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Efficacy Analysis Of Validated Nutritional Status Assessment Tools In A Critical Care Setting From Kochi, Kerala

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ABSTRACT
This study aimed to assess the nutritional status of 199 patients in a critical care setting using standard tools that included NRS, MNA, GLIM, SGA, PNI and MUST respectively. Data was collected over one year using a questionnaire administered at the bedside, adopting a judgmental sampling methodology. The analysis was conducted using SPSS and focused on evaluating the sensitivity, specificity and accuracy of the different nutritional assessment tools. All tools were compared with SGA. On assessing Body Mass Index, only 62 among the critically ill belonged to the normal category (18.5- 22.9 kg/m^2) BMI. Results indicated that MNA and GLIM outperformed SGA in identifying malnutrition in the critically ill. MNA was reported to have the highest sensitivity (77.50%) and GLIM, the highest specificity (93.67%). NRS and PNI detected the lowest prevalence of malnutrition. MNA, GLIM, and PNI positively correlated with the length of ICU and hospital stay, while SGA had correlation with length of hospital stay. Mortality odds were higher for at-risk or high-risk groups classified using SGA, MNA, GLIM or PNI. MNA had the highest odds ratio (OR = 6.858) and MUST had the lowest odds ratio (OR = 1.535) for mortality. It can be concluded that MNA and GLIM are more effective tools to assess malnutrition in critically ill patients with MNA having the highest sensitivity and GLIM the highest specificity respectively. The study highlighted a high prevalence of malnutrition and the importance of accurate assessment to plan nutrition support in critical care settings.

Keywords - Nutritional assessment, Nutritional Risk Screening (NRS), Mini nutritional Assessment (MNA), Global Leadership Initiative on Malnutrition (GLIM), Subjective Global Assessment (SGA), Malnutrition Universal Screening Tool (MUST), Prognostic Nutritional Index (PNI)

INTRODUCTION

Assessment of nutritional status of critically ill patients is crucial. Nutritional status of patients in critical care settings is influenced by chronic and acute starvation, and also severity of the underlying pathophysiological conditions. Nutritional Risk Screening (NRS), a simple and rapid first-line tool to detect patients at risk of malnutrition can be performed systematically in patients upon hospital admission[1]. Malnourished patients commonly develop sarcopenia due to hyper catabolism, deep sedation and immobility impairing functional capacity prolonging recovery[2].

It has been reported that approximately half of the patients in the intensive care unit are malnourished at admission. Undernutrition delays recovery and prioritizing nutrition care can facilitate better healing. Focusing on disease and injuries with appropriate nutritional assessment and management is pivotal[3]. Identification of critically ill who require nutritional support, can be facilitated with validated nutritional assessment tools[4]. Using a more specific and sensitive nutritional assessment tool is crucial as inaccurate tool selection can negatively impact the nutrition care process, leading to delayed recovery.

In a meta-analysis regarding SGA and NRS in critically ill, SGA was more favorable and those assessed with SGA grade B and C had poor outcomes[5]. The SGA rating correlated significantly with percentage of body mass loss, serum albumin level, health status scores and mortality[6]. NRS-2002, validated in many studies, including RCTs, has been reported to be very reliable with appropriate training[7]. There exists clear evidence for diagnosis of malnutrition by GLIM to be highly relevant[8]. PNI has a critical role in predicting clinical outcomes of patients with chronic underlying diseases[9].

A systematic and standardized approach to identifying malnutrition is required, mandating appropriate nutritional screening tools. There are many validated tools from across the globe like SGA, MNA, PNI, GLIM and NRS, 2002. The sensitivity and specificity analysis of these tools have not been conducted in Indian settings[10]. This study envisaged the assessment of nutritional status of critically ill patients using NRS, MNA, GLIM, PNI and MUST with a sensitivity, specificity and outcome analysis.

METHODOLOGY

The observational study was conducted among the critically ill. Their nutrition status was analyzed using various nutrition screening tools. The study was approved by the Institutional Ethics Committee (LHRC/EC-2022-02/02), Kochi, Kerala.

Data was collected with help of a questionnaire at the bedside of the critically ill patients. 199 critically ill patients were assessed using retrospective analysis. Data was collected over a period of one year. The judgmental sampling method was used to enroll critically ill in the age group of 20 - 85 years. Retrospective data was collected from 199 critically ill with a questionnaire. The tools used include:

Nutritional Risk Screening (NRS)

The Nutritional risk screening 2002 (NRS, 2002) was developed by Kondrup et al. The tool comprises standard screening parameters, such as Body Mass Index (BMI), patient's age, weight loss, dietary intake, and severity of underlying disease. The total NRS-2002 score ranges from 0 to 7, a score of 3 and below indicates 'low nutritional risk', score of 4 indicates 'at nutritional risk' and above 5 indicates 'high nutritional risk' as per this classification [7].

Mini nutritional Assessment (MNA)

The Mini Nutritional Assessment was implemented by Kaiser et al in 2009. MNA is available in two forms- complete form and short form. The complete MNA includes eighteen items in four domains. While the MNA-SF includes only six items, it is quicker and as effective. Less than 7 points indicates 'malnourished', 8-11 points indicates 'at risk of malnutrition' and 12- 14 points indicates normal nutritional status as per MNA.[5]

Global Leadership Initiative on Malnutrition (GLIM)

In January 2016, the Global Leadership Initiative on Malnutrition (GLIM) was convened by several of the major global clinical nutrition societies. GLIM uses two criteria to assess malnutrition- Phenotypic and Etiological criteria. The phenotypic criteria includes weight loss, low Body Mass Index (BMI), reduced muscle mass and the etiological criteria includes reduced food intake or assimilation and disease burden/inflammation[8].

To diagnose malnutrition at least one phenotypic criterion and one etiologic criterion should be fulfilled. Severity of malnutrition is then graded into stage one and two depending on the score obtained.

Subjective Global Assessment (SGA)

The Subjective Global Assessment (SGA) as a method of assessing nutritional status was developed by Detsky et al in 1987. Data are scored subjectively to determine nutritional status in three major SGA categories as 'well nourished' (A), 'mild to moderately malnourished' (B), or 'severely malnourished' (C). The SGA scale includes parameters to assess subcutaneous fat, muscle wasting, fluid retention, weight change, recent food intake, gastrointestinal symptoms, and functional capacity. SGA is regarded by many clinicians as the gold standard method for diagnosing protein-energy malnutrition due to its simplicity and reproducibility; it has been validated against alternative measures of nutritional status[11].

Malnutrition Universal Screening Tool (MUST)

The British Association for Parenteral and Enteral Nutrition (BAPEN) has developed the Malnutrition Universal Screening Tool (MUST). This tool was developed and validated in 2003 and has been promoted by BAPEN as a nutrition screening tool. Three independent criteria are used by MUST to

determine the overall risk for malnutrition: current weight status using BMI, unintentional weight loss, and acute disease effect that has induced a phase of nil per oral for > 5 days. Each parameter can be rated as 0, 1, or 2 respectively. Overall risk for malnutrition is established as 'low' (score = 0), 'medium' (score = 1), or 'high' (score > 2) as per MUST classification[12].

Prognostic Nutritional Index (PNI)

The Prognostic Nutritional Index (PNI), initially developed by Buzby[13] and later modified by Onodera and Kosaki[14] in 1985, is a readily accessible marker evaluating nutritional and inflammatory status. It is a simple index which is calculated by combining the serum albumin concentration and total peripheral blood lymphocyte count, classifying individual into three categories 'normal', 'mildly malnourished' and 'malnourished' respectively.

Data were analyzed using SPSS version 25 for Windows (version 25, 2017, IBM Corporation, Armonk, New York, United States). Data was presented as Frequency or Percentage. Cross tabulations were computed. Sensitivity, Specificity, Positive Predictive Value, Negative Predictive Value and Accuracy were calculated.

RESULTS

On studying the baseline information of the critically ill (Table 1), the mean age was found to be 56.5±16.5 years. The mean BMI of study participants was 23.8±4.6 kg/m^2. The average length of ICU stay was five days and the length of hospital stay was 12±13 days.

Table 1: Baseline information of critically ill (N=199)

Criteria	Mean± SD
Age (years)	56.5±16.5
Body Mass Index (kg/m^2)	23.8±4.6
Length of hospital stay (days)	12±13
Length of ICU stay (days)	5±5

As indicated in Table 1, on assessing the BMI profile of the critically ill, 31.2% of the patients had normal BMI. Around 13.6% of the patients were underweight, 18.6% were overweight and 36.6% were obese (Figure 1). A study conducted in France revealed that among 222 patients, 15.3% had normal BMI, 41.4% were overweight, 36% were moderately obese and 7.2% were severely obese[15].

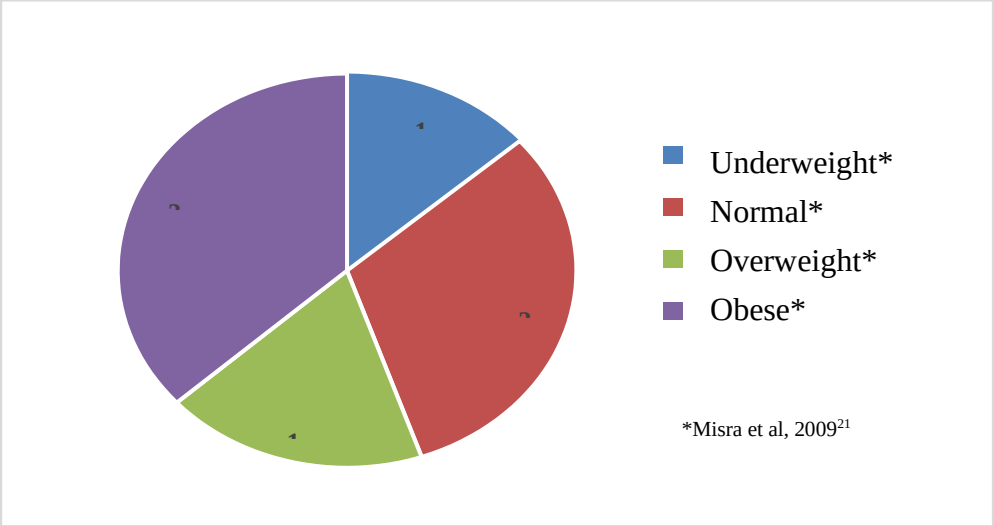

Figure 1: BMI profile of the critically ill

The nutritional status of the critically ill was assessed by different validated methods and the results are presented in Figure 2. On assessing the nutritional status using Nutritional Risk Screening (NRS), majority (79.9%) of the patients were at low risk of malnutrition and a small 5.5% of the patients were at high risk. It was observed that 14.6 % of the patients were at risk of malnutrition. A similar study at Mumbai reported 35.06 % of the patients to be at low risk and 64.94% of patients were

identified as high risk[10]. Another study in Switzerland reported 31% having low risk, 38% at risk and 31% high risk using NRS [16].

On studying the nutritional status using MNA, 22.6% of the critically ill were malnourished and 43.7% were at risk for malnutrition. It was observed that 33.7% were normal by MNA. Similarly in a study in Poland, MNA showed that malnutrition prevalence in older patients ranged from 23.2–34.4% [6]. In another study in Brazil, MNA identified the highest nutritional risk prevalence (73.2%) compared to MUST (39.6%) and NRS, 2002 (27.9%). [17]

The prevalence of malnutrition assessed using GLIM indicated that the majority (73.9%) of patients were normal. Approximately 19.6% of patients were stage 1 malnourished and 6.5% of patients were stage 2 malnourished. A similar study reported prevalence of malnutrition assessed by GLIM to be 59.6%[18]. Another study with 252 older patients revealed that according to GLIM criteria, one-third of outpatient older adults were malnourished[19]

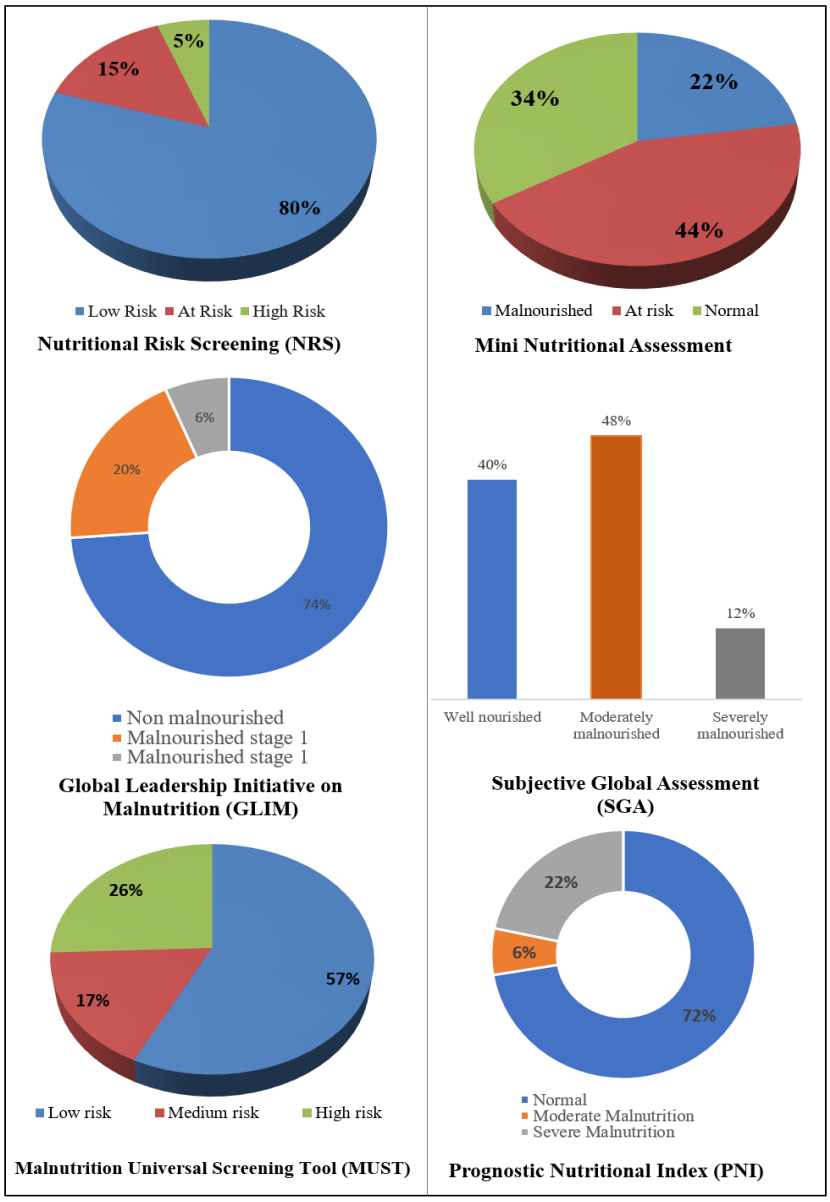

Figure 2: Assessment of nutritional status of critically ill by validated methods

By Subjective Global Assessment. 39.7 % of the patients were well nourished. It was observed that 47.7% of the patients were moderately malnourished and 12.6% were severely malnourished. Assessment by MUST indicated that 57.3% of patients were at low risk of malnutrition. 17.1% of them were at medium risk of malnutrition and 25.6% of the patients were at high risk of malnutrition. A similar study reported that 39% were at medium risk and 61% of the patients were at a high risk of malnutrition[6].

Assessment of nutritional status by PNI indicated that 72.4% of the patients were normal and at low risk of malnutrition. 6% of the patients had moderately malnutrition and 21.6% of patients had severe malnutrition.

As indicated in Table 2, at risk and risk/ malnutrition was combined for all scales for the sensitivity and specificity analysis with respect to SGA. GLIM had the highest specificity (93.67%) in comparison to SGA whereas MNA had the lowest specificity (57.14%) in comparison to SGA. Highest sensitivity was observed for MNA (77.50%) whereas lowest sensitivity was observed for NRS (27.5%). MNA had the best accuracy (70%) followed by GLIM (60.8%).

Table 2: Sensitivity and Specificity of various tools to assess malnutrition in comparison to SGA

	NRS		MNA		GLIM		MUST		PNI	
SGA	**Low risk (n=159)**	**At Risk/ High Risk (n=40)**	**Low risk (n=67)**	**At Risk/ High Risk (n=132)**	**Well nourished (n=147)**	**Mal-nourished (n=52)**	**Well nourished (n=114)**	**Mal-nourished (n=85)**	**Well nourished (n=147)**	**Mal-nourished (n=52)**
Well nourished (n=79) n (%)	72 (45.3) (TN)	7 (17.5) (FP)	40(59.7)	30(29.5)	74(50.3)	5 (9.6)	53(46.5)	26(30.6)	64(44.4)	15(27.3)
Malnourish-ed (n=120) n (%)	87 (54.7) (FN)	33(82.5) (TP)	27(40.3)	93(70.5)	73(49.7)	47(90.4)	61(53.5)	59(69.4)	80(55.6)	40(72.7)
	Value	**95% CI**	**Value**	**95% CI**	**Value**	**95% CI**	**Value**	**95% CI**	**Value**	**95% CI**
Sensitivity (%)	27.5	19.75-36.4	77.50	68.98-84.62	39.17	30.39-48.50	49.17	39.93-58.45	33.33	24.99-42.52
Specificity (%)	91.14	82.59-96.36	57.14	44.75-68.91	93.67	85.84-97.91	67.09	55.60-77.25	81.01	70.62-88.97
Positive Predictive Value (%)	82.50	68.70-91.01	75.61	69.94-80.51	90.38	79.63-95.76	69.41	61.20-76.55	72.73	61.30-81.79
Negative Predictive Value (%)	45.28	42.09-48.52	59.70	50.10-68.61	50.34	46.48-54.19	46.49	40.74-52.34	44.44	40.40-48.56
Accuracy (%)	52.76	45.58-59.86	70.00	62.94-76.42	60.80	53.65-67.63	56.28	49.09-63.28	52.26	45.08-59.37

***TP- True Positive, FP- False Positive, FN- False Negative, TN- True Negative**

A study by Bolayir et al revealed that NRS-2002 has a sensitivity of 88% and specificity of 92%. The positive and negative predictive values were 87% and 92% respectively[20].

As indicated in Table 3, MNA, GLIM and PNI classifications were significantly positively correlated with length of ICU and hospital stay ($p<0.05$). SGA classification was also positively correlated with length of hospital stay ($p<0.05$). However, NRS and MUST classification had no correlation with length of ICU or hospital stay ($p>0.05$).

Table 3: Correlation of various assessment tools with length of ICU and Hospital stay

Assessment tool	Length of ICU stay		Length of Hospital stay	
	Spearman Rho Value	**P Value**	**Spearman Rho Value**	**P Value**
SGA	0.414	0.054	0.243	0.001
NRS	0.017	0.816	-0.060	0.417
MNA	0.328	0.001	0.321	0.001
GLIM	0.237	0.001	0.218	0.001
MUST	0.081	0.272	0.099	0.189
PNI	0.305	0.001	0.248	0.001

As indicated in Table 4, odds ratio for mortality was significantly higher for patients belonging to at-risk or high-risk groups when classified using SGA, NRS, MNA, GLIM and PNI scoring. Highest odds ratio was obtained for MNA (OR = 6.858) followed by GLIM (OR= 5.554) whereas the lowest odds ratio for mortality was obtained for the MUST scoring system (OR = 1.535).

Table 4: Odds ratio of mortality using various assessment tools

Assessment tools	Mortality in low risk group [n (%)]	Mortality in at risk/ high risk group [n (%)]	Odds Ratio (OR)	95% CI	P value
SGA	4 (5.1)	21(17.5)	3.977	1.310 - 12.075	0.014
NRS	16 (10.1)	9 (22.5)	2.595	1.050 - 6.409	0.039
MNA	2 (3)	23 (17.4)	6.858	1.565-30.074	0.012
GLIM	10 (6.8)	15 (28.8)	5.554	2.307-13.373	0.001
MUST	12 (10.5)	13 (15.3)	1.535	0.662-3.557	0.317
PNI	9 (6.3)	16 (29.1)	6.154	2.525-15.000	0.001

CONCLUSION

A significant prevalence of malnutrition was observed among the critically ill, with MNA and GLIM being more accurate assessment tools in comparison to SGA. It was observed that MNA had the highest sensitivity, and GLIM had the highest specificity. The Odds ratio for mortality was the highest for MNA (OR=6.858) and the lowest mortality odds ratio was for MUST (OR=1.535). Nutritional status has a significant impact on the duration of ICU and hospital stays, as well as the morbidity outcome. Further research to validate MNA and GLIM in Indian critical care settings will facilitate establishment of precision with respect to these tools to assess malnutrition. Accurate assessment will facilitate optimal implementation of the nutrition care process in the critically ill with improved morbidity outcome.

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