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Original Article

Prognostic Evaluation of Nutritional Status in Hospitalized Geriatric Covid- 19 Patients

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ABSTRACT

Background: The elderly are more likely to develop symptomatic severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) infection. Malnutrition is a risk factor that can affect the clinical course of disease and physical and mental performance.

Objective: To assess the nutritional status of geriatric patients using the modified nutritional risk in critically ill patients (mNUTRIC) and the geriatric nutritional risk index (GNRI), and evaluate the prognosis with the short-term outcome.

Methods: A number of elderly individuals (> 65 years) hospitalised with COVID -19 were included in the study. Data on demographics, laboratory results, and concomitant diseases were collected. The geriatric nutritional risk index (GNRI) and modified nutritional risk index for critically ill patients (mNUTRIC) were used to assess nutritional status. For statistical analysis, categorical data were analysed with the Pearson chi-square test and continuous variables were analysed with the unpaired Student's t test.

Results: A total of 86 (59.27%) were survivors and 58 (40.28%) were nonsurvivors. The mean value of APACHE II and SOFA was significantly increased in the nonsurvivors compared with the survivor group. Mean GNRI and mNUTRIC values were 87.93±8.49 and 2.41±0.82 in survivors and 81.40±6.32 and 4.78±1.39 in the survivor group. The mean GNRI and mNUTRIC were significantly different between the survivor and non-survivor groups

Conclusion: GNRI was significantly lower and mNUTRIC was significantly higher in the non-survivor group compared with the survivor group. The change in GNRI was significantly negatively correlated with mortality and MNUTRIC was significantly positively correlated with mortality.

Key Words: *COVID-19, Elderly, Malnutrition, mNUTRIC, Geriatric nutritional risk index*

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INTRODUCTION

The 2019 coronavirus pandemic (COVID -19) is having a devastating impact worldwide. It is a contagious disease caused by a virus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2); the first known case was detected in Wuhan, China [1]. Several factors determine the severity and symptoms of this COVID -19 infection [2]. This disease has spread rapidly throughout the world, and 6 million cases of COVID -19 have been reported worldwide by June 1, 2020, including > 371,000 deaths [3]. Age, diabetes, cardiovascular disease, immunocompromised state, and organ failure are risk factors related to the severity of the disease [4]. SARS-CoV-2 infection is associated with a wide clinical spectrum of illness, ranging from asymptomatic symptoms to the development of severe pneumonia, acute respiratory distress syndrome, and even death. Data from 72,314 patients with COVID -19 show that the prevalence of mild, severe, and critical cases was 81%, 14%, and 5%, respectively. Fever, cough, fatigue, muscle pain, diarrhea, and pneumonia are the most common symptoms of COVID -19 and can lead to progression of acute respiratory distress syndrome, metabolic acidosis, septic shock, coagulopathy, and organ failure, including liver, kidney, and heart [5, 6].

The changes associated with the normal aging process increase the nutritional risk for the elderly. The aging process is characterized by reduced reserves of organ systems and weakening of homeostatic controls. Data from several studies of acute hospitalization in the elderly indicate that up to 71% are at nutritional risk or malnourished [3]. Malnutrition is associated with increased mortality [7]. Older age and underlying diseases are the major challenges in controlling and treating COVID -19 [2]. COVID-19 patients usually present with lymphocytopenia on admission, and elevated levels of C-reactive protein and proinflammatory cytokines such as IL -6 have also been associated with disease severity [8, 9]. The body's initial response to viral infection is the onset of a rapid and synchronized innate immune response that causes

a cytokine storm. However, an exaggerated response can result in damage to human tissues [10, 11]. It is postulated that hyperinflammatory aggression of the lung triggered by disproportionate immune activation and coagulopathy is involved in disease progression and exacerbation.

Some of the molecular mechanisms of how micronutrients optimize immune function have been described [12]. Most micronutrients exhibit pleiotropic functions in supporting immune function. In the area of innate immunity, the relevant vitamins and minerals collectively support the development and maintenance of physical barriers, the production and activity of antimicrobial proteins, the growth, differentiation, and chemotaxis of innate cells, the phagocytic and destructive activities of neutrophils and macrophages, and the promotion and healing of inflammation [13]. For this reason, nutritional screening must be performed in patients admitted to hospitals for various diseases. In the case of COVID -19 infection, evaluation with different methods such as the Geriatric Nutritional Risk Index (GNRI), Nutritional Risk Screening 2002 (NRS-2002), modified Nutrition Risk in the Critically Ill (mNUTRIC), or bioelectrical impedance analysis (BIA) is useful to better manage these patients [14]. Malnutrition is common in the elderly and is a major burden responsible for serious health-related adverse outcomes. The Modified Nutritional Risk in Critically Ill (mNUTRIC) does not include IL -6 as used in the NUTRIC score. Specifically for geriatric patients, there is no validated nutrition assessment tool. The Geriatric Nutrition Risk Index (GNRI) has been proposed to assess nutritional status in elderly patients. It includes serum albumin in the calculation, which is a negative acute phase protein and is usually low in critically ill patients [15]. Therefore, in this study, we aim to assess the nutritional status of geriatric patients using the modified nutritional risk in critically ill patients (mNUTRIC) and the geriatric nutritional risk index (GNRI), and evaluate the prognosis with the short-term outcome.

Material and methods

This prospective observational study was conducted in the Department of Medicine, Era's Lucknow Medical College & Hospital (ELMCH). ELMCH is a tertiary care center with state of the art infrastructure serving mainly the socio-economically underprivileged suburban and rural population of Lucknow. All consecutive patients with moderately severe COVID -19 pneumonia aged > 65 years attending Era's Lucknow Medical College & Hospital. RT-PCR diagnosed cases of COVID -19 pneumonia (moderate and severe cases) were included patients aged > 65 years. Patients with end-stage malignancies and known psychiatric disorders were excluded from the study. Ethical approval was obtained from the ethical committee of the institution. Informed consent was obtained from all patients.

A total of 144 moderate-to-severe COVID -19 patients who met the inclusion criteria were enrolled in the study. Demographic information and clinical findings of the study population were recorded along with laboratory findings. These data were used for analysis. The severity of COVID -19 was determined using the ICMR criteria as follows:

Mild	Patients with upper respiratory tract infection, may have mild symptoms such as fever, cough, sore throat, nasal congestion, malaise, headache	Without evidence of breathlessness or hypoxia (normal saturation)
Moderate	Pneumonia with no signs of severe disease	With presence of clinical features of dyspnea and or hypoxia, fever, cough, including SpO_2<94% (range 90-94%) on room air, Respiratory rate more or equal to 24 per minute
Severe	Severe pneumonia	With clinical signs of pneumonia plus one of the following: respiratory rate >30 breaths/min, severe respiratory distress, SpO_2<90% on room air.

In order to assess the GNRI we have to measure the patient present body weight and height in cm. Thereafter the blood sample was taken to get the value of serum albumin.

The ideal body weight was derived by using the equations of lorentz
Ideal body weight for men = 0.75 × height (cm) − 62.5
Ideal body weight for women=0.60 × height (cm)−40.

The index was calculated as follows:
GNRI=1.489 × serum albumin (g/L)+41.7 × present weight/ideal weight (kg).

Each patient was evaluated within 24 hours of ICU admission according to the Acute Physiology and Chronic Health Evaluation II (APACHE II) and Sequential Organ Failure Assessment (SOFA) criteria. The nutritional risk of each patient was assessed on admission to the ICU using the mNUTRIC score. This score (0 - 9 points) was calculated based on the NUTRIC score by eliminating the values IL -6. It was composed of five variables: Age, APACHE II -score on admission, SOFA -score on admission, number of co morbidities, and length of hospital stay before ICU (LOS).

Statistical analysis:

Data of an individual patient was recorded on a separate case sheet, which was later on entered in MS-excel data sheet and was subjected to statistical analysis. SPSS version 21.0 was used for statistical analysis. Data was presented as mean (standard deviation) and percentage (%). The Chi-square test was used to compare the categorical variables and independent t test was used to compare discrete variables between groups. The p value 0.05 was considered significant.

RESULTS

The mean age was 73.40±6.09 years in the survivor group and 71.34±5.09 years in the nonsurvivor group. Age differed significantly between the survivor group and the nonsurvivor group. The percentages of male and female sex were 66.28% and 33.72% in the survivors and 74.14% and 25.86% in the non-survivors group, respectively. Mean weight (kg) and height (cm) were 63.38±9.32 and 165.36±8.54 in the survivors and 64.55±9.50 and 166.29±7.68 in the nonsurvivors. The frequency of sex, mean weight (kg), and height (cm) did not differ significantly between the survivors and nonsurvivors groups. Mean heart rate (beats/min) and MAP (mmHg) were 93.87±12.88 and 91.97±11.39 in the survivor group and 103.52±16.35 and 82.21±14.54 in the nonsurvivor group. Heart rate (beats/min) was significantly higher and MAP (mmHg) was significantly lower in the non-survivors group compared to the survivors group. Mean hospital stay (days) was 8.05±5.59 in the survivor group and 10.59±6.67 in the nonsurvivor group. Hospital stay was significantly longer in the nonsurvivors than in the survivors (Table 1).

Table 1: Comparison of baseline characteristics of the patients in between Survivors and Non-Survivors groups

	Survivors (n=86)		Non-Survivors (n=58)		t	p-Value
	Mean	±SD	Mean	±SD		
Age (years)	73.40	6.09	71.34	5.09	2.113	0.036*
Gender (n, %)						
Male	57	66.28	43	74.14	0.67	0.412
Female	29	33.72	15	25.86		
Weight (kg)	63.38	9.32	64.55	9.50	-0.732	0.465
Height (cm)	165.36	8.54	166.29	7.68	-0.669	0.505
Heart Rate (beats/min)	93.87	12.88	103.52	16.35	-3.949	<0.001*
MAP (mmHg)	91.97	11.39	82.21	14.54	4.506	<0.001*
Respiratory Rate (per Min.)	26.22	4.24	27.84	5.23	-2.049	0.042*
Hospital Stay (days)	8.05	5.59	10.59	6.67	-2.474	0.015*

*=Significant (p<0.05)

The mean white blood cell count x103 (cells /Cumm), neutrophil count (%), and lymphocyte count (%) were significantly higher and platelet count significantly lower in the nonsurvivors than in the survivors group. Mean PaO2 was significantly decreased in the nonsurvivors compared with the survivor group, whereas Na, K, P.C.T. (ng/dl), pH, and PaCO2 were not significantly different in the survivors and nonsurvivors. Mean total bilirubin (mg/dl) was significantly higher and albumin (g/dl) significantly lower in the nonsurvivors than in the survivors group. In contrast, A.S.T. (unit/tr), A.L.T. (unit/tr), and L.D.H. (unit/tr) were not significantly different in survivors and nonsurvivors. Mean urea (mg/dl) and creatinine (mg/dl) were 54.33±44.91, 1.46±1.16 in the survivor group and 77.43±61.45 and 1.93±1.53 in the nonsurvivor group. Mean urea (mg/dl) and creatinine (mg/dl) were significantly higher in the non-survivor group than in the survivor group. The mean values of D DIMER (µg/ml), IL 6, and C.R.P. (mg/dl) were 3.01±11.36, 55.52±70.21, 65.57±33.98 in the survivors and 6.44±23.89, 97.04±112.98, and 79.63±38.60 in the survivors group. Mean C.R.P. (mg/dl) was significantly higher in nonsurvivors than in survivors (Table 2).

Table 2: Comparison of biochemical parameters in between Survivors and Non-Survivors groups

	Survivors (n=86)		Non-Survivors (n=58)		t	p-Value
	Mean	±SD	Mean	±SD		
Hemoglobin (gm/dl)	11.15	2.32	11.49	2.37	-0.842	0.401
White blood cells $x10^3$ (Cells /Cumm)	10.92	4.83	15.33	8.52	-3.949	<0.001*
Neutrophils (%)	85.20	9.69	89.26	7.28	-2.716	0.007*
Lymphocytes (%)	11.02	8.39	7.55	6.59	2.648	0.009*
Platelet count (per lakh)	2.10	0.78	1.66	0.66	3.522	0.001*
Hematocrit	35.78	6.97	34.04	8.63	1.328	0.186
Platelet count (per lakh)	2.06	0.80	1.67	0.64	2.786	0.006*
Prothrombin time (Sec.)	13.17	2.79	15.74	12.05	-1.356	0.179
Na	137.86	6.56	139.19	6.93	-1.166	0.246
K	4.17	0.89	3.95	1.17	1.305	0.194
P.C.T. (ng/dl)	3.27	9.57	2.34	6.88	0.534	0.594
pH	7.40	0.12	7.38	0.14	1.024	0.308
PaO2	78.56	28.47	67.45	32.46	2.170	0.032*
PaCO2	37.48	13.06	42.80	21.88	-1.827	0.070
Total bilirubin (mg/dl)	0.78	0.43	1.13	1.09	-2.501	0.014*

A.S.T. (Unit/Ltr.)	76.40	113.99	242.02	937.72	-1.623	0.107
A.L.T. (Unit/Ltr.)	56.03	65.10	201.31	742.62	-1.807	0.073
Total bilirubin (mg/dl)	0.77	0.41	1.15	1.13	-2.849	0.005*
Albumin (g/dl)	3.11	0.57	2.67	0.43	4.987	<0.001*
L.D.H. (Unit/Ltr.)	404.00	84.33	764.00	660.33	-0.911	0.398
Urea (mg/dl)	54.33	44.91	77.43	61.45	-2.606	0.010*
Creatinine (mg/dl)	1.46	1.16	1.93	1.53	-2.080	0.039*
D-DIMER (µg/ml.)	3.01	11.36	6.44	23.89	-0.895	0.373
IL 6	55.52	70.21	97.04	112.98	-1.679	0.099
C.R.P. (mg/dl)	65.57	33.98	79.63	38.60	-2.052	0.042*

*=Significant (p<0.05)

The frequency of fever, cough, hemoptysis, dyspnea, and diarrhoea did not differ significantly between survivors and nonsurvivors. The frequency of hypertension, diabetes, cardiovascular disease, and CKD comorbidity did not differ significantly between survivors and nonsurvivors. The frequency of the presence of inotropics was 16.28% in the survivor group and 81.03% in the nonsurvivor group. The frequency of inotropics was significantly higher in the nonsurvivor group than in the survivor group (Table 3).

Table 3: Comparison of frequencies of different symptoms and comorbidities in between Survivors and Non-Survivors groups

		Survivors (n=86)		Non-Survivors (n=58)		Total	Chi Sq.	p-Value
		n	%	n	%			
Fever	Yes	58	67.44	34	58.62	92	0.81	0.366
	No	28	32.56	24	41.38	52		
Cough	Yes	48	55.81	23	39.66	71	3.00	0.083
	No	38	44.19	35	60.34	73		
Hemoptysis	Yes	2	2.33	2	3.45	4	0.12	0.644
	No	84	97.67	56	96.55	140		
Dyspnea	Yes	62	72.09	36	62.07	98	1.17	0.279
	No	24	27.91	22	37.93	46		
Diarrhoea	Yes	1	1.16	1	1.72	2	0.08	0.778
	No	85	98.84	57	98.28	142		
Hypertension	Yes	60	69.77	45	77.59	105	0.71	0.399
	No	26	30.23	13	22.41	39		
Diabetes	Yes	51	59.30	30	51.72	81	0.53	0.467
	No	35	40.70	28	48.28	63		
Cardiovascular disease	Yes	15	17.44	7	12.07	22	0.41	0.520
	No	71	82.56	51	87.93	122		
C.K.D.	Yes	4	4.65	3	5.17	7	0.02	0.887
	No	82	95.35	55	94.83	137		
Inotropes	Yes	14	16.28	47	81.03	61	56.87	<0.001*
	No	72	83.72	11	18.97	83		

*=Significant (p<0.05)

The mean percentages of mechanical ventilation, noninvasive ventilation, high-flow nasal cannula, nonrebreathing mask, face mask, and nasal prongs were 1.16%, 9.30%, 11.63%, 19.77%, 26.74%, and 31.40% in the survivor group and 29.31%, 22.41%, 24.14%, 15.52%, 8.62%, and 0.00% in the survivor group, respectively. The mean frequency of the different types of oxygen delivery was significantly lower in the nonsurvivor group compared with the survivor group (Table 4).

Table 4: Comparison of mode of oxygen delivery in survivors and non-survivors patients

Mode of Oxygen Delivery	Survivors (n=86)		Non-Survivors (n=58)		Total	Chi sq.	p-Value
	n	%	n	%			
Mechanical ventilation	1	1.16	17	29.31	18	53.70	<0.001*
Non-invasive ventilation	8	9.30	13	22.41	21		
High flow nasal cannula	10	11.63	14	24.14	24		
Non-rebreather mask	17	19.77	9	15.52	26		
Face mask	23	26.74	5	8.62	28		
Nasal prongs	27	31.40	0	0.00	27		

*=Significant (p<0.05)

Mean FIO2 was 65.63±25.94 in survivors and 92.76±12.40 in the survivor group. Mean APACHE II score was 8.20±2.86 in survivors and 17.12±4.45 in the survivor group. The mean SOFA score was 3.13±1.83 in the survivors and 7.78±2.60 in the survivors group. The mean mNUTRIC score was 2.41±0.82 in the survivors and 4.78±1.39 in the survivors group. Mean FIO2, APACHE II SCORE, SOFA SCORE, and MNUTRIC values were significantly increased in the nonsurvivors compared with the survivor group. In contrast, mean GNRI was significantly decreased in the nonsurvivors compared with the survivor group (Table 5).

Table 5: Comparison of mean FIO2, APACHE II SCORE, SOFA SCORE, GNRI and MNUTRIC **in survivors and non-survivors patients**

	Survivors (n=86)		**Non-Survivors (n=58)**		**t**	**p-Value**
	Mean	**±SD**	**Mean**	**±SD**		
FIO2	65.63	25.94	92.76	12.40	-7.409	<0.001*
APACHE II SCORE	8.20	2.86	17.12	4.45	-14.654	<0.001*
SOFA SCORE	3.13	1.83	7.78	2.60	-12.615	<0.001*
GNRI	87.93	8.49	81.40	6.32	4.997	<0.001*
MNUTRIC	2.41	0.82	4.78	1.39	-12.862	<0.001*

*=Significant (p<0.05)

The change in GNRI was significantly negative correlated with mortality and MNUTRIC was significantly positive correlated with mortality as shown in Table 6.

Table 6: correlation of GNRI and MNUTRIC with mortality of patients (N=144)

	Pearson Correlation	p-Value
GNRI	-0.387**	<0.001*
MNUTRIC	0.734**	<0.001*

*=Significant (p<0.05)

DISCUSSION

In our study, of 144 patients, a total of 86 (59.27%) were survivors and 58 (40.28%) were nonsurvivors. Similarly, a study reported that the mortality rate in hospitalized elderly patients with COVID -19 was 54.3% [16]. The reported high mortality rate is consistent with several studies in older adults [17, 18]. It may be due to the weak immune response of older adults, which makes them more susceptible to acute respiratory distress syndrome and respiratory failure [19]. Another study reported that the ninety-five subjects (29.5%) died during hospitalization, with 62 dying within the first 15 days (65.2% of those who died) [20].

In our study, the mean age was 73.40±6.09 years in the survivor group and 71.34±5.09 years in the nonsurvivor group. Moreover, age was significantly different in the survivor and nonsurvivor groups. Similarly, a study reported that median age was significantly higher for death in hospital [85.5 (79-86.7)] than for death without hospitalization [79 (74-92)] [21]. Chronologic age was not a significant risk factor for mortality because frailty, functional status, and comorbidity play important roles in prognosis in older adults [16]. This finding is confirmed by another retrospective study of hospitalized geriatric patients with COVID -19 [22]. Another study demonstrated that the mean age of the survivor and nonsurvivor groups was 76 years (interquartile range [IQR], 69-84) and 80 years (IQR, 75-85), respectively [23].

The percentages of male and female sex were 66.28% and 33.72% in the survivor group and 74.14% and 25.86% in the nonsurvivor group. Gender did not differ significantly between the survivor and nonsurvivor groups. Elsorady et al [16] showed that sex was not a predictor of mortality [16].

In this study the mean hospital stay was significantly more in non-survivors (10.59±6.67days) as compared to survivors group (8.05±5.59days). Similarly, Ahmadi et al reported that the length of hospitalization was slightly more in non-survivor group (19.52 ± 11.14 day) as compared to non-survivor group (16.09 ± 13.65 day) [24]. Contrary, Na et al demonstrated that Length of hospital stay (day) was not significantly different in the survivor group [17.0 (10.0–27.0)] and the nonsurvivor group [17.0 (10.0–27.0)] [23]. Recinella et al. also find out the length of hospital stay was significantly more in non-survivor group [11 (8–15) day] as compared to non-survivor group [8 (7–15) day] [21].

In the current study, there was no discernible difference in the frequency of fever, cough, hemoptysis, dyspnea, or diarrhoea between patients who survived and those who did not. There was also no discernible difference in the frequency of comorbidities such as GCS, C.K.D., diabetes, hypertension, and cardiovascular disease between survivors and nonsurvivors. A history of CKD and hypertension was strongly associated with death [16]. This is consistent with previous research [17, 25] showing the importance of CKD in predicting mortality in the elderly. The dyspnea was the most commonly reported symptom among participants (69.7%), followed by fever (62.8%) and cough (57.4%) [16]. According to previous studies showed that the delirium correlates with severity of illness and can be used to predict in-hospital mortality [22, 26].

In our study the mean D-DIMER (µg/ml.), IL 6 and C.R.P. (mg/dl) were 3.01±11.36, 55.52±70.21, 65.57±33.98 in survivors and 6.44±23.89, 97.04±112.98 and 79.63±38.60 in survivors group. The mean C.R.P. (mg/dl) were significantly more in non-survivors as compared to survivors group.According to Elsorady et al. [16], the study calculated the predictive value of a number of inflammatory markers that indicate the likelihood of cytokine storm upon admission [16].

In our study the mean APACHE II and SOFA score was significantly increased in non-survivors as compared to survivors group. The patients with severe COVID -19 had a higher mortality rate the higher their SOFA score [23]. The cut-off value of the SOFA -score for predicting in-hospital mortality in this study was 2.50. The cut-off value of the SOFA -score for predicting severe COVID -19 in the 2021 study by Yang et al. was 2, and the cut-off value for predicting death was 5. An increase of 2 or more in the SOFA -score was associated with an increased risk of in-hospital death in a study of patients with suspected infections admitted to an intensive care unit [27]. The SOFA threshold of 2.5 in our study appears to be lower than the SOFA score of critically ill ICU patients in general. This is most likely due to the fact that in many patients with severe COVID -19 exacerbation is primarily due to respiratory failure. There have been studies of how well individual scores predict severity and mortality, but none have examined the relationship between an overall scale of frailty and severity. The SOFA score had the strongest ability to predict death when severity and frailty scores were evaluated in this study. However, given the current shortage of ICU beds, it is better to consider multiple factors when deciding on ICU admission [28-30].

In our study the mean GNRI and mNUTRIC were 87.93±8.49 and 2.41±0.82 in survivors and 81.40±6.32 and 4.78±1.39in survivors group. The mean GNRI was significantly decreased and mNUTRIC was significantly increased in non-survivors as compared to survivors group. The risk of malnutrition was generally evenly distributed among low-risk (30%), moderate-risk (29%), and high-risk (41%) categories [24]. However, compared with patients who recovered, a much higher percentage of those who died at COVID -19 were at high risk for malnutrition (NRS 5). In fact, starvation was a serious risk for slightly more than 70% of those who died. In contrast, the majority (69.9%) of ICU COVID -19 patients in one study were at moderate risk for malnutrition [31]. Differences in socioeconomic level, diet, lifestyle, environmental factors, viral load, and treatment timing between research groups may help explain these differences [31, 17]. These factors have been shown to affect nutritional status. Previous studies have highlighted the clinical value of the NRS-2002 for assessing nutritional risk and predicting length of hospital stay in COVID -19 patients [32].

CONCLUSION

Of the 144 patients, 58 (40.28%) were nonsurvivors. Mean FIO2 was significantly increased in the nonsurvivors compared with the survivor group. The mean APACHE II and SOFA score was significantly increased in the nonsurvivors compared with the survivor group. The mean GNRI score was significantly lower and the mNUTRIC score was significantly higher in the nonsurvivors compared with the survivor group. The change in GNRI was significantly negatively correlated with mortality and MNUTRIC was significantly positively correlated with mortality. Nutritional status assessed by GNRI and MNUTRIC is a prognostic factor for in-hospital mortality.

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