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ORIGINAL ARTICLE

Global Leadership Initiative on Malnutrition and Mini Nutritional Assessment in Evaluation of Nutritional Status of COVID-19 Patients

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ABSTRACT

Background: Considering that nutritional status is one of the influential factors in the process of recovery of patients with COVID-19, this study was conducted to determine the nutritional status of COVID-19 patients and its relationship with clinical outcomes.

Methods: This cross-sectional study included 155 patients diagnosed with COVID-19 disease (18-80 years) using PCR test and chest CT scan. The nutritional status of participants was assessed employing Mini Nutritional Assessment (MNA) questionnaire, Global Leadership Initiative on Malnutrition (GLIM) criteria, and Nutrition Risk in Critically (NUTRIC) score.

Results: Among 81 men (52.3%) and 74 women (47.7%) based on MNA, 30 participants (19.4%) and based on GLIM criteria, 42 participants (27.1%) suffered from malnutrition. Also, systolic and diastolic blood pressure (GLIM: p=0.038, p=0.008, respectively; MNA: p=0.04, p=0.01, respectively) and blood oxygen saturation (MNA: p=0.01; GLIM: p=0.012) were significantly associated with nutritional status of participants. MNA and GLIM findings showed a relative agreement of 0.35 (p<0.0001).

Conclusion: Nutritional status was demonstrated to be a critical factor that can affect the clinical condition and recovery process of COVID-19 patients. GLIM was shown to be practical and reliable criteria to measure the nutritional status for diagnosis and prognosis of patients with COVID-19.

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Introduction

SARS-CoV-2 is one of the seven types of viruses in the Coronaviridae family. It is a new type of coronavirus capable of infecting humans identified in December 2019 in Wuhan, Hubei province, China (1, 2). Throughout the spread of the coronavirus, different types of the virus have emerged due to various mutations in its structure (3). World Health Organization statistics indicated that over 659 million people worldwide and more than 7.5 million people in Iran have been infected with the coronavirus. Unfortunately, more than 144,000 people have lost their lives (4). So far, various approaches have been proposed to treat and prevent this disease, and using multiple vaccines has significantly reduced the rate of infection, complications, and its mortality (5). Based on studies on the effect of vaccination on COVID-19, although the rate of complications and mortality caused by the disease has decreased, it has not yet reached zero. We are still witnessing complications and mortality caused by COVID-19 due to various reasons, including underlying diseases, old age, allergic reactions to vaccination, and drug interactions (6, 7). In addition, malnutrition can lead to lower immune responses to the infection and the production of fewer antigens with lower response rates to vaccines (8).

The COVID-19 disease affects body systems, including the respiratory, cardiovascular, and nervous systems, and has long-term complications, especially respiratory and cardiovascular complications, after infection (9-11). Patients with COVID-19 show symptoms such as fever, cough, fatigue, and muscle pain, and in severe cases, they are hospitalized with respiratory failure, septic shock, and other organ dysfunctions (12). Many factors are associated with the risk of COVID-19 infection, among which nutritional status is of paramount importance (13). Nutrition and food are the most critical exogenous factors affecting the immune defense response. Adequate nutrition can reduce the risk of chronic diseases caused by the immune system or minimize their complications (14-16). Therefore, individuals with malnutrition are more susceptible to infectious diseases, including coronavirus (13). On the other hand, studies have shown that patients infected with COVID-19 may be at risk of malnutrition due to decreased food consumption, catabolism related to inflammation, and decreased mobility due to long-term hospitalization (17), which creates a vicious cycle for hospitalized COVID-19 patients. Malnutrition increases sensitivity to infection, while infection exacerbates the need for nutrients by reducing appetite (18). Deficiencies in nutrients such as selenium, zinc, copper, and vitamins D, C, A, and E can adversely affect the immune system and its function (8).

There is no widely accepted tool to measure nutritional status, and various tools have been proposed to determine the risk of malnutrition. Among these tools, the Mini Nutritional Assessment tool (MNA) has high sensitivity, specificity, and diagnostic accuracy in different clinical environments (19). The Global Leadership Initiative on Malnutrition index (GLIM) is another tool for assessing nutritional status, the efficacy of which has been demonstrated in various studies in COVID-19 patients (20, 21). The MNA, GLIM, and Nutrition Risk in Critically Ill score (NUTRIC score) are useful scoring tools to determine the nutritional status during various diseases, including COVID-19. Establishing an agreement between the results provided by these scoring tools can be beneficial for decision-making in using them to assess nutritional status. Therefore, this study aimed to define the correlation between nutritional status and clinical outcomes in COVID-19 patients using nutritional status assessment scoring tools, including MNA, GLIM, and NUTRIC scores, and to evaluate the agreement between them.

Materials and Methods

The present study is an analytical cross-sectional study conducted on 155 COVID-19 patients aged between 18 and 80 years investigating the nutritional condition of these patients admitted to the COVID ward and Intensive Care Unit (ICU). The sampling in the study was carried out non-randomly and simply from the hospitals of Shahid Beheshti and Shahid Jalil in Yasuj County, Iran for about three months. The inclusion criteria for the study were patients willing to participate, a definite diagnosis of COVID based on a positive PCR and chest CT scan, and an age between 18 and 80 years. The exclusion criteria included unwillingness to participate in the study, being pregnant and breastfeeding, and fewer than 24 hours of admission time. The study protocol was confirmed by the Ethics Committee of Yasuj University of Medical Sciences, Yasuj, Iran (IR.YUMS.REC.1400.146).

The MNA questionnaire is a nutritional status evaluation tool for elderly patients in all healthcare fields recommended by European Society for Clinical Nutrition and Metabolism (ESPEN). In this study, the short form was utilized. The questionnaire includes six questions on reducing weight loss, food intake, mobility, psychological pressure or acute illness, psychological or neurological problems, and Body Mass Index (BMI). Its score ranged from 0 to 14. A score of 12-14 represented a normal state of nutrition, while a score of 8-11 showed malnutrition, and a score of 0-7 indicated the severe status of malnutrition (19). The GLIM criteria were developed in 2016 to evaluate the nutritional status using phenotypic and etiologic criteria. Phenotypic criteria included unwanted weight loss (more than 5% in the past six months or more than 10% in the past, over six months), low BMI (less than 18.5 kg/m^2 in young individuals and less than 20 kg/m^2 in individuals older than 70 years), and reduced muscle mass determined by fat-free mass index (FFMI) which was not used in this study. Etiologic criteria also included two criteria of inadequate food intake (more than 50% for more than one week or any chronic gastrointestinal problems that impaired digestion and absorption) and inflammation or disease burden that might result from acute diseases or chronic injuries. Malnutrition was diagnosed if at least one phenotypic and one etiologic criterion were present (22).

The NUTRIC score tool was developed by Holland and colleagues in 2011 to assess the nutritional status of patients admitted to the ICU. This tool consisted of two sections of APACHE II and SOFA, and the final score was the sum of age, APACHE II, SOFA, number of comorbidities, number of days hospitalized from the hospital to the ICU, and interleukin-6 (IL-6). In the newer version of this tool, called the modified NUTRIC score (mNUTRIC score), the IL-6 variable has been removed (23). The demographic information questionnaire included age, gender, weight, height, BMI, alcohol and smoking status, medical information and history, method of nutrition, various diseases, used medications, allergies to medications, and signs and symptoms of the disease. Additionally, information on the severity of the illness, complications, and length of hospitalization was obtained from patients.

Shapiro-Wilk test was used to test the data normality. Then, qualitative data were reported as numbers (percentages), and quantitative data were reported as mean±standard deviation (if normal) and median (interquartile range, if non-normal). Qualitative variables were compared with different levels of nutritional status using the Chi-square test or Fisher's exact test, and quantitative variables were compared with different levels of nutritional status using a one-sided analysis of variance (if normal) and the Kruskal-Wallis test (if non-normal). Cohen's Kappa test was utilized to evaluate the agreement of the results obtained from different nutritional status assessment tools. After collecting data, they were analyzed and interpreted employing SPSS software (Version 25, Chicago, IL, USA). Also, a significance level of p value<0.05 was considered in all tests.

Results

Table 1 presents the general characteristics of patients. In this study, 155 patients met eligibility criteria of the study including patients with a mean age of 48.60±15.38 and a mean BMI of 27.85±13.09. The mean of symptom onset to admission was 7.34±4.70 days, while the mean length of hospitalization was 6.5±4.98 days. According to the MNA score and GLIM criteria, malnutrition was found in 30 (19.4%) and 42 (27.1%) patients, and 12 patients were hospitalized in ICU (Table 1). During the sampling process, 38.7% of patients recovered completely, and 3.2% died. Based on the results

Table 1: Baseline demographic and clinical data.

Variable	Mean±SD
Age (years)	48.60±15.38
Height (cm)	168.38±9.58
Male n (%)	81 (52.3%)
Weight (kg)	78.89±13.09
BMI (cm/kg^2)	27.85±4.62
Admission duration (days)	7.34±4.70
Duration of hospitalization (days)	6.5±4.98
MNA score	
Normal (12-14)	125 (80.6%)
Malnutrition (0-11)	30 (19.4%)
GLIM criteria (22)	
Normal	113 (72.9)
Malnutrition	42 (27.1%)
NUTRIC score	
Low risk (0-4)	12 (100%)
At risk (5-9)	0 (0%)

Data were reported as Mean±SD. MNA: Mini Nutritional Assessment. NUTRIC score: Nutrition Risk in Critically Ill score.

from the mNUTRIC score, all of the 12 patients hospitalized in the ICU had low risk in terms of nutritional status (score: 0-4). The information of the patients based on the nutritional status according to MNA and GLIM questionnaires was reported in Table 2.

Table 2: Nutritional status assessed by MNA and GLIM scoring tools.

Variable	**MNA**		***P* value**	**GLIM criteria**		***P* value**
	Normal (Mean±SD)	**Malnutrition (Mean±SD)**		**Normal (Mean±SD)**	**Malnutrition (Mean±SD)**	
Duration of hospitalization (days)	6.42±5.10	6.83±4.51	0.68	6.46±5.30	6.60±4.10	0.88
Disease Severity			0.07			0.16
Mild	56 (36.12%)	10 (6.45%)		53 (34.16%)	13 (8.38%)	
Moderate	58 (37.40%)	20 (12.90%)		51 (32.90%)	27 (17.41%)	
Severe	11 (7.09%)	0 (0.00%)		9 (5.80%)	2 (1.29%)	
COVID-19 complications						
Shortness of breath	73 (47.09%)	15 (9.67%)	0.08	62 (40%)	26 (16.77%)	0.62
Wheezing	55 (35.48%)	18 (11.61%)	0.31	49 (31.61%)	24 (15.48%)	0.21
Cough	96 (61.93%)	19 (12.25%)	0.38	84 (54.19%)	31 (20%)	0.88
Fever	18 (11.61%)	10 (6.45%)	0.06	15 (9.67%)	13 (8.38%)	0.27
Chilling	22 (14.19%)	7 (4.51%)	0.76	17 (10.96%)	12 (7.74%)	0.24
Headache	39 (25.16%)	13 (8.38%)	0.43	35 (22.58%)	17 (10.96%)	0.61
Diarrhea	9 (5.80%)	3 (1.93%)	0.72	8 (5.16%)	4 (2.58%)	0.80
Constipation	16 (10.32%)	2 (1.29%)	0.53	16 (10.32%)	2 (1.29%)	0.15
Nausea	19 (12.25%)	6 (3.87%)	0.55	19 (12.25%)	6 (3.87%)	0.77
Vomiting	11 (7.09%)	1 (0.64%)	0.80	8 (5.16%)	4 (2.58%)	0.73
Comorbidities						
Heart diseases	24 (15.48%)	8 (5.16%)	0.45	24(15.5%)	8(5.2%)	0.82
Kidney diseases	18 (11.61%)	3 (1.93%)	0.58	18(11.61%)	3(1.93%)	0.19
Hypertension	26 (16.77%)	8 (5.16%)	0.62	28(18.10%)	6(3.90%)	0.19
Anemia	12 (7.74%)	0 (0%)	0.13	12 (7.74%)	0 (0%)	0.03
Diabetes	22 (14.19%)	3 (1.93%)	0.41	20 (12.90%)	5 (3.22%)	0.46
Brain ischemia	1 (0.6%)	0 (0%)	1	0(0%)	1(0.6%)	0.27
Pulmonary diseases	11 (7.09%)	6 (3.87%)	0.10	11 (7.10%)	6 (3.87%)	0.56
Anorexia disease	1 (0.6%)	0 (0%)	1	1 (0.6%)	0 (0%)	1.00
Cancer disease	5 (3.2%)	1 (0.6%)	1	5 (3.2%)	1 (0.6%)	1.00
Liver disease	5 (3.2%)	1 (0.6%)	1	6 (3.9%)	0 (0%)	0.12
Thyroid diseases	15 (9.67%)	6 (3.87%)	0.37	16 (10.32%)	5 (3.22%)	0.79
Mental disease	3 (1.9%)	2 (1.3%)	0.25	4 (2.6%)	1 (0.6%)	1.00
Other diseases	34 (21.93%)	13 (8.38%)		35 (22.58%)	12 (7.74%)	
Vital signs						
SBP (mmHg)	116.67±16.68	108.37±13.92	0.04*	116.73±16.74	110.57±15.01	0.038*
DBP (mmHg)	72.88±10.50	68.37±8.37	0.01*	73.33±10.43	68.45±8.93	0.008*
PR	78.60±14.28	78.73±10.13	0.53	79.04±13.97	77.48±12.42	0.526
RR	20.61±4.53	20.13±1.43	0.80	20.57±4.71	20.38±1.68	0.799
BT (degrees Celsius)	36.58±2.43	36.31±0.18		36.61±2.56	36.31±0.23	0.676
SO2	92.59±3.84	89.77±5.76	0.01*	92.70±3.75	90.31±5.47	0.012*
Drugs						
Corticosteroid	116 (74.83%)	28 (18.06%)	1	105 (67.74%)	39 (25.16%)	1.00
Anticoagulant	117 (75.43%)	29 (18.70%)	0.69	107 (69.0%)	39 (25.2%)	0.70
Antiviral	108 (69.67%)	23 (14.83%)	0.26	94 (60.64%)	37 (23.87%)	0.47
Respiratory	98 (63.22%)	24 (15.48%)	1	89 (57.41%)	33 (21.29%)	1.00
Painkiller	52 (33.54%)	13 (8.38%)	1	46 (29.67%)	19 (12.25%)	0.71
Antibacterial	29 (18.70)	5 (3.22%)	0.48	27 (17.41%)	7 (4.51%)	0.38
Gastrointestinal	72 (46.45%)	21 (13.54%)	0.30	64 (41.29%)	29 (18.70%)	0.19
Anti-diabetes	28 (18.06%)	7 (4.51%)	1	26 (16.77%)	9 (5.80%)	1.00
Supplement	39 (25.16%)	10 (6.45%)	0.83	38 (24.51%)	11 (7.09%)	0.44

Laboratory data						
WBC	7.57±4.10	7.60±4.38	0.72	7.00±3.00	7.00±4.00	0.72
RBC (10^6)	5.00±1.17	4.91±0.79	0.79	4.00±1.00	4.00±0.00	0.80
Hb (g/dL)	14.03±2.20	13.31±1.86	0.91	13.00±2.00	13.00±2.00	0.90
Hct (%)	38.74±5.31	38.01±4.80	0.55	38.00±5.00	38.00±5.00	0.55
MCV (FL)	79.53±9.11	78.33±10.22	0.2	79.00±9.00	77.00±8.00	0.20
MCH (pg)	28.78±3.70	27.55±4.48	0.49	28.00±3.00	28.00±4.04	0.50
MCHC (g/dL)	36.16±2.05	36.06±5.12	0.05	35.00±2.00	36.00±4.00	0.04*
Plt (U/L)	196.30±81.98	201.90±85.02	0.36	193.00±74.00	2.7.00±100.00	0.36
Neutrophil (%)	76.98±10.19	78.77±10.30	0.83	77.00±9.00	77.00±10.00	0.82
Lymphocyte (%)	18.56±10.39	16.11±9.14	0.56	18.00±10.00	17.00±9.00	0.56
Monocyte (%)	4.36±3.00	3.72±2.38	0.36	4.00±3.00	3.00±2.00	0.35
BS (mg/dL)	142.03±75.22	153.83±102.56	0.58	146.00±83.00	138.00±74.00	0.58
BUN (mg/dL)	17.93±8.68	18.75±9.56	0.93	18.00±9.00	17.00±8.07	0.93
Cr (mg/dL)	1.06±0.35	1.04±0.26	0.24	1.07±0.00	1.00±0.00	0.23
Alb (mg/dL)	4.21±0.54	4.05±1.02	0.92	4.00±0.00	4.00±0.00	0.92

Alb: Albumin, BS: Blood Sugar, BUN: Blood Urea Nitrogen, Cr: Creatinine, GLIM: Global Leadership Initiative on Malnutrition, Hb: Hemoglobin, Hct: Hematocrit, MCH: Mean Corpuscular Hemoglobin, MCHC: Mean Corpuscular Hemoglobin Concentration, MCV: Mean Corpuscular Volume, MNA: Mini Nutritional Assessment, Plt: Platelet, RBC: Red Blood Cell, WBC: White Blood Cell. Values were expressed as mean±standard deviation unless indicated otherwise. **P* values based on analysis of variance (ANOVA) (for normally distributed variables) or Pearson Chi-square test. ($p<0.05$ was considered significant).

In normal patients compared to malnutrition patients, some variables, including systolic and diastolic blood pressure (SBP and DBP), and O_2 saturation, were significantly different in both MNA and GLIM criteria. Other variables in both questionnaires were not significantly different in normal and malnourished patients. Due to the small number of patients hospitalized in the ICU, the NUTRIC-score questionnaire was not compared with the other two scoring tools. As shown in Table 3, there was no significant relationship between GLIM variables in ICU and non-ICU patients. While in the MNA questionnaire, a significant relationship was observed between food intake in the last three months (p=0.01) and mobility of patients (p=0.003) (Table 4). The findings of Cohen's Kappa analysis demonstrated the relative compatibility of these two scoring tools with a value of 0.35 and $p<0.0001$.

Discussion

The present study was conducted to examine the nutritional status of COVID-19 patients and its relationship with clinical outcomes of the disease, including disease complications, severity, and length of hospitalization. The MNA and GLIM scoring tools were used to determine the nutritional status of patients and their concordance. The data analysis in this study showed a significant relationship between the reduction of SBP and DBP with the nutritional status of COVID-19 patients. There are various mechanisms for this phenomenon; on the other one hand, it can be said that systemic oxidative stress plays a fundamental role in causing high blood pressure, which is prevented by calorie intake limitation, and as a result of the endothelium-dependent vasomotor function, blood pressure decreases (24). The study conducted by Kunduraci *et al.* on patients with metabolic syndrome revealed that calorie intake limitation could reduce blood pressure (25). Additionally, Alam *et al.* examined the effect of limited calorie intake on cardiovascular factors such as blood pressure and found that calorie intake reduction could lead to a decrease in SBP and DBP (26).

Table 3: Comparing the GLIM criteria of ICU with non-ICU Covid-19 patients.

Variable		ICU	Non-ICU	*P* value[a]
Phenotypic criteria (weight loss)	Yes	2	37	0.73
	No	10	106	
Phenotypic criteria (BMI)	Yes	0	6	1.00
	No	12	137	
Etiologic criteria (intake)	Yes	4	90	0.063
	No	8	53	

BMI: Body Mass Index. ICU: Intensive Care Unit. GLIM: Global Leadership Initiative on Malnutrition. [a]Obtained from Pearson Chi-square test ($p<0.05$ was considered significant).

Table 4: Comparing the MNA criteria of ICU with non-ICU Covid-19 patients.

Variable	Score	ICU	Non-ICU	*P* value[a]
MNA 1: Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?	0: Severe decrease in food intake	0	19	0.01*
	1: Moderate decrease in food intake	5	97	
	2: No decrease in food intake	7	27	
MNA 2: Weight loss during the last 3 months	0: Weight loss greater than 3kg	2	31	0.09
	1: Does not know	5	18	
	2: Weight loss between 1 and 3kg	1	23	
	3: No weight loss	4	71	
MNA 3: Mobility	0: Bed or chair bound	4	8	0.003*
	1: Able to get out of bed/chair but does not go out	6	71	
	2: Goes out	2	64	
MNA 4: Has suffered psychological stress or acute disease in the past 3 months?	0: Yes	2	68	0.06
	2: No	10	75	
MNA 5: Neuropsychological problems	0: Severe dementia or depression	1	20	0.24
	1: Mild dementia	0	24	
	2: No psychological problems	11	99	
MNA 6: BMI	0: BMI less than 19	0	2	0.77
	1: BMI 19 or less than 21	0	5	
	2: BMI 21 or less than 23	0	14	
	3: BMI 23 or greater	12	122	

BMI: Body Mass Index. ICU: Intensive Care Unit. MNA: Mini Nutritional Assessment. [a]Obtained from Pearson Chi-square test ($p<0.05$ was considered significant).

The oxygen saturation level (SaO_2) of patients is another factor that was observed in this study displaying a significant difference between normal and malnourished states. According to the obtained results, consuming non-normal food caused a decrease of approximately 2.5% in the oxygen saturation level in malnourished individuals when compared to normal subjects. Insufficient intake of iron-containing foods can lead to a decrease in the available iron for hemoglobin production, which can limit the blood oxygen saturation level (27). Another factor involved in hemoglobin biosynthesis is the active form of vitamin B6 (pyridoxal 5-phosphate or PLP), and also the amino acid glycine. PLP is the co-factor of the amino levulinic acid synthase (ALA) enzyme, which is the first enzyme in hemoglobin biosynthesis and its role is to combine glycine and succinyl-coenzyme A (succinyl-CoA) as the initial step in hemoglobin production (28). Therefore, it can be concluded that one of the consequences of malnutrition is insufficient intake of vitamin B6 and glycine, which can disrupt the process of hemoglobin production and lead to a decrease in oxygen saturation level and hypoxia.

Based on these findings, it can be said that nutritional status can be considered important for managing the clinical consequences of COVID-19 and reducing its complications. Bedock and colleagues examined the nutritional status and its relationship with the severity of the disease in 114 patients with COVID-19. The importance of initial nutritional screening in patients with COVID-19 was emphasized in this study (22). Additionally, Rouget and colleagues calculated a high rate of malnutrition (37.5%) in patients with COVID-19, and based on their data, it was found that nutritional support was essential for COVID-19 care (29). Mohammadi *et al.* found that nutritional status was of particular importance in hospitalized patients with COVID-19, while malnutrition could lead to longer hospitalization periods and even increased mortality in these patients (30).

In our study, the GLIM criteria were compared with the MNA scoring tool to determine their validity and reliability in assessing nutritional status. The analyses showed that the MNA tool and GLIM index had a relative agreement based on Cohen's analysis. Furthermore, the GLIM criteria were found to be more practical and accessible, making it suitable criteria to evaluate the nutritional status of individuals, especially those suffering from malnutrition. Shahbazi *et al.* have also demonstrated GLIM criteria to provide a fast diagnostic power and with adequate accuracy and reliability to be a good diagnostic tool for assessing nutritional status due to the reduced time for patient interaction (21109 ICU patients were assessed for malnutrition based on GLIM and SGA criteria.

The relation between nutrition assessment tools and duration of hospitalization and mortality were also evaluated. The sensitivity and specificity of GLIM criteria concerning the detection of malnutrition was assessed based on the area under the curve. RESULTS: Malnutrition, according to the SGA and GLIM criteria, was found in 68 (62.4%). However, other researchers have found that the GLIM criteria were not a precise and reliable measure to investigate the severity and prevalence of malnutrition, contrary to our study's findings. Rouget's study used GLIM criteria to determine the level of malnutrition in patients with COVID-19 and ultimately reported that GLIM could not accurately determine the prevalence of malnutrition (29).

In our study, we analyzed each item of MNA and GLIM separately in hospitalized and non-hospitalized ICU patients. The results showed significant differences between hospitalized and non-hospitalized ICU patients for item 1 of MNA which was related to a reduction in food consumption three months before the disease. Regarding item 3 which was related to the level of patient mobility during hospitalization, significant differences between hospitalized and non-hospitalized ICU patients were observed. Approximately 67.8% of non-hospitalized ICU patients had a moderate reduction in food intake for item 1 of MNA, while 41.6% of hospitalized ICU patients exhibited a moderate reduction in food intake three months before COVID-19. On the other hand, 18.8% of non-hospitalized ICU patients did not have a decrease in food intake, and 58.3% of hospitalized ICU patients did not have a decline in food intake. It can be interpreted that hospitalized ICU patients consumed more medication, including corticosteroids. One of the side effects of these medications was an increase in patients' appetite (31), as some hospitalized ICU patients reported an increase in their appetite and food intake during hospitalization.

In the analysis conducted on item 3 of the MNA tool, which was correlated with patients' mobility, approximately 5.6% of non-ICU hospitalized patients and 33.3% of ICU hospitalized patients were unable to get out of bed; 49.6% of non-ICU hospitalized patients and 50% of ICU hospitalized patients could get out of bed but were unable to walk, and 44.7% of non-ICU hospitalized patients could leave the ward and walk, while only 16.7% of ICU hospitalized patients had this ability. The reason for this may be due to the clinical condition of patients and their hospital ward, where COVID-19 patients hospitalized in the ICU because of various reasons, including low oxygen saturation and shortness of breath, causing less mobility compared to non-ICU hospitalized patients.

In our study, there were also some limitations. In addition to the MNA tool and GLIM criteria, we also used the NUTRIC-score questionnaire, but meaningful data could not be obtained due to the low number of analyzed patients. Furthermore, due to limitations in facing patients to measure their nutritional status using the GLIM criteria, their muscle mass was not determined from the phenotypic criteria, and was based on previous study, (17). Additionally, since all patients were diagnosed with COVID-19, inflammatory conditions were considered for all of them.

Conclusion

Nutritional status is one of the factors that significantly affect the clinical status of COVID-19 patients. It can be said that nutritional status is an important parameter that can be considered for managing these patients and mitigating the related complications. The GLIM criteria is one of the indicators used to assess nutritional status, and based on our findings, the results of our scoring criteria were reliable, and it could be employed to determine the prevalence, severity, and status of malnutrition in different individuals, including COVID-19 patients. GLIM criteria showed a good accuracy in determining nutritional status when compared to other assessment tools like MNA, and due to its ease of use, quickness, and accessibility, it can be a good option to be utilized in various settings, including clinical environments such as hospitals.

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Authors' Contribution

NS, MB, MVB and MN contributed to data collection. NR contributed to data analysis. NS, MB and MRJ drafted the manuscript. NS, BP and ZH contributed to manuscript revising and editing. ZS and JMM obtained funding. AP supervised the study. All authors read and approved final manuscript.

Conflict of Interest

None declared.

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