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Original Article

Factors Associated with the Nutritional Status of Mechanically Ventilated Patients in Intensive Care Unit: A Cross Sectional Study

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ABSTRACT

Background: Nutritional status significantly impacts the outcomes of critically ill patients in intensive care units (ICU), with malnutrition being a common complication that can exacerbate morbidity and mortality rates. The Nutrition Risk in the Critically ill (NUTRIC) score is a valuable tool for identifying patients at risk of malnutrition and guiding nutritional interventions.

Objective: This study aimed to evaluate the factors influencing the nutritional status, as assessed by the NUTRIC score, of mechanically ventilated patients in ICUs across tertiary care hospitals, and to explore the association between nutritional risk and patient outcomes.

Methods: A cross-sectional descriptive study was conducted in five tertiary care hospitals in Khyber Pakhtunkhwa, Pakistan, from August to December 2023. The study included patients aged 18 and above, who were mechanically ventilated for more than 48 hours. The NUTRIC score was calculated based on data collected on demographics, clinical characteristics, and laboratory investigations. Multiple linear regression analysis was performed to identify factors affecting the NUTRIC score using SPSS version 25.

Results: Out of 335 patients, 75.2% were male, and 51.3% were aged between 50-75 years. A high NUTRIC score (indicating higher risk of malnutrition) was found in 25% of patients, while 74.9% had a low NUTRIC score. Factors significantly affecting the NUTRIC score included ventilation status (invasive/non-invasive), number of comorbidities, age, status of life (alive/deceased), and length of stay in ICU. The mortality rate was 3.9%, with a higher prevalence in older age groups.

Conclusion: The study highlights the prevalence of nutritional risk among mechanically ventilated ICU patients and underscores the importance of early nutritional assessment and intervention. Targeted nutritional support, especially for patients with higher risk profiles, is crucial for improving outcomes and reducing mortality rates in this vulnerable population.

Keywords: NUTRIC score, mechanical ventilation, ICU, nutritional status, malnutrition risk, patient outcomes, cross-sectional study, critical care nutrition.

INTRODUCTION

Poor nutritional status frequently accompanies a high burden of comorbidity, playing a significant role in perpetuating a cycle of illness, exacerbating the impact of acute concurrent diseases, and prolonging the effects of chronic conditions (1). In this context, the NUTRIC score, an assessment tool designed to evaluate nutrition risk in critically ill patients, emerges as a pivotal mechanism for identifying those in the intensive care unit (ICU) who could derive the most benefit from nutritional interventions (2). Evidence supporting the correlation between a lower NUTRIC score and reduced mortality spans various patient groups, including those critically ill with COVID-19, individuals undergoing mechanical ventilation in ICUs, patients recovering from cardiothoracic surgery, and those suffering from severe community-acquired pneumonia (3-5). This underscores the importance of evaluating the nutritional status of ICU patients prior to the commencement of general treatment, given the significant role of nutritional therapy

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in reducing mortality rates within this setting. Nutritional risk, defined as the potential for dietary factors to adversely affect clinical outcomes, necessitates the assessment of nutritional status for all patients at high risk upon their initial admission to the ICU (6,7).

Nutritional support stands as a cornerstone in the management of critically ill patients, with the prevalence of malnutrition varying between 39% to 50% depending on the population studied and the screening methods employed (8,9). This condition is associated with higher rates of nosocomial infections, delayed wound healing, and increased mortality. Both acute and chronic phases of starvation can affect a patient's nutritional status upon admission to the ICU, leading to catabolic processes that include loss of body mass and organ failure (10).

In Pakistan, particularly during the three waves of COVID-19, there was a significant increase in the number of patients requiring ICU admission, yet there remains a scarcity of research focused on the nutritional status of these critically ill individuals. The aim of this study is to assess the NUTRIC scores of patients undergoing mechanical ventilation in the ICU, addressing this gap in the literature and contributing to the understanding of nutritional risks and their implications on patient outcomes in this context.

MATERIAL AND METHODS

This cross-sectional descriptive study was conducted across five tertiary care hospitals in Khyber Pakhtunkhwa from August to December 2023. The study aimed to investigate the nutritional status of patients admitted to intensive care units (ICUs) of these hospitals. The inclusion criteria targeted individuals aged 18 and above who were subjected to mechanical ventilation, either invasive or non-invasive, for a duration exceeding 48 hours. Exclusion criteria encompassed patients who succumbed within the initial 48 hours of admission, those diagnosed with brain death, patients transferred to another facility, critically ill patients due to transplant complications, and individuals diagnosed with mental retardation.

Data collection was executed in two phases. Initially, demographic information, including gender, age, previous hospitalizations, and co-morbidities, was extracted from patient files. Laboratory investigations, such as arterial blood gases (ABGs), electrolyte levels, renal function tests, complete blood count, liver function tests, and hematocrit values, were obtained from both the hospital information system and patient files. Clinical assessments including oxygen saturation, blood pressure, pulse rate, body temperature, Glasgow Coma Scale (GCS) level, respiratory rate, mean arterial pressure, and ventilator status were also documented.

In the subsequent phase, patient nutritional status was evaluated using a reliable nutritional score questionnaire, incorporating the Sequential Organ Failure Assessment (SOFA) and Acute Physiology and Chronic Health Evaluation II (APACHE-II) scores to calculate the patient's nutritional risk (NUTRIC) score (11). The SOFA score allocation ranged from 1 point for scores between 6 and 10, indicating low nutrition risk, to 2 points for scores above 10, denoting severe malnutrition. The APACHE-II scoring system assigned 1 point for scores between 15 and 20, 2 points for scores between 21 and 28 (indicating moderate malnutrition), and 3 points for scores above 28, indicative of severe malnutrition. The overall NUTRIC score was categorized into two groups: scores from 0 to 5 suggested low nutritional risk, whereas scores between 6 to 10 indicated high malnutrition risk (11).

Statistical analysis was conducted using SPSS version 25, employing both descriptive and inferential statistics. Multiple linear regression analysis was utilized to ascertain the factors influencing the SOFA, APACHE-II, and NUTRIC scores of the participants.

Ethical considerations were meticulously observed throughout the study. The research protocol received approval from the institutional review board, and permission for data collection was granted through a formal request to the participating hospitals. The study's objectives were clearly communicated to both patients and their attendants, ensuring an understanding that participation was voluntary, devoid of any potential harm, and that withdrawal could occur at any stage. Confidentiality of participant data, to be used solely for analysis purposes, was guaranteed. The commencement of data collection was predicated on obtaining informed consent from either the participant or a family member, in the presence of hospital staff, in adherence to the principles outlined in the Declaration of Helsinki.

RESULTS

In the conducted study, a total of 335 patients admitted to intensive care units across five tertiary care hospitals in Khyber Pakhtunkhwa were assessed to determine the impact of various factors on their nutritional status. The demographic distribution of the participants revealed a predominant male representation, accounting for 75.2% (252) of the sample, while females constituted 24.8% (83) (Table 1). Age-wise, the majority of the patients fell into the 18-50 and 50-75 year brackets, with 46.3% (155) and 51.3% (172) respectively, and a minimal percentage, 2.4% (8), being older than 75 years. The incidence of co-morbidity was notably divided, with 47.5% (159) of the patients having one co-morbidity and 52.5% (176) presenting with two or more. The length of stay in the ICU varied, with a significant majority, 72.5% (243), staying between 2 to 3 days, 11.9% (40) for 4 to 6 days, and 15.5% (52) for 7 days or more. The outcome status post-ICU stay indicated a high survival rate, with 96.1% (322) being discharged alive, whereas only 3.9% (13) succumbed during their stay (Table 1).

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The nutritional assessment through the SOFA and APACHE scores, along with the NUTRIC score, provided insight into the nutritional risks and status of the ICU patients. The SOFA score averaged at 9.5 ± 2.9, with a significant distribution across the scoring range: no patients scored between 1-5, 53.1% (178) scored between 6-9 (1 point), and 44.7% (150) scored above 10 (2 points), indicating a prevalence of severe malnutrition risk among nearly half of the patients. The APACHE score further underscored this risk, with an average score of 19.3 ± 3.3; 6.2% (21) scored below 15, nearly half, 49.8% (167), fell into the 15-19 score range, and 42.9% (144) scored between 20-28, with a negligible 0.8% (3) scoring above 28. The categorization of NUTRIC scores reflected that a substantial majority, 74.9% (251), had low nutritional risk, while 25.0% (84) exhibited high malnutrition risk (Table 2).

Table 1: Demographic Data of the Participants

Variable	Frequency	Percentage (%)
Gender		
Male	252	75.2
Female	83	24.8
Age (years)		
18-50	155	46.3
50-75	172	51.3
>75	8	2.4
Co-morbidity		
One	159	47.5
Two or more	176	52.5
Length of Stay (days)		
2 to 3	243	72.5
4 to 6	40	11.9
7 and above	52	15.5
Status of Life		
Alive discharge	322	96.1
Death during stay	13	3.9

Table 2: SOFA, APACHE, and NUTRIC Scores

Score Type	Measurement	Frequency/ Mean ± SD
SOFA Score		9.5 ± 2.9
	1-5 (0 points)	0 (0%)
	6-9 (1 point)	178 (53.1%)
	>10 (2 points)	150 (44.7%)
APACHE Score		19.3 ± 3.3
	<15 (1 point)	21 (6.2%)
	15-19 (2 points)	167 (49.8%)
	20-28 (3 points)	144 (42.9%)
	>28 (4 points)	3 (0.8%)
NUTRIC Score		
	Low (0-5)	251 (74.9%)
	High (6-10)	84 (25.0%)

Table 3: Factors Affecting SOFA, APACHE, and NUTRIC Scores of ICU Admitted Patients

Factor	SOFA Score	APACHE Score	NUTRIC Score
	B	SE	t
Constant	3.899	.719	5.426
Gender	.430	.298	1.444
Ventilation Status	1.340	.302	4.443
Number of Comorbidities	1.173	.524	2.238

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Factor	SOFA Score	APACHE Score	NUTRIC Score
Age	-.419	.484	-.865
Status of Life	3.675	.718	5.121
Total Days in ICU	1.872	.228	8.225

The regression analysis elucidated the factors affecting the SOFA, APACHE, and NUTRIC scores. The analysis highlighted that the type of mechanical ventilation (invasive/non-invasive) had a significant impact on both SOFA and APACHE scores, suggesting a direct correlation between ventilation method and nutritional risk. The number of comorbidities was another critical factor, significantly influencing all three scores, which underscores the complexity of managing patients with multiple health issues. The age of the patients showed a differential impact; while it negatively affected the APACHE score, indicating older patients might have higher severity scores, it positively influenced the NUTRIC score, suggesting an increased nutritional risk with advancing age. The total length of stay in the ICU was directly proportional to the severity of the scores across all measures, indicating prolonged stays are associated with higher nutritional risks and severity of illness (Table 3).

DISCUSSION

The investigation into the nutritional status of ventilated patients in the intensive care units of tertiary care hospitals revealed significant insights into the prevalence and determinants of malnutrition among this vulnerable population. The importance of nutrition in the management of critically ill patients cannot be overstated, as it plays a pivotal role in patient rehabilitation, outcomes, and the mitigation of nosocomial infections, while concurrently reducing the treatment costs associated with serious conditions in the ICU (12, 13, 14). Both acute and chronic malnutrition were identified as critical factors affecting the nutritional condition of patients, triggering catabolic processes such as the rapid loss of lean body mass and organ failure. The urgency of nutritional assessment within 48 hours of hospital admission was underscored, aiming to identify those at risk and initiate appropriate interventions (15, 16).

In this study, a quarter of the patients (25%) exhibited high NUTRIC scores (6 to 10), placing them at a significant risk of malnutrition, while the majority (74.9%) had low NUTRIC scores (1 to 5), indicating a lower risk. These findings align with previous research conducted in diverse geographical locations, including China, where a high NUTRIC score (≥5) was observed in 28.2% of patients, correlating with a poor prognosis in ICU patients (17), and Turkey, which reported a malnutrition prevalence of 22.4% among ICU patients with high NUTRIC scores (9). Similar observations were made by Lew et al., who found that 28% of patients had high NUTRIC scores using a 7-point subjective global assessment (18), and in Pakistan, where 45% of ICU patients had mNUTRIC scores of > 5, indicating high nutritional risk (19). These studies collectively highlight the global challenge of managing malnutrition among mechanically ventilated ICU patients and underscore the predictive value of the NUTRIC score in assessing nutritional risk.

Mortality rates within the study cohort were observed to be 3.9%, with the age groups of 50-75 years and above 75 years being the most affected. This is relatively lower compared to other studies, where mortality rates ranged significantly from 20.7% in specific age groups to over 50% in broader patient populations (10, 11, 21). The significant factors affecting NUTRIC scores included ventilation status, number of comorbidities, age, life status, and length of stay in the ICU. This is consistent with findings from an Indian study, where high mNUTRIC scores (≥5) were associated with longer ICU stays and a higher mortality rate of 41.4% (10). Our analysis suggests that the probability of mortality was notably influenced by the NUTRIC score, aligning with other research indicating a mortality rate of 67.7% among patients with the highest NUTRIC scores, a figure comparable to Jeong's study, which reported a rate of 62.5% (22).

The study, however, is not without its limitations. The focus on a Pakistani population within a single province may restrict the generalizability of the findings. Furthermore, the exclusion of specific nutrient information, such as calorie and protein provision, due to the unavailability of medical records, represents a significant gap. The observational retrospective nature of the study further limits the ability to draw causal inferences. To overcome these limitations and enhance the outcomes of ICU patients through dietary interventions, there is a pressing need for comprehensive randomized controlled trials.

CONCLUSION

In conclusion, while the majority of the study population presented with low nutritional risk, a substantial proportion exhibited high NUTRIC scores, indicating a severe risk of malnutrition. This risk was particularly pronounced among patients with invasive ventilation, multiple comorbidities, older age, and extended hospital stays. These findings not only reinforce the critical importance of early and accurate nutritional assessment in the ICU but also call for targeted interventions to mitigate the risks associated with malnutrition in this highly vulnerable patient group.

This study underscores the critical importance of nutritional assessment and intervention in the management of mechanically ventilated ICU patients, revealing a significant proportion at high risk of malnutrition. The findings highlight the need for integrated healthcare strategies that prioritize nutritional support, particularly for patients with invasive ventilation, multiple comorbidities, advanced age, and longer hospital stays. By addressing these nutritional risks, healthcare providers can significantly improve patient outcomes, reduce mortality rates, and alleviate the burden on healthcare systems, underscoring the vital role of nutrition in the comprehensive care of critically ill patients.

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