RESEARCH ARTICLE

Nutritional risk assessment of critically ill patients based on NUTRIC score at Shifa International Hospital, Islamabad

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Abstract

Objective: To assess the nutritional risk of critically ill patients.

Method: The single-centre, prospective, observational study was conducted at the Shifa International Hospital, Islamabad, Pakistan, from November 9, 2020, to May 8, 2021, and comprised critically ill patients of either gender admitted to pulmonology, neurology, nephrology, cardiology, gastroenterology and general intensive care units. They were subjected to screening using the Nutritional Risk of Critically Ill tool, and the risk was categorised as moderate and high. Data was analysed using SPSS 23.

Results: Of the 88 patients, 58 (66%) were males. The overall mean age of the sample was 62.71±12.62 years. The nutritional risk was moderate in 39(44%) patients and high in 49(56%). The mean Acute Physiology, Age and Chronic Health Evaluation II score, Sequential Organ Failure Assessment score and Nutritional Risk of Critically Ill was 16.73±4.34, 5.91±1.92 and 5.71±1.41, respectively. There was a significant association of nutritional risk with age ($p=0.04$) and Sequential Organ Failure Assessment score ($p<0.001$). Biochemical markers were different between those with high risk and patients with moderate risk ($p<0.05$).

Conclusion: The overall prevalence of malnutrition in critically ill patients was high which may further affect clinical outcomes.

Key Words: Nutritional status, Malnutrition, Nutritional assessment, Risk assessment.

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Introduction

Malnutrition was the most common complication in hospitalised patients of coronavirus disease-2019 (COVID-19), especially in the intensive care units (ICUs)[1]. The risk factors for malnutrition while hospitalised can be inadequate dietary intake, increased nutritional requirements due to hypermetabolic condition, excess loss of body fluids and nutrients, and malabsorption disorders, such as disruption in the absorption and availability of protein, fats, carbohydrates and micronutrients deficiencies[2,3]. Nutritional requirements of critically ill patients are usually higher than the general patients. Critically ill patients have sepsis frequently, trauma and inflammation which can increase the rate of metabolism that leads to muscle loss and malabsorption syndrome[4]. Adequate nutritional support to critically ill patient is fundamental for minimising the complications related to malnutrition in hospitalised individuals[5]. However, nutritional risk assessment can be of great concern in critically ill patients as it can further lead to the negative upshots, including extended stay in hospital, ventilator dependency, impaired healing, increased rate of infections, multiple hospitalisation and high hospital cost[6].

Hospital-related malnutrition ranges from 20-50% and this figure goes up when it is taken in reference to ICU patients[7]. The onset of nutritional risk in critically ill patients also depends on the tool used for screening. In Pakistan, prevalence of high nutritional risk, defined as Nutritional Risk of Critically Ill (NUTRIC) score >5 (NS>5) is 45% in mechanically ventilated critically ill patients, with longer ICU stay and higher mortality rate[8].

Nutrition screening and assessment of patients at the time of admission in hospital, particularly in ICU, can contribute to minimising the negative outcomes of malnutrition as the nutritional status usually worsens because of different medical treatments and procedures[9], but it remains mostly unnoticed and un-explored[10]. Critically ill patients' response to medical nutrition therapy (MNT) may not be significant in all cases, and it is directly associated with nutritional status. Therefore, more significant response has been reported in patients with higher risk[11]. Appropriate nutrition support can be functional in all sick individuals, but more significant response is in patients at nutritional risk[12].

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Appropriate nutritional screening technique is the most demanding aspect of studies conducted for the assessment of relationship between nutritional status and clinical outcomes[13]. NS is one of the validated tools for nutritional risk assessment, and does not depend on traditional variables, like anthropometric and dietary variables but associated with severity of disease and clinical condition of the patients[1]. The current study was planned to assess the nutritional risk of critically ill patients based on NS.

Patients and Methods

The single-centre, prospective, observational study was conducted at the Shifa International Hospital, Islamabad, Pakistan, from November 9, 2020, to May 8, 2021. After approval from the institutional ethics review committee, the sample was raised using convenience sampling technique. All critically ill patients admitted to pulmonology, neurology, nephrology, cardiology, gastroenterology and general ICUs were screened. Those included were critically ill adult patients of either gender who spent >48 hrs in the ICUs. Pregnant and lactating women were excluded. Sample size was calculated using the WHO sample calculation criteria; Considering Nutritional Risk as primary outcome, a sample size estimation has been performed considering a t test difference (at 5% level of significance) in means between the 2 groups (moderate and high nutritional risk group), for a specified power of 0.8[14].

After taking informed consent from the patients, data was collected regarding age, gender, reason of hospitalisation, past medical record, recent weight loss history, smoking history and recent hospitalisation history. Data was gathered through interview either with patients or their attendants. Anthropometric assessment, including weight, height and body mass index (BMI), was recorded following the World Health Organisation (WHO) criteria[15].

NUTRIC Score[16] is a validated scoring system for ICU patients, including age points, chronic diseases, SOFA; Sequential Organ Failure Assessment[17] and APACHE II; Acute Physiology and Chronic Health Evaluation II[18], and ranges 0-9. SOFA was used to assess the extent of organ functions. Standard scoring system was assigned to each category, with total scoring categorisation for multiple experimental tools being 0-6, 7-9 and 10-12. APACHE II was used to assess the severity of disease through 17 parameters, such as pulse rate, total lymphocytes count (TLC), respiratory rate, oxygenation and GCS; Glasgow Coma Scale[19] etc. The stratification of APACHE II score was done as NS 0-15, 16-19 and 20-30. NS was calculated for each patient by a registered dietitian within 24-48 hrs, and was categorised as NS 3-5 moderate nutritional risk and NS >5 high nutritional risk, Patients having NS <3 had low nutritional risk, and were excluded from further analysis.

Secondary data regarding albumin, C-reactive protein (CRP), bilirubin, creatinine, glycated haemoglobin (HbA1c), haemoglobin (Hb) and magnesium, was obtained from patients' electronic medical record, while nitrogen balance (NB) was calculated for each patient from urine urea nitrogen (UUN) obtained from 24hr urine analysis. The values were used in the NB formula: NB = Intake of protein (g)/6.25 – [(24 hr. UUN / 0.85) + (2- 4)][20].

In the equation, NB for insensible nitrogen losses from sweat, stool, skin and hair, constant value of 2 and 4 was used. Factor 2 was used for insensible losses in patients with <1L daily stool volume, and 0-500mL/d of output from any wound or drain. Factor could be up to 3 for output of 1-1.5L/d of stool or wound execute or drain 500-1000mL/d, and up to 4 for stool output 1.5-2L/d.

Data was analysed using SPSS 23. Means and standard deviation were used for continuous variables, while frequencies and percentages were used for categorical variables. Kolmogorov Smirnov was used to check data normality and it was found to be normally distributed. For comparison of continuous variables, independent sample t-test was used, while for categorical variables, chi-square test and binary logistic regression were used. P<0.05 was considered significant.

Results

Of the 376 patients initially screened, 88(23.4%)

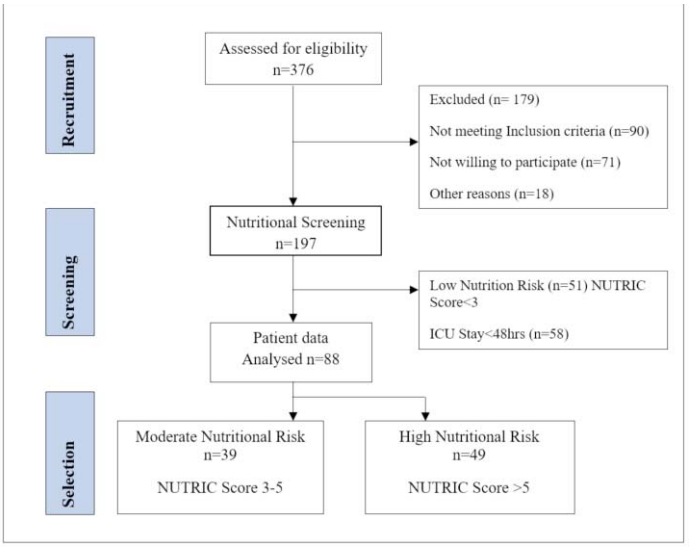

Figure-1: Study flowchart

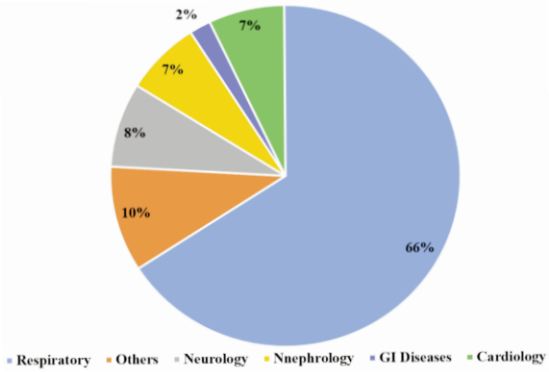

Figure-2: Diagnostic disease-wise distribution of critically ill patients

Table-1: Patients' data

Variable	Categories	N(%)	Mean±SD
Age (Year)	18-64	46(52.0)	62.71 ± 12.62
	>65	42(48.0)	
Gender	Male	58(65.9)	--
	Female	30(34.1)	
BMI	18.5-22.9	28(31.8)	26.90 ± 5.61
	>23	60(68.1)	
Co morbid History	Diabetes	37(43.0)	--
	Hypertension	51(57.0)	
Admission Status	Direct ICUs	57(64.8)	--
	Ward	31(35.2)	
Weight loss History	Yes	16(18.2)	--
	No	72(81.8)	
Loss of Appetite History	Yes	47(53.4)	--
	No	41(46.6)	
Recent Hospitalisation History	Yes	25(28.4)	--
	No	63(71.6)	
Route of Feeding	Oral	56(63.6)	--
	Enteral/Tube	22(25.0)	
	NPO	10(11.0)	
Smoking	Yes	22(25.0)	--
	No	52(59.0)	
	Ex. smokers	14(16.0)	
NUTRIC Score (NS)	Moderate Risk (3-5)	39(44.0)	5.71±1.41
	High Risk (>5)	49(56.0)	
APACHE II	0-15	34(38.0)	
	16-19	33(37.5)	16.73±4.34
	20-30	21(23.8)	
SOFA	0-6	54(61.0)	5.91±1.92
	>6	34(38.0)	
Diagnosis Category	Respiratory	57 (61.0)	
	GI Disease	2 (2.3)	
	Nephrology	6 (6.8)	
	Neurology	7 (8.0)	
	CVD Disease	6 (6.8)	
	Other	10 (11.0)	
COVID-19 Status	COVID-19	51(66.0)	
	None COVID-19	37(34.0)	

BMI: Body mass index, NPO: Nil per oral, APACHE: Acute physiology and chronic health evaluation, SOFA: Sequential organ failure assessment, NUTRIC: nutritional risk in critically ill, GI: Gastrointestinal, CVD: Cardiovascular disease, COVID-19: Coronavirus disease-2019.

completed the study. The nutritional risk was moderate in 39(44%) patients and high in 49(56%) (Figure 1). Majority of the patients had respiratory problems 57(66%) (Figure 2).

Of the total, 58(66%) were males and 30(34%) were females. The overall mean age of the sample was 62.71±12.62 years. The most common comorbid condition was hypertension (HTN) 51(57%) and diabetes mellitus (DM) 37(43%) More than half the patients 47(53.4%) had low appetite history (Table 1).

The mean APACHE II score, SOFA score and NS was 16.73±4.34, 5.91±1.92 and 5.71±1.41, respectively.

There was a significant association of nutritional risk with age (p=0.04) and SOFA score (Tables 2-3). Biochemical

Table-2: Comparison of associated factors based on NUTRIC score.

Variables	Categories	NUTRIC Score (3-5)	NUTRIC Score (5-9)	*P-value*
Age (Year)				
	18-64	27 (69.2)	19 (38.7)	0.04
	>65	12 (30.7)	30 (61.2)	
Gender				
	Male	26 (66.7)	32 (65.3)	0.894
	Female	13 (33.3)	17 (34.7)	
BMI				
	Normal	10 (25.6)	13 (26.5)	0.435
	Overweight	29 (74.3)	36 (73.4)	
Hospitalisation History				
	Yes	8 (20.5)	17 (34.7)	0.073
	No	31 (79.5)	32 (65.3)	
Weight loss History				
	Yes	6 (15.4)	10 (20.4)	0.544
	No	33 (84)	39 (79.6)	
Diagnoses Categories				
	Covid-19	22 (56.4)	29 (59.2)	0.793
	None Covid-19	17 (43.6)	20 (40.8)	
HbA1c				
	Diabetic	23 (59.0)	19 (38.8)	0.059
	Non-Diabetic	16 (41.0)	30 (61.2)	
APACHE				
	0-15	20 (51.3)	14 (28.6)	0.069
	16-19	13 (33.3)	20 (40.8)	
	20-30	6 (15.4)	15 (30.6)	
SOFA				
	0-6	34 (87.2)	20 (40.8)	<0.001
	>6	5 (12.8)	29 (59.2)	
Smoking				
	Yes	10 (25.6)	12 (24.5)	0.988
	No	23 (59.0)	29 (59.2)	
	Ex	6 (15.4)	8 (16.3)	

NUTRIC: nutritional risk in critically ill, BMI: Body mass index; HbA1c: Glycated haemoglobin, APACHE: Acute physiology and chronic health evaluation; SOFA: Sequential organ failure assessment

Table-3: Nutritional risk in critically ill patients and its relationship with age and SOFA score.

Selected variables				95% CI			
	Chi- Square	S.E	Odd Ratio	Lower	Upper	*p- value*	Predicted corrected (%)
Age (Year)	31.92	0.02	1.05	1.40	2.80	<0.001	75.0
SOFA	25.44	0.169	2.01	1.01	1.10	0.01	71.6

SOFA: Sequential organ failure assessment, CI: Confidence interval, SE: Standard error..

Table-4: NUTRIC score-based comparison of biochemical variables.

Variables	Mean ±SD		
	NUTRIC Score (3-5)	NUTRIC Score (5-9)	*P-value*
C-Reactive Protein	86.69±90.6	167.30±201.50	0.023
Albumin	3.21± 0.58	2.81± 0.54	0.001
Creatinine	1.79±1.81	2.51±1.97	0.081
Total Bilirubin	1.00±0.98	1.62±2.52	0.156
Nitrogen Balance	-7.02±4.87	-10.63±3.73	<0.001
Haemoglobin	13.14±2.57	11.03±2.89	0.001
Magnesium	1.87±0.37	1.76±0.43	0.023

NUTRIC: Nutritional risk in critically ill.

markers were different between those with high risk and patients with moderate risk (Table 4).

Discussion

Malnutrition has been characterised as an unconstrained risk indicator for undesirable clinical outcomes in ICU patients. High-risk patients are more susceptible to infection and related complications with slow recovery compared to those with good nutritional status[21]. Initial screening and assessment of critically ill patients after admission within 48h is a principal step in patient critical care process. The NS tool for nutritional risk assessment is a validated screening tool[22,23].

In the present study, moderate nutritional risk was defined as NS 3-5, and high nutritional risk as NS >5. There are some controversies in the cut-off values, as some studies have considered high risk at NS >5, and others as >4[23]. The current study used NS <5 at the cut-off for lower nutritional risk and NS >5 for high-risk group, which is consistent with other studies[24,25]. The study found 56% patients at high nutritional risk and 44% at moderate risk. These were consistent with previous studies[25] . High risk was observed in patients who were overweight, COVID-19 positive, had APACHE II score and had the male gender. The mean APACHE II score was 16.7±4.3 with more patients (40.8%) in the high nutritional risk group. This might be because there were patients diagnosed with COVID-19, and the disease severity deteriorates with time[22]. A study also reported high APACHE II score in critically ill patients and the score was higher than the current study due to the fact that, unlike the current study, it targeted only patients on mechanical ventilation (MV)[1]. A study on critical ill neurological patients reported that APACHE II scores of low and high nutritional risk groups were 16.56 and 19.08, respectively[26]

The current study showed that the high nutritional risk was observed more in geriatric population aged >65 years, with increase in mean APACHE II and SOFA scores in high nutritional risk group compared to the moderate risk group ($p<0.05$), which was similar to earlier findings[25]. Studies have reported significant association of age with nutritional status of hospitalised patients and with nutritional risk in critically ill patients[27,28]. The current study endorsed such findings.

The current study was conducted during the active phase of COVID-19 pandemic, had 56% COVID-19 patients who reported with NS >5. HTN and DM were the most common co-morbidities among the patients which was consistent with previous findings[29]. The weight-to-height ratio (WHR) assessment is not a reliable factor for nutritional assessment as in critical illness, oedema, ascites and post-surgical fluid retention are very common and affect the weight as well as the BMI[22]. That explains the lack of significant changes in BMI and WHR in the current study.

Biochemical variables, including albumin, Hb and Mg were found to be low, and pro-inflammatory factors, like creatinine, CRP and total bilirubin were high in the high nutritional risk group, which was consistent with a previous study[27]. These inflammatory and malnutrition biomarkers were impaired due to the raised inflammation and catabolism in critically ill patients with the progression of the disease. In the current study, albumin level was lower in high nutritional risk group than moderate nutritional risk group, which may indicate the chronic malnutrition status of the critically ill patients. Hypoalbuminemia in a critically ill patient means an exhaustion of body protein in response to protein catabolism and/or decreased intake of protein. Negative NB indicates catabolism, while positive NB indicates anabolism of the protein in the form of albumin[30]. In the present study, most of the patients had negative NB whereas a very few had positive balance as critically ill patients are mostly in a stressful situation[31]. Mean NB

difference was significantly associated with high nutritional risk (p<0.001). Negative NB in critically ill patients may impair renal and liver functions. In the current study, Mg and Hb were low in the high nutritional risk group. These two biochemical variables are regularly used for nutritional status assessment in critically ill patients. The Hb protein has a major role in oxygen carrying process in the blood, while Mg is an important trace mineral that can be associated with irregular bowel movement[32].

The current study has limitations as it was done at a single center and most of the study participants were COVID-19 patients.

Conclusion

Nutritional risk in critically ill patients was found to be on the higher side. The older population had significantly higher NUTRIC score. Nutritional risk might be associated with increase in inflammation and malnutrition due to raise in basal metabolism and catabolism during a critical illness.

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