Zagazig University Medical Journal
www.zumj.journals.ekb.eg

https://doi.org/10.21608/zumj.2024.331350.3665 Volume 31, Issue 1.1, JAN. 2025, Supplement Issue

Manuscript ID ZUMJ-2410-3665
DOI 10.21608/zumj.2024.331350.3665

ORIGINAL ARTICLE

Incidence Rate and Risk Factors of Malnutrition in Critically Ill Patients

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Submit Date 27-10-2024
Accept Date 08-11-2024

ABSTRACT:

Background: A common condition that is commonly observed in severely ill individuals is malnutrition. It has been claimed that between 38% and 78% of patients in the intensive care unit are dangerously unwell. Higher rates of morbidity, mortality, and hospital-related costs are associated with these patients. Therefore, this study's objective was to assess the prevalence and risk factors of malnutrition in Zagazig University Hospital's surgical intensive care unit.

Methods: This cross-sectional study was conducted in surgical intensive care unit in Zagazig university Hospital on 92 patients admitted to surgical intensive care unit and stayed more than 1 week in surgical intensive care in Zagazig university hospital. Risk factors were assessed in all cases.

Results: 92 patients were investigated, 66 of them were nutritionally high risk and the remaining were nutritionally low risk. There is significant increase of nutrition risk in the critically ill score (NUTRIC score), incidence of comorbidities and length of stay in malnourished group. Age ≥ 60 years, comorbidities ≥ 2 and length of stay more than 10 days are considered risk factors of malnutrition.

Conclusions: On ICU admission, about 71.8 % of the patients were nutritionally at high risk of malnutrition. Age more than 60 years, presence of more than two comorbidities and prolonged length of stay in ICU more than 10 days are considered risk factors to develop malnutrition in critically ill patients.

Keywords: Malnutrition; Surgical Intensive Care Unit; Critically ill patients**.**

INTRODUCTION

For critically ill patients to manage stress, prevent metabolic problems, and preserve immune system function, nutritional support is crucial. Sufficient nutritional support is necessary for critically ill patients whose clinical situation, such as trauma, almost puts them in a hypermetabolic state, sepsis, or major surgery [1].

Patients in critical condition frequently suffer from malnutrition. In the intensive care unit, the incidence among severely ill patients is between 38% and 78%, according to reports. This is linked to higher rates of morbidity, death, and hospitalization costs for patients [2].

Nutritional support can be given enterally, by a tube placed in the stomach that distributes liquid formulations containing all the nutrients required, or parenterally, by injecting complete nutritional solutions into the patient's bloodstream via peripheral or central venous access. However, in order to evaluate the nutritional status of ICU patients and determine risk factors for undernutrition, clinical research uses nutrition support therapy [3].

Because of their greater reliance on mechanical breathing, longer hospital stays, intensive care unit (ICU) readmissions, infection rates, and elevated risk of hospital death, patients in the ICU are particularly vulnerable to undernutrition. To identify patients who will benefit from aggressive nutritional care and to identify which critically ill patients are at high nutrition risk, the NUTRIC score (nutrition risk in critically ill patients) was developed. [4]. A variety of metrics and tools, including energy expenditure, nutritional intake, and assessment of nutrition-related factors, can be used to ascertain the nutritional status of patients. The body mass index (BMI), physical examination, anthropometric measurements, and some biochemical indicators, like serum albumin and prealbumin levels, are frequently used to evaluate nutritional status in the context of nutrition-related issues. Low levels of these biochemical indicators, on the other hand, indicated that the underlying disease was still under physiological stress and lacked inadequate nutrition. [5].

METHODS

Patients admitted to the surgical critical care unit and those who remained for more than a week were the subjects of this cross-sectional study, which was conducted at Zagazig University Hospital's surgical intensive care unit. The IRB committee accepted this study (number #7074-7-11-2021). The clinical trials registration number is NCT06047054. Patients or their guardians gave their informed permission.

Regardless of gender, the study included all adult patients over 18 who were hospitalized to the surgical critical care unit (ICU). Patients or their guardians were excluded from the study due to their reluctance to participate and referrals from other hospitals or intensive care units.

Age, sex, cause of admission, comorbidities, days from hospital to intensive care unit admission, and nutritional history were among the data collected. Vital signs, respiration rate, SPO2, height, weight, BMI, and mid-arm circumference (MAC) were all part of the general assessment. On admission and at the conclusion of the trial, laboratory tests included complete blood counts, albumin, and prealbumin.

***Patient assessment*:**

Sequential Organ Failure Assessment (SOFA) scoring system: The SOFA score measures organ function based on six different organ systems, with a score ranging from 0 to 4. Assessments are made of the liver, coagulation, pulmonary, cardiovascular, renal, and central nervous systems. The overall SOFA score, which varies from 0 to 24, is calculated by adding the results from each organ system. [6].

Acute Physiology and Chronic Health Evaluation (APACHE) II score: Taking into consideration both acute and chronic illness, the APACHE II Score calculates intensive care unit mortality using a range of laboratory data and patient symptoms. [7].

Assessment of malnutrition risk: Assessment of nutritional status was done using Nutrition Risk in the Critically ill (NUTRIC) Score: The purpose of the NUTRIC Score is to assess the probability that patients in critical condition may suffer adverse outcomes that could be changed by intensive nutritional therapy. The score, which goes from 1 to 10, is determined by six elements. **[8]**.

The nutrition plan includes information on when to start nutrition, what type of nutrition (enteral, parenteral, or supplemental), how much protein and calories are consumed, and whether the nutrition is adequate.

Weekly albumin and prealbumin readings were made until discharge or death, and the NUTRIC score was calculated during the ICU stay.

Outcomes:

Both the length of stay in the intensive care unit and the ICU mortality rate were noted. It was established how long patients remained in the ICU from the time of admission until they were released or passed away there. The outcomes of each patient's clinical follow-up were recorded until they either died or left the intensive care unit.

Sample size:

All cases attended surgical intensive care unit and will stay more than 1 week in surgical intensive care in Zagazig University hospital within 6 months. As the total number of cases admitted and stay more than 1 week in 1 year is 120 cases and prevalence of malnutrition 50% so sample size is 92 cases. Sample size was calculated using an open EPI program with an incidence limit 5% and design effect 1.

Statistical Methods

2015 IBM Corp was used for data collection, tabulation, and statistical analysis. Version 23.0 of IBM SPSS Statistics for Windows. NY / Armonk: IBM Corp. Mann Whitney U test, logistic regression, chi-square test, and Fisher exact test, Hosmer and Lemeshow tests were used.

RESULTS

120 patients were recruited for the current study, only 28 patients were excluded. While the remaining 92 patients were investigated. The age distribution was 33.61 ± 10.64 years. The majority of the study participants were male (56.5%). The mean ± SD of BMI was (21.32± 4.23) Kg/m^2. Whereas mean ± SD

of Mid Upper Arm Circumference (MUAC) was (240.77± 23.41) mm (Table 1). The most frequent associated comorbidity was diabetes in (45.7%) of the studied patients, followed by hypertension in (38%). Also, the most common cause of admission was surgical (64.2%), then trauma (35.8%). The mean± SD of duration from hospital admission to ICU admission was 2.88 ± 1.5 days. The mean ± SD of SOFA score was 10.1± 4.91, and mean ± SD of APACHE II score was 22.5 ± 8.58 (Table 1).

On admission, among the total studied 92 participants; 26 patients (28.3%) had low risk of malnutrition, while 66 patients (71.7%) had a high NUTRIC score, indicating a high risk of malnutrition. Malnutrition was evident in 55 patients (59.7%) at the end of the study (untill discharge or death), 37 patients (40.22%) had low risk of malnutrition according to NUTRIC score (Table 2).

Enteral feeding was 30.43%, parenteral feeding was 25% and Enteral with supplemental parenteral feeding was 44.56%. It was found that the time to initiate nutrition from ICU admission ranged from 6 to 72 (hours), while mean ± SD was (40.6 ± 15.86) hours. It was found that the mean ± SD of the prescribed energy was (20.3 ± 4.1) Kcal/kg/day, while the mean ± SD of prescribed protein dose was (1.4± 0.94) g/kg/day. While the mean ± SD of the actually delivered nutrition energy was (16.9± 5.69) Kcal/kg/day, and mean ± SD of delivered protein was (0.87± 0.21) g/kg/day (Table 3).

Albumin levels at the end of the study were significantly higher in comparison to levels on admission *(P=≤0.001)*. Similarly, pre-albumin levels were significantly higher at the end of the study in comparison to levels on admission *(P=≤0.001)* (Table 4).

Table (5) shows the clinical outcomes where 29 patients (31%) died and duration of the ICU stay ranged from 8 to 75 (days), while mean ± SD was 35.5 ± 17.25 days. Is death related to disease or malnutrition? There was a statistically significant increase in the NUTRIC score, length of ICU stay, and the incidence of DM, HTN, and IHD in malnourished patients when compared to well-nourished patients (Table 6).

In the univariate analysis, malnutrition was the dependent variable, while sex, age≥ 60, surgical and trauma patients, prolonged ICU stay and comorbidites ≥2 were the independent variables. Age ≥ 60 showed an odds ratio [OR]; 1.260, and 95% confidence interval [CI];0.603-2.153) which was associated with significant rate of malnutrition, prolonged ICU stay >10 days showed an odds ratio [OR]; 0.368, and 95% confidence interval [CI]; 0.137-0.993) which was associated with significant rate of malnutrition, and comorbidities ≥2 showed an odds ratio [OR]; 5.711, and 95% confidence interval [CI]; 1.508-21.627) which was associated with significant rate of malnutrition (Table 7).

Table 1: Demographic data, Anthropometrics measures and Clinical data among studied participants.

Variables	Study population N=92
Age (years) *Mean ± SD* *(range)*	 33.61±10.64 (18-66)
Gender (*N. %)* Female Male	 40 (43.5%) 52 (56.5%)
BMI (kg/m^2) *Mean ± SD* *(range)*	 21.32±4.23 (18-32)
MUAC (mm) *Mean ± SD* *(range)*	 240.77±23.41 (174-295)
No. of associated comorbidities No comorbidity One comorbidity	 21 (22.82%) 43 (46.73%)

Two comorbidities >2 comorbidities	17 (18.47%) 11 (11.95%)
Comorbidities* *(N. %)* DM HTN IHD Others	 42 (45.7%) 35 (38%) 19 (20.65%) 15 (16.3%)
Cause of admission *(N%)* Trauma Surgical (pre\ postoperative)	 33 (35.8%) 59 (64.2%)
Duration from hospital admission to ICU admission in days *Mean ± SD* *(range)*	 2.88 ± 1.5 (1 – 6)
SOFA score *Mean ± SD* *(range)*	 10.1± 4.91 (1-18)
APACHE II score *Mean ± SD* *(range)*	 22.5 ± 8.58 (3-40)

*BMI: Body Mass Index, MUAC: Mid Upper Arm Circumference

Table 2: Incidence rate of malnutrition on admission to surgical intensive care unit and at the end of the study.

Variables	On admission		At the end of the study	
High & low risk of malnutrition by NUTRIC score Study population N=92(*N. %*)	Well nourished Low risk (0-4) N=26 patients (28.3%)	Malnourished High risk (5-9) N=66 patients (71.7%)	Well nourished Low risk (0-4) N=37 patients (40.22%)	Malnourished High risk (5-9) N=55 patients (59.78%)

Table 3: Nutritional related values of study patients.

Variables	Study population N=92
Type of Nutrition Oral/ Enteral Enteral with supplemental parenteral Parenteral	 28 (30.43%) 41 (44.56%) 23 (25%)
Time to initiate nutrition from ICU admission (hrs.) *Mean ± SD* *(range)*	 40.6 ± 15.86 (6-72)
Adequacy of received nutrition	
Protein - <80% of the protein requirements – ≥ 80-100% of the protein requirements	 69 (75%) 23 (25%)
Lipid – <30% of the caloric requirements – 30-40% of the caloric requirements – ≥ 40% of the caloric requirements	 25 (27%) 48 (52.17%) 19 (20.65%)

Variables	Study population N=92
CHO -<60% of caloric requirements – 60-70% of caloric requirements – ≥70% of caloric requirements	 41 (44.56%) 27 (29.34%) 24 (26.08%)
Prescribed Energy/ Protein Energy (kcal/kg/d) *Mean ± SD* Protein (g/kg/d) *Mean ± SD*	 20.3 ± 4.1 1.4± 0.94
Delivered Energy/ Protein Energy (kcal/kg/d) *Mean ± SD* Protein (g/kg/d) *Mean ± SD*	 16.9± 5.69 0.87 ± 0.21

Table 4: Albumin & pre albumin levels on admission and at the end of the study.

	On admission	At the end of the study	P-value
Albumin *(g/dl)*	2.48 ± 0.512	3.2± 0.5	**≤0.001**
Pre-albumin *(mg/dl)*	16.9 ± 4.49	23 ± 3.5	**≤0.001**

Table 5: Outcomes among studied patients.

Variables	Study population N=92
ICU mortality rate *(N. %)*	29 (31%)
Duration of ICU stay (days) *Mean ± SD* *(range)*	 35.5 ± 17.25 (8-75)

Table 6: Comparison between well nourished and malnutrition patients on admission.

	Well-nourished N=26	Malnourished N=66	P value
Age (years) *Mean ± SD*	34.5±10.5	33.3±10.4	0.613
Gender *(N. %)* **Male** **Female**	 14 (53.8%) 12 (46.2%)	 38 (57.6%) 28 (42.4%)	0.74
BMI (kg/m^2) *Mean ± SD*	21.58±4.2	21.23±4.3	0.723
MUAC (mm) *Mean ± SD*	238.58±23.7	241.64±23.4	0.575
Duration from hospital admission to ICU admission (days) *Mean ± SD*	3.35±1.5	2.69±1.5	0.068
Cause of admission *(N. %)*			
Trauma	13 (50%)	20 (30.3%)	0.07
Surgery	13 (50%)	46 (69.7%)	

	Well-nourished N=26	Malnourished N=66	P value
Comorbidities *(N. %)*			
DM	7 (26.9%)	35 (53%)	**0.02**
HTN	5 (19.2%)	30 (45.5%)	**0.01**
IHD	1 (3.8%)	18 (27.3%)	**0.01**
others	5 (19.2%)	10 (15.2%)	0.63
NUTRIC score *Low risk* *High risk*	 16 (17.39%) 10 (10.87%)	 21 (22.83%) 45 (48.91%)	**0.008**
APACHE II score *Mean ± SD*	24.81±9.3	21.71±8.2	0.12
SOFA score *Mean ± SD*	9.04±3.5	10.53±5.3	0.19
ICU mortality rate *(N. %)* Yes	9 (34.6%)	20 (30.3%)	0.68
Duration of ICU stay (days) *Mean ± SD*	33.16±10.9	38.77±13.5	**0.04**

P value >0.05: Not significant, P value <0.05 is statistically significant, p<0.001 is highly significant., SD: standard deviation.

Table 7: Logistic regression analysis of the different variables.

Variables	Malnourishment		
	OR	**95% CI**	***P* value**
Male	1.113	0.542–0.928	0.704
Age ≥ 60	1.260	0.603–2.153	**0.03**
Surgery	2.151	0.904–5.120	0.083
Trauma	2.345	0.911–5.725	0.072
Prolonged ICU stay >10days	0.368	0.137-0.993	**0.04**
Comorbidities ≥2	5.711	1.508-21.627	**0.01**

DISCUSSION

The current study comprised 92 patients who were admitted to Zagazig University Hospital's surgical intensive care unit over the course of six months. They were 33.61 ± 10.64 years old on average.
This was close to study of Shpata et al. [9], The prevalence of malnutrition risk among patients in the intensive care unit (ICU) between the ages of 18 and 64 was 48.45±12.07 years on average.
On the other hand, the mean age of our patients was younger than those of Osooli et al. [10] who aimed to improve the nutritional support offered in the intensive care unit (ICU) by identifying the causes of malnutrition and inadequate calorie intake. The trial included 150 individuals. The average age was 17.20 ± 57.42 years.
Regarding the gender distribution of our patients, 43.5% of the study participants were women, while the majority (56.5%) were men. Similar to this, a prior study by Havens et al. [11] found that the majority of patients (58%) were men.
Based on available data, the majority of admissions (59 cases, or 64.2%) were related to surgical operations, with trauma coming in second (33 patients, or 35.8%).
In our study, it took an average of 2.88 ± 1.5 days from hospital admission to intensive care unit admission.

The findings of Osooli et al. [10], who reported that the average time from hospital admission to the intensive care unit was 2.16±1.2 days, were in agreement with our study.

The time between hospitalization and intensive care unit admission varied from 1 to 6.4 days, according to a different study by Kucukardali et al. [12].

The mean ± SD for the SOFA and APACHE II scores in the current study were 10.1± 4.91 and 22.5± 8.58, respectively. According to Sheean et al.'s study [13], the mean APACHE II score of the patients they included was 28.4 ± 6.5.

Magnette et al. [14] reported in a related earlier study that the SOFA score of the patients they examined upon ICU admission ranged from 6.7 to 9.2, with a mean value of 8.0± 0.72.

Of the 92 participants in the study, 66 had nutritionally high risk (NUTRIC score ≥5) and 26 had nutritionally low risk (NUTRIC score <5) before admission. Based on follow-up NUTRIC scores, only 55 patients had nutritionally high risk at the end of the trial, while 37 patients had nutritionally low risk.

Similarly, Osooli et al. [10] found that 79 patients (52.7%) had a high nutritional risk score (defined as NUTRIC score ≥5).

Mendes et al. [15] demonstrated in a prior study that the NUTRIC score is a reliable way to identify patients in the intensive care unit who are at nutritional risk and could experience malnutrition.

Our results showed that albumin levels at the end of the study were significantly higher than those at admission (P=≤0.001). Likewise, pre-albumin levels were considerably greater at the end of the study than they were at admission (P=≤0.001).

Although false positive and negative results hampered the use of albumin and prealbumin as biomarkers to identify malnutrition, recent research has shown that prealbumin levels below 15 mg/dl may be linked to malnutrition [16].

In this study, patients with a high risk of malnutrition had a significantly higher incidence of comorbidities such as diabetes, hypertension, and IHD.

According to a recent study by Mao et al. [17], elderly people are at high risk for preoperative malnutrition. Longer hospital stays and a higher risk of surgical complications are associated with patients at high risk for malnutrition. In order to pursue nutritional optimization, patients with frailty and a high load of comorbidities should be evaluated for malnutrition.

Protein and energy delivery in our study were below recommended levels. This is comparable to another study that showed patients were given up to 64% of their daily energy needs [18].

According to Osooli et al. [10], malnutrition occurred in over 80% of the studied group, and over half of the patients were at high risk at admission. Malnutrition resulted from the majority of nutritionally high-risk patients not getting enough calories. 29 patients (31%) died in the current study, and the mean ± SD length of stay in the intensive care unit was 35.5 ± 17.25 days.

Also in our study there was no significant difference in mortality rate between nutritionally high risk patients and those with low risk but length of stay increased significantly in nutritionally high risk patients.

Various investigations found that nutritional deterioration during the ICU stay was independently linked to negative outcomes [19]. The study by Caporossi et al. [20], which found a link between prolonged ICU stay and malnutrition, supported our findings. However, according to Lew et al. [2], there was no discernible link between malnutrition and the length of stay in the intensive care unit (ICU). This might be because to the brief ICU-LOS, which makes it challenging to establish any correlation between malnutrition and other factors (such the severity of the disease).

Malnutrition was the dependent variable in the univariate analysis, and the independent variables were sex, age ≥60, trauma and surgical patients, and patients who spent a prolonged amount of time in the intensive care unit. Significant rates of malnutrition were linked to comorbidities ≥ 2, extended ICU stays >10 days, and age ≥ 60. The following elements are regarded as malnutrition risk factors. ICU stay >10 days, age ≥ 60 years, and comorbidities ≥ 2. In a previous study Hickson, [21] determined that one of the main risk factors for malnutrition was age. Compared to younger patients, 38.2% of patients over 70 had a considerably greater rate of malnutrition (17.2% vs. 38.2%, P < 0.001). Malnutrition was also found to be highly prevalent in older individuals (43%), according to the previously cited study. As patients age, several physiological, social, and psychological changes take place, making the elderly especially susceptible to malnutrition. Also, Shpata et al., [9] showed that the following factors were found to be independent risk factors for malnutrition risk in elderly patients using multivariate logistic regression analysis: emergency hospital admission, presence of malignancy, APACHE II score ≥15 and patient age.

Conclusion

Approximately 71.8% of the patients were nutritionally at high risk of malnutrition at the time of ICU admission. Risk factors for malnutrition in critically ill patients include being older than 60, having more than two comorbidities, and spending more than 10 days in the intensive care unit

Conflict of interest: The authors declare that they have no competing interest.

Financial Disclosure:

This research received no specific grant from any funding agency in the public, commercial, or non-profit sectors

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Citation

Elbahrawy, A., Abdel-Raziq, G., Kamel, A., Abdelhaleem, N. Incidence Rate and Risk Factors of Malnutrition in Criticall Ill Patients. *Zagazig University Medical Journal*, 2025; (15-23): -. doi: 10.21608/zumj.2024.331350.3665