Research

Predictors Analysis of Malnutritional Risk in Patients Admitted to Intensive Care Unit in the First 36 Hours: an Observational Study

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Abstract

Introduction. Contributing factors to the development of malnutrition include the presence of a critical illness. A state of malnutrition is associated with worse outcomes, such as prolonged length of stay and mechanical ventilation, increased risk of contracting infections and developing pressure sores, increased readmission rates, morbidity, and mortality. The aim of the following study is to is to identify predictors of early nutritional risk in critical illness in relation to mNUTRIC, in the first 36 hours of ICU admission.

Methods. This is a single-center observational study. The sample consisted of 103 patients admitted to the ICUs of a university hospital in central-southern Italy. The instrument, created on the basis of the literature review, is made of 25 items. A descriptive statistycal analysis was then conducted and the correlation between the items of the instrument and the independent variables were analyzed with Kendall's Tau. Multiple regression analysis was performed, which was evaluated to describe the relationship between the variables, therefore to determine how the various coefficients affect the mNUTRIC variables.

Results. The sample had a mean age of 62.25 years, with a mean risk of malnourishment of 3.30 on the mNUTRIC scale. The overall model was statistically significant ($F(3, 85) = 31.92$, $p < .001$), age showed a significant positive effect ($\beta = .485$, $t = 6.43$, $p < .001$) as well as lactates that showed a significant positive effect ($\beta = .204$, $t = 2.73$, $p = .008$) and the positive and significant effects of meccanical ventilation and sedation (β =

.423; t = 5.625; p < .001).
Discussion and Conclusions. Predictor analysis has succeeded in defining variables that can be considered to improve early metabolic consequences in critically ill patients. Therefore, it is necessary to create rapid and comprehensive tools with specific variables to reduce malnutrition conditions early and activate ad hoc nutritional pathways in critically ill patients.

Keywords: Critical Illness, Intensive Care Unit, Nutrition Assessment, Nursing Assessment

Introduction

Malnutrition is a problem in intensive care units (ICUs), presenting with a prevalence of between 38% and 78% [1, 2]. Contributing factors to the development of malnutrition include the presence of critical illness [3], which activates the inflammatory process [4], leading to increased energy expenditure and protein catabolism [5], which, in turn, result in the loss of muscle mass [6]. Additional factors include a failure to perform nutritional screening and assessment [7], episodes during hospitalization of discontinuation of nutritional therapy [8], gastrointestinal dysfunction [9], administration of inadequate nutritional support and inflammation-induced reduction of appetite [5]. Persistence of the inflammatory state results in increased protein catabolism to the point of muscle atrophy, promoting a condition termed chronic critical illness [10]; or it can lead to the development of post-intensive care syndrome (PICS), which impairs functional status [11].

A state of malnutrition is associated with worse outcomes, such as prolonged length of stay and mechanical ventilation [12], increased risk of contracting infections [13] and developing pressure sores increased readmission rates, morbidity, and mortality [14].

To date, tools such as the Subjective Global Assessment (SGA), recommended by the Indian Society of Critical Care Medicine, have been used to assess patients' nutritional conditions. However, the SGA is not designed for critically ill patients and it does not include severity of illness [1], which interferes with energy expenditure [15]. Additionally, in the SGA it can be difficult to obtain all the data [16], and it may take several days before it registers changes [1].

Recently, several techniques have been implemented in practice to assess nutritional status in the ICU inpatient, such as quantification of muscle mass [17], through the use of computed tomography (CT), ultrasonography or with bioelectrical impedance analysis (BIA) [1]. This evaluation allows information to be obtained on nutritional status before hospitalization and the monitoring of this status [17], since muscle represents the largest protein reserve [17]. The use of these methods is still limited for critically ill patients [18], and CT is hardly feasible unless performed for other evaluations [18]. Ultrasound may be affected by fluid accumulation at the muscle level, so much so that, to perform it, compression of the muscle should be performed [19], which means it is operator-dependent; moreover, no nutritional risk cut-off values have been defined using this instrumental examination [17].

To our knowledge, the literature reports no validated and recommended tool for assessing the risk of malnutrition in patients with critical illness admitted to the ICU and furthermore there are no precise values in the literature that can identify early and prevent malnutrition in these patients [12]. Indeed, there are conflicting opinions on using several scales simultaneously to make more appropriate malnutrition risk assessments [20], using multiple scales in a non-standardized manner would result a complex and fragmented assessment for nurses [21] .

There is a scale Global Leadership Initiative on Malnutrition (GLIM) for diagnosing the state of malnutrition in critically ill patients [22], but it requires complex tests such as Body impedance analysis (BIA). Furthermore, it is not a tool that investigates the risk of malnutrition early and does not integrate fundamental laboratory tests to prevent the risk of malnutrition, which is the expertise of the nurses in ICU [23]. Such an analysis would allow adequate nutritional support to be administered in cases of nutritional deficiency [24].

A recent systematic review[25] states that the Nutrition risk in the Critically ill (NUTRIC), modified NUTRIC (mNUTRIC), Nutrition Risk Screening 2002 (NRS 2002), SGA, Malnutrition Universal Screening Tool (MUST) and the criteria of American Society for Parenteral and Enteral Nutrition (ASPEN) and European Society for Parenteral and Enteral Nutrition (ESPEN) criteria scales are the most widely used tools for defining the risk of malnutrition in critical illness patients. However, the mNUTRIC is found to be the one that most predicts mortality in critical illness patients[25]. Although nutritional assessment is recommended by the Society of Critical Care Medicine (SCCM) and the ASPEN guidelines [26], and represents a fundamental element in the care of patients with critical illness [27], it is frequently ignored in the ICU[1]. Possibly because staff lack information about its importance [7] or because there are no quick and accessible nursing scales as the lack of time in ICU nurses is a factor limiting the compilation of assessment scales[28]. Hence, there is an urgent need to analyze the the predictive effect between some variables and the mNUTRIC scale in order to develop a tool for early assessment of nutritional risk in patients admitted to the ICU [27], which also integrates blood laboratory values with rapid outcome [25] and can be completed early by ICU nurses. A literature review emphasised the importance of investigating clinical and socio-demographic variables in ICU patients in relation to malnutrition risk scales to prevent outcomes such as ICU readmissions, infectious risk, prolonged mechanical ventilations and increased length of stay[29]. Therefore, the analysis of variables that predict early nutritional risk is of paramount importance to identify the elements necessary for the development of a multidimensional nursing scale specifically for critically ill patients, which is necessary to develop early and appropriate nutrition care plans.

The aim of the following study is to is to identify the predictors of early nutritional risk in critical illness in the first 36 hours of ICU admission.

Methods

A single-center prospective observational pilot study was conducted. Article development was guided by the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for describing observational studies.

Participants

It's a convenience sample consisting of 103 patients admitted to the General Surgery Intensive Care Unit (GS-ICU), Medical Intensive Care Unit (M-ICU), and Cardio-Thoracic-Vascular Surgery Intensive Care Unit (CTVS-ICU) of a university hospital in south-central Italy.

Eligibility Criteria

Subjects included in the study had to be at least 18 years old, and hospitalized in one of the named ICUs for at least 36 hours during the period in which data collection took place.

Exclusion criteria were patient not admitted to the ICU, ICU admission more than 36 hours at the time of enrollment, ICU admission duration less than 24 hours, and age less than 18 years.

Ethical Considerations

Data collection was carried out in compliance with the privacy rules set out in the Helsinki declaration [30]. The study received approval from the local Ethics Committee "Campania Sud" (protocol no.124_r.p.s.o.). Patient data were collected retrospectively by reviewing medical records. Data such as arm circumference and body weight were taken directly from the patient during the hospital stay, through the use of a centimetre and a bed scale which was present at each bedside. Anonymity was ensured by assigning each patient an alpha-numeric code, which was reported and entered into Excel®.

Data Collection

Admissions were identified from the admission and emergency room lists, and a 'walk around' of ICUs. All data collectors received training on the assessment instruments at the beginning and completed a refresher session mid-study. Data collection took place between April 2023 and September 2023, 36 hours after the patient's admission to the ICU, through a review of both paper and computerized medical records.

Some laboratory data were not available for all patients. Albumin was obtained in 58 patients and lactates in 89. Anthropometric data were obtained by measuring the patients' weight and arm circumference. The latter was measured in 96 patients.

Instruments

Sociodemographic and clinical variables

An ad hoc form was developed based on existing literature, to assess nutritional status.

In the study was used a form made of 25 items, each of which contained a variable to be investigated, which were selected following a review of the literature. The items were then divided into five sections. Sociodemographic data, including, age, sex, days of hospitalization, diagnosis, and medical history. Anthropometric data, including weight, height, body mass index (BMI), and arm circumference. For the assessment of nutritional status, anthropometric data must be considered simultaneously [31]; since anthropometry influences energy expenditure [24]. The sociodemographic data collected were age, gender and days of hospitalisation; these were taken from the review of medical records. While anthropometric data such as weight, height and arm circumference were taken by bed scale measurement, height was taken from the patient when awake and oriented or from family members when unconscious. Finally, the circumference was taken by the use of a centimetre. Finally, an assessment form, included information such as the presence or absence of mechanical ventilation, whether receiving sedation, the presence of pressure ulcers and their classification whether evacuation has occurred and its type, classified along the Bristol stool Form scale.

Bristol Stool Form Scale (BSFS)

The BSFS is the most widely used scale in adults to classify faeces according to their shape and consistency. This classifies stools into 7 types; type 1 and type 2 considers abnormally hard stools, types 3-4 and 5 are normal stools, while types 6 and 7 represent liquid and soft stools [32].

European Pressure Ulcer Advisory Panel (EPUAP)

Decubitus injuries have been classified using the EPUAP scale, which has four grades of classification. The first grade involves discolouration of the skin, heat, oedema, while for those with darker skin the indicators used are induration or hardness; the skin does not turn white under pressure. The second degree involves the prezsence of a blister or abrasion of the skin characterised by a partial loss of skin thickness involving epidermis and/or dermis. The third degree is characterised by a complete loss of skin thickness, resulting in necrosis with damage to the subcutaneous tissue that may extend to the underlying fascia, without crossing it. Finally, grade four is determined by the presence of extensive destruction, with tissue necrosis or damage to muscles, bones or supporting structures, with or without complete loss of skin thickness [33].

mNUTRIC

The Nutrition Risk in Critically Ill (NUTRIC) score was a new screening tool that Heyland et al. presented that was validated for ICU patients[34]. According to Heyland et al. (2011), this score assesses the risk of unfavorable outcomes (mortality, mechanical ventilation) that can be altered by intensive dietary intervention [34]. Age, the Acute Physiology and Chronic Health Disease Classification System II (APACHE II), the Sequential Organ Failure Assessment (SOFA) score, comorbidities, the number of days spent in the hospital before being admitted to the intensive care unit, and Interleukin-6 (IL-6) are the factors that go into this score [34].

A modified NUTRIC (mNUTRIC) without IL-6 can be used considering a high nutritional risk cutoff point ≥ 5[35]. Guidelines [26] recommend nutritional risk assessment at 24-36 hours, in every patient in the ICU [1]. Nutritional therapy can be administered via several modalities, including enteral, parenteral or oral [36].

Laboratory data

The laboratory data including albumin, hemoglobin, and lactates were assessed to describe the outcome of the nutritional status. Albumin may be considered as a parameter of inflammation and disease severity [31], as it interferes with energy expenditure and protein catabolism [15] Particularly, lower plasma albumin content was linked to higher daily caloric intake and weight growth, revealing albumin as a measure of controlling caloric intake [37]. States of anemia are affected by micronutrient deficiency or blood loss [38]. Lactates are associated with increased energy expenditure [39], a frequent phenomenon during critical illness [5, 24].

Data Analysis

IBM-SPSS® (version 26.6) databases was used for statistical analysis. A descriptive statistical analysis was first carried out on the variables collected. Categorical variables were stated as numbers and percentages, and continuous variables as mean and standard deviation (*SD*) values, or if not in accordance with the normal distribution, as median, minimum, and maximum values. For the demographic data and variables used in the study, preliminary testing using the Shapiro-Wilk yielded a statistically significant result ($p < .001$). This finding suggests that neither of the data was normally distributed.

To evaluate the relationships between nutritional risk (dependent variable, measured by the mNUTRIC score) and potential independent variables, a non-parametric correlational analysis was conducted using Kendall's tau coefficient. This methodological choice is appropriate considering the ordinal nature of the mNUTRIC scale. Kendall's Tau rank correlation coefficient was used for the ordinal ones, and it is preferred to Spearman when samples are small[40].

Each variable significantly associated with the mNUTRIC score was entered into a multiple regression analysis. The coefficient of determination is also reported to measure the variances of the statistical model considered in predicting outcomes.. In all tests, a $p < 0.05$ (two-sided) was accepted as the level of statistical significance.

Sample Size

A priori power analysis was conducted using GPower (version 3.1.9.7) to determine the minimum required sample size[41]. For a two-tailed paired-samples t-test with $\alpha = 0.05$, power $(1-\beta) = 0.80$, and an anticipated medium effect size ($d = 0.30$), the minimum required sample size was 90 participants. The final sample of 103 subjects exceeded this requirement, achieving a post-hoc statistical power of 0.88[42].

Results

The present study collected data on a sample of 103 patients admitted to the ICU. The sociodemographic, clinical, and anthropometric characteristics of the sample are summarized in Table 1. The mean age of participants was 62.25 years (SD = 16.73), with a predominance of male subjects (69.9%, n = 72). The median length of stay in the ICU was 3 days (SD = 9.17). The mean weight recorded was 80.04 kilograms (SD = 18.72), with a mean BMI of 28.27 (SD = 6.61), a value that places the sample in the overweight category. Among the patients, 48.5% (n = 50) were on mechanical ventilation and 52.4% (n = 54) were sedated. The mean value that was obtained from the considered sample on the mNUTRIC scale was 3.30 (SD = 1.71).

The mean lactate value was 1.31 (SD= 1.06). The mean level of haemoglobin was 10.38 (SD= 1.93); mean albumin value was 3.07 (SD= 0.80). 5.8% of the patients had no comorbidities. The most common comorbidities were cardiovascular diseases (30%) and diabetes mellitus 1 and 2 (13%). High nutritional risk (defined by an mNUTRIC score ≥ 5) was found in 23 patients, corresponding to 22.3% of the total sample.

The analysis revealed statistically significant correlations between the mNUTRIC score and several variables. In particular, positive correlations emerged with age ($\tau = 0.399$, $p < 0.001$), with lactate levels ($\tau = .183$, $p < .05$), with mechanical ventilation ($\tau = .366$, $p < .001$), as well as between the mNUTRIC score and sedation ($\tau = .320$, $p < 0.001$). Furthermore, by examining the correlation matrix between all independent variables, we verified a high correlation between ventilation and sedation ($r = 0.847$; $p < 0.001$) suggesting possible multicollinearity. In this specific case, we verified a VIF = 3.198 for ventilation and a VIF = 3.167 for sedation. The sample was then divided into two populations: a sub-sample comprising sedated and ventilated patients and a second sub-sample with the remaining categories. Finally, a positive and significant correlation was identified between the mNUTRIC score and the divided sample in comparison to the sedated/ventilated sub-sample ($\tau = 0.493$, $p < 0.001$).

Table 1. Sociodemographic and clinical characteristics of participants (n = 103).

	M ± SD (range)
Age (years)	62.25 ± 16.72 (18-95)
Length of Stay	5.97 ± 9.17 (1-58)
Weight	80.04 ± 18.72 (50.00-141.50)
Height	168.14 ± 8.36 (150-194)
Arm	30.28 ± 5.79 (5.60-46.50)
BMI	28.27 ± 6.61 (18.04-53.30)
mNUTRIC	3.30 ± 1.71 (0-8)
Lactates	1.31 ± 1.06 (.40-7.90)
Hemoglobin	10.38 ± 1.93 (6.80-15.80)
Albumin	3.06 ± .79 (1.40-6.40)
	n (%)
Gender:	
Male	72 (69.9)
Diagnosis:	
Neurological pathology	13 (12)
Polytrauma	15 (15)
Respiratory system pathologies	13 (13)
Pathologies of the digestive system	13 (13)
Neoplasm	9 (9)
Cardiovascular pathologies	30 (28)
Other	10 (10)
Anamnesis:	
Cardiovascular pathologies	58 (30)
Diabetes	26 (13)
Respiratory system pathologies	16 (8)
Dyslipidemia	14 (7)
Neoplasm	12 (6)
Urinary tract pathologies	10 (5)
Other	58 (31)
Mechanical ventilation:	
Yes	50 (8.5)
No	53 (51.5)
Sedation:	
Yes	54 (52.4)
No	49 (47.6)
Pressure Ulcers:	
Yes	9 (8.7)
No	94 (91.3)
Pressure ulcer staging:	
Stage I	5 (4.9)
Stage II	1 (1)
Stage III	3 (2.9)
Regular bowel function:	
Yes	10 (9.7)
No	93 (90.3)
*BSC**:	
Constipation	1 (1)
Fiber lacking	3 (2.9)
Diarrhea	6 (5.8)
Gastric protection:	
Yes	97 (94.2)
No	6 (5.8)
Prokinetics:	
Yes	5 (4.9)
No	98 (95.1)
Nutrition:	
Yes	35 (34)
No	68 (66)
Type of nutrition:	
Fasting	68 (66)
OS*	14 (13.6)
EN*	20 (19.4)
PN*	1 (1)

* M=Mean. SD=Standard Deviation. BSC=Bristol Stool Chart. OS= Oral Solution. EN=Enteral Nutrition. PN=Parenteral Nutrition

To evaluate the combined effect of these predictors, a multiple regression model was developed incorporating all four variables simultaneously (Table 2). The overall model was statistically significant ($F(3, 85) = 31.92$, $p < 0.001$), explaining 53% of the variance in mNUTRIC scores. Specifically, age showed a significant positive effect ($\beta = 0.485$, $t = 6.43$, $p < 0.001$) as well as lactates that showed a significant positive effect ($\beta = 0.204$, $t = 2.73$, $p = 0.008$) and the positive and significant effects of meccanical ventilation and sedation ($\beta = 0.423$; $t = 5.625$; $p < 0.001$). The analysis of effect sizes through squared partial correlations indicates that age ($pr^2 = 0.33$) has substantially greater explanatory power than sedated/ventilated sub-sample (pr2 = 0.27) and lactate levels ($pr^2 = 0.08$) in predicting nutritional risk in this ICU population.

Table 2. Results of the multivariable regression models predicting mNUTRIC

Model[a]	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	-1.030	.533		-1.932	.057	-2.090	.030
Age	.052	.008	.485	6.431	.000	.036	.067
Lactates	.339	.124	.204	2.732	.008	.092	.586
Other vs V/S	1.498	.267	.423	5.167	.000	.968	2.208
R^2	**.530***						

a. Dependent Variable: mNUTRIC
b. * p < .001

Discussion

The aim of this study was to identify predictors of early nutritional risk in critical illness in the first 36 hours of admission to ICU. The gender of the sample examined is representative of the population admitted to the ICU with the majority of patients being male, which is in line with the the literature [43]. Of all the subjects, 66% (n = 68) of them did not receive nutrition within the 36 hours of hospitalization, although this is recommended[44]. Wischmeyer et al.[15] stated that, on average, at least 60 hours elapse before nutritional therapy starts within the ICU [15]. In cases in the study where nutritional therapy was administered, the guidelines [26] were adhered to; 19.4% (n = 20) received enteral nutrition, 13.6% (n = 14) oral, and only 1% (n = 1) parenteral. Enteral nutrition is to be preferred when oral nutrition is not feasible [18] as it has non-nutritional advantages, such as maintaining the integrity of the intestinal barrier and preventing bacterial translocation [45]; in contrast to parenteral nutrition, which is associated with more complications [46]. Behaviour that delays the start of nutrition in patients admitted to the ICU could be due to practical activities performed on the airway, gastric intolerance or dislocation of the nasogastric tube[47]; the presence of a multidisciplinary team and proper communication on the management of nutritional therapy in patients admitted to the ICU has been given in the literature as a key to solving these problems [48].

The age of patients admitted to the ICU is one of the strongest predictors of early malnutrition in our model. This finding is consistent with the literature[49], which states that the hospitalised elderly population requires early nutritional assessment [50, 51,52], due to their risk of malnutrition linked to comorbidity status, frailty and altered microbiome[51]. Since, this population if already malnourished on admission can affect the days of stay in the ICU, incidence of infections, altered cognitive and functional status by developing the so-called multifactorial syndromes typical of the elderly population surviving ICU admissions [50, 51]. To date, the elderly population admitted to the ICU has only been studied as a substratum of the intensive care population[52, 53]. Moreover, predictors (delirium or dysphagia) of malnutrition have been studied only in the elderly population admitted to the ICU[50, 54].

Lactate was also indentified as a predictor of nutritional risk in this population.The increase in lactates is due to the body's inability to regulate energy expenditure, based on the amount of oxygen received [39]. Therefore, in situations of imbalance between the demand and supply of oxygen, the cells activate an anaerobic metabolism, leading to an increase in the production of lactates [55]. Critical illness leads to an increase in energy expenditure and catabolic processes [5], favoring the production of lactates [39]. The increase in lactates lowers the pH [56] and increases the chance of developing acidosis [57], which in turn increases the clinical severity score on the APACHE II scale [58] as this considers the pH as a parameter [57]. As expressed in recent studies[59], our results confirmed lactates, in the multivariate regression model, as a predictor of early nutritional risk at 36 hours in patients admitted to the ICU.

Among the clinical data, being sedated and mechanically ventilated was found to be a significant predictor of nutritional risk in the regression model. This finding is in line with the most recent literature [60], which states it as a factor closely associated with malnutrition status. In our sample, this could be due to the fact that most patients were fasting in the first 36 hours as they performed instrumental examinations such as CT, fibrobronchoscopy, RX or cultural examinations such as broncholavage. In fact, these examinations and the procedures performed on the airway (bronchoaspiration, alveolar lavage, weaning from ventilation with CT, etc.) in the first 36 hours are the main reasons why ICU physicians delay enteral nutrition[47, 61]. High caloric support in mechanically ventilated patients is associated with low mortality and early discharge from ICUs [61]. The novel finding is its characteristic as a significant predictor of malnutrition risk when the combination of sedation and ventilation coexists. Indeed, recent studies[60] confirm mechanical ventilation as a risk factor without considering the state of sedation. It is possible to hypothesize that excluding sedation status as a predictor of malnutrition risk on a mechanically ventilated patient population is determined by misinterpretation and clinical misbehavior. Precisely because, patients who receive sedation show a decrease in metabolic stress, which determines a decrease in energy needs [24]. Furthermore, sedated patients receive non-nutritional calories (e.g; Propofol, dextrose infusion and citrate dialysis), which increases their caloric needs [12]. Non-nutritional calories are those from taking certain drugs, such as propofol or sodium citrate, or from intravenous administration of glucose[12]. For instance, propofol contains 0.1g fat per millilitre, accounting for approximately 17% of the total nutritional requirement. If the calories from such administrations are not taken into account for the definition of the patient's nutritional requirements, the patient is exposed to the risk of overnutrition[12]. The problem in the literature also arises as misbehaviour in that clinicians include the caloric intake of sedation but consequently lower the amount of NE to be administered to the patient, thus generating a nutritional risk from undernutrition[62]. It might be a solution to involve the pharmacist and nutritionist in order to have a correct caloric and protein balance, avoiding under- or over-nutrition during EN sedation combination therapies[62]. To date, the relationship between sedation and mechanical ventilation on the nutritional effect was still unclear in the literature, in fact a study of 701 patients stated that mismanagement of NE and sedation combination prolonged the time of mechanical ventilation with a consequent effect on the patient's catabolism and subsequently on malnutrition status[63].

The regression model shows in a hierarchical projection the effect of predictors such as age, mechanical ventilation, sedation, and lactates as alarm bells for nutrition screening of patients admitted to ICU. Hence, the SCCM and the ASPEN guidelines recommend administration of a nutritional screening test 24–36 hours after hospitalization [26], with a particular indication for those for whom prolonged hospitalization is foreseen [12]. Future research should investigate how these predictors may moderate the risk of malnutrition, and a tool could be developed for ICU nurses that is quick and accessible, so as to stratify the population at risk of malnutrition in the first 36 hours by activating tailored nutritional pathways.

Implications for clinical practice

Implications for practice are that variables found to be significantly correlated with early malnutrition outcomes in patients in critical illness, can be used to construct a multidimensional nursing scale. This would trigger an early pathway of clinical nutrition specialists which may ameliorate or avoid outcomes such as increased ICU length of stay, difficulty weaning off mechanical ventilation and sedation, increased infections, increased gastrointestinal disorders, and systemic worsening of the patient due to the conditions of hypoalbuminemia and metabolic alkalosis.

An essential element for research could be the construction of a multidimensional scale on early nutritional risk in patients with a critical illness, which could cover all these variables, providing a valid and rapid nursing assessment tool in the ICU.

Limitations

The first limitation is that the study is single-center, with a small sample, which potentially makes the data unrepresentative of the general population.

It should be emphasized that an intrinsic limitation of the mNUTRIC tool is the lack of inclusion of direct nutritional parameters in the score calculation. Data on the type of sedation (lipid or other) and mode of ventilation would have led to a more consistent assessment as would other data, such as energy expenditure, the presence of a state of delirium, active/passive ventilation rewarming, hydration/dehydration status, and diuretics and diuresis output. Water balance in ICU patients is important as they may have oedema or have undergone volemic resuscitation, affecting anthropometric variables (LaRosa, 2019; Taylor et al. 201643).

Conclusions

Age, sedation and mechanical ventilation status, and serum lactates were found to be early predictors of elevated risk of malnutrition. Nursing's contribution to the prevention of early malnutrition in ICU patients can lead to patient-focused changes such as reduced infections, days of ventilation, faster functional and cognitive recovery; and to health system-focused changes such as reduced ICU admissions, reduced ICU inpatient costs, earlier discharges and safer transitions of care.

Identifying malnutrition risk is a nursing competence. Given the lack of time and the need for rapid tools in the ICU, a smart malnutrition risk assessment tool for ICU nurses could be developed in a future perspective. In order to fortify the nursing core competence in a shorter time, activating a multidisciplinary and multidimensional nutrition pathway in ICU patients.

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