REVISTA CIÊNCIAS EM SAÚDE
HEALTH SCIENCES JOURNAL e-ISSN 2236-3785

ORIGINAL ARTICLE

Relationship between nutritional status, lifestyle, and prognosis in patients diagnosed with COVID-19 hospitalized in the state of Pernambuco

Relação entre estado nutricional, hábitos de vida e prognóstico em pacientes diagnosticados com COVID-19 hospitalizados no estado de Pernambuco

Maria Bárbara Galdino Silva[1,*], Cláudia Porto Sabino Pino[1], João de Araújo Barros Neto[2], Marina de Moraes Vasconcelos Petribú[3], Keila Fernandes Dourado[3], Regiane Maio[1]

[1]*Nutrition Residency Program, Department of Nutrition, Hospital das Clínicas, Federal University of Pernambuco (HC-UFPE). Recife, Pernambuco, Brazil.*
[2]*Faculty of Nutrition (FANUT), Federal University of Alagoas (UFAL). Maceio, Alagoas, Brazil.*
[3]*Federal University of Pernambuco, Vitória Academic Center (UFPE-CAV). Vitoria de Santo Antao, Pernambuco, Brazil.*

Received 6 Apr 2022, accepted 24 Sep 2022, published 9 Dec 2022.

KEYWORDS

Coronavirus infections
Life style
Nutritional status
Prognosis
SARS-CoV-2 infection

ABSTRACT

Objective: To analyze the relationship between nutritional status and lifestyle habits and the prognosis of hospitalized patients with COVID-19 in Pernambuco.
Methods: Multicenter, cross-sectional study, associated with prospective analysis variables, involving patients with COVID-19 and admitted to 8 hospitals. Individuals aged ≥ 18 years of both sexes, hospitalized from June 2020 to June 2021, were included. Socioeconomic, clinical, anthropometric, lifestyle and prognostic variables were collected.
Results: The sample consisted of 263 individuals with a mean age of 62.9 ± 16.6 years and homogeneous distribution between genders. It was observed that 8.2% were smokers, 20.9% reported alcohol consumption, and 80.1% were sedentary. The anthropometric profile indicated that 49.5% were overweight and 7.0% were underweight. Malnutrition and excess weight were associated with more extended hospital stays (66.7% weight loss and 64.5% weight gain vs. 30.0% eutrophy; p = 0.021), smoking with death (tab 65 .0% vs. non-tab 33.7%; p = 0.006) and need for admission to the intensive care unit (yes 64.3%, no 31.5%; p = 0.014). The frequency of dyspnea was higher in patients who reported drinking alcohol (yes 69.6% vs. no 48.1%; p = 0.007). Physical activity was not associated with any prognostic factor.
Conclusion: Nutritional extremes and bad lifestyle habits, such as smoking and alcohol consumption, are risk factors for a poor prognosis in individuals with COVID-19.

*Corresponding author:
Serviço de Nutrição, Hospital das Clínicas – Universidade Federal de Pernambuco.
Addr.: Av. Moraes Rego, 1235 - Cidade Universitária. Recife, PE, Brasil | CEP: 50.670-901
E-mail: barbaragaldiino@gmail.com (Silva MBG)

This study was conducted at the Hospital das Clínicas of the Federal University of Pernambuco.

https://doi.org/10.21876/rcshci.v12i4.1296

How to cite this article: Silva MBG, Pino CPS, Barros Neto JA, Pertibú MMV, Dourado KF, Maio R. Relationship between nutritional status, lifestyle and prognosis in patients diagnosed with COVID-19 hospitalized in the state of Pernambuco. Rev Cienc Saude. 2022;12(2):19-27. https://doi.org/10.21876/rcshci.v12i4.1296

PALAVRAS-CHAVE

Estado nutricional
Estilo de vida
Infecção por SARS-CoV-2
Infecções por coronavírus
Prognóstico

RESUMO

Objetivo: Analisar a relação entre estado nutricional e hábitos de vida com o prognóstico de pacientes hospitalizados com COVID-19 acompanhados no estado de Pernambuco.
Métodos: Estudo multicêntrico, transversal, acoplado a variáveis de análise prospectiva, envolvendo pacientes com COVID-19 e internados em 8 hospitais. Foram incluídos indivíduos com idade ≥ 18 anos, de ambos os sexos, hospitalizados no período de junho de 2020 a junho de 2021. Foram coletados dados socioeconômicos, clínicos, antropométricos, hábitos de vida e variáveis prognósticas.
Resultados: A amostra foi composta por 263 indivíduos com média de idade de 62,9 ± 16,6 anos e distribuição homogênea entre os sexos. Observou-se que 8,2% eram tabagistas, 20,9% referiram o consumo de álcool e que 80,1% eram sedentários. O perfil antropométrico apontou 49,5% de excesso de peso e 7,0% de baixo peso. A desnutrição e o excesso de peso foram associados a um maior tempo de internamento (desn. 66,7% e exc. peso 64,5% vs. eutrofia 30,0%; p = 0,021), o tabagismo com óbito (tab 65,0% vs. não-tab 33,7%; p = 0,006) e necessidade de internação em Unidade de Terapia Intensiva (sim 64,3%, não 31,5%; p = 0,014). A frequência de dispneia foi superior nos pacientes que referiram o consumo de bebidas alcoólicas (sim 69,6% vs. não 48,1%; p = 0,007). A atividade física não se associou a nenhum fator prognóstico.
Conclusão: Os extremos nutricionais e hábitos de vida inadequados, como o tabagismo e o consumo de álcool, constituem fatores de risco para um mau prognóstico em indivíduos com COVID-19.

INTRODUCTION

The world is experiencing the COVID-19 pandemic, caused by a new coronavirus infection (SARS-CoV-2). By mid-November 17, 2021, there were already 253,640,693 infected individuals and more than 5,104,889 deaths. In Brazil, simultaneously, there were 21,957,967 confirmed cases and 611,283 deaths[1].

The virus structure is composed of a genome and four structural proteins, among them the spike protein (S), which acts on the entry of the virus into the host cells[2]. SARS-CoV-2 infection occurs through the union of this protein, present on the surface of the virus, with the Angiotensin-Converting Enzyme 2 (ACE2), which will act as a receptor and gateway of this microorganism into the cell, thus facilitating the process of dissemination and intracellular involvement, as ACE2 is present in various organs, such as the lungs, heart, kidneys, intestine and blood vessels[3].

Some factors have been studied as poor prognostic factors in SARS-CoV-2 infection, including nutritional deviations and inadequate life habits[4]. The nutritional component is essential in the infectious process and in the recovery time of patients diagnosed with COVID-19, and the hepatic and gastrointestinal involvement during this process may contribute to the compromise of the distribution and mobilization of nutrients, mainly proteins[5-6].

Among the behavioral habits, the consumption of tobacco, alcohol, and physical inactivity should be highlighted. The social isolation contributed to a decrease in physical activity practice, favoring the adoption of behaviors that are barriers to health promotion strategies by increasing sedentary lifestyle and inadequate food intake, leading to physical and metabolic changes in the individual associated with depression, anxiety, and stress[7]. Smoking and alcohol intake predispose the development of severe symptoms during the infection since they increase the expression of ACE2 and lead to neuroendocrine changes, in addition to organic lesions and the production of reactive oxygen species[7,8].

The importance of attention to nutritional care and lifestyle habits is highlighted, aiming at better clinical outcomes. Therefore, this investigation tests the hypothesis that extremes of body mass index (BMI) and bad lifestyle habits, such as smoking, physical inactivity, and alcohol consumption, are related to a worse prognosis in hospitalized patients diagnosed with COVID-19.

METHODS

This is a multicenter, cross-sectional study that presents prospective analysis variables (complications and outcome) involving individuals diagnosed with COVID-19, of both sexes, aged ≥ 18 years, admitted to wards and intensive care units of 8 hospitals in the State of Pernambuco, from June 2020 to June 2021.

This study is a research subproject entitled "Clinical, nutritional and sociodemographic aspects associated with mortality in patients with COVID-19: a multicenter study in northeastern Brazil", with a Coordinating Center based in the city of Maceió, at the Federal University of Alagoas. All Northeastern states were included and had their collaborating coordinators.

For this investigation, data from the State of Pernambuco were considered, which involved 8 partner health units: Hospital da Restauração Governador Paulo Guerra, Pronto-Socorro Cardiológico Universitário de Pernambuco Professor Luíz Tavares (PROCAPE), Hospital do Servidores do Estado (HSE), Dom Moura Regional Hospital, Miguel Arraes Hospital, UFPE Clinics Hospital, Barão de Lucena Hospital and Provisional Hospital of Recife/Aurora.

Patients diagnosed with COVID-19, diagnosed by laboratory tests, admitted to the study were identified by professionals from the services of each hospital. After identification, the health professionals who made up the team in each institution informed the Coordinating Center, which contacted the patient or responsible family member by telephone to explain the study, invited them to the research and, after their agreement by telephone, the online form for consent and assent (when necessary) was sent. The team at each institution was trained in the investigation protocol and the data collection instruments.

Individuals with a confirmed test for COVID-19 infection by the RT-PCR molecular test through naso-oropharyngeal secretion swab or laboratory serology were included. Individuals with symptoms but without confirmation through exams, pregnant women, postpartum women, and children were excluded.

The sample size was determined considering an alpha error of 5%, a beta error of 20%, and a correlation between the Body Mass Index (BMI) and the length of hospital stay of 0.3 (p) (obtained in a pilot study with the first 30 patients admitted to the study) and a variability of 0.12 (d^2), with an estimated minimum sample size of 115 individuals. The sample was obtained by convenience, considering the subsequent hospitalizations among the patients eligible for the study.

To assess nutritional status, data were collected at the hospital admission and determined by the BMI, considering the measures taken, reported or estimated measurements of current weight (kg) and height (m). When the patient did not have the physiological conditions to respond to them (unconsciousness, sedation, intubation, etc.), the report of family members or the silhouette scale method, through which the body image of the individual was observed, and the corresponding figure was selected, was considered, thus verifying the BMI and average weight[9]. The BMI classification considered the cutoff points proposed by the World Health Organization[10] for adults and Lipshitz[11] for the elderly.

The analysis of life habits included the consumption of alcohol, smoking habits, and physical activity collected during the first contact with the patient during recruitment or through an interview with a family member. All those who reported using alcoholic beverages, although rarely (<1 time/month), were considered consumers of alcohol. Regarding smoking, those who reported such practice were classified as smokers, regardless of the frequency. Concerning the physical activity, individuals who reported practicing moderate-intensity aerobic activity for at least 30 min/day for 5 days a week or intense activities for at least 20 min/day, 3 times a week, were considered physically active, following the American College of Sports Medicine and American Heart Association criteria[12].

As prognostic variables, the following were considered: symptom intensity, presence of dyspnea, secondary infection, hemodynamic condition (stability or instability defined from the record in the medical record and considering the clinical criteria of the attending physician), need for vasoactive drugs (VAD), need for mechanical ventilation, type of hospitalization (clinical ward or intensive care unit), length of stay and clinical outcome (discharge or death), collected through the patient's medical record.

The intensity of symptoms was verified by the presence of diarrhea, nausea, vomiting, fever, sore throat, arthralgia, fatigue, myalgia, headache, cough, sputum production, runny nose, tiredness, shortness of breath, loss of taste, smell or appetite, and classified as mild, moderate or severe. "Mild symptoms" were defined as individuals who did not present tiredness, had a low-grade fever, or no fever, with or without cough. "Moderate symptoms" were considered when the symptoms were tolerable, such as slight shortness of breath, and fever higher than 38 °C, with or without cough. "Severe symptoms" were established when there was a more significant impairment of health status, with signs and symptoms of high or very high fever, severe headache, muscle pain, intense shortness of breath and tiredness, without walking, and the need for oxygen therapy or be referred to the ICU when the patient was admitted to the emergency room.

The sociodemographic covariates were gender, age, marital status (with and without a partner), skin color (self-reported), education (in years of study, categorized as ≤9 years and >9 years), monthly household income *per capita* (based on the median income of the population) and presence of comorbidities, collected in the first contact with the patient during recruitment or an interview with a family member.

The study was approved by the Research Ethics Committees (REC) at the Coordinating Center and collaborating centers. This subproject, which evaluated only hospitals in the State of Pernambuco, was also approved by the Ethics and Research Committee of the Clinical Hospital of Pernambuco under decision nr 5.007.695/2021 (CAAE 50967221.0.0000.8807). The study protocol followed ethical precepts following Resolution No. 466/12 of the National Health Council/Ministry of Health.

Patients signed the Free and Informed Consent Form (FICF) using digital tools as a matter of health safety, minimizing physical contact between researchers and patients. When patients were not in a clinical condition to express consent for their participation, their guardians or family members were contacted to sign the Free and Informed Assent Term (FIAT). Exemption from obtaining the FICF and FIAT was requested for patients who died before being admitted to the study, and in this case, all data were collected from the clinical record.

Data were analyzed using SPSS software, version 13.0 (SPSS Inc., Chicago, IL, USA). Pearson's chi-square or Fisher's exact test was used to test the relationship between nutritional status and lifestyle variables with prognostic variables. Statistical significance was considered at $p < 0.05$.

RESULTS

The total sample consisted of 263 patients, and their characterization is described in Table 1. The mean age was 62.9 ± 16.6 years, and males corresponded to 52.1%. 57.9% reported having a partner, and 57.4% had ≤ 9 years of schooling. SAH, DM, and CVD prevalence were 64.4%, 37.7%, and 28.3%, respectively.

Regarding life habits, 8.2% were smokers, 20.9% reported alcohol consumption, and 80.1% were sedentary. The anthropometric profile showed 49.5% overweight and 7.0% underweight (Table 1).

It was observed that 59.8% of the patients exhibited moderate intensity, and 19.6% had severe symptoms. More than half (51.8%) of the patients had dyspnea, 11.4% had haemodynamic instability, and 9.2% used VAD. The need for invasive or non-invasive mechanical ventilation occurred in 42.3%. It was also evidenced that 34.7% of the patients were hospitalized in Intensive Care Units (ICUs), and 38.6% died (Table 2).

Tables 1 — Demographic, clinical, nutritional characteristics, and lifestyle of hospitalized COVID-19-infected patients.

Variable	n	%
Sex	263	
Female	126	47.9
Male	137	52.1
Age group	262	
Adult	111	42.4
Elderly	151	57.6
Skin color	247	
White	58	23.5
Brown	176	71.3
Black	13	5.3
Marital status	252	
With partner	146	57.9
No partner	106	42.1
Schooling (years of study)	237	
≤ 9	136	57.4
> 9	101	42.6
Per capita Family income (R$)	218	
< 300.00	142	65.1
≥ 300.00	76	34.9
Systemic Arterial Hypertension	261	
No	93	35.6
Yes	168	64.4
Diabetes Mellitus	260	
No	162	62.3
Yes	98	37.7
Cardiovascular disease	258	
No	185	71.7
Yes	73	28.3
Smoking	257	
No	236	91.8
Yes	21	8.2
Alcohol consumption	258	
No	204	79.1
Yes	54	20.9
Physical activity	236	
No	189	80.1
Yes	47	19.9
Nutritional status (BMI)	115	
Low weight	8	7.0
Eutrophy	50	43.5
Overweight	57	49.5

BMI: Body mass index.

The analysis of the association between prognostic factors and nutritional status showed that the length of hospital stay ≥ 12 days was twice as long among underweight and overweight individuals compared to eutrophic patients (malnutrition 66.7% vs. weight 64.5% vs. eutrophy 30.0%; p = 0.021) (Table 3).

Smoking was associated with death (smoking 65.0% vs. non-smoking 33.7%; p = 0.006) and the need for admission to the intensive care unit (yes 64.3% vs. no 31.5%; p = 0.014) (Table 4). The frequency of dyspnea was 40% higher in patients who reported alcohol consumption (yes 69.6% vs. no 48.1%; p = 0.007), the only variable associated with alcohol consumption (Table 4). Physical activity, in turn, was not associated with any prognostic factor (Table 4).

Table 2 — Prognostic variables in hospitalized COVID-19-infected patients

Variable	n	%
Intensity of symptoms	204	
Mild	42	20.6
Moderate	122	59.8
Severe	40	19.6
Dyspnea	237	
No	114	48.1
Yes	123	51.8
Secondary infection	207	
No	198	95.7
Yes	9	4.3
Hemodynamic	245	
Stability	217	88.6
Instability	28	11.4
Vasoactive drug use	239	
No	217	88.6
Yes	22	9.2
Ventilation	234	
Spontaneous	135	57.7
Mechanics (I/NI)	99	42.3
Type of hospitalization	150	
Clinical ward	98	65.3
ICU	52	34.7
Length of stay (days)	155	
< 12	93	60.0
≥ 12	62	40.0
Outcome clinical	210	
Discharge	129	61.4
Death	81	38.6

I - Invasive; NI - No-invasive; ICU - Intensive care unit.

DISCUSSION

Our results showed a high prevalence of overweight, approximately 50%, while malnutrition affected 7.0% of the sample. Similar results were found by Simonnet et al.[13] in a retrospective cohort of patients diagnosed with COVID-19 in France, where 75% of the population was identified as overweight.

Similarly, Hamer et al.[14], in a population-based cohort with a mean age of 54 years, observed that 66% of the population studied was overweight, and there was a linear increase in the risk of COVID-19 with an increase in BMI.

Table 3 — Association between nutritional status and prognostic variables in hospitalized COVID-19 infected patients. Values in n(%).

Variable	Nutritional Status			p-value*
	Low weight	Eutrophy	Overweight	
Intensity of symptoms (n = 109)				0.529
Mild	2(28.6)	13(27.6)	15(27.3)	
Moderate	5(71.4)	27(57.4)	27(49.1)	
Severe	0(0)	7(14.9)	13(23.6)	
Dyspnea (n = 113)				0.135
No	4(50.0)	27(56.3)	21(36.8)	
Yes	4(50.0)	21(43.7)	36(63.2)	
Secondary infection (n = 84)				0.292
No	5(100.0)	35(89.8)	39(97.5)	
Yes	0(0)	4(10.2)	1(2.5)	
Hemodynamic (n = 105)				0.324
Stability	7(100.0)	43(95.6)	47(88.7)	
Instability	0(0)	2(4.4)	6(11.3)	
Vasoactive drug use (n = 95)				0.699
No	5(100.0)	40(95.2)	47(97.9)	
Yes	0(0)	2(4.8)	1(2.1)	
Mechanic (n = 103)				0.396
Spontaneous	5(71.4)	34(75.6)	32(62.8)	
Mechanic (I/NI)	2(28.6)	11(24.4)	19(37.2)	
Type of hospitalization (n = 67)				0.066
Clinical ward	2(50.0)	28(90.3)	23(71.9)	
ICU	2(50.0)	3(9.7)	9(28.1)	
Length of stay (n = 64)				**0.021**
< 12 days	1(33.3)	21(70.0)	11(35.5)	
≥ 12 days	2(66.7)	9(30.0)	20(64.5)	
Clinical outcome (n = 88)				0.372
Discharge	3(60.0)	32(84.2)	38(84.4)	
Death	2(40.0)	6(15.8)	7(15.5)	

I - Invasive; NI - No-invasive; ICU - Intensive care unit. * Pearson's Chi-Square or Fisher's Exact Test.

Regarding malnutrition, a cross-sectional study by Li et al.[15] showed that the prevalence in elderly patients with SARS-CoV-2 infection, using the Mini Nutritional Assessment (MNA), corresponded to approximately 53%.

Alternatively, corroborating our findings, Pironi et al.[16], in a study conducted in Italy in April 2020, observed a prevalence of underweight in 9.3% of the individuals. These data differed between the intensity of care environments (intermediate care units, sub-intensive care, intensive care, and rehabilitation). The burden of disease, inflammation, decreased food intake, stage, and severity of the infection may be the central factors for this malnutrition process.

The association of nutritional extremes with worse prognosis was observed in other investigations[17,18]. Our results also showed that malnourished and overweight patients predominantly had a hospital stay of greater than or equal to 12 days. In eutrophic patients, in turn, a hospital stay of fewer than 12 days predominated. A single-center cohort conducted in Italy by Moriconi et al.[19], with patients with COVID-19, showed that obese individuals had a longer hospitalization time compared with non-obese individuals (mean 21 days vs. 13 days, respectively), and these results were related to the intensity of the inflammatory process.

Al-Salamehet et al.[20], in a study with individuals diagnosed with SARS-Cov-2 and hospitalized in France, revealed a higher probability of ICU admissions and death in overweight/obese patients. Cordova et al.[21,] in a multicenter study with adults and elderly individuals with a mean age of 53 years, concluded that obesity is one of the main risk factors for complications and unfavorable clinical outcomes; among them, more prolonged hospitalizations in ICUs.

Some mechanisms have been postulated to explain this relationship. Chronic inflammation resulting from excess adipose tissue can lead to metabolic changes, intensify the progress of some associated pathologies, modify immune responses, with a decrease in cells with an antiviral role, and favor the process of intestinal dysbiosis, further compromising the regulation of host's organic defenses and contributing negatively to the progress of infections[22].

Similar to our study, Nicolau et al.[18] also reported more extended hospital stays and more frequent ICU

Table 4 **—** Association between prognosis and lifestyle in hospitalized patients infected with COVID-19. Values in n(%).

Variable	Consumption of Alcoholic Beverages		p-value*	Smoking		p-value*	Physical Activity		p-value*
	No	Yes		No	Yes		No	Yes	
Intensity of symptoms			0.578			0.061			0.355
Mild	34(21.6)	8(18.6)		41(21.8)	1(7.1)		30(19.1)	12(29.3)	
Moderate	94(59.9)	24(55.8)		113(60.1)	7(50.0)		95(60.5)	21(51.2)	
Severe	29(18.5)	11(25.6)		34(18.1)	6(42.9)		32(20.4)	8(19.5)	
Dyspnea			**0.007**			0.937			0.090
No	97(51.9)	14(30.4)		105(47.7)	7(46.7)		92(50.0)	17(36.2)	
Yes	90(48.1)	32(69.6)		115(52.3)	8(53.3)		92(50.0)	30(63.8)	
Secondary infection			0.174			0.170			0.609
No	155(95.1)	39(100.0)		177(96.2)	15(88.2)		141(96.0)	33(97.1)	
Yes	8(4.9)	0(0)		7(3.8)	2(11.8)		6(4.0)	1(2.9)	
Hemodynamics			0.068			0.744			0.435
Stability	174(90.2)	38(80.9)		192(88.1)	19(90.5)		156(88.1)	39(90.7)	
Instability	19(9.8)	9(19.1)		26(11.9)	2(9.5)		21(11.9)	4(9.3)	
Vasoactive drug use			0.608			0.263			0.741
No	170(91.4)	44(91.7)		195(91.5)	17(85.0)		161(93.6)	39(92.9)	
Yes	16(8.6)	4(8.3)		18(8.5)	3(15.0)		11(6.4)	3(7.1)	
Ventilation			0.233			0.149			0.853
Spontaneous	111(59.7)	23(52.3)		126(59.2)	8(42.1)		102(58.0)	25(59.5)	
Mechanics (I/NI)	75(40.3)	21(47.7)		87(40.8)	11(57.9)		74(42.0)	17(40.5)	
Type of hospitalization			0.218			**0.014**			0.889
Clinical ward	72(64.3)	25(75.8)		89(68.5)	5(35.7)		59(57.8)	12(44.4)	
ICU	40(35.7)	8(24.2)		41(31.5)	9(64.3)		43(42.2)	15(55.6)	
Length of stay (days)			0.565			0.969			0.170
< 12	66(57.4)	22(64.7)		77(58.3)	10(58.8)		101(68.2)	28(80.0)	
≥ 12	49(42.6)	13(35.3)		55(41.7)	7(41.2)		47(31.8)	7(20.0)	
Outcome clinical			0.912			**0.006**			0.170
Discharge	101(63.1)	28(62.2)		122(66.3)	7(35.0)		59(57.8)	12(44.4)	
Death	59(36.9)	17(37.8)		62(33.7)	13(65.0)		43(42.2)	15(55.6)	

I – Invasive; NI – No-invasive; ICU – Intensive care unit. * Pearson's Chi-Square or Fisher's Exact Test.

admissions in malnourished compared to well-nourished individuals. Fiorindi et al.[23] found that approximately 9.0% of the patients studied with COVID-19 in Italy were malnourished, and this factor contributed to a more extended hospital stay and clinical severity during the infection.

The relationship between malnutrition and SARS-CoV-2 infection could be explained by the presence of immunometabolic modifications and changes in protective responses, as well as the intensification of catabolism and increased frailty since the inflammatory process negatively influences the protein stores, mainly due to the increase in acute phase proteins[24].

Although smoking was observed in a small portion of the sample (8.2%), its important relationship with adverse health outcomes, particularly in severe respiratory syndromes, should alert us to the importance of tracking this habit in patients with COVID-19. Our findings showed a relationship between tobacco use and a higher frequency of ICU admission and mortality. Studies have reported that smokers with COVID-19 had more severe symptoms and major clinical complications, such as the need for mechanical ventilation, ICU admissions, and/or death[25,26].

A multicenter cohort conducted in China with adults and elderly individuals observed a smoking prevalence in 6.0% of the sample, and this number was higher in non-survivors[27] as well as a study developed by Liu et al.[28] in three tertiary hospitals in Wuhan, which found significant disease progression in patients with a history of tobacco use. Patanavanich and Glantz[29,] in a meta-analysis involving 11,590 patients, concluded that smoking is a risk factor for the worsening of COVID-19, and critical manifestations are more significant in these individuals compared to non-smokers.

The act of smoking increases ACE2 expression and the number of viral receptors, acting as a risk factor for SARS-CoV-2 infection. Furthermore, it intensifies the release of inflammatory cytokines, impairs the immune system by inhibiting the action of macrophages and defense cells, and constitutes an independent risk factor for cardiopulmonary complications[30].

Regarding alcohol consumption, the prevalence found in our study (20.9%) was lower than the values found by Hamer et al.[14], as they revealed that 33.5% of the individuals studied in a cohort in the United Kingdom consumed alcoholic beverages and, among certain lifestyle habits, alcohol consumption could be a risk factor for hospitalization for COVID-19. A case-control study carried out in India by Saurabh et al.[31], from March to July 2020, noted a prevalence of alcoholism in 9.2% of the sample and concluded that alcohol was a negative factor for the infection progress.

The role of alcohol as a predictor of adverse outcome risk has not been extensively studied yet. In our results, consuming alcohol was associated with a higher frequency of dyspnea. A study conducted in the United Kingdom on individuals diagnosed with COVID-19 by Fan et al.[32] described that individuals who consumed alcoholic beverages had a high risk of adverse clinical outcomes, such as increased mortality. Feng et al.[33], in a retrospective study in China, also reported that alcohol consumption in patients infected with the SARS-CoV-2 contributed to increased severity and higher mortality.

This possible relationship has been attributed to the fact that alcohol consumption increases the risk of severe infections and lung injury, thus contributing to the fibrosis process. Additionally, it leads to metabolic changes due to the decrease in glutathione and increased production of oxygen-reactive species and nitric oxide during the metabolization process — consequently, respiratory distress, immunological changes, and clinical complications such as kidney and endothelial damage emerge[34].

The prevalence of physical inactivity in our sample was high (80.1%), and a study conducted in China by Yuan et al.[35], from February to March 2020, with hospitalized patients, indicated that approximately 62.8% of the sample had physical inactivity. This condition increased the chances of worsening COVID-19 infection.

Although our results did not show any relationship between the practice of physical activity and the prognostic variables, a study carried out in California involving more than 48,000 individuals with a positive diagnosis of COVID-19 showed that 14.4% were physically inactive and were 2.49 times more likely to die and 1.7 times more likely to be admitted to ICUs compared with physically active individuals[36]. Zhang et al.[37], in a survey of individuals infected with SARS-CoV-2 at an outpatient and hospital level, suggested that physical activity could be protective against the infection but without a causal relationship.

The benefits of physical exercise in the infection process, such as COVID-19, are numerous and can be metabolic (hormone secretion), immunological, vascular, and cognitive. Reduction in the risk of acute events, better control of comorbidities, greater effectiveness of the immune system, and favorable organic responses are consequent factors that tend to end in a good prognosis for the individual[38].

Physical inactivity promotes the loss of muscle mass, leading to impairment of muscle strength and power and a decrease in motoneurons, mitochondrial dysfunction, and oxidative damage. Therefore, a sedentary lifestyle can lead to higher rates of morbidity and mortality, prolonged hospital stays, and contribute to costly expenses for the healthcare sector[39].

Therefore, the importance of health promotion measures linked to primary care is highlighted, as well as diagnosis and adequate and individualized nutritional management as part of the routine care of patients infected with SARS-CoV-2.

This study has some limitations that deserve to be considered in interpreting our results. First, the hospital-based sample may limit the generalizability of results to other groups of COVID-19 patients. Second, there was a significant lack of response, especially about the nutritional status variable and length of stay, which may limit the data's external validity. Third, it should be considered that nutritional status was assessed only through BMI, which has some limitations, mainly because it does not distinguish between body compartments (fat and lean mass). Additionally, weight and height measurements, when they could not be directly obtained, were considered based on self-report or estimation, which can cause some information bias, mainly because it has already been shown that patients with COVID-19 are inserted in a condition of acute malnutrition in the days before hospitalization[40], which can culminate in weight loss and a false report of the current weight. Furthermore, one must consider the limitation of the definition of some variables, such as "hemodynamic stability", considered only from the records in the medical records, without prior standardization between the institutions that composed the multicenter study.

However, the positive aspect that should be highlighted is that this is one of the only studies that, to date, has evaluated the association of lifestyle habits with prognostic factors in patients hospitalized for COVID-19 infection.

Other larger studies are needed to analyze the associations studied but note that preserving good nutritional status and cultivating good lifestyle habits are relevant for a favorable evolution in COVID-19 infection.

CONCLUSION

It is concluded that nutritional extremes and bad lifestyle habits, such as smoking and alcohol consumption, constituted risk factors for a poor prognosis in individuals with COVID-19.

REFERENCES

1. World Health Organization (WHO). WHO Coronavirus (COVID-19) Dashboard. Situation by Region, Country, Territory & Area. [cited 17 Nov 2021]. Available from: https://covid19.who.int/table
2. Lai CC, Shih TP, Ko WC, Tang HJ, Hsueh PR. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease-2019 (COVID-19): The epidemic and the challenges. Int J Antimicrob Agents. 2020;55(3):105924. https://doi.org/10.1016/j.ijantimicag.2020.105924
3. Azevedo RB, Botelho BG, Hollanda JVG, Ferreira LVL, Andrade LZJ, Oei SSML, et al. Covid-19 and the cardiovascular system: a comprehensive review. J Hum Hypertens. 2020;35:4-11. https://doi.org/10.1038/s41371-020-0387-4
4. Sobrado MM, Mateo-Abad M, Vrotsou K, Vergara I. Health Status and Lifestyle Habits of Vulnerable, Community-Dwelling Older People During the COVID-19 Lockdown. J Frailty Aging. 2021;10(3):286-9. https://doi.org/10.14283/jfa.2021.12
5. Zabetakis I, Lordan R, Norton C, Tsoupras, A. The Inflammation Link and the Role of Nutrition in Potential Mitigation. Nutrients. 2020;12(5):1466. https://doi.org/10.3390/nu12051466
6. Anker MS, Landmesser U, Haehling SV, Butler J, Coats AJS, Anker SD. Weight loss, malnutrition, and cachexia in COVID-19: facts and numbers. J Cachexia Sarcopenia Muscle. 2021;12(1):9-13. https://doi.org/10.1002/jcsm.12674
7. Stanton R, To QG, Khalesi S, Williams SL, Alley SJ, Thwaite TL, et al. Depression, Anxiety and Stress during COVID-19: Associations with changes in physical activity, sleep, tobacco and alcohol use in australian adults. Int J Environ Res Public Health. 2020;17(11):4065. https://doi.org/10.3390/ijerph17114065
8. Engin AB, Engin ED, Engin A. Two important controversial risk factors in SARS-CoV-2 infection: Obesity and smoking. Environ Res. 2020;78:103411. https://doi.org/10.1016/j.etap.2020.103411
9. Beserra EA, Rodrigues PA, Lisboa AQ. Validação de métodos subjetivos para estimativa do índice de massa corporal em pacientes acamados. Com Ciências Saúde [Internet]. 2011[cited 21 Nov 2022];22(1):19-26. Available from: http://bit.ly/3GBunsE
10. World Health Organization (WHO). Physical status: the use and interpretation of anthropometry: Report of a WHO Expert Committee. Technical Report Series nº 854. Geneva: World Health Organization; 1995.
11. Lipschitz DA. Screening for nutritional status in the elderly. Primary Care. 1994; 21(1):55-67. https://doi.org/10.1016/S0095-4543(21)00452-8
12. Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, et al. A Physical activity and public health: updated recommendation for adults from the American Collegeof Sports Medicine and the American Heart Association. Med Sci Sports Exerc. 2007;39(8):1423-34. https://doi.org/10.1249/mss.0b013e3180616b27
13. Simonnet A, Chetboun M, Poissy J, Raverdy V, Noulette J, Duhamel A, et al. High prevalence of obesity in severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) requiring invasive mechanical ventilation. Obesity. 2020;28(7):1195-9. https://doi.org/10.1002/oby.22831
14. Hamer M, Gale, CR, Kivimaki M, Batty GD. Overweight, obesity, and risk of hospitalization for COVID-19: A community-based cohort study of adults in the United Kingdom. Proc Natl Acad Sci U S A. 2020;117(35):21011-3. https://doi.org/10.1073/pnas.2011086117
15. Li T, Zhang Y, Gong C, Wang J, Liu B, Shi L, et al. Prevalence of malnutrition and analysis of related factors in elderly patients with COVID-19 in Wuhan, China. Eur J Clin Nutr. 2020;74:871-5. https://doi.org/10.1038/s41430-020-0642-3
16. Pironi L, Sasdelli AS, Ravaiolli F, Leoni L, Mari GA. Malnutrition and nutritional therapy in patients with SARS-CoV-2 disease. Clin Nutr. 2021;40(3):1330-7. https://doi.org/10.1016/j.clnu.2020.08.021
17. Fresán U, Guevara M, Elía F, Albéniz E, Burgui C, Castilla J, et al. Independent Role of Severe Obesity as a Risk Factor for COVID-19 Hospitalization: A Spanish Population-Based Cohort Study. Obesity. 2021;29(1):29-37. https://doi.org/10.1002/oby.23029
18. Nicolau J, Ayala L, Sanchís P, Olivares J, Dotres K, Soler AG, et al. Influence of nutritional status on clinical outcomes among hospitalized patients with COVID-19. Clin Nutr ESPEN. 2021;43:223-9. https://doi.org/10.1016/j.clnesp.2021.04.013
19. Mariconi D, Mais S, Rebelos E, Virdis A, Manca ML, Marco S, et al. Obesity prolongs the hospital stay in patients affected by COVID-19, and may impact on SARS-COV-2 shedding. Obes Res Clin Pract. 2020;14(3):205-9. https://doi.org/10.1016/j.orcp.2020.05.009
20. Al-Salameh A, Lanoix JP, Bennis Y, Andrejak C, Brochot E, Deschasse G, et al. The association between body mass index class and coronavirus disease 2019 outcomes. Int J Obes. 2021;45(3):700-5. https://doi.org/10.1038/s41366-020-00721-1
21. Cordova E, Mykietiuk A, Sued O, Vedia L, Pacifico N, Matias H, et al. Clinical characteristics and outcomes of hospitalized patients with SARS-CoV-2 infection in a Latin American country: Results from the ECCOVID multicenter prospective study. Plos One. 2020;16(10):e0258260. https://doi.org/10.1371/journal.pone.0258260
22. Petrova D, Fernández ES, Barranco MR, Pérez PN, Moleón JJJ, Sánchez MJ. La obesidad como factor de riesgo en personas con COVID-19: posibles mecanismos e implicaciones. Aten Primaria. 2020; 52(7):496-500. https://doi.org/10.1016/j.aprim.2020.05.003
23. Fiorindi C, Campani F, Rosero L, Campani C, Livi L, Giovannoni L, et al. Prevalence of nutritional risk and malnutrition during and after hospitalization for COVID-19 infection: Preliminary results of a single-centre experience. Clin Nutr ESPEN. 2021;45:351-5. https://doi.org/10.1016/j.clnesp.2021.07.020
24. Fedele D, Francesco A, Riso S, Collo A. Obesity, malnutrition, and trace element deficiency in the coronavirus disease

(COVID-19) pandemic: An overview. Nutrition. 2021;81:111016. https://doi.org/10.1016/j.nut.2020.111016
25. Zhang J, Dong X, Cao Y, Yuan Y, Yang Y, Yan Y, et al. Clinical characteristics of 140 patients infected with SARS-CoV-2 in Wuhan, China. Allergy. 2020;75:1730-41. https://doi.org/10.1111/all.14238
26. Guan W, Ni Z, Hu Y, Liang W, Ou C, He J, et al. Clinical Characteristics of Coronavirus Disease 2019 in China. N Engl J Med. 2020;382:1708-20. https://doi.org/10.1056/NEJMoa2002032
27. 27 - Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet. 2020;395(10229):1054-62. https://doi.org/10.1016/S0140-6736(20)30566-3
28. Liu W, Tao Z, Wanh L, Yuan M, Liu K, Zhou L, et al. Analysis of factors associated with disease outcomes in hospitalized patients with 2019 novel coronavirus disease. Chin Med J (Engl). 2020;133(9):1032-8. https://doi.org/10.1097/CM9.0000000000000775
29. Patanavanich R, Glantz AS. Smoking Is Associated With COVID-19 Progression: A Meta-analysis. Nicotine Tob Res. 2020;22(9):1653-6. https://doi.org/10.1093/ntr/ntaa082
30. Berlin I, Thomas D, Faou AL, Cornuz J. COVID-19 and Smoking. Nicotine Tob Res. 2020;22(9):1650-2. https://doi.org/10.1093/ntr/ntaa059
31. Saurabh S, Verma MK, Gautam V, Kumar N, Jain V, Goel AD, et al. Tobacco, alcohol use and other risk factors for developing symptomatic COVID-19 vs asymptomatic SARS-CoV-2 infection: a case-control study from western Rajasthan, India. Trans R Soc Trop Med Hyg. 2021;115(7):820-31. https://doi.org/10.1093/trstmh/traa172
32. Fan X, Liu Z, Poulsen KL, Wu X, Miyata T, Dasarathy S, et al. Alcohol Consumption Is Associated with Poor Prognosis in Obese Patients with COVID-19: A Mendelian Randomization Study Using UK Biobank. Nutrients. 2021;13(5):1592. https://doi.org/10.3390/nu13051592
33. Feng Y, Ling Y, Bai T, Xie Y, Huang J, Li J, et al. COVID-19 with Different Severities: A Multicenter Study of Clinical Features. Am J Respir Crit Care Med. 2020; 201(11):1380-8. https://doi.org/10.1164/rccm.202002-0445OC
34. Ojo AS, Balagun AS, Williams O, Ojo OS. Pulmonary Fibrosis in COVID-19 Survivors: Predictive Factors and Risk Reduction Strategies. Pulm Med. 2020; 2020:6175964. https://doi.org/10.1155/2020/6175964
35. Yuan Q, Huang H, Chen X, Chen R, Zhang Y, Pan X, et al. Does pre-existent physical inactivity have a role in the severity of COVID-19? Ther Adv Respir Dis. 2021;15:17534666211025221. https://doi.org/10.1177/17534666211025221
36. Sallis R, Young DR, Tartof SY, Sallis JF, Sall J, Li Q, et al. Physical inactivity is associated with a higher risk for severe COVID-19 outcomes: a study in 48 440 adult patients. Br J Sports Med. 2021;55:1099-105. https://doi.org/10.1136/bjsports-2021-104080
37. 37 - Zhang X, Li X, Sun Z, He Y, Xu W, Campbell H, et al. Physical activity and COVID-19: an observational and Mendelian randomisation study. J Glob Health. 2020;10(2):020514. https://doi.org/10.7189/jogh.10.020514
38. Fuzeki E, Groneberg DA, Banzer W. Physical activity during COVID-19 induced lockdown: recommendations. J Occup Med Toxicol. 2020;15:25. https://doi.org/10.1186/s12995-020-00278-9
39. Milogia MN, Vito G, Franchi M, Paoli A, Moro T, Marcolin G, et al. Impact of sedentarism due to the COVID-19 home confinement on neuromuscular, cardiovascular and metabolic health: Physiological and pathophysiological implications and recommendations for physical and nutritional countermeasures. Eur J Sport Sci. 2021;21(4):614-35. https://doi.org/10.1080/17461391.2020.1761076
40. Berger MM. Nutrition Status Affects COVID-19 Patient Outcomes. JPEN J Parenter Enteral Nutr 2020;44(7):1166-7. https://doi.org/10.1002/jpen.1954

Conflicts of interest: No conflicts of interest declared concerning the publication of this article.

Author contributions:
Conception and design: MBGS, CPSP, RM
Analysis and interpretation of data: MBGS, CPSP, RM
Data collection: Not applicable
Writing of the manuscript: MBGS
Critical revision of the article: CPSP, RM
Final approval of the manuscript*: MBGS, CPSP, RM, JABN, MMVP, KFD
Statistical analysis: CPSP
Overall responsibility: CPSP, RM
*All authors have read and approved of the final version of the article submitted to Rev Cienc Saude.

Funding information: Not applicable.