Prevalence of malnutrition during patient admission in Intensive Care Unit (ICU) through GLIM criteria: a cross-sectional study

Prevalência de desnutrição na admissão de pacientes em Unidade de Terapia Intensiva (UTI) através dos critérios GLIM: um estudo transversal

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Bianca de Athayde[1]
Renata Vieira de Souza Bortolini[2]
Yasmim Sena Silva de Carvalho[2]
Quetlim dos Passos Almeida[3]
Renata Wolf[3]

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Address for correspondence:
Bianca de Athayde
Hospital Nossa Senhora da Conceição, Serviço de Nutrição e Dietética - Avenida Francisco Trein, 596 - Cristo Redentor - Porto Alegre, RS, Brasil.
E-mail: nutribianca.athayde@gmail.com

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ABSTRACT

Introduction: Nutritional status has prognostic impacts on critical patients. Thus, malnutrition can bring significant and influential risk factor in the outcomes of these patients. This study aimed to determine the prevalence of malnutrition upon admission of patients to the Intensive Care Unit (ICU) according to GLIM criteria. **Methods:** Cross-sectional, retrospective study, conducted in a public hospital mixed ICU. The sample comprised 380 individuals aged 18 years or older. Data were collected through electronic medical records. **Results:** The mean age was 63.46±14.47 years. Most patients were male (58.2%), had multimorbidities (75.5%), were mechanically ventilated (68.7%), and were admitted to the ICU for clinical reasons (81.6%). Median weight was 65.7±20.85 kg. Patients had a Bory Mass Index (BMI) of 24.9±7.45 kg/m². Median Calf Circunference (CC) was of 33±5.5 cm, being reduced in 61.3% of the total sample. On physical examination, 72.5% of the sample presented reduced muscle mass. According to the GLIM criteria, the prevalence of malnutrition among all patients was of 57.6%. Of those, 64.4% were categorized as moderate and 35.6%, severe. Among the malnourished, 16.9% had a high BMI, with 12.3% (n=27) of those being overweight/obese. Malnutrition was more prevalent among males (p=0.002). Men had a 1.44 times higher prevalence of malnutrition than women (PR=1.44; CI95%=1.14-1.82). **Conclusions:** The prevalence of malnutrition on admission to the ICU was found in more than half of the patients evaluated, mostly among males.

RESUMO

Introdução: O estado nutricional tem impacto prognóstico nos pacientes críticos. A desnutrição, por exemplo, é um fator de risco significativo e influente nos desfechos desses pacientes. Este estudo teve como objetivo determinar a prevalência de desnutrição na admissão de pacientes em Unidade de Terapia Intensiva (UTI), de acordo com os critérios GLIM. **Método:** Estudo transversal, retrospectivo, realizado em UTI mista de um hospital público. A amostra foi composta por 380 indivíduos de 18 anos ou mais. Os dados foram obtidos por meio de prontuário eletrônico. **Resultados:** A média de idade entre os pacientes foi de 63,46±14,47 anos. A maior parte dos pacientes era do sexo masculino (58,2%), com multimorbidades (75,5%), ventilados mecanicamente (68,7%) e com internação na UTI por motivo clínico (81,6%). A mediana de peso foi 67,5±20,85kg. O índice de Massa Corporal (IMC) mediano foi de 24,9±7,45 kg/m². A mediana da Circunferência da Panturrilha (CP) foi de 33±5,5 cm, estando reduzida em 61,3% da amostra total. Ao exame físico, 72,5% da amostra apresentou massa muscular reduzida. A prevalência de desnutrição através dos critérios GLIM foi de 57,6%. Desses, 64,4% apresentou grau de desnutrição moderado e 35,6%, grave. Entre os desnutridos, 16,9% apresentou IMC elevado, sendo 12,3% (n=27) desses com excesso de peso/obesidade. A desnutrição foi mais prevalente no sexo masculino (p=0,002). Os homens apresentaram prevalência de desnutrição 1,44 vezes maior que as mulheres (RP=1,44; IC95%=1,14-1,82). **Conclusões:** A prevalência de desnutrição na admissão na UTI foi encontrada em mais da metade dos pacientes da amostra avaliada, principalmente no sexo masculino.

1. Grupo Hospitalar Conceição, Residência Multiprofissional em Saúde, Programa de Atenção ao Paciente Crítico, Porto Alegre, Rio Grande do Sul, Brasil. Universidade Federal de Ciências da Saúde de Porto Alegre (UFCSPA), Programa de Pós-Graduação em Ciências da Nutrição, Porto Alegre, Rio Grande do Sul, Brasil.
2. Grupo Hospitalar Conceição, Serviço de Nutrição e Dietética do Hospital Nossa Senhora da Conceição, Porto Alegre, Rio Grande do Sul, Brasil.
3. Grupo Hospitalar Conceição, Residência Multiprofissional em Saúde, Programa de Atenção ao Paciente Crítico, Porto Alegre, Rio Grande do Sul, Brasil.

INTRODUCTION

Nutritional status has a prognostic effect in critical patients. Malnutrition is an important risk factor with a high influence in outcomes[1,2]. It is associated with increased mortality, longer hospitalization periods, higher complication rate, and a general increase of hospital costs[3-5].

Assessing the nutritional status of patients in Intensive Care Unit (ICU) through traditionally proposed methods meets several barriers. The nutritional history obtained through anamnesis is precluded by the absence of verbal interaction. Besides, physical alterations inherent to the acute phase in severe illnesses might impair weight and body composition measurements due to the excess of fluids and edema[6].

In 2018, the Global Leadership Initiative on Malnutrition (GLIM), a group involving the main clinical nutrition societies in the world, established a new global consensus aiming to standardize and unify the malnutrition diagnosis and its classification in terms of severity in clinical environments[7]. One of the phenotypical GLIM criteria is the assessment of muscle mass. It can be measured using different methods, including the indirect assessment of the patient's muscle mass through Calf Circunference (CC) and a physical examination for the qualitative assessment of muscle mass loss[8]. These are the most practical, low-cost methods, providing the best bedside access to providers when compared to direct assessment methods[9].

Early identification of malnutrition and adequate nutritional intervention can contribute to improved patient outcomes[5]. Thus, the goal of the present study is to determine the prevalence of malnutrition on admission of ICU patients according to the GLIM criteria.

METHODS

This was a cross-sectional study with retrospective data collection carried out in a mixed ICU (clinical and surgical patients) at a public hospital in the south of Brazil. The study was reported in accordance with the Strengthening The Reporting of Observational Studies in Epidemiology (STROBE)[10].

The sample was composed of 380 individuals aged 18 years or older, admitted to the ICU between July 2022 and April 2023. The sample size (n=380) was calculated using the Wald method, with 44.2% of malnutrition prevalence as a basis[11]. The 95% confidence interval (CI) was calculated using an amplitude of 10%. This calculation was conducted using the online version of Power and Sample Size for Health Researchers (PSS Health).

Patients were included if they had been in the ICU for more than 48 hours and had undergone a nutritional assessment carried out by a team of dietitians, who had previously been trained and had drawn up a standardized protocol for applying the GLIM. Patients without Arm Circumference (AC) and/or CC assessment, with bilateral amputation of lower limbs, cerebral palsy, or who were pregnant/puerperal were excluded.

Data were collected using the institution's own electronic medical record, which includes a record of all the stages of the nutritional diagnosis, including weight loss, anthropometry, physical examination, nutritional anamnesis and the phenotypic and etiological criteria used for diagnosis using the GLIM. Data collection occurred between June and November 2023.

The data contained nutritional assessment, age, sex, presence of morbidities, (characterized by the presence of 2 or more previous illnesses described in the patient's previous medical history), and the reason for admission to the ICU, which was separated into clinical (non-surgical pathologies) and surgical (immediate or late post-operative patients).

The data extracted from the nutritional assessment were: CC, AC, Knee Height (KH) for those who required weight estimation, Body Mass Index (BMI), muscle mass assessment through targeted physical examination, measured or estimated weight, measured or estimated height, history of weight loss (when reported by the patient or family members/caregivers), and data on reduced food intake and/or malabsorption (when reported by the patient or family members/caregivers). Finally, the nutritional diagnosis according to the GLIM was collected, along with the phenotypic and etiologic criteria used.

All the patients included were considered to be at nutritional risk, as they had been in the ICU for more than 48 hours, following the European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines[12]. Nutritional diagnoses were made within 72 hours of admission.

GLIM is part of the protocol used for the nutritional diagnosis of all patients admitted to the institution's ICU. The assessment requires a combination of one of the phenotypical criteria and one of the etiological criteria. Reduced BMI, involuntary weight loss or reduced muscle mass (assessed through CC and/or physical examination) were the phenotypical criteria considered. The diagnosis was based on the criteria that could be applied, according to the conditions of the anamnesis and nutritional assessment, due to the reality of clinical practice in an intensive care environment.

The presence of inflammation is the etiological criterion applied to all patients, given that this condition is present during ICU stays[7], whether combined or not with previous dietary history and/or presence of malabsorptive disease. The definition of malnutrition severity was based on phenotypical criteria[7], as demonstrated in Figure 1.

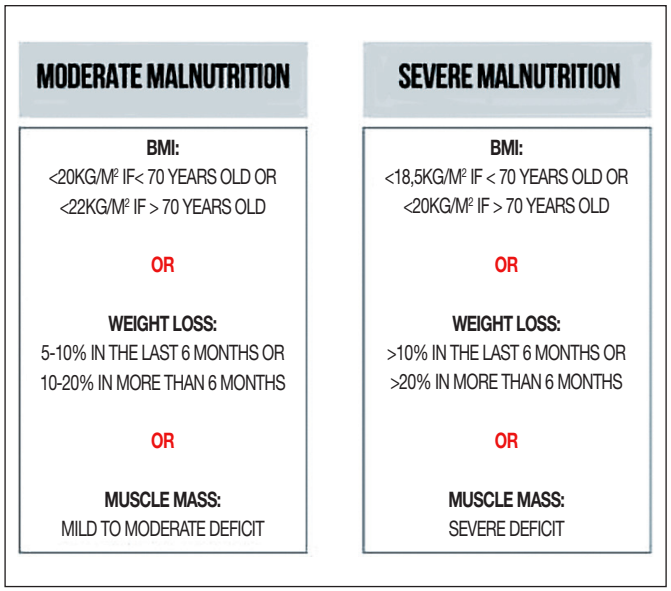

Figure 1 - *Classification of malnutrition severity.*

The cut-points adopted for reduced CC are less than or equal to 34 cm for men and less than or equal to 33 cm for women[9]. Reduced muscle mass noted upon physical examination was based on anatomical points in the temples, clavicle, shoulders, shoulder blades, quadriceps and calves8. It was classified as absent, mild, moderate or severe decrease. Reduced muscle mass was assessed by CC alone and/or in combination with physical examination.

The study was approved by the Conceição Hospital Group Research Ethics Committee (CEP/GHC) under protocol number 6.077.685, and is in accordance with the Resolution nº 466/12 of the National Health Council. This research is in accordance with that established in the General Data Protection Act. The proposed methodological design exempts the study from the application of a Free and Informed Consent Form to the participants.

Data were analyzed statistically using the program Statistical Package for the Social Sciences (SPSS), version 26.0. Categorical variables were described in terms of absolute and relative frequencies. Data with normal distribution were assessed via the Kolmogorov-Smirnov test. After assessing the data distribution using the Kolmogorov-Smirnov test, normally distributed data were expressed as mean and standard deviation, while non-normally distributed data were expressed as median and interquartile range. A chi-square test was applied for comparison between groups. Student's t-test was employed to assess the difference in mean age between nourished and malnourished patients. A 95% CI was used for the estimated prevalence ratio (PR). To indicate statistical significance, $p<0.05$ was used.

RESULTS

This research screened the medical records of 517 patients potentially eligible for the study. After inclusion criteria were applied, 137 individuals were removed, resulting in a final sample of 380 participants. Details on sample composition are available in Figure 2.

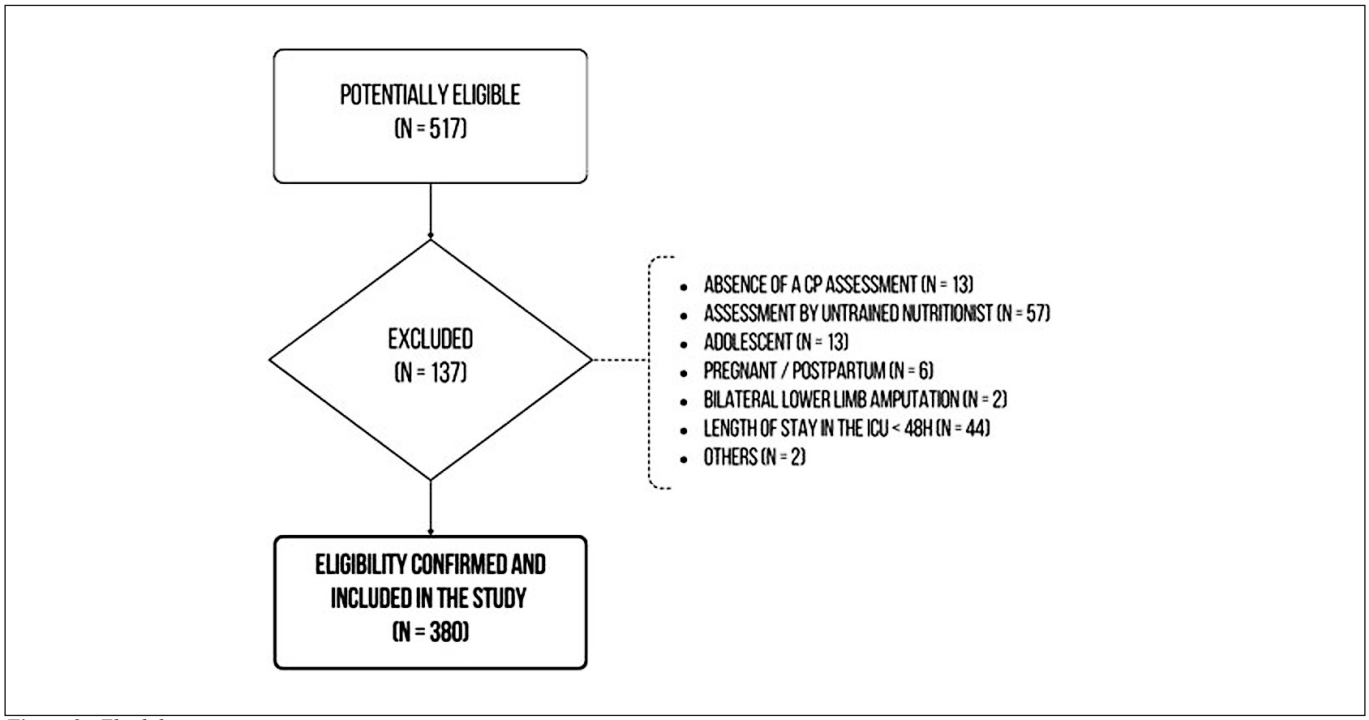

Figure 2 - *Eligibility screening.*
N = sample size.

The sample studied had a mean age of 63.46±14.47 years-old. Most of the patients were males (58.2%), with multimorbidities (75.5%) and mechanically ventilated (68.7%). In the sample, 81.6% of patients were admitted to the ICU for clinical reasons (81.6%), where the most common diseases were sepsis (30.6%) and respiratory dysfunction (30.3%). Enteral nutrition was the most used feeding method (67.3%) in the initial assessment. Data related to sample characterization are shown in Table 1.

Table 1 – General characteristics.

Characteristics	Sample (n = 380)
Age (years)	63.46±14.47
Sex	
Male	221 (58.2%)
Female	159 (41.8%)
Reason for ICU admission	
Clinical	310 (81.6%)
Surgical	70 (18.4%)
Multimorbidities	
Yes	287 (75.5%)
No	93 (24.5%)
Feeding route	
Oral	132 (34.7%)
Enteral	242 (67.3%)
Parenteral	6 (1.6%)
Invasive Mechanical Ventilation	
Yes	261 (68.7%)
No	119 (31.3%)

Continuous variable expressed as mean and standard deviation. n = sample size; ICU = intensive care unit.

Table 2 – Nutritional characteristics of the patients included in the study.

Characteristics	Sample
Weight (kg)	67.5±20.85 (29-150)
BMI (kg/m²)	24.9±7.45 (12.4-54)
CC (cm)	33±5.5 (21-52.5)
AC (cm)	29±6 (16.5-55.5)
Weight loss (%)[1]	11±11.42 (1.1-51)
Classification of CC	
Reduced	233 (61.3%)
Adequate	147 (38.7%)
Muscle reduction on physical examination	
Absent	104 (27.5%)
Reduced muscle mass	276 (72.5%)
Slightly reduced	94 (24.7%)
Moderately recuced	129 (33.9%)
Severely reduced	53 (13.9%)
BMI classification	
Underweight	82 (21.6%)
Eutrophy	159 (41.8%)
Overweight	26 (6.8%)
Obesity	113 (29.7%)
Nutritional diagnosis	
Malnutrition	219 (57.6%)
Not malnutrition	161 (42.4%)
Malnutrition classification[2]	
Moderate Malnutrition	141 (64.4%)
Severe Malnutrition	78 (35.6%)

BMI = body mass index; CC = calf circumference; AC = arm circumference. Continuous variable expressed as median, interquartile range, maximum and minimum values. [1]Percentage value based on n=108. [2]Percentage value based on the sample with malnutrition (n=219).

The nutritional characteristics of the sample are available on Table 2. Weight loss was reported in 108 patients (28.4% of the total). Reduced muscle mass assessed through physical examination was present in 72.5% of the sample.

The prevalence of malnutrition through the GLIM criteria was of 57.6% in the studied sample, with 64.4% of this portion occurring at a moderate degree and 35.6% at a severe degree (Table 2). Among the malnourished, 16.9% presented high BMI, where 12.3% (n = 27) had a BMI classified as overweight (elderly) and obesity (adults).

The most commonly used phenotypical criterion for nutritional diagnosis was reduced muscle mass (47.5%), assessed through physical examination and/or CC. It can be seen that BMI was not used in isolation in any patient and that the three phenotypical criteria combined were only prevalent in 8.9% of the sample.

Assessing the nutritional diagnosis in relation to the participants' general traits reveals that malnutrition is more prevalent in male individuals (p=0.002). Males showed 1.44 times higher prevalence of malnutrition upon admission to the ICU than females (PR=1.44; 95%CI=1.14-1.82). Reason for ICU admission (p=0.089), presence of multimorbidities (p=0.700) and age (p=0.740) showed no statistically significant differences when assessed in relation to the nutritional diagnosis (Table 3).

Figure 3 shows the prevalence of malnutrition upon ICU admission, its classification according to severity, and the proportional difference of prevalence between male and female individuals. Approximately half of all women and seven out of ten men were already be malnourished upon their arrival.

Table 3 – Association between nutritional diagnosis and general characteristics.

Characteristics	Nutritional diagnosis		p-value
	No malnutrition (n = 161)	Malnutrition (n = 219)	
Sex			
Male	79 (35.7%)	142 (64.3%)	**0.002**
Female	82 (51.6%)	77 (48.4%)	
Reason for ICU admission			
Clinical	125 (40.3%)	185 (59.7%)	0.089
Surgical	36 (51.4%)	34 (48.6%)	
Multimorbidities			
Yes	120 (41.8%)	167 (58.2%)	0.700
No	41 (44.1%)	52 (55.9%)	

ICU = intensive care unit. Analyses using chi-square test.

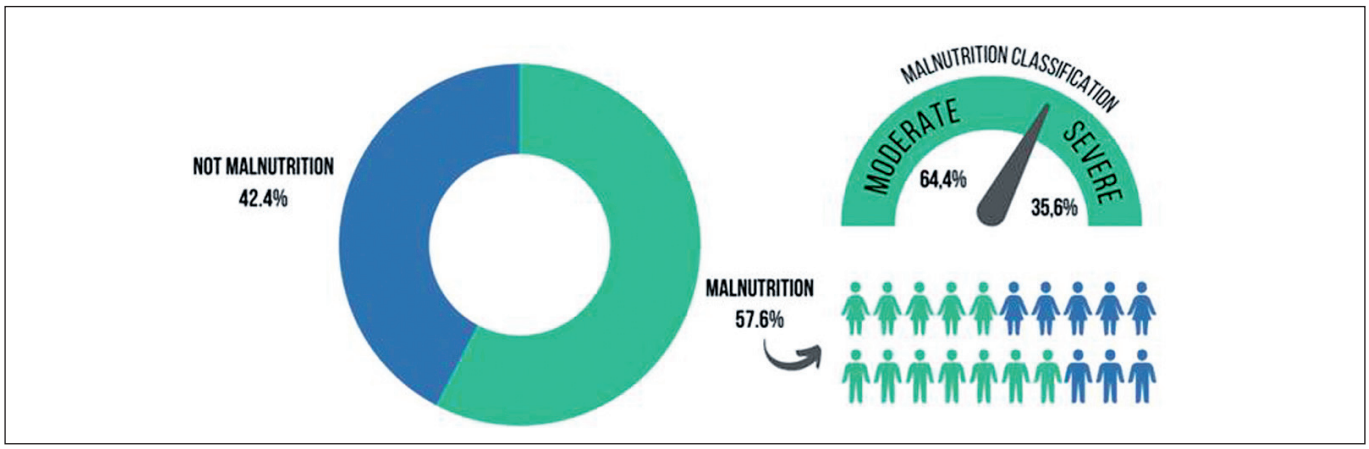

Figure 3 - *Prevalence of malnutrition, severity classification and distribution between genders.*

DISCUSSION

In the sample studied, made up of adult and elderly ICU patientes, most were already malnourished on admission. The majority of the malnourished patients were male, and the diagnosis was not related to the reason for ICU admission or multimorbidities. To date, there have been no previous studies correlating these factors.

A cohort study conducted during the COVID-19 pandemic at the same institution's ICU where this research was carried out found a similar population profile. Male individuals were predominant (53.8%), with a mean age of 62.2±13.9 years old[13]. An important difference between the two populations is the greater predominance of patients with multimorbidities (54.6% v. 75.5%). This can be explained by the fact that, in the post-pandemic period, the causes for hospitalizations reverted back to the chronic acute diseases.

In a systematic review of 20 studies, comprising 1,168 critical patients, the prevalence of malnutrition went from 38% to 78%, depending on the diagnostic tool used[1]. Theilla et al.[14] found a prevalence of ICU malnutrition of 41% through the GLIM criteria, with high sensitivity (85%) and specificity (79%) when compared to the golden standard of the Subjective Global Assessment (SGA). In a recent Brazilian cohort study in critical patients, the prevalence of malnutrition according to the GLIM criteria was of 68.9% in the model that considered inflammation an etiological criterion for all patients[15]. Such results corroborate the present study's findings of a high prevalence of malnutrition according to GLIM upon ICU admission.

The most commonly used phenotypical criterion for diagnosing malnutrition was reduced muscle mass. Despite not using objective tools and the best scientific evidence for evaluation, this study used pragmatic and feasible data within the reality of bedside professionals in ICUs in any other institution.

Assessing muscle reduction through physical examination and CC seems to make a major contribution to defining the diagnosis of malnutrition.

The nutritional diagnosis must be performed using validated nutrition assessment tools, such as the SGA and the Mini Nutritional Assessment (MNA). However, both demand data related to the nutritional history, which needs to be reported by the patients themselves or by family members[1]. In the studied sample, 68.7% of patients were already on invasive mechanical ventilators upon ICU admission, which hindered the collection of information through nutritional anamnesis. In such situations, it is more common to rely on physical examination to aid in the definition of a nutritional diagnosis[4]. The GLIM criteria allow healthcare providers to carry out a complete nutritional assessment without depending exclusively on subjective information[7]. However, when these data are available, they must be used to reach a more comprehensive diagnosis.

The GLIM body composition working group advises that anthropometry and physical examination are measures that can be utilized for muscle mass assessment if it is not possible to use assessment methods based on more complex technologies[7,8]. CC, which is part of the anthropometric parameters, has a high correlation to direct measures of muscle mass[9] and has been gaining projection in clinical practice, especially due to the need for simpler, more low-cost tools that can be easily applied in bedside assessments. However, studies that evaluate CC as an indicator of reduced muscle mass in critical patients are still scarce.

In the first study that assessed the association between CC and mortality in the ICU[13], 39.1% of patients had reduced CC upon admission. This study's prevalence rate was considerably higher (61.3%), which can be justified by the greater prevalence of elderly patients with multimorbidities, that may have had greater prior deterioration of nutritional status. The median value of CC was reduced in both genders, according to their respective cutoff points. This data reflects low muscle reserve already upon admission, which tends to get worse over the course of the hospitalization period, especially during the first week at the ICU, in which an accelerated loss occurs that can reach 10% of the total muscle mass[17].

Around 28.2 to 36% of ICU patients are overweight or have obesity[18,19], a result that corroborates the findings of this research. Malnutrition is possibly underdiagnosed in this patient profile, both due to the lack of appropriately validated tools for this population and due to the evaluator's unpreparedness and the stigma of obesity, which may influence the screening and confirmation of the diagnosis[18]. The excess of body adiposity constitutes a challenge for the execution of a physical examination that is precise and focused on muscle assessment.

Malnourished patients with concomitant obesity have a lower diagnostic probability than those whose BMI is within the normal range or below it[2,18]. In the present day, BMI alone is contraindicated for assessing nutritional status[19]. Assessment needs to go far beyond this metric. Obesity and malnutrition can coexist and must be correctly identified. GLIM offers this kind of evaluation, as it is not dependent on BMI for the diagnostic procedure. Of all obese individuals in this sample, 12.3% were diagnosed with malnutrition, a result that is similar to the prevalence (14%) found by Agarwal et al.[19] in a sample of non-critically ill obese patients.

As a limitation, CC adjusted for adiposity was not used to assess muscle mass in these patients. This adjustment could be considered for future studies, as it could be very important in helping to identify the phenotypical criterion of reduced muscle mass in patients with obesity. Although a recent published study found no difference in primary outcomes comparing adjusted and unadjusted CC[20], this measure was associated with a higher occurrence of readmission to the ICU.

Another limitation of this study is the reliance on electronic medical records to conduct the research, which could lead to the loss of important information, such as identifying weight loss and previous food intake. Furthermore, the Sequential Organ Failure Assessment (SOFA) score was not collected, which would have made it possible to assess the severity of the disease on admission and correlate it with the prevalence of malnutrition, as well as carrying out multivariate analyses, using the disease severity as a confounding factor.

Measurement bias might have occurred during the course of the study. Different dietitians were responsible for assessments and each dietitian used her own anthropometric equipment and clinical judgment based on professional experience to carry out the physical examination. However, the entire team underwent training to standardize the diagnosis prior to the study period.

More studies validating the GLIM as an instrument for nutritional assessment in critically ill patients are necessary, especially in obese people, using adjusted CC. Despite being an observational study, the data from this study adds to and updates the available literature. There was a representative sample and the results can be used for comparative purposes, especially in ICUs with a clinical profile. However, these results cannot be extrapolated for surgical patients and trauma victims.

This study provides important information. The majority of patients are already malnourished on admission to the ICU, a factor that will become even worse over the course of the days, due to their critical state and intense catabolism. There is a necessity to be even more attentive to early nutritional therapy for these individuals.

CONCLUSION

The prevalence of malnutrition according to GLIM criteria on admission to the ICU was found in more than half of the patients in the sample evaluated, a worrying finding that requires attention.

More studies need to be carried out to investigate the association between male sex and the prevalence of malnutrition, as well as to assess the impact of reduced muscle mass in defining the diagnosis of malnutrition and its prognostic power.

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Location of the study: Hospital Nossa Senhora da Conceição, Porto Alegre, RS, Brasil.

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