Research Paper

Dysphagia and Dysphonia in COVID-19 Patients Hospitalized in the Ward Versus Intensive Care Unit

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ABSTRACT

Objectives: COVID-19 was triggered by the severe acute respiratory syndrome coronavirus-2, leading to a pandemic. The risk of developing dysphonia and dysphagia amongst COVID-19 patients is considered to be high.

Methods: In this prospective study, 150 patients affected by COVID-19 admitted to the intensive care unit (ICU) and the ward of Firoozgar Hospital in Tehran, Iran, were analyzed. Dysphagia and dysphonia were evaluated according to the swallowing impairment score and the consensus auditory-perceptual evaluation of voice (CAPE-V). Also, the quality of life (QoL) was measured using the Persian version of the voice handicap index, the swallowing QoL and the Persian version of the dysphagia handicap index (DHI).

Results: A total of 150 COVID-19 patients (mean age: 59.64±17.87 years and 54.3% male; 75 admitted patients to the ICU and 75 patients admitted to the ward) were evaluated. A total of 115(77%) patients with COVID-19 were experiencing dysphagia, and the prevalence of dysphagia did not vary meaningfully between the two sets. According to the swallowing QoL, the QoL of the two groups was meaningly different (P<0.05). Also, the QoL of patients admitted to the ICU was lower than those admitted to the ward. A total of 91(61%) COVID-19 patients had dysphonia and dysphonia prevalence was significantly varied among the two groups (P<0.05). Investigating the relationship between dysphagia severity, dysphonia severity, and age showed a significantly positive correlation (P<0.01). However, the length of stay had a positive correlation only with the severity of dysphonia (P<0.05). Also, a negative correlation was found between swallowing QoL, dysphagia severity, and dysphonia severity (P<0.01).

Discussion: Dysphagia and dysphonia were prevalent among COVID-19 patients and more common in older patients. Early evaluation is required for timely and efficient intervention to avoid further complications and to progress their QoL.

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Highlights

● Dysphonia prevalence and dysphagia prevalence in hospitalized COVID-19 patients were high and detrimental to their quality of life (QoL). As a result, these two problems can be considered the leading clinical manifestations in COVID-19 patients and specialists, nurses and speech and language pathologists should be completely aware of these symptoms to be capable of taking the necessary protective and treatment actions.

● A positive correlation was found between dysphagia severity, dysphonia severity and age. Therefore, in COVID-19 patients, dysphagia and dysphonia are more prevalent in older patients. Higher age indicates that such disorders are more common.

● A negative correlation was found between swallowing QoL and dysphagia severity, and dysphonia severity. Accordingly, early evaluation is required for timely and efficient intervention to avoid further complications and to improve their QoL.

● Awareness of the prevalence rate and risk factors allows specialists to accurately identify and evaluate patients with swallowing and voice disorders and subject them to early intervention.

Plain Language Summary

COVID-19, a viral disease that has grown alarmingly worldwide, is currently the main global health problem. The COVID-19 disease affects various organs of the body, including the brain and lungs, and leads to hospitalization of patients. As a result of long-term intensive care and respiratory treatment procedures, this disease may lead to neuromuscular weakness and have negative effects on swallowing and voice production ability in this group of patients. Dysphonia and dysphagia may cause pneumonia, dehydration, aspiration, and malnutrition, reducing the patient's QoL and thus compromising the prognosis. The outcomes of the existing study revealed the prevalence of dysphagia and dysphonia is extremely high among COVID-19 patients and is more common among older patients. Awareness of the prevalence rate and risk factors allows specialists to accurately identify and evaluate patients with swallowing and voice disorders and subject them to early intervention.

Introduction

COVID-19 was triggered by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) which was called COVID-19 and started a pandemic [1, 2]. COVID-19 has highly variable manifestations, such as neurologic disorders, acute ischemic heart disease, and acute respiratory distress syndrome [3, 4]. Approximately 3% to 5% of COVID-19 patients must be hospitalized and they may undergo mechanical ventilation (MV), intubation, or tracheostomy [4, 5]. The risk of dysphagia and dysphonia is increased due to the employment of such devices [6, 7].

Dysphagia prevalence in these patients has been described as 7% [8] to 55% [9] and the prevalence of dysphonia has been reported at 2% [10] to 66% [6]. Although these studies were conducted in different communities, the results are inconsistent because of different methodologies, using different tools for evaluation, and most importantly, investigating patients in different periods ranging from the time of hospitalization to several months after discharge. Martin-Martinez et al. in 2021, investigated the dysphagia prevalence in 205 patients affected by COVID-19 admitted to the ward of a hospital placed in Spain. The study reported that the prevalence of dysphagia at admission was 51.7% [11]. The results of European studies that investigated the prevalence of dysphonia amongst COVID-19 patients variated, with Cantarella et al. describing approximately 44%, and Lechien et al., reporting approximately 27% [12, 13]. According to the hypothesis of ethnic differences in the manifestations of the COVID-19 [14], it is necessary to conduct such studies in different ethnicities and countries to get a more comprehensive view of the disease.

Based on previous studies, patients with dysphagia and dysphonia often face serious psychological and social complications, such as feelings of shame, reduced self-esteem, depression, anxiety, fear, communication difficulties, and social isolation that have noticeable effects

on their daily lives [15-18]. However, in such studies that investigated dysphagia and dysphonia in COVID-19, less attention has been given to the patient's point of view. Marchese et al. disclosed that 50% of the studied patients had abnormal swallowing quality of life (QoL). However, they examined only eight patients [8]. The dysphonia-related QoL of COVID-19 patients was not investigated at all.

Researchers have been studying the relationship between dysphagia and dysphonia with various clinical factors such as MV variables, sedative agents, prone positioning, hospital and intensive care unit (ICU) length of stay (LOS) and demographic variables including gender, age and comorbidities [19, 20]. However, there is little information about these factors' potential role in the manifestation of dysphagia and dysphonia. A study conducted by Clayton et al. in 2022 investigated the physiological aspects of dysphagia and the pattern in which swallowing was recovered amongst 27 ICU patients with COVID-19. They found a negative correlation between the dysphagia severity and the MV period, the intubation period, hospital LOS and ICU LOS [21]. In 2021, Regan et al. studied post-extubation dysphonia among 100 adults with SARS-CoV-2 who were intubated to find out the predictive variables of post-extubation dysphonia. Their results showed that the history of respiratory diseases and intubation injury were predictors of the quality of voice after extubation [6]. Accordingly, there is a discrepancy between the results of different studies.

Despite the great importance of the effects of COVID-19 on dysphagia and dysphonia, there is limited literature about this phenomenon. To the best of our knowledge, dysphagia prevalence in these patients has not been studied in Iran (except for one study that used clinician-driven instruments). Additionally, dysphonia and dysphagia-related QoL have been neglected. Thus, this study examines the following objectives: Investigating and comparing dysphonia and dysphagia prevalence amongst COVID-19 patients admitted to the ICU and the ward; investigating and comparing the QoL related to dysphonia and dysphagia amongst COVID-19-affected people hospitalized in the ICU and the ward; investigating potential dysphagia and dysphonia-related risk factors amongst COVID-19 patients in the ICU and the ward; and investigating the correlation between dysphagia severity and dysphonia severity in COVID-19 patients.

Materials and Methods

Study design

This was a cross-sectional study.

Study participants

We prospectively recruited 150 COVID-19 patients by applying the convenience sampling method (75 ICU patients and 75 from the ward) from Firoozgar Hospital in Tehran, Iran, between February 2022 and April 2022. The inclusion criteria in this study were as follows: Clinical evidence of contraction of the virus using the positive result of the polymerase chain reaction test; having at least 18 years of age; having no history of swallowing disorders and voice disorders before being affected 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; having no history of central or peripheral nervous system disease before getting affected by COVID-19; and 5) being a Persian-speaker. Patients who reported a history of addiction, cancer, chemotherapy, asthma, and history of anxiety, depression, or reflux before contracting COVID-19 in a clinical interview (with the patient or his family) were excluded from this study.

Study evaluations

Swallowing impairment score

The swallowing impairment score (SIS-6) is a validated patient-reported questionnaire to self-evaluate one's swallowing situation. This questionnaire consists of 6 items which can get scores ranging from 0 (no swallowing difficulties) to 24 (maximum swallowing difficulties) [22, 23].

Dysphagia handicap index (DHI)

The DHI was constructed by Silbergleit et al. in 2012. [25]. The purpose of developing this instrument was to measure the detrimental influence of deglutition difficulties on the functional, emotional and physical domains of a person's life related to swallowing disorders caused by different etiologies. It is a questionnaire completed by the patient that specifically measures dysphagia's influence on the QoL [24, 25]. DHI is a reliable and relatively new instrument with great psychometric characteristics [24]. This tool includes 25 items and three subtests, namely functional, emotional, and physical aspects. The functional subtest consists of 9 items associated with the influence of swallowing disorder on the daily life and

activity of an individual. Meanwhile, 7 items included in the emotional subtest investigate the emotional reactions of a patient to their swallowing disorder. Then, 9 items comprise the physical subtest that investigates the understanding of the patient about their experience of physical discomfort due to dysphagia. Each question has three possible answers (0=never, 2=sometimes and 4=always). When a patient completes the test, the next question is to determine their swallowing disorder severity based on a 7-point scale with equal intervals. On this scale, the measurements are as follows: 1=without any problem, 7=a major problem, and 4=moderate dysphagia [25]. In 2016, Barzegar-Bafrooei et al. translated DHI into Persian and stated that the content validity for the Persian version of the DHI (P-DHI) was confirmed. They reported a relatively good internal consistency of this instrument [25]. Based on the stated findings, P-DHI has been a reliable and valid instrument for the evaluation of the impairing influence of swallowing disorder on the QoL of Iranian patients experiencing oropharyngeal dysphagia [15].

Swallowing QoL questionnaire (SWAL-QoL)

The development of the SWAL-QoL in 2002 by McHorney et al. and good psychometric properties have been reported for this tool [26]. It has been commonly used as a gold standard in clinical situations and dysphagia exploration [16]. This is a questionnaire investigating the dysphagia-related QoL, in 10 categories and one complementary part about the frequency of symptoms. The 10 categories include mental health, eating duration, food choice, eating desire, fear, communication, burden, sleep, social role, and fatigue. The scale of symptoms contains 14 symptoms of dysphagia consisting of gagging, choking coughing and drooling. Every category has at least two aspects based on a 5-point Likert scale. All of the scales are then transmuted into a "0-100" measure; the score "0" shows the worst possible and the score "100" offers the best possible circumstance. This instrument can distinguish people with normal swallowing from oropharyngeal dysphagic patients and is sensitive to different clinically defined severities of dysphagia [26]. In the original version, fear (α=0.79) was the only scale that failed to gain the reliability standard of 0.80, which is the suggested figure for group-level studies. However, α coefficients for five scales ranged from 0.80 to 0.89, and seven scales had α coefficients >0.90. These scales had Pearson correlations ranging from 0.60 to 0.91 and the median for this parameter was 0.76. Thus, these scales have great internal consistency and reliability [26]. In 2017, Tarameshlu et al. conducted research to undertake an adaptation of the Persian version of this tool. The results showed that all of the scales, except for one (eating time: α=0.68) had Cronbach α coefficients ranging from 0.73 to 0.97 and a reliability of 0.70 for group-level. Therefore, the homogeneity of the items in these 9 scales that measure the same subjects is signified by this justifiable internal consistency [16].

Consensus auditory-perceptual evaluation of voice (CAPE-V)

In the present study, to investigate dysphonia and its characteristics via auditory-perceptual assessment, the total severity CAPE-V was used. The Persian translation of this tool and its content validity were reported by Salary Majd et al. [27] in 2014. The Cronbach α was 0.95 which is notably high. Also, the coefficients of intra-rater reliability varied between 0.42 for the pitch section and 0.86 for the overall severity of this tool. Meanwhile, for inter-rater reliability, this number varied between 0.32 for the pitch section and 0.85 for the overall severity. Finally, for evaluating the auditory-perceptual characteristics of voice in the adult population we can use the Persian version of CAPE-V (P-CAPE-V) is a valid and reliable instrument. In the P-CAPE-V, 6 aspects of the voice disorder are rated separately based on a 10 cm scale. These aspects include the general severity, strain, breathiness, roughness, loudness of voice and pitch level. Based on the CAPE-V outcomes, the evaluators place a sign on a 10 cm lateral line from the left, to identify the disorder's severity [27]. Based on the set of scores in this instrument, 0 equals normal voice or no dysphonia, any number from 1 to 9 indicates mild dysphonia, a total number from 10 to 59 represents moderate dysphonia, and finally, numbers ranging from 60 to 100 are equal to severe dysphonia [28]. In the present study, the scale was scored by a speech and language pathologist (SLP) who had 5 years of clinical practice. First, the patient was asked to sustain each of the /a/ and /i/ vowels for 3-5 s, read 6 sentences aloud and finally speak continuously for at least 20 s. The SLP determined the patient's score after performing the tasks. The SLP used a Zoom H5 mic (frequency response=5000-20000 Hz) to collect samples (24 bits and 44100 Hz sampling rate).

Voice handicap index

QoL is one of the main areas of health that must be considered during the process of assessment and treatment. The validation of the Persian version of the voice handicap index (P-VHI) and its reliability has been proven. P-VHI is a questionnaire, which is used by voice therapists to complete their evaluation of an individual with a voice disorder and to give them knowledge about the various

aspects of voice disorders [17]. Jacobson et al. [29] created the original version of VHI. Their goal was to study the different aspects of individuals with voice disorder and to understand the disabling harms of the disorder. This questionnaire includes functional, emotional, and physical domains related to the disorder. Each domain is composed of 10 items, each item can be scored from 0 (never) to 4 (always) based on a Likert scale. The Cronbach α for the questionnaire's total score and each subscale separately was considerably high (for all of the questions α=0.87, for the physical domain α=0.84, for the functional domain α=0.86, and the emotional domain α=0.91). Therefore, this tool showed a strong internal consistency. The Pearson correlation coefficients for the total questionnaire and each domain separately were notably high in the results of the test-re-test comparison for the patient group. The correlation coefficient for the total scale, emotional, physical and functional subscales represented the figures 0.96, 0.94, 0.93 and 0.93 respectively [29]. The psychometric characteristics of the P-VHI were studied amongst 160 participants including an equal number 80 of patients and healthy individuals. The discrimination coefficient of all the items was quite significant. Accordingly, these items can discriminate between individuals with and without the disorder. In 2012, Moradi et al. investigated the consistency of this tool. They found that Cronbach α coefficients for all of the items, the functional, and the emotional subtests were 0.84, 0.87 and 0.91, respectively. The results achieved by performing the test-re-test method on this questionnaire, and each one of its subtests, indicated the questionnaire's high reliability during the time. The P-VHI provides Iranian voice therapists with a tool letting them perform a more comprehensive and detailed assessment of the patient's well-being, investigate the detrimental influence of dysphonia on the patient's QoL, and also identify the possible actions to help them change their lifestyle to a better state [17].

Study procedure

The present study investigated the COVID-19 ICU and ward-admitted patients of Firoozgar Hospital in Tehran, Iran. If the patient completed and signed the informed consent form, then the COVID-19 patient would be evaluated for inclusion criteria. In the first hours of admission, the medical histories were used to extract clinical and demographic information including sex, comorbidities, age, and BMI. All eligible patients underwent the SIS-6 for dysphagia screening and the CAPE-V for dysphonia screening by a skilled SLP. In addition, the P-DHI, the SWAL-QoL and the P-VHI were also completed by the patients. Regarding the ICU-admitted patients, most of them had favorable conditions and the questionnaires were completed by the patient. In some cases, when the general condition of the patient was not good, the questionnaires were completed by the patient's relatives. The SLP performed all of these tests on the patient's first day in the ICU and the COVID-19 ward. The voice and swallowing of the patients who underwent intubation were not evaluated due to the distortion of the results. These patients were evaluated 24 h after extubation. At the time of discharge from the hospital, other information, including the presence/absence of intubation and tracheostomy (days), presence/absence of prone positioning and presence/absence of oxygen supplement were extracted from the medical records.

Data analyses

In this study, we analyzed the data via the SPSS software, version 26 and $P<0.05$ was considered statistically significant. To explore the performance of these groups in the above tests, descriptive methods (percentage and Mean±SD score) were used and inferential statistical analysis was used for the comparability of the mean score among these two groups. Because of the normal distribution of our data according to the Kolmogorov-Smirnov test and the Q-Q plots, parametric methods were used to analyze the data, for example, t-test and Pearson.

Results

Patients' characteristics

In the extant study, the total number of included patients, who were subjects confirmed to have COVID-19 upon admission, was 150. The Mean±SD age was 59.64±17.87 years and 81 patients (54.3%) were male, with a mean body mass index (BMI) of 23.83±4.75 kg/m^2 Mean±SD LOS of 6.8±3.42 days. Almost 91% of the total participants had pre-existing comorbidities. Baseline clinical details and other demographic characteristics are shown in Table 1.

Dysphagia and dysphonia in two groups: Prevalence and severity

According to the SIS-6, a total number of 115(77%) patients with COVID-19 were experiencing dysphagia, and the prevalence of dysphagia did not confirm a notable variation between the two sets ($P>0.05$). However, dysphagia severity was significantly different based on the P-DHI and the SIS-6 ($P<0.05$). As shown in Table 2, the dysphagia severity based on the SIS-6 and all sub-

Table 1. Demographics and baseline medical details of COVID-19 patients admitted to the ICU and ward

Demographics		Mean±SD/No. (%)		P
		ICU (n=75)	Ward (n=75)	
	Age range (y)	63.05±18.34 (19-93)	56.22±16.83 (19-84)	0.01*
	Male/Female	41/34	40/35	0.87**
	BMI range	24.5±5.06 (15-38)	23.16±4.34 (14-35)	0.08*
	LOS range (d)	7.68±3.58 (3-18)	6±3.06 (2-24)	0*
	Any comorbidity	71(94.6)	65(86.6)	0.57**
Categories of Comorbidity	Hypertension	28(37.3)	21(28)	0.22**
	Diabetes	25(33.3)	19(25.3)	0.40**
	Obesity	22 (29.3)	13(17.3)	0.08**
	Chronic kidney disease	11 (14.7)	11(14.7)	1**
	Cardiac	6 (8)	3(4)	0.30**
	Cancer outside of head and neck	4 (5.3)	4(5.3)	1**
	Chronic obstructive pulmonary disease	3(4)	4(5.3)	0.69 **
	Other respiratory disease	6(8)	4(5.3)	0.51 **
	Other disease	5(6.7)	3(4)	0.46**
	Intubated during admission	10(13.3)	0	0 **
	Length of intubation range (d)	0.94±2.55 (0-11)	0	0*
	Tracheostomy during admission	16 (21.3)	0	0**
	Length of tracheostomy range (d)	1.25±2.77 (0-11)	0	0*
	Prone during admission	9(12)	6(8)	0.41**
	Oxygen supplement	34(45.3)	31(41.3)	0.62 **

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Abbreviations: SD: Standard deviation; ICU: Intensive care unit; BMI: Body mass index; LOS: Length of stay.

*Independent t-test, **Chi-square test.

scales of the P-DHI was worse in ICU patients than in ward patients. Also, based on the SWAL-QoL and all of its subtests, the QoL of the two groups was meaningly different (P<0.05) and the QoL of ICU patients was lower than ward patients (Table 2).

According to the CAPE-V, 91(61%) COVID-19 patients were experiencing dysphonia, and dysphonia prevalence was significantly different between the two groups (P<0.05). Also, the severity of dysphonia significantly varies based on the CAPE-V and the P-VHI (P<0.05). As shown in Table 2, the prevalence and severity of dysphonia based on the CAPE-V and all subscales of the P-VHI were higher in the ICU patients than in patients in the ward.

Correlations

A positive correlation was found between dysphagia severity (SIS-6 and P-DHI), dysphonia severity (CAPE-V and P-VHI) and age (P<0.01). The LOS had a positive correlation only with dysphonia severity (Based on P-VHI; P<0.05). Also, a negative correlation has been found between swallowing QoL, dysphagia severity, and dysphonia severity (P<0.01) (Table 3).

Table 2. Prevalence and severity of dysphagia and dysphonia in the two studied groups (n=150)

Demographics		Mean±SD/No. (%)		P
		ICU (n=75)	Ward (n=75)	
SIS-6[&]		62(82.7)	53(70.7)	0.080[**]
		10.8±8.7	7±7.8	0.005[*]
P-DHI	Physical disability	16.6±5.2	14.3±4.7	0.004[*]
	Emotional disability	12.9±3.9	11.6±3.9	0.048[*]
	Functional disability	16.2±5.5	13.8±4.9	0.006[*]
	Total	45.7±14	39.7±12.8	0.007[*]
CAPE-V[&]		57(76)	34(45.3)	0[**]
		181.9±138.5	107.9±135.5	0.001[*]
P-VHI	Physical disability	16.2±9.8	10.9±9.2	0.001[*]
	Emotional disability	13.7±9.6	9.1±9.2	0.003[*]
	Functional disability	14.9±10	9.9±9.3	0.002[*]
	Total	43±27.6	28.9±25.7	0.001[*]
SWA-LQoL	Burden	5.9±3.1	7.8±2.8	0.000[*]
	Eating desire	8.6±3.9	10.9±3.5	0[*]
	Eating duration	5.8±2.9	7.4±2.4	0[*]
	Food selection	5.8±2.6	7.4±2.4	0[*]
	Communication	6.1±2.3	7.7±2.1	0[*]
	Fear	12.2±5.8	15.6±4.9	0[*]
	Mental health	15.9±7.2	19.7±6.3	0[*]
	Social functioning	14.7±7.3	19±6.7	0[*]
	Sleep	5.3±2.7	6.6±2.8	00.008[*]
	Fatigue	7.8±3.2	9.8±3.9	0.001[*]
	Total	134.8±52.7	165.2±47.5	0[*]

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Abbreviations: SIS-6: Swallowing impairment score; P-DHI: Persian version of dysphagia handicap index; CAPE-V: Consensus auditory-perceptual evaluation of voice; P-VHI: Persian version of voice handicap index; SWAL-QoL: Swallowing quality of life; ICU: Intensive care unit; SD: Standard deviation.

[&]Score >0, [*]Independent t-test, [**]Chi-square test.

Discussion

This was a prospective study to investigate voice and swallowing difficulties amongst adult COVID-19 people hospitalized in the ward and the ICU which showed high rates and severity of dysphagia and dysphonia amongst these patients in Iran. Related factors of dysphagia and dysphonia were discovered, which may provide necessary information for the early diagnosis and intervention of COVID-19-related dysphonia and dysphagia in this

Table 3. Correlations between variables (n=150)

Variables	SIS-6	P-DHI	SWAL-QoL	CAPE-V	P-VHI
Age	0.19*	0.16*	-0.12	0.15	0.12
LOS	0.13	0.10	-0.14	0.15	0.19*
SIS-6	1	0.84**	-0.86**	0.62**	0.64**
P-DHI	-	1	-0.88**	0.56**	0.60**
SWAL-QoL	-	-	1	-0.62**	-0.63**
CAPE-V	-	-	-	1	0.84**
P-VHI	-	-	-	-	1

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Abbreviations: LOS: Length of stay; SIS-6: Swallowing impairment score; P-DHI: Persian version of dysphagia handicap index; CAPE-V: Consensus auditory-perceptual evaluation of voice; P-VHI: Persian version of voice handicap index; SWAL-QoL: Swallowing quality of life.

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

population. Also, in addition to clinician-driven assessments, this study focused on the patient's self-perception of these disorders to administer a multidimensional assessment considering all the aspects of a person's well-being. The present study focused on two clusters of COVID-19 patients: One group was admitted to the ICU and the other group was in the ward. In the ICU, there are specialized devices, such as invasive and non-invasive MV, aspirator and vital signs monitor. ICU-admitted patients are usually in a critical situation and require intensive care. Patients who are admitted to the ward are in a much better condition and mostly receive public care and for some, even the problem is so mild that they are just quarantined. Patients with a critical situation are hospitalized in the ICU and then transferred to the ward after their situation improves and afterward, as they feel better, they can get discharged from the ward.

Even though COVID-19 has caused a pandemic that affected the lives of billions of people, it is considered an active disease due to its changing clinical presentation [30]. In the present study, a high prevalence of dysphagia (77%) was observed. According to our study, 82.7% of patients hospitalized in the ICU had dysphagia, while this rate was 70.7% in patients hospitalized in the ward. The higher prevalence of dysphagia in the ICU compared to the ward may be related to more severe respiratory problems and the requirement of MV, a much higher volume of secretions, and therefore the need for suctioning amongst these patients. This finding was following earlier studies. Research conducted by Regan et al. in 2021, studied 100 adults infected with COVID-19 who underwent intubation and were administered to hospitals across the country of Ireland, aiming to find out post-extubation dysphagia prevalence using functional oral intake status. They realized that 86% of their studied population had post-extubation dysphagia [6]. One another investigation conducted in 2021 by Regan et al. considered the presence of dysphagia amongst 315 hospitalized adults infected with COVID-19 in hospitals across Ireland using functional oral intake status. Their results demonstrated that dysphagia's presence in this population is considerably high (73.4%). Respiratory problems related to COVID-19 infection are one of the causes of dysphagia in these individuals which may result in damaging the swallowing-breathing coordination [31]. The swallowing and breathing systems indicate a complex relationship and they both have common components in physiological, functional, structural, and neurological fields. Swallowing usually takes place in the pattern of exhalation-swallow-exhalation, which keeps the trachea and larynx away from pharyngeal contents. The absence of coordination between these two systems may result in dehydration, aspiration pneumonia, and malnutrition, causing a reduction of the patient's QoL, hence worsening the prognosis [32-34].

Dysphonia can be caused by common viral infections (with an incidence rate of <20%) [35]. Although Cantarella et al. in 2021 researched to study the dysphonia prevalence in 160 non-hospitalized COVID-19 patients in Lombardy, Italy (Italy was significantly affected by the disease during COVID-19's first epidemic wave in Europe), they reported that in the slight and modest cat-

egories of COVID-19 infections, there is 43.7% prevalence rate of dysphonia which is a much higher rate. They measured the severity of dysphonia with a 4-point scale, and the data was gathered via telephone interviews [13]. In the current study, the dysphonia prevalence in hospitalized sick adults was stated at 61% which was a higher figure than in the previous study. A different study protocol might be partly responsible for this dissimilarity. In the previous study, data was gathered via telephone interviews [13]; however, in the current study, the evaluation was carried out in person. Thus, the present information might be more precise. Previous studies investigated patients entirely from Lombardy in Italy [13]; however, the present study investigated patients admitted to the Firoozgar Hospital from different states throughout Iran. Accordingly, this dissimilarity might be due to the hypothesis related to different manifestations of COVID-19 based on different ethnicity [13]. The finding of our existing study confirms the study of Regan et al., in 2021, which the harvest of that study disclosed that 66% of 100 intubated patients with COVID-19, developed dysphonia. These researchers assessed the patient's voice quality by using the grade, roughness, breathiness, asthenia, strain, or grade, roughness, breathiness, asthenia, and strain scale [6]. The pulmonary system is affected by COVID-19, so there might be an explanation for the dysphonia onset since the pulmonary system's ideal function has been needed to provide the required amount of air supply for phonation [36].

The information of the standing study showed a positive correlation amongst severity of dysphagia, the severity of dysphonia, and the age of COVID-19 patients. Accordingly, as the severity of dysphagia worsens, the severity of dysphonia increases. Lechien et al. also found a significant correlation between dysphonia and dysphagia severity [37]. One possible cause can be that the voice production system has many common elements in physiology, neurophysiology, and anatomy with the swallowing system [38]. Another possible reason for this positive correlation is respiratory problems associated with COVID-19 disease which might result in the impairment of breathing-swallowing coordination. Additionally, the risk of dysphagia and dysphonia in this clinical population is exacerbated as a result of MV and intubation, which are treatment procedures used for acute respiratory distress syndrome [6]. In the extant study, a momentous correlation was identified between age and swallowing outcomes. So, as age increases, there is a higher chance of deglutition disorders. Regan et al. [6, 31] also reported age as a predictor of dysphagia in. COVID-19 patients which may be the result of cachexia, sarcopenia, and a number of coexisting conditions amongst older adults, which all can cause deglutition deficits [31]. Considering that older patients might have already had presbyphagia before contracting COVID-19, it makes them more susceptible to developing dysphagia [6]. Therefore, swallowing disorder is experienced more often by elderly patients due to sensorimotor changes, connective tissue weakening, and muscle atrophy [39].

In the present study, a positive correlation was found between LOS and the severity of dysphonia. However, this positive correlation was not found in a few studies relating to COVID-19. However, researchers studying patients with other health conditions also reported a positive correlation between dysphonia and a higher length of hospitalization [40, 41].

In addition to the aforementioned data, a negative correlation was found between swallowing-related QoL and dysphagia severity, and dysphonia severity. Accordingly, as the swallowing function improves, QoL increases. In addition to this, oral feeding might be correlated with better QoL scores as a result of fulfilling basic human needs. Based on Maslow's original hierarchy, human needs are classified into five levels which can be seen as a motivational theory [42]. The lowest level of the hierarchy comprises physiological needs which are counted as the primary needs; in other words, these needs should be met before proceeding with higher levels of needs. Patients with dysphagia often show low levels of QoL and motivation due to a struggle to fulfill a fundamental physiologic need: Eating [42]. Consequently, it is assumed that oral feeding for patients with COVID-19 will enhance the QoL and swallowing function. Anomalous deglutition can cause dehydration, malnutrition, pneumonia, and weight loss, or death [25, 45]. Additionally, the inability to eat properly demonstrates a social impediment that affects the patient mentally and physically [25]. Therefore, dysphagia has a notable negative influence on the QoL [15, 16, 25]. Similarly, dysphonia can affect the QoL of an individual [44]. Therefore, as the severity of dysphonia and dysphagia gets worse, the chance of worse patients' QoL reports gets higher. Therapists have to investigate the trace of swallowing disorders and voice problems on the individual's QoL to find out strategies that help improve the individual's lifestyle [16, 17].

As mentioned earlier, a patient's report of his or her current impairment must be considered because it provides significant information and plays a crucial part in the comprehensive assessment [44]. Based on the results from the P-DHI, we concluded that the highest score, meaning the worst QoL, belongs to the physical subscale

of the instrument, in the patients admitted to the ward as well as the ICU. This result is in line with studies conducted by Silbergleit et al. [24] and Farahat. et al. [45] and Barzegar-Bafrooei et al. [25]. Patients who are experiencing swallowing disorder are more often aware of their physical manifestations compared to the other two subscales (the emotional and the functional subscales), and they are likely to couple physical manifestations with dysphagia [15]. However, the total score reported by the ICU-admitted patients was higher than patients admitted to the ward. Consistent with our earlier statement, in the present study according to the P-VHI scores, the highest average score gained by the patients in both the ward and ICU was mostly in the physical subscale, and. the functional and the emotional. subscales, respectively. The items included in the physical subscale were easier for the patients to understand, and also similar to the statement of several other researchers [46, 47], the physical aspect of the disorder compared to other aspects, might cause them more distress. In line with previous studies [17], in our study, the average score of the emotional subtest gained by the patients was lower, compared to the other two subtests.

The result of SWAL-QoL shows that COVID-19 patients hospitalized in ICU have a worse health-related QoL in all domains than patients hospitalized in the ward. The most affected domain in ICU patients was "sleep" followed by "eating duration," "food selection," and "burden." Patients hospitalized in the ward also reported similar results. They reported the most damage in the areas of "sleep," "eating duration," "food selection," "communication," and "burden," respectively. Because of the weakness of swallowing-breathing coordination, needing more time than usual to finish a meal is an important and common complaint among patients with COVID-19. Thus, they tend to swallow more cautiously and have smaller sizes of bolus. Research conducted by Marchese et al. [8] studied dysphagia characteristics in COVID-19 patients after being hospitalized and also after recovery from the disease. They reported that dysphagia related to COVID-19 mostly affected "eating desire," "time of meals," and "sleep." Sample features in these studies might have caused the difference in results. The biggest difference between the scores obtained by the hospitalized patients in the ICU and the ward was respectively in social functioning and then mental health. Therefore, swallowing impairment related to the COVID-19 disease hurts a patient's QoL and as the disease progresses, the patient's swallowing QoL deteriorates. According to Bo et al. [31] and Zhang et al. [32], the prevalence of depression (29.2%) and post-traumatic stress disorder (96.2%) amongst hospitalized COVID-19 patients are quite significant. Appetite and sleep quality are most probably affected by depression and psychosocial stressors.

Accordingly, screening for dysphagia and dysphonia is crucial for all patients with COVID-19 who are hospitalized. If in the process of screening, dysphagia or dysphonia is detected, patients must be evaluated further for swallowing or voice impairments, so that, complications, such as bronchial aspiration and nutritional problems can be prevented [48]. Physicians need to bear in mind that dysphonia in patients infected by SARS-CoV-2 might develop during the time they are being hospitalized [37]. Knowing the co-occurring conditions, their symptoms, and their prevalence might help to better understand the disease [49]. Awareness of the aforementioned risk factors can ensure that dysphonia and dysphagia are evaluated and diagnosed early in the adult population to minimize further QoL and clinical complications [31].

Conclusion

The present study highlights the dysphagia and dysphonia prevalence among COVID-19 adults. Knowledge about the prevalence and correlations of impaired swallowing and voice quality will result in multidimensional evaluation and early diagnosis of these patients and monitoring them during their stay at the hospital. Early dysphonia and dysphagia assessment and their prompt management are required to minimize QoL and clinical complications. Also, patients' reports about their present handicap and their characteristics should be considered as it provides practitioners with significant and various data, hence it can be a notably important part of the process of diagnosis. Furthermore, taking the patient's view about dysphagia and dysphonia into account in addition to clinician-driven assessments, provides the therapist with a broader image of the person's health state which can be beneficial when considering therapeutic procedures.

Study limitations and future research

The study limitations of this research include the absence of instrumental evaluation. We did not have access to stroboscopy and fiberoptic endoscopic evaluation of swallowing in Firoozgar Hospital because of the possible risk of transmission. The information provided by the fiberoptic endoscopic evaluation of swallowing includes physiological data about aspiration, residue, secretions, and also pharyngeal sensation [6]. Also, we did not follow the patients at the time of discharge and after discharge. However, it has been stated by other studies that the self-perception of the patient about dysphagia

and dysphonia must be considered even though unlike the present study they did not use these types of questionnaires [6]. Also, this study conducted research that includes 5 questionnaires (3 questionnaires for dysphagia and 2 questionnaires for dysphonia) to have both the expert opinion and the patient's sight and to get a comprehensive picture of the patient.

The authors recommend that researchers for future studies can focus on treatment and apply these questionnaires that use patients' responses about their problems pre- and post-treatment. Dysphagia and dysphonia researchers studying future pandemic waves are necessary to establish the influence of different variants of the virus which are mutated and intensive care management on swallowing and voice outcomes. In addition, time points after discharge for capturing the longer term difficulties with swallowing and voice could guide the multidisciplinary services in the community. Additionally, in future studies, researchers can consider medical treatment methods, including the medications used for COVID-19 patients. Changes in patients' sleep and reduced QoL might be related to their medications.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of the University of Social Welfare and Rehabilitation Sciences (Code: IR.USWR.REC.1400.224). All participants signed a consent form.

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Authors' contributions

All authors contributed equally to this research.

Conflict of interest

The authors declared no conflict of interest.

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