The prevalence of dysphagia and changes in the quality of swallowing in patients infected with COVID-19

A prevalência de disfagia e alterações na qualidade da deglutição em pacientes infectados pela COVID-19

La prevalencia de disfagia y cambios en la deglución en pacientes infectados con COVID-19

Andréia Martins de Souza Cardoso
ORCID: https://orcid.org/0000-0003-4758-9396
Brazilian Air Force, Brazil
E-mail: andreiasouz@yahoo.com.br
Ana Clara Gonçalves de Figueiredo
ORCID: https://orcid.org/0000-0003-4154-9991
Tuiuti University of Paraná, Brazil
E-mail: figueiredo.anaclarag@gmail.com
Maria Cristina de Alencar Nunes
ORCID: https://orcid.org/0000-0001-5882-7527
Hospital of Clinics of the Federal University of Paraná, Brazil
E-mail: mcrisnunes@yahoo.com.br
José Stechman Neto
ORCID: https://orcid.org/0000-0002-0259-2420
Tuiuti University of Paraná, Brazil
E-mail: stechman1@gmail.com
Cristiano Miranda de Araújo
ORCID: https://orcid.org/0000-0003-1325-4248
Tuiuti University of Paraná, Brazil
E-mail: cristiano.araujo@utp.br
Rosane Sampaio Santos
ORCID: https://orcid.org/0000-0001-6400-5706
Tuiuti University of Paraná, Brazil
E-mail: rosane.santos2@utp.br

Abstract
Introduction: The emergence of COVID-19 has given rise to research on possible consequences on swallowing and on the quality of swallowing in individuals who were infected by SARS-CoV2. Pulmonary infections, the need for orotracheal intubation, tracheostomy, symptoms, comorbidities, and other factors caused uncertainties about the interference of these factors in the function of swallowing and in quality of life. Objective: To verify the association between the prevalence of swallowing disorders and the quality of life of patients with possible risk factors infected with COVID-19. Methods: This is an observational, analytical, cross-sectional, quantitative study. It was carried out from August to September 2020, in a Hospital in Brasília – DF, with patients hospitalized due to COVID-19 infection. 90 individuals participated in this study; they were adults and elderly with a mean age of 59.9 ± 16.09. Among participants, 55 were men (61.1%) and 35 were women (38.9%) who had a history of swallowing disorders. Data were collected through the analysis of patients' medical records, application of the EAT-10 Test, and the Quality of Life in Swallowing Disorders (SWAL-QOL) validated for Brazilian Portuguese. Results: Considering the scores obtained by the EAT-10 questionnaire, the analysis showed a statistical significance for the variables senescence and tracheostomy (p < 0.05). The analysis of the SWAL-QOL test was performed by domains and showed a statistical significance between the variables senescence, tracheostomy, ageusia, anosmia, and hyporexia. Conclusion: Elderly people infected with COVID-19 and in need of tracheostomy have a greater chance of dysphagia. In addition, factors such as senescence, tracheostomy, age and hyporexia can improve the quality of swallowing in these patients.
Keywords: Swallowing disorders; Coronavirus infections; Respiratory aspiration.

Resumo
Introdução: O surgimento da COVID-19 deu origem a pesquisas sobre possíveis consequências na deglutição e na qualidade da deglutição em indivíduos infectados pelo SARS-CoV2. Infecções pulmonares, necessidade de intubação orotraqueal, traqueostomia, sintomas, comorbidades e outros fatores causaram incertezas sobre a interferência desses fatores na função da deglutição e na qualidade de vida. Objetivo: Verificar a associação entre a prevalência de distúrbios da deglutição e a qualidade de vida de pacientes com possíveis fatores de risco infectados pela COVID-19. Métodos:

Trata-se de um estudo observacional, analítico, transversal, quantitativo. Foi realizado de agosto a setembro de 2020, em um Hospital de Brasília – DF, com pacientes internados por infecção por COVID-19. 90 indivíduos participaram deste estudo; eram adultos e idosos com média de idade de 59,9 ± 16,09. Entre os participantes, 55 eram homens (61,1%) e 35 eram mulheres (38,9%) com histórico de distúrbios da deglutição. Os dados foram coletados por meio da análise dos prontuários dos pacientes, aplicação do Teste EAT-10 e do Quality of Life in Swallowing Disorders (SWAL-QOL) validado para o português brasileiro. Resultados: Considerando os escores obtidos pelo questionário EAT-10, a análise mostrou significância estatística para as variáveis senescência e traqueostomia (p < 0,05). A análise do teste SWAL-QOL foi realizada por domínios e mostrou significância estatística entre as variáveis senescência, traqueostomia, ageusia, anosmia e hiporexia. Conclusão: Idosos infectados com COVID-19 e com necessidade de traqueostomia têm maior chance de disfagia. Além disso, fatores como senescência, traqueostomia, idade e hiporexia podem melhorar a qualidade da deglutição desses pacientes.
Palavras-chave: Distúrbios da deglutição; Infecções por coronavírus; Aspiração respiratória.

Resumen
Introducción: La aparición de la COVID-19 ha dado lugar a investigaciones sobre las posibles consecuencias sobre la deglución y sobre la calidad de la deglución en individuos infectados por SARS-CoV2. Las infecciones pulmonares, la necesidad de intubación orotraqueal, la traqueostomía, los síntomas, las comorbilidades y otros factores generaron incertidumbres sobre la interferencia de estos factores en la función de la deglución y en la calidad de vida. Objetivo: Verificar la asociación entre la prevalencia de trastornos de la deglución y la calidad de vida de pacientes con posibles factores de riesgo infectados por COVID-19. Métodos: Se trata de un estudio observacional, analítico, transversal, cuantitativo. Fue realizado de agosto a septiembre de 2020, en un Hospital de Brasilia – DF, con pacientes internados por infección de COVID-19. 90 personas participaron en este estudio; eran adultos y ancianos con una edad media de 59,9 ± 16,09. Entre los participantes, 55 eran hombres (61,1%) y 35 mujeres (38,9%) que tenían antecedentes de trastornos de la deglución. Los datos fueron recolectados a través del análisis de las historias clínicas de los pacientes, la aplicación del Test EAT-10 y el Quality of Life in Swallowing Disorders (SWAL-QOL) validado para el portugués brasileño. Resultados: Considerando los puntajes obtenidos por el cuestionario EAT-10, el análisis mostró significación estadística para las variables senescencia y traqueotomía (p < 0,05). El análisis de la prueba SWAL-QOL se realizó por dominios y mostró significación estadística entre las variables senescencia, traqueostomía, ageusia, anosmia e hiporexia. Conclusión: Los adultos mayores infectados con COVID-19 y con necesidad de traqueotomía tienen mayor probabilidad de presentar disfagia. Además, factores como la senescencia, la traqueotomía, la edad y la hiporexia pueden mejorar la calidad de la deglución en estos pacientes.
Palabras clave: Trastornos de la deglución; Infecciones por coronavirus; Aspiración respiratoria.

1. Introduction

In December 2019, the city of Wuhan, China, recorded a group of patients with an unknown cause of pneumonia. The causative pathogen was a new Coronavirus. COVID-19 quickly triggered a global health emergency alert and had spread to 46 countries by February 27, 2020 (Zhu et al., 2020; Chunget al., 2020; Wang et al., 2020; Tian et al., 2020).

Recent data have shown that the clinical severity of COVID-19 varies widely from an asymptomatic infection to death. In children, COVID-19 is usually asymptomatic or mildly symptomatic. Most immunocompetent adult patients with COVID-19 have fever, dry cough, dyspnea, hyporexia, altered smell and taste, and radiological image showing ground-glass opacity in the lungs. In severe cases, especially among the elderly and immunocompromised patients, in addition to the symptoms above, there may be other alterations, such as diarrhea, mental confusion, hepatic and renal dysfunction, lymphopenia, thrombocytopenia, inflammatory biomarkers, and ophthalmological and neurological alterations. Individuals with breathing difficulties may present changes in the coordination of breathing with swallowing, leading possibly to bronchoaspiration. Therefore, patients affected by COVID-19 are a target population for studies on dysphagia (Guan et al.,2020; Gonda et al., 2020).

Analyses of the central nervous system have shown that the COVID-19 virus can cause neurological damage when it invades the brain through the nasal route or the bloodstream. It is not yet known the degree to which these neurological changes can affect the swallowing function. In addition, hyporexia and changes in smell and taste are symptoms that may be present in such cases, causing changes in the dietary quality of life of these patients, which points to the importance of investigating the quality of life in swallowing in these subjects (Baig et al., 2020; Ohla et al., 2020; Aziz et al., 2020).

In view of the Coronavirus pandemic, many patients with acute respiratory syndrome are in need of ventilatory support through orotracheal intubation. For Coronavirus cases, hospitals are choosing to modify the standard protocol by extending the patient's time with the endotracheal tube to longer than usual. In many cases, tracheostomy is only performed after 30 days of intubation, which is otherwise not commonly done. Therefore, individuals who undergo orotracheal intubation and post-extubation tracheostomy may present dysphagia, which justifies conducting research on swallowing disorders among this population (Zareifopoulos et al., 2020; Heidler, 2019; Friche et al., 2019; Gharib et al., 2019).

The Eating Assessment Tool Test (EAT-10) is a validated instrument that monitors an individual's ability to swallow and makes it possible to measure the risk of aspiration in patients who are experiencing difficulties in swallowing after being infected with COVID-19. The Quality of Life in Swallowing Disorders (SWAL-QOL) test allows measuring the impacts of dysphagia on people's quality of life. This instrument allows elucidating the impacts on quality of life resulting from swallowing alterations in subjects who were infected by the Coronavirus (Arrese et al., 2017; Menezes, 2019; Andrade et al., 2018; Pilz et al., 2020; Sola et al., 2019).

By applying these instruments, it is possible to verify the association between the prevalence of swallowing disorders and the quality of life of patients with possible risk factors infected with COVID-19.

2. Methodology

The present study was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) initiative Von et al., 2014.

Study design

This research is an observational, analytical, cross-sectional, quantitative study.

Setting

This research was carried out through a convenience sample recruited at the Armed Forces Hospital (HFA) of patients exposed to hospitalization due to infection by COVID-19. Data collection for each participant was performed at the time of hospital discharge or at the latest five days after discharge.

This research was approved by the Ethics Committee of the Universidade Tuiuti do Paraná under opinion no. 4,323,677 and by the HFA under the substantiated opinion no. 4,400,742. The Informed Consent was presented to the research participants before analyzing the information in the patients' medical records. This project followed the Guidelines and Regulatory Norms for research involving human beings in compliance with Resolution no. 196 of October 10, 1996, of the National Health Council.

Participants
Inclusion Criteria

Adult and elderly individuals who had a diagnosis of infection by COVID-19, determined through a PCR examination, and with need for hospitalization, regardless of gender, ethnicity, or severity level, were included in this study.

Exclusion Criteria

Individuals aged < 18 years or who already had a history of swallowing disorders prior to infection by COVID-19 were excluded from the sample. In addition, individuals who do not understand simple verbal commands, individuals with a Glasgow level below 11, and an alert level below 15 minutes were also excluded.

Variables

Swallowing and quality of life assessment scores were analyzed according to the following possible confounding factors: senescence, gender, presence/absence of intubation, presence/absence of tracheostomy, level of pulmonary impairment, ageusia, hyporexia, anosmia, weight loss, oral diet or feeding through a food tube, and the presence of any comorbidity (hypertension, diabetes, obesity, cardiovascular disease, or chronic lung disease).

Data sources/measurement

Data were collected through the analysis of patients' medical records, application of the EAT-10 Test, and the Quality of Life in Swallowing Disorders (SWAL-QOL) validated for Brazilian Portuguese.

Through the analysis of the patients' medical records, data were collected on age, gender, comorbidities, symptoms, type of diet, food consistencies, intubation, tracheostomy, state of consciousness, level of pulmonary impairment, and presence or absence of swallowing difficulties.

The Eating Assessment Tool-10 (EAT-10) was used as a self-reporting questionnaire to document a specific outcome of symptoms related to the patient's own swallowing. The test consists of ten items to be evaluated with a five-point response scale, in which 0 corresponds to the absence of problems and the 4 indicates a serious problem. The maximum test score is 40. Scores equal to or greater than 3 already indicate a possible change in swallowing Florie et al., 2020.

The Quality of Life in Swallowing Disorders (SWAL-QOL), Brazilian Portuguese version, was applied in order to assess the general quality of life (QoL) and quality of life related to swallowing. The SWAL-QOL was designed to assess eight domains of QoL related to swallowing (general load, food selection, feeding duration, food craving, fear of eating, communication, social functioning, and mental health), two generic QoL concepts (fatigue and sleep), and a scale of clinical symptoms of dysphagia (symptom score). The score for each domain is calculated based on two or more questions. The domain score ranges from 0 (extremely impaired) to 100 (without impairment) Hong & Yoo, 2017; Moon et al., 2018; Mayo et al., 2019.

Bias

To reduce possible sources of bias, the variance of the questionnaire scores was determined using a linear regression model.

Study Size

The sample calculation was performed through a pilot study with a portion of the population of interest considering a value of $\alpha = 5\%$ and a test power $(1-\beta) = 80\%$. The required number was 90 individuals, taking into account a possible sample loss of 10%.

Statistical Methods

From the results obtained, a statistical analysis was performed. The association between independent variables and impacts on the change in scores of the EAT-10 questionnaires and in the domains of the SWAL-QOL questionnaire were analyzed using univariate analysis (non-parametric Mann-Whitney and Kruskal-Wallis tests). The variables that showed statistical significance in the univariate analysis ($\alpha = 5\%$) were included in a logistic regression model, estimating the odds ratio adjusted to a multivariate model with 95% confidence intervals. The assumptions of absence of multicollinearity were tested for the multivariate model. All analyses were performed using the software SPSS adopting the level of significance of 5%.

3. Results

This study considered data obtained from 90 participants, all of whom were infected with COVID-19 at different degrees of severity. The mean age of the population was 59.9 ± 16.09, of which 55 were men (61.1%) and 35 were women (38.9%). A smaller proportion of patients required intubation and tracheostomy, with a prevalence of 12.2% and 7.8%, respectively. Most individuals in the sample showed severe pulmonary impairment (>50%), with a prevalence of 47.8%. The prevalence of alterations in the EAT-10 questionnaire was 28.9% and in the quality of life assessed by the SWAL-QOL questionnaire was 67.8% (Table 1).

Table 1 - Initial characteristics of the study population.

Characteristic		n	%
	Male	45	61.6
	Female	28	38.4
Intubation			
	No	64	87.6
	Yes	9	12.4
Tracheostomy			
	No	67	91.8
	Yes	6	82.2
Diet			
	Oral	67	91.8
	Probe	6	82.2
EAT-10 questionnaire score altered (> 3)			
	No	55	75.3
	Yes	18	24.7
SWAL-QOL questionnaire score altered (<50)			
	No	27	37
	Yes	46	63
Ageusia			
	No	48	65.8
	Yes	25	34.2
Anosmia			
	No	54	74
	Yes	19	26
Hyporexia			
	No	38	52
	Yes	35	48
Weight loss			
	No	39	53.5
	Yes	34	46.5
Age (years) - Mean (SD)		58.5 (15.4)	

Source: Authors.

Considering the scores obtained by the EAT-10 questionnaire, the univariate analysis showed a statistical significance for the variables senescence, intubation, tracheostomy, and diet (p < 0.05). There was no statistical difference in EAT-10 scores for the variables gender, level of pulmonary impairment, ageusia, anosmia, hyporexia, weight loss, and presence of any comorbidity (p > 0.05). Therefore, these variables were not present in final regression model (Table 2).

Table 2 - Explanatory variable characteristics and results of comparisons by median score of EAT-10.

Explanatory variables	Category	Median (IQR)	p-value
Senescence (age)	No	1.0 (2.0)	
	Yes	2.0 (35.0)	0.007*
Sex			
	Male	2.0 (33.5)	0.639
	Female	2.0 (32.5)	
Intubation			
	No	1.0 (1.5)	< .001*
	Yes	40 (21.0)	
Pulmonary impairment			
	Mild (0-25%)	1.0 (2.0)	0.681
	Moderate (25-50%)	2.0 (32.75)	
	Severe (50% or more)	2.0 (32.0)	
Ageusia			
	No	2.0 (32.0)	0.421
	Yes	1.5 (25.3)	
Anosmia			
	No	2.0 (32.0)	0.09
	Yes	1.0 (2.0)	
Hyporexia			
	No	1.5 (24.3)	0.424
	Yes	2 (32.0)	
Tracheostomy			
	No	2 (1.0)	<.001*
	Yes	40.0 (1.0)	
Weight loss			
	No	2 (1.5)	0.355
	Yes	2 (32.5)	
Diet			
	Oral	2.0 (1.0)	<.001*
	Probe	40.0 (0.5)	
Presence of some comorbidity			
	No	2.0 (3.0)	0.456
	Yes	2.0 (32.0)	

* p <0.05. P-values for the Mann-Whitney and Kruskal-Wallis tests. Source: Authors.

The covariable diet was also absent from the final regression model due to the breaking of the multicollinearity assumption (variance inflation factor > 10). The variable intubation did not show statistical significance (p > 0.05) after fitting; there was no association between changes in EAT-10 scores and the patient being intubated. On the other hand, there was a positive association between senescence and EAT-10 scores, with a greater chance of higher scores in patients exposed to senescence [OR = 2.32; CI95% = 1.08-5.07; p = 0.032]. Exposure to tracheostomy was associated with high EAT-10 scores; there was a greater chance of higher EAT-10 scores in patients exposed to tracheostomy [OR = 23.44; CI95% = 1.96 - 343; p = 0.014] (Table 3).

Table 3 - Predictors of impact on EAT-10 scores and unadjusted/adjusted Odds ratio (95% CI).

Explanatory variables	Category	Unadjusted Odds ratio (95% CI)	p-value	Adjusted Odds ratio (95% CI)	p-value
Senescence (age)					
	Under 60 years of age	Ref.	0.007*	2.32 (1.08 - 5.07)	0.032*
	Over 60 years of age	2.63 (1.35 - 6.21)			
Intubation					
	No	Ref.	<.001*	3.36 (0.58 - 22.50)	0.181
	Yes	23.5 (6.25 - 104)			
Tracheostomy					
	No	Ref.	<0.001*	23.44 (1.96 - 343)	0.014*
	Yes	79.0 (14.1 - 684)			

* p <0.05. Source: Authors.

When considering the quality of life associated with swallowing in these patients, the univariate analysis performed by domains showed a statistical significance between the variables senescence, intubation, tracheostomy, diet, weight loss, ageusia, anosmia, and hyporexia in the different domains evaluated (p < 0.05) (Table 4).

Table 4 - Explanatory variable characteristics and results of comparisons by median score of SWAL-QOL.

Explanatory variables	Category	Burden M (IQR)	p-value	Eating desire and Eating duration M (IQR)	p-value	Symptom frequency M (IQR)	p-value	Food selection M (IQR)	p-value	Communication M (IQR)	p-value	Fear M (IQR)	p-value	Mental health M (IQR)	p-value	Social M (IQR)	p-value	Sleep and fatigue M (IQR)	p-value
Senescence (age)	No	100 (6.2)	0.016*	35 (63.8)	0.189	79.5 (32.2)	0.003*	50 (43.8)	0.05*	100 (0)	0.787	100 (0)	0.002*	100 (0)	0.004*	100 (10)	0.007*	70 (15)	0.04*
	Yes	100 (75)		22.5 (61.2)		75 (40.2)		37.5 (71.9)		100 (0)		78.1 (68.7)		87.5 (75)		75 (75)		57.5 (28.7)	
Sex	Male	100 (75)	0.579	25 (72.5)	0.848	76.8 (52.7)	0.815	50 (50)	0.213	100 (0)	0.667	100 (59.4)	0.404	100 (65)	0.624	100 (70)	0.377	65 (25)	0.651
	Female	100 (68.7)		25 (35)		76.8 (53.6)		50 (56.25)		100 (0)		100 (62.5)		100 (65)		95 (75)		70 (25)	
Intubation	No	100 (25)	0.002*	35 (67.5)	0.018*	78.6 (33.9)	0.001*	50 (50)	0.002*	100 (0)	0.544	100 (28.1)	<.001*	100 (25)	0.001*	100 (30)	0.018*	70 (25)	0.014*
	Yes	25 (37.5)		10 (30)		42.9 (26.8)		0 (25)		100 (0)		25 (43.8)		25 (42.5)		30 (52.5)		45 (5)	
Pulmonary impairment	Mild (0-25%)	100 (25)		45 (60)		78.6 (30.3)		50 (37.5)		100 (0)		100 (43.7)		100 (25)		100 (30)		70 (15)	
	Moderate (25-50%)	100 (75)	0.645	25 (82.5)	0.300	76.8 (53.6)	0.933	56.3 (68.75)	0.433	100 (0)	0.510	100 (62.5)	0.557	100 (65)	0.555	100 (75)	0.202	70 (23.7)	0.107
	Severe (50% or more)	100 (75)		20 (42.5)		76.8 (46.5)		37.5 (50)		100 (0)		100 (59.4)		100 (75)		90 (70)		55 (30)	
Ageusia	No	100 (75)	0.913	47.5 (81.2)	0.004*	76.8 (57.1)	0.499	62.5 (53.1)	0.014*	100 (0)	0.640	100 (62.5)	0.888	100 (65)	0.904	100 (71.2)	0.752	65 (25)	0.941
	Yes	100 (53.1)		20 (25)		77.7 (27.7)		37.5 (43.75)		100 (0)		100 (53.1)		100 (55)		100 (60)		70 (25)	
Anosmia	No	100 (75)	0.494	42,5 (81.3)	0.021*	76,8 (57.1)	0.907	62,5 (62.5)	0.062	100 (0)	0.888	100 (62.5)	0.510	100 (67.5)	0.487	100 (75)	0.217	60 (25)	0.311
	Yes	100 (25)		20 (25)		77,7 (12.1)		37,5 (25)		100 (0)		100 (29.7)		100 (25)		100 (28.7)		70 (15)	
Hyporexia	No	100 (62.5)	0.405	80 (72.5)	<.001*	77.7 (49.1)	0.816	75 (75)	<.001*	100 (0)	0.410	100 (57.8)	0.532	100 (55)	0.567	100 (60)	0.239	70 (25)	0.680
	Yes	100 (75)		20 (15)		76.8 (50.5)		37.5 (40.62)		100 (0)		100 (62.5)		100 (75)		95 (71.2)		60 (25)	
Tracheostomy	No	100 (25)	<.001*	35 (70)	0.008*	78.6 (33.9)	<.001*	50 (50)	<.001*	100 (0)	0.185	100 (28.1)	<.001*	100 (25)	<.001*	100 (30)	<.001*	70 (25)	0.003*
	Yes	25 (6.2)		5 (12.5)		37.5 (17)		0 (0)		100 (12.5)		25 (0)		25 (12.5)		25 (30)		45 (2.5)	
Weight loss	No	100 (25)	0.541	80 (67.5)	<.001*	78.6 (35.7)	0.395	75 (68.7)	<.001*	100 (0)	0.455	100 (43.7)	0.307	100 (25)	0.327	100 (30)	0.119	70 (20)	0.325
	Yes	100 (75)		20 (15)		76.8 (51.7)		37.5 (50)		100 (0)		100 (65.6)		100 (75)		95 (75)		60 (27.5)	
Diet	Oral	100 (25)	<.001*	35 (71.2)	0.003*	78.6 (32.2)	<.001*	50 (50)	<.001*	100 (0)	0.266	100 (25)	<.001*	100 (25)	<.001*	100 (30)	<.001*	70 (23.7)	0.002*
	Probe	25 (3.1)		5 (11.3)		40.2 (15.7)		0 (0)		100 (6.2)		25 (0)		25 (6.2)		27.5 (30)		45 (1.2)	
Presence of some comorbidity	No	100 (25)	0.801	20 (65)	0.949	76.8 (19.6)	0.942	37.5 (75)	0.488	100 (0)	0.446	100 (43.7)	0.708	100 (25)	0.719	100 (30)	0.774	70 (15)	0.535
	Yes	100 (75)		30 (65)		76.8 (57.1)		50 (50)		100 (0)		100 (62.5)		100 (75)		100 (70)		65 (25)	

* p <0.05. P-values for the Mann-Whitney and Kruskal-Wallis tests. Legends: M - Median; IQR - interquartile range. Source: Authors.

There was no association between gender, comorbidity, and level of pulmonary impairment for any of the evaluated domains (p > 0.05). After adjusting the odds ratio by the multivariate model, exposure to intubation, anosmia, and weight loss showed no association with variance in SWAL-QOL scores in the respective domains (p > 0.05) (Table 5).

Table 5 - Predictors of impact on SWAL-QOL scores and adjusted Odds ratio (95% CI).

Explanatory variables	Category	Burden Adjusted Odds ratio (95% CI)	p-value	Eating desire and eating duration Adjusted Odds ratio (95% CI)	p-value	Symptom frequency Adjusted Odds ratio (95% CI)	p-value	Food selection Adjusted Odds ratio (95% CI)	p-value	Fear Adjusted Odds ratio (95% CI)	p-value	Mental health Adjusted Odds ratio (95% CI)	p-value	Social Adjusted Odds ratio (95% CI)	p-value	Sleep and fatigue Adjusted Odds ratio (95% CI)	p-value
Senescence (age)																	
	Under 60	Ref.				Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
	Over 60	0.36 (0.14 - 0.88)	0.028*			0.35 (0.16 - 0.74)	0.007*	0.36 (0.15 - 0.82)	0.017*	0.26 (0.10 - 0.65)	0.005*	0.32 (0.12 - 0.79)	0.018*	0.34 (0.14 - 0.79)	0.014*	0.50 (0.23 - 1.07)	0.09
Intubation																	
	No	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
	Yes	1.67 (0.20 - 35.2)	0.667	0.67 (0.11 - 4.04)	0.647	0.72 (.014 - 3.64)	0.691	0.96 (0.16 - 5.08)	0.966	1.48 (0.15 - 33.2)	0.750	1.53 (0.18 - 32.7)	0.719	2.77 (0.36 - 57.6)	0.385	0.92 (0.17 - 5.19)	0.07
Tracheostomy																	
	No	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
	Yes	0.04 (0.01 - 0.45)	0.017*	0.04 (0.01 - 0.46)	0.009*	0.08 (0.01 - 0.67)	0.020*	0.02 (0.01 - 0.20)	0.009*	0.02 (0.01 - 0.20)	0.004*	0.04 (0.01 - 0.45)	0.017*	0.04 (0.01 - 0.47)	0.019*	0.17 (0.02 - 1.32)	0.923
Ageusia																	
	No			Ref.				Ref.									
	Yes			0.45 (0.13 - 1.52)	0.201			0.28 (0.10 - 0.71)	0.008*								
Hyporexia																	
	No			Ref.	0.007*			Ref.									
	Yes			0.17 (0.04 - 0.61)				0.27 (0.07 - 1.07)	0.061								
Weight loss																	
	No			Ref.	0.137			Ref.									
	Yes			0.36 (0.09 - 1.42)				0.70 (0.18 - 2.67)	0.603								
Anosmia																	
	No			Ref.	0.924												
	Yes			0.94 (0.29 - 3.03)													

* p <0.05. Source: Authors.

Exposure to senescence showed an inverse association with increased quality of life; there was a greater chance of patients exposed to senescence with lower SWAL-QOL scores in the domains of swallowing as a burden [OR = 0.36; 95% CI = 0.14 - 0.88; p = 0.028], frequency of symptoms [OR = 0.35; 95% CI = 0.16 - 0.74; p = 0.007], food selection [OR = 0.36; 95% CI = 0.15 - 0.82; p = 0.01], fear [OR = 0.26; 95% CI = 0.105 - 0.65; p = 0.005], mental health [OR = 0.32; 95% CI 0.12 - 0.79; p = 0.018], and social [OR = 0.34; 95% CI = 0.14 - 0.79; p = 0.014], with no significance only for the domain related to sleep and fatigue. In the same sense, exposure to tracheostomy was statistically significant in all quality of life domains evaluated, except for sleep and fatigue, showing an inverse association and a lower quality of life related to swallowing as the variables increased: swallowing as a burden [OR = 0.04; 95% CI = 0.01 - 0.45; p = 0.017], desire and duration of feeding [OR = 0.04; 95% CI = 0.01 - 0.46; p = 0.009], frequency of symptoms [OR = 0.08; 95% CI = 0.01 - 0.67; p = 0.020], food selection [OR = 0.02; 95% CI = 0.01 - 0.20; p = 0.009], fear [OR = 0.02; 95% CI = 0.01 - 0.20; p = 0.004], mental health [OR = 0.04; 95% CI = 0.01 - 0.45; p = 0.017], social [OR = 0.04; 95% CI = 0.01 - 0.47; p = 0.019] (Table 5). The variables ageusia and hyporexia showed statistical significance for the domains food selection [OR = 0.28; 95% CI = 0.10 - 0.71; p = 0.008] and desire and duration of feeding [OR = 0.17; 95% CI = 0.04 - 0.61; p = 0.007], respectively, with an inverse association between domain scores and covariables.

4. Discussion

Some studies have reported the information currently available on the existence of a risk for dysphagia in cases of intubation, tracheostomy, senescence, preexisting diseases, and pulmonary alterations. Furthermore, they raised the possibility of risk for dysphagia in cases of COVID-19 due to these same factors (Frajkova et al., 2020). However, this research shows no significant results between the variables gender, level of pulmonary involvement, ageusia, anosmia, hyporexia, weight loss, and presence of any comorbidity. The EAT-10 showed that these aspects are not determinant for risk dysphagia in patients who had COVID-19. On the other hand, there is a significant difference for the following variables: senescence and tracheostomy.

The existence of a significant result for the variable senescence with the EAT-10 shows that elderly individuals who were infected by COVID-19 are at a greater risk for dysphagia than adults and children are. These findings are in agreement with the studies of Applebaum et al. and Melgaard et al., who showed that aging causes changes in the oral sensorimotor system. In the elderly, there is a slowdown in the swallowing mechanism with a reduction in orofacial sensitivity, strength, and mobility of some oral structures responsible for this process (Lee, Harun, Davis, Hillel, Best, Lee & Akst, 2020; Sørensen et al., 2020).

Statistical data showed that intubation alone does not pose a greater risk for dysphagia in individuals who had COVID-19 and needed to be intubated. The variable intubation did not show statistical significance after performing the adjusted odds ratio, showing that this variable only explained variance in swallowing scores and quality of life when not associated with tracheostomy. These data show that the risk for dysphagia occurs in individuals who were intubated and later needed to be tracheostomized. The results corroborate the modification of the standard tracheostomization protocol described in the studies of Zareifopoulos et al. and Heidler, Orser and Muzlovic et al. for Coronavirus cases in hospitals. Due to the production of aerosols that may cause contamination to health professionals, in many cases tracheostomy is only performed after 30 days of intubation. This prolongs the patient's time using the endotracheal tube (Baig et al., et al., 2020; Orser, 2018; Muzlovic et al., 2018). On the other hand, a prolonged intubation may also increase the risk for dysphagia as, according to Ducan et al., intubation promotes the immobilization of the oral, pharyngeal, and laryngeal muscles of swallowing. This fact may cause atrophy of this musculature and reduced pharyngeal and laryngeal sensitivity, justifying the risk of dysphagia in these individuals (Sørensen et al., 2020). Tracheostomized individuals also had an altered quality of life. This contradicts the studies carried out by Heidler and McGrath et al., who demonstrated that tracheostomized individuals present changes in their quality of life due to the presence of dysphagia (Yanan et al., 2020; McGrath, Brenner et al., 2020). In the present study, the presence of dysphagia in the studied population and the decrease in quality of life was more associated with tracheostomy than with intubation.

The presence of a significant result for the variable tracheostomy with the EAT-10 showed that the risk for dysphagia is greater in patients undergoing tracheostomy. This result is in agreement with the research carried out by Rovira et al. and Schröder et al. on the evolution commonly found in severe cases of COVID-19. Typically, these patients require a longer period of tracheostomy to facilitate ventilation due to pulmonary impairment and respiratory distress syndrome. These patients may take time to achieve self-ventilation with a deflated cuff, which may delay the decannulation process. The presence of the tracheostomy tube reduces the excursion of the larynx in the neck and changes the path of the expiratory airflow to the stoma in the neck. This path modification causes reduced flow and reduced infraglottic pressure, justifying the risk for dysphagia in this population (Dawson et al., 2020; Marian et al., 2019_.

The results found in the SWAL-QOL test showed that senescent people showed alterations in the domains 1, 3, 4, 6, 7, and 8. Most of these individuals had complaints related to these domains, such as difficulty in dealing with the change in swallowing, presence of coughing, throat clearing, choking, and chewing difficulties, leftover food in the mouth, uncomfortable for not being able to eat everything, fear of choking, discouragement because they need to be careful when eating, and difficulty in social life due to changes in swallowing. These findings are in agreement with the studies of Fernández *et al.* (2020), who demonstrated that the elderly present a greater change in the quality of the swallowing process because they are a population with a higher incidence of dysphagia (Fernández-Ruiz et al., 2020_.

Tracheostomized individuals showed changes in the domains 1, 2, 3, 4, 6, 7, and 8. Most of these individuals had complaints related to these domains, such as difficulty in dealing with the change in swallowing, longer time needed for eating, presence of coughing, throat clearing, choking, and chewing difficulties, leftover food in the mouth, uncomfortable for not being able to eat everything, fear of choking, discouragement because they need to be careful when eating, and difficulty in social life due to changes in swallowing. These findings are in agreement with the studies of Pandian *et al.* (2021), who demonstrated that tracheostomized patients present a greater change in the quality of the swallowing process because they are also a population with a higher risk for dysphagia (Pandian et al., 2021_.

Most participants with symptoms of ageusia had changes in the item 4 of the SWAL-QOL. There was a consensus in the report that it is difficult for them to find any food they like. This result is in line with research carried out by Bagheri *et al.* (2020) and Lechien *et al.*, who demonstrated that the loss of pleasure in eating changes the quality of swallowing since the swallowing process begins in the oral phase(Bagheri et al., 2020; Lechien et al., 2020_.

Participants with symptoms of hyporexia complained that they do not care whether they ate or not, which corresponds to an alteration in the domain 2 of the SWAL-QOL. This result corroborates the study of Giacomelli *et al.* (2020), who describes that the loss of appetite changes the quality of swallowing (Giacomelli et al., 2020_.

However, some limitations should be considered: the present study is a cross-sectional study, thus it does not evaluate the temporal aspect of disease evolution, therefore reducing the certainty of the evidence. On the other hand, given the current pandemic moment, knowledge about dysphagia and its relationship with the quality of life of patients infected with COVID-19 is important for the construction of scientific knowledge on the subject.

5. Conclusion

The prevalence of swallowing disorders is higher when associated with risk factors for senescence and the presence of tracheostomy in individuals infected with COVID-19. The prevalence of alterations in the quality of the swallowing process is higher when related to risk factors for senescence, presence of tracheostomy, ageusia, and hyporexia.

References

Andrade PA, Santos CA, Firmino HH, Rosa CO. The importance of dysphagia screening and nutritional assessment in hospitalized patients. Einstein. 2018; 16(2): 1-6. DOI: 10.1590/S1679-45082018AO4189

Applebaum J et al. Characterization of geriatric dysphagia diagnoses in age-based cohorts. Oto Open. 2020; 4(3): 1-6. DOI: 10.1177/2473974X20939543

Arrese LC, Carrau R, Plowman EK. Relationship between the Eating Assessment Tool-10 and objective clinical ratings of swallowing function in individuals with head and neck câncer. Dysphagia. 2017; 32(1): 83-89. DOI: 10.1007/s00455-016-9741-7

Aziz M, Perisetti A, Lee-Smith WM, Gajendran M, Bansal P, Goyal H. Taste changes (dysgeusia) in COVID-19: a systematic review and metaanalysis. Gastroenterology. 2020; 159(3):1132-1133. DOI:10.1053/j.gastro.2020.05.003

Bagheri SHR, Asghari AM, Farhadi M, Shamshiri AR, Kabir A, Kamrava SK, Jalessi M, Mohebbi A, Alizadeh R, Honarmand AA et al. Coincidence of COVID-19 epidemic and olfactory dysfunction outbreak. Med J Islam Repub Iran. 2020; 34(62): 1-7. DOI: 10.34171/mjiri.34.62

Baig AM, Khaleeq A, Ali U, Syeda H. Evidence of the covid-19 virus targeting the cns: Tissue distribution, host–virus interaction, and proposed neurotropic mechanisms. ACS Chemical Neuroscience. 2020; 11(7): 995-998. DOI: 10.1021/acschemneuro.0c00122

Chen X, Liu S, Zhang C, Pu G; Sun J; Shen J, Chen Y. Dynamic chest ct evaluation in three cases of 2019 novel coronavirus pneumonia. Arch Iran Med. 2020; 23(4):277-280. DOI: 10.34172/aim.2020.11

Chung M, Bernheim A, Mei X, Zhang N, Huang M, Zeng X et al. CT imaging features of 2019 novel coronavirus. Radiology. 2020; 295(1):202-207. doi: https://doi.org/10.1148/radiol.2020200230

David D, Gonda MD, Meng H et al. Protecting Against Postoperative Dyspnea and Dysphagia After Occipitocervical Fusion. Operative Neurosurgery. 2020; 3(18): 254-269. DOI: 10.1093/ons/opz122

Fernández-Ruiz VE, Paredes-Ibáñez R, Armero-Barranco D, Sánchez-Romera JF, Ferrer M. Analysis of quality of life and nutritional status in elderly patients with dysphagia in order to prevent hospital admissions in a COVID-19 pandemic. Life (Basel). 2020; 11(1): 22. DOI: 10.3390/life11010022

Florie M, Pilz W, Kremer B, Verhees F, Waltman G, Winkens B, Winter N, Baijens L. EAT-10 scores and fiberoptic endoscopic evaluation of swallowing in head and neck cancer patients. Laryngoscope. 2021; 131(1): E45-E51. DOI: 10.1002/lary.28626. Epub 2020 Apr 4. PMID: 32246779; PMCID: PMC7754346.

Frajkova Z, Tedla M, Tedlova E, Suchankova. Postintubation dysphagia during COVID-19 outbreak-contemporary review. Dysphagia. 2020; 35(4):549-557. DOI: 10.1007/s00455-020-10139-6. Epub 2020 May 28. PMID: 32468193; PMCID: PMC7255443.

Gharib AZ, Felix GB, Rossoni DF, Yamada SS. Effectiveness of therapy on post-extubation dysphagia: clinical and electromyographic findings. Clin Med Insights Ear Nose Throat. 2019; 12:1-6. DOI:10.1177/1179550619873364

Giacomelli A, Pezzati L, Conti F et al. Self-reported olfactory and taste disorders in SARS-CoV-2 patients: a cross-sectional study. Clin Infect Dis. 2020; 71(15): 889-890. DOI: 10.1093/cid/ciaa330

Guan WJ, Ni ZY, Hu Y et al. Clinical Characteristics of Coronavirus Disease 2019 in China. N Engl J Med. 2020; 80(6): 656–665. DOI: 10.1056/NEJMoa2002032

Heidler MD. Dysphagie bei tracheotomierten patienten nach langzeitbeatmung. Anasthesiol Intensivmed Notfallmed Schmerzther. 2019; 54(3):218-222. DOI: 10.1055/a-0769-6551

Hong D, Yoo D. A comparison of the swallowing function and quality of life by oral intake level in stroke patients with dysphagia. J Phys Ther Sci. 2017; 29(9): 1552-4. DOI: 10.1589/jpts.29.1552

Lechien JR, Chiesa-Estomba CM, De Siati DR et al. Olfactory and gustatory dysfunctions as a clinical presentation of mild-tomoderate forms of the coronavirus disease (COVID-19): a multicenter European study. Eur Arch Otorhinolaryngol. 2020; 277(8): 2251-2261. DOI: 10.1007/s00405-020-05965-1

Li Y, Wang M, Zhou Y, Chang J, Xian Y, Mao L et al. Acute cerebrovascular disease following COVID-19: a single center, retrospective, observational study. Stroke Vasc Neurol. 2020; 5(3): 279-284. DOI: 10.1136/svn-2020-000431

Liaw M. Y. et al. Respiratory muscle training in stroke patients with respiratory muscle weakness, dysphagia, and dysarthria - a prospective randomized trial. Medicine (Baltimore). 2020; 99(10): e19337. DOI: 10.1097/MD.0000000000019337

Mayo, B. C., Massel, D. H., Bohl, D. D. et al. Dysphagia following anterior cervical spine surgery: assessment using an abridged SWAL-QOL. Int J Spine Surg. 2019; 13(1): 102-109. DOI:10.14444/6014

McGrath, B. A., Brenner, M.J, Warrillow SJ et al. Tracheostomy in the COVID-19 era: global and multidisciplinary guidance. Lancet Respir Med. 2020; 8(7): 717-725. DOI:10.1016/S2213-2600(20)30230-7

Melgaard D et al. Systematic dysphagia screening of elderly persons in the emergency department - a feasibility study. Geriatrics. 2020; 5(4): 75. DOI: 10.3390/geriatrics5040075

Menezes, E. C. Disphagia in the elderly in long-stay institutions – a systematic literature review. CEFAC. 2019. DOI: https://doi.org/10.1590/1982-0216/201921116418re

Moein, S. T, Hashemian, S. M. R., Mansourafshar B., Khorram-Tousi, A., Tabarsi, P., Doty, R. L.. Smell dysfunction: a biomarker for COVID-19. Int Forum Allergy Rhinol. 2020; 10(8):944-950. DOI: 10.1002/alr.22587

Moon J, Hahm S, Won Y, Cho H. The effects of tongue pressure strength and accuracy training on tongue pressure strength, swallowing function, and quality of life in subacute stroke patients with dysphagia: a preliminary randomized clinical trial. Int J Rehabil Res. 2018; 41(3): 204-10. DOI: 10.1097/MRR.0000000000000282

Muzlovic I, Perme J, Stubljar D. Orotracheal tube as a risk factor for lower respiratory tract infection: preliminary data from a randomised trial. Wien. Klin. Wochenschr. 2018;130(9–10): 328–334. DOI: 10.1007/s00508-017-1304-x

Oliveira, A. C. Friche, A. A., Salomão, M. S., Bougo, G. C.; Vicente, L. C. Predictive factors for oropharyngeal dysphagia after prolonged orotracheal intubation. Braz J Otorhinolaryngol. 2018; 84(6): 722-8. doi: https://doi.org/10.1016/j.bjorl.2017.08.010

Orser, B. A. Recommendations for endotracheal intubation of COVID-19 patients. Anesth Analg. 2020;130(5):1109-1110. DOI:10.1213/ANE.0000000000004803

Pandian V, Brodsky MB, Brigham EP, Parker AM, Hillel AT, Levy JM, Rassekh CH, Lalwani AK, Needham DM, Brenner MJ. COVID-19 survivorship: how otolaryngologist-head and neck surgeons can restore quality of life after critical illness. Am J Otolaryngol. 2021; 42(3): 102917. DOI: 10.1016/j.amjoto.2021.102917

Parma, V., Ohla, K., Veldhuizen, M. G. et al. More than smell - COVID-19 is associated with severe impairment of smell, taste, and chemesthesis. Chem Senses. 2020; 45(7):609-622. doi: 10.1093/chemse/bjaa041

Pilz W, Passos VL et al. Swallow-related quality of life and oropharyngeal dysphagia in myotonic dystrophy. European Archives of Oto-Rhino-Laryngology. 2020; 277:2357–2362. DOI: https://doi.org/10.1007/s00405-020-05964-2

Rovira A et al. Tracheostomy care and decannulation during the COVID-19 pandemic. A multidisciplinary clinical practice guideline. Eur Arch Otorhinolaryngol. 2020; 278(2): 313-312. DOI: 10.1007/s00405-020-06126-0

Schröder J et al. Intubation, tracheostomy, and decannulation in patients with Guillain-Barré-syndrome-does dysphagia matter? Muscle Nerve. 2019; 59(2): 194-200. DOI: 10.1002/mus.26377

Sola, A. G., Soler, N. B., Marco, E et al. Effects of prophylactic swallowing exercises on dysphagia and quality of life in patients with head and neck cancer receiving (chemo) radiotherapy: the redyor study, a protocol for a randomized clinical trial. Trials. 2019; 20(1): 1-7. DOI: 10.1186/s13063-019-3587-x

Tian S, Hu N, Lou J et al. Characteristics of COVID-19 infection in Beijing. J Infect. 2020; 80(4): 401-406. DOI: 10.1016/j.jinf.2020.02.018

Von E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP; STROBE Initiative. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. Int J Surg. 2014; 12(12):1495-9. DOI: 10.1016/j.ijsu.2014.07.013. Epub 2014 Jul 18. PMID: 25046131.

Wang, D., Hu, B, Hu C, Zhu F, Liu X, Zhang J et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA. 2020; 323(11): 1061–1069. DOI: 10.1001/jama.2020.1585

Zareifopoulos N, Lagadinou M, Karela A, Karantzogiannis G, Velissaris D. Intubation and mechanical ventilation of patients with COVID-19: what should we tell them? Monaldi Arch Chest Dis. 2020; 90(1): 191-192. DOI: 10.4081/monaldi.2020.1296

Zhou, Peng; Yang, Xing-Lou; Wang, Xian-Guang; Hu, Ben; Zhang, Lei; Zhang, Wei; Si, Hao-Rui; Zhu, Yan; Li, Bei; Huang, Chao-Lin; Chen, Hui-Dong; Chen, Jing; Luo, Yun; Guo, Hua; Jiang, Ren-Di; Liu, Mei-Qin; Chen, Ying; Shen, Xu-Rui; Wang, Xi; Zheng, Xiao-Shuang; Zhao, Kai; Chen, Quan-Jiao; Deng, Fei; Liu, Lin-Lin; Yan, Bing; Zhan, Fa-Xian; Wang, Yan-Yi; Xiao, Geng-Fu; Shi, Zheng-Li. A pneumonia outbreak associated with a new coronavirus of probable bat origin. Nature. 2020; 579(7798): 270–273. DOI: 10.1038/s41586-020-2012-7

Zhu, Zhang, Wang, Li, Yang, Song, Zhao, Huang, Shi, Lu, Niu, Zhan, Ma, Wang, Xu, Wu, F. Gao, D.Phil., & Tan. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med. 2020; 382(8):727-733. DOI: 10.1056/NEJMoa2001017