ORIGINAL ARTICLE

SWALLOWING AND NUTRITIONAL CHARACTERISTICS OF PATIENTS WITH POST-COVID-19 SYNDROME: AMBISPECTIVE STUDY

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Highlights: (1) Post-COVID-19 patients who were hospitalized exhibited swallowing alterations. (2) High prevalence of malnutrition risk following hospital discharge. (3) Evaluated individuals were obese and presented a risk of malnutrition.

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ABSTRACT

The objective of this study was to describe the swallowing profile through clinical and instrumental assessments and the nutritional profile of patients with post-COVID-19 syndrome, stratified by sex. This was an ambispective study. Primary data collection was conducted at the Post-COVID-19 Rehabilitation Outpatient Clinic of a university hospital, selecting 50 adult individuals who had been hospitalized for severe COVID-19. All participants underwent swallowing assessments (Eating Assessment Tool-10 – EAT-10; Volume-Viscosity Swallowing Test – V-VST; and Fiberoptic Endoscopic Evaluation of Swallowing – FEES) and nutritional evaluations (Mini Nutritional Assessment – MNA and Body Mass Index – BMI). The study included 26 women (51.04 ± 13.59 years) and 24 men (55.92 ± 10.18 years) assessed four months after acute COVID-19 infection, with a history of prolonged intensive care unit (ICU) hospitalization for more than 20 days. Swallowing alterations in females and males were identified through EAT-10 (53.85% vs. 8.33%; p=0.001), V-VST (76.92% vs. 79.17%; p=0.848), and FEES (92.31% vs. 83.33%; p=0.651), respectively. Both women (35.41 ± 5.68 kg/m²) and men (31.65 ± 4.64 kg/m²) were classified as obese. Nutritional risk, as assessed by the MNA, was observed in both sexes (53.85% of women and 58.33% of men), with 23.08% of women classified as malnourished. No correlations were observed between swallowing variables and BMI classification or MNA scores. Our results suggest that individuals with post-COVID-19 syndrome are at risk for dysphagia and obesity, regardless of sex. Furthermore, malnutrition was more prevalent among women. These findings highlight the importance of timely management of swallowing and nutritional disorders to assess and optimize rehabilitation, preventing associated sequelae.

Keywords: COVID-19; Swallowing; Malnutrition; Swallowing Disorders.

INTRODUCTION

COVID-19 is a disease caused by a type of coronavirus that has affected a significant portion of the global population. Even after two years of the pandemic, it

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remains one of the greatest health, economic, and social crises, leading to a high number of cases, a substantial percentage of severe patients, and elevated mortality rates[1].

Symptoms can range from a mild cold with myalgia, fatigue, headache, and cough to severe pneumonia[1]. It is estimated that 80% of cases present mild symptoms, 15% are severe, and 5% are critical, potentially leading to acute respiratory distress syndrome. Up to 20% of patients require prolonged hospitalization in an Intensive Care Unit (ICU) and may develop functional sequelae due to prolonged hospitalization[2-3].

Post-COVID-19 syndrome manifests in some patients as a set of signs and symptoms that emerge up to three months after the acute infection. Persistent symptoms are varied, such as anosmia, ageusia, fatigue, dyspnea, and sleep disorders[4].

With the introduction of COVID-19 vaccines, there has been a 15% reduction in the incidence of long COVID-19[5]. However, the prevalence of post-COVID-19 sequelae continues to rise. Patients with severe cases may develop conditions such as malnutrition and dysphagia due to prolonged hospitalization and orotracheal intubation (OTI)[6].

Dysphagia is a symptom of an underlying disease characterized by an impaired swallowing ability, which can affect both the safety and efficiency of the swallowing process[6]. Patients who experience prolonged hospitalization are at greater risk of developing swallowing impairments. If the larynx is affected by the use of invasive mechanical ventilation (IMV) for OTI and/or tracheostomy (TQT), the severity of dysphagia can significantly increase.

The incidence of post-extubation dysphagia varies from 3% to 62%, and among these patients, 60% continue to experience oropharyngeal dysphagia (OD) at hospital discharge[7]. Post-extubation dysphagia may result from various factors, including mechanical causes, cognitive impairment, and residual effects of sedatives and other medications used during treatment[8].

Swallowing disorders in patients with COVID-19 are influenced by two primary mechanisms. The first is muscular and structural discomfort, in which the muscles and structures involved in swallowing fail to function properly after prolonged disuse. The second is a neurological process, as SARS-CoV-2 can impact cranial nerves[6-7].

Dysphagia in COVID-19 patients can affect the neural network and its effectors, as six cranial nerves are involved in the swallowing process[6-7]. When the virus reaches

neurological structures, it disrupts neuromuscular responses, leading to conditions such as anosmia and ageusia[79]. According to the literature, approximately 44.8% of COVID-19 patients present with OD after hospital discharge[10], with reported prevalence ranging from 27%[12] to 29.3%[11].

Increased nutritional demands and the presence of severe inflammatory states are associated with a high risk of malnutrition. Changes in the nutritional status of post-COVID-19 patients were identified in a previous study, in which 27.5% of individuals were at risk for malnutrition, and 52.7% were classified as malnourished[13]. Similarly, the prevalence of malnutrition has been shown to range from 37.5% to 42.1% in other studies[14-15].

Given the above, our hypothesis was that individuals who experienced severe COVID-19 could present with impaired swallowing function and nutritional status after hospital discharge. Therefore, this study aimed to describe the swallowing profile through clinical and instrumental assessment and the nutritional profile of patients with post-COVID-19 syndrome, considering sex differences.

METHOD

This was an ambispective study conducted at the Post-COVID-19 Rehabilitation Outpatient Clinic of a university hospital between August 2021 and May 2022. The study was approved by the institution's Research Ethics Committee under protocol number 4.527.287.

The sampling was conducted by convenience, and the following inclusion criteria were applied: age between 18 and 85 years, clinically stable at the time of assessment (i.e., afebrile, vital signs within normal parameters, and peripheral oxygen saturation above 90%), and availability to attend the post-COVID-19 rehabilitation outpatient clinic for assessments. Participation in the study was confirmed only after informed consent was voluntarily given and signed in two copies. Once consent was obtained, evaluations were scheduled accordingly.

Hospitalization data were extracted from the University Hospital Management System, including length of hospital stay (in days), need for OTI and TQT, pre-existing health conditions (systemic arterial hypertension, diabetes mellitus, respiratory diseases,

and other comorbidities grouped under "others"), and weight loss during hospitalization. The time elapsed between hospital discharge and the first outpatient evaluation was also recorded.

Data collection was conducted at the Post-COVID-19 Rehabilitation Outpatient Clinic, with assessments scheduled in advance and performed by experienced and trained professionals.

Self-perception of dysphagia was assessed using the Eating Assessment Tool-10 (EAT-10), adapted to the Brazilian version[16]. This tool evaluates swallowing-related alterations and the limitations they impose on patients' social and emotional lives. It consists of ten questions that provide information on physical symptoms, as well as the emotional and functional impact that a swallowing disorder may have on an individual's life. A score of three or more points suggests a risk for dysphagia[16].

To complement the dysphagia risk assessment, the Volume–Viscosity Swallowing Test (V-VST) was utilized. Originally developed by Clavé[17] and adapted to the Portuguese version[18], this is a dysphagia screening protocol in which different consistencies (nectar, liquid, and pudding) and volumes (5 mL, 10 mL, and 20 mL) are administered. The consistencies are obtained by adding 1.2 g and 6 g of thickener (Thicken Up Clear®, Nestlé) to 100 mL of water to achieve nectar and pudding thickness, respectively. Consistencies are administered using a syringe to ensure consistent volume delivery. Clinical signs of efficacy are assessed, including lip closure alterations, presence or absence of oral and/or pharyngeal residue, and multiple swallows. Safety signs are identified through clinical indicators of aspiration, such as coughing, vocal changes (wet voice), and a peripheral oxygen desaturation of 3% or more during each swallow[17].

Fiberoptic Endoscopic Evaluation of Swallowing (FEES) was performed by an otolaryngologist and a speech-language pathologist, both experienced in dysphagia management, using a Karl Storz 3.4 mm flexible endoscope, positioned at the transition between the nasopharyngeal and oropharyngeal regions. The evaluation involved the administration of food prepared with filtered water, blue aniline food dye, and ThickenUp Clear® thickener. The tested consistencies included liquid, nectar, honey, pudding, and solid, with volumes of 5 mL and 10 mL; the solid consistency was assessed using a biscuit. The structural and functional assessments of swallowing aimed to examine

anatomical aspects, including the vocal folds, larynx, hypopharynx, oropharynx, oral cavity, and the upper portion of the trachea, as well as swallowing functionality. Useful information was obtained regarding the oral phase, including lip closure, extraoral leakage, oral transit time, and oral residue retention. In the pharyngeal phase, aspects such as nasal regurgitation, spontaneous swallows, hypopharyngeal residue, pharyngoesophageal transition, laryngeal penetration, laryngotracheal aspiration, and reflex cough were assessed. The degree of dysphagia was classified according to the O'Neil et al. (1999) scale[19].

Nutritional screening was performed by measuring body weight (kg, Tanita BC 601 scale, Tokyo, Japan) and height (cm, Personal Caprice stadiometer – Sanny ES2060), followed by the calculation of BMI (dividing body weight in kilograms by the square of height in meters). Nutritional status was classified according to the WHO[20] criteria as underweight ($\leq$18.49 kg/m²), normal weight (18.5–24.99 kg/m²), overweight (25.0–29.99 kg/m²), obesity class 1 (30.0–34.99 kg/m²), obesity class 2 (35.0–39.99 kg/m²), and obesity class 3 ($\geq$40.0 kg/m²).

The Mini Nutritional Assessment (MNA) is a widely used tool for detecting malnutrition or nutritional risk. It consists of 18 items divided into two parts: screening and global assessment. The screening section comprises six items, with a maximum total score of 14 points. A score of 11 or less indicates a risk of malnutrition, necessitating progression to the second part, the global assessment, which consists of 12 items with a maximum score of 16 points. The total score from both sections determines the nutritional risk: a score between 17 and 23.5 indicates nutritional risk, while a score below 17 points indicates malnutrition[21].

Statistical Analysis

The data were recorded using independent double entry and organized in Microsoft Excel 2010. The dataset was analyzed using GraphPad Prism 5 statistical software (GraphPad Software Inc., San Diego, CA, USA). The distribution of continuous variables was assessed using the Shapiro-Wilk normality test. Parametric variables were presented as mean and standard deviation (SD), while non-parametric variables were

expressed as median, minimum and maximum values, or interquartile range. Categorical
variables were reported as absolute and relative frequencies. Comparisons between sexes
were performed using the independent t-test, Mann-Whitney test, chi-square test, and
Fisher's exact test. A significance level of 5% ($p<0.05$) was adopted.

RESULTS

A total of 50 individuals (Figure 1) who had been hospitalized due to severe
COVID-19 and attended the post-COVID-19 rehabilitation outpatient clinic were
included in the study, with a median of 80 days after hospital discharge. The sample
characteristics are presented in Table 1.

Figure 1. Study Flowchart
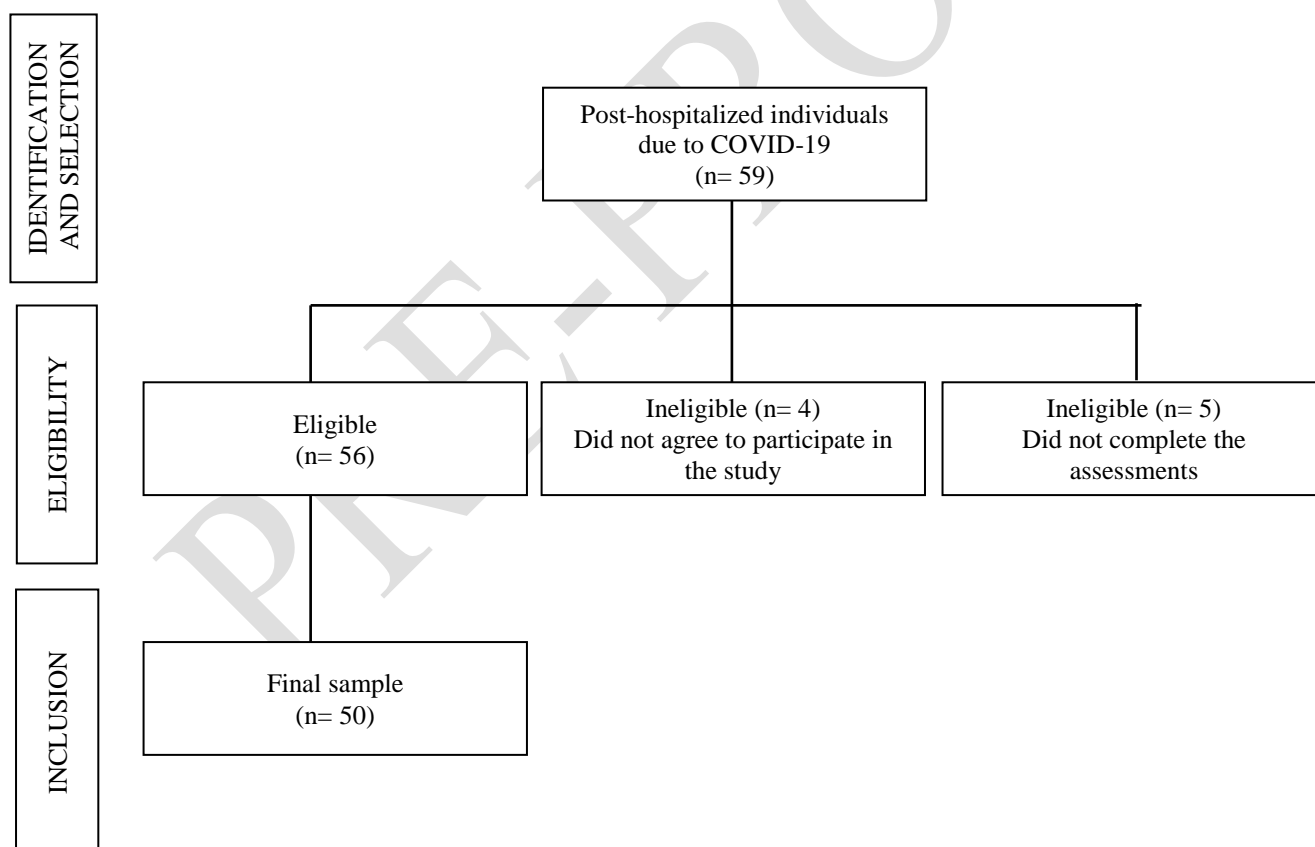
Legend: n = number of participants

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Table 1 – Characterization of Post-COVID-19 Patients

Variables	Total (n=50)	Female (n= 26)	Male (n=24)	p-value
Age, years old, mean±SD	53.38 ±12.20	51.04 ±13,59	55.92 ±10.18	0.027*
OTI, n (%)	26 (52)	15 (57.60)	11 (45.83)	0.401
Tracheostomy, n (%)	8 (16)	5 (19.23)	3 (12.50)	0.516
Length of hospital stay, days median (IQR 25–75)	17 (12 - 27)	15.50 (5–108)	19 (9 – 66)	0.770[a]
Discharge to assessment, days median (min - máx)	80 (48 – 203.25)	74 (31 – 338)	86 (26 – 384)	0.590[a]
Previous diseases, n (%)				
SAH	28 (56)	15 (57.69)	13 (54.17)	0.801
Obesity	21 (42)	7 (26.92)	14 (58.33)	0.024*
Diabetes Mellitus	13 (26)	6 (23.08)	7 (29.17)	0.743
Respiratory disease	12 (24)	8 (30.77)	4 (17)	0.243
Others	31 (62)	17 (54.38)	14 (58.33)	0.607

Legend: OTI, Orotracheal intubation; n, number of patients; SD, Standard deviation; IQR, Interquartile range; min, minimum; max, maximum; SAH, Systemic arterial hypertension.
Independent T-test[a]; Chi-square test; Fisher's exact test; *p<0.05.

It was observed that 52% of patients required orotracheal intubation (IOT), and the median length of hospital stay was 17 days. Additionally, male patients were significantly older and had a higher prevalence of obesity.

There were no reports of pre-existing OD before SARS-CoV-2 infection in the study population. However, in the OD risk assessment, 32% of the sample was identified as at risk according to the EAT-10, and 78% according to the V-VST. Swallowing was classified as functional in 52% of individuals based on the FEES. Statistical differences between sexes were found in OD risk assessed by the EAT-10, with a higher prevalence in females (Table 2).

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Table 2 – Risk Assessment and Clinical Evaluation of Swallowing in Post-COVID-19 Patients

Variables	Total (n=50)	Female (n= 26)	Male (n=24)	p-value
EAT-10, n (%)				
Dysphagia risk	16 (32)	14 (53.85)	2 (8.33)	0.001*
V-VST, n (%)				
Dysphagia risk	39 (78)	20 (76.92)	19 (79.17)	0.848
FESS, n (%)				
Normal	6 (12)	2 (7.69)	4 (16.67)	
Functional	26 (52)	14 (53.85)	12 (50)	
Mild	13 (26)	8 (30.77)	5 (20.83)	0.651
Moderate	5 (10)	2 (7.69)	3 (12.59)	

Legend: EAT-10, Eating Assessment Tool; V-VST, Volume-Viscosity Swallow Test; FEES, Fiberoptic Endoscopic Evaluation of Swallowing; n, number of patients.
Chi-square test; Fisher's exact test. *p<0.05.

Regarding nutritional status, according to Table 3, the evaluated individuals were obese and presented a risk of malnutrition. Weight loss during hospitalization was 10.03 ± 9.47 kg, being significantly higher in male patients.

Table 3 – Anthropometric Data and Mini Nutritional Assessment of Post-COVID-19 Patients

Variables	Total (n=50)	Female (n= 26)	Male (n=24)	p-value
Weight loss during Hospitalization, Kg	8 (2.87–15)[a]	5.50 (0.75 -10,50)[a]	13 (7 -20)[a]	0.010*
BMI, kg/m^2, mean±SD	33.60± 5.49	35.41 ± 5.68	31,65 ± 4,64	0.177
MNA, n (%)				
Normal	14 (28)	6 (23.08)	8 (33.33)	
Nutritional risk	28 (56)	14 (53.85)	14 (58.33)	0.331
Malnutrition	8 (16)	6 (23.08)	2 (8.33)	

Legend: Kg, Kilogram; SD, Standard deviation; BMI, Body mass index; m², Square meter; Data presented as median (IQR 25–75)[a]; MNA, Mini Nutritional Assessment; n, Number of patients. Independent t-test, *p<0.05.

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Figure 2 describes the aspects of the MNA and FEES evaluation, considering sex and the need for orotracheal intubation (IOT) in post-COVID-19 patients. It is observed that more than 80% of women at risk of malnutrition underwent IOT during hospitalization, while in men, the risk of malnutrition was higher among those who were not intubated (Figure 2a). In the FEES evaluation, moderate-degree OD was observed in non-intubated women and in intubated men (Figure 2b).
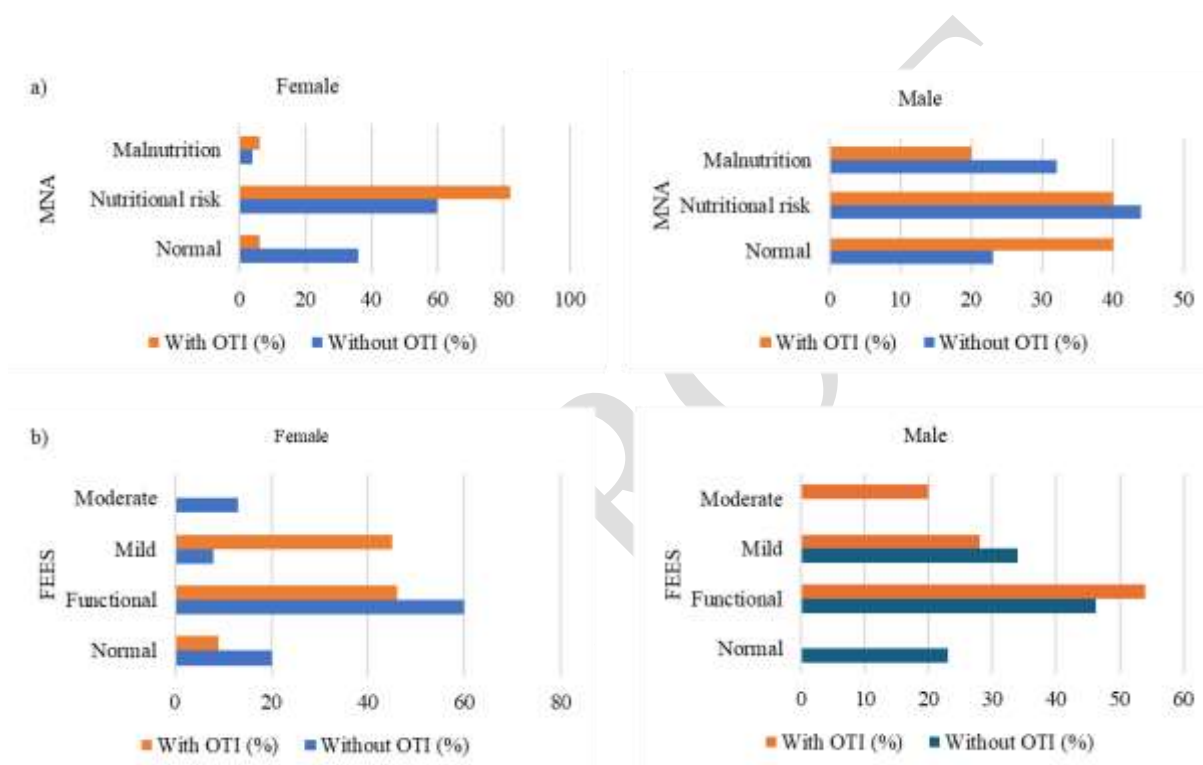

Figure 2. a) Distribution of nutritional status with and without orotracheal intubation, by sex. b) Distribution of dysphagia risk with and without orotracheal intubation, by sex.
Legend: OTI, orotracheal intubation; MNA, Mini Nutritional Assessment; FESS, Fiberoptic Endoscopic Evaluation of Swallowing

DISCUSSION

In the present study, the mean age of the evaluated patients was 53.38 years, which is lower compared to other studies in the literature, where the reported mean ages were 69.28, 63.41, and 62 years, respectively[11-13].

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Regarding sex distribution, there was a predominance of female participants, a result also observed by Martin-Martinez[10] (52.2% female population), but differing from other studies[11-12,22].

It is well known that several factors are associated with the severity and poorer prognosis of COVID-19, such as age, the presence of cardiovascular and immune system diseases, and chronic conditions like type 2 diabetes mellitus, hypertension, and obesity[2]. In the study by Shah et al.[4], researchers found that among intubated patients, the majority were male and had comorbidities such as cardiovascular disease, hypertension, or diabetes**.** In the present study, hypertension was the most prevalent comorbidity. Additionally, obesity was more common among male patients, a difference that was statistically significant.

Studies in the literature have shown that patients who developed severe COVID-19 could experience impairments in swallowing and nutritional status after hospital discharge[11-12]. Regarding swallowing assessments, a statistically significant difference was observed in the EAT-10 results between sexes. In this study, women reported more dysphagic symptoms than men, which may be related to a more accurate self-perception among women compared to men.

In the other swallowing assessments, findings suggest a high prevalence of swallowing impairments even long after hospital discharge in post-COVID-19 patients. The prevalence was higher among individuals classified as having functional swallowing compared to those with mild or moderate dysphagia. These findings align with previous studies[10-12] on oropharyngeal dysphagia and malnutrition complications in COVID-19 patients, which reported post-discharge dysphagia prevalence rates of 44.8%, 29.3%, and 27%.

The nutritional characteristics of the patients in the present study highlight its clinical relevance, suggesting that post-severe COVID-19 patients are at high nutritional risk. Although the sample, in general, reported weight loss after hospitalization, the high obesity rate is evident, aligning with other studies in the field that indicate increased post-COVID-19 complications in overweight and obese populations[23]. Abumweis et al.[24] conducted a meta-analysis investigating the association between obesity and COVID-19

severity and mortality. The authors found that the incidence and severity of infectious diseases are higher in obese individuals compared to healthy ones.

Patients who required TQT mostly exhibited both swallowing impairments and a risk of malnutrition or malnutrition after hospital discharge. These findings are consistent with the study by Tobar et al.[25], who described complications and disadvantages of TQT with repercussions on swallowing functionality. One of these complications is an increased frequency of aspiration, ranging from 43% to 60%, which appears to be associated with the presence of a TQT and an inflated cuff[26-27], resulting in swallowing function and mechanics that are comparatively inferior to those observed in individuals without this device[25].

Post-extubation dysphagia may result from laryngeal and/or oropharyngeal trauma, altered consciousness (due to pathology and/or sedation), gastroesophageal reflux, critical illness neuromyopathy, reduced pharyngolaryngeal sensitivity, discoordination between breathing and swallowing, and compression of the recurrent laryngeal nerve by the endotracheal tube cuff. These factors reduce the patient's ability to manage secretions, protect the airway, and swallow, potentially leading to silent aspiration after extubation and further increasing morbidity and mortality[7].

In this study, patients who underwent IMV and those who were not OTI exhibited swallowing alterations. This finding suggests that swallowing dysfunction may not be solely related to mechanical factors but also influenced by other variables such as length of hospitalization, age, comorbidities, or even the underlying COVID-19 disease itself[1,6,23]. Additionally, patients who experienced longer hospital stays showed a higher incidence of swallowing disorders.

Among the group of patients with swallowing alterations, a high percentage also presented malnutrition or risk of malnutrition. These findings align with the study by Martin-Martinez et al.[10], in which the studied population exhibited a high prevalence of dysphagia (51.7%) and malnutrition (45.5%) after hospital discharge. This information suggests that dysphagia, by compromising the effectiveness of food intake, can lead to a decline in nutritional status, as also identified in a recent systematic literature review[28].

Conversely, within the group of patients with malnutrition and risk of malnutrition, a high prevalence of swallowing alterations was observed. Swallowing

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muscles can be severely affected by malnutrition, as well as by inactivity or disuse. Sarcopenic dysphagia is defined as dysphagia caused by the loss of muscle strength and mass throughout the body and/or in the muscles involved in the swallowing process[29]. Several studies, including those by Li et al.[13], Bedrock et al.[14], and Rouget et al.[22], have investigated the prevalence of malnutrition in the COVID-19 population, reporting findings similar to those in this study (52.7%, 42.1%, and 37.5%, respectively).

These findings suggest that, among the post-COVID-19 patients evaluated in this study, those who were malnourished were also more likely to present swallowing alterations. Additionally, a high percentage of patients with swallowing dysfunction were found to be at risk of malnutrition or already malnourished. However, despite this clear clinical trend, no statistically significant association was observed in the statistical analysis. These results highlight the complexity of the relationship between swallowing dysfunction and nutritional status in post-COVID-19 patients, reinforcing the need for comprehensive nutritional and swallowing assessments in this population.

Studies consistently recognize dysphagia and malnutrition as significant factors associated with lower quality of life, particularly in aspects related to social interaction, sleep, burden, and mental health. Moreover, these indicators are linked to worse clinical outcomes, as affected patients may experience substantial lifestyle changes, dehydration, aspiration pneumonia, and an increased risk of morbidity and mortality[30–31].

Therefore, understanding the swallowing and nutritional profile of the patients evaluated in this study provides an important clinical reference, contributing not only to scientific advancement but also serving as a foundation for the implementation of clinical protocols and multidisciplinary interventions. This approach aims to prevent further health complications in patients experiencing post-COVID-19 sequelae.

As limitations of this study, we highlight the sample size, which is relatively small compared to the overall population affected by COVID-19, and the fact that this is a single-center study. We suggest the conduct of multicenter studies with a larger sample size, exploring additional variables such as age, comorbidities, medical examinations, and different severities of COVID-19. Furthermore, future research should incorporate other assessments, including body composition, muscle strength, and muscle quality, to

enhance nutritional diagnosis. Additionally, new studies should include a control group of patients with similar characteristics but without a history of COVID-19 infection.

CONCLUSIONS

Our findings suggest that individuals with post-COVID-19 syndrome are at risk for dysphagia and obesity, regardless of sex. Additionally, malnutrition was more prevalent among women. These results highlight the importance of timely assessment and management of swallowing and nutritional disorders to optimize rehabilitation and prevent associated sequelae.

Although the introduction of the COVID-19 vaccine has led to a reduction in long COVID manifestations, this study demonstrates a high prevalence of individuals affected by the disease's sequelae. This underscores the importance of post-COVID-19 evaluations and the need for continued research in this field.

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