Research Article

Investigating the Prevalence of Dysphagia and Dysphonia in Patients with COVID-19 in the Intensive Care Unit

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ABSTRACT

Introduction: The world has been suffering from COVID-19 since 2020 and the disease continues up to now. COVID-19 patients are at high risk of dysphagia and dysphonia. Accordingly, this study aims to determine the prevalence of dysphonia and dysphagia and identify correlated factors to develop dysphagia and dysphonia in COVID-19 patients admitted to intensive care units (ICU).

Materials and Methods: A total of 70 patients with COVID-19 (Mean±SD age of 63.1±18.6; males=39) hospitalized in ICUs were evaluated by an expert on speech and language. The patients were evaluated for swallowing disorder via the Mann assessment of swallowing ability and the Persian version of the functional oral intake scale. The consensus auditory-perceptual evaluation of voice was also used to evaluate voice disorders.

Results: Overall, 58.6% of patients presented dysphagia and 74.3% of patients had dysphonia. Meanwhile, 34.3% of the patients were on mechanical ventilation. A correlation was detected between dysphagia severity and the number of mechanical ventilation days, the length of stay, and age ($P<0.05$). Dyspnea impacts the prevalence of dysphonia and dysphagia in COVID-19 patients ($P<0.05$). Vomiting has been effective on only the prevalence of dysphagia ($P<0.05$). Furthermore, a significant correlation was found between dysphagia and dysphonia ($P<0.01$).

Conclusion: A high prevalence rate of dysphagia and dysphonia exists in patients with COVID-19 admitted to ICUs. An early evaluation by a speech and language pathologist is essential to identify the suspected patients and provide early intervention to prevent further complications and improve their quality of life.

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1. Introduction

As of 2020, the world is struggling with COVID-19 [1, 2]. This is a respiratory illness that spreads with symptoms, such as fatigue, fever, cough, and in some cases, respiratory distress [3]. So far, it has plagued populations with dangerous variants, such as alpha, beta, delta, gamma, and lambda [4], and recently with the omicron variant, which has a very high transmission power [5]. Because of respiratory problems, these patients need to be hospitalized in intensive care units (icus) and undergo mechanical ventilation (MV) [6, 7]. Approximately, a third of patients infected by COVID-19 worldwide are hospitalized in ICUs [8]. Intubation and MV increase the hazard of dysphagia and dysphonia in these patients [6]. Dysphagia may lead to malnutrition, pneumonia, increased hospital length of stay (LOS), dehydration, and death. Dysphagia and dysphonia may eventually lead to reduced quality of life [9].

Dysphagia refers to the difficulty in eating and drinking. It can affect people of any age; however, it is more common among the elderly [10]. As mentioned, intensive management of critical patients may involve some invasive respiratory devices, such as intubation and MV. These patients are fed through a nasogastric tube, which increases the danger of pneumonia and dysphagia [7]. A study that examined the relationship between COVID-19 and dysphagia showed that the disease manifestations, such as acute respiratory distress syndrome, loss of taste, neurological manifestations, tachypnea, and dyspnea, as well as treatment measures for this disease, such as oxygen treatment, non-invasive MV, tracheostomy, intubation, and drugs used in the ICU setting, negatively affect swallowing performance [6, 11].

Dysphonia is well-defined as the disturbance specify by changed loudness, pitch, vocal quality, or vocal attempt [12]. In the respiratory phase of voice production, exhaled air from the lungs provides the primary energy for sound production. People with COVID-19 may have shortness of breath due to lung involvement, disrupting the normal cycle of voice production [13]. A reason for the dysphonia in people with COVID-19 is treated in the ICU (endotracheal intubation), which can lead to unilateral paralysis of vocal folds [14]. Another possible cause of dysphonia in these patients is the presence of coronavirus in the larynx. Studies have demonstrated that the angiotensin-converting enzyme-2 receptor in the laryngeal vocal folds contains a coronavirus receptor that causes inflammation of the larynx and vocal folds when the virus enters [15]. One study has also mentioned that the cause of dysphonia may be a direct virus attack on the laryngeal nerve [16].

Accordingly, respiratory problems with COVID-19 may lead to the loss of swallowing-breathing coordination or decreased respiratory support for voice [17]. Numerous studies have been published in different communities to consider the rate of dysphonia and dysphagia in patients infected by COVID-19. Each study has reported participants with specific conditions. Some of these authors predict that dysphonia and dysphagia are common symptoms in COVID-19 patients admitted to ICUs [1, 6, 18, 19]. Awareness of the prevalence and risk factors of dysphonia and dysphagia will lead to the evaluation and monitoring of these patients at the time of inpatient, as well as informing outpatient services [6], especially in long, when there is a shortage of staff and the medical system is under severe pressure [17]. By screening these patients and providing appropriate intervention, a significant part of the swallowing and voice problems of these patients will improve [9]. Accordingly, this study aims to explore the prevalence of dysphonia and dysphagia and identify correlated factors with dysphagia and dysphonia in patients infected by COVID-19 admitted to the ICUs.

2. Materials and Methods

Study design

This was a cross-sectional study.

Study participants

In this prospective single-center study, 70 laboratory-confirmed COVID-19 patients (39 males and 31 females) in the age range of 19 to 93 years (Mean±SD age of 63.11±18.64 years) were admitted to the ICUs of Firoozgar Hospital, Tehran City, Iran, from January 1 to February 1, 2022, and were registered in the study. All of the patients were residents of Tehran and their skin color was white. The inclusion criteria in this study were as follows: 1) The positive COVID-19 test using the polymerase chain reaction (PCR) test; 2) Having at least 18 years of age; 3) No history of swallowing disorders and voice disorders before being infected by COVID-19, based on a clinical interview with the patient or their family and by providing main examples of clinical symptoms of dysphonia and dysphagia; 4) Having no history of central and peripheral nervous diseases before being infected by COVID-19; and 5) being a native Persian speaker. The patients who reported a history of addiction, cancer, chemotherapy, asthma, anxiety, depression, or reflux before contracting COVID-19 in a clinical interview (with the patient or their family) were excluded from the study. Also, patients who underwent intubation or tracheostomy upon entering the ICU were

not evaluated for dysphagia and dysphonia because of the distortion of the results of voice and swallowing status. These patients were evaluated 24 h after removal of intubation or tracheostomy.

Study measurements

Consensus auditory-perceptual evaluation of voice

The dysphonia evaluation was performed using the overall severity of the dysphonia component of the consensus auditory-perceptual evaluation of voice (CAPE-V) which is a clinician-based tool. The evaluator determines the severity of dysphonia by placing a tick on a 100 mm line. As the tick is tilted toward the right, it indicates a more severe disorder [20]. Based on the CAPE-V results, the overall severity between 0 to 9 shows a normal voice, grades 10 to 39 represent mild voice disorder, grades 40 to 69 specify moderate disorder, and grades 70 to 100 indicate severe problems [21]. In the present study, the speech and language pathologist (SLP) plied a Zoom H5 microphone with a response of frequency ranging from 5000 to 20000 Hz to collect the samples (24 bits and 44100 Hz sampling rate). First, the SLP illustrated the data, collected the procedure verbally, and performed the tasks for the patient. Subsequently, the patient was asked to sustain the phonation of /a/ and /i/ vowels for 3 to 5 s and then read 6 valid sentences. Finally, the patients were asked to speak continuously for at least 20 s [20]. The recorded audio files were transferred to a laptop and CAPE-V was scored by an SLP with 5 years of experience and awareness of CAPE-V scoring.

The Mann assessment of swallowing ability

The Mann assessment of swallowing ability (MASA) is a simple, reliable, and non-instrumental tool that examines the deglutition action. The MASA describes eating problems and determines the subjects with aspiration and dysphagia. This tool has 24 items and every section is graded on a 5- or 10-point scale. The total score of this tool ranges from 38 to 200. Higher scores indicate better swallowing performance. The cut-off scores for the dysphagia severity are as follows: Severe dysphagia ≤138; moderate ≤139–167; mild ≤168–177; without dysphagia=178–200. Meanwhile, the scores for aspiration severity are as follows: Severe aspiration ≤140; moderate 141–148; mild ≤149–169; without aspiration=170–200 [22, 23]. In the present study, the intraclass correlation coefficient (ICC) method was used to determine the reliability of MASA. The calculated coefficient of the entire questionnaire was 0.7 which indicates the moderate and acceptable reliability of this questionnaire.

The functional oral intake scale

The functional oral intake scale (FOIS) is one of the most applied scales for oral intake status evaluation. The Persian version of FOIS (P-FOIS) is a validated scale and is scored based on a 7-point ordinal scale. Based on this scale, the patients were separated into 2 sets with dysphagia (1-5 grades) and without dysphagia (6-7 grades) [24, 25].

Study procedures

This study was performed on COVID-19 patients hospitalized in the ICUs at admission. All of the patients were appraised for the inclusion criteria if the patients completed the consent form. In the primary hours of the admission to the ICUs, the demographic information, including comorbidities, body mass index (BMI), sex, age, and also symptoms of the COVID-19 disease were pulled out from the medical records. All eligible patients underwent P-FOIS along with MASA for dysphagia screening in addition to CAPE-V for dysphonia screening. A skilled SLP performed all the tests on day 1 in the ICU. At the time of discharge from the ICU, other information, including the presence or absence of intubation and tracheostomy (days), presence or absence of prone positioning, receiving or not receiving oxygen supplement, and the LOS in the ICU were extracted from the medical records.

Statistical analysis

In most cases, descriptive statistics of frequency were used. Most data were reported as mean or percentage. The normality of the data distribution was confirmed via the Kolmogorov-Smirnov test. Additionally, the relationship between the severity of dysphagia and dysphonia and variables was analyzed by the Pearson correlation coefficient. The independent samples t-test was used to analyze the prevalence of dysphagia and dysphonia based on the clinical symptoms of the patients. The level of significance was considered <0.05. The SPSS software, version 26 was applied to analyze the statistical data.

3. Results

Patients' characteristics

A total of 70 participants with a confirmed diagnosis of COVID-19 were admitted to the ICUs and were included in the data collection. The Mean±SD age was 63±18.64 and 39 patients (55.7%) were male with a Mean±SD of BMI 24.44±5 kg/m^2. A total of 24(34.3%) of our patients were on MV (41.6% through intubation and 58.4% through tracheostomy). The mean LOS was 7.8 days (3–18 days) and the mean MV days was 1.13 days (0–11 days). Almost 87% of the participants had pre-existing comorbidities with the most common being hypertension and diabetes mellitus. The main clinical symptoms during the admission period were fever, cough, dyspnea, and diarrhea (Table 1). The demographic characteristics and clinical details of these patients are provided in Table 1.

Prevalence of dysphagia

Dysphagia (P-FOIS score 1-5) was detected in 41 (58.6%) of 70 of our patients. In detail, 41.4% of the participants were on a normal (P-FOIS score 7) or soft diet (P-FOIS score 6). In contrast, 57.1% needed tube feeding (P-FOIS score 1–3), and 37.1% (P-FOIS score 1) were nil by mouth (Figure 1).

According to the MASA scores, 41(58.6%) out of 70 patients had dysphagia. In detail, 2 patients had mild dysphagia, 8 patients had moderate dysphagia, and 31 patients had severe dysphagia (Figure 2). Also, according to the MASA scores, 39 out of 70 patients (55.7%) had aspiration. In detail, 7 patients had mild aspiration and 32 patients had severe aspiration.

Prevalence of dysphonia

At the admission, 74.3% of the samples presented with dysphonia based on the CAPE-V, with 31.4%, 17.1%, and 25.7% in mild, moderate, and severe groupings, respectively (Figure 3).

Variables' correlations

A negative correlation was seen between the dysphagia severity score and the number of MV days ($P<0.01$), LOS days ($P<0.05$), and age ($P<0.05$). There was no correlation between dysphagia severity and further variables, such as comorbidities, BMI, sex, proning, and oxygen supplement. Also, a correlation was detected between dysphonia severity and the number of MV days ($P<0.05$), and the number of LOS days ($P<0.05$) (Table 2). By analyzing the data of the clinical symptoms of COVID-19 patients via the independent samples t-test, the results showed that dyspnea is effective in the prevalence of dysphonia and dysphagia ($P<0.05$). Vomiting has been effective on only the prevalence of dysphagia in these patients ($P<0.05$). Other symptoms did not have any statistically significant impact on the prevalence of dysphonia and dysphagia ($P>0.05$). Table 3 shows the correlation between the severity of dysphagia and dysphonia.

4. Discussion

This study aimed to evaluate the prevalence and related factors concerning the development of dysphagia and dysphonia in 70 participants with COVID-19 who were admitted to the Firoozgar Hospital ICUs, in Tehran City, Iran. In this study, 2 instruments, namely MASA and P-FOIS, were used to measure the prevalence of dysphagia. Meanwhile, CAPE-V was used to assess the prevalence of dysphonia. The results confirmed that if a person develops COVID-19 disease, they may develop dysphagia and dysphonia and the results were in line with the author's hypothesis. The knowledge of physicians about the precise prevalence of deglutition and voice disorders in patients infected by COVID-19 will cause more attention to the symptoms of these disorders in these patients and necessary measures will be taken to evaluate and monitor these disorders early. As a result, dangerous complications of dysphagia and dysphonia, such as the increased risk of delayed oral feeding, pneumonia, malnutrition [7], dehydration, increased burden on caregiver and community, and death, will be prevented and these patients will recover faster [26].

Based on the results, 58.6% of COVID-19 patients had dysphagia, which indicates that the rate of swallowing disorder in this group of patients is high. According to gender segregation, of this prevalence, men account for about 60% and women for about 40%. This rate of dysphagia was much higher than the 7% rate in the report by Marchese et al. [3]. However, Marchese et al. reported the long-term prevalence of dysphagia after COVID-19, while in the present study, the patients were hospitalized in the ICU, and studies were conducted on different variants of the disease. Because different variants may have different clinical manifestations [18] and according to our results, these symptoms can be a risk factor for different prevalences of dysphagia and dysphonia. In addition, they used fiberoptic endoscopic evaluation of swallowing, an objective tool that comes with subjective tools, such as eating assessment tool-10 and gugging

Table 1. Demographic and clinical characteristics of COVID-19 patients admitted to intensive care units

Demographics		Mean±SD/No. (%)		
		Male (n=39)	Female (n=31)	Total (n=70)
Age (y)/Range		64.1±19.08/19-91	61.87±18.31/21-93	63.11±18.64 (19-93)
BMI (kg/m^2)/Range		24.17±5.74/15-38	24.77±4.08/15-38	24.44±5.04 (15-38)
LOS (d)		8.28±3.53/3-16	7.32±3.78/3-18	7.85±3.64 (3-18)
Any comorbidity		38(97)	28(90)	66(87)
Hypertension		16(41)	10(32.3)	26(37.1)
Diabetes		12(30.7)	11(35.5)	23(32.9)
Obesity		11(28.2)	9(29)	20(28.6)
Chronic kidney disease		8(20.5)	2(6.5)	10(14.3)
Cardiac		1(2.6)	5(16.1)	6(8.6)
Cancer outside of head and neck		1(2.6)	3(9.7)	4(5.7)
Chronic obstructive pulmonary disease		2(5.1)	1(3.2)	3(4.3)
Other respiratory diseases		4(10.3)	2(6.5)	6(8.6)
Other diseases		2(5.1)	2(6.5)	4(5.7)
Intubated during admission		8(20.5)	2(6.5)	10(14.3)
Length of intubation (range) (d)		1.53±3.22 (0-11)	0.35±1.37 (0-6)	1.01±2.62 (0-11)
Tracheostomy during admission		7(17.9)	7(22.6)	14(20)
Length of tracheostomy (range) (d)		1.00±2.33 (0-9)	1.54±3.37 (0-11)	1.24±2.83 (0-11)
Prone during admission		7(17.9)	2(6.5)	9(12.9)
Oxygen supplement		18(46.2)	13(42)	31(44.3)
Clinical symptoms	Fever	36(92.3)	17(54.8)	53(75.7)
	Cough	26(66.7)	17(54.8)	43(61.4)
	Dyspnea	20(51.3)	14(45.2)	34(48.6)
	Diarrhea	12(30.8)	8(25.8)	20(28.6)
	Vomiting	5(12.8)	2(6.5)	7(10)
	Anosmia	4(10.3)	3(9.7)	7(10)
	Ageusia	3(7.7)	0	3(4.3)

Abbreviations: SD: Standard deviation; BMI: Body mass index; LOS: Length of stay.

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swallowing screen [3], while we did not have access to objective tools and used different subjective tools. The high prevalence of dysphagia has also been reported in other new studies [6, 17]. Also in another study, the prevalence of dysphagia in men was reported at 78.2% [27].

Based on the results, LOS, length of intubation, length of tracheostomy, and age were associated with poorer swallowing outcomes. This result was in line with prior research that indicated with prolonged intubation, the risk of swallowing disorder increases [17, 24, 28].

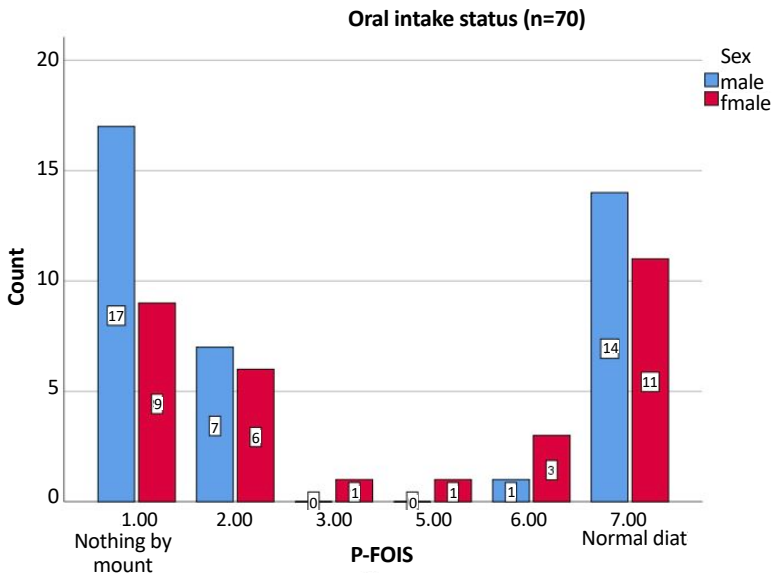

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Figure 1. Oral intake status at the intensive care unit admission about 60% of patients with COVID-19 had dysphagia.

P-FOIS: The Persian version of the functional oral intake status.

Also, Skoretz et al. found that the frequency of swallowing disorders raised with the period of intubation [29]. Malandraki et al. also obtained similar findings [30]. There is evidence of swallowing disorders in patients who underwent tracheostomy due to COVID-19 [1, 31]. We recognized that age is linked with worse swallowing problems; therefore, as age increases, the possibility of swallowing disorder in these patients is higher. Regan et al. also reported that age is a predictor of this condition [6, 17] Dysphagia is observed more commonly in old patients because of sensorimotor changes and atrophy [32]. Studies that have considered the relationship between dysphagia and LOS have reported that people with swallowing disorders spend significantly more time in the ICU [1, 24]. However, other authors did not find this relationship in their research [18, 28]. The present study discovered a longer LOS in patients infected by COVID-19 with dysphagia.

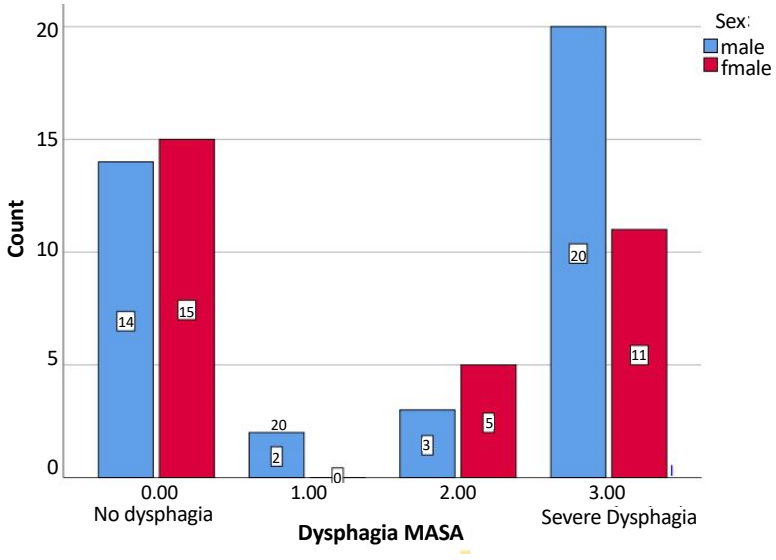

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Figure 2. Dysphagia severity based on MASA scale at intensive care unit admission about 60% of the COVID-19 patients had dysphagia.

MASA: Mann assessment of swallowing ability.

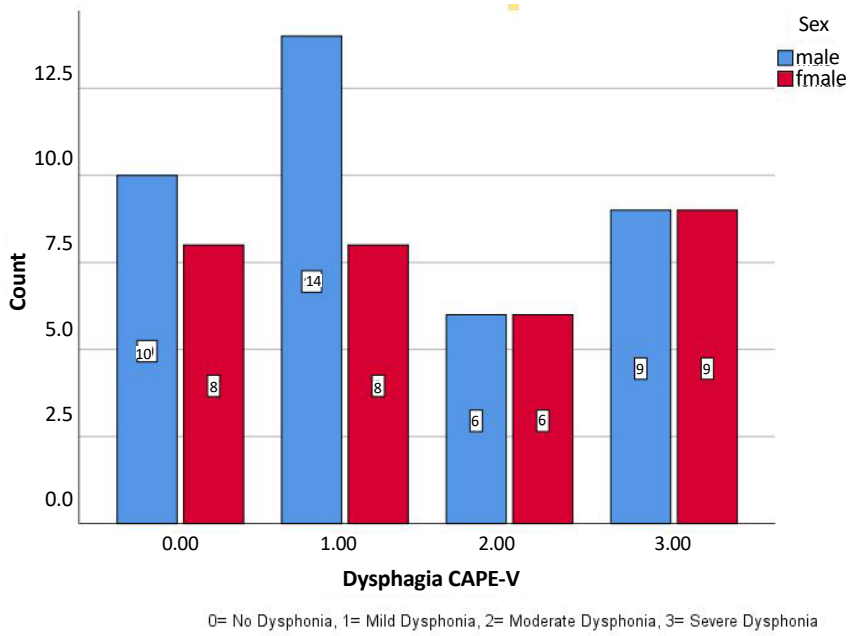

Figure 3. The severity of dysphonia based on the CAPE-V of the four patients with COVID-19, three had dysphonia

CAPE-V: Consensus auditory-perceptual evaluation of voice.

Based on the results, the dysphonia prevalence was high (74.3%) in patients with COVID-19. About 55.8% of men had dysphonia. Other studies with similar results have been published [6, 13]. This emphasizes that to detect and early diagnosis of COVID-19 patients, more attention should be paid to changes in voice quality be-

Table 2. Dysphagia and dysphonia correlations in COVID-19 patients

Variables	Variables	Age	LOS	Length of Tracheostomy	Length of Intubation
Dysphagia severity	MASA	-0.21	-0.35**	-0.62**	-0.32**
	FOIS	-0.25*	-0.26*	-0.42**	-0.33**
Dysphonia severity	CAPE-V	0.13	0.25*	0.47**	0.29*

LOS: Length of stay; MASA: Mann assessment of swallowing ability; FOIS: Functional oral intake scale; CAPE-V: Consensus auditory-perceptual evaluation of voice.

*Significant correlation with a P<0.05, **Significant correlation with P<0.01.

Table 3. Correlation between dysphagia and dysphonia in COVID-19 patients admitted to the intensive care unit

Correlation		Dysphagia Severity	
		P-FOIS	MASA
Dysphonia severity (CAPE-V)	Pearson correlation	0.63**	0.76**
	Significance	0.000	0.000
	Number	70	70

CAPE-V: Consensus auditory-perceptual evaluation of voice; P-FOIS: Persian version of the functional oral intake status; MASA: Mann assessment of swallowing ability.

**Significant correlation with a P<0.01.

cause dysphonia can be one of the first symptoms [16]. Some studies reported a much lower rate of dysphonia in these patients [33, 34]. Cantarella et al. conducted a study to evaluate the prevalence of dysphonia and they reported a rate of 43.7% [35]. In the present study, the prevalence was much higher, equivalent to 74.3%. This discrepancy may be due to different study protocols because in the previous study, the patients were not hospitalized and the physician asked questions about the presence of dysphonia through telephone interviews with patients [35]. This is while in the present study, patients were hospitalized in ICU and the SLP directly evaluated them. Hence, our findings may be more accurate. A recent meta-analysis study showed the prevalence of dysphonia in these patients is 31% [16]. Different factors, such as examining the patient in different conditions (hospitalized patients or patients after discharge), hospitalized patients in different sections (ICU or ward), conducting research in different variants, different instrumental and non-instrumental evaluations, as well as conducting this research in different communities may be the cause of this difference in prevalence [16]. In a study, the prevalence of dysphonia in infected patients at admission to the hospital was 51.7%. This number was 44.8% at the time of discharge, 24% three months after discharge, and 23.3% six months after discharge [18]. This shows the great importance of voice quality assessment time.

According to the results, a positive correlation was detected between the severity of dysphonia and LOS, representing that as CAPE-V increases, the age-long LOS raises. This is consistent with earlier studies [6]. There was also a correlation between the severity of dysphonia and the duration of MV. This is in line with a recent study [6]. Intubation injury and pre-existing respiratory disease can predict voice quality [6].

The main symptoms of the disease included fever, dyspnea, cough, diarrhea, and vomiting. Similar clinical manifestations have been reported in studies [18, 36]. In contrast to the present study, similar research reported a prevalence of more than 40% for anosmia and ageusia [37, 38]. These percentages were much lower in our study. In this case, the more precise methodology may be the cause. Dyspnea is an effective clinical symptom of the prevalence of dysphonia and dysphagia. As we mentioned, respiratory problems with COVID-19 disease may lead to a loss of swallowing-breathing coordination or decreased respiratory support for voice and it can negatively affect swallowing and voice [17].

Our findings indicated a positive correlation between the severity of dysphagia and the severity of dysphonia in COVID-19 patients. This means that the higher the severity of dysphagia, the more severe the dysphonia. Lechien et al. also reported a significant correlation between dysphonia and dysphagia severity in these patients [39]. One possible cause can be that, based on evidence, the voice production system has many common elements in physiology, neurophysiology, and anatomy with the swallowing system [40]. Another possible reason for this correlation is respiratory problems associated with COVID-19 disease which might result in the loss of coordination between breathing and swallowing [17]. In addition, the risk of dysphagia and dysphonia in these patients is exacerbated because of MV and intubation [6].

Since the spread of COVID-19, several studies have been conducted in different communities to investigate the dysphagia and dysphonia in COVID-19 patients, all of which indicate an important correlation between COVID-19 with dysphonia and dysphagia. The prevalence of dysphagia has been reported in studies in Italy, Switzerland, and Ireland at 7%, 54.8%, and 90%, respectively [1, 3, 6]. In the field of COVID-19, studies examining the prevalence of dysphonia in Ireland, Spain, and Iraq have reported rates of 27%, 10.3%, and 22.3%, respectively [6, 14, 19]. Accordingly, the data reported in different countries are contradictory depending on the methodology [41]. On the other hand, these contradictions can be attributed to racial differences in the COVID-19 demonstrations [19, 42].

5. Conclusion

This study showed that the prevalence of swallowing disorders and voice disorders is high in patients with COVID-19 hospitalized in the ICUs. The knowledge of physicians about these disorders leads to a more detailed examination of these patients. SLPs, as the main element in the rehabilitation of swallowing and voice disorders, have a more accurate evaluation and if necessary, intervention for these patients. Early detection of voice and swallowing disorders can improve a patient's quality of life.

Study limitations and future research

The study restrictions include the dearth of instrumental assessments. The patient-reported questionnaires can also be used. This is difficult to implement due to the medical conditions and the need of the rest of the COVID-19 patients. In addition, we did not follow the patients at the time of discharge and after discharge. Anoth-

er limitation of this study was the use of history-taking to determine the absence of dysphonia and dysphagia before contracting COVID-19.

Ethical Considerations

Compliance with ethical guidelines

All procedures in the study were approved by the Ethics Committee of the University of Social Walfare and Rehabilitation Sciences (Code: IR.USWR.REC.1400.224). Also, all participants signed a consent form.

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Authors' contributions

All authors contributed equally in conducting this research.

Conflict of interest

The authors declared no conflict of interest.

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