Assiut Scientific Nursing Journal
http://asnj.journals.ekb.eg http://www.arabimpactfactor.com
DOI:10.21608/asnj.2025.386711.2091 http://olddrji.lbp.world/indexedJournals.aspx
https://vlibrary.emro.who.int/journals/assiut-scientific-nursing-journal

Relationship between mNutric score and Outcomes in Patients with Critically Illness Myopathy

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Abstract:
Malnutrition and muscular atrophy developed early in the intensive care unit stay due to an imbalance in energy and protein demands and intake. Early identification of individuals with high nutritional risk may enhance clinical outcomes since these patients may benefit more from nutritional therapies than those with reduced nutritional risk. The modified nutrition risk in the critically ill score (mNUTRIC) was developed as a suitable nutritional assessment tool in critically ill patients. **Study aim:** To assess the relationship between mNutric score and outcomes in patients with critical illness myopathy. **Design:** Descriptive correlational research design. **Setting:** The study was conducted at different critical care units at Sohag University Hospitals. **Sample:** All available adult critically ill patients met inclusion criteria. **Tools:** Two main tools were used to collect data, **Tool (I):** Myopathy patient assessment sheet, **Tool (II):** Patient outcomes assessment sheet **The Results** of the present study revealed that the bulk of the patients were males with ages over fifty. Also, more than half of patients experienced high mNutric ≥ 5, and furthermore, there were significant positive correlations of mNutric score with mortality, Acute Physiology and Chronic Health Evaluation II score, and Sequential Organ Failure Assessment, while there was a significant negative correlation of mNutric score with Medical Research Council scale for muscle strength. **Conclusion:** The mNUTRIC score is most effective in the prediction of the prognosis of patients with critical illness myopathy. **Recommendations**: Incorporate a nutritional assessment into regular clinical assessments of patients in the critical care units.

Keywords: Critically illness myopathy, mNUTRIC, & Outcomes.

Introduction

Muscles are organs made up primarily of muscle tissue. known as muscle fibers (skeletal and cardiac muscle) or myocytes (smooth muscle). Muscle cells are long, thin tissues specialized for contracting. They comprise protein filaments that slide across each other via the energy in ATP. Sliding filaments tighten or shorten muscle cells, leading to contractions. Muscle contractions are responsible for almost all of the body's movements, both internal and external. **(Cornish et al., 2020)**

Muscles are essential to daily living and general health since they are needed for movement, circulation, digestion, and other physiological processes. Maintaining muscle strength and function throughout one's life requires both regular exercise and a healthy nutrition. **(Fountain et al., 2023)**

Myopathies are a broad category of disorders that mainly affect the muscles, causing weakness and dysfunction; they can be caused by genetic mutations, autoimmune reactions, metabolic disorders, or exposure to specific toxins or medications. Myopathies are characterized by the progressive degradation of muscle fibers and can range in severity, affecting a person's capacity to carry out daily tasks**. (Lundberg et al 2021)**

Skeletal muscle atrophy occurs in response to a variety of stresses, including decreased external loading and neural activation, raises in inflammatory cytokines and glucocorticoids, and malnutrition. is a catabolism condition that causes a considerable decrease of muscle mass. **(Perens et al., 2022)**

Critical Illness Myopathy (CIM), also known as intensive care unit (ICU) myopathy, is a type of widespread weakness affecting the muscles of the extremities, trunk, and respiration that is usually associated with severe illness. Weakness is often accompanied by significant muscle atrophy. **(Teixeira et al., 2023)**

The histological features include an overall decline in muscle fiber cross-sectional area and a selective degradation of the motor protein myosin in with no evidence of inflammatory infiltrates but with detectable cytokine activation. The first histological changes have been observed to emerge already on day 5 of the ICU stay. **(Gomes Dos Santos. et al., 2024)**

During critical illness, the body enters a hypercatabolic condition, which means it breaks down proteins at a faster pace. Insufficient protein and calorie intake aggravates this process, resulting in severe muscle atrophy. This muscle mass atrophy remains in adults even 3 months after serious illness,

impeding their recovery. Furthermore, vitamin and mineral deficiencies can exacerbate severe sick myopathy. **(Liang et al., 2022)**

Malnutrition is characterized as the existence of two or more of the following: inadequate nutritional intake, decreasing body weight, loss of muscle mass, loss of subcutaneous fat, localized or widespread fluid accumulation, or impaired functional status. Malnutrition rates range between 38% and 78%. At the time of admission to the hospital, at least one-third of patients are malnourished, and two-thirds continue to decrease without sufficient nutritional support**.(Zhang et al. 2020)**

Nutritional screening is carried out to critically ill patients to determine the patients at high risk of malnutrition. The Nutrition Risk in Critically Ill (NUTRIC) Score is an assessment tool that takes this into account and has been verified in critical patients. This score system is a model that analyzes famine, inflammation, illness severity, and organ dysfunction features that can alter nutritional status during ICU admission and have consequences for patient outcomes**.(Rodrigues et al 2020)**

Nurses take a crucial part in the two distinct acute and recovery stages of critically ill myopathy by combining clinical competence with ongoing patient-centered care. Early preventive treatments conducted by nurses in the intensive care unit, such as lowering sedation, supporting early movement, and maintaining adequate nutritional intake, are critical in minimizing the severity and duration of muscle wasting. Nurses continue to make major contributions to patients' recovery by designing tailored care plans, increasing functional independence, and resolving mobility limitations. **(Fountain et al., 2023)**

Significance of the study:

Critical illness myopathy is a frequent complication of severe illness involving both motor and sensory axons. It usually present as flaccid and symmetric paralysis. This condition represents approximately 25–45% of critically ill patients who are admitted to intensive care units that may be progress after a five days from admission to critical care units. **(Rodriguez et al 2022) .**

Critically ill patients who are nearly at the hyper-metabolic state of their clinical condition, such as trauma, sepsis, or major surgery, proper nutritional support is essential. One These severe circumstances cause an excessive release of stress hormones and cytokines, which change the metabolism of proteins and energy and ultimately end in malnutrition. **(Rattanachaiwong et al 2020).** The approximate prevalence of Critical Illness Myopathy among intensive care unit (ICU) patients in Sohag university hospitals is approximately range from 15% and 20% in 2023-2024. Therefore he researcher carried this study to determine the prognosis of nutritional risk status among those with critical illness myopathy.

Operational definition:

- **Critical Illness Myopathy** (CIM), also known as intensive care unit (ICU) myopathy, is a type of widespread weakness affecting the muscles of the extremities, trunk, and respiration that is usually associated with severe illness. Weakness is often accompanied by significant muscle atrophy. **(Teixeira et al., 2023)**
- **Modified Nutrition Risk in Critically ill (mNutric) score** often refers to a specific nutritional scoring system or tool used to assess the nutritional status and identify patients who are at risk of malnutrition or who may require specialized nutritional interventions. according to the following five variables: These included age, APACHE II score, SOFA score, number of co-morbidities, days from hospital admission to ICU admission.

Aim of the study:

To assess the relationship between mNutric score and outcomes in patients with critically illness myopathy through:

- Determine incidence of the nutritional risk status via (mNutric) score for patients with critically illness myopathy
- Identify outcomes among patients with critically illness myopathy.
- Identify the relationship between mNutric score and outcomes in patients with critically illness myopathy

Patients and Method

Research design:

A descriptive correlational research design was used to conduct this present study.

Research question:

- What is the incidence of the nutritional risk status via (mNutric) score for
- What are outcomes of patients with critically illness myopathy?
- Is the relationship between mNutric score and outcomes in patients with critically illness myopathy?

Study variables:

Dependent variables: Patients' outcomes.

Independent variable: mNutric score for critically illness myopathy.

Setting: The study was conducted at several critical care units at Sohag university hospitals including general intensive care unit (12 beds), trauma intensive care unit (7 beds).

Sample: Sixty one adult patients from both sex with critically illness myopathy (n=61) who were recently diagnosed in the intensive care unit. Data collection

took six months, from the beginning of September 2024 to the end of February 2025.

The sample size was calculated by using Epi info according to the following:

Sample size

$$n=[DEFF*Np(1-p)]/[(d^2/Z^2_{1-\alpha/2}*(N-1)+p*(1\ p)]=61 patien$$

Population size(for finite population correction factor or fpc)(N):	118
Hypothesized % frequency of outcome factor in the population (p):	75%+/-5
Confidence limits as % of 100 (absolute +/- %)(d):	5%
Design effect (for cluster surveys DEFF):	1

Inclusion criteria:

- Adult patients their age > 18 years old
- Medical research council scale for muscle strength < 48

Exclusion criteria:

Patients with pre-existing neuromuscular disorders (Gallian Barre and Myasthenia Gravis)

Tool:

Two tools were utilized to collect data pertinent to the study the validity & reliability of these tools were revised by a panel of medical and nursing experts then pilot study would be done.

Tool (1): Myopathy patient assessment sheet: the researcher developed this tool after examining related literature **[Elkalawy et al., 2023;. Wang et al., 2020; Vanhoutte et al., 2012: Kiper et al., 2022]**

Part (I): personal and clinical data which included age, sex, medical diagnosis, and past medical history.

Part (II): Medical Research Council (MRC) scale for muscle strength: adopted from **Vanhoutte, et al., 2012** and reused **by Kiper et al., 2022** Medical Research Council (MRC)-sum score evaluates global muscle strength through six muscle groups (shoulder abduction, elbow flexion, wrist extension, hip flexion, knee extension, and ankle dorsiflexion), which evaluated on both sides using MRC scale.

Scoring system: Summation of scores gave MRC-sum score, ranging from 0 to 60.

- Normal strength > 48-60
- Mild weakness (< 48-36)
- Severe weakness (< 36).

Part (III): Modified Nutrition Risk in Critically ill (mNUTRIC) score adopted from **(Lee & Heyland, 2018)** reused by **(Lopulalan et al., 2021)** which used to identify patients at nutritional risk according to the following five variables: These included age, APACHE II score, SOFA score, number of co-morbidities, days from hospital admission to ICU admission.

Scoring system: Summation of scores given The available data was used for determining the mNUTRIC score, and patients were divided into two groups: high nutrition risk (5-9 score) and low nutrition risk (0-4 score).

Tool (2): Patient outcomes assessment sheet developed by researcher after reviewing literature [**Frithiof et al., 2020; Jackson, & Cairns, 2021; (Christakou, et al., 2013; Van Aerde et al., 2020]**: length of stay, 28 days mortality, BMI, APACHE II at discharge, and SOFA score at discharge

Methods

The study was conducted throughout two main phases, which are preparatory, and implementation phase

Preparatory phase:

1. Official Permission to conduct the study was obtained from the dean of faculty of nursing Assuit university after explanation of the aim and nature of the study.
2. Development of the tools after reviewing the related literature**.**
3. The tools was reviewed by a jury to assess the clarity, feasibility, applicability, and the content validity was carried out by 3 nursing staff at critical care and emergency nursing one medical expert at Sohag university, and 1 nursing staff at intensive care and emergency nursing
4. A pilot study was conducted in 6 patients of sample to evaluate the applicability and clarity of the developed tools no modification was done
5. The reliability of the adapted tools was done after reviewing literature using Cronbach coefficient alpha test. It was (0.89) for the first tool myopathy patient assessment sheet, (0.93) for Medical Research Council (MRC) scale for muscle strength: **(Kiper et al., 2022)**, (0.768) for modified Nutrition Risk in Critically ill (mNUTRIC) score **(Lopulalan et al., 2021)** and (0.673) for patient outcomes assessment sheet

Ethical considerations:

1. Research proposal was approved from ethical committee in the faculty of nursing assuit university date (26/8/2024) No. (1120240864).
2. There is no risk for study subject during application of the research.
3. The study was followed common ethical principles in the clinical research.
4. oral consent was obtained from patients or guidance who are willing to participate in the study. After explaining the nature and purpose of the study.
5. Confidentiality and anonymity was assured.
6. Study subjects have the right to refuse to participate and/or withdraw from the study without any rational at any time.
7. Study subject privacy was considered during collection of data

Implementation phases:

After explaining the purpose of the study to patient. The study data was collected for six months throughout the following:

- Personal and medical data of patients who met inclusion criteria and accepted to participate in the study were assessed. This data include age, gender, current medical diagnosis and past medical history
- Muscle strength using Medical Research Council (MRC) was assessing on the only once shift to ensure patient eligibility to the study this take about ten minute.
- Once patient confirmed myopathy , the researcher assess nutritional risk using modified Nutric score according to the following five variables: These included age, APACHE II score, SOFA score, number of co-morbidities, days from hospital admission to ICU admission.. and determined which of them was high or low risk.
- Throughout patients stay in ICU, the researcher monitor BMI, assess APACHE II, and SOFA scores again at discharge to followup patient prognosis. Also, Length of stay in ICU, and mortality rate were assessed and documented.

Statistical analysis:

Every patient's information was entered into a unique chart. The gathered information was coded, examined, and totaled. The statistical software program SPSS 26.0 was used for data entry and analysis. Descriptive statistics were used to display the data, with means and standard deviations for quantitative variables and frequencies and percentages for qualitative variables. Regression analysis, the Pearson correlation coefficient (r), and chi-squared comparison between categorical variables were employed. P >0.05 was determined to be non-significant, P<0.05 to be significant, and P<0.01 to be very significant.

Results

Table (1): Comparison between demographic characteristic of patients regarding according to nutritional risk (n=61)

Demographic characteristic	All patients (n= 61)		Low risk (n=19)		High risk (n=42)			p-value
	No.	%	No.	No.	%	No.		
Gender								
Male	34	**55.7**	6	31.6	28	66.7	X2 (6.528)	**0.011***
Female	27	44.3	13	68.4	14	33.3		
Age								
18 – 30	12	19.7	7	36.8	5	11.9	X2 (7.195)	0.073
>30 – 40	5	8.2	1	5.3	4	9.5		
>40 – 50	9	14.8	4	21.1	5	11.9		
More than 50	35	**57.4**	7	36.8	28	66.7		
(Mean ± SD)	54.98 ± 19.69		45.37 ± 19.819		59.33 ± 18.239		T (1.041)	**0.009***

Table (2): Distribution of studied patients regarding their Clinical data (n=61)

Clinical data	(n= 61)		Low risk mNutric < 5 (n=19)		High risk mNutric ≥ 5 (n=42)			p-value
	No.	%	No.	%	No.	%		
Past-medical history:								
No	15	**24.6**	6	10.5	9	21.4%	**X2 (4.979**	**0.440**
DM	12	19.7	2	10.5%	10	23.8%		
HTN	13	21.3	4	21.1%	9	21.4%		
HTN & DM	11	18.0	2	10.5%	9	21.4%		
Cancer	7	11.5	4	21.1%	3	7.1%		
Autoimmune disease	3	4.9	1	4.8%	2	5.3%		
Current diagnosis:								
Trauma	12	19.7	3	15.8	9	21.4%	X2 (5.109)	0.403
COPD	7	11.5	1	5.3	6	14.3		
DKA	8	13.1	4	21.1%	4	9.5		
Post-operative	13	21.3	3	15.8	10	23.8		
Muscles weakness	7	11.5	4	21.1%	3	7.1		
Sepsis	14	23.0	4	21.1%	10	23.8		
MRC score (Mean ± SD)	16.82 ± 9.12		14.71 ± 4.81		21.05 ± 5.73		T (20.115)	0.000*

*Chi-square test * Statistical significant difference (p<0.05)* ***DM:*** *Diabetes mellitus,* ***HTN:*** *Hypertension,* ***COPD:*** *chronic obstructive pulmonary disease* ***DKA:*** *diabetic ketoacidosis* ***MRC:*** *Medical Research Council*

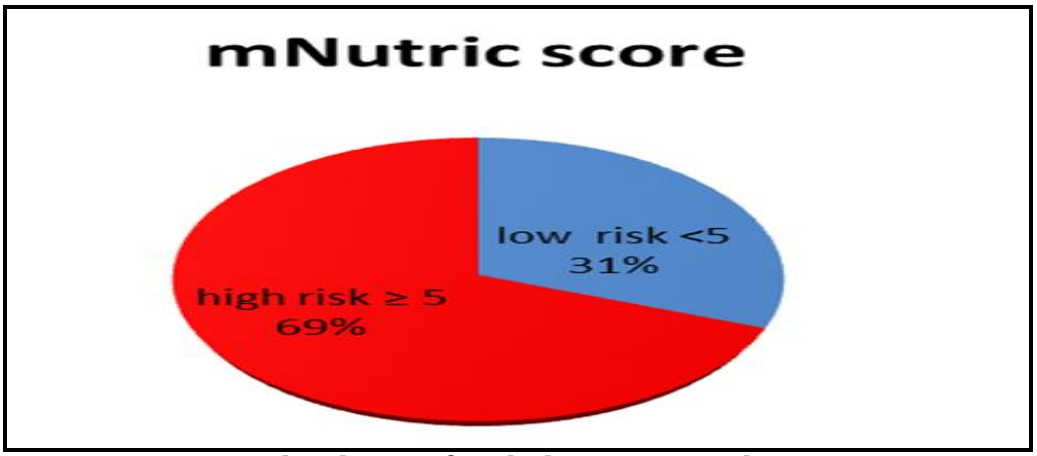

Figure (1): Percentage distribution of studied patients regarding mNutric score (n=61)

Table (3): Comparison between outcomes of patients according to mNutric score (n=61)

Outcomes	(n= 61)		Low risk mNutric < 5 (n=19)		High risk mNutric ≥ 5 (n=42)			p.value
	No.	%	No.	%	No.	%		
length of stay								
<15 days	22	36.1	6	31.6	16	38.1	X2 (0.241)	0.424
>15 days	39	63.9	13	69.4	26	61.9		
(Mean ± SD)	15.34 ± 9.74		14.53 ± 8.02		15.71 ± 10.48		T (0.192)	0.667
Mortality	39	63.9	4	10.3	35	89.7	X2 (22.007)	**0.000**
BMI								
Less than 18.5	8	13.1	2	10.5	6	14.3	X2 (0.750)	0.687
18.5 - 24.9	21	34.4	8	42.1	13	31.0		
25 - 29.9	32	52.5	9	47.4	23	54.8		
APACHE II at discharge								
Low < 20	29	47.5	15	78.9	14	33.3	X2 (35.580)	**0.001***
High > 20	32	52.5	4	21.1	28	66.7		
Mean ± SD	20.41 ±6.06		14.79 ±3.98		22.41 ± 6.06		T (10.805)	**0.000**
SOFA at discharge								
Low < 6	14	23.0	8	57.1	6	42.9	X2 (4.725)	**0.022***
High > 6	47	77.0	11	23.4	36	76.6		
Mean ± SD	7.70 ± 2.84		6.05 ± 2.24		8.45 ± 2.79		T (10.805)	**0.002**

APACHE II score: *Acute Physiologic Assessment and* ***Chronic Health Evaluation SOFA:*** *Sequential Organ Failure Assessment score* ***BMI:*** *body mass index*

Table (4): Correlation of mNutric score of patients with LOS, SOFA, and APACHE II and mortality (n=61)

	Correlation	p.value
APACHE II score	**0.423**	**0.001***
SOFA score	**0.393**	**0.002****
length of stay	**- 0.063**	**0.630**
Mortality	**0.601**	**0.000***
MRC score	**-0.267**	**0.039***

APACHE II score: *Acute Physiologic Assessment and* ***Chronic Health Evaluation SOFA:*** *Sequential Organ Failure Assessment score* ***BMI:*** *body mass index*

Table (1): Illustrates that the highest percentage of the total studied population is male (55.7%), with ages over fifty (57.4%) years old. Significant differences are observed between high mNutric and low risk patients in gender and mean age with p value (0.011 &0.009)

Table (2): Illustrates that the highest percentage of the studied population with have hypertension , sepsis and Post-operative are the most common current diagnosis with percentage (23.0& 21.3 respectively). There are no significant differences high and low risk patients regarding clinical data. Also, the mean of

MRC score is higher in patients with mNutric ≥ 5 with significant difference.

Figure (1): Illustrates nutritional risk status among study sample where more than half of patients with High mNutric ≥ 5.

Table (3): Illustrates that the highest percentage of study sample stay in ICU >15 days (63.9%) , more than half of them dead (63.9%), Moreover the majority of patients (52.5%) has a BMI in the range of 25 to 29.9. Additionally means APACHE II score and SOFA is high. There are Significant differences are observed between high mNutric and low risk patients regarding APACHE II mortality and SOFA.

Table (4): Illustrates that statistical significant correlations between of **mNutric score** and, APACHE II, SOFA, and mortality with p value (0.001& 0.002&0.000 respectively)

Discussion:

Myopathy is a rare incurable disease of gait ability loss and joint stiffening from muscle weakness and atrophy due to gradual loss of muscle mass. Respiratory care through a respirator may be required for the weakening of the respiratory muscles. **(Yildirim et al., 2024).** Nutritional deficiency is common in critically ill hospitalized patients. This condition may be aggravated by increased dietary requirements and deficiencies in nutrient absorption. **(Ibrahim et al., 2020)**

In terms of age and gender, the current study found that men make up the majority of the entire studied population, with an average age of over fifty. There are significant gender and mean age disparities between high and low risk patients. From the researcher point of view, From the researcher's opinion, this may be related to the elderly's reduced response to protein consumption on muscle protein synthesis, which results in severe cachexia.

The current study supports the findings of **Padilha de Limain et al., 2020,** who examine the relationship between inflammation, frailty, and nutrition: perspectives on preventive and adjuvant treatment. They found that older males were the most frequently identified individuals with high nutritional risk among patients with myopathy..

Regarding current diagnosis, Sepsis and post-operative care are the most prevalent current diagnoses among the patients in this study. According to the researcher, this might be because inflammatory mediators modify the metabolic pathways, which change the metabolism of skeletal muscle and cause increased gluconeogenesis, protein breakdown, and a decrease in the synthesis of different proteins in skeletal muscle.

This result is consistent with the findings of **Reintam & Am's (2020)** study, "Update on nutritional assessment and therapy in critical care." Sepsis was the most often diagnosed condition. However, the findings of the study "Nutritional status of patients with nemaline myopathy and related congenital myopathies" by **Lehtokari et al., (2025)** indicate that a greater proportion of subjects experienced trauma.

According to nutritional risk status., over half of patients in **the current study** have mNutric ≥ 5. The researcher guess patients who are admitted to intensive care units are probably at a high risk of developing malnutrition, which is primarily brought on by stress-induced catabolism from severe illness, insufficient food intake, inactivity, and trouble swallowing and chewing.

This is in line with a study conducted by **Inci et al., 2024** which examined "the relationship between nutritional risk status and diaphragm atrophy." According to reports, people with myopathy typically have higher nutritional risk status. In addition, **Leoni et al. (2022) & Adam et al., (2020)** found that almost two-thirds of their study sample are at high nutritional risk.

Regarding LOS, This study found that patients with nutritional risk (mNUTRIC ≥5 points) had a longer length of stay than patients with low nutritional risk (mNUTRIC <5 points), but there was no significant difference. From the researcher point of view , This is because malnutrition in critically ill patients is associated with inflammation and a hypermetabolic state, which can further lead to weakened immunity, muscle atrophy, and worsening infectious processes.

This is in line with what **Wang et al., (2021)** found. They evaluate the relationship between clinical outcomes in the intensive care unit and the modified Nutrition Risk in Critically Ill (mNUTRIC) score, finding that patients with higher NUTRIC scores had longer ICU length of stay and a higher fatality rate.

Malnourished patients have a greater risk for bad patient outcomes, such as increased morbidity, mortality, and prolonged intensive care unit (ICU) admission. Furthermore, fast protein loss in ICU patients is most likely correlated with proinflammatory factors and serious. catabolism caused by elevated stress-related cytokines and hormones **(Kim et al., 2022).**

In terms of mortality, the vast majority of research participants died. Especially those with high nutritional risk compared to low nutritional risk one. Additionally. There is positive significant correlation. The researcher guesses that This could be related to the influence of malnutrition on poor health and a weakened immune system.

This is consistent with **Leoni et al., (2022),** who discovered that higher nutritional risk was associated with a higher risk of 30-day ICU mortality in critically ill patients. **Machado et al., (2020)**

observed that patients with mNUTRIC ≥5 points had a higher risk of 28-day death than those with mNUTRIC <5 points.

In terms of body mass index, the current study found that the majority of patients are overweight. From the researcher's perspective, This could be attributed to fat mass increasing as the disease progresses among myopathy patients, while lean body mass decreasing and also due to decreased physical activity.

This is consistent with **Lehtokari et al., (2025).** Who evaluated the dietary condition of patients with nemaline myopathy and associated congenital myopathies, reporting that majority of their study participants were overweight. However, this contradicts **Lopulalan et al., (2021).** The researchers that investigated the "Relationship between (mNUTRIC) Score and muscle thickness" concluded that the majority of their study subjects had a normal BMI.

The current study found that the mean APACHE II and SOFA in high nutritional risk patients were significantly greater than those in low risk nutrition. This is consistent with **Inci et al., 2024,** who investigated the association between dietary risk status and diaphragm atrophy. While inconsistent with the findings of **Mahmoodpoor et al., 2023** in the study about "Prognostic values of modified NUTRIC score to assess outcomes in critically ill patients admitted to intensive care units," where the mean APACHE II and SOFA were higher than that in the present study, which could be due to a different sample.

Regarding correlation mNutric score and MRC score, the present study show that there is moderate negative significant correlation This is identical with **Lopulalan, et al., (2021).** Who the study the "Relationship between modified Nutrition Risk in the Critically Ill (mNUTRIC) Score and muscle thickness" reported that there are negative significant correlation between nutritional risk and muscle wasting.

Conclusion:

According to the findings of the current study, the incidence of nutritional risk among patient with myopathy in Sohag University's critical care units was 69 %. Furthermore, a significant positive correlation of mNutric score with mortality, APACHE II and SOFA while significant negative correlation with MRC score. So, there are relationship between mNutric score and outcomes

Recommendations

- Incorporate nutritional assessment into regular clinical assessments of patients in the critical care units.
- Provide educational program about nutritional screening for critical care nurses.
- Further research determine the effect of malnutrition after ICU discharge
- Apply modified Nutrition Risk (mNUTRIC) Score as abased part in clinical assessments of patients in the critical care units.

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