Original Article

GLIM criteria for the diagnosis and prevalence of malnutrition in intensive care units

Critério GLIM para o diagnóstico e prevalência de desnutrição em unidade de terapia intensiva

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ABSTRACT

Introduction: Malnutrition is a multifactorial disease that may be related to social vulnerability or unfavorable clinical conditions. To identify malnutrition, the Global Leadership Initiative on Malnutrition (GLIM) nutritional assessment method addresses phenotypic and etiological criteria for diagnosis. Weight loss, reduced body mass index (BMI), and reduced muscle mass are categorized as phenotypic criteria, while reduced food intake/assimilation and disease/inflammation burden are categorized as etiological criteria. The aim of this study was to evaluate malnutrition, according to the GLIM method, in patients admitted to a general intensive care unit. **Methods:** This is a prospective cross-sectional study, in which demographic (gender and age), anthropometric (weight, height, calf circumference and weight loss), clinical (disease), and food intake/assimilation data were collected through medical records and nutritional anamnesis of adult and elderly patients. This study was carried out in an intensive care unit (ICU) environment in a public hospital in Joinville, SC, Brazil, between June and September 2024. **Results:** The sample consisted of 101 individuals, of which the majority 64.35% (n=65) were classified as without malnutrition, according to the GLIM assessment method. Among individuals with malnutrition (35.6%; n=36), 30.5% (n=11) presented moderate malnutrition and 69.4% (n=25) severe malnutrition. **Conclusion:** Patients who presented significant weight loss, reduced muscle mass, low BMI and/or reduced food intake had a high prevalence of malnutrition when GLIM assessment criteria were applied. There was no prevalence of malnutrition in relation to age or gender, or specific diseases, but the most prominent diseases were related to the gastrointestinal tract and respiratory diseases.

RESUMO

Introdução: A desnutrição é uma doença de natureza multifatorial, que pode estar relacionada à vulnerabilidade social ou condição clínica desfavorável. Para a identificação de desnutrição, o método de avaliação nutricional da Iniciativa de Liderança Global sobre Desnutrição (GLIM) aborda critérios fenotípicos e etiológicos para o diagnóstico. A perda de peso, redução do índice de massa corporal (IMC) e redução da massa muscular são categorizadas como critérios fenotípicos, enquanto a redução da ingestão/assimilação de alimentos e a carga de doença/inflamação são categorizados como critérios etiológicos. O objetivo deste estudo foi avaliar a desnutrição, conforme o método GLIM, em pacientes internados em unidade de terapia intensiva geral. **Método:** Foi feito um estudo de transversal de caráter prospectivo, foram coletados dados demográficos (gênero e idade), antropométricos (peso, altura, circunferência de panturrilha e perda de peso), clínicos (doença) e ingestão/assimilação alimentar, por meio de prontuários e anamnese nutricional de pacientes adultos e idosos. Este estudo foi realizado em um ambiente de unidade de terapia intensiva (UTI) em um hospital da rede pública de Joinville, SC, Brasil, entre os meses de junho a setembro de 2024. **Resultados:** A amostra foi composta por 101 indivíduos, que, em sua maioria 64,35% (n=65), foram classificados sem desnutrição, conforme o método de avaliação GLIM. Dos indivíduos com desnutrição (35,6%; n=36), 30,5% (n=11) apresentavam desnutrição moderada e 69,4% (n=25) desnutrição grave. **Conclusão:** Os pacientes que apresentaram grande perda de peso, redução de massa muscular, baixo IMC e/ou redução da ingestão alimentar tiveram alta prevalência de desnutrição quando aplicados os critérios de avaliação GLIM. Não houve prevalência de desnutrição em relação à idade ou gênero, ou doença específica. Porém, as doenças em destaque foram relacionadas ao trato gastrointestinal e às doenças respiratórias.

Keywords:
Malnutrition. Weight loss. Food intake. Intensive care unit.

Unitermos:
Desnutrição. Perda de peso. Ingestão alimentar. Unidade de terapia intensiva.

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INTRODUCTION

Hospital malnutrition was first reported in 1974 by Charles Butterworth, who warned of the need to adopt practices aimed at the diagnosis and adequate treatment of malnourished patients[1]. However, despite this discovery and the warning having occurred so long ago, this condition persists to this day. It is known that hospital malnutrition promotes an increase in morbidity and mortality and inflates financial costs. However, nutritional screening of patients at nutritional risk or malnourished is still often neglected. This problem occurs mainly due to the lack of knowledge of the literature, consensus and awareness of the negative impact of malnutrition on the patient and hospital management. Nutritional intervention becomes relevant in malnourished patients because it presents itself as a low cost-benefit strategy, allowing for improving the quality of hospital care, but for this intervention to happen, it requires interdisciplinary collaboration[1].

Classifying nutritional status is essential to raise awareness and improve screening of patients at nutritional risk, making nutritional screening, such as the NRS-2002, essential in the first 72 hours of hospital admission, as recommended by method[2]. Most hospital units already use some assessment tool to identify patients at risk of malnutrition, but in some cases, screening is only performed at the beginning of hospitalization and may neglect some diagnoses that do not only affect body mass index (BMI).

Malnutrition can be caused by reduced food intake or impaired nutrient absorption, but there is a growing understanding that malnutrition can also be caused by inflammatory mechanisms associated with disease or other mechanisms. Malnutrition associated with disease or injury invariably consists of a combination of reduced food intake or absorption and varying degrees of acute or chronic inflammation, resulting in altered body composition and decreased biological function. Inflammation contributes to malnutrition through loss of appetite and decreased food intake, as well as altered metabolism, with increased resting energy expenditure and increased muscle catabolism. Body composition alterations are manifested by a decrease in a marker of muscle mass (fat-free mass, muscle mass index or body cell mass). Thus, malnutrition is associated with adverse functional and clinical outcomes[3]. In critically ill patients, there are large losses of muscle mass, and the causes are multifactorial, including reduced contractility of muscle fibers, disuse and muscle degradation. Meanwhile, protein anabolism may be insufficient to compensate for these losses, and if these are generalized losses of muscle mass, they can affect important muscles, such as the diaphragm and intercostal muscles, which are essential for breathing and torso stability[4].

There are studies that report that the hypermetabolic state can persist for up to two years after hospital discharge, prolonging the comprehensive rehabilitation of patients and increasing the difficulty of recovering lean mass and its functionality[3].

Although malnutrition is a global concern associated with increased morbidity, mortality and costs, there has been a fundamental lack of consensus on diagnostic criteria for application in clinical settings. No existing approach has ensured broad global acceptance, and to respond to the needs of the medical and clinical nutrition communities, the Global Leadership Initiative on Malnutrition (GLIM) was convened in January 2016, when several clinical nutrition societies with global reach focused on standardizing the clinical practice of diagnosing malnutrition and classifying its severity in clinical settings[3].

For a patient to be diagnosed with malnutrition, it is necessary to present one of the three phenotypic criteria (unintentional weight loss, low BMI, reduction in muscle mass) and one of the two etiological criteria (reduction in food intake/absorption and inflammation)[3]. One of the GLIM phenotypic criteria is the assessment of muscle mass, which can be performed using different methods. Calf circumference is an option for qualitative assessment of this reduction, being a practical, low-cost method that provides better access to the professional at the bedside when compared to direct assessment methods. However, as there is only one classification cutoff ($\leq$34 centimeters for men and $\leq$33 centimeters for women)[5], the measurement is only present, but not classifiable according to the severity of malnutrition. As such, the study aimed to use GLIM criteria as a method of evaluating malnutrition in the general clinical and surgical intensive care environment in a public hospital in Joinville, SC, Brazil.

METHODS

A prospective, cross-sectional study was performed, approved by the Regional Hospital Hans Dieter Schmidt (HRHDS) Research Ethics Committee through the Brasil platform, with number 6,832,144. The study was performed from June 2024 to September 2024 in the Clinical and Surgical intensive care unit (ICU). The study was based on the review of medical records from the SGS® system of the nutrition service, as well as dialogue with patients or companions during anamnesis at the beginning of hospitalization in the intensive care unit. The inclusion criteria were adults (18–59 years)[6] and elderly individuals ($\geq$60 years)[7], of both sexes, with nutritional assessment performed through anthropometric measurements. Patients who did not fit into the proposed age range or had medical records with incorrect completion or missing data necessary for the study were excluded from the sample.

To characterize the sample, the following data were obtained from the patients' electronic medical records:

sociodemographic data (sex and age); anthropometric data (history of weight changes in the previous 3 months, current weight and height); clinical data (clinical diagnosis and/or associated diseases); dietary data (acceptance and change in food consumption); date of data collection and clinical outcome (discharge or death).

Patients' height was measured with a stadiometer or estimated through knee height was used, applied using the formula by Chumlea et al. (1985)[8] - for the elderly, and Chumlea et al. (1994)[9] - for adults. The measurement was made using a tape measure positioned to identify the length from the bottom of the feet to the anterior surface of the knee, above the femoral condyles and close to the kneecap. Patients' weight was measured on a digital scale or estimated using the formula by Rabito et al. (2006)[10]. For this calculation, arm circumference, abdominal circumference and calf circumference were used.

Nutritional status according to BMI was classified according to the World Health Organization (WHO)[11] for adults (>18 years and <60 years) and the Pan American Health Organization[12] for elderly people (≥60 years). The percentage of weight loss was calculated using the formula by Blackburn et al.[13].

After collecting anthropometric and dietary data, the GLIM assessment criteria were applied to classify and assess the severity of malnutrition, which include the phenotypic and etiological criteria as shown in Tables 1 and 2.

Considering the criteria tabulated above, for a patient to be diagnosed with malnutrition, they needed to present a phenotypic and an etiological criterion. The severity of malnutrition was classified as moderate or severe using only the cutoff data according to the criteria of weight loss or BMI present. The data obtained were compiled and recorded in a Microsoft Office Excel 365 spreadsheet. The sample characteristics were described in absolute and relative frequencies and the Pearson chi-square test, the same used for categorical variables, was used for statistical analysis. For numerical variables, Student's t-test was used. The analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 22 software and were performed by an individual not involved in the research. Values of $p < 0.05$ were considered statistically significant.

Table 1 – GLIM phenotypic criteria.

Severity level	Moderate	Severe
Weight loss	>5-10% last 6 months	>10% last 6 months
	10-20% beyond 6 months	>20% beyond 6 months
Low BMI <70 years	<20 kg/m²	<18.5 kg/m²
Low BMI ≥70 years	<22 kg/m²	<20 kg/m²
Reduced muscle mass – female	≤33 cm calf	
Reduced muscle mass - male	≤34 cm calf	

BMI = body mass index.

Table 2 – GLIM etiologic criteria.

Reduced food intake or assimilation	≤50% of energy requirements >1 week
	Any reduction for >2 weeks, or any chronic gastro-intestinal condition that adversely impacts food assimilation or absorption
Inflammation	CRP above 1 mg/dL

CRP = C-reactive protein.

RESULTS

The study sample consisted of 101 patients, of whom 64.35% (n=65) were classified as not having malnutrition according to the GLIM assessment method. Among individuals with malnutrition (35.6%; n=36), 30.5% (n=11) presented to moderate malnutrition and 69.4% (n=25) severe malnutrition. The individuals were predominantly male (53.5%; n=54), with a mean age of 60.45 ±15.52 years (max. = 93 years; min. = 18 years). More than half of patients (57.4%; n=58) were elderly, while 42.6% (n=43) were adults.

According to the GLIM phenotypic criteria, 97.1% (n=33) of the patients who did not have weight loss prior to hospitalization did not have malnutrition, while 66.3% (n=67) who did have this loss were included in the malnutrition group (p<0.000) (Table 3). According to BMI, eutrophy was the most common classification (32.7%; n=33). However, among patients with low weight (11.9%; n=12), the majority of them (83.3%; n=10) also presented malnutrition (p<0.000). When evaluating anthropometric measurements, the results were well distributed, with 40.4% (n=19) of the female population and 50% (n=27) of the male population presenting reduced measurements. However, the measurements pointed out a tendency towards malnutrition when they were correlated to the reduction of muscle mass (p<0.000).

When assessing the etiological criteria, oral or nasogastric tube food intake was inadequate in 75.2% (n=76) of the individuals, highlighting that the malnourished group had a significantly greater reduction in intake when compared to the non-malnourished group (p=0.018). In the ICU, 94.0% (n=95) of the individuals expressed a biochemical test for C-reactive protein (CRP) >1.0. The most common diseases were those linked to the gastrointestinal tract and lungs (Table 5), regardless of patient nutritional status.

Table 3 – Weight loss, BMI, and calf circumference.

		Malnutrition	
Weight loss	**Total n (%)**	**No n (%)**	**Yes n (%)**
No	34 (33.7)	33 (97.1)	1 (2.9)
5% or more	67 (66.3)	32 (47.8)	35 (52.2)
Body mass index classification			
Low weight	12 (11.9)	2 (16.7)	10 (83.3)
Eutrophy	33 (32.7)	18 (54.5)	15 (45.5)
Overweight	28 (27.7)	20 (71.4)	8 (28.6)
Obesity	28 (27.7)	25 (89.3)	3 (10.7)
Calf circumference			
Normal (female)	28 (59.6)	19 (67.9)	8 (28.6)
Normal (male)	27 (50.0)	22 (81.5)	5 (18.5)
Reduced (female)	19 (40.4)	9 (47.4)	11 (57.9)
Reduced (male)	27 (50.0)	15 (55.6)	12 (44.4)

n = sample size.

Table 4 – Relationship between weight loss, BMI, and calf circumference and nourishment status.

Variables	**Nourished**	**Malnourished**	p
Weight loss (%)			
Mean ± SD	2.5 ± 2.5	13.2 ± 5.6	0.000
Calf circumference (cm)			
Mean ± SD	35.3 ± 3.8	31.6 ± 3.9	0.000
Body mass index (BMI)			
Mean ± SD	29.2 ± 5.3	23.7 ± 4.4	0.000

SD = standard deviation.

Table 5 – Number of patients with described diases.

		Malnutrition	
Gastrointestinal diseases	**Total n (%)**	**No n (%)**	**Yes n (%)**
Pancreatitis	8 (7.9)	5 (62.5)	3 (37.5)
Gastrointestinal tract neoplasm	6 (5.9)	3 (50.0)	3 (50.0)
Hematemesis (gastric ulcer)	3 (3.0)	2 (66.7)	1 (33.3)
Diverticulitis	3 (3.0)	2 (66.7)	1 (33.3)
Cholestatic syndrome	3 (3.0)	1 (33.3)	2 (66.7)
Reconstruction of intestinal transit	2 (2.0)	1 (50.0)	1 (50.0)
Choledocholithiasis	2 (2.0)	2 (100.0)	0 (–)
Others	3 (3.0)	1 (33.3)	2 (66.7)
Lung diseases			
Bronchospasm	6 (5.9)	2 (33.3)	4 (66.7)
Acute respiratory failure	4 (4.0)	3 (75.0)	1 (25.0)
Acute pulmonary edema	3 (3.0)	2 (66.7)	1 (33.3)
Community-associated pneumonia	2 (2.0)	2 (100.0)	0 (0.0)
Pulmonary thromboembolism	2 (2.0)	1 (50.0)	1 (50.0)
Others	6 (5.9)	4 (66.7)	2 (33.3)

Continuation Table 5 – Number of patients with described disases.

		Malnutrition	
Gastrointestinal diseases	**Total n (%)**	**No n (%)**	**Yes n (%)**
Heart diseases			
Decompensated congestive heart failure (CHF)	6 (5.9)	4 (66.7)	2 (33.3)
Acute myocardial infarction (AMI)	3 (3.0)	3 (100.0)	0 (–)
Others	4 (4.0)	3 (75.0)	1 (25.0)
Vascular diseases			
Aortic aneurysm	2 (2.0)	0 (–)	2 (100.0)
Coumarin poisoning	2 (2.0)	1 (50.0)	1 (50.0)
Others	8 (7.9)	6 (75.0)	2 (25.0)
Kidney diseases			
Urinary sepsis	4 (4.0)	1 (25.0)	3 (75.0)
Nephrectomy	2 (2.0)	2 (100.0)	0 (–)
Hemodialysis access infection	2 (2.0)	2 (100.0)	0 (–)
Other complications			
Exogenous intoxication	2 (2.0)	2 (100.0)	0 (–)
Leptospirosis	2 (2.0)	1 (50.0)	1 (50.0)
Others	5 (5.0)	3 (60.0)	2 (40.0)
Hernias			
Others	3 (3.0)	3 (100.0)	0 (–)
Liver diseases			
Others	3 (3.0)	3 (100.0)	0 (–)

n = sample size.

Table 6 – Relationship between age and lenght of ICU stay and hospital outcome.

Variable	Hospital discharge	Death	p
Age (years)			
Mean ± SD	57.57 ± 15.60	65.81 ± 14.05	0.013
Length of ICU stay (days)			
Mean ± SD	15.46 ± 13.16	33.75 ± 17.11	0.002

There was no relationship between total length of hospital stay, malnutrition, or specific diseases. Age and length of stay in the ICU affected the outcome ($p<0.013$ and $p=0.002$, respectively). Most patients (33.7%; n=34) stayed in the ICU for 8 to 14 days (1 to 2 weeks) (Table 6).

DISCUSSION

The GLIM criteria for classifying the severity of malnutrition have several parameters, ensuring greater specificity by including phenotypic criteria and etiological criteria, for a complete diagnosis of malnutrition, even classifying its intensity as moderate or severe[3]. In the ICU, only 6 patients had a laboratory test with CRP ≤1.0. Of these, only 1 patient did not have a reduction in food intake and was not classified according to the etiological criteria, demonstrating how patients in ICUs are vulnerable against malnutrition. This corroborates the study by Souza et al.[12], in which all patients in an ICU were evaluated as positive for the criterion.

Protein-calorie malnutrition is common in patients with diseases that affect the respiratory system, due to decreased food intake (secondary to anorexia) and increased resting metabolic rate due to increased respiratory effort. However, in this study, respiratory diseases ranked second when correlated with malnutrition, showing that gastrointestinal diseases, with or without the presence of abdominal distension and/or vomiting, may also be correlated with malnutrition[15]. This research was carried out in a hospital that is a reference in cardiac treatment with 20 ICU beds dedicated to the treatment of cardiac diseases. However, when investigating the other 20 general clinical and surgical beds, 13 patients were admitted for cardiac reasons. This may camouflage the real malnutrition of these diseases, since when there were vacant beds in the ICU specialized in cardiology, these patients were not included in the study.

Muscle weakness is a condition seen in patients admitted to the ICU, aggravated by immobilization and the presence of critical illnesses that prolong the length of hospital stay, affecting between 30% and 60% of hospitalized patients. However, in this study, it was difficult to classify reduced muscle mass, since the validated measurement was calf circumference. This measurement only provides a cutoff for the minimum value to disregard reduced muscle mass, and not two values that allow a classification of the severity of malnutrition as moderate and severe, which made this criterion present, but not classifiable in the study[16]. Although only 5 patients presented edema identified by pitting edema scale in the lower limbs (LL), calf circumference can bring edema as a confounding factor for the identification of muscle mass when this measurement is used.

The European Society for Clinical Nutrition and Metabolism (ESPEN) states that malnutrition results from inadequate nutrient intake, leading to altered body composition and decreased cell mass, causing physical and mental dysfunctions[17]. The study corroborates with this, as even though the BMI classified 15 individuals as eutrophic, 8 as overweight, and 3 as obese, some patients with a BMI considered desired still presented malnutrition. Therefore, although BMI is an easily applicable and validated parameter, it should not be used as the sole tool to diagnose malnutrition in a hospital setting.

Weight loss, low BMI, and reduced food intake are correlated with significant results for malnutrition because they are the GLIM criteria themselves. It is the nutritionist's job to take these criteria into consideration when performing nutritional screening. When this result is named as "malnutrition", it gives more weight and support for nutritional intervention to take place.

The study also showed that the older the age of hospitalized patients, the greater the incidence of death. At the same time, the greater the severity of the disease, the more time in the ICU is needed, which eventually translates into greater number of deaths as an outcome. However, according to the Brazilian Institute of Geography and Statistics, the population of elderly people residing in Brazil is 32,113,490, an increase of 56.0% compared to that censused in 2010[18]. Thus, the data regarding age may only be a reflection of the population residing in Brazil.

Corroborating with Solon et al.[19], although GLIM has not yet been validated in Brazil, its use has resulted in many satisfactory results in previous studies and in the current one. Considering all the benefits associated with early identification of malnutrition and the development of criteria to standardize its diagnosis, further studies are needed to improvethe applicability of this nutritional assessment method, especially when standardizing the criteria and cuttoff ranges used to evaluate the severity of muscle mass reduction

CONCLUSIONS

Patients who presented significant weight loss, reduced muscle mass, low BMI and/or reduced food intake had high prevalence of malnutrition when the GLIM assessment criteria were applied. There was no prevalence of malnutrition in relation to age or gender, or specific disease, however the most prominent diseases were related to the gastrointestinal tract (pancreatitis and neoplasms of the gastrointestinal tract) and respiratory diseases (bronchospasms, acute respiratory failure and acute pulmonary edema).Although data collection was carried out over a period of 4 months (June to September), the ongoing diseases and the age of the population may differ depending on the period of the year being studied, allowing for other results depending on the seasonality.

New studies are needed to apply an initial nutritional assessment according to the GLIM criteria, assessing weight loss, loss of appetite and lean mass and, thus, prevent malnutrition, facilitating the identification of patients at nutritional risk and interventions against it.

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