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Original Article

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Associação do estado nutricional com espessura do músculo adutor do polegar e escore fisiológico agudo simplificado em pacientes de UTI

Association of nutritional status with adductor pollicis muscle thickness and simplified acute physiological score in intensive care unit patients

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Resumo

Introdução: O uso rotineiro de índices prognósticos e indicadores para avaliação do estado nutricional pode ter impactos decisivos sobre as chances de reabilitação e sobrevivência em pacientes críticos. Objetivos: Avaliar a prevalência de desnutrição em pacientes admitidos em Unidade de Terapia Intensiva e verificar a associação entre a espessura do músculo adutor do polegar (EMAP) e o índice de prognóstico Simplified Acute Physiology Score III (SAPS III) com o estado nutricional dos pacientes. Materiais e métodos: Foram avaliados 60 pacientes admitidos na UTI adulto. A avaliação do estado nutricional foi realizada nas primeiras 48 horas de internação, por meio do Índice de Massa Corporal (IMC) e pela adequação da circunferência de braço (CB). A EMAP foi coletada na mão não dominante e os valores de SAPS III foram calculados e fornecidos pelos médicos responsáveis pela UTI. Resultados: A prevalência de desnutrição foi de 25% segundo IMC e de 35% segundo a porcentagem de adequação da CB. Os pacientes eutróficos apresentaram valores médios da EMAP significativamente menores quando comparados com os indivíduos com excesso de peso, de acordo com o IMC. Os indivíduos desnutridos, segundo adequação da CB, apresentaram valores médios de EMAP significativamente menores quando comparados com os indivíduos com excesso de peso. Conclusões: A prevalência de desnutrição entre os pacientes variou entre 25 e 35%, conforme indicador utilizado. Os valores médios de EMAP foram diferentes segundo estado nutricional e não foi observada associação entre o estado nutricional e o índice prognóstico SAPS III.

Palavras-chave: nutrição; unidades de terapia intensiva; estado nutricional.

Abstract

Introduction: The use of prognostic indices and indicators to assess nutritional status can have decisive impacts on the chances of rehabilitation and survival in critically ill patients. Objectives: To assess the prevalence of malnutrition in patients admitted to the Intensive Care Unit and to verify the association between adductor pollicis muscle thickness (APMT) and the Simplified Acute Physiology Score III (SAPS III) prognostic index with the nutritional status of patients. Methods: Sixty clinical and surgical patients admitted to the adult ICU were evaluated. The assessment of nutritional status was performed in the first 48 hours of hospitalization, using the Body Mass Index (BMI) and the adequacy of the arm circumference (AC). APMT was collected from the non-dominant hand and SAPS III values were calculated and provided by the physicians responsible for the ICU. Results: The prevalence of malnutrition was 25% according to BMI and 35% according to the percentage of adequacy of AC. Eutrophic patients had significantly lower mean APMT values when compared to overweight individuals, according to BMI. Undernourished individuals, according to AC adequacy, had significantly lower mean APMT values when compared to overweight individuals. Conclusions: The prevalence of malnutrition among patients ranged between 25 and 35%, depending on the indicator used. Mean APMT values were different according to nutritional status and no association was observed between nutritional status and the SAPS III prognostic index.

Keywords: nutrition; intensive care units; nutritional status.

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Introduction

Intensive care units (ICU) are of primordial importance in the control of most varied severe illnesses that affect human beings and represent a powerful tool in modern medicine[1].

Patients assisted in intensive care units have different severe pathologies and systemic inflammatory responses, which generate intense catabolism, mobilization of proteins to repair the damaged tissues and energy supply, fluid overload, besides several other changes that may determine significant loss in lean fat. As a result of these significant metabolic alterations, the risk of malnutrition in these patients increases substantially[2,3,4,5,6].

Calorie/protein malnutrition may cause increases risk of infections by reducing immunity, reduced wound healing, changes in the coagulation cascade balance, in electrolyte and hormonal balance and in renal function, in addition to prolonging mechanical ventilation time by reducing epithelium regeneration. This condition, consequently, may lead to increased period of hospitalization and hospital costs, which reinforces the need to identify malnourished patients or those with the potential to develop malnutrion[7,8,9,10].

The prevalence of malnutrition in the hospital environment varies from 20% to 50% in different studies, according to the criteria used. Some patients are already admitted to the hospital with malnutrition and others develop it after hospitalization[11,12,13].

In underdeveloped countries such as Brazil, factors such as the underlying disease, poor socioeconomic conditions and deficiency of the public health system often make malnutrition pre-existent. A study conducted in hospitals in 12 states of Brazil showed that 48% of hospitalized patients were malnourished, and 33,2% already had this condition in the first two days of hospitalization, indicating a pre-existing condition of poor nutritional status (NS)[14,15].

Considering the high prevalence of malnutrition in the hospital environment, investigation of the nutritional status (NS) of hospitalized patients is directly related to improved patient recovery and shorter period of hospitalization. Therefore, it is essential to perform a nutritional assessment (NA) when the critically ill patient is admitted to intensive care. Several methods may be used, however, the most effective ones are sophisticated, expensive and not applicable at bedside, not being part of the daily practice in public hospitals. It should also be considered that in the intensive care setting, changes in fluid distribution and body composition make it difficult to accurately diagnose the NS. In this scenario, a strategy that combines different NA tools may be the most appropriate for this group of patients[4,16,17].

The anthropometric measurements used to evaluate individuals in the hospital context involves: body mass index (BMI), skinfold thickness, arm circumference (AC), arm muscle circumference (AMC), body weight (BW) and height (H)[16,18]. BMI, calculated by dividing weight (body mass in kilograms) by the height (in meters) squared, has an important association with body fat, but does not adequately describe the body composition of an individual. On the other hand, the measurement of AC can provide information about the deposition of fat and local muscle[16,18].

In addition to these measurements, Lameu et al.[19] proposed the measurement of the Adductor Pollicis Muscle thickness (APMT), a low-cost, non-invasive, and simple procedure. This muscle is flat, fixed between two bony structures, and because of this, it is the only one that can be measured directly, without the need for equations or adjustments to estimate its real value.

Pereira et al.[20] showed that the APMT can be used in different populations and is capable of estimating the nutritional status and muscle mass, since it was correlated, even if weakly or moderately, with the anthropometric indicators of weight, Body Mass Index (BMI), Arm Circumference (AC) and others. These authors considered the APMT to be a relatively recent measurement and pointed out the need to identify cut-off points for the classification of nutritional status.

Besides the specific indicators to assess the nutritional status, ICU health teams use prognostic indexes of patients' mortality. These indexes make it possible, on one hand, to verify the severity of the disease presented by the population assisted in a given unit, providing a direction for the allocation of personnel and equipment, and on the other hand, to allow periodic verification of the team's performance by comparing, for example, the predicted mortality with that observed.

One of the most used prognostic indexes is the *Simplified Acute Physiology Score III* (SAPS III), composed of 20 different variables easily measurable at the patient's admission to the ICU. The variables are divided into three parts, demographic variables, physiological variables, and reasons for ICU admission, which represent the degree of disease impairment and assess the health status prior to hospital admission, an indicator of premorbid condition.[21].

Thus, the daily use of prognostic indexes to assess nutritional status is essential to improve the care of critically ill patients, and can have decisive impacts on rehabilitation and survival chances.

In this context, the objective of this study was to determine the prevalence of malnutrition in patients admitted to the Intensive Care Unit of a private hospital in the city of São Paulo and to verify the association between Adductor Pollicis Muscle thickness (APMT) and the *Simplified Acute Physiology Score III* (SAPS III) prognostic index with the patients' nutritional status.

Materials and Methods

Sample and type of study

This is a cross-sectional study, inserted in the research Project entitled "Malnutrition on admission of patients in Intensive Care Unit, association with the predictive score of severity and its impact on clinical evolution ("Desnutrição na admissão de pacientes em Unidade de Terapia Intensiva, associação com o escore preditivo de gravidade e seu impacto na evolução clínica"), developed in a private hospital in the city of São Paulo. The sample was composed of adult patients of both genders, admitted to the adult ICU between November 2019 and June 2020.

The procedures for the development of this research followed the guidelines and standards regulating trials involving humans, and the study was approved by the Ethics and Research Committee of Santa Casa de Misericórdia de São Paulo (CAAE: 24712419.6.0000.5479).

Trial design

Data related to patient identification and medical information were collected from electronic medical record. Nutritional assessment was performed within the 48 hours of ICU admission.

The following variables were analyzed: gender, age, administration routes of the diet, weight and height (using measured data of arm circumference – AC and knee height – KH), nutritional status at the time of admission (according to Body Mass Index – BMI and AC adequacy), patient's admission unit, clinical or surgical patient, personal antecedents, period of stay (in days), patient's outcome (whether discharge to ward or death), nutritional status assessment by Adductor Pollicis Muscle thickness (APMT) and the SAPS III prognostic index.

Inclusion and Exclusion Criteria

Clinical and surgical patients admitted to the adult ICU, over 18 years old, of both genders were included in the study. Exclusion criteria were: pregnant or puerperal patients, patients in exclusive palliative care, patients unable to undergo the nutritional assessment proposed by the study or lacking information and patients without nutritional assessment performed within the first 48 hours of ICU admission.

Procedures

The arm circumference (AC) and knee height (KH) were measured using an inelastic and flexible Sanny ® anthropometric tape. These data were used to calculate the estimate weight (by the Chumlea et al.[22] formula) and height (by the Chumlea e Guo[23] formula).

BMI classification for adults was done according to the World Health Organization[18] and for the elderly the Organización Panamericana de la Salud[24] recommendation was used.

The percentage of adequacy of the AC was determined using the equation according to Blackburn & Thornton[25] for the classification of nutritional status in: malnutrition (mild, moderate and severe), eutrophic, overweight and obesity (level I, II, III)[25,26]. BW and APMT were collected for the assessment of patients' nutritional risk and correlated to the parameters of AC.[19,27].

With the help of a Sanny ® adipometer, the thickness of the pollicis muscle (APMT), in mm, of the non-dominant hand was collected (information obtained from the patient or Family member) according to the techniques of Lameu et al.[19].

To obtain the SAPS III, the variables were divided into three categories: demographic variables and reasons for ICU admission. For each of the analyzed variables a weight is attributed, according to the severity of the physiological disorder. In theory, the minimum value assigned for the score is 16 and maximus is 217 points. The physiological variables that compose the acute physiological score are: systolic blood pressure, temperature, heart and respiratory rate, oxygenation, arterial pH, sodium, potassium, bilirubin, creatinine, hematocrit, leukocytes, platelets, and Glasgow coma scale[21]. The SAPS III values were calculated by the ICU physicians in charge and made available to the study researchers.

The collected data were uploaded to a database and evaluated by the Statistical Package for Social Science (SPSS), version 2.2. A descriptive analysis was performed to characterize the sample. Initially, the variables were analyzed for adherence to normal distribution using the Kolmogorov-Smirnov test. The association between socio-demographic variables, nutritional status and outcome was performed using Pearson's chi-square test. The mean values of APMT, SAPS III and probability of death were compared according to nutritional status (assessed by BMI and AC adequacy), using the analysis of variance (ANOVA). For quantitative variables without normal distribution, corresponding nonparametric statistical tests were used. All statistical analyses considered a significance level of 5%

Results

60 patients were evaluated, the majority being female, over 60 years old, with personal background of systemic arterial hypertension, followed by Diabetes mellitus (Table 1). Most patients had undergone surgical procedure and remained in the ICU for less than 3 days, with oral diet. No significant association was observed between socio-demographic characteristics and outcome (ICU discharge or death).

Most of the patients on admission to the ICU were from the surgical inpatient unit (83,3%), units mainly being the orthopedic and cardiac units (36,7%).

Table 1. Characterization of patients evaluated at the Intensive Care Unit of a private hospital in the city of São Paulo, 2022.

Socio-demographic characteristics	N (%)	OUTCOME		p*
		ICU DISCHARGE	DEATH	
Sex				0,444
Feminine	34 (56,7)	31	3	
Masculine	26 (43,3)	25	1	
Age Group (Years)				0,878
18 – 30	3 (5)	3	-	
31 – 60	26 (43,3)	24	2	
>60	31 (51,7)	29	2	
Personal History				0,769
SAH[a]	14 (23,3)	13	1	
Tabagism	2 (3,3)	2	-	
Diabetes Mellitus	4 (6,7)	3	1	
Others [b]	7 (11,7)	7		
Dyslipidemia	1 (1,7)	1	-	
Cancer	1 (1,7)	1	-	
Multiple Background [c]	20 (33,3)	18	2	
No Background	11 (18,3)	11	-	
ICU period of hospitalization				0,186
≤ 3 days	34 (56,7)	33	1	
> 3 days	26 (43,3)	23	3	

[a]Systemic Arterial Hypertension. [b]Ostemioelitis, hypothyroidism, stroke, chronic kidney disease, dialysis, angina, amputation, osteoporosis, and adenocarcinoma. [c]Patients who presented more than one personal history.
*Chi-square test.

Table 2 presents the nutritional status (according to BMI and adequacy of the arm circumference) of the patients evaluated, according to the outcome. According to the BMI, we observed a prevalence of overweight patients, followed by eutrophic patients. The prevalence of malnutrition according to this indicator was 25%. Considering the adequacy of the arm circumference, most patients were eutrophic (40%), but the prevalence of malnutrition according to this indicator was 35%. No statistically significant association between nutritional status and outcome was identified.

Table 2. Nutritional status of patients evaluated at the Intensive Care Unit of a private hospital in the city of São Paulo, according to outcome. São Paulo, 2022.

Nutritional Outcome	N (%)	OUTCOME		p*
		ICU DISCHARGE N (%)	DEATH N (%)	
BMI[a]				0,276
Malnutrition	15 (25,0)	14 (23,3)	1 (1,7)	
Eutrophic	20 (33,3)	20 (33,3)	-	
Overweight	25 (41,7)	22 (36,7)	3 (5,0)	
AC adequacy[b]				0,245
Malnutrition	21 (35,0)	21 (35,0)	-	
Eutrophic	24 (40,0)	21 (35,0)	3 (5,0)	
Overweight	15 (25,0)	14 (23,3)	1 (1,7)	

[a]Body Mass Index, [b]Adequacy of arm circumference. *Chi-square test.

According to Table 3, it is possible to observe that there was a difference between the means of APMT according to the categories of BMI and adequacy of the AC. For the BMI measurement, there was a difference between eutrophic and overweight measurements, that is, eutrophic individuals according to BMI

had significantly lower APMT values when compared to overweight individuals. For AC adequacy, there was difference between the averages of malnutrition and overweight i.e. malnourished individuals according to AC had significantly lower APMT values when compared to overweight

Table 3. Mean and standard deviation of adductor pollicis muscle thickness (APMT) of patients evaluated at the Intensive Care Unit of a private hospital in the city of São Paulo, according to nutrtional status. São Paulo, 2022.

Nutritional Status	APMT (mm)		p*
	Mean	Standard Deviation	
BMI[a]			0,006
Malnutrition	9,9	5,0	
Eutrophic	11,2	4,4	
Overweight	15,0	5,5	
AC Adequacy[b]			0,021
Malnutrition	10,1	5,0	
Eutrophic	12,8	4,5	
Overweight	15,1	6,3	

[a]Body Mass Index, [b] Adequacy of arm circumference. *ANOVA

The investigation about the relationship between SAPS III values and the probability of death and nutritional status is described in Table 4. No difference was observed between the means of SAPS III and probability of death according to categories of BMI and AC adequacy.

Table 4. Mean values of SAPS III and Death Probability according to nutritional status of patients evaluated at the Intensive Care Unit of a private hospital in the city of São Paulo, according to nutrtional status. São Paulo, 2022.

Nutritional Status	SAPS III			Death prob (%)		
	Mean	SD	p*	Mean	SD	p**
BMI[a]			0,485			0,794
Malnutrition	52,2	24,9		22,4	31,6	
Eutrophic	45,9	16,4		18,7	23,6	
Overweight	44,8	17,5		18,2	24,5	
AC Adequacy[b]			0,506			0,694
Malnutrition	49,5	22,6		20,2	28,3	
Eutrophic	47,9	18,7		22,3	26,9	
Overweight	42,1	15,1		13,9	20,2	

[a]Body Mass Index, [b] Adequacy of arm circumference *ANOVA **Kruskal-Wallis

Discussion

The prevalence of elderly patients in the hospital environment has become more frequent in recent decades, showing an increase in admissions of this age group in the ICUs. This is mainly due to the change in population profile and life expectancy increase[28].

The literature points out that more than 40% of the ICU patients are postoperative, however, in the present study, this percentage was higher, being 83% of the ICU patients considered postoperative. Admission of postoperative patients to the ICU allows intensive care and close monitoring and early intervention. Many surgical deaths occur several days after surgery, indicating that adequate care and intervention in the ICU may prevent deaths[29].

In treatment units, nutrition aims at weight maintenance and preservation of lean mass. There are several methods of nutritional assessment used in clinical practice, but there are still doubts about which would be the most appropriate when referring to critically ill patients. It is necessary to define a method that provides

safety to the health professional when defining the nutritional diagnosis and nutritional needs of patients, which can contribute more effectively to health recovery. The literature points out that there is no consensus about the best nutritional assessment method for critically ill patients, and the election of a single assessment technique is not advisable, especially when the focus is the intensive care[16].

In this research, two methods were used to evaluate the nutritional status. According to the body mass index, the highest prevalence of nutritional status was overweight, followed by eutrophic and malnutrition was the least present, representing 25% of patients. As for the percentage of adequacy of the AC, most patients were classified as eutrophic, followed by malnutrition with 35% of the patients. As described, the objective methods used had distinct results. The adequacy of the AC identified a higher prevalence of malnutrition When compared to the BMI, a similar result found by Santos e Araújo[30], in which the prevalence indicated by the adequacy of the AC was higher than that observed by the BMI.

BMI has been recommended by WHO[18] as an indicator of body fat because it is obtained quickly and practically free of charge[31]. However, the use of BMI as a method for assessing body composition presents inaccurate values, both for the evaluation of lean mass and fat mass[32].

In a study carried out with 328 critically ill patients it was found that 18,9% were malnourished according to BMI and most patients were classified as eutrophic (46,04%) [28]. In the same study, the authors also calculated the nutritional status by means of the adequacy of the AC and identified a percentage of 38,17% of malnourished patients. In the present study, BMI showed a higher prevalence of overweight patients, followed by eutrophic and Only 25% of patients classified as malnourished. Both studies, however, identified a higher prevalence of malnourished patients according to the percentage of adequacy of the AC[28], when compared to evaluation by BMI.

The present study also showed similar results to the research carried out by Schleder et al.[33] with 57 critically ill patients, which indicated a result of 22,81% of malnourished patients by BMI and a higher prevalence of eutrophic individuals. The same result was not found in another study with 813 critically ill patients, in which the relationship between mortality and BMI was evaluated[34]. The authors identified about 50% eutrophic patients, 10% malnourished and 40% overweight and significantly higher mortality was observed in patients with BMI < 18,5 kg/m^2 and BMI > 30 kg/m^2.

In the present study, no associations were found between the nutritional status according to BMI and adequacy of the AC and the patient's outcome. The association between malnutrition and outcome was demonstrated by the study of Badosa et al.[35], in which malnutrition considerably increases hospital mortality.

Differences were identified between mean APMT according to BMI and AC adequacy categories. For the BMI measurement, eutrophic patients had significantly lower mean APMT values when compared to overweight individuals. For the adequacy of AC, malnourished individuals had significantly lower means APMT values when compared to overweight individuals. Research conducted with emergency and urgent care patients in the year 2019 pointed out that all patients assessed as malnourished, by classical methods of nutritional assessment, had lower mean APMT[27].

Pereira et al.[20], in a study with patients with chronic kidney disease, observed that the APMT was significantly lower in individuals classified as malnourished and/or with muscle mass depletion according to several parameters. In a research with critically ill patients it was also identified that the measurements

of the APMT may be a valuable prognostic indicator and a new tool in the evaluation of malnutrition in these patients, being an easy, fast and non-invasive measurement[36]. Systematic review published in the year 2018 indicated that the APMT can be evaluated in different clinical conditions and ages, showing higher values in young, male, and dominant side individuals. The mean values of APMT indicated in the review study varies from 7,3 ± 2,7 mm to 16,2 ± 4,3 mm, whereas the values in this present study are close to these ones[20].

Regarding SAPS III values, no difference was identified in mean values of these indicators, according to categories of nutritional status assessed by BMI as by adequacy of AC. In a study with 529 patients in the Intensive Care Unit (ICU) at the University Hospital of Universidade Federal de São Paulo (HU/UNIFESP), the SAPS III mean was also evaluated in relation to the nutritional status by BMI – classified as low weight (<18,5 kg/m2), normal/pre-obese (>= 18,5 e < 30 kg/m2) and obese (>= 30) – and also no significant differences were observed between the SAPS III means according to the patients' nutritional status[37].

Conclusion

The prevalence of malnutrition on ICU admission was 25% according to BMI and 35% according to the percentage of adequacy of the AC. Although literature shows an association between nutritional status and the period of stay at the ICU with the outcome, in the present study it was not possible to observe this relationship.

Eutrophic patients showed significantly lower mean values of APMT when compared to overweight individuals, according to BMI. For the adequacy of the AC, malnourished individuals showed significantly lower mean values of APMT when compared to overweight individuals. Further studies about APMT are still needed, but the literature already points out important data on its efficacy in the assessment of nutritional status, being a good option for evaluating critically ill patients because it is minimally invasive, low-cost, and practical.

The treatment and prevention of hospital malnutrition are a great challenge, especially when referring to critically ill patients. Thus, obtaining an adequate diagnosis becomes essential for a fast and effective dietary action, reducing the risks of morbidity and mortality.

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