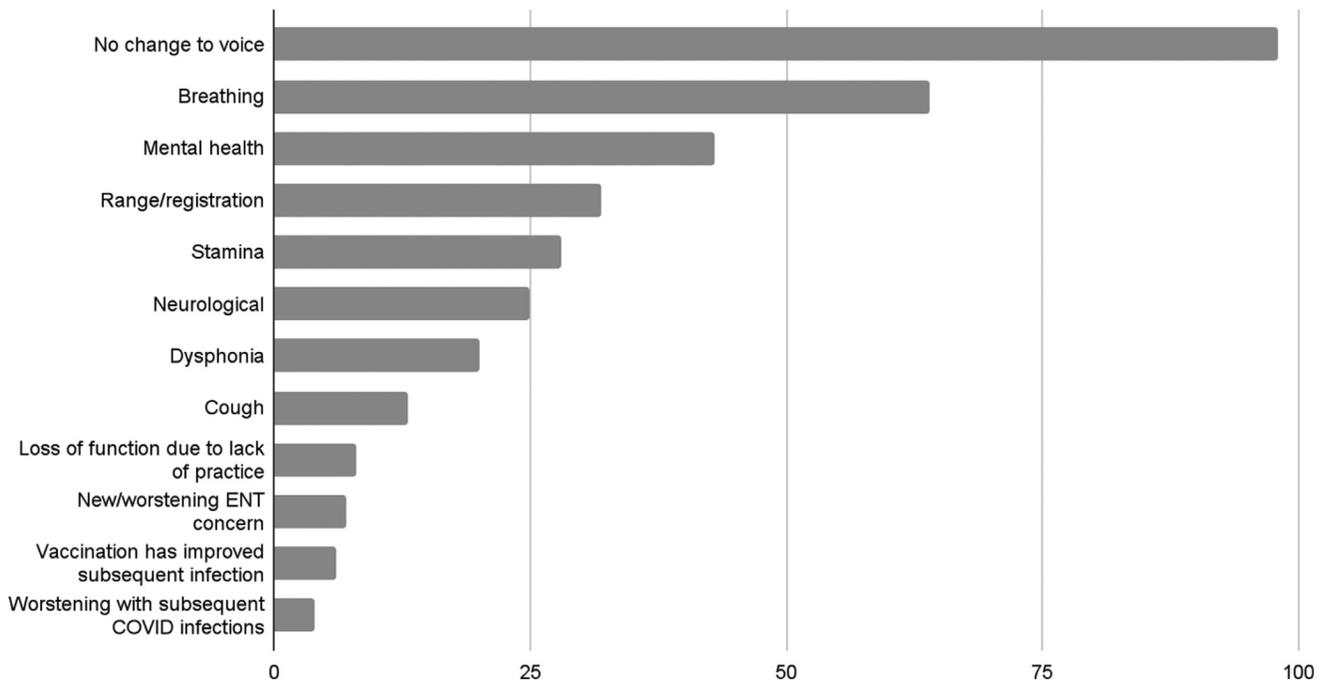


FIGURE 6. Themes of question 23 written answers by frequency.

TABLE 5.

Q. 23 Short Answer Themes: "Additional concerns About Singing Following COVID-19?"

Breathing concerns
"Scanned while initially sick and 12 weeks after. Lungs showed opaque ground glass. Was in bed for a month"
"It is so difficult to regain the control you had before once your lungs are affected by COVID"
"For a couple of months after my infection I would be short of breath while in the middle of phrases I had comfortably sung for years"
Mental health concerns
"I am concerned that I will never fully regain my voice after COVID"
"I'm worried and sad about myself. I don't think I can go back to the way I used to sing. I lost interest in singing and lost confidence in myself"
"I didn't have the courage to practice or take care of myself for a long time; which ends up affecting other facets of vocal discipline, such as, for example, reflux and sleep"

TABLE 6.

Signs and Symptoms by Percentage

Sequelae Initial Infection	Current Study	Lechien et al
Fatigue	79%	63%
Sore throat	65%	53%
Runny nose	64%	60%
Headache	57%	70%
Fever	55%	45%
Cough	51%	63%
Muscle aches	49%	63%
Loss of ability to smell	29%	70%
Loss of ability to taste	27%	54%
Sequelae 4 weeks out	Current study	Lopez-Leon et al
Fatigue	63%	58%
Shortness of breath	41%	24%
Foggy brain	33%	7%
Headache	14%	44%
Hair loss	7%	25%

Many sequelae experienced at time of infection were reported in this study at comparable rates to those found by Lechien et al with the exception of loss of smell and taste. The authors posit this may reflect the change in symptomatology between the original variant present during the data collection period of Lechien et al and those caused by the Omicron variant. Due to the timing of our survey, it is likely

that a portion of our respondents were infected with the Omicron variant, which may result in a loss of smell less frequently than previous variants such as Delta.¹⁵

The current study found sequelae several weeks postinfection at rates that differed from those reported by Lopez-Leon et al. Noteworthy differences include shortness of breath, fatigue, headache, and foggy brain (N.B. - the current survey

queried for “brain fog” which may or may not be strictly synonymous with “attention disorder,” the term used in the Lopez-Leon et al survey). The current study found substantially higher rates of dyspnea than Lopez-Leon et al, and fewer respondents reporting hair loss and headache. This discrepancy could be due to differences in the definition of long-COVID onset. This study defined long-COVID onset at 4 weeks out, whereas Lopez-Leon defined long-COVID-19 onset between 14 and 110 days postacute COVID-19 infection. The higher levels of lingering dyspnea in this study may be due to the hyper-sensitivity to breathing changes found in singers as discussed previously.

Two multivariable models (see Tables 2 and 3) were used to identify whether a specific sign or symptom might predict a change in the singing voice. The resulting analysis suggested that an unexpected protective relationship may exist between “cough” by “sore throat experienced upon initial infection” and a “change in singing voice.” It is plausible that respondents who reported both cough and sore throat upon initial infection may have been more likely to engage in complete voice rest and were therefore less likely to report a change in their singing voice.

Likewise, the relationship between “runny nose/congestion” (Table 2) during initial infection and a “change to singing voice” suggests a possible protective relationship. The novel Omicron variant became dominant in the second half of 2021, resulting in a noticeably more transmissible yet potentially less severe virus.¹⁶ This may be due to this particular variant’s mutations which result in enhanced binding to the upper respiratory tract as compared to the lower airways and alveolae,¹⁷ possibly preventing more severe pulmonary sequelae.¹⁸ Though we cannot be sure if our data are due to alternations observed by those infected with this new variant, it was the predominant strain circulating during our survey period. This change in Omicron’s respiratory tract tropism may explain why a runny nose (more likely indicating an Omicron infection) might result less often in the virus binding to the lungs and causing a notable change in the singing voice.

Pulmonary changes are expected with a SARS-CoV-2 virus by definition,¹⁹ however a high percentage of non-pulmonary related sequelae were also relevant concerns for the surveyed singers. This is consistent with the literature and suggests non-dyspnea or dysphonic sequelae are as common (if not more so) than pulmonary sequelae.^{20,21}

Limitations of the study: This cross-sectional survey was limited by its strength of association and recall bias. While 6.6% of those who responded were sick fewer than 8 months ago, 26.7% were sick over a year before taking the survey. Recall bias may have challenged the accuracy or completeness of what respondents remembered of their SARS-CoV-2 sequelae. This study failed to specify if respondents were experiencing acute changes to their singing voice or ongoing changes at the time of the survey. Due to the survey’s cross-sectional nature, a currently affected singing voice is assumed. Though the study had a fairly large number of participants, low frequency counts in the post-COVID-19 groups limited bivariate analysis power.

An additional limitation is the subjective nature of many singing voice terms. An example of this may be seen in the terms, “breath support” and “breath control,” neither of which are strictly based in a physiological function. While some singers and pedagogues use them interchangeably, others argue they are not synonymous. Defining these terms within the survey instrument may have improved response specificity.

Lastly, voice teachers and singers may benefit from knowing how soon singers could return to their normal singing activities following COVID-19 infection. Regrettably, this prompt was omitted. Further research may include a case study of a few singers as they begin to practice and re-incorporate performances following a SARS-CoV-2 infection to determine when and at what intensity they are able to return without injury to the voice. Despite these limitations, this study provides an initial multi-language international perspective on the most common sequelae singers from different cultures and vocal techniques experienced following a COVID-19 disease.

CONCLUSION

Vocologists and singing voice instructors working with persons who have been infected with SARS-CoV-2 should be aware that the amount of time a singer can practice or perform in one sitting may decrease substantially following a SARS-CoV-2 infection. We found that those with severe infections are over five times more likely to experience a change in singing voice as compared with those who had a mild infection. The most commonly reported lingering sequelae in this study were fatigue, changes to breath management, and brain fog. However, lingering fatigue, changes to breath management, and cough are more likely to correlate to a change to their singing voice.

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APPENDIX A: THE SURVEY ONLINE INSTRUMENT

1. Informed consent (Shenandoah University IRB #1071)

In order to participate in this study, you must have either received a positive COVID-19 test result or experienced COVID-19 symptoms. Common COVID-19 symptoms include fever or chills, cough, shortness of breath or

difficulty breathing, fatigue, muscle or body aches, headache, new loss of taste or smell, sore throat, congestion or runny nose, nausea or vomiting, and/or diarrhea.

2. Have you had COVID-19?
 - a. Yes
 - b. No (SKIP TO END)
3. Have you tested positive for COVID-19 at some point?
 - a. Yes, I have tested positive via rapid, PCR, or antibody test
 - b. No, I have never (SKIP TO END)
4. What is your age?
 - a. Under 18 (SKIP TO END)
 - b. Please specify
5. What is your level of singing?
 - a. I do not sing (IF NO, SKIP TO END)
 - b. I sing for fun but only by myself
 - c. I sing with others for fun
 - d. I sing in public and occasionally for money
 - e. I am a professional singer and most of my income comes from singing
 - f. Prefer not to answer
6. What is your gender?
 - a. Male
 - b. Female
 - c. Another option not listed (text box)
 - d. Prefer not to answer
7. What is your race/ethnicity? (multiple options available)
 - a. Asian
 - b. Black/African
 - c. Indigenous
 - d. Hispanic/ Latino/a/x
 - e. Middle Eastern/North Africa
 - f. White
 - g. Don't know
 - h. Prefer not to answer
 - i. Another option not listed (text box)
8. Where are you located?
 - a. Africa
 - b. Asia
 - c. Australia/New Zealand
 - d. Europe
 - e. North America
 - f. South America
9. What level of voice instruction have you received?
 - a. No solo voice lessons— I am self-taught
 - b. No solo voice lessons but I have sung in school or church groups
 - c. Extracurricular voice lessons
 - d. Voice lessons in higher education
 - e. Prefer not to answer
10. When did you first have symptoms or test positive for COVID-19?
 - a. Less than a month ago (IF SELECTED, go to end)
 - b. Between a month and 4 months ago
 - c. Between four months and 8 months ago
 - d. Between 8 and 12 months ago
 - e. Over a year ago
 - f. Prefer not to answer
11. How would you describe your health in the weeks before you became sick with COVID-19?
 - a. I had no major health issues
 - b. I had no major health issues, but some minor ones
 - c. I had one major health issue, but it was controlled
 - d. I had some major and minor health issues
 - e. I had several major health issues
 - f. Prefer not to answer
12. How would you classify your COVID-19 illness?
 - a. I had no symptoms
 - b. Mild
 - c. Moderate
 - d. Severe
 - e. Prefer not to answer
 - f. Don't know
13. Currently, how is your health compared to before your COVID-19 illness?
 - a. 0% - 25% (barely) recovered
 - b. 26% - 50% (half) recovered
 - c. 51% - 75% (mostly) recovered
 - d. 76% - 99% (almost) recovered
 - e. 100% (fully) recovered
 - f. Prefer not to answer
14. When you first became ill with COVID-19, what signs or symptoms did you *initially* experience? Select all that apply. (ability to choose multiple answers)
 - a. Fever >100.4°F or >38°C
 - b. Fever but I do not know exact temperature
 - c. Cough
 - d. Sore throat
 - e. Runny nose/congestion
 - f. Shortness of breath
 - g. Chills/Repeated shaking with chills
 - h. Fatigue, lack of energy or general tired feeling
 - i. Loss of appetite
 - j. Discomfort, tightness, or pressure in chest
 - k. Upset stomach or vomiting
 - l. Diarrhea
 - m. Muscle aches
 - n. Joint aches
 - o. Headache
 - p. Seizure
 - q. Dizziness
 - r. Hallucinations, altered consciousness
 - s. Loss of ability to smell
 - t. Loss of ability to taste
 - u. Seasonal allergies
 - v. Pain in teeth

For the next set of questions, if you have been infected with COVID-19 more than once, please base your responses on your first infection with COVID-19:

- w. Insomnia
 - x. Hair loss (alopecia)
 - y. Heavy limbs
 - z. Tremors
 - aa. Rapid heart rate
 - bb. Difficulty sleeping
 - cc. Eye problems
 - dd. Prickling, burning, or numb sensation (neuropathy)
 - ee. Ringing or buzzing in ears (tinnitus)
 - ff. Skin problems
 - gg. Other (please specify in text box)
 - hh. I did not have any signs or symptoms
15. Did any of your COVID-19 signs or symptoms last for a month or more? Select all that apply (ability to choose multiple answers)
- a. Fever >100.4°F or >38°C
 - b. Fever but I do not know exact temperature
 - c. New or worsening cough
 - d. Shortness of breath
 - e. Fatigue, lack of energy or general tired feeling
 - f. Loss of appetite
 - g. Discomfort, tightness, or pressure in chest
 - h. Feeling sick to your stomach or vomiting
 - i. Diarrhea
 - j. Insomnia
 - k. Muscle aches
 - l. Joint aches
 - m. Headache
 - n. Seizure
 - o. Dizziness
 - p. Having hallucinations, altered consciousness
 - q. Loss of ability to smell
 - r. Loss of ability to taste
 - s. Pain in teeth
 - t. Hair loss (alopecia)
 - u. Heavy limbs
 - v. Tremors
 - w. Rapid heart rate
 - x. Chills/Repeated shaking with chills
 - y. Difficulty sleeping
 - z. Foggy brain
 - aa. Feeling down or depressed
 - bb. Feeling anxious
 - cc. Always feeling hot or cold (temperature dysregulation)
 - dd. Feeling dizzy or lightheaded when standing up after sitting (orthostatic hypotension)
 - ee. Eye problems
 - ff. Prickling, burning, or numb sensation (neuropathy)
 - gg. Ringing or buzzing in ears (tinnitus)
 - hh. Skin problems
 - ii. Other (please specify in text box)
 - jj. I have not experienced any new or continuing signs or symptoms (If this option is selected, skip to 21st question)
16. Were you vaccinated for COVID-19 or enrolled in the COVID-19 clinical vaccine trials?
- a. Yes, fully vaccinated and boosted
 - b. Yes, fully vaccinated but not boosted
 - c. Partially vaccinated
 - d. Not vaccinated
 - e. Prefer not to answer
17. Which of the following describes you?
- a. I was vaccinated, then infected with COVID, and then had long lasting COVID symptoms
 - b. I was infected with COVID, then got long lasting COVID symptoms, and then vaccinated
 - c. I was infected with COVID, then vaccinated, and then got long lasting COVID symptoms
 - d. I was not vaccinated
 - e. Prefer not to answer
18. Do you feel COVID-19 has affected your singing? (if no, skip following question)
- a. Yes
 - b. No
19. What are the main ways COVID-19 has affected your singing? (open ended text box)
20. Before you had COVID-19, about how long could you comfortably sing in one session?
- a. Less than 15 minutes
 - b. 15 - 30 minutes
 - c. 31 - 45 minutes
 - d. 46 - 59 minutes
 - e. An hour or more
 - f. Prefer not to answer
21. Since having COVID-19, how long can you comfortably sing in one session?
- a. Less than 15 minutes
 - b. 15 - 30 minutes
 - c. 31 - 45 minutes
 - d. 46 - 59 minutes
 - e. An hour or more
 - f. Prefer not to answer
22. How is your singing voice today?
- a. I am starting to recover but only able to do 0% - 25% (a little) of my usual practicing/singing
 - b. I am recovering and able to do 26% - 50% (some) of my usual practicing/singing
 - c. I am recovering and am able to do 51% - 75% (most) of my usual practicing/singing
 - d. I am almost fully recovered and can do 76% - 99% (almost all) of my usual practicing/singing
 - e. I am fully recovered and can do 100% (all of) my usual practicing/singing
 - f. Don't know
 - g. Prefer not to answer
 - h. Other (open ended text box)
23. Would you like to share any additional concerns about singing following COVID-19? (open ended text box)

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