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Assessment of Nutritional Status for Intensive Care Patients

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Abstract

Malnutrition is highly prevalent among intensive care unit (ICU) patients and is considered one of the major public health problems associated with a variety of negative clinical outcomes. Therefore, identifying malnourished patients as early as possible on admission to the ICU by applying nutritional assessment will help in developing appropriate nutritional plans to minimize the consequences of malnutrition and may reduce the length of ventilator dependency and ICU- length of stay (LOS). Several nutritional assessment tools are used to identify patients at nutritional risk using various criteria including anthropometric data, history of weight loss, clinical diagnosis, physical examination, and dietary intake. This study sought to assess the nutritional status of ICU patients who are on enteral feeding by detecting the prevalence of malnutrition risk among them at different hospitals in Holy Makkah. This is an observational cross-sectional study that was conducted on 100 ICU patients on enteral feeding. Patients were recruited from ICUs words in the Saudi Ministry of Health's Hospital connected to Holy Makkah

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Healthcare Cluster. The Nutritional Screening and Assessment Tool was used to evaluate Patients' nutritional status. Data analysis were statistically performed using SPSS program version 23. The nutritional assessment of the ICU patients showed that 79% were at high risk of malnutrition, and most of these (78%) had low albumin levels. Moreover, 18% of the patients were underfed based on calorie intake and 37% of them were underfed based on protein intake. Furthermore, there was an association between patients' risk level for malnutrition and some factors, including gender and feeding type (P = 0.014 and P = 0.012, respectively). The findings indicate a prevalence of malnutrition risk among ICU patients in some Holy Makkah Hospitals was 79%, with underfed calories and protein

Introduction

Nutritional status refers to the presence or absence of malnutrition.[1] Malnutrition term can result from either under-nutrition (insufficient intake or impaired use), or over-nutrition (excessive calorie intake and/or inadequate physical activity) of both macronutrients or special micronutrients.[2] Malnutrition is a global health concern that is highly prevalent among intensive care unit (ICU) patients. In developing countries, the prevalence is 78.1%, whereas in developed nations, 50.8%.[3] Furthermore, over half of all ICU patients worldwide are significantly underfed.[4] In addition, a pilot study conducted in Saudi Arabia assessed the sufficiency of enteral feeding administration in ICU patients. The results showed that around 44% of the ICU patients were malnourished on admission, and the incidence of underfeeding exceeded 90%.[5] A previous prospective study in the ICU showed that enteral nutrition interruption resulted in approximately 25% of patients included in this study failing to meet calculated caloric and protein requirements during the first 4 days of admission.[6]

Nutritional assessment is a crucial step for critically ill patients.[7] Furthermore, assessing the nutritional status of all ICU patients must be performed within 24 hours of admission by using a validated tool that should not delay the initiation of nutrition intervention.[8]

Several nutritional assessment tools are employed to assess patients' nutritional status and to identify their nutritional risk by collecting various criteria including anthropometric data, body mass index (BMI), history of weight loss, clinical diagnosis, physical examination, and dietary intake.[9] According to biochemical indicators such as serum levels of albumin, they are commonly used to monitor nutritional status.[10] Moreover, there is a clear relationship between all-cause mortality and serum albumin concentrations in elderly subjects.[11]

Recently, other cross-sectional study was conducted among ICU patients who may have been in a state of malnutrition before admission, or they are at high risk of being malnourished. In addition, intensive care patients were in a catabolic state that increased metabolic demands and raised the incidence of malnutrition.[3] ICU patients need more nutrients and energy compared with simple-condition patients to improve their health and achieve a normal state of health.[12] Literature studies suggest other factors that are associated with malnutrition that influence its prevalence, including polypharmacy, educational level, higher age, health care system, and economic status of the nation. Furthermore, one study on ICU patients found that delayed initiation of enteral feeding had a straightforward influence on malnutrition severity.[14] Moreover, there is strong evidence showing that early initiation of enteral feeding is useful for critically ill patients.[15]

Several studies have explored the effects of malnutrition on ICU patients, finding that malnutrition is associated with longer hospital stays, as well as higher mortality rates.[16] Another prospective study reported that underfeeding hurt critically ill patients' outcomes.[17] Hence, Identifying malnourished patients as early as possible after patients' admission to the ICU using nutritional assessment tools will help in developing nutritional interventional plan to minimize the consequences of malnutrition and potentially reduce the length of ventilator

dependency, as well as ICU/hospital stay, and mortality rate.[5, 14]

Thus, nutritional support should be provided to all ICU patients. However, despite the widespread recognition of the importance of nutritional intervention in ICUs, achieving optimal nutrition remains difficult in most ICUs.[12] Accordingly, our study aimed to evaluate the nutritional status of ICU patients receiving enteral feedings, and to determine the prevalence of malnutrition risk among these patients at different hospitals in Holy Makkah.

Material and Methods

Study Subjects

This project assessed the nutritional status of 100 ICU patients on enteral feeding using an observational cross-sectional study. We used the Raosoft® website to determine the sample size (http://www.raosoft.com/samplesize.html). A random sampling technique selected the patients through files from medical records or during regular morning rounds in the ICU at five Hospitals in Holy Makkah. The study was conducted between May 30, 2021, and March 30, 2022.

Inclusion and Exclusion Citeria

Male and female ICU enteral-feeding patients aged ≥ 18 – 90 years old were enrolled in the study. Part of their inclusion criteria is that their length of ICU hospital stays (LOS) ≥ 3 days. The exclusion criteria included any patients aged under 18 and above 90 years old; not on enteral feeding (nothing by mouth (NPO); on oral or parenteral nutrition (PN); and with ICU-LOS less than 3 days. Also, patients who were diagnosed with brain death at admission or with terminal cancer were excluded.

Data Collection Tool

Saudi Ministry of Health assessment tool (The Nutrition Screening and Assessment Form) was used to assess nutritional status for ICU patients. This tool contains four main parts concerning patients' demographic data: anthropometric measurements, biomedical data, clinical evaluation, and dietary history.[18]

Procedure

The nutrition Screening and Assessment Form was used to collect the data, either through files from medical records or through regular morning rounds in the ICU according to the inclusion and exclusion criteria. The Data included age, gender, diagnosis, anthropometric measurements to assess body mass index (BMI), laboratory serum analysis such as: albumin, sodium, potassium, hemoglobin, blood urea nitrogen (BUN), and creatinine; and dietary intake of proteins and calories that patient received from enteral feeding. After that, calorie and protein requirements were calculated by using simple weight-based equations according to European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines on clinical nutrition in the ICU and comparing the results with the amount of feeding those patients received.[19] Calories and protein intake sufficiency from nutritional therapy was defined as 80–120% of the goal-feeding amounts.[10] Laboratory test results were compared to the reference value approved by the Saudi Ministry of Health's Hospital and were determined as low, normal, and high values.[20]

Moreover, data was interpreted and compared with the patient's requirements according to ESPEN guidelines to determine if the patient was at risk of malnutrition or not. Meanwhile, the type of enteral feeding (continuous or bolus), Mechanical ventilation (MV) dependency, and LOS were also reported to define any significant relation between them and the risk of malnutrition.

Statistical Analysis

The Statistical Package for the Social Sciences, SPSS version 23.0 was used for data analysis. For categorical variables, frequencies and percentages were calculated. Data was expressed as mean ± standard deviation or frequencies (percentages). Independent t-tests for continuous variables. The p-value of less than 0.05 ($P < 0.05$) was considered statistically significant.

Results

Demographic and Clinical characteristics of the Patients

The patients were predominantly greater than 60 years (72%), and most of the patients enrolled were male (58%). According to the BMI classification, 10% of patients were underweight, 27% were overweight, and 15% were obese. Moreover, 70% of patients received continuous enteral feeding, while 30% received bolus feeding, and 82% were on MV. Furthermore, 37% of patients had a three- to six-day

stay in ICU, and 36% stayed in an ICU for over 14 days. Demographic and clinical data are presented in Table (1). Moreover, pulmonary disease (37%), cardiac disease (19%), and sepsis (17%) were the most prevalent diagnoses, as displayed in Figure (1).

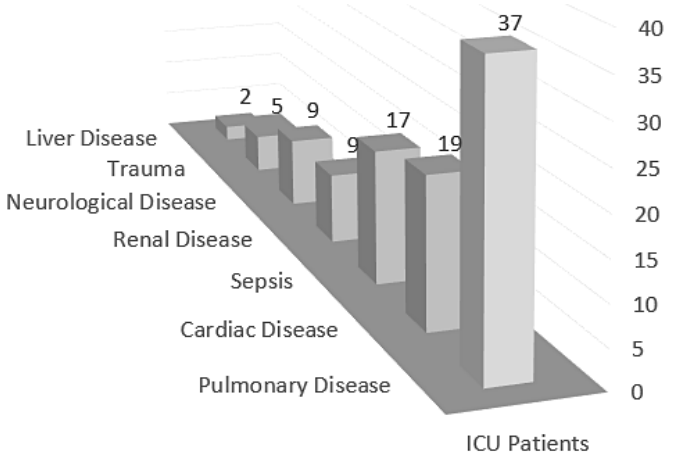

Fig 1: ICU patients' diagnosis according to the cause of admission

Table 1: Demographic and clinical data of ICU patients (N=100)

Characteristics	Number of Patients	%
Age		
18 – 60 years	28	28.00
Greater than 60 years	72	72.00
Gender		
Male	58	58.00
Female	42	42.00
BMI		
Underweight	10	10.00
Normal weight	48	48.00
Overweight	27	27.00
Obesity class 1	9	9.00
Obesity class 2	3	3.00
Obesity class 3	3	3.00
Feeding Type		
Continuous Feeding	70	70.00
Bolus Feeding	30	30.00
MV* Dependency		
Yes	82	82.00
No	18	18.00
LOS**		
3 - 6 days	37	37.00
7 - 14 days	27	27.00
More than 14 days	36	36.00

*MV: Mechanical ventilation, **LOS: Length of stay

Caloric, Protein Intake and Requirements

Table (2) demonstrates the nutritional status of the ICU Patients, based on calorie and protein intake. The mean calories and protein intake were 1444.35 ± 312.71 kcal and 71.91 ± 22.78 g, respectively. These results showed a significant decrease in calories and protein intake when compared to recommended dietary intake (RDI), which were 1574.1 + 237.66 kcal for calories and 81.24 + 14.52 g for protein, indicating that the mean percentage of calorie and protein intakes per daily requirements was 92.44% and 88.6%, respectively.

Overall, 18% of the patients were underfed (based on calorie intake), and 37% of the patients were underfed (based on protein intake) with underfeeding being an intake of less than 80% of daily requirements as seen in Table (3).

Serum Laboratory Findings for Studied Samples

Table (4) summarizes the biochemical measurements (hemoglobin, sodium, potassium, creatinine, BUN, and albumin levels). Most of the patients (78%) had low albumin levels, 81% had hemoglobin below the normal range, and 81% of patients had high BUN levels. In addition, 39% of patients had high levels of creatinine and according to their potassium levels, 25% of patients had hypokalemia.

Table 2: Caloric, protein intake and requirements

Calorie	**Mean + SD***
Calorie requirement per day	1574.1 + 237.66
Calorie intake per day	1444.35 + 312.71
Percentage of calorie intake from calorie requirements	92.44 + 16.86
Protein	**Mean + SD***
Protein requirement per day	81.24 + 14.52
Protein intake per day	71.91 + 22.78
Percentage of protein intake from protein requirements	88.6 + 21.38

*SD: Standard deviation

Table 3: Level of feeding according to calorie and protein intake

Calorie	**N**	**%**
Underfeeding (intake less than 80% of daily requirements)	18	18
Recommended-feeding amount (intake between 80% - 120% of daily requirements)	78	78
Overfeeding (intake higher than 120% of daily requirements)	4	4
Protein	**N**	**%**
Underfeeding (intake less than 80% of daily requirements)	37	37
Recommended-feeding amount (intake between 80% - 120% of daily requirements)	57	57
Overfeeding (intake higher than 120% of daily requirements)	6	6

Table 4: Laboratory data studied for ICU patients

Laboratory Test	**Result**	**N**	**%**
Hemoglobin (Hb)* (mg/L)	Anemia	81	81
	Normal Hb level	17	17
	High Hb level	1	1
	Undocumented	1	1
Sodium (mmol/L)	Hyponatremia	26	26
	Normal level of sodium	52	52
	Hypernatremia	22	22
Potassium (mmol/L)	Hypokalemia	25	25
	Normal level of potassium	68	68
	Hyperkalemia	6	6
	Undocumented	1	1
Creatinine (umol/L)	Low level of creatinine	35	35
	Normal creatinine	26	26
	High level of creatinine	39	39
BUN** (mmol/L)	Low level of BUN	1	1
	Normal level of BUN	18	18
	High level of BUN	81	81
Albumin (g/L)	Hypoalbuminemia	78	78
	Normal level of albumin	10	10
	Undocumented	12	12

*Hb: Hemoglobin, **BUN: Blood urea nitrogen.

Table 5: Assessment of malnutrition risk levels based on various parameters: *BMI: Body mass index

Malnutrition Risk Assessment	N	%
Based on BMI*		
No risk of malnutrition (normal BMI (18.5 – 24.9 kg/m²))	50	50
Low risk of malnutrition (BMI is between 16.6–18.49 or 25-29.9 kg/m²)	30	30
High risk of malnutrition (BMI is less than 16.6 or 30 kg/m² and higher)	20	20
Based on Albumin Level		
No risk of malnutrition (albumin = 34 – 50 g/l)	10	10
Low risk of malnutrition (albumin = 30.6 – 33.9 g/l)	9	9
High risk of malnutrition (albumin less than 30.6 g/l)	69	69
Undocumented	12	12
Based on Calorie Intake		
No risk of malnutrition (intake between 80% - 120%)	72	72
Low risk of malnutrition (intake between 60% - 80% or 120% - 140%)	22	22
High risk of malnutrition (intake less than 60% or higher than 140%)	6	6
Based on Protein Intake		
No risk of malnutrition (intake between 80% - 120%)	55	55
Low risk of malnutrition (intake between 60% - 80% or 120% - 140%)	37	37
High risk of malnutrition (intake less than 60% or higher than 140%)	8	8

The assessment of Malnutrition Risk Levels based on various Parameters

The values of BMI, albumin levels, calorie and protein intakes are shown in Table (5). Based on BMI values, 50% of ICU patients were not at risk of malnutrition, 20% of them were at high risk and 30% were at low risk. According to their albumin levels, most patients were at high risk of malnutrition (69%) while 9% were at low risk. Based on their calorie intake, 22% of patients were at low risk of malnutrition, and only 6% of them were at high risk. Moreover, 37% of patients were at low risk of malnutrition, and only 8% of the patients were at high risk based on their protein intake.

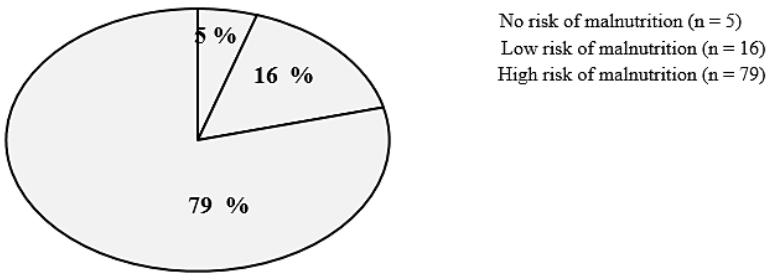

Fig 2: Prevalence of malnutrition risk among ICU patients

Prevalence of Malnutrition Risk among ICU Patients

The percentage of patients at malnutrition risk is shown in Figure (2), based on various parameters (BMI, albumin level, calories, and protein intake). There were 79% of patients at high risk of malnutrition, 16% at low risk, and 5% had no risk of malnutrition.

Factors Correlated with the Risk of Malnutrition in ICU Patients

Table (6) demonstrates the association of the risk level of malnutrition with various factors, including age, gender, diagnosis, feeding type, MV dependency, and LOS. It could be concluded that there was no substantial association between

the factors and malnutrition risk based on overall parameters, including BMI, albumin level, protein, and calories intake. However, 79.2% of patients older than 60 years were at high risk of malnutrition. Moreover, 81.7% of MV-dependent patients were at high risk of malnutrition, and 13.4% of patients were at low risk.

Correlation of Factors with the Risk of Malnutrition based on BMI and Protein

The association of the risk level of malnutrition with some factors, including; gender and feeding type is recorded in Table (7). Based on the BMI value, gender type was significantly associated with malnutrition risk (P = 0.014), indicating that female ICU patients showed a significantly higher rate of high risk (33.3%) compared to male patients (10.3%). Similarly, the association based on protein intake and feeding type was significantly related to the risk of malnutrition (P = 0.012), with those receiving bolus feeding exhibiting a notably higher risk of malnutrition (20%) compared to those receiving continuous feeding (2.9%). (P value < 0.05)

Table 6: Factors correlated with the risk of malnutrition in ICU patients

Factors	Malnutrition Risk Assessment			
	No risk (n = 5)	Low risk (n = 16)	High risk (n = 79)	P-Value
Age				
18 – 60 (n = 28)	1 (3.5%)	5 (17.8%)	22 (78.5 %)	0.874
Older than 60 years (n = 72)	4 (5.6%)	11 (15.3%)	57 (79.2%)	
Gender				
Male (n = 58)	2 (3.4%)	8 (13.8%)	48 (82.8%)	0.514
Female (n = 42)	3 (7.1%)	8 (19%)	31 (73.8%)	
Diagnosis				
Pulmonary disease (n = 37)	2 (5.4%)	6 (16.2%)	29 (78.4%)	0.991
Cardiac disease (n = 19)	2 (10.5%)	4 (21.1%)	13 (68.4%)	
Renal disease (n = 9)	0 (0%)	1 (11.1%)	8 (88.9%)	
Liver disease (n = 2)	0 (0%)	0 (0%)	2 (100%)	
Sepsis (n = 17)	1 (5.9%)	3 (17.6%)	13 (76.5%)	
Neurological disease (n = 9)	0 (0%)	1 (11.1%)	8 (88.9%)	
Trauma (n = 5)	0 (0%)	1 (20%)	4 (80%)	
Gastrointestinal diseases (n = 2)	0 (0%)	0 (0%)	2 (100%)	
Feeding Type				
Continuous (n = 70)	3 (4.3%)	11 (15.7%)	56 (80%)	0.870
Bolus (n = 30)	2 (6.7%)	5 (16.7%)	23 (76.7%)	
MV* Dependency				
Yes (n = 82)	4 (4.9%)	11 (13.4%)	67 (81.7%)	0.310
No (n = 18)	1 (5.6%)	5 (27.8%)	12 (66.7%)	
LOS**				
3 - 6 days (n = 37)	2 (5.4%)	5 (13.5%)	30 (81.1%)	0.955
7 - 14 days (n = 27)	1 (3.7%)	4 (14.8%)	22 (81.5%)	
More than 14 days (n = 36)	2 (5.6%)	7 (19.4%)	27 (75%)	

*MV: Mechanical ventilation, **LOS: Length of stay.

Discussion

Assessing nutritional status should be done for all hospitalized patients, particularly ICU patients. Nutritional intervention is the essential key factor in the recovery of these patients. Additionally, malnutrition is typical in critically ill patients and is associated with adverse clinical outcomes. In our study, 79% of patients in the ICU were at

high risk of malnutrition. Our findings are similar to those of a study[3] that assessed malnutrition by using a subjective global assessment (SGA) tool, which showed that the prevalence of malnutrition among ICU patients in developing countries was 78.1%. Furthermore, the underlying causes for the development of malnutrition are inadequate dietary intake or malabsorption, increased nutritional needs, complications of the underlying disease, or a combination of these factors.[21]

Table 7: Correlation of factors with the risk of malnutrition based on BMI and protein intake

Factors	**Malnutrition risk based on BMI***			**P-Value****
Gender	**No risk (n = 50)**	**Low risk (n = 30)**	**High risk (n = 20)**	
Male (n = 58)	34 (58.6%)	18 (31%)	6 (10.3%)	0.014
Female (n = 42)	16 (38.1%)	12 (28.6%)	14 (33.3%)	
Factors	**Malnutrition risk based on protein intake**			**P-Value**
Feeding type	**No risk (n = 55)**	**Low risk (n = 37)**	**High risk (n = 8)**	
Continuous (n = 70)	42 (60%)	26 (37.1%)	2 (2.9%)	0.012
Bolus (n = 30)	13 (43.3%)	11 (36.7%)	6 (20%)	

*BMI: Body mass index, **Significant level P < 0.05

Malnutrition risk is highly prevalent among elderly ICU patients who are greater than 60 years old. The high risk of malnutrition for this group is connected to many malnutrition-enhancing changes related to the aging process, along with other risk factors, including chronic diseases, drug interactions, organic disorders, psychological disorders, physical impairment, lifestyle, and social factors, improper oral intake, and other conditions that impair nutritional status. A previous study [22] showed that the prevalence of malnutrition risk in a group of older patients was 71.24%,compared to younger patients This result is consistent with our finding that most ICU patients were older than 60 years, and 79.2% of these patients were at high risk of malnutrition.

In the current study, we observed that the most prevalent diagnoses were pulmonary disease, cardiac disease, and sepsis, respectively. A similar pattern of results was obtained from a study conducted to assess the nutritional status of critically ill patients where they found sepsis and infection, cardiovascular diseases, and neoplasms were the most prevalent diagnoses.[23]

Therefore, an early intervention of nutritional screening targeting these populations are vital within their 24 admissions to improve their quality of life, accordingly, the results related to the level of feeding according to calorie and protein intakes which were conducted by an earlier study 10 which evaluated nutritional adequacy considering 80-120% of calorie and protein intake from nutrition therapy of patients' requirements. Moreover, below 80% of calorie and protein intake was reflected as underfeeding while consuming more than 120% of the patients' requirements is considered as over-feeding. Moreover, the result of this study found that 61.85% of prescribed calories and 63.9% of proteins could be delivered to patients. In consequence, 80% of the researchers' population failed to meet optimal energy and protein targets 10. However, In the present study, according to the patients' nutritional data, which included the amounts of protein and calorie requirements and received, we found that the mean percentage of calories and protein intake from requirement per day were 92.4 and 88.6%, respectively. Additionally, we found that based on calorie intakes, 18% of the patients were classified as underfed and 4% were overfed; and based on protein intakes, 37% of patients were classified as underfed and 6% were overfed.

Furthermore, underfeeding is associated with increased ICU-LOS, infections, and overall complications. Conversely, overfeeding has also been well-described in ICU patients and is associated with high blood glucose, liver dysfunction, azotemia, and high mortality.[17] However, prior studies addressed the reasons for insufficient enteral feeding in ICU patients, which included gastrointestinal intolerance, delayed initiation, slow infusion rates, discontinuing and resuming enteral feeding due to endotracheal intubation, surgical interventions, or diagnostic procedures.[24]

Our study found that there is a significant correlation between malnutrition risk based on protein intake and feeding type (P = 0.012), 20% of the patients who received bolus enteral feeding were at high risk of malnutrition, while only 2.9% of those who received continuous enteral feeding were at high risk. Also, receiving enteral nutrition by bolus puts the patient at high risk of aspiration, increased esophageal pressure, and the risk for reflux, all of which interfere with the full nutrient delivery so the amount of protein intake could be affected by the type of enteral feeding that patients receive during ICU admission, meanwhile, the most abundant protein in human serum is albumin which used as a marker of the nutritional status of patients and an indicator of malnutrition.[25] According to our study, most of the patients (78%) had a low albumin level, and (69%) of patients had a high risk of malnutrition based on their albumin values. Another study [23] considered a serum albumin value of less than 3.5 g/dL as an indicator of malnutrition, and they found the prevalence of malnutrition according to the albumin values was 81.1%. In contrast, study [26] reported that albumin levels can be affected by a multitude of disease processes and concluded that albumin is good for detecting inflammatory states rather than malnutrition. Thus, as can be seen, the role of serum albumin in diagnosing malnutrition is controversial. This is explained by the fact that underlying diseases such as inflammatory states are considered a main factor in causing low levels of serum albumin.[11]

In the context of malnutrition, using albumin as a marker for nutritional status has been a topic of ongoing debate in the research. In the past, albumin was considered a reliable marker of protein-energy malnutrition, especially in clinical settings. However, more recent research has suggested that albumin levels are influenced by various factors beyond nutrition alone, such as inflammation, infection, hydration status, liver function, and other underlying conditions. This makes it a less specific indicator of nutritional status. More studies are needed to better clarify the impact of albumin in assessing nutrition with the presence of factors such as inflammation. Combining albumin with other nutritional markers or assessments, such as prealbumin, transferrin, or functional evaluations, might provide a more accurate picture of a patient's nutritional status.

As for the relationship between the ICU patient's LOS and malnutrition risk, our study found no significant association between them (P = 0.955). This may result from the short ICU-LOS as most of our patients (37%) had an ICU-LOS from 3 to 6 days, hence, it is difficult to establish this association because it might be related to other parameters such as disease severity.[27] Moreover, there were not any association between malnutrition and ICU-LOS, and this may be attributed to their participants' shortened average ICU-LOS (i.e., three days).[28] In contrast, one study found that the prevalence of malnutrition increases during an ICU stay, with 83% of the patients, they examined having malnutrition upon ICU admission, and 90% having malnutrition on discharge. The nutritional assessments of BMI, weight, and height, for the patients who completed two weeks in ICU showed significant differences, while there was no significant correlation in these parameters in the fourth week.[12]

Study[3] assessed nutrition status in critically ill patients and found that the anthropometric measurements relating to BMI were more effective predictor of malnutrition in critically ill ICU patients compared to biochemical tests. According to the factors that may be associated with the risk of malnutrition, our study found a significant correlation between gender and increased risk of malnutrition based on BMI value (P = 0.014), and we found that females had a higher risk (33.3%) of malnutrition than males (10.3%). A previous study measured optimal nutrition during the period of MV in acute critically ill female patients, which found that the optimal energy goal for female patients was achieved easily while protein was not, with no difference in outcome related to feeding in male patients.[28]

Conclusion

Malnutrition risk is highly prevalent among ICU patients in some Holy Makkah Hospitals with underfed calories and protein intake. Gender and feeding types are considered factors that may correlated with the risk of malnutrition in ICU patients. The findings indicate a prevalence of malnutrition risk among ICU patients in some Holy Makkah Hospitals was 79%, with underfed calories and protein. Therefore, it is important to review the nutritional support lists, especially for protein and calories, especially for intensive care patients in hospitals, to avoid potentially related risk factors.

Significant Statement

Malnutrition is highly prevalent among ICU patients and is considered a serious public health problem that is associated with a variety of negative clinical outcomes. Results highlighted the critical need for early detection and intervention for assessing the nutritional status of ICU patients who are on enteral feeding while detecting the prevalence of malnutrition risk among them at different hospitals.

Recommendations

From our study some recommendations need to be considered with ICU patients including the importance of nutrition and its impact on patients' outcomes must be understood by all healthcare providers, establishing specific tools to assess nutritional status in ICU patients, clinical dietitians must accurately assess patients upon admission and determining individualized calories and other nutrient requirements and compensate deficiency if present. Moreover, future studies are recommended to be conducted on a larger group of patients. Furthermore, it is better to design interventional instead of observational studies to confirm and clarify the relationship between reported risk factors and nutritional values including albumin status in patients with enteral and parenteral feeding.

Study Strengths

To our knowledge, our study is the first one in the KSA, especially in the Western region (Holy Makkah region) assess the nutritional status of ICU patients from Ministry of Health Hospitals. Moreover, the study population's homogeneity was considered the main strength of this study. Moreover, the sample size was recruited from five hospitals related to the Holy Makkah Healthcare Cluster in different regions including three hospitals at Makkah and two hospitals at AlQunfutha.

Study Limitations

The sample size was small and most of the ICU-admitted patients were in isolation rooms and subjected to isolation precautions. Also, the patients were collected from five hospitals without equal distribution ideally and this would be 20% of the participants from each hospital).

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Conflict of Interest

The authors have no conflicts of interest to declare.

Data Availability Statement

The manuscript incorporates all datasets produced or examined throughout this research study.

Ethics Statement

Ethical approval was obtained from the Scientific Research Ethics Committee as a committee of the College Vice-Deanship for Postgraduate Studies No. (MH22 05(, Umm Al-Qura University, Makkah, Saudi Arabia.

Informed Consent Statement

Informed consent was obtained from the patients or their relatives by the regulations the health affairs of the Saudi Ministry of Health. Moreover, consent for publication was obtained.

Clinical Trial Registration

This research does not involve any clinical trials.

Author Contributions

- **El-Sayed Hamed Bakr:** Study design, methodology, supervision.
- **Bashayer Omar Bosaeed:** Data collection,

data analysis, conceptualization.

- **Dalal Mohammed Alkhiri:** Data collection, data analysis, original draft.
- **Marwa Amer Ahmed:** Result interpretation, manuscript editing.
- **Rehab Ahmed Shehata:** Manuscript writing, review.
- **Reem Othman Basaqr:** Manuscript writing, supervision, review.

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