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Prevalence of Dysphonia due to COVID-19 Infection

Hassnaa Hussin Afifi*, Hossam Mohammed Abd El Azeem, Salwa Ahmed Abd El Hay
Department of Otorhinolaryngology, Faculty of Medicine, Benha University, Egypt
***Corresponding author:** Hassnaa Hussin Afifi, **Mobile:** (+20) 01061591953, **E-mail:** hassnaahussin58@gmail.com

ABSTRACT

Background: A voice problem known as dysphonia has been identified as a potential adverse effect of COVID-19 infection.

Objective: This study aimed to assess the prevalence of dysphonia in COVID-19 patients and the impact of his/her voice disorder upon daily activities using the Voice Handicap Index (VHI-30).

Patients and methods: This prospective study was conducted on a cohort of 231 COVID-19 patients selected from the Otorhinolaryngology Department, Benha University Hospital. Patient evaluation included comprehensive history taking, physical and local examinations, laboratory investigation, voice assessments using (VHI-30), auditory perceptual analysis and local laryngeal examination by indirect rigid laryngoscopy.

Results: Among the enrolled patients, 46.8% were males and 53.2% were females, with a mean age of 48.73 ± 11.58 years. The most prevalent symptoms reported were fever (93.5%), exhaustion (83.1%), and cough (76.2%). Dysphonia was found in 37.6% of the patients, with 58.6% experiencing mild dysphonia, 28.7% moderate dysphonia, and 12.6% severe dysphonia. The Voice Handicap Index (VHI) scores, which mean that physical VHI was 18.82 ± 4.69, mean functional VHI was 17.42 ± 3.73, and mean emotional VHI was 14.97 ± 4.67. While mean total VHI was 36.02 ± 13.62 and the result explained the positive relation between total mean VHI score and grade of dysphonia. The mild grade was total mean 25.49 ± 5.11, moderate grade was total mean 42.56 ± 5.3 and severe grade was total mean 61.54 ± 8.16. Our findings showed that the more severe the COVID-19 infection, the higher the scores of total VHI-30. Laryngoscope findings revealed laryngeal mucosa congestion and edema as the most common finding (35.5%), followed by early starting nodules (20.8%), vocal fold immobility (1%), Vocal fold polyp (haemorrhagic polyp) (1%) and normal laryngeal mucosa (42%). The most prevalent cause of dysphonia is organic lesion (22.8%) followed by nonorganic (functional) (15.5%).

Conclusion: Our study revealed a considerable prevalence of dysphonia among COVID-19 patients in Benha University Hospitals. The VHI scores indicated the negative impact of dysphonia on physical, functional, and emotional aspects of patients' lives.

Keywords: Prevalence, Dysphonia, COVID-19, VHI-30.

INTRODUCTION

A widespread new epidemic has been brought on by respiratory virus SARS-CoV2 (also known as COVID-19). Airways and lungs are COVID-19's primary targets. It is transmitted from person to person by airborne droplets or direct touch. It might take up to 14 days for symptoms to show up. Sneezing, coughing, fever, and breathing difficulties are of the signs that can be mistaken for the flu or a cold in 80–85% of patients [(1)]. The lower respiratory system may be seriously impacted by COVID-19, which can lead to bilateral pneumonia and ARDS [(1)].

Olfactory and taste dysfunctions, in particular, have been widely established as early signs of COVID-19 infection. They can be viewed as warning indications and may aid certain symptomatic patients in reaching the diagnosis [(2)].

The cytokine storm that the SARS-CoV-2 virus causes in some infected people damages the heart, lungs, digestive system, and other organs. This incident has a variety of potential side effects, including death [(3)].

Any region of the body, including the larynx (voice box), might be harmed by this virus, which causes dysphonia. This has a strong negative impact on how colleagues communicate during the COVID-19 epidemic [(4)]. At some time in their life, about one-third of people will experience dysphonia, or poor voice production [(5)]. Although the terms dysphonia and hoarseness are sometimes used interchangeably, dysphonia refers to poor voice production as identified by a clinician. A sign of a person's voice changing quality is hoarseness [(6)].

Dysphonia is frequently brought on by benign or self-limiting diseases, but it can also be the first sign of a more serious or developing problem that has to be identified and treated right away [(7)].

Dysphonia is one of the otorhinolaryngological consequences of COVID-19 that occurs the most frequently (19.8% of the time). Additionally, dysphonia was previously noted in 26.8% of individuals with mild-to-moderate COVID-19 symptoms [(8)]. According to **Lechien *et al.*** [(8)] and **Oran and Topol** [(9)], there is a significant incidence of dysphonia caused by COVID-19 disease, with a frequency of 26.8% and 43.7% respectively.

The goal of this study was to assess the prevalence of dysphonia in COVID-19 patients and the impact of his/her voice disorder upon daily activities using the VHI-30 in Benha University Hospitals.

PATIENTS AND METHODS

This prospective study was conducted on a cohort of 231 positive COVID-19 patients, who were selected

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and collected from the Otorhinolaryngology Department at Benha University Hospital. The data collection period extended from January 2021 to June 2022.

Inclusion criteria: Patients suffering from COVID-19 infection aged above 18 years.

Exclusion criteria: Patients who had a history of benign or cancerous laryngeal lesions, psychiatric disorders, or who required intubation as part of their COVID-19 therapy and who had dysphonia before the illness started.

All enrolled cases underwent a comprehensive evaluation, which included a detailed history taking (Name, age, sex, residence, occupation, family history, marital status, and special habits such as smoking or alcohol consumption), present history (Onset, course, and duration of symptoms) and past history that explored any previous surgeries or systemic diseases.

A general examination was carried out, assessing the patient's overall appearance, heart rate, respiratory rate, and temperature. Additionally, a local examination was performed, encompassing a chest examination to evaluate the shape of the chest, respiratory movements, tenderness, tracheal position, and chest movement. Auscultation was conducted to assess air entry, breathing type, and the presence of rhonchi. Furthermore, a local laryngeal examination was performed using indirect rigid laryngoscopy.

Voice assessment involved the use of the Voice Handicap Index (VHI-30), a popular patient questionnaire that included psychological and functional elements of a patient's voice disturbance. The VHI-30 questionnaire consisted of 30 questions divided into three domains: physical (VHI-P), emotional (VHI-E), and functional (VHI-F). Each question was scored on a 5-point Likert scale, with higher scores indicating more severe voice disorders. Auditory perceptual analysis (APA) was also employed using the Modified Grade, Roughness, Breathiness, Asthenia, Strain scale (GRBAS scale) to subjectively assess hoarseness. The APA involved evaluating voice parameters such as overall grade, character, pitch, loudness, glottal attacks, and related laryngeal functions, and assigning scores based on the modified GRBAS scale.

Laboratory investigations included various tests such as complete blood count (CBC), C-reactive protein (CRP), D-dimer, serum ferritin, kidney function tests (urea & creatinine), liver function tests (AST & ALT), prothrombin time (PT), partial thromboplastin time (PTT), international normalized ratio (INR), and electrolyte levels (Na, K, Ca, Mg & Ph). Nasopharyngeal swabs were obtained for COVID-19 testing, and chest X-rays and computed tomography (CT) scans were performed.

Ethical approval: Medical Ethics Committee of Benha Faculty of Medicine approved this study [Approved number: MS 43-3-2022]. After obtaining the necessary information, all participants provided signed consents. The Helsinki Declaration was observed throughout the study's duration.

Statistical analysis

Every piece of data was gathered, analysed, and statistically examined using SPSS Version 22.0 for Windows. To represent qualitative data, frequencies and relative percentages were employed. The mean ± SD, and range were used to characterise quantitative data. A significant p-value was considered when it is equal or less than 0.05.

RESULTS

53.2% of the patients were females and 46.8 were males with mean age 48.73 ± 11.58 years. Meanwhile, 55% of the patients were rural and 45% were urban (Table 1).

Table (1): Demographic data

		(n=231)
Age (years), Mean ± SD		48.73 ± 11.58
Sex	Male	108 (46.8%)
	Female	123 (53.2%)
Residence	Rural	127 (55%)
	Urban	104 (45%)

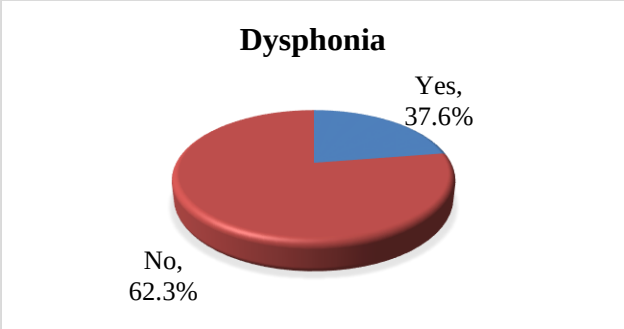
The most prevalent symptom presented was fever (93.5%) followed by exhaustion (83.1%), cough (76.2%), body ache (64.5%), loss of taste and smell (39.4%) and digestive problems (29.4%) (Table 2).

Table (2): Clinical presentations, among the studied patients

Clinical presentations	The studied patients (n=231)
Fever	216 (93.5%)
Cough	176 (76.2%)
Body ache	149 (64.5%)
Exhaustion	192 (83.1%)
Loss of taste and smell	91 (39.4%)
Digestive problems	68 (29.4%)

The prevalence of dysphonia was 37.6% (Figure 2 A). 58.6% of the patients had mild dysphonia, 28.7% were moderate and 12.6% were severe (Figure 2 B).

(A)



(B)

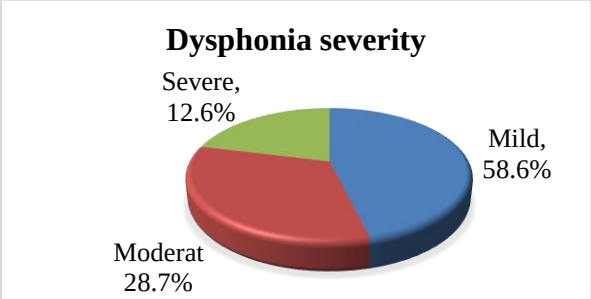


Figure (2): (A) Dysphonia prevalence among the studied patients and (B) Dysphonia severity among the dysphonic patients.

The physical VHI was 18.82 ± 4.69, mean functional VHI was 17.42 ± 3.73, and mean emotional VHI was 14.97 ± 4.67. While, mean total VHI was 36.02 ± 13.62 (Table 3).

Table (3): VHI subscales distribution among patients with dysphonia

	Patients (n=87)
Physical	18.82 ± 4.69
Functional	17.42 ± 3.73
Emotional	14.97 ± 4.67
Total VHI	36.02 ± 13.62

The data are presented as frequency (%). Regarding overall grade: 58.6% were mild, 28.7% were moderate, and 12.6% were severe. Regarding quality strained: 83.9%. Regarding breathy: 2.2%. Regarding leaky: 2.2%. Regarding irregular: 13.7%. Regarding pitch: 100% were decreased. Regarding intensity100% were soft. Moreover, all patients had preserved associated laryngeal functions (Table 4).

Table (4): Auditory perceptual assessment among patients with dysphonia.

			Patients (n=87)
Overall grade		Mild	51 (58.6%)
		Moderate	25 (28.7%)
		Severe	11 (12.6%)
Quality	Strained	73 (83.9%)	
	Breathy	2 (2.2%)	
	Leaky	2 (2.2%)	
	Irregular	12 (13.7%)	
Pitch		Increased	0(0 %)
		Decreased	87 (100 %)
Intensity		Soft	87 (100%)
		Loud	0 (0%)
Associated laryngeal functions		Preserved	87 (100%)

The patients with mild grade of dysphonia had total mean of 25.49 ± 5.11 of the total mean score of VHI, moderate grade had total mean of 42.56 ± 5.3 and severe grade had total mean of 61.54 ± 8.16. The data explained the positive relation between total mean score of VHI 30 and grade of dysphonia by auditory perceptual assessment (Table 5).

Table (5): The relation between scores of VHI and dysphonia by APA

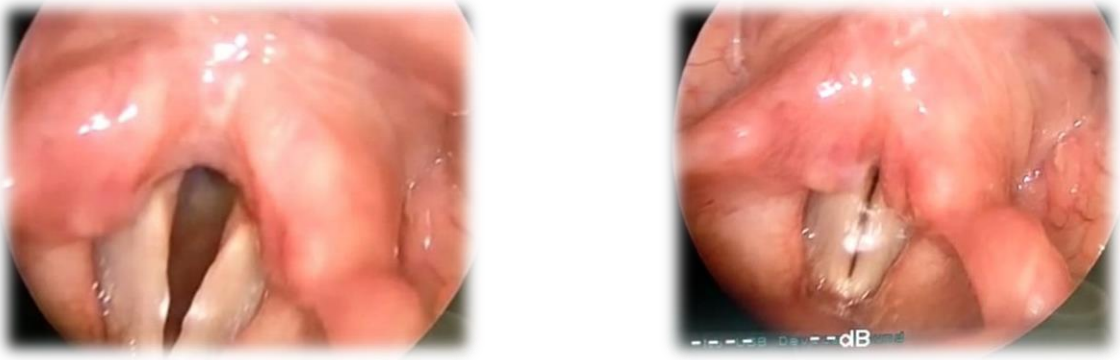
APA Overall grades	VHI30 total mean score
Mild 51 (58.6%)	25.49 ± 5.11
Moderate 25 (28.7%)	42.56 ± 5.3
Severe11 (12.6%)	61.54 ± 8.16

According to laryngoscope findings in the studied patients: The most detected finding was laryngeal mucosa congestion (35.5%) followed by early starting nodule identified by early starting lesion covered by mucous strand at junction between anterior 1/3 and post 2/3 of both vocal fold with phonatory waste (20.8%), vocal fold immobility (1%), Vocal fold polyp (haemorrhagic polyp) (1%) and 42% were normal.

Table (6): Laryngoscope findings among the studied patients

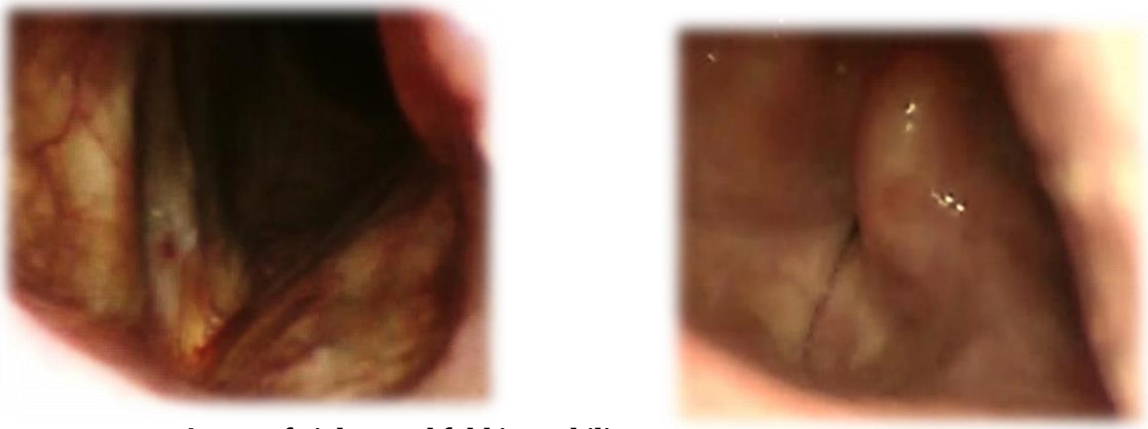
		Patients (n=231)
Laryngoscope findings	Laryngeal mucosa congestion and edema	82 (35.5%)
	Vocal fold immobility	2 (1%)
	Early starting nodules	48 (20.8%)
	Vocal fold polyp (haemorrhagic polyp)	2 (1%)
	Normal	97 (42%)

A case of early starting nodules



Respiration Phonation

A case of haemorrhagic polyp



A case of right vocal fold immobility

Respiration Phonation

Figure (3): Laryngoscope findings among the studied patient.

Regarding etiological causes among studied patient the most common cause of dysphonia was organic lesion (22.8%) followed by non-organic (functional) (15.5 %) (Table 6 and figure 4).

Table (6): Etiological causes of dysphonia among studied patient of covid19

		Patient 87 from 231
Organic	Vocal fold immobility	2 (1 %)
	Early starting nodules	48 (20.8)
	Vocal fold polyp (haemorrhagic polyp)	2 (1 %)
Nonorganic	Functional	35 (15.5%)

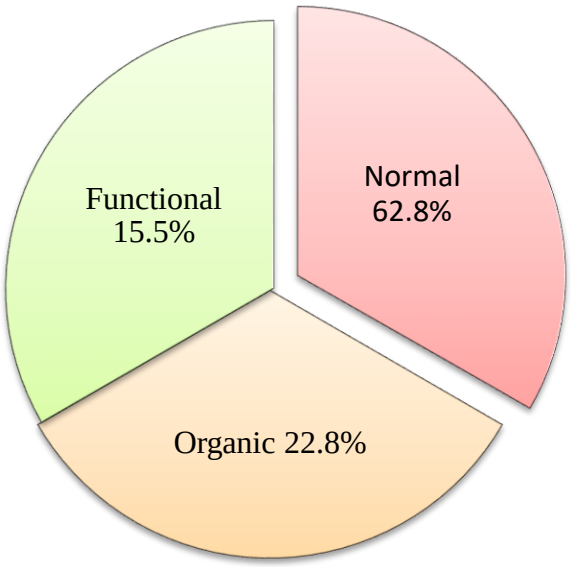


Figure (4): Etiological causes of dysphonia among studied.

DISCUSSION

In addition to non-specific upper airway symptoms as rhinorrhea, nasal obstruction, pharyngitis, and laryngitis, COVID-19 patients may also have other conditions. Numerous otolaryngological symptoms, such as anosmia, sore throat, ageusia, nasal congestion, hoarseness, and others, have been linked to COVID-19 patients in studies [(10)]. Patients with COVID-19 have been found to be more likely to experience dysphonia, which can include hoarseness, laryngeal dryness, voice fatigue, or aphonia. Additionally, 27% of patients with mild to moderate COVID-19 reported dysphonia at some point throughout the course of the disease, according to research including European hospitals [(8)].

The term "post-COVID-19 condition," often referred to as "long COVID" or "long-haul COVID," describes the continuation of symptoms after the infection has passed its acute stage. One of the symptoms of this illness, which frequently affects people who have a history of suspected or proven SARS-CoV-2 infection, is dysphonia. More study is needed to better understand the occurrence of dysphonia in COVID-19 patients and how it impacts their daily activities [(10)].

In this prospective study 231 COVID-19 patients aged 18 years or older were evaluated. The assessment included historical, clinical, and physical examinations, as well as local laryngeal examination and voice assessment using the VHI-30. According to our results, 46.8% of the patients were males and 53.2% were females with mean age of 48.73 ± 11.58 years. Meanwhile, 55% of the patients were rural and 45% were urban. A study **Leis-Cofiño *et al.*** [(11)] collected data from COVID-19 patients who developed dysphonia and were assessed using the VHI-10, and a fibro-laryngoscope examination. In the group of dysphonia patients, the median age was 64.5 years (58.5-69.25), and a greater number of females (60%) than males (40%) were seen. Moreover, **Cantarella *et al.*** [(12)] studied 160 consecutive individuals with the diagnosis of COVID-19. According to the study, there were 50 male instances and 110 female cases. Male patients had a mean age of 55.0 years, whereas female patients had a mean age of 49 years, ranging from 16 to 90 (P = 0.055).

In our study, the most common symptom reported was fever (93.5%) followed by exhaustion (83.1%), and cough (76.2%). In consistence with our results, a study of **Al-Ani and Rashid** [(4)] reported that in terms of symptomatology, cough (98.9%), fever (100%), and dyspnea (100%) were the most prevalent symptoms. Anosmia (35.4%), sore throat (27%), ageusia (16.1%), nasal congestion (12.9%), postnasal discharge (6%), otalgia (2%), runny nose (9%), tinnitus (1.2%), hoarseness (5.1%), gingivitis (1.2%), Bell's palsy (0.6%), and sudden hearing loss problems (0.6%) were the most common otolaryngological symptoms among 57.4% of patients in a single study.

Our results revealed that the prevalence of dysphonia was 37.6%. Conforming to our results, dysphonia is prevalent in individuals with COVID-19 illness, with a 31% frequency [(13)]. In this regard, in recent research to evaluate the frequency of dysphonia among COVID-19 patients, it was shown that the prevalence was 32.8% in women and 28.2% in men [(13)]. According to large population studies, 0.98% of persons suffer dysphonia. Males experience less of an influence (0.7%) than females (1.2%) [(5, 14)]. The substantial female prevalence may be due to differences in the inflammatory procedure between the sexes [(14)].

In our study, 58.6% of the patients had mild dysphonia, 28.7% had moderate dysphonia, and 12.6% had severe dysphonia. In line with our findings, a study by **Cantarella *et al.*** [12] reported that 69 individuals had mild to moderate dysphonia, while one patient had severe (aphonia) dysphonia.

In our study, the most detected finding was laryngeal mucosa congestion (35.5%) followed by early starting nodule with phonatory waste (20.8%), vocal fold immobility (1%) and vocal fold polyp haemorrhagic polyp (1%) and 42 % normal. In terms of the laryngoscopic results, this study revealed that the glottis was most frequently damaged, which is comparable to a study of **Naunheim *et al.*** [15], which showed that 93.8% of patients had aberrant results in the glottis with closure accounting for the majority (50%). All relevant tests were completed in one individual in the current research that had right vocal cord paralysis, but the etiology of this palsy was never discovered. This result is consistent with another research [16]. This demonstrates the neuro-invasive property of the COVID-19 [4].

In our study, the most prevalent cause of dysphonia between studied patients was organic lesion (22.8%) followed by non-organic (functional) causes (15.5%). In agreement with our study; **Nawaz *et al.*** [17] found that organic lesions were the most common condition (67.9%), followed by functional disorders (22.6%), and neurological and psychogenic illnesses were the least common. When COVID-19 patients have chemosensory abnormalities, dysphonia may be a result of the virus's neuro-invasive characteristics, an unforeseen finding, or other unidentified factors. Additionally, it has been observed by some writers that severe dysphonia in mild-to-moderate COVID-19 individuals may be caused by vocal fold edema or inflammation during the infection, which is probably connected to laryngeal involvement by the airway inflammatory process [8, 18]. Corditis may result after prior laryngeal exposure to SARS-CoV-2. Two studies have reported the detection of the ACE-2 receptor, which is believed to represent the SARS-CoV-2 receptor, in the larynx, including the vocal folds [19, 20]. Therefore, SARS-CoV-2 may directly enter laryngeal cells, causing laryngeal and vocal cord inflammation, and cause dysphonia as a sign of COVID-19. Furthermore, since optimal pulmonary air supply is necessary for successful phonation, the severe pulmonary system impairment caused by SARS-CoV-2 may account for the dysphonia that recently developed in COVID-19 patients [16]. Given that the majority of individuals are experiencing mental stress due to the ongoing pandemic, psychogenic dysphonia is a disorder that should not be ignored. When a person has a dysregulated emotional system, psychogenic dysphonia often manifests between the ages of 30 and 50, mostly in women [11]. Particularly in susceptible individuals, sudden dysphonia may potentially be associated with the psychopathological strain caused by COVID-19 [21]. Psychogenic dysphonia is characterised as psychogenic abnormalities of voice and speech quality that do not stem from intrinsic laryngeal organic abnormalities. The trajectory of verbal communication is significantly influenced by the human mind, which also affects speech and voice quality. Emotional state has a major impact on the respiratory-phonatory-articulation mechanism, suprasegmental speech components, and the process of producing voice [22].

Videolaryngostroboscopic examination is one method to study the cause of dysphonia in COVID-19 patients, as it is still unclear. Physicians classify individuals exhibiting dysphonia into four distinct illnesses categories: benign or malignant lesions of the vocal folds, neuromuscular or skeletal disorders of the larynx and functional abnormalities of the larynx. An excessive amount of tension in the laryngeal muscles results in a form of functional dysfunction called MTD. It can be primary or secondary and is commonly caused by upper respiratory tract infections [4]. A typical symptom of acute mild to moderate COVID-19 is dysphonia, however it is unclear what the long-term functional implications are [4]. It has been stated that compensatory dysphonia that endures after inflammation resolves is post-viral laryngitis MTD. Compensation for post-acute COVID-19 syndrome-related long-term dyspnea must to be taken into account as a potential cause of MTD. Diagnosing and treating these patients requires multidisciplinary treatment involving speech-language pathology [23].

In the present study, The Voice Handicap Index (VHI) scores, which its mean physical VHI was 18.82 ± 4.69, mean functional VHI was 17.42 ± 3.73, and mean emotional VHI was 14.97 ± 4.67. While its mean total VHI was 36.02 ± 13.62. In another study, **Moradi *et al.*** [24] study assessed voice-related quality of life (QoL) and overall health. Total VHI score for COVID-19 patients was 42.47 ± 4.74 when 34 recovered COVID-19 patients were evaluated by VHI-30 two months after recovery and were released from the hospital.

Our results showed that the patients with mild grade of dysphonia had total mean of 25.49 ± 5.11 of the total mean score of VHI-30, moderate grade had total mean of 42.56 ± 5.3 and severe grade had total mean of 61.54 ± 8.16. The data explained the positive relation between total mean score of VHI-30 and grade of dysphonia by auditory perceptual assessment and demonstrated the effectiveness of APA as the gold standard for voice evaluation in determining the severity of dysphonia and its subsequent influence on our patients' self-perception of voice impairment. As previously mentioned, the VHI is a useful tool for assessing how a voice issue affects QoL. Even after recovery, the VHI results showed that COVID-19 had a significant detrimental effect on the person's emotional, functional, and physical elements of their life. Due to respiratory involvement and potential vocal tract injury, COVID-19 irritates the larynx. Additionally, it is hypothesized that COVID-19 may

result in recurrent and superior laryngeal nerve neuropathy, which would disrupt phonation and lead to permanent dysphonia. VHI can have a significant physical impact due to laborious and strained voice production caused by coughing and insufficient respiratory support [24]. A concern for others in this pandemic era is that these patients continue to cough frequently even after they have recovered. This makes them appear embarrassing, irritable, and disabled, which eventually limits their participation in face-to-face interactions, makes them less gregarious, and lowers their emotional quality of life in relation to their voice. The study's functional VHI subscale was most impacted because COVID-19 recovered patients felt more limited in their ability to communicate in social situations and in their personal lives. For example, individuals reported participating less in phone conversations and group discussions since it is difficult for others to hear and understand them. This leads to irritation and reduced communication because of their dysphonia, which is reflected in their lower functional VHI scores [24].

Gölaç *et al.* [25] found that there was a strong correlation between VHI and long-term COVID-19 symptoms including coughing, fatigue, and breathing difficulties in recovered COVID-19 patients. The overall VHI appears to have grown and gotten worse two months after recovery for these reasons, indicating that dysphonia can have an impact on day-to-day functioning, lower people's quality of life, and interfere with social interactions.

Definitive confirmed diagnosis of COVID-19, APA was carried out on patients who were admitted to or presented to Kasr Al Ainy Hospital. The VHI-10 questionnaire, Arabic version, was given to the patients to complete. 65.5% of patients had mild COVID-19, 27.5% had moderate COVID-19, and 7% had severe COVID-19. These patients made up the bulk of the patients. The APA found mild to moderate dysphonia in 35% of the patients. Compared to other infection categories, severe patients showed higher values for total voice handicap (20 ± 6.57) [24-26]. Our findings concur with the research on these individuals.

Our findings showed that the total VHI scores increased with the severity of the COVID-19 infection. Therefore, it is acknowledged that self-perceived vocal problems may worsen as a result of a decline in voice quality following a COVID-19 infection.

CONCLUSION

We proofed that around one-third of COVID-19 patients may simply have dysphonia as a symptom. Thus, dysphonia was previously unrecognized as a frequent and persistent condition. As a result, during the COVID-19 pandemic, it is important to use caution while speaking to and approaching people who simply have dysphonia. Dysphonia may occur due to different causes of organic lesions like early starting nodules, vocal fold immobility and vocal fold polyp followed by functional dysphonia.

Also, psychogenic dysphonia must be taken into consideration due to stress effect of pandemic. Finally, our study found that following COVID-19 infection, overall health and voice-related QoL, as measured by VHI and APA, was deteriorated. Additionally, there was a significant correlation between the VHI and APA, where the higher the VHI total score the greater was the severity of the COVID-19 infection.

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