UNIVERSIDADE FEDERAL DO PARANÁ

ANA MARIA VAVRUK

ANÁLISE COMPARATIVA UTILIZANDO-SE DOIS NOVOS INSTRUMENTOS NO DIAGNÓSTICO DE DESNUTRIÇÃO: “CARACTERÍSTICAS CLÍNICAS DA DESNUTRIÇÃO” E “INICIATIVA DAS LIDERANÇAS GLOBAIS EM DESNUTRIÇÃO” COM O MÉTODO TRADICIONAL DA “AVALIAÇÃO SUBJETIVA GLOBAL” EM PACIENTES INTERNADOS EM UMA UNIDADE DE TERAPIA INTENSIVA

CURITIBA

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Tese apresentada com objetivo de conclusão do Curso de Pós-Graduação em Medicina Interna e Ciências da Saúde - Doutorado, Setor de Ciências da Saúde, Universidade Federal do Paraná.

Orientador: Prof. Dr. Marcelo Mazza do Nascimento
Coorientadora: Dra. Cristina Martins

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RESUMO

Introdução: A desnutrição é um grande problema mundial, sendo comum nas unidades de terapia intensiva (UTIs). No entanto a avaliação nutricional é limitada por vários fatores, dentre os quais encontram-se a falta de instrumentos subjetivos validados. **Objetivo:** Comparar dois instrumentos de diagnóstico de desnutrição: Características Clínicas da Desnutrição (*Malnutrition Clinical Characteristics* – MCC) e Iniciativa das Lideranças Globais em Desnutrição (*Global Leadership Initiative on Malnutrition* – GLIM), com o método de Avaliação Subjetiva Global – ASG (*Subjective Global Assessment* – SGA) tradicional considerando medidas antropométricas, comorbidades e mortalidade em pacientes gravemente enfermos. **Métodos:** Foi realizado um estudo observacional e longitudinal que incluiu 102 pacientes (amostra de conveniência) na unidade de terapia intensiva (UTI) geral de um hospital público no período de abril a setembro de 2018. Os critérios de inclusão foram indivíduos de ambos os sexos e idade maior ou igual a 18 anos. Foram aplicados, pelo pesquisador, os três instrumentos de diagnóstico de desnutrição, MCC, GLIM e ASG, em cada paciente. Foram coletados dados demográficos bem como avaliada a presença de comorbidades e de desfechos clínicos. Também, foram coletadas as seguintes medidas antropométricas: índice de massa corporal (IMC) e circunferência da panturrilha (CP). Foram aplicados testes estatísticos (exato de Fisher, t de Student ou U de Mann-Whitney e Kolmogorov-Smirnov), bem como coeficiente de Kappa de Cohen para avaliar a concordância. **Resultados:** O instrumento MCC, apresentou uma especificidade de 87,5% (coeficiente kappa=0,87), sensibilidade de 100%, acurácia de 93,3%, valor preditivo positivo (VPP) de 87,5% e valor preditivo negativo (VPN) de 100%, quando comparada às classificações originais de desnutrição da ASG, no diagnóstico de desnutrição. Quanto a comparação entre ASG e GLIM, na classificação original da ASG, foi encontrada especificidade de 80% (coeficiente kappa=0,7), sensibilidade de 90,9%, acurácia de 84,9%, VPP de 78,9% e VPN de 91,4%. Quando os pacientes foram classificados em dois grupos (sem desnutrição e com desnutrição), a especificidade (coeficiente kappa=1), sensibilidade, acurácia, VPP e VPN entre ASG e MCC foram de 100%. Quando comparados os instrumentos ASG e GLIM, foi demonstrada uma especificidade de 90,12% (coeficiente kappa=0,73), sensibilidade de 90,47%, acurácia de 90,19%, VPP de 70,37% e VPN de 97,33%. A ASG e o MCC classificaram 27 pacientes como sem desnutrição, enquanto o GLIM classificou 21. Todos os pacientes com desnutrição apresentaram coeficiente de mortalidade significativamente maiores (GLIM, 19,8%, p=0,038; ASG e MCC, 21,3%, p=0,006) e tempo de internamento mais longo (GLIM, 25±18,3 dias, p=0,006, ASG e MCC, 26±18,7 dias, p <0,001). Por fim, quando comparados aos instrumentos ASG, MCC e GLIM, as médias de IMC (GLIM, 24,05kg/m², p=0,001; ASG e MCC, 24,06kg/m², p=0,004) e CP (GLIM, 32,06cm, p<0,001; ASG e MCC, 32,04cm, p=0,001) apresentaram-se estatisticamente menores para pacientes com desnutrição. **Conclusões:** MCC e GLIM se mostraram instrumentos adequados no diagnóstico de desnutrição, em pacientes críticos, quando comparados a ASG. Portanto, MCC e GLIM parecem ser instrumentos válidos para identificar e classificar a desnutrição de pacientes críticos, constituindo-se alternativas seguras no diagnóstico da desnutrição para este grupo de pacientes.

Palavras-chave: Doença crítica. Avaliação Subjetiva Global. Características Clínicas da Desnutrição. Iniciativa das Lideranças Globais em Desnutrição. Desnutrição. Avaliação nutricional.

ABSTRACT

Introduction: Malnutrition is a major global problem and is common in intensive care units (ICUs). However, nutritional assessment is limited by several factors, among which are the lack of validated subjective instruments. **Objective:** To compare two malnutrition diagnosis tools: Malnutrition Clinical Characteristics (MCC) and Global Leadership Initiative on Malnutrition (GLIM), with the traditional Subjective Global Assessment (SGA) method considering anthropometric measures, comorbidities, and mortality in critically ill patients. **Methods:** a longitudinal, observational study has been performed and included 102 patients (convenience sample) in a general intensive care unit (ICU) of a public hospital from April to September 2018. Patients older than 18 years of both sexes were included. Three malnutrition diagnostic instruments, MCC, GLIM, and SGA, were applied to each patient by the researcher. Demographic data were collected as well as the presence of comorbidities and clinical outcomes were assessed. Also, the following anthropometric measurements were collected: body mass index (BMI), and calf circumference (CC). Statistical tests were applied (Fisher's exact, Student's t, or Mann-Whitney U, and Kolmogorov-Smirnov), and Cohen's kappa coefficient to assess agreement. **Results:** The MCC instrument, showed a specificity of 87.5% (kappa coefficient = 0.87), sensitivity of 100%, accuracy of 93.3%, positive predictive value (PPV) of 87.5% and negative predictive value (NPV) of 100%, when compared to the original SGA malnutrition classifications, in the diagnosis of malnutrition. The comparison between SGA and GLIM, showed, a specificity of 80% (kappa coefficient = 0.7), sensitivity of 90.9%, accuracy of 84.9%, PPV of 78.9%, and NPV of 91.4% were found. When patients were classified into two groups (without malnutrition and with malnutrition), the specificity (kappa coefficient=1), sensitivity, accuracy, PPV, and NPV between SGA and MCC were 100%. Moreover, when comparing the SGA and GLIM instruments, a specificity of 90.12% (kappa coefficient, 0.73), sensitivity of 90.47%, accuracy of 90.19%, PPV of 70.37%, and NPV of 97.33% were demonstrated. SGA and MCC classified 27 patients as well-nourished, while GLIM classified 21. All patients with malnutrition had significantly higher mortality coefficient (GLIM, 19.8%, p=0.038; SGA or MCC, 21.3%, p=0.006) and longer length of hospital staying (GLIM, 25±18.3 days, p=0.006, SGA or MCC, 26±18.7 days, p <0.001). Finally, when compared to the ASG, MCC, and GLIM instruments, the mean BMI (GLIM, 24.05kg/m², p=0.001; ASG and MCC, 24.06kg/m², p=0.004), and CP (GLIM, 32.06cm, p<0.001; ASG and MCC, 32.04cm, p=0.001) were statistically significantly lower for patients with malnutrition. **Conclusions:** MCC and GLIM proved to be adequate tools in the diagnosis of malnutrition in critically ill patients as compared to SGA. Therefore, MCC and GLIM are valid instruments to identify and classify malnutrition in critically ill patients and are safe alternatives in the diagnosis of malnutrition in critically ill patients.

Keywords: Critical illness. Subjective Global Assessment. Malnutrition Clinical Characteristics. Global Leadership Initiative on Malnutrition. Malnutrition. Nutritional assessment.

LISTA DE TABELAS

LISTA DE ABREVIATURAS OU SIGLAS

ACADEMY - Academia de Nutrição e Dietética
APACHE - *Acute Physiology And Chronic Health Evaluation*
ASG - Avaliação Subjetiva Global
ASPEN - *American Society for Parenteral and Enteral Nutrition*
CMB - Circunferência Muscular do Braço
CP - Circunferência da Panturrilha
ELAN - Estudo Latino Americano de Nutrição
ESPEN - *European Society for Clinical Nutrition and Metabolism*
GLIM - *Global Leadership Initiative on Malnutrition*
IBRANUTRI - Inquérito Brasileiro de Nutrição Hospitalar
IMC - Índice de Massa Corporal
MCC - *Malnutrition Clinical Characteristics*
NCP - *Nutrition Care Process*
SCCM - *Society of Critical Care Medicine*
UTIs - Unidades de Terapia Intensiva
VPN - Valor Preditivo Negativo
VPP - Valor Preditivo Positivo

SUMÁRIO

1 INTRODUÇÃO

A desnutrição, especificamente em pacientes hospitalizados, é considerada um grande problema clínico em todo o mundo.(1-5) Na América Latina, o ELAN (Estudo Latino Americano de Nutrição), realizado em 12 países, inclusive no Brasil, demonstrou aproximadamente 50% de desnutrição na população hospitalizada. O Inquérito Brasileiro de Nutrição Hospitalar (IBRANUTRI) mostrou que 48,1%, dos 4000 pacientes avaliados, apresentaram algum grau de desnutrição, sendo que o tempo de internação entre pacientes desnutridos é aproximadamente 16% maior do que em pacientes nutridos. As complicações clínicas aumentam de duas a seis vezes, e o índice de mortalidade também cresce consideravelmente.(6) Uma grande porcentagem de pacientes sofre um declínio no estado nutricional durante todo o período de hospitalização.(7) Embora grandes esforços tenham sido feitos para prevenir e tratar a desnutrição em pacientes hospitalizados, estudos ainda mostram que o problema é recorrente.(8, 9) Os resultados adversos à saúde e o aparecimento da desnutrição são sérios e ameaçadores e resultam em maior risco de morbidades, tais como infecção, tempo de internação hospitalar, taxa de mortalidade e impacto financeiro.(5, 9-16)

Nas unidades de terapia intensiva (UTIs), a desnutrição é particularmente comum.(11, 12, 14, 17, 18) Portanto, a identificação e o tratamento da desnutrição são de máxima prioridade. Entretanto, a aplicabilidade de instrumentos de avaliação nutricional para pacientes críticos é limitada por vários fatores, inclusive por não haver uma ficha de avaliação padrão-ouro para esta população. Alguns consensos internacionais vêm sendo desenvolvidos com o intuito de definir critérios mínimos para o diagnóstico de desnutrição(19, 20), baseados em medidas antropométricas, condições relacionadas a doença, injúria aguda, circunstâncias sociais/ambientais. Muitas alterações metabólicas também estão significativamente alteradas com a desnutrição.(21) Evidências recentes sugerem que a inflamação desempenha um papel fundamental na patofisiologia da desnutrição relacionada à doença. O componente inflamatório possui implicações diagnósticas e terapêuticas.(22) A Avaliação Subjetiva Global (ASG) é um instrumento comum utilizado e padronizado em hospitais para avaliar a desnutrição.(23, 24) A ASG tem se mostrado eficaz para pacientes internados em UTI,(11, 12, 25-27) embora possa subdiagnosticar a desnutrição grave.(28)

Em 2012, a Academia de Nutrição e Dietética (*Academy of Nutrition and Dietetics – Academy)* (29) e a Sociedade Americana de Nutrição Enteral e Parenteral (*American Society for Parenteral and Enteral Nutrition – ASPEN)* publicaram um consenso, chamado Características Clínicas da Desnutrição (*Malnutrition Clinical Characteristics* – MCC), recomendando um conjunto padronizado de características diagnósticas para identificar a desnutrição em adultos na prática clínica.(29) O MCC usa uma abordagem baseada na etiologia da doença de base e inclui seis características gerais, tais como: redução no consumo de energia, perda de peso não intencional e achados físicos (perda de gordura subcutânea, perda de massa muscular, acúmulo de líquidos e redução da força de preensão manual), para delinear a presença de desnutrição severa e moderada.(30) O MCC pode ser usado para diagnósticos de desnutrição, mesmo quando a força de preensão manual não está disponível, uma vez que tem validade concorrente e preditiva satisfatória.(31)

Em 2016, representantes da ASPEN, da Sociedade Europeia de Nutrição Clínica e Metabolismo (*European Society for Clinical Nutrition and Metabolism* – ESPEN), da Federação Latino-Americana de Terapia Nutricional, Nutrição Clínica e Metabolismo (*Latin American Federation for Nutritional Therapy, Clinical Nutrition and Metabolism* – FELANPE), e da Sociedade de Nutrição Parenteral e Enteral da Ásia (*Parenteral and Enteral Nutrition Society of Asia* – PENSA), colaboraram na construção da Iniciativa das Lideranças Globais em Desnutrição (*Global Leadership Initiative on Malnutrition* – GLIM).(32) Estas sociedades concordaram que a abordagem ideal para diagnosticar a desnutrição deve ser simples, incluir critérios clinicamente relevantes, ser apropriada para uso por profissionais de saúde e conter medidas que estejam amplamente disponíveis. Para o diagnóstico da desnutrição, o GLIM recomenda a combinação de pelo menos um critério fenotípico (perda de peso, baixo índice de massa corporal ou massa muscular reduzida) e um critério etiológico (ingestão ou assimilação reduzida de alimentos ou inflamação). Muitos estudos têm fornecido evidências claras apoiando que os critérios acordados para diagnóstico de desnutrição são altamente relevantes, e cada um deles pode ser usado para prever os resultados clínicos adversos.(32) Um estudo recente publicou recomendações para identificar a redução de massa muscular usando os critérios fenotípicos do GLIM, entretanto, não há evidências suficientes para definir claramente os valores de corte e distinguir entre os graus de desnutrição moderada e severa.(33)

Os integrantes do consenso GLIM reconheceram que o tipo de doença/inflamação tem sido amplamente aceito como critério etiológico para os instrumentos de triagem e avaliação. O baixo índice de massa corporal (IMC) é frequentemente utilizado como critério fenotípico, enquanto que tanto a redução da ingestão/assimilação de alimentos quanto a carga inflamatória/doença são utilizados como critérios etiológicos.(34) A identificação da inflamação pode ser realizada por meio dos níveis séricos de proteína C-reativa, albumina e pré-albumina.(32) Os níveis de proteína C-reativa aumentam rapidamente em resposta a várias condições infecciosas e inflamatórias, sendo um potente preditor de morbidade e mortalidade.(35)

A abordagem GLIM é comparável com outros instrumentos de avaliação nutricional há muito tempo estabelecidos e utilizados para diagnosticar a desnutrição e o risco associado para resultados adversos. Um destes instrumentos validados, amplamente utilizados e aceitos pelo consenso GLIM é a ASG.(23, 27)

Outro instrumento que cumpre os critérios do GLIM para uma boa avaliação, é o MCC, dado que se aplica à segunda etapa de avaliação para diagnóstico e graduação de gravidade da desnutrição.(32) Estudos têm sido realizados para avaliar o MCC, concluindo-se que este instrumento é viável para o diagnóstico nutricional, desde que aplicado por nutricionistas treinados, enfatizando a necessidade de identificar as principais comorbidades associadas à desnutrição.(13, 14, 18, 36-38) Em uma avaliação piloto, a desnutrição, conforme definida pelo MCC, foi relacionada a piores resultados de morbidade e mortalidade, função física, qualidade de vida, readmissões e custos de saúde.(39) Recentemente, um estudo retrospectivo verificou a correlação entre a pontuação ASG e o diagnóstico de desnutrição pelo MCC em pacientes adultos hospitalizados.(28) Contudo, ainda há uma falta de investigação prospectiva em relação à validação dos instrumentos MCC e GLIM em comparação a instrumentos ou métodos padrão de referência, como a ASG. É importante que os profissionais de saúde da área clínica e investigadores no campo da nutrição utilizem os critérios GLIM para estudos de coorte prospectivos e retrospectivos, bem como para ensaios clínicos em diferentes populações a fim de validar sua utilidade na prática clínica.(32, 34)

2 JUSTIFICATIVA

Observa-se na prática clínica a importância na detecção dos fatores de risco modificáveis para desnutrição, e a necessidade de estudos que visem o diagnóstico e prevenção deste quadro clínico, proporcionando o bem-estar do paciente e sua mais rápida recuperação no ambiente hospitalar.

Especialistas desenvolveram nos últimos anos dois novos instrumentos de avaliação da desnutrição que precisam ser validados, por meio de pesquisa em pacientes graves, em nível terciário de atenção, pois são os mais susceptíveis a mudanças do estado nutricional, seja por jejum, cirurgias, queda do estado geral, entre outros. Até o presente momento, não existe uma avaliação padrão-ouro para este grupo populacional, fato que incentivou o desenvolvimento desta tese. Além disto, observamos a necessidade de metodologias que facilitem o diagnóstico de desnutrição destes pacientes, mas que ao mesmo tempo sejam reprodutíveis e confiáveis, e que tragam benefícios fornecendo um diagnóstico rápido e eficaz de desnutrição.

3 OBJETIVOS

Comparar os instrumentos de avaliação nutricional *Malnutrition Clinical Characteristics* (MCC) e *Global Leadership Initiative on Malnutrition* (GLIM) em relação à Avaliação Subjetiva Global (ASG), considerando medidas antropométricas, comorbidades e mortalidade em pacientes gravemente enfermos.

4 MATERIAIS E MÉTODOS

Este foi um estudo observacional prospectivo longitudinal, realizado por meio de uma amostra de conveniência constituída de pacientes internados na UTI geral de um hospital público no Brasil, no período de abril a setembro de 2018.

Os critérios de inclusão do estudo foram: indivíduos de ambos os sexos e idade maior ou igual a 18 anos. Os instrumentos para diagnóstico nutricional, ASG (Anexo 1), MCC (Anexo 2) e GLIM (Anexo 3) foram aplicados a cada paciente dentro das primeiras 48 horas da admissão na UTI, de acordo com os critérios da

Sociedade de Medicina Intensiva (*Society of Critical Care Medicine* – SCCM) e da ASPEN.(40) A coleta de dados de prontuário foi realizada neste período e documentada através de um fluxograma padronizado. Dados bioquímicos e outros dados objetivos foram coletados dos prontuários eletrônicos dos pacientes. O tempo de internamento hospitalar ou óbito foi documentado para cada paciente durante toda a internação.

A ASG está bem estabelecida e foi validada em vários estudos clínicos, por esse motivo foi usada como padrão de referência para avaliação da desnutrição.(41) A ASG divide a avaliação nutricional em história (mudança de peso recente, alterações na ingestão alimentar, presença de sintomas gastrointestinais e disfunção na capacidade funcional) e exame físico (perda de gordura corporal subcutânea, perda de massa muscular e presença de edema/ascite). As classificações finais dos avaliados são bem nutridos, moderadamente desnutridos e severamente desnutridos (A, B e C, respectivamente).

O MCC separa os pacientes em três amplas categorias: desnutrição relacionada a doença ou injúria aguda, desnutrição relacionada a doença ou condição crônica e desnutrição relacionada a circunstâncias sociais ou ambientais.(30) Para todas as categorias, o MCC se baseia em seis indicadores clínicos subjetivos para diagnosticar a desnutrição(39): ingestão de energia reduzida, perda de peso involuntária, perda de gordura subcutânea, perda de massa muscular, acúmulo de líquidos, redução da força de preensão manual. Pelo menos dois indicadores necessitam estar presentes para o diagnóstico de desnutrição. Cada categoria tem diferentes limiares em seus indicadores para melhor determinar a gravidade da desnutrição de acordo com a condição em que o paciente se apresenta. Uma vez que todos os nossos pacientes estavam internados na UTI, este estudo se concentrou especificamente na categoria "desnutrição relacionada a doença ou injúria aguda".

O instrumento GLIM subdivide a avaliação nutricional em critérios fenotípicos e etiológicos.(32) Os critérios fenotípicos incluem porcentagem de perda de peso, baixo IMC e massa muscular reduzida (a qual pode ser avaliada de acordo com a circunferência muscular do braço [CMB] ou circunferência da panturrilha [CP]). Para os critérios etiológicos são incluídos: a redução da ingestão ou assimilação de alimentos e inflamação. Pelo menos um critério fenotípico e um critério etiológico devem estar presentes para o diagnóstico de desnutrição.

Por ser tratarem de pacientes em UTI, e tendo em vista a dificuldade em aferição da prega cutânea tricipital neste grupo de pacientes para cálculos da CMB, utilizamos para esta pesquisa as aferições de CP.

Apenas uma nutricionista realizou a avaliação nutricional, a fim de diminuir o risco de diferenças interobservadores.(33) A avaliação da ASG já fazia parte do protocolo hospitalar. Portanto, não havia necessidade de treinamento adicional, uma vez que a nutricionista era suficientemente experiente para realizá-la. Em relação a avaliação do MCC e GLIM, foi necessário um treinamento formal, o qual foi realizado um mês antes da coleta de dados. O treinamento foi conduzido por uma nutricionista membro da Academia de Nutrição e Dietética (*Academy*) seguindo o método sugerido por Cederholm(32) e White.(29)

Embora ASG, MCC e GLIM tenham o mesmo objetivo, existem diferenças em alguns indicadores, que foram enfatizados durante o treinamento. Na categoria "desnutrição relacionada a doença ou injúria aguda", o MCC analisa a ingestão de alimentos em dias, enquanto a ASG a considera durante as duas últimas semanas. Além disso, para a perda de peso não intencional, o MCC estabelece períodos mais curtos para a identificação da desnutrição. O instrumento GLIM tem critérios de ambos, ASG e MCC, e inclui IMC e inflamação.

Para a primeira análise geral, os resultados dos três instrumentos foram divididos em dois grupos: "sem desnutrição" (ASG A) e "com desnutrição" (ASG B e C). Em uma segunda análise, a classificação ASG original foi utilizada a fim de avaliar as diferenças entre os grupos e compará-las aos resultados do MCC e GLIM.

Medidas antropométricas, tais como peso e altura, foram obtidas de acordo com o protocolo hospitalar. A altura foi aferida usando um estadiômetro, com o paciente na posição supina, reto, e com a cabeceira da cama em 0º. O peso, em quilogramas (kg), foi medido com auxílio de um guincho elevador elétrico para pessoas acamadas (marca: Freedom, país: Brasil, fabricante: Freedom Veículos Elétricos Ltda), o qual elevava os pacientes em um cesto. Para os cálculos da perda de peso não intencional de pacientes com nível de consciência reduzido, foram solicitados dados de peso usuais aos membros da família. Para os demais, o questionário foi realizado diretamente ao paciente.

O índice de massa corporal (IMC) foi classificado de acordo com as recomendações da ESPEN.(19) Para calcular a perda de massa muscular, foram realizadas as medidas da e CP utilizando uma fita métrica não elástica no ponto médio mais saliente e de acordo com as recomendações de Barazzoni(33).

Outros dados coletados foram idade, motivo da admissão, presença de comorbidades na admissão, necessidade de intubação e/ou infecção, escore *Acute Physiology And Chronic Health Evaluation* (APACHE) II, tempo de internamento hospitalar e óbito. O APACHE II continua sendo um dos melhores escores de previsão de mortalidade e sistema de classificação da gravidade da doença de pacientes internados em UTI de acordo com estudos clínicos.(42) O APACHE é dividido em oito escores distintos (0-4, 5-9, 10-14, 15-19, 20-24, 25-29, 30-34, e 35-100 pontos). Quanto maior a pontuação, mais grave é a doença. Para facilitar a análise estatística, os pacientes foram agrupados em: grupo 1 (0-9 pontos), grupo 2 (10-19 pontos), e grupo 3 (≥20 pontos).

Os níveis de albumina sérica e proteína C-reativa foram medidos usando os métodos enzimático e turbidimétrico, respectivamente. Os resultados destes testes bioquímicos foram coletados no mesmo dia da avaliação nutricional e foram usados para verificar a existência de inflamação, visto ser um dos critérios para o GLIM. Os testes bioquímicos já faziam parte da prática clínica de rotina no hospital.

Os dados foram compilados usando o Microsoft Office Excel 2003 e analisados de acordo com a distribuição de frequência das variáveis de interesse. Variáveis quantitativas contínuas e discretas foram analisadas e expressas como média, mediana, desvio padrão e valores mínimos e máximos. As variáveis categóricas foram apresentadas como frequência e porcentagem.

A fim de estimar sensibilidade, especificidade, acurácia e valores preditivos positivos e negativos (VPP e VPN respectivamente), ASG, MCC e GLIM foram comparados em suas classificações originais. Estas classificações foram: sem desnutrição, desnutrição moderada e desnutrição grave. A análise de concordância Kappa de Cohen foi calculada.

Para a análise dos fatores associados à desnutrição e morte hospitalar foi utilizado o teste exato de Fisher ou o teste de qui-quadrado (variáveis categóricas). Variáveis quantitativas foram analisadas usando o teste t de Student para amostras independentes ou o teste U de Mann-Whitney. A normalidade das variáveis quantitativas contínuas foi avaliada usando o teste Kolmogorov-Smirnov. A análise de regressão logística múltipla foi realizada para ajustar os fatores de confusão. Os dados foram analisados usando Stata/SE versão 14.1 (StataCorp LP, EUA)(43) e valores de p <0,05 foram considerados estatisticamente significativos.

O protocolo do estudo foi aprovado pelo Comitê de Ética em Pesquisa (Certificado de Apresentação para Apreciação Ética 74217517.1.0000.0102, número 2.552.546). Somente os pacientes que preencheram integralmente os critérios do estudo foram solicitados a dar o consentimento livre e esclarecido (pacientes ou seus representantes legais).

5 RESULTADOS

Cento e trinta e um pacientes foram internados na UTI geral no período proposto por este trabalho. Vinte e nove pacientes não foram incluídos no estudo por falta de dados dos critérios GLIM ou devido a óbito antes do período de avaliação nutricional. O familiar de um paciente com nível de consciência rebaixado, e que alcançou os critérios do estudo, recusou-se a assinar o termo de consentimento, logo, este paciente não foi incluído nas análises. Consequentemente, uma amostra de 102 pacientes críticos foi analisada.

Os principais diagnósticos de internamento agudo foram distúrbios gastrointestinais (34,3%), principalmente coledocolitíase e hemorragia digestiva, seguido por doenças pulmonares (31,4%), principalmente insuficiência respiratória e septicemia. A maioria dos pacientes apresentou duas (30,4%) e três ou mais comorbidades (27,5%). As comorbidades crônicas mais comuns foram hipertensão, diabetes mellitus, insuficiência hepática, doença pulmonar (insuficiência respiratória), insuficiência cardíaca e dislipidemia.

Os resultados da análise geral quanto as variáveis demográficas e nutricionais da população do estudo estão descritos na Tabela 1. Do total de pacientes analisados, 59,8% (n = 61) tiveram complicações clínicas durante o período de internamento na UTI. As mais comuns foram a necessidade de intubação (45,1%), seguidas por outras em porcentagem menos expressivas, incluindo insuficiência renal aguda, fístula biliar e melena. Para o modelo de análise geral, entre pacientes sem desnutrição e com desnutrição, ASG e MCC tiveram resultados iguais, portanto, dos pacientes que tiveram complicações, 64% (n = 48), estavam com desnutrição de acordo com a ASG ou MCC (p=0,174) e 65,4% (n = 53) de acordo com o GLIM (p=0,027). Os níveis de albumina sérica não mostraram associação estatisticamente significativa, quando comparados aos três instrumentos. No entanto, em relação aos níveis séricos de proteína C-reativa, houve associação estatisticamente significativa com desnutrição de acordo com o GLIM, mas não de acordo com ASG e MCC.

A maioria dos pacientes apresentava desnutrição (ASG ou MCC, n = 75 [73,5%]; GLIM, n = 81 [79,4%]). Estes pacientes eram significativamente mais velhos (>60 anos) do que os pacientes sem desnutrição, apresentaram maior tempo de internamento e maior mortalidade durante a hospitalização. Todos os pacientes que morreram (n = 16) apresentavam desnutrição de acordo com os três instrumentos, ASG, MCC e GLIM.

Em relação as variáveis antropométricas, pacientes com desnutrição tiveram menor média de IMC (ASG ou MCC, 24,06kg/m², p=0,004; GLIM, 24,05kg/m², p=0,001) e CP (ASG ou MCC, 32,04cm, p=0,001; GLIM, 32,06cm, p <0,001) quando comparados aos pacientes sem desnutrição. Para a análise de concordância, os instrumentos ASG e MCC demonstraram resultados de sensibilidade, especificidade (coeficiente kappa, 1), acurácia, VPP e VPN de 100%. Quando comparados os instrumentos ASG e GLIM, foi demonstrada uma especificidade de 90,12% (coeficiente kappa, 0,73), sensibilidade de 90,47%, acurácia de 90,19%, VPP de 70,37% e VPN de 97,33%. A ASG e MCC classificaram 27 pacientes como sem desnutrição, enquanto o GLIM classificou 21.

Uma análise de regressão logística múltipla foi realizada a fim de ajustar os fatores de confusão, incluindo idade e sexo em quatro modelos, usando as variáveis IMC, CP, tempo de internamento e escore APACHEII (Tabela 2). Para os dois primeiros modelos, observou-se que IMC e CP foram fatores protetores contra a desnutrição, de acordo com os três instrumentos, ASG, MCC e GLIM. Para o terceiro modelo de análise, os pacientes com maior tempo de internamento tiveram uma chance 6% maior de serem classificados como desnutridos de acordo com o ASG ou MCC, mas não houve diferença significativa de acordo com o GLIM. Para o quarto modelo de análise, nenhuma associação significativa foi encontrada nos escores do APACHE II de acordo com a ASG ou MCC; entretanto, com base nos critérios GLIM, um paciente tinha um risco 1,13 vezes maior de ser classificado com desnutrição quando comparado ao paciente sem desnutrição.

Na comparação entre ASG e MCC para análise em três grupos (sem desnutrição, com desnutrição moderada e com desnutrição grave), cinco pacientes foram diagnosticados com desnutrição moderada de acordo com a ASG, no entanto com desnutrição grave de acordo com o MCC (Tabela 3). Portanto, a ASG classificou 35 pacientes (87,5%) com desnutrição grave, enquanto a MCC classificou 40 pacientes. Entre estes dois instrumentos observou-se ainda uma especificidade de 87,5% (coeficiente kappa, 0,87), sensibilidade 100%, acurácia 93,3%, VPP 87,5% e VPN 100%. Para esta mesma comparação entre três grupos, no entanto entre os instrumentos ASG e GLIM foi demonstrada uma concordância de 75% para desnutrição moderada e 91,4% para desnutrição grave, com especificidade de 80% (coeficiente kappa, 0,7), sensibilidade de 90,9%, acurácia de 84,96%, VPP de 78,94% e VPN de 91,42%. Para finalizar o comparativo entre as três classificações do estado nutricional, foram comparados os instrumentos MCC e GLIM. Nesta análise observou-se uma concordância de 85,7% para desnutrição moderada, 90% para desnutrição grave, especificidade de 90% (coeficiente kappa, 0,81), sensibilidade de 90,9%, acurácia de 90,41%, VPP 88,23% e VPN 92,3%.

Um maior número de pacientes com desnutrição grave foi a óbito, quando comparados aos pacientes com desnutrição moderada, de acordo com os instrumentos ASG (n = 10, 28,6%), MCC (n = 11, 27,5%) e GLIM (n = 10, 23,8%). (Tabela 4), porém não houve diferença estatisticamente significativa. De acordo com os três instrumentos, pacientes com desnutrição grave tinham IMC e CP significativamente menores quando comparados aos pacientes com desnutrição moderada.

A Tabela 5 mostra a análise entre diversas variáveis em relação ao óbito. Menor albumina sérica, maior idade, maiores escores APACHE II e maiores valores séricos de proteína C-reativa foram significativamente associados à morte. Do total de pacientes que foram a óbito (n=16), 11 tiveram pontuação de APACHE II ≥20 pontos (p = 0,003). Tempo de internamento, IMC e CP também não foram associados ao óbito.

6 DISCUSSÃO

Este trabalho comparou os instrumentos ASG ao MCC e GLIM. A ASG é um instrumento bem validado e tem sido recomendado em vários estudos como comparador de validação para MCC e GLIM.(32, 34) Em nosso estudo, quando os pacientes foram separados em dois grandes grupos (com desnutrição e sem desnutrição) ou três grupos (sem desnutrição, com desnutrição moderada ou desnutrição grave), o MCC e a ASG tiveram uma concordância quase perfeita entre si, enquanto ASG e GLIM, uma concordância forte. Permanecendo na classificação em três grupos (sem desnutrição, com desnutrição moderada ou desnutrição grave), houve uma diferença de 12,5% entre ASG e MCC. Essa diferença se deveu ao maior número de pacientes com desnutrição grave, classificados de acordo com o MCC, mas com desnutrição moderada de acordo com a ASG. Em relação a concordância entre MCC e GLIM, esta manteve-se forte entre estes dois instrumentos quando os pacientes estavam separados em dois grandes grupos (sem desnutrição e com desnutrição), e quando classificados em três grupos (sem desnutrição, com desnutrição moderada ou desnutrição grave), semelhante aos resultados relatados por Balci et al.(44) Estes resultados podem ter sido em decorrência do maior número de pacientes classificados com desnutrição grave de acordo com os instrumentos MCC e GLIM, quando comparados ao instrumento ASG.

A diferença entre esses três instrumentos pode estar relacionada aos critérios indicadores de cada instrumento. Por exemplo, a ASG classifica "perda grave de gordura ou massa muscular" como desnutrição severa, enquanto o MCC, de acordo com a categoria "desnutrição relacionada a doença ou injúria aguda", considera "perda moderada de gordura ou massa muscular" como desnutrição grave. O GLIM também estratifica a perda de peso para desnutrição moderada ou grave em períodos de tempo específicos, semelhante ao MCC. Embora GLIM e MCC sejam mais comparáveis considerando o diagnóstico de desnutrição grave, a presença de IMC e critérios de inflamação no GLIM o tornam mais complexo. Pacientes com edema ou inflamação, seja por administração excessiva de líquidos ou baixa reserva proteica, precisam de um exame físico mais detalhado, uma vez que a perda de gordura corporal e massa muscular pode não ser tão evidente quando comparada a pacientes sem edema ou não inflamados. Portanto, é importante que o nutricionista seja bem treinado e atento aos sinais de desnutrição, realizando um exame físico completo nos pacientes. Em nossa opinião, parece adequado que uma perda "moderada" de massa corporal possa ser considerada "grave" para pacientes agudos, de alto risco nutricional, internados em UTI.

Sendo um grupo de pacientes críticos, outro ponto importante é a categoria "desnutrição relacionada a doença ou injúria aguda" do MCC que avalia a ingestão alimentar em um período mais curto, em comparação com a ASG. A categoria considera desnutrição moderada quando a ingestão é <75% das necessidades energéticas estimadas para um período >7 dias. Além disso, define desnutrição severa quando a ingestão é de ≤50% das necessidades energéticas estimadas para ≥5 dias. O GLIM é semelhante ao MCC quanto ao período de avaliação reduzido de consumo alimentar. A ASG não tem diferenciação de categoria para classificações de desnutrição moderada ou severa. Ao contrário do MCC e GLIM, a ASG considera mudanças na ingestão alimentar nas últimas duas semanas a seis meses.

O MCC é um dos instrumentos de avaliação mencionados no consenso GLIM.(32) Portanto, para avaliar a desnutrição em pacientes internados em UTI, que geralmente têm perda de peso curta e doença grave, o MCC e o GLIM parecem ser mais precisos.

O GLIM aborda os indicadores práticos para o diagnóstico de várias formas de desnutrição, em diferentes populações-alvo e locais. Não há consenso sobre qual a melhor maneira de medir e definir a redução de massa muscular, particularmente em ambientes clínicos. Portanto, para análise dos critérios fenotípicos, o GLIM recomenda a aferição por absortometria radiológica de dupla energia (DEXA), análise de impedância bioelétrica, tomografia computadorizada ou ressonância magnética. Entretanto, quando estas modalidades de avaliação não estão disponíveis ou não são viáveis, o consenso GLIM recomenda que estas modalidades de avaliação sejam substituídas por exames físicos e/ou avaliações antropométricas, tais como CP ou IMC.(32, 33) Para apoiar estas recomendações, um estudo prospectivo com pacientes de UTI, utilizou as aferições antropométricas e estas foram comparadas a ASG.(15) Neste estudo de Gattermann et al., os pacientes classificados com desnutrição grave tinham menor peso corporal, IMC, e CP. Em nosso trabalho, IMC e CP mais baixos também foram associados à desnutrição. Embora os pacientes com desnutrição tivessem um menor IMC, os valores de corte para estes pacientes de acordo com os critérios GLIM, MCC ou SGA não foram baixos. Portanto, o uso de valores baixos de IMC como único critério para o diagnóstico de desnutrição não é recomendado(45), pois carece de sensibilidade quando usado em outros instrumentos.(34, 46) As medidas atuais de composição corporal usadas para avaliar a massa muscular podem ter limitações inerentes entre indivíduos com excesso de gordura ou acúmulo de líquidos, o que é comumente observado naqueles com obesidade ou edema significativo, respectivamente.(33) Em relação a CP, foi encontrada uma associação significativa entre pacientes sem desnutrição e com desnutrição ao utilizar as novas recomendações propostas por Barazzoni.(33) Esta diferença também foi observada em pacientes com desnutrição moderada e grave, em comparação aos instrumentos ASG e MCC, no entanto não em relação ao GLIM.

A presença de desnutrição também pode ser confirmada pelas taxas de morbidade e mortalidade, redução na qualidade de vida, readmissões hospitalares e tempo de internamento hospitalar.(21, 39) Nossos resultados demonstraram que pacientes com desnutrição eram mais velhos e tiveram tempo de internamento hospitalar mais longo em comparação aos pacientes sem desnutrição, resultados semelhantes aos estudos conduzidos por Shimizu et al.,(47) Muñoz Fernandez et al.,(48) e Gattermann Pereira et al.(15) Neste último estudo, foi utilizada a ASG e pacientes com desnutrição tiveram um tempo de internamento hospitalar mais longo (>31 dias), mas não foi demonstrado um aumento no risco de morte. Em outro estudo, um tempo de internamento hospitalar mais longo foi associado ao declínio no estado nutricional de acordo com a ASG e perda de peso ≥5%.(23) Além destes resultados, o Nutrition Day mostrou que a maior associação com mortalidade hospitalar foi observada em pacientes com mobilidade reduzida ou que estavam acamados.(49)

Em relação à mortalidade e ao tempo de internamento hospitalar, nossos resultados encontraram associação com desnutrição, semelhante a outros estudos.(12, 15, 31, 50, 51) Além do mais, uma taxa de mortalidade relativamente baixa (15,7%), foi verificada, talvez relacionada a um baixo valor do escore APACHE II. A literatura tem apontado taxas de mortalidade mais elevadas em pacientes internados em UTI,(16, 44) entretanto, há relatos, corroborando nossos resultados, com taxas de mortalidade de 7,8%.(52) A investigação prospectiva conduzida por Balci et al.(44) foi uma das primeiras a associar o GLIM à ASG; nesse estudo, a maioria dos pacientes com desnutrição foi a óbito. Similarmente, vários outros estudos confirmaram a associação entre desnutrição e aumento nas taxas de mortalidade.(14, 53-55)

Em concordância a Contreras-Bolivar et al.,(56) nossos resultados mostraram que a maioria dos pacientes que foram a óbito estavam com desnutrição grave.

Bector et al. mostraram taxas de mortalidade significativamente maiores em pacientes com desnutrição moderada (45,5%) e grave (55,6%), em comparação com pacientes sem desnutrição (10,8%).(12) Os resultados de nosso estudo foram semelhantes, e todos os pacientes que morreram apresentavam desnutrição de acordo com os instrumentos ASG, MCC e GLIM. Entretanto, não foi encontrada nenhuma diferença estatística na taxa de mortalidade entre pacientes com desnutrição moderada ou grave.

7 CONSIDERAÇÕES FINAIS

Os resultados obtidos atingiram os objetivos propostos, com a publicação de um artigo científico na *Nutrition in Clinical Practice*, Qualis A2 (link: https://doi.org/10.1002/ncp.10637) e outro artigo em processo de revisão também na *Nutrition in Clinical Practice*, os quais encontram-se nos apêndices 1 e 2, respectivamente.

Reconhecemos que nosso trabalho teve algumas limitações, como por exemplo, a condução em um único centro. Um número maior de UTIs poderia fortalecer os resultados, visto a heterogeneidade desta população. Entretanto, nossa amostra parecia ser representativa da população habitual das UTIs no Brasil.

Como não estávamos avaliando a reprodutibilidade entre os examinadores e visávamos diminuir o risco de diferenças interobservadores, particularmente no caso de dados subjetivos(33), apenas um nutricionista foi treinado para coletar os dados de avaliação nutricional, o que incluiu a aplicação dos critérios ASG, MCC e GLIM. Desta forma, o examinador tinha mais chances de ser imparcial na aplicação dos instrumentos, pois a maioria dos dados eram os mesmos.

Em relação à comparação de apenas uma categoria do MCC ("desnutrição relacionada a doença ou injúria aguda") com a ASG, pode ser considerada uma limitação. Entretanto, o foco do estudo foram os pacientes internados em UTI, e não a população geral de enfermos.

Independente das limitações observadas, os instrumentos de avaliação nutricional MCC e GLIM parecem ser válidos quando comparados à ASG para pacientes internados em UTI. Como a avaliação é rápida e não requer equipamentos caros e de difícil manuseio, acredita-se que os instrumentos MCC e GLIM sejam práticos, de baixo custo e fáceis de usar.

Este estudo representa uma grande contribuição para o meio acadêmico pois foi o primeiro a validar o instrumento MCC para a população internada em UTI, apesar dos vieses inerentes a esta população. Em relação ao instrumento GLIM, poucos estudos foram publicados, e este foi o primeiro a comparar as novas recomendações fenotípicas em pacientes críticos. Sugere-se que os instrumentos MCC e GLIM sejam aplicados em outros grupos, além deste que apresentamos em nosso trabalho para aperfeiçoamento do método de avaliação e extensão dos resultados.

8 CONCLUSÕES

1) MCC e GLIM quando comparados a ASG tem boa especificidade, sensibilidade, acurácia, VPP e VPN. Por esta razão, esses instrumentos podem ser apontados como válidos para classificar a desnutrição em pacientes internados em UTI.
2) MCC e GLIM identificaram mais pacientes com desnutrição grave em relação a ASG, sugerindo que sejam mais sensíveis no diagnóstico de desnutrição severa de pacientes internados em UTI.
3) De acordo com os três instrumentos, todos os pacientes que foram a óbito estavam desnutridos.
4) Estudos multicêntricos, incluindo outras diferentes populações clínicas, são importantes para avaliações futuras.

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TABELA 1 – Variáveis demográficas e nutricionais.

Variável	Geral[a] (n=102)	Estado nutricional de acordo com a ASG*			Estado nutricional de acordo com o GLIM		
		Sem desnutrição[a] (n=27)	Com desnutrição[a] (n=75)	p[b]	Sem desnutrição[a] (n=21)	Com desnutrição[a] (n=81)	p[b]
Idade (anos)	59,1±18,4	49,1±16,3	62,7±17,8	0,001	49,1±16,9	61,2±17,9	0,004
≥60 (anos)	60 (58,8%)	9 (33,3%)	51 (68,0%)	0,003	7(33,3%)	53(65,4%)	0,012
Sexo masculino (n)	58 (56,9%)	10 (37,0%)	48 (64%)	0,023	7(33,3%)	51 (63,0%)	0,025
APACHE II (pontos)	16,51 (15)	13,05 (12)	17,64 (17)	0,01	11,93 (9)	17,48 (16)	0,006
Tempo de internamento hospitalar (dias)	23 (18)	15 (12)	26 (16)	<0,001	15,7 (12)	25 (20)	0,006
Óbitos durante o internamento hospitalar (n)	16 (15,7%)	0 (0%)	16 (21,3%)	0,006	0 (0%)	16 (19,8%)	0,038
Pacientes com complicações durante o internamento (n)	61 (59,8%)	13 (48,1%)	48 (64,0%)	0,174	8 (38,1%)	53 (65,4%)	0,027
Pacientes com doença crônica associada a injúria aguda (n)	2,83±1,37	3,11±1,37	2,73±1,38	0,222	2,9±1,38	2,8±1,38	0,791
Pacientes com infecção (n)	41 (40,2%)	8 (29,6%)	33 (44,0%)	0,254	7 (33,3%)	34 (42%)	0,619
Albumina sérica (g/dL)	2,7±0,8	3,0±1,0	2,7±0,8	0,516	2,9±0,98	2,7±0,75	0,424
Proteína C-reativa sérica (mg/dL)	9,56 (7,0)	8,05 (6,2)	10,01 (8,12)	0,315	5,63 (4,03)	10,57 (8,8)	0,004
IMC (kg/m^2)	24,99±5,56	27,6±5,3	24,06±5,38	0,004	28,7±5,5	24,05±5,2	0,001
IMC <20 kg/m^2 (<70 anos) ou <22 kg/m^2 (≥70 anos)[c] (n)	19 (17,6%)	0 (0%)	19 (25,3%)	0,003	1 (4,8%)	18 (22,2%)	0,112
CP (cm)	32,8±4,12 (33)	34,92±3,19 (35)	32,04±4,16 (32)	0,001	35,64±2,91 (35,5)	32,06±4,07 (32,5)	<0,001
CP <33cm[e] (masculino) ou <32cm (feminino)[d] (n)	47 (46,07%)	6 (22,22%)	41 (54,66%)	<0,0001	3 (14,28%)	44 (54,32%)	<0,0001
CP masculino (cm)	32,47±4,19 (32,5)	34,35±3.74 (33,75)	32,08±4,21 (32,25)	0,121	35±3,68 (34)	32,12±4,17 (32,5)	0,089
CP feminino (cm)	33,24±4,02 (33,75)	35,27±2,89 (35,5)	31,96±4,15 (31,5)	0,006	35,97±2,54 (35,55)	31,96± 3,98 (31,5)	0,001

Fonte: O Autor (2022).

Nota: *Resultados para ASG e MCC foram iguais. Significância: p<0,05. [a]Resultados descritos em média ± desvio padrão ou média (mediana) ou frequência (porcentagem); [b]teste t de Student para amostras independentes ou não paramétricas ou teste de Mann-Whitney (variáveis quantitativas), teste exato de Fisher (variáveis categóricas); [c]ESPEN, 2015[19]; [d]Percentil de acordo com Barazzoni, 2022[33].

Legenda: APACHE, *Acute Physiology And Chronic Health Evaluation*; IMC, índice de massa corporal; CP, circunferência da panturrilha; ASG, Avaliação Subjetiva Global; MCC, *Malnutrition Clinical Characteristics*; GLIM, Global *Leadership Initiative on Malnutrition*.

TABELA 2 – Análise de regressão logística múltipla em cinco modelos ajustados para idade e sexo com as variáveis IMC ou CP ou tempo de internamento ou APACHE II.

Modelo	Variável	ASG*			GLIM		
		p	OR	IC 95%[a]	p	OR	IC 95%[a]
1	Idade (anos)	<0,001	1,06	1,03 – 1,09	0,001	1,06	1,02 – 1,09
	Sexo masculino (n)	0,02	3,73	1,22 – 11,40	0,047	3,4	1,01 – 11,39
	IMC (kg/m²)	0,01	0,88	0,80 – 0,97	0,003	0,85	0,76 – 0,95
2	Idade (anos)	0,001	1,05	1,02 – 1,08	0,003	1,05	1,01 – 1,08
	Sexo masculino (n)	0,007	4,71	1,54 – 14,42	0,011	4,85	1,44 – 16,25
	CP (cm)	0,006	0,81	0,7 – 0,94	0,001	0,64	0,69 – 0,89
3	Idade (anos)	0,001	1,05	1,02 – 1,08	0,003	1,04	1,01 – 1,07
	Sexo masculino (n)	0,01	4,02	1,34 – 12,04	0,012	4,47	1,39 – 14,39
	Tempo de internamento (dias)	0,03	1,06	1,0 – 1,11	0,11	1,04	0,99 – 1,09
4	Idade (anos)	0,01	1,04	1,01 – 1,08	0,07	1,03	0,99 – 1,07
	Sexo masculino (n)	0,01	4,86	1,43 – 16,52	0,013	5,74	1,44 – 22,92
	APACHE II (pontos)	0,12	1,08	0,98 – 1,19	0,06	1,13	0,99 – 1,28

Fonte: O autor (2022).

Nota: *Resultados para ASG e MCC foram iguais. [a]Valores de *Odds Ratio* (OR) com 95% de intervalo de confiança (IC 95%).

Legenda: IMC, índice de massa corporal; CP, circunferência da panturrilha; APACHE II, *Acute Physiology And Chronic Health Evaluation*.

TABELA 3 – Concordância entre Avaliação Subjetiva Global (ASG) com *Malnutrition Clinical Characteristics* (MCC) ou ASG com *Global Leadership Initiative on Malnutrition* (GLIM) ou MCC com GLIM.

	ASG (n=102)	MCC (n=102)	Concordância[a]	ASG (n=102)	GLIM (n=102)	Concordância[b]	MCC (n=102)	GLIM (n=102)	Concordância[c]
Sem desnutrição	27	27	100%	27	21	70,37%	27	21	70,37%
Com desnutrição moderada	40	35	87,5%[d]	40	39	75%[e]	35	39	85,7%[f]
Com desnutrição grave	35	40	87,5%[d]	35	42	91,4%[e]	40	42	90%[f]

Fonte: O autor (2022).

Nota: [a]Concordância entre ASG e MCC em relação a classificação do estado nutricional.

[b]Concordância entre ASG e GLIM em relação a classificação do estado nutricional.

[c]Concordância entre MCC e GLIM em relação a classificação do estado nutricional.

[d]Especificidade = 87,5% (coeficiente kappa = 0,87); sensibilidade = 100%; acurácia = 93,3%; valor preditivo positivo = 87,5%; valor preditivo negativo = 100%.

[e]Especificidade = 80% (coeficiente kappa = 0,7); sensibilidade = 90.9%; acurácia = 84,93%; valor preditivo positivo = 78,94%; valor preditivo negativo = 91,42%.

[f]Especificidade = 90% (coeficiente kappa = 0,81); sensibilidade = 90,9%; acurácia = 90,41%; valor preditivo positivo = 88,23%; valor preditivo negativo = 92,3%.

TABELA 4 – Graus de desnutrição de acordo com ASG ou MCC (n = 75), e de acordo com GLIM (n = 81).

Variável	ASG			MCC			GLIM		
	Desnutrição moderada[a] (n=40)	Desnutrição grave[a] (n=35)	p[b]	Desnutrição moderada[a] (n=35)	Desnutrição grave (n=40)	p[b]	Desnutrição moderada[a] (n=39)	Desnutrição grave[a] (n=42)	p[b]
Idade (anos)	60,3 ± 19,1	65,4 ± 16,1	0,219	59.03 ± 19.42	65.88 ± 15.88	0.097	58,18 ± 19,45	64,95 ± 15,92	0,089
≥60 (anos)	25 (62,5%)	26 (74,3%)	0,327	22 (62.9%)	29 (72.5%)	0.459	22 (56,4%)	31 (73,8%)	0,11
Sexo masculino (n)	26 (65%)	22 (62,9%)	1	23 (65,71%)	25 (62,5%)	0,813	26 (66,7%)	25 (59,5%)	0,646
APACHE II (pontos)	16,78 (16)	18,5 (16,5)	0,334	17.61 (18)	17.67 (16)	0.974	17,75 (18)	17,26 (16)	0,771
Tempo de internamento hospitalar (dias)	22,43 (20)	29,51 (23)	0,102	22.51 ± 14.12	28.55 ± 21.72	0.154	25,85 (21)	23,71 (20)	0,604
Óbitos durante o internamento hospitalar (n)	6 (15%)	10 (28,6%)	0,171	5 (14.3%)	11 (27.5%)	0.258	6 (15,4%)	10 (23,8%)	0,41
IMC (kg/m^2)	25,15 ± 2,29	22,81 ± 6,32	0,06	25,43±4,28	22,86±5,99	0,035	24,84 ± 3,96	23,31 ± 6,11	0,189
IMC <20 kg/m^2(<70 anos) ou <22 kg/m^2(≥70 anos)[c] (n)	5 (12,5%)	14 (40,0%)	0,008	4 (11.4%)	15 (37.5%)	0.015	3 (7,7%)	15 (35,7%)	0,003
CP (cm)	33,63 ± 3,24(33)	30,21 ± 4,38(29)	<0,001	33,72 ± 3,09(33)	30,56 ±4,44(29,5)	0,001	33,23 ± 3,46(33)	30,98 ± 4,34(30,5)	0,012
CP <33cm[e] (masculino) ou <32cm (feminino)[d] (n)	15 (37,5%)	26 (74,28%)	0,002	13 (37,14%)	28 (70%)	0,006	18 (46,15%)	26 (61,9%)	0,184
CP masculino (cm)	34,01±3,56(33,25)	29,79±3,8(29,25)	<0,0001	34,34±3,3(33,5)	30±3,9(29,5)	<0,001	33,78±3,84(33,25)	30,4±3,83(30)	0,003
CP feminino (cm)	32,92 ± 2,51 (33)	30,92 ± 5,32 (28,5)	0,233	32,54 ± 2,33 (32,75)	31,5 ± 5,23 (29,5)	0,498	32,11± 2,25 (31,5)	31,85 ± 4,98 (31)	0,849

Fonte: O autor (2022).

Nota: Significância: $p<0,05$. [a]Resultados descritos em média ± desvio padrão ou média (mediana) ou frequência (porcentagem); [b]teste t de Student para amostras independentes ou não paramétricas ou teste de Mann-Whitney (variáveis quantitativas), teste exato de Fisher (variáveis categóricas); [c]ESPEN, 2015[19]; [d]Percentil de acordo com Barazzoni, 2022[33].

Legenda: APACHE, *Acute Physiology And Chronic Health Evaluation*; IMC, índice de massa corporal; CP, circunferência da panturrilha; ASG, Avaliação Subjetiva Global; MCC, *Malnutrition Clinical Characteristics*; GLIM, Global *Leadership Initiative on Malnutrition*.

TABELA 5 – Análise dos óbitos de acordo com variáveis demográficas e antropométricas.

Variável	Óbitos durante o internamento hospitalar		p^b
	Não[a] (n=86)	Sim[a] (n=16)	
Idade (anos)	57,2 ± 18,9 (18-96)	69,4 ± 11,1 (46-86)	0,001
Sexo masculino (n)	48 (55,8%)	10 (62,5%)	0,785
APACHE II (pontos)	15,3 (14)	22,3 (22)	0,005
Albumina sérica (g/dL)	2,9 ± 0,8 (0,8-4,5)	2,1 ± 0,6 (0,7-3)	0,009
Proteína C-reativa sérica (mg/dL)	8,4 (6,14)	15,7 (11,17)	0,038
Tempo de internamento hospitalar (dias)	22 (17)	30 (29)	0,098
IMC (kg/m²)	24,53 ± 4,88 (15,6-37,9)	27,51 ± 8,06 (16,2-47,6)	0,171
CP (cm)	32,61 ± 3,95 (22-42,5)	33,81 ± 4,93 (27-43)	0,289

Fonte: O autor (2022).

Nota: Significância: $p<0,05$. [a]Resultados descritos em média ± desvio padrão (valores mínimos – máximos) ou média (mediana) ou frequência (porcentagem); [b]teste t de Student para amostras independentes ou não paramétricas ou teste de Mann-Whitney (variáveis quantitativas), teste exato de Fisher (variáveis categóricas).

Legenda: APACHE, *Acute Physiology And Chronic Health Evaluation*; IMC, índice de massa corporal; CP, circunferência da panturrilha.

APÊNCIDE 1 – ARTIGO 1: VALIDATION OF MALNUTRITION CLINICAL CHARACTERISTICS IN CRITICALLY ILL PATIENTS

Abstract

Background: This study aimed to validate the Malnutrition Clinical Characteristics (MCC) compared with the Subjective Global Assessment (SGA), considering anthropometric measures, comorbidities, and mortality in critically ill patients.

Methods: This longitudinal observational study included patients admitted to the general intensive care unit (ICU) of a public hospital. SGA was used as the reference standard for diagnosing malnutrition. Patients older than 18 years of both sexes were included. Hospital length of stay (LOS), comorbidities on admission, and death were documented during the entire hospitalization of each patient. Body mass index (BMI), and calf circumference (CC) were considered anthropometric measures.

Results: The convenience sample comprised 102 ICU patients. Comparing the original malnutrition classifications of SGA with MCC, the specificity was 87.5%; sensitivity, 100%; accuracy, 93.3%; positive predictive value, 87.5%; and negative predictive value, 100%. When classified in two groups, namely “well nourished” and “malnourished”, specificity and sensitivity were 100% between both groups. Malnourished patients had significantly higher mortality rates (p=0.006) and longer LOS (p <0.001). As expected, BMI, and CC results were similar for SGA and MCC.

Conclusions: MCC was a valid tool for classifying malnutrition in ICU patients. Because the evaluation is fast and does not require expensive equipment that is difficult to handle, it is believed to be practical, low-cost, and easy to use.

Keywords: Critical illness. Length of stay. Malnutrition. Mortality. Nutrition assessment.

Introduction

Malnutrition specifically in hospitalized patients is considered a major clinical problem worldwide.(1-5) A large percentage patients experience a decline in nutritional status throughout their hospitalization.(7) Although major efforts have been made to prevent and treat malnutrition in hospitalized patients, studies still show that the problem is recurrent.(8, 9) The adverse health outcomes of malnutrition are serious and life-threatening and result in increased risk of infection, hospital length of stay (LOS), mortality rate, and healthcare costs.(5, 9-16)

In intensive care units (ICUs), malnutrition is particularly common.(11, 12, 14, 17, 18) Therefore, the identification and treatment of malnutrition is of utmost priority. However, the applicability of nutrition assessment tools for critically ill patients is limited by several factors. For example, anthropometric measures and biochemical markers, such as serum proteins, are inaccurate due to significant fluid shifts and presence of inflammation.(17) The Subjective Global Assessment (SGA) is a common tool used in hospitals to assess malnutrition.(23, 24) SGA has been shown to be effective for ICU patients.(11, 12, 25, 26) However, a recent study showed that the tool can underestimate severe malnutrition.(28)

In 2012, the Academy of Nutrition and Dietetics(57) and the American Society for Parenteral and Enteral Nutrition (ASPEN) published a consensus, called Malnutrition Clinical Characteristics (MCC), recommending a standardized set of diagnostic characteristics to identify malnutrition in adults in the clinical practice.(57) MCC uses an etiology-based approach, and includes six general characteristics (reduction in energy intake, unintentional weight loss, and physical findings [loss of subcutaneous fat, loss of muscle mass, fluid accumulation, and reduced grip strength]) to delineate severe and non-severe malnutrition.(30)

The Global Leadership Initiative on Malnutrition (GLIM) consensus(32) states that the desirable approach for diagnosing malnutrition should be simple, include clinically relevant criteria, be appropriate for use by healthcare professionals, and contain measures that could be broadly available. MCC accomplishes GLIM´s criteria for a good assessment tool, given that it applies for the second step of assessment for diagnosis and severity grading of malnutrition.(32) Studies have been conducted evaluating MCC and have concluded that it is feasible to diagnose malnutrition, provided that applied by trained nutritionists emphasizing the need to identify the main comorbidities associated with malnutrition.(14, 18, 36-38, 58) In a pilot evaluation to malnutrition, as defined by MCC, was related to poorer outcomes (morbidity and mortality, physical function, quality of life, readmissions and LOS, healthcare costs).(39) Recently, a retrospective study verified the correlation between the SGA score and the diagnosis of malnutrition by MCC in hospitalized adult patients.(28) However, there is a lack of prospective investigation regarding MCC validation in comparison to reference standard tools or methods.

There is a need for a methodology that facilitates the diagnosis of malnutrition in critically ill patients that is reliable and permits a quick and effective diagnosis. Therefore, the aim of this study was to validate Malnutrition Clinical Characteristics (MCC) compared to Subjective Global Assessment (SGA), considering anthropometric measures, comorbidities, and mortality in critically ill patients.

Materials and methods

This was a longitudinal prospective observational study. A convenience sample of patients admitted to the general ICU of a public hospital in Brazil was collected from April to September 2018.

Inclusion criteria for the study were: individuals of both sexes and aged >18 years. The instruments for nutritional diagnosis, SGA, MCC and GLIM were applied to each patient within the first 48 hours of ICU admission, according to the criteria of the Society of Critical Care Medicine (SCCM) and ASPEN(40) Biochemical and other objective data were collected from the patients' electronic health records. Hospital LOS or death was documented for each patient during the entire hospitalization.

SGA was used as the reference standard for malnutrition assessment.(41) The tool is well established and has been validated in several clinical studies. For all patients, SGA divides the nutrition assessment in medical history and physical findings. The subject final classifications are well-nourished, moderately malnourished, and severely malnourished (A, B, and C respectively). In order to describe the whole study population, SGA results were divided into two groups: "well-nourished" (SGA A) and "malnourished" (SGA B and C). This division into two groups was performed to obtain a general analysis of "well-nourished" and "malnourished" patients. In a second analysis, the original SGA classification was used to evaluate the differences between groups.

MCC separates patients in three broad categories: malnutrition related to acute illness or injury, malnutrition related to a chronic disease or condition, and malnutrition related to social or environmental circumstances.(30) Since our patients were all in ICU, this study focused specifically on the category "malnutrition related to acute disease or injury". For all categories, MCC is based on the six subjective clinical indicators to diagnose malnutrition(39): reduced energy intake, unintentional weight loss, loss of subcutaneous fat, loss of muscle mass, fluid accumulation, reduced hand grip strength. At least two indicators have to be present to identify malnutrition. Each category has different thresholds in its indicators in order to better determine the severity of malnutrition according to the condition in which the patient presents.

The SGA assessment was already part of the hospital protocol. Therefore, there was no need for further training since the dietitian-in-charge was sufficiently experienced in performing it. To perform the MCC assessment, formal training was required, which was conducted one month before the data collection. The training was conducted by a dietitian member of the Academy of Nutrition and Dietetics (Academy) following the method suggested by White.(29) Only one examiner collected the nutrition assessment data, in order to decrease the risk of interobserver differences.

Although SGA and MCC have the same goal, differences exist in some indicators, which was stressed during the training. In the category "malnutrition related to acute disease or injury", MCC analyzes the food intake in days, whereas SGA considers it for the last two weeks. Also, for unintentional weight loss, MCC establishes shorter periods for malnutrition indication. For patients with lowered level of consciousness, usual weight data was asked to family members and the percentage of unintentional weight loss was calculated. Anthropometric measures, such as weight and height, were obtained according to the hospital protocol. Height was measured using a stadiometer, with the patient in supine position, straight, and with the bed head on 0º. Weight, in kilograms (kg), was measured with a mechanical aid, which raised the bedridden patients on a hammock transfer basket.

Body mass index (BMI) was classified according to the European Society for Clinical Nutrition and Metabolism (ESPEN) recommendations.(59) Mid-arm circumference(60) and calf circumference (CC) were measured using a nonelastic tape. With the patient in supine position, the most protuberant part of the calf was measured, according to the WHO recommendations.(61) The nonelastic tape was inserted behind the patient's arm.

Other data collected were age, reason for admission, presence of comorbidities on admission, need for intubation and/or infection, Acute Physiology And Chronic Health Evaluation (APACHE) II score, hospital LOS, and death. APACHE II remains one of the best mortality predictor score and severity of disease classification system of ICU patients according clinical studies.(42) The score is divided into eight distinct scores (0–4, 5–9, 10–14, 15–19, 20–24, 25–29, 30–34, and 35–100 points). The higher the score, the more severe the illness. In order to facilitate the statistical analysis, patients were grouped into the three groups: group 1 (0–9 points), group 2 (10–19 points), and group 3 (≥20 points).

Serum albumin and C-reactive protein levels were measured using enzymatic and turbidimetric methods, respectively. The biochemical tests were already part of the routine clinical practice in the hospital.

Data were compiled using Microsoft Office Excel 2003 and analyzed according to the frequency distribution of the variables of interest. Quantitative continuous and discrete variables were analyzed and expressed as mean, standard deviation, and minimum and maximum values. Categorical variables were presented as frequency and percentages.

In order to estimate sensitivity, specificity, accuracy, and positive and negative predictive values (PPV and NPV respectively), SGA and MCC were compared in their original classification. These classifications were well nourished, moderate malnourished and severe malnourished. Cohen’s kappa coefficient was calculated.

Analysis of factors associated with malnutrition and hospital death used Fisher’s exact test or the chi-squared test (categorical variables). Quantitative variables were analyzed using Student’s t-test for independent samples or the Mann–Whitney U test. The normality of quantitative continuous variables was evaluated using the Kolmogorov–Smirnov test. Multiple logistic regression analysis was performed to adjust the confounding factors. A p value <0.05 was considered statistically significant. Data were analyzed using Stata/SE version 14.1 (StataCorp LP, USA).(62)

The study protocol was approved by Ethics Committee of Research (Presentation Certificate for Ethical Appreciation 74217517.1.0000.0102, number 2.552.546). Only patients who full filled the study criteria were asked to give the informed consent (patients or their legal representatives).

Results

A convenience sample of 102 critically ill patients of were analyzed. Only the family of one unconscious patient, who reached the study's criteria, refused to sign the consent form.

Table 1 describes the study population comparing well-nourished and malnourished patients, according to SGA. The majority (n = 75, 73.5%) were malnourished. These patients were significantly older than the well-nourished patients and over 60 years old, longer LOS and higher mortality during hospitalization. All patients who died (n = 16) were malnourished, according to SGA. Multiple logistic regression analysis was performed to adjust the confounding factors for the outcome of malnutrition (Table 2). It is observed that regardless of sex and APACHE II, every year of age had an increase of 4% in the chance of being classified as malnourished. In this same model, when adjusted to age and sex, APACHE II there was not significant association with malnutrition classification. In relation to LOS, the results remained similar as in the univariate analysis, therefore, there was association between LOS and malnutrition, independent of age and sex. From the total of patients, 59.8% (n = 61) had clinical complications during ICU stay. The most common were the need for intubation (45.1%), followed by other of less significance, including acute renal failure, biliary fistula and melaena. Malnourished and well-nourished patients presented a considerable percentage of clinical complications during ICU stay, however, the differences between groups were not statistically significant. Serum albumin and C-reactive protein were also not associated to malnutrition in this study, showing there was no association between inflammation and malnutrition. This can be explained by the low value of albumin in well-nourished and malnourished group. Regarding C-reactive protein, only three patients had serum levels within normality. The major acute diagnosis found were gastrointestinal disorder, mainly choledocholithiasis and digestive hemorrhage

(34.3%), followed by lung alterations, mainly pleural spill, respiratory failure and septicemia (31.4%). The majority of the patients had two (30.4%) or three or more (27.5%) comorbidities. The most common chronic comorbidities were hypertension, diabetes, liver failure, lung failure, heart failure, congestive cardiac insufficiency and dyslipidemia. As expected, BMI, and CC results were similar for SGA and MCC.

BMI and CC were significantly lower in malnourished patients. A larger number of malnourished patients were at the lower limits of normal for BMI and CC as compared with well-malnourished.

Comparing MCC with SGA both tools classified as well-nourished 27 patients. (Table 3). Five patients were found moderately malnourished according to SGA but severely malnourished according to MCC. Therefore, SGA classified 35 patients (87.5%) as severely malnourished, whereas MCC classified 40 patients as so. The specificity was 87.5% (the kappa coefficient of 0.87), sensitivity was 100%, accuracy 93.3%, PPV was 87.5% and NPV was 100% between MCC and SGA.

When separated in two larger groups of only well-nourished or malnourished patients, to obtain a general analysis of nutritional status, the results of sensitivity were 100%, specificity were 100% and accuracy was 100% between tools. Therefore, PPV and NPV were, both, 100% and the kappa coefficient was equal 1.
More severely than moderately malnourished patients died, according to SGA (n=10, 28.6%) and to MCC (n=11, 27.5%) (Table 4), however this difference was not statistically significant. According to both tools, severely malnourished patients had significantly lower BMI and CC than the patients with moderately malnourished.

Table 5 explored death related to other variables. Lower serum albumin and higher age, APACHE II scores and serum C-reactive protein were significantly associated with death. From the total of deaths (n=16), 11 patients had APACHE II score ≥20 points (p = 0.003). LOS, BMI, and CC were also not associated with death.

Discussion

In this study comparison of MCC to SGA demonstrated 100% sensitivity and 100% specificity for MCC, compared to SGA as reference standard, when ICU adult patients were separated into two large groups (well-nourished and malnourished). When classified in three groups (well-nourished, moderately malnourished, or severely malnourished), there was a 12.5% difference between the MCC and SGA. The difference was due, probably, to the larger number of patients classified as severely malnourished according MCC, but moderately malnourished by SGA.

Therefore, compared to SGA, we can indicate that MCC may be a better tool to classify severe malnutrition in ICU patients. The difference may be related to the indicators criteria of each tool. For example, SGA classifies “severe loss of fat or muscle mass” as severe malnutrition, while the MCC, according the category “malnutrition related to acute illness or injury”, considers “moderate loss of fat or muscle mass” as severe malnutrition. Patients with edema or inflammation, either from excessive serum administration or low protein reserve, need a more detailed physical examination, since the loss of body fat and muscle mass may not be as evident when compared to patients without edema or not inflamed. Therefore, it is important that the nutritionist is well trained and attentive to the signs of malnutrition, performing a complete physical examination on patients. In our opinion it seems suitable that a “moderate” loss of body mass could be considered “severe” for acute, high nutrition risk, ICU patients.

Being a group of critical patients, another related and important point is thar MCC´s “malnutrition related to acute disease or injury” category assesses intake in a shorter period of time, compared to SGA. The category considers moderate malnutrition when the intake is <75% of the estimated energy needs for >7 days. Additionally, it defines severe malnutrition when the intake is ≤50% of the estimated energy needs for ≥5 days. SGA does not have category differentiation for moderate or severe malnutrition classifications. Unlike MCC, SGA considers changes in nutritional intake during the last two weeks to six months.

MCC is one of the assessment tools mentioned in the GLIM consensus(32). GLIM approaches the practical indicators for the diagnosis of various forms of malnutrition, in different target populations and locations. There is not consensus regarding how best to measure and define reduced muscle mass, particularly in clinical settings. Therefore, GLIM recommends measurement by dual-energy X-ray absorptiometry, bioelectrical impedance analysis, computed tomography or magnetic resonance imaging. However, such tools are not usually available or indicated to ICU patients. The GLIM consensus also recommends that these tools might be replaced by physical examination and/or anthropometric measurements, such as MAC or CC. In this study we used WC measurements due to difficulties in measuring the triceps cutaneous fold for MAC calculations in ICU patients. To support these recommendations, a prospective study with ICU patients, anthropometric measurements were compared to SGA.(15) In study of Gattermann et al, patients classified as severely malnourished had the lowest body weight, BMI, and CC. In our study, lower BMI and CC were also associated to severe malnutrition but did not compare the results with GLIM consensus criteria. We collected only a few anthropometric variables, to minimize the subjectivity of the nutrition assessment tools.

According to Hand et al., it is not possible to confirm the presence of malnutrition without comparing it with well-established and measurable health outcomes, such as morbidity and mortality, decreased function and quality of life, increased hospitalization frequency and hospital LOS, and higher healthcare costs.(39) In agreement, Mogensen et al. have discussed the significant correlation of malnutrition with negative clinical outcomes, including increased mortality rate, hospital LOS, and readmissions.(13)

In our study, we observed that malnourished patients had longer hospital LOS than well-nourished patients. Gattermann Pereira et al., using SGA, also have observed longer LOS (over 31 days) for malnourished patients.(15) Interestingly, in their results, malnutrition did not increase the death risk. Another study has observed that hospital LOS was longer when there was a decline in nutritional status or when unintentional weight loss was ≥5%.(7) Regarding the association among age and LOS with malnutrition, our results were consistent with a large study in Philadelphia(38): malnourished were older and had longer LOS than well-nourished patients. Corroborating with our studies, Ceniccola et al.(14) have observed that malnourished patients were older, compared to well nourished. However, they did not find association with LOS. Possible explanations could be the differences in population profiles, as the study by Ceniccola et al.(14) has a smaller prevalence of malnutrition (29.7%) when compared of our results.

In relation to mortality and LOS, our results found a positive association with malnutrition, similar to other studies.(12, 15) In the recent study conducted in a New

York hospital, which included more than 5,000 ICU patients, has found that malnourished patients had longer LOS (21.2 days) and high in-hospital mortality rate.(18) In our study, the mortality rate was relatively low (15.7%), maybe related to a low APACHE II value. The literature generally shows higher mortality rates in ICU patients.(16) However, at least one study corroborates with our results, showing mortality rate of 7.8% of in ICU patients.(52)

In agreement with Contreras-Bolivar et al.,(56) one of the first prospective studies associating MCC and SGA, our study have found that all patients who died were severely malnourished, according to SGA and to MCC. Bector et al. have shown significantly higher mortality rates in moderately (45.5%) and severely malnourished (55.6%) patients, compared to well-nourished (10.8%) patients.(12) Several other studies have confirmed the association between malnutrition and increased mortality rates.(14, 53-55) Also, the Nutrition Day showed that largest association with hospital death was observed in patients with reduced mobility or those who were bedridden.(49)

We understanding there were a few limitations to this study, such as it did not include handgrip strength assessment. However, as found by Ceniccola et al,(14) the use of dynamometer is not practical or even feasible for the ICU patients. The MCC tool establishes the need of at least two of six variables to diagnosis malnutrition. Except for handgrip strength, all other MCC measurements were feasible in our population. Additionally, this study compared the final results of MCC with SGA, and not the efficacy of each indicator in diagnosing malnutrition.

This study did not search for reproducibility between tools among different examiners. Therefore, we established that only one examiner would collect data for the nutrition assessment in order to decrease the risk of interobserver differences, particularly in the case of subjective data. The examiner was trained to be impartial and use the same principle for both, SGA and MCC, at the same time.

In relation to the comparison of only one category of the MCC (“malnutrition related to acute disease or injury”) to SGA it might be considered a limitation. However, our focus were ICU patients, and not the overall ill population. An additional limitation is the study was conducted in a single center. A broader number of ICU settings might improve the strength of the results. And inherent limitation of ICU population is the heterogeneity. However, our sample seemed to be representative of usual general ICU population in Brazil.

Conclusion

MCC compared to SGA has good specificity, sensitivity, accuracy, PPV and NPV when compared. For this reason, MCC was determined to be a valid tool for classifying malnutrition in ICU patients, as compared to SGA. Since the evaluation is fast and does not require expensive equipment that is difficult to handle, MCC is believed to be practical, low-cost and easy to use. MCC identified more patients with severe malnutrition compared to SGA, showing MCC to be more feasible to assess severe malnutrition of ICU patients than SGA. In both tools, malnutrition was related to hospital LOS and mortality. Multicentric studies, including all MCC categories for all different clinical populations, will be important for future evaluation. Regarding the evaluation of MCC or SGA in times of COVID-19 pandemic, in order to meet safety criteria, and due to the restricted number of professionals in direct contact with patients suspected or confirmed with SARS-CoV-2, it is believed that patients hospitalized for more than 48 hours in ICU should be considered at nutritional risk. Furthermore, if the team of nutritionists is reduced, as in our case, it is suggested not to perform the MCC or SGA assessment directly to the patient, but to make use of secondary data, such as patients' health records and discussion with the multiprofessional team.

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Supplementary Materials

The files (.xls) may be requested by email for the corresponding author.

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Table 1 - Demographics and nutrition variables of the study population.

Variable	General[a] (n=102)	Nutrition status according to SGA		p[b]
		Well-nourished[a] (n=27)	Malnourished[a] (n=75)	
Age (years)	59.1±18.4	49.1±16.3	62.7±17.8	0.001
≥60 (years)	60 (58.8%)	9 (33.3%)	51 (68.0%)	0.003
Male sex (n)	58 (56.9%)	10 (37.0%)	48 (82.8%)	0.023
APACHE II (points)	15 (12)	12 (7)	16 (11)	0.01
Hospital LOS (days)	23±17	15±10	26±19	<0.001
Deaths during the hospital stay (n)	16 (15.7%)	0 (0%)	16 (21.3%)	0.006
Patients with complications during stay (n)	61 (59.8%)	13 (48.1%)	48 (64.0%)	0.174
Chronic disease associated with acute injury (n)	2 (2)	2 (2)	2 (2)	0.142
Patients with infection (n)	41 (40.2%)	8 (29.6%)	33 (44.0%)	0.254
Serum albumin (g/dL)	2.7±0.8	3.0±1.0	2.7±0.8	0.516
Serum C-reactive protein (mg/dL)	7 (9.9)	8.1 (10.1)	6.2 (8.4)	0.373
BMI (kg/m^2)	24.99±5.56	27.6±5.3	24.06±5.38	0.005
BMI <20 kg/m^2 (<70 y) or <22 kg/m^2 (≥70 y)[c] (n)	19 (17.6%)	0 (0%)	19 (25.3%)	0.003
CC (cm)	32.8±4.12	34.93±3.19	32.04±4.16	<0.001
CC <31cm[e] (n)	30 (29.4%)	2 (7.4%)	28 (38.4%)	0.003

Significance: $p<0.05$. SGA = Subjective global assessment. [a]Results described as mean ± standard deviation, median (interquartile range) or frequency (percentage); [b]Student's t test for independent samples or non-parametric Mann-Whitney test (quantitative variables), Fisher exact test (categorical variables); [c]ESPEN, 2015[34]; [e]World Health Organization, 1995[36].

Abbreviations used: APACHE, Acute Physiology And Chronic Health Evaluation; BMI, body mass index; CC, calf circumference; LOS, length of stay; MCC, Malnutrition Clinical Characteristics; SGA, Subjective Global Assessment.

Table 2 - Multiple logistic regression analysis to determine the predictive validity for the outcome of malnutrition. The analysis was realized in five models adjusted for age, sex with variables BMI or CC or Hospital LOS or APACHE II

Model	Variable	p	OR	IC 95%[a]
1	Age (years)	<0.001	1.06	1.03 – 1.09
	Male sex (n)	0.02	3.73	1.22 – 11.40
	BMI (kg/m²)	0.01	0.88	0.80 – 0.97
2	Age (years)	0.001	1.05	1.02 – 1.09
	Male sex (n)	0.007	4.72	1.54 – 14.42
	CC (cm)	0.006	0.81	0.70 – 0.94
3	Age (years)	0.001	1.05	1.02 – 1.08
	Male sex (n)	0.01	4.02	1.34 – 12.04
	Hospital LOS (days)	0.03	1.06	1.0 – 1.11
4	Age (years)	0.01	1.04	1.01 – 1.08
	Male sex (n)	0.01	4.86	1.43 – 16.52
	APACHE II (points)	0.12	1.08	0.98 – 1.19

[a]Odds Ratio (OR) values with respective 95% confidence intervals (95%CI).

Abbreviations used: BMI, body mass index; CC, calf circumference; LOS, length of stay; APACHE II, Acute Physiology And Chronic Health Evaluation.

Table 3 - Agreement between Subjective Global Assessment (SGA) and Malnutrition Clinical Characteristics (MCC) of 102 critically ill patients.

	SGA (n=102)	MCC (n=102)	Agreement[a]
Well-nourished	27	27	100%
Moderate malnourished	40	35	87.5%[b]
Severe Malnourished	35	40	87.5%[b]

[a]Agreement between MCC and SGA related to nutrition classification.

[b]Specificity = 87.5% (kappa coefficient = 0.87); sensitivity = 100%; accuracy = 93.3%; positive predictive value = 87.5%; negative predictive value = 100%.

Table 4 - Malnutrition degrees according to SGA and MCC and outcomes of 75 critically ill patients.

Variable	SGA			MCC		
	Moderate malnourished[a] (n=40)	Severe Malnourished[a] (n=35)	p[b]	Moderate malnourished[a] (n=35)	Severe Malnourished[a] (n=40)	p[b]
Age (years)	60.3 ± 19.1	65.4 ± 16.1	0.219	59.03 ± 19.42	65.88 ± 15.88	0.097
≥60 (years)	25 (62.5%)	26 (74.3%)	0.327	22 (62.9%)	29 (72.5%)	0.459
Male sex (n)	26 (65.0%)	22 (62.9%)	1.0	23 (65.7%)	25 (62.5%)	0.813
APACHE II (points)	16.78 ± 6.79	18.5 ± 7.3	0.334	17.61 ± 6.82	17.67 ± 7.31	0.974
Hospital LOS (days)	22.43 ± 14	29.51 ± 22.55	0.102	22.51 ± 14.12	28.55 ± 21.72	0.165
Deaths during the hospital stay (n)	6 (15%)	10 (28.6%)	0.171	5 (14.3%)	11 (27.5%)	0.258
BMI <20 kg/m^2 (<70 y) or <22 kg/m^2 (≥70 y)[c] (n)	5 (12.5%)	14 (40.0%)	0.008	4 (11.4%)	15 (37.5%)	0.015
CC <31cm[e] (n)	6 (15.4%)	22 (64.7%)	<0.0001	5 (14.7%)	23 (59.0%)	<0.0001

Significance: $p<0.05$. [a]Results described as mean ± standard deviation or frequency (percentage); [b]Student's t test for independent samples or non-parametric Mann-Whitney test (quantitative variables), Fisher exact test (categorical variables); [c]ESPEN, 2015[34]; [e]World Health Organization, 1995[36].

Abbreviations used: APACHE, Acute Physiology And Chronic Health Evaluation; BMI, body mass index; CC, calf circumference; LOS, length of stay; MCC, Malnutrition Clinical Characteristics; SGA, Subjective Global Assessment.

Table 5 - Death analysis according to demographics and other variables of 102 critically ill patients.

Variable	Deaths during the hospital stay		p^b
	No[a] (n=86)	Yes[a] (n=16)	
Age (years)	57.2±18.9 (18-96)	69.4±11.1 (46-86)	0.001
Male sex (n)	48 (55.8)	10 (62.5)	0.785
APACHE II (points)	15.3±6.4 (3-31)	22.3±7.8 (6-34)	0.005
Serum albumin (g/dL)	2.9±0.8 (0.8-4.5)	2.1±0.6 (0.7-3)	0.009
Serum CRP (mg/dL)	8.4±7.8 (0.05-41.1)	15.7±12.5 (0.7-39.4)	0.038
Hospital LOS (days)	22±18 (5-105)	30±15 (10-61)	0.098
BMI (kg/m²)	24.53±4.88 (15.6-37.9)	27.51±8.06 (16.2-47.6)	0.171
CC (cm)	32.61±3.95 (22-42.5)	33.81±4.93 (27-43)	0.289

Significance: $p<0.05$. [a]Results described as mean ± standard deviation (minimum – maximum), median (interquartile range) or frequency (percentage); [b]Student's t test for independent samples or non-parametric Mann-Whitney test (quantitative variables), Fisher exact test (categorical variables).

Abbreviations used: APACHE, Acute Physiology And Chronic Health Evaluation; BMI, body mass index; CC, calf circumference; CRP, C-reactive protein; LOS, length of stay.

APÊNDICE 2 – ARTIGO 2: GLOBAL LEADERSHIP INITIATIVE ON MALNUTRITION IS A VALID TOOL WHEN COMPARABLE TO THE SUBJECTIVE GLOBAL ASSESSMENT FOR INTENSIVE CARE PATIENTS IN A LONGITUDINAL PROSPECTIVE OBSERVATIONAL STUDY

Abstract

Background: To validate the malnutrition diagnostic instrument Global Leadership Initiative on Malnutrition (GLIM) with Subjective Global Assessment (SGA) of critically ill patients, and to identify the characteristics associated with a malnutrition diagnosis using both tools. **Methods:** This longitudinal observational study included patients aged >18 years, admitted to a general intensive care unit (ICU). The GLIM and SGA tools were applied and their diagnostic accuracy was compared with one another. The additional anthropometric measures included calf circumference (CC); body mass index (BMI) was also calculated. The hospital length of stay (LOS) and number of deaths were documented. **Results:** Data from a convenience sample of 102 critically ill patients were analyzed. A total of 21 patients were classified as well-nourished using the GLIM, while 27 were classified in this category using the SGA. The kappa coefficient between GLIM and SGA was substantial. Regardless of the tool used, malnourished patients exhibited significantly higher mortality rates (GLIM, p=0.038; SGA, p=0.006) and longer LOS (GLIM, p=0.006, SGA, p<0.001). In terms of anthropometric variables, malnourished patients had significantly lower means compared with well-nourished patients: BMI (SGA, p=0.004; GLIM, p=0.001), and CC (SGA, p=0.001; GLIM, p<0.001). Compared with patients who were moderately malnourished, severely malnourished patients exhibited smaller CC according to the GLIM (p<0.012) and SGA (p<0.001). **Conclusions:** The GLIM was a valid tool and comparable to the SGA for assessing malnutrition. In both tools, malnourished patients had lower BMI, and CC and higher LOS and mortality.

Keywords: malnutrition; nutritional assessment; SGA; GLIM; anthropometric measurements; critically ill

1. Introduction

In 2016, representatives from the American Society for Parenteral and Enteral Nutrition (ASPEN), the European Society for Clinical Nutrition and Metabolism (ESPEN), the Latin American Federation for Nutritional Therapy, Clinical Nutrition and Metabolism, and the Parenteral and Enteral Nutrition Society of Asia collaborated in building the Global Leadership Initiative on Malnutrition (GLIM).(32) These societies agreed that the optimal approach to diagnosing malnutrition should be simple, include clinically relevant criteria, be appropriate for use by healthcare professionals, and contain measures that are widely available. For malnutrition diagnosis, GLIM recommends the combination of, at least, one phenotype criterion (weight loss, low body mass index, or reduced muscle mass) and one etiological criterion (reduced food intake or assimilation, or inflammation). Many studies have provided clear evidence supporting that the agreed criteria for diagnosis of malnutrition are highly relevant, and each of them can be used to predict the adverse clinical outcomes.(32) A recent study reported the recommendations for identifying reduced muscle mass using the phenotypic GLIM criteria; however, there is insufficient evidence to clearly define the cut-off values for distinguishing moderate malnutrition from severe malnutrition.(33)

The GLIM members recognized that the type of disease/inflammation has been widely accepted as an etiological criterion in screening and assessment tools. Low body mass index (BMI) is frequently used as a phenotypic criterion, whereas both reduced food intake/assimilation and inflammation/disease burden are frequently used as etiological criteria.(34) The measures used to identify inflammation include serum C-reactive protein, albumin, and prealbumin levels.(32) C-reactive protein levels increase rapidly in response to several infectious and inflammatory conditions, and is a potent predictor of morbidity and mortality.(35)

Malnutrition is particularly common among patients admitted to the intensive care units (ICUs).(11, 12, 14, 17, 18, 50) The GLIM method identified a strong association between mortality and longer duration of ICU stay.(51) After launching the GLIM consensus, it is important that clinicians and investigators in the field of nutrition use the criteria for prospective and retrospective cohort studies, as well as for clinical assays in different populations to validate its utility in clinical practice.(32, 34)

The GLIM approach is comparable with other long established nutritional assessment tools used to diagnose malnutrition and the associated risk for adverse outcomes.(23) A universal and valid tool used to compare GLIM is the Subjective Global Assessment (SGA) tool. It has traditionally been used in hospitals to assess for malnutrition(23, 24) and is effective in evaluating this condition in ICU patients,(11, 12, 25, 26) although it may underdiagnose severe malnutrition.(28)

To date, only a few studies have compared the diagnostic accuracy of GLIM and SGA among ICU patients.(27) As such, this study aimed to validate the GLIM in relation to SGA in diagnosing malnutrition among critically ill patients, and to identify the characteristics associated with a malnutrition diagnosis using both tools.

2. Materials and Methods

A longitudinal prospective observational study was conducted from April to September 2018 in a general ICU of a public hospital located in Brazil. A convenience sample of patients aged >18 years of both sexes was included.

Data were collected from each patient within the first 48 hours of ICU admission, according to the criteria of the Society of Critical Care Medicine and ASPEN.(40) First, data on patients' clinical history (recent weight loss, changes in usual diet, presence of severe gastrointestinal symptoms, and functional ability) and physical examination findings (loss of body fat, loss of muscle mass, and presence of edema) were evaluated using the SGA. Then, the phenotypic (percent weight loss, low BMI, and reduced muscle mass) and etiological (reduced food intake or assimilation and inflammation) criteria present in the GLIM tool were added as diagnostic criteria.(32) At least one phenotypic criterion and one etiological criterion should be present for the diagnosis of malnutrition.

SGA is a well-established tool and has been validated in several clinical studies(41); it was used as the reference tool to define malnutrition in this study.

No previous training was required to perform nutritional assessment using the SGA. However, for the GLIM tool, which is more recent, a training period of 1 month was necessary before data collection is performed. This training was conducted by a

PhD, RDN, a member of the Academy of Nutrition and Dietetics (Academy), following the methodology proposed by Cederholm.(32)

The GLIM uses some criteria from previous screening tools for malnutrition, one of which is the SGA. However, it also includes other criteria such as BMI, inflammation, and muscle loss (which can be evaluated according to the mid-arm circumference [MAC] or calf circumference [CC]). Due to difficulties in measuring the triceps cutaneous fold for MAC calculations in ICU patients, CC measurements was used. To calculate the unintentional weight loss in patients with a lower level of consciousness, the usual (i.e., typical) weight data were collected from family members.

For diagnostic classification, the patients were divided into groups according to the original SGA classification: well-nourished, moderately malnourished, and severely malnourished (A, B, and C respectively). Further analysis was performed by dividing the patients into two major groups: well-nourished (SGA-A) and malnourished (SGA-B and SGA-C).

The biochemical data and demographic information were collected from the electronic medical records. The biochemical parameters included serum albumin and C-reactive protein levels, which were routinely measured in the hospital using enzymatic and turbidimetric methods, respectively. Results of these biochemical tests were collected on the same day that the findings of nutrition assessment were collected and were used to examine for inflammation as a criterion in the GLIM tool. The number of deaths and LOS of each patient were also documented.

As regards the anthropometric variables, height, weight, and CC were measured. Height was measured using a stadiometer, with the patient placed in supine position. Weight was measured using an electric hoist personal transfer elevator (brand: Freedom). BMI was classified according to the recommendations of the ESPEN.(59) To calculate the muscle mass loss, the CCs(60) were measured using a non-elastic tape at the most protruding midpoint and in accordance with the recommendations of Barazzoni(33).

The Acute Physiology and Chronic Health Evaluation (APACHE) II score was used to classify the predicted mortality and severity of illness.(63) The APACHE II score is divided into eight distinct categories, with higher scores indicating greater severity of illness. For statistical analysis, the patients were divided into three groups according to their score: group 1 (0–9 points), group 2 (10–19 points), and group 3 (≥20 points).

2.1 Ethics

The study protocol was approved by the Ethics Committee of Research (Presentation Certificate for Ethical Appreciation 74217517.1.0000.0102, number: 2.552.546). Only patients who fulfilled the inclusion criteria were asked to provide informed consent (patients or their legal representatives).

2.2 Statistical analysis

Quantitative continuous and discrete variables were expressed as mean, standard deviation, and minimum and maximum values, while categorical variables were expressed as frequency and percentage. To determine the sensitivity, specificity, accuracy, and positive and negative predictive values (PPV and NPV, respectively), the SGA and GLIM were compared based on their original classification of malnutrition. These classifications included well-nourished, moderately malnourished, and severely malnourished. Cohen's kappa coefficient was performed.

Analysis of the factors associated with malnutrition and in-hospital mortality was performed using Fisher's exact test or chi-square test for categorical variables. Quantitative variables were analyzed using the Student's *t*-test for independent samples or the Mann–Whitney U test. The normality of quantitative continuous variables was evaluated using the Kolmogorov−Smirnov test. Multiple logistic regression analysis was performed to adjust for confounding factors.

Statistical analysis was performed using Stata/SE version 14.1 (StataCorp LP, USA)(62), and a p value of <0.05 was considered significant.

3. Results

The data from a sample of 102 critically ill patients were evaluated. Only one family member refused to sign the consent form; as such, this patient was not included in further analysis.

The demographic information and nutritional variables of the study population are summarized in Table 1. No significant association was found between comorbidities and nutritional status in two instruments. The most prevalent complications during ICU stay were intubation (45.1%), followed by acute renal failure, biliary fistula, and melena. Of the patients who experienced complications, 64% (n = 48) were malnourished according to the SGA (p=0.174) and 65.4% (n = 53) according to the GLIM (p=0.027). The serum albumin level was not associated with malnutrition, regardless of whether the SGA or GLIM was used. The C-reactive protein level was associated with malnutrition according to the GLIM, but not according to the SGA.

Most of the patients were malnourished (SGA, n = 75 [73.5%]; GLIM, n = 81 [79.4%]). Compared with well-nourished patients, malnourished patients were significantly older (> 60 years age), had a longer LOS, and higher mortality rates during hospitalization. All patients who died (n = 16) were malnourished according to the SGA and GLIM classifications.

In relation to the anthropometric variables, malnourished patients had significantly lower mean BMI (SGA, p=0.004; GLIM, p=0.001), and CC (SGA, p=0.001; GLIM, p <0.001) compared with well-nourished patients.

Multiple logistic regression analysis was performed to adjust for confounding factors including age and sex in four models, using the variables BMI, CC, LOS, and APACHE II score (Table 2). For the two first models, independent of age and sex, higher BMI, and CC were found to be protective against malnutrition according to the SGA and GLIM criteria. For the third analysis model, patients with higher LOS had a 6% higher chance of being classified as malnourished according to the SGA, but no significant difference was found according to the GLIM. For the fourth analysis model, no significant association was found in the APACHE II scores according to the SGA; however, based on the GLIM criteria, a patient had a 1.13-fold increased risk of being classified as malnourished.

Analysis performed using data from two larger groups (well-nourished and malnourished patients) revealed a specificity of 90.12% (kappa coefficient, 0.73), a sensitivity of 90.47%, an accuracy of 90.19%, a PPV of 70.37%, and an NPV of

97.33%, when the SGA was compared with the GLIM (Table 3). The SGA classified 27 patients as well-nourished, while the GLIM classified 21 as well nourished.

Comparison of the SGA and GLIM in analyzing the three groups (well-nourished, moderate malnourished, or severe malnourished patients) revealed 75% agreement for moderate malnutrition and 91.4% for severe malnutrition, with a specificity of 80% (kappa coefficient, 0.7), a sensitivity of 90.9%, an accuracy of 84.93%, a PPV of 78.94%, and an NPV 91.42% (Table 4).

According to the SGA (n = 10 [28.6%]) and GLIM (n = 10 [23.8%]) criteria, the proportion of severely malnourished patients who died was high compared with that of moderately malnourished patients (Table 5); however, the difference was not statistically significant. Compared with those who were moderately malnourished, severely malnourished patients exhibited a smaller CC according to the SGA and GLIM criteria.

4. **Discussion**

The SGA is a well-validated tool and has been recommended as a comparator when validating the GLIM criteria.(32, 34) Therefore, this study compared the GLIM with the SGA in a group of critically ill patients. When the patients were divided into two large groups (i.e., well-nourished and malnourished), or three groups (well-nourished, moderately malnourished, or severely malnourished), the agreement between the GLIM and SGA was substantial, similar to the results reported by Balci et al.[(44)]

Compared with the SGA, the GLIM includes an evaluation of the “reduced food intake” within a shorter period (one week). The SGA uses a longer time frame (two weeks to six months). The GLIM also stratifies weight loss for moderate or severe malnutrition in specific periods of time, while the SGA does not make this differentiation. Therefore, to assess for malnutrition in ICU patients, who usually have short LOS and severe illness, the GLIM appeared to be more accurate.

For analysis of phenotypic criteria, the GLIM consensus also recommends the use of dual-energy X-ray absorptiometry, bioelectrical impedance analysis, computed tomography, or magnetic resonance imaging.[(32)] When these assessment modalities are not available or not feasible, measurement of anthropometric variables, such as MAC or

CC, BMI, and/or physical examination, are applicable.[32, 33] In our study, the patients were evaluated based on the BMI, and CC, and compared using the GLIM and SGA tools. Malnourished patients exhibited lower BMI, and CC. This result corroborates those of a prospective study conducted by Gattermann et al.,[15] who reported similar results for severely malnourished ICU patients.

Although malnourished patients exhibited a lower mean BMI, the cut-off values for these patients according to the GLIM or SGA criteria were not low. Therefore, using low BMI as the only phenotypic criterion for diagnosing malnutrition is not recommended[45] because it lacks the sensitivity when used in other tools.[34, 46] Current body composition measures used to assess muscle mass may have inherent limitations among individuals with excess fat or fluid accumulation, which is commonly observed in those with significant obesity or edema, respectively.[33] With regard to CC, a significant association was found between well-nourished and malnourished patients when using the new recommendations proposed by Barazzoni.[33] This difference was also observed in moderate and severely malnourished patients, even when the comparison was carried out in men. However, no difference was found between moderate and severe malnutrition in women, probably due to the small number of women with malnutrition compared with the number of men with malnutrition.

The presence of malnutrition may also be confirmed by the morbidity and mortality rates, decreased quality of life, hospital readmissions, and hospital LOS.[13], [39] Our results demonstrated that malnourished patients were older and experienced longer hospital LOS than well-nourished patients, which was similar to findings of the studies conducted by Shimizu et al.,[47] Muñoz Fernandez et al.,[48] and Gattermann Pereira et al.[15] In the latter study, malnutrition was found using SGA, and malnourished patients had a longer LOS (> 31 days) but did not show an increase in the risk for death. In another study, a longer LOS was associated with the decline in nutritional status according to the SGA and weight loss of ≥5%.[7]

Regarding to mortality and LOS, our results revealed a positive association with malnutrition, which was similar to the findings of other studies.[12, 15, 31, 50] Our study found a relatively low mortality rate (15.7%). The literature generally reports higher mortality rates in ICU patients.[16, 44] Results from at least one study corroborate those of our study, with a mortality rate of 7.8% in ICU patients.[52] A possible explanation for our mortality results was the low APACHE II scores.

The prospective investigation conducted by Balci et al.[44] was one of the first to associate GLIM with SGA; in that study, most malnourished patients died. Several other studies have confirmed the association between malnutrition and increased mortality rates.[14, 53-55] Bector et al. reported significantly higher mortality rates among moderately (45.5%) and severely (55.6%) malnourished patients compared with well-nourished patients (10.8%).[12] The results of our study were similar, and all patients who died were classified as malnourished according to the SGA and GLIM criteria. However, no statistical difference was found in the mortality rate between moderately malnourished patients and severely malnourished patients.

We acknowledge that our study had some limitations, including its single-center design; as such, data from a larger number of ICUs would strengthen the results. Our population was also heterogeneous; however, it appears to have been generally representative of the patients in the ICU settings.

Since we were not assessing for reproducibility among examiners and aimed at decreasing the risk of interobserver differences, particularly in the case of subjective data(33), only one nutritionist was trained to collect the nutrition assessment data, which included the application of the SGA and GLIM criteria. In this manner, the examiner was more likely to be impartial in tool application because most data were the same.

The GLIM was a valid tool and comparable to the SGA, with good specificity, sensitivity, accuracy, PPV, and NPV. In both tools, malnourished patients had a lower BMI, and CC and higher LOS and mortality.

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Supplementary Materials

The files (.xls) may be requested by email for the corresponding author.

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Table 1 – Demographics and nutrition variables of the study population.

Variable	General[a] (n=102)	Nutrition status according to SGA			Nutrition status according to GLIM		
		Well-nourished[a] (n=27)	Malnourished[a] (n=75)	p[b]	Well-nourished[a] (n=21)	Malnourished[a] (n=81)	p[b]
Age (years)	59.1±18.4	49.1±16.3	62.7±17.8	0.001	49.1±16.9	61.2±17.9	0.004
≥60 (years)	60 (58.8%)	9 (33.3%)	51 (68.0%)	0.003	7(33.3%)	53(65.4%)	0.012
Male sex (n)	58 (56.9%)	10 (37.0%)	48 (64%)	0.023	7(33.3%)	51 (63.0%)	0.025
APACHE II (points)	16.51 (15)	13.05 (12)	17.64 (17)	0.01	11.93 (9)	17.48 (16)	0.006
Hospital LOS (days)	23 (18)	15 (12)	26 (16)	<0.001	15.7 (12)	25 (20)	0.006
Deaths during the hospital stay (n)	16 (15.7%)	0 (0%)	16 (21.3%)	0.006	0 (0%)	16 (19.8%)	0.038
Patients with complications during stay (n)	61 (59.8%)	13 (48.1%)	48 (64.0%)	0.174	8 (38.1%)	53 (65.4%)	0.027
Chronic disease associated with acute injury (n)	2.83±1.37	3.11±1.37	2.73±1.38	0.222	2.9±1.38	2.8±1.38	0.791
Patients with infection (n)	41 (40.2%)	8 (29.6%)	33 (44.0%)	0.254	7 (33.3%)	34 (42%)	0.619
Serum albumin (g/dL)	2.7±0.8	3.0±1.0	2.7±0.8	0.516	2.9±0.98	2.7±0.75	0.424
Serum C-reactive protein (mg/dL)	9.56 (7.0)	8.05 (6.2)	10.01 (8.12)	0.315	5.63 (4.03)	10.57 (8.8)	0.004
BMI (kg/m^2)	24.99±5.56	27.6±5.3	24.06±5.38	0.004	28.7±5.5	24.05±5.2	0.001
BMI <20 kg/m^2 (<70 y) or <22 kg/m^2 (≥70 y)[c] (n)	19 (17.6%)	0 (0%)	19 (25.3%)	0.003	1 (4.8%)	18 (22.2%)	0.112
CC (cm)	32.8±4.12 (33)	34.92±3.19 (35)	32.04±4.16 (32)	0.001	35.64±2.91 (35.5)	32.06±4.07 (32.5)	<0.001
CC <33cm[e] (males) or <32cm (females)[d] (n)	47 (46.07%)	6 (22.22%)	41 (54.66%)	<0.0001	3 (14.28%)	44 (54,32%)	<0.0001
CC male (cm)	32.47±4.19 (32.5)	34.35±3.74 (33.75	32.08±4.21 (32.25)	0.121	35±3.68 (34)	32.12±4.17 (32.5)	0.089
CC female (cm)	33.24±4.02 (33.75)	35.27±2.89 (35.5)	31.96±4.15 (31.5)	0.006	35.97±2.54 (35.55)	31.96± 3.98 (31.5)	0.001

Significance: $p<0.05$. [a]Results describeds mean ± standard deviation or mean (median) or frequency (percentage);

[b]Student's t test for independent samples or non-parametric Mann-Whitney test (quantitative variables), Fisher exact test (categorical variables); [c]ESPEN, 2015[20]; [d]Percentile according to Barazzoni, 2022[2].

Abbreviations used: APACHE, Acute Physiology And Chronic Health Evaluation; BMI, body mass index; CC, calf circumference; LOS, length of stay; SGA, Subjective Global Assessment; GLIM, Global Leadership Initiative on Malnutrition.

Table 2 – Multiple logistic regression analysis in five models adjusted for age and sex to determine the predictive validity for the outcome of malnutrition.

Model	Variable	SGA			GLIM		
		p	OR	IC 95%[a]	p	OR	IC 95%[a]
1	Age (years)	<0.001	1.06	1.03 – 1.09	0.001	1.06	1.02 – 1.09
	Male sex (n)	0.02	3.73	1.22 – 11.40	0.047	3.4	1.01 – 11.39
	BMI (kg/m²)	0.01	0.88	0.80 – 0.97	0.003	0.85	0.76 – 0.95
2	Age (years)	0.001	1.05	1.02 – 1.08	0.003	1.05	1.01 – 1.08
	Male sex (n)	0.007	4.71	1.54 – 14.42	0.011	4.85	1.44 – 16.25
	CC (cm)	0.006	0.81	0.7 – 0.94	0.001	0.64	0.69 – 0.89
3	Age (years)	0.001	1.05	1.02 – 1.08	0.003	1.04	1.01 – 1.07
	Male sex (n)	0.01	4.02	1.34 – 12.04	0.012	4.47	1.39 – 14.39
	Hospital LOS (days)	0.03	1.06	1.0 – 1.11	0.11	1.04	0.99 – 1.09
4	Age (years)	0.01	1.04	1.01 – 1.08	0.07	1.03	0.99 – 1.07
	Male sex (n)	0.01	4.86	1.43 – 16.52	0.013	5.74	1.44 – 22.92
	APACHE II (points)	0.12	1.08	0.98 – 1.19	0.06	1.13	0.99 – 1.28

Abbreviations used: BMI, body mass index; CC, calf circumference; LOS, length of stay; APACHE II, Acute Physiology And Chronic Health Evaluation; SGA, Subjective Global Assessment; GLIM, Global Leadership Initiative on Malnutrition.

Table 3 – Agreement between Subjective Global Assessment (SGA) with Global Leadership Initiative on Malnutrition (GLIM) using two major groups: well-nourished (SGA-A) and malnourished (SGA-B and SGA-C).

	SGA (n=102)	GLIM (n=102)	Agreement[a]
Well-nourished	27	21	70.37%
Malnourished	75	81	97.33%[b]

[a]Agreement between SGA and GLIM related to nutrition classification.

[b]Specificity = 90.12% (kappa coefficient = 0.73); sensitivity = 90.47%; accuracy = 90.19%; positive predictive value = 70.37%; negative predictive value = 97.33%.

Table 4 – Agreement between Subjective Global Assessment (SGA) with Global Leadership Initiative on Malnutrition (GLIM) according to the original SGA classification: well-nourished, moderately malnourished, and severely malnourished (A, B, and C respectively).

	SGA (n=102)	GLIM (n=102)	Agreement[a]
Well-nourished	27	21	70.37%
Moderate malnourished	40	39	75%[b]
Severe Malnourished	35	42	91.4%[b]

[a]Agreement between SGA and GLIM related to nutrition classification.

[b]Specificity = 80% (kappa coefficient = 0.7); sensitivity = 90.9%; accuracy = 84.93%; positive predictive value = 78.94%; negative predictive value = 91.42%.

Table 5 – Malnutrition degrees according to SGA, 75 critically ill patients, and 81 critically ill patients of according to GLIM.

Variable	SGA			GLIM		
	Moderate malnourished[a] (n=40)	Severe Malnourished[a] (n=35)	p[b]	Moderate malnourished[a] (n=39)	Severe Malnourished[a] (n=42)	p[b]
Age (years)	60.3 ± 19.1	65.4 ± 16.1	0.219	58.18 ± 19.45	64.95 ± 15.92	0.089
≥60 (years)	25 (62.5%)	26 (74.3%)	0.327	22 (56.4%)	31 (73.8%)	0.11
Male sex (n)	26 (65.0%)	22 (62.9%)	1.0	26 (66.7%)	25 (59.5%)	0.646
APACHE II (points)	16.78 (16)	18.5 (16.5)	0.334	17.75 (18)	17.26 (16)	0.771
Hospital LOS (days)	22.43 (20)	29.51 (23)	0.102	25.85 (21)	23.71 (20)	0.604
Deaths during the hospital stay (n)	6 (15%)	10 (28.6%)	0.171	6 (15.4%)	10 (23.8%)	0.41
BMI (kg/m^2)	25.15 ± 2.29	22.81 ± 6.32	0.06	24.84 ± 3.96	23.31 ± 6.11	0.189
BMI <20 kg/m^2 (<70 y) or <22 kg/m^2 (≥70 y)[c] (n)	5 (12.5%)	14 (40.0%)	0.008	3 (7.7%)	15 (35.7%)	0.003
CC (cm)	33.63 ± 3.24 (33)	30.21 ± 4.38 (29)	<0.001	33.23 ± 3.46 (33)	30.98 ± 4.34 (30.5)	0.012
CC <33cm[e] (males) or <32cm (females)[d] (n)	15 (37.5%)	26 (74.28%)	0.002	18 (46.15%)	26 (61.9%)	0.184
CC male (cm)	34.01 ± 3.56 (33.25)	29.79 ± 3,8 (29.25)	<0.0001	33.78 ± 3.84 (33.25)	30.4 ± 3.83 (30)	0.003
CC female (cm)	32.92 ± 2.51 (33)	30.92 ± 5.32 (28.5)	0.233	32.11 ± 2.25 (31.5)	31.85 ± 4.98 (31)	0.849

Significance: $p<0.05$. [a]Results described as mean ± standard deviation or mean ± standard deviation (median) or mean (median) or frequency (percentage); [b]Student's t test for independent samples or non-parametric Mann-Whitney test (quantitative variables), Fisher exact test (categorical variables); [c]ESPEN, 2015[20](59); [d]Percentile according to Barazzoni, 2022[2].

Abbreviations used: APACHE, Acute Physiology And Chronic Health Evaluation; BMI, body mass index; CC, calf circumference; LOS, length of stay; SGA, Subjective Global Assessment; GLIM, Global Leadership Initiative on Malnutrition.

ANEXO 1 – FICHA DE AVALIAÇÃO SUBJETIVA GLOBAL (ASG)

Nome do Paciente: ________________________ID:___ Data: ___/___/___

	Escore da ASG		
PARTE 1 – **HISTÓRIA**	A	B	C
1. Mudança de Peso			
A. Mudança geral nos últimos 6 meses: ______kg			
B. Porcentagem de mudança			
______<5%			
______perda de 5-10%			
______perda >10%			
C. Mudança nas últimas 2 semanas:			
______ aumento			
______ sem mudança			
______ diminuição			
2. Ingestão alimentar (em relação ao normal):			
A. Mudança geral:			
______sem mudança			
______mudança			
B. Duração:			
______semanas			
C. Tipo de mudança:			
______dieta sólida insuficiente			
______dieta líquida completa			
______dieta líquida hipocalórica			
______jejum			
3. Sintomas gastrointestinais (com >2 semanas de duração):			
______nenhum ______náusea ______diarreia ______anorexia ______vômito			
4. Capacidade funcional (relacionada à nutrição):			
A. Disfunção geral:			
______nenhuma			
______moderada			
______grave			
______melhora			
______sem mudança			
______regrediu			

PARTE 2 – **EXAME FÍSICO**	Escore da SGA			
	Normal	Leve	Moderada	Grave
5. Evidência de: Perda de gordura subcutânea (suborbital, tríceps, bíceps, cintura)				
Perda de massa muscular (têmporas, clavícula, ombros, adutor, escápula, costelas, quadríceps, joelhos, panturrilha)				
Presença de edema (tornozelo, sacral)				
Presença de ascite				

PARTE 3 – **AVALIAÇÃO SUBJETIVA GLOBAL (assinalar uma)**		
A. Bem nutrido	B. Desnutrido leve/moderado	C. Gravemente desnutrido

ANEXO 2 – FICHA DE AVALIAÇÃO MCC (*MALNUTRITION CLINICAL CHARACTERISTICS*)

Indicadores clínicos	**Desnutrição Relacionada à Doença ou Injúria Aguda**		**Desnutrição Relacionada à Doença ou Condição Crônica**		**Desnutrição Relacionada a Circunstâncias Sociais/Ambientais**	
	Desnutrição moderada	**Desnutrição grave**	**Desnutrição moderada**	**Desnutrição grave**	**Desnutrição moderada**	**Desnutrição grave**
1. Ingestão Energética	<75% da necessidade estimada de energia por >7 dias ( )	≤50% da necessidade estimada de energia por ≥5 dias ( )	<75% da necessidade estimada de energia por ≥1 mês ( )	<75% da necessidade estimada de energia por ≥1 mês ( )	<75% da necessidade estimada de energia por ≥3 meses ( )	≤50% da necessidade estimada de energia por ≥1 mês ( )
2. Perda de Peso	% | Tempo 1-2 | 1 sem 5 | 1 mês 7,5 | 3 meses ( )	% | Tempo >1-2 | 1 sem >5 | 1 mês >7,5 | 3 meses ( )	% | Tempo 5 | 1 mês 7,5 | 3 meses 10 | 6 meses 20 | 1 ano ( )	% | Tempo >5 | 1 mês >7,5 | 3 meses >10 | 6 meses >20 | 1 ano ( )	% | Tempo 5 | 1 mês 7,5 | 3 meses 10 | 6 meses 20 | 1 ano ( )	% | Tempo >5 | 1 mês >7,5 | 3meses >10 | 6 meses >20 | 1 ano ( )
3. Perda de Gordura Corporal	Leve ( )	Moderada ( )	Leve ( )	Grave ( )	Leve ( )	Grave ( )
4. Perda de Massa Muscular	Leve ( )	Moderada ( )	Leve ( )	Grave ( )	Leve ( )	Grave ( )
5. Acúmulo de Líquido	Leve ( )	Moderada a grave ( )	Leve ( )	Grave ( )	Leve ( )	Grave ( )
6. Força de Preensão das Mãos	-	Reduzida ( )	-	Reduzida ( )	-	Reduzida ( )

*Pelo menos dois indicadores ou características clínicas devem estar presentes para o diagnóstico de desnutrição

ANEXO 3 – FICHA DE AVALIAÇÃO GLIM (*GLOBAL LEADERSHIP INITIATIVE ON MALNUTRITION*)

<table>
<tr><td rowspan="2"></td><td colspan="3">Critérios Fenótipicos</td><td colspan="2">Critérios Etiológicos</td></tr>
<tr><td>Perda de peso (%)</td><td>Baixo Índice de Massa Corporal (kg/m²)</td><td>Redução da massa muscular</td><td>Redução da ingestão de alimentos</td><td>Inflamação</td></tr>
<tr><td>Estágio 1 - Desnutrição Moderada</td><td>5-10% nos últimos 6 meses, ou

10-20% acima de 6 meses</td><td><20 se <70 anos, ou
<22 se >70 anos</td><td>Déficit leve a moderado

Circunferência do braço, ou

Circunferência da panturrilha</td><td rowspan="2">≤50% de requerimento energético >1 semana, ou qualquer redução por >2 semanas, ou qualquer condição gastrointestinal crônica que afete negativamente a assimilação ou absorção de alimentos. disfagia, náusea, vômitos, diarréia, constipação e dor abdominal.</td><td rowspan="2">Doença aguda/lesão ou doença crônica-relacionada

Proteína C-reativa, ou

Albumina</td></tr>
<tr><td>Estágio 2 - Desnutrição Grave</td><td>>10% nos últimos 6 meses, ou

>20% acima de 6 meses</td><td><18,5 se <70 anos, <20 se ≥70 anos</td><td>Déficit grave

Circunferência do braço, ou

Circunferência da panturrilha</td></tr>
</table>

*Necessário pelo menos 1 critério fenotípico e 1 critério etiológico para o diagnóstico de desnutrição.