UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL

FACULDADE DE MEDICINA

PROGRAMA DE PÓS-GRADUAÇÃO EM ALIMENTAÇÃO, NUTRIÇÃO E SAÚDE

AVALIAÇÃO NUTRICIONAL EM PACIENTES IDOSOS COM TUMORES SÓLIDOS:

COMPLEMENTARIEDADE DE INSTRUMENTOS PARA PREDIZER TEMPO DE INTERNAÇÃO PROLONGADA E READMISSÃO HOSPITALAR.

GIOVANNA POTRICK STEFANI

ORIENTADORA: PROFª. Drª. THAIS STEEMBURGO

DISSERTAÇÃO DE MESTRADO

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Formato da dissertação

Essa dissertação segue o formato proposto pelo Programa de Pós-Graduação em Alimentação, Nutrição e Saúde da Universidade Federal do Rio Grande do Sul:

1. Revisão da literatura sobre o tema
2. Artigo Original
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ASG	Avaliação Subjetiva Global
ASG-PPP	Avaliação Subjetiva Global – Produzida Pelo Paciente
ASG-PPP SF	Avaliação Subjetiva Global – Produzida Pelo Paciente versão reduzida
ASPEN	*American Society for Parenteral and Enteral Nutrition*
AVC	Acidente Vascular Cerebral
DCNT	Doença Crônica Não Transmissível
ESPEN	*European Society for Clinical Nutrition and Metabolism*
FELANPE	*Federación Latinoamericana de Terapia Nutricional, Nutrición Clínica y Metabolismo*
GLIM	*Global Leadership Initiative on Malnutrition*
IMC	Índice de Massa Corporal
MNA-SF	Mini Avaliação Nutricional versão reduzida
MST	*Malnutrition Screening Tool*
MUST	*Malnutrition Universal Screening Tool*
NRS-2002	*Nutritional Risk Screening-2002*
NUTRIC	Nutrition Risk in Critically Ill
NUTRISCORE	*Nutritional screening tool score*
PENSA	*Parenteral and Enteral Nutrition Society of Asia*
SBNO	Sociedade Brasileira de Nutrição Oncológica

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Resumo

A desnutrição é uma manifestação clínica comum em pacientes hospitalizados e pode levar a desfechos clínicos desfavoráveis como maior tempo de internação, readmissão e mortalidade. Pacientes com câncer tem mais risco de desnutrição que pacientes que não tem câncer. E este cenário é ainda mais preocupante em pacientes idosos com câncer. De fato, o estado nutricional está associado a sobrevida bem como a resposta ao tratamento oncológico. Neste sentido, identificar e diagnosticar precocemente tanto o risco nutricional e a presença da desnutrição beneficiam estes pacientes com uma intervenção nutricional precoce e especializada. Tais diagnósticos são realizados pelos instrumentos de triagem e de avaliação nutricional.

As principais ferramentas de triagem validadas em indivíduos hospitalizados são: [1] *Nutritional Risk Screening-2002* (NRS-2002) – projetada para incluir medidas de desnutrição atual, bem como a gravidade da doença, [2] *Malnutrition Screening Tool* (MST) – uma das ferramentas de triagem amplamente utilizadas e é baseada em apenas duas questões relacionadas à mudança de peso e perda de apetite, [3] *Malnutrition Universal Screening Tool* (MUST) - ferramenta que foi especificamente validada em pacientes com câncer, [4] Mini Avaliação Nutricional Short Form (MNA-SF) – desenvolvido para avaliar o risco nutricional particularmente em pacientes idosos, e, [5] Avaliação Subjetiva Global Produzida pelo Paciente versão reduzida (ASG-PPP SF) – ferramenta específica para pacientes com câncer. Além disso, para realizar uma avaliação nutricional completa em pacientes com câncer, recomenda-se a utilização da Avaliação Subjetiva Global (ASG) – considerada o critério de referência ou ASG-PPP - adaptada da ASG e desenvolvida especificamente para

indivíduos com câncer e, os critérios propostos pelo consenso do *Global Leadership Initiative on Malnutrition* (GLIM) para diagnosticar de desnutrição

Em pacientes adultos com câncer, evidências científicas mostram associação positiva entre alto risco e pior estado nutricional, identificado por diferentes ferramentas, com maior tempo de hospitalização e períodos de reinternação. Em pacientes adultos hospitalizados com câncer instrumentos como NRS-2002, ASG e ASG-PPP foram eficazes para avaliar desfechos clínicos desfavoráveis, no entanto, os dados na população idosa com câncer ainda são escassos. Mais recentemente, estudos vêm demonstrando a importância do uso combinado de instrumentos para obter um prognóstico mais completo e preciso do risco e estado nutricional em pacientes oncológicos. Contudo, até o momento, não há estudo que avaliou a complementariedade dos principais instrumentos de risco nutricional e de diagnóstico nutricional para predizer desfechos negativos em individuos idosos com câncer.

Considerando que a desnutrição é frequentemente observada em pacientes idosos com câncer e está associada a desfechos clínicos ruins e que estudos sobre a complementaridade neste grupo de indivíduos ainda estão sendo explorados, este estudo teve como objetivo analisar a complementaridade de cinco instrumentos de risco nutricional (NRS-2002, MST, MUST, MNA-SF e ASG-PPP SF) combinados com três ferramentas de diagnóstico de desnutrição (ASG, ASG-PPP e GLIM) e sua capacidade de prever desfechos clínicos desfavoráveis, como tempo de internação e reinternação em 60 dias em pacientes idosos com câncer.

CAPÍTULO I

REVISÃO DA LITERATURA

1. Câncer

Conceito e epidemiologia

O câncer é caracterizado pela formação e pelo crescimento anormal de células e podem invadir partes adjacentes do corpo e se espalhar para outros órgãos, afetando as funções vitais do organismo (1). O processo de formação de um tumor maligno é o resultado de uma complexa interação entre fatores do hospedeiro, como características genéticas; fatores ambientais, como exposição a substâncias cancerígenas; infecções, como vírus e bactérias; e fatores comportamentais, que envolvem variáveis como alimentação, atividade física, etilismo e tabagismo (2).

O câncer se destaca como o principal obstáculo para o aumento da expectativa de vida da população mundial (3). Segundo o *Global Cancer Statistics* esse cenário é preocupante e foi corroborado pela estimativa mundial de incidência e mortalidade por câncer no último ano de 2020 que estimou em 19,3 milhões de novos casos de câncer em todo o mundo, juntamente com aproximadamente 10 milhões de mortes (4). No Brasil, o câncer é a segunda principal causa de morte prematura, atrás apenas das doenças cardiovasculares (3). A crescente incidência e mortalidade da doença tem causas complexas, mas reflete, sobretudo, o aumento da expectativa de vida e as condições socioeconômicas das populações ao redor do mundo (5). Ainda, em média 60% dos cânceres acometem pessoas com 60 anos ou mais, isso pode ser explicado devido ao envelhecimento da população e ao aumento dos fatores de risco no estilo de vida, como por exemplo: tabagismo, má alimentação e inatividade física (6). Os tipos de cânceres mais prevalentes nesse grupo são o câncer de pulmão, colorretal, melanoma, próstata e mama, em mulheres (7).

Segundo o Instituto Nacional de Câncer José Alencar Gomes da Silva (INCA), estima-se para cada ano do triênio 2023-2025 a ocorrência de 704 mil novos casos

de câncer. Os casos mais incidentes serão o câncer de mama em mulheres (30,1%) e o de próstata em homens (30,0%). Na Região Sul, em mulheres, as três maiores incidências serão os cânceres de mama (27,8%), cólon e reto (10,1%) e traqueia, brônquio e pulmão (8,2%). Já em homens, a incidência maior será o câncer de próstata (20,4%), seguido por tumores de traqueia, brônquio e pulmão (11,6%) e o câncer colorretal ocupará a terceira posição (18,2%). E, no Rio Grande do Sul, a taxa estimada para este mesmo triênio será de 189 mil novos casos, sendo que os tumores de mama (3.720 novos casos) e de próstata (3.510 novos casos) manterão a liderança seguidos do câncer de cólon e reto (3.120 novos casos em homens e mulheres) (7).

2. Desnutrição no paciente idoso com câncer

O câncer ocasiona muitas alterações clínicas nos pacientes, decorrentes tanto do estresse causado pela própria doença quanto do tratamento quimioterápico e radioterápico ao qual são submetidos (8). Algumas das manifestações clínicas apresentadas são perda de peso, náuseas, vômitos, anorexia, diarreia, constipação, alterações no paladar, xerostomia, mucosite, fadiga, entre outras (9).

Pacientes com câncer apresentam alto risco para desnutrição porque tanto as características da doença quanto os efeitos do tratamento antitumoral ameaçam o estado nutricional (10, 11). O risco de desnutrição em pacientes com câncer é maior do que em pacientes que não tem a doença (12). E isso é ainda mais preocupante quando falamos do paciente idoso com câncer. Quanto às características da doença que contribuem para quadros de desnutrição, podemos citar a ativação da inflamação sistêmica que leva a piora da anorexia e do catabolismo, além de

contribuir para a depleção dos estoques de tecido adiposo e para a degradação da massa magra e, consequentemente, para a perda de peso corporal (8, 11, 13).

Sobre os tratamentos mais utilizados para o câncer, evidenciam-se o tratamento cirúrgico, quimioterápico e radioterápico. Bem reportados, os efeitos adversos decorrentes do tratamento oncológico clínico (quimioterapia e radioterapia) intensificam o declínio do estado nutricional porque são, em maioria, sintomas que impactam a ingestão de alimentos: náuseas, vômitos e anorexia (14). Por sua vez, a desnutrição pode acentuar ainda mais a toxicidade das terapias, reduzindo a tolerância e a resposta do paciente ao tratamento antineoplásico (13, 15).

Pacientes com câncer apresentam risco elevado de desnutrição. Dados do estudo multicêntrico Inquérito Brasileiro de Avaliação Nutricional (IBRANUTRI), apontam que a desnutrição calórica proteica em pacientes internados por diversas doenças chega a 50% nos hospitais brasileiros. Entre os pacientes oncológicos esse índice chega a 66,4% (16). A desnutrição é ainda mais prevalente em pacientes idosos com câncer, variando de 25% a 85%, uma vez que o processo de envelhecimento está associado às diversas alterações fisiológicas, que podem comprometer o estado nutricional (17, 18). As alterações funcionais naturais do envelhecimento levam a alterações no estado nutricional, incluindo: diminuição das papilas gustativas e do olfato, redução das sensações gustativas e olfativas, diminuição da secreção salivar e gástrica, falha na mastigação (devido à ausência de dentes e/ou próteses mal adaptadas) e constipação. Quando há doenças crônicas, esse processo é ainda mais acelerado (19).

O desenvolvimento e o grau da desnutrição estão relacionados com diversos fatores, tais como, idade do paciente, tipo de câncer, estágio da doença e tipo de tratamento. Estima-se que cerca de 10 a 20% dos óbitos nos pacientes com câncer

possam ser atribuídos à desnutrição e não à doença oncológica (11). Ainda, a desnutrição pode causar desfechos clínicos negativos e prognósticos ruins em pacientes com neoplasias malignas. Entre os desfechos clínicos negativos associados à desnutrição, está a diminuição da resposta ao tratamento oncológico, a redução da qualidade de vida, o aumento de risco para complicações pós-operatórias, aumento do tempo de hospitalização, morbidade e mortalidade (20).

3. Importância da avaliação da nutrição no paciente idoso com câncer

Como apontado anteriormente, o déficit do estado nutricional está estreitamente relacionado com a diminuição da resposta ao tratamento oncológico e da qualidade de vida, com maiores riscos de complicações pós-operatórias, aumento na morbimortalidade, no tempo de internação e no custo hospitalar (21). Desta forma, identificar o risco nutricional neste grupo de pacientes de forma precoce, com o fim de oferecer uma conduta nutricional adequada cujo objetivo é minimizar a desnutrição bem como os efeitos colaterais da terapia se torna de extrema importância e relevância clínica-nutricional (9).

De fato, a avaliação nutricional completa é um dos recursos disponíveis e de fácil aplicabilidade em pacientes com câncer, possibilita reduzir o risco da desnutrição, bem como a síndrome de anorexia-caquexia e as demais manifestações clínicas oriundas da doença e da terapia oncológica (22). A Diretriz Nacional e Internacional, como o Consenso Brasileiro de Nutrição Oncológica da Sociedade Brasileira de Nutrição Oncológica (21) e o *The European Society For Clinical Nutrition* (10), respectivamente, recomendam a utilização de ferramentas de triagem de risco nutricional e de diagnósticos de desnutrição em um período de até 48 horas da internação (10, 21). A partir disso, a avaliação do risco e estado

nutricional do paciente deve ser realizado periodicamente e monitorado para melhor resposta ao tratamento e da intervenção nutricional aplicada (10). Neste sentido, compreender os diferentes tipos instrumentos e, suas especificidades, que podem ser aplicados em distintos grupos de pacientes idosos ou não, é de extrema importância para o sucesso da terapia nutricional. Abaixo apresentaremos as principais ferramentas de triagem e de diagnóstico nutricional. Um quadro resumo dos instrumentos que serão discutidos nesta revisão estão demonstrados na Tabela 1 (Página 30) e Tabela 2 (Página 31).

4. Instrumentos de avaliação de risco nutricional

4.1 Nutritional Risk Screening – 2002 (NRS-2002)

O escore NRS-2002 foi fundamentado em 128 estudos de ensaios clínicos randomizados, realizados com pacientes hospitalizados (23). O rastreamento inicial do risco nutricional desse instrumento é baseado nas variáveis como índice de massa corporal (IMC) <20,5 Kg/m², perda de peso nos últimos três meses, redução na ingestão alimentar na última semana e presença de severidade da doença. Já o rastreamento final é avaliado pela pontuação do estado nutricional e ao aumento das necessidades devido a severidade da doença. A pontuação varia de 0 – 7 pontos, sendo necessário somar 1 ponto quando idade ≥70 anos (23). Desta forma, quando a avaliação pontuar ≥3 pontos, se classifica como presença de risco nutricional (23).

Estudos prévios vêm demonstrando a associação do alto risco nutricional, avaliado pelo NRS-2002, com desfechos clínicos em diferentes grupos de pacientes (24- 26). Estudo de coorte prospectivo realizado em 260 pacientes idosos (≥65 anos) demonstrou que pacientes com risco nutricional (≥3 pontos) apresentaram menor chance para alta hospitalar e maior risco ao óbito (24). Esses dados corroboram em

estudo de coorte prospectivo com 375 pacientes adultos críticos, que demonstrou que o risco nutricional pela NRS-2002 (≥3 pontos) foi associado com o maior risco de mortalidade (25). Em um estudo transversal realizado em 752 pacientes admitidos em uma Emergência no Brasil, foi demonstrado uma associação positiva e significativa entre o alto risco nutricional, de acordo com a NRS-2002 (≥3 pontos) com o maior tempo de permanência hospitalar (aproximadamente 16 dias) e prevalência de mortalidade (26).

Em pacientes oncológicos hospitalizados, a NRS-2002 demonstrou que 32% dos pacientes apresentaram risco nutricional, sendo 18% com escore = 3 e 14% com escore > 3 pontos (27). Estudo prospectivo desenvolvido com 212 pacientes oncológicos hospitalizados mostrou aumento na ingestão alimentar e menor tempo de internação em pacientes que receberam intervenção nutricional após serem classificados como apresentando risco nutricional pela NRS-2002 (28).

Mais recentemente, estudo que avaliou 301 pacientes diagnosticados com câncer colorretal e submetidos à cirurgia, mostrou que o risco nutricional, triado pela NRS-2002, foi um fator de risco independente para complicações pós-operatórias (29). Em pacientes em tratamento combinado de quimioterapia e radioterapia, a NRS-2002 teve um bom desempenho em prever a necessidade de hospitalização, eventos hematológicos adversos e perda de peso. Ainda pacientes em risco nutricional, identificados pela NRS-2002, não finalizaram o tratamento combinado e/ou isolado como a quimioterapia (30).

4.2 Malnutrition Screening Tool (MST)

O MST é um instrumento simples, de fácil e rápida aplicação e pode ser preenchida por qualquer membro da equipe de saúde. Traz questões sobre perda

de peso recente, quantidade de peso perdido e se o paciente apresentou redução da ingesta alimentar por perda do apetite. Pacientes podem apresentar um escore de 0 a 5, aqueles que apresentarem 2 pontos ou mais são classificados com risco nutricional (31).

De acordo com a pesquisa *nutritionDay*, projeto realizado na América Latina, 2 a cada 5 pacientes hospitalizados por diferentes causas estão em risco de desnutrição de acordo com o instrumento MST (32). Em um estudo multicêntrico incluindo 800 pacientes hospitalizados em 4 hospitais da Colômbia, foi demonstrado uma associação positiva e significativa entre risco nutricional, avaliado pelo MST (escore ≥ 2), e maior tempo de hospitalização e maiores taxas de mortalidade (33).

Conforme evidenciado em estudos prévios, em pacientes oncológicos ambulatoriais, o MST é válido, sensível e específico na identificação de desnutrição usando a Avaliação Subjetiva Global Produzida Pelo Paciente (ASG-PPP), ferramenta frequentemente utilizada para avaliar pacientes com câncer (34). Em pacientes idosos com câncer, o risco de desnutrição avaliado pelo MST foi um potencial indicador de mortalidade em 12 meses nos casos em que a quimioterapia foi considerada inviável (35).

4.3 Malnutrition Universal Screening Tool (MUST)

O MUST é uma ferramenta validada em pacientes adultos e é muito utilizada em hospitais e ambulatórios por ser de fácil e rápida aplicação. O escore inclui três parâmetros clínicos: perda de peso, IMC e redução da ingestão alimentar por, pelo menos, cinco dias (36). Os pacientes são categorizados como de baixo risco nutricional se a pontuação for 0 e de risco médio se a pontuação for 1, enquanto uma pontuação de 3 define a desnutrição (36, 37, 38).

Recentemente, um estudo que avaliou 600 pacientes hospitalizados mostrou a associação do MUST com desfechos clínicos desfavoráveis, como tempo de hospitalização prolongado, mortalidade em 6 meses e aumentou o risco de morte intra-hospitalar (39). Em um estudo de coorte prospectiva realizado em pacientes hospitalizados por diferentes causas, mostrou associação entre médio e alto risco nutricional avaliado pelo MUST (escore 1 e escore ≥ 2, respectivamente) e mortalidade em até 6 meses (40).

Em pacientes com câncer, submetidos à cirurgia, o MUST identificou mais de 83% dos pacientes em risco nutricional e foi preditor de morbidade geral pós-operatória, ocorrência de infecção, tempo de internação e mortalidade no pós-operatório (41). Estes dados estão de acordo com estudo realizado em pacientes que realizaram cirurgia de câncer colorretal, que apresentou associação significativa entre risco nutricional, avaliado pelo MUST, com o tempo de hospitalização >7 dias e aumento do risco do no número de mortes em 3 anos (42). Em um estudo de coorte prospectivo com 80 pacientes oncológicos, mostrou que pacientes com uma pontuação que indica um alto risco nutricional (escore ≥ 2), identificado pela MUST, têm um risco significativamente maior de complicações pós-operatórias após ressecção colorretal em comparação àqueles pacientes que apresentaram baixo risco de desnutrição (43).

4.4 Mini Nutritional Assessment Short Form (MNA-SF)

A MNA foi elaborada especificamente para triar e diagnosticar risco nutricional e desnutrição em pessoas idosas (44, 45). Mais tarde, a MNA na sua forma reduzida foi idealizada para gerar praticidade em comparação à ferramenta completa e com o propósito de triagem nutricional, ela aborda questões sobre diminuição da ingesta

alimentar, perda de peso nos últimos 3 meses, mobilidade reduzida, estresse psicológico, problemas neuropsicológicos, como demência ou depressão, e IMC ou circunferência da panturrilha, caso o cálculo do IMC não seja possível. Pacientes que apresentarem 11 pontos ou menos são classificados com risco nutricional (44).

Estudo realizado com mais de 5.500 pacientes idosos hospitalizados, identificou que 46% dos pacientes estavam desnutridos ou em risco de desnutrição, de acordo com a MNA-SF. Pacientes avaliados com escores entre 0 e 7 foram associados a uma probabilidade seis vezes maior de morte, comparados com pacientes com escore entre 12 e 14 (46). Estudo de coorte prospectivo em 536 idosos hospitalizados (≥ 65 anos), acompanhados por aproximadamente 2,5 anos demonstrou que o risco nutricional, pela MNA-SF, foi preditor para o maior de mortalidade neste grupo de pacientes (46).

Revisão sistemática desenvolvida em pacientes com câncer, avaliou a associação da pontuação da MNA-SF e MNA na sua forma longa, a qual avalia a presença da desnutrição, com diferentes desfechos clínicos, e foi demonstrado que pacientes desnutridos tem menores taxas de sobrevivência e menor qualidade de vida comparado aos pacientes bem nutridos (48). Estudo de coorte e multicêntrico que incluiu 44 instituições do Brasil, utilizou a MNA-SF para avaliar a desnutrição em mais de 3.000 pacientes idosos com câncer hospitalizados. Segundo a MNA-SF, 33.4% dos pacientes estavam desnutridos e 39.3% estavam em risco de desnutrição; e foi encontrada associação positiva e significativa entre desnutrição/risco nutricional e maior tempo de hospitalização (18).

4.5 Avaliação Subjetiva Global – Produzida pelo Próprio Paciente (ASG-PPP) versão reduzida

A ASG-PPP versão reduzida (ASG-PPP SF), parte da ASG-PPP completa, tem recebido mais atenção como uma ferramenta de triagem nutricional válida. Ela compreende as primeiras quatro caixas da versão completa da ferramenta, que abordam questões sobre histórico de peso (pontuação de 0 a 5), ingestão alimentar (pontuação de 0 a 4), sintomas de impacto nutricional (pontuação de 0 a 24) e atividades e função (pontuação 0 a 3) (49). A ferramenta gera uma pontuação de 0 a 36 e o pacientes são categorizados em três grupos baseados no resultado de sua avaliação. São classificados como baixo risco (0 a 3 pontos), médio risco (4 a 8 pontos) e alto risco nutricional (≥ 9 pontos) (28).

Estudos vem demostrando a associação desta ferramenta com desfechos clínicos em pacientes com câncer hospitalizados e ambulatoriais (34, 50, 51). Estudo transversal que avaliou 443 pacientes hospitalizados com câncer e com outros diagnósticos clínicos mostrou que o tempo de hospitalização de pacientes com alto risco nutricional, segundo a ASG-PPP SF, foi 36% maior em comparação com pacientes com baixo risco nutricional (50). Em pacientes ambulatoriais com câncer e em tratamento quimioterápico, o risco nutricional, segundo a ASG-PPP SF (≥ 5 pontos), foi associado com o maior risco de mortalidade em 1 ano (aproximadamente 3,5 vezes) quando comparado aos pacientes sem risco nutricional (34). Recente estudo de coorte em pacientes oncológicos idosos (mediana de 4,5 anos de acompanhamento) que avaliou o poder prognóstico da ASG-PPP SF na predição da mortalidade demonstrou que a taxa de mortalidade geral para pacientes com risco nutricional (> 5 pontos) foi de 41,1%, e este foi associado de forma positiva e significativa com pior sobrevida global (51).

4.6 Nutritional screening tool score (NUTRISCORE)

O NUTRISCORE foi desenvolvido por um grupo de pesquisa espanhol para detectar risco nutricional em pacientes adultos ambulatoriais com diagnóstico de câncer sólido e hematológico (52). Para a elaboração do instrumento, a MST foi utilizada como base. Além disso, foram adicionadas variáveis sobre a localização do tumor e tratamento, bem como intervalo de tempo específico nas questões referentes a perda de peso e redução da ingesta alimentar (52). O NUTRISCORE consiste em quatro partes: [1] perda de peso involuntária nos últimos 3 meses, [2] redução da ingesta alimentar devido inapetência na última semana, [3] localização do tumor e, [4] tratamento oncológico. A ferramenta foi desenhada para classificar pacientes oncológicos ambulatoriais de acordo com a presença de risco nutricional usando sistema de pontuação (0 a 11 pontos); pacientes que obtiverem ≥ 5 pontos são considerados com risco, enquanto pacientes que obtiverem < 5 são considerados sem risco nutricional (52).

Estudo multicêntrico com pacientes oncológicos hospitalizados, realizado na China, mostrou que apenas 2,9% dos pacientes apresentaram ≥ 5 pontos com a avaliação do NUTRISCORE, enquanto 36,7% dos pacientes estavam em risco nutricional com a avaliação do MST. Quando avaliado o desempenho, utilizando a ASG-PPP como critério referência, o instrumento NUTRISCORE demonstrou sensibilidade mais baixa do que o MST para diagnosticar risco nutricional (53). Outro estudo que avaliou o NUTRISCORE e MUST em pacientes oncológicos hospitalizados, demonstrou que o tempo de hospitalização dos pacientes em risco nutricional avaliados pelo MUST, foi significativamente mais longo que os pacientes avaliados pelo NUTRISCORE (13,3 *vs.* 7,9 dias; p <0,05) (54).

5. Instrumentos de diagnósticos de desnutrição

5.1 Avaliação Subjetiva Global (ASG)

A ASG foi desenvolvida por Detsky et al. em 1987, com o propósito de não apenas diagnosticar a presença de desnutrição, mas sim identificar aqueles pacientes com maior risco de complicações associadas ao estado nutricional durante sua internação, sendo assim um instrumento tanto prognóstico, como diagnóstico (55). Como critério de referência para o diagnóstico nutricional, a ASG avalia perda de peso, ingestão alimentar, sintomas gastrointestinais e capacidade funcional. Um exame físico também é necessário para avaliar a perda de gordura, perda muscular e retenção de líquidos. Uma classificação A, B ou C indica paciente bem nutrido, moderadamente desnutrido e gravemente desnutrido, respectivamente (55).

Diversos estudos vêm analisando a associação da desnutrição, identificada pela ASG, com desfechos clínicos desfavoráveis (56, 57, 58). Estudo prospectivo em pacientes oncológicos submetidos à cirurgia colorretal demonstrou que desnutrição, identificada pela ASG, se correlacionava positivamente com o maior tempo de hospitalização pós-operatória e taxas gerais de complicações clínicas. Os pacientes bem nutridos (ASG, A) tiveram internações significativamente mais curtas do que aqueles diagnosticados como moderadamente desnutrido e gravemente desnutrido (ASG, B e C) (56, 57). Esses dados corroboram com estudo prévio de coorte prospectivo que avaliou 818 pacientes hospitalizados durante 3 anos. Usando a ASG, 71% dos pacientes foram diagnosticados como bem nutridos e 29% como desnutridos (as categorias moderadamente e severamente foram agrupadas). Os resultados mostraram que os pacientes desnutridos permaneceram no hospital, em média, dois dias a mais e tiveram quase duas vezes mais chances de serem readmitidos em 15 dias após a alta do que os pacientes bem nutridos. Quando

acompanhada por um ano e três anos, a desnutrição aumentou as mortes em quase quatro e três vezes, respectivamente (58).

Em estudo coorte prospectivo que avaliou 234 pacientes com câncer colorretal, pacientes com ASG A (bem nutridos) apresentaram maior tempo de sobrevida que os pacientes com ASG B ou C (desnutrição moderada ou severa), (59). Outro estudo de coorte prospectivo, porém em pacientes com tumores em estágio avançado (III/IV) demostrou que ~82% dos pacientes apresentaram desnutrição, sendo 56% severamente desnutridos (ASG C). Ainda, foi observado que os pacientes severamente desnutridos, segundo a ASG, apresentaram 2,73 vezes mais chance de ir a óbito em um período de seis meses quando comparados a pacientes bem nutridos (ASG A) (60).

5.2 Avaliação Subjetiva Global – Produzida pelo Próprio Paciente (ASG-PPP)

A partir da ASG, Ottery criou em 1996 uma adaptação específica para a população oncológica: a ASG-produzida pelo próprio paciente (PPP) (22). Esse instrumento é considerado um critério referência para o diagnóstico do estado nutricional em indivíduos com câncer, em razão da avaliação mais direcionada sobre sintomas do tratamento oncológico que causam impacto na nutrição e, na sua sensibilidade na predição de complicações clínicas (61).

Este instrumento é composto por duas partes: [1] uma seção com quatro perguntas a serem respondidas pelo paciente e uma para o profissional de saúde responder. A seção preenchida pelo paciente considera histórico de peso, presença de sintomas relacionados à nutrição, ingestão alimentar e nível de capacidade funcional; [2] as seções preenchidas por um profissional de saúde incluem uma avaliação da demanda metabólica, presença de doença e sua relação com as

necessidades nutricionais, além de elementos do exame físico. Além disso, a ferramenta fornece uma pontuação numérica que orienta o nível de intervenção nutricional necessária, com uma pontuação mais alta indicando maior risco de desnutrição (22). As classificações A, B e C indicam que o paciente está bem nutrido, moderadamente desnutrido e gravemente desnutrido, respectivamente.

Apesar de ser amplamente utilizada em pacientes oncológicos, a ASG-PPP também é usada em diversos outros públicos, como pacientes com tuberculose e em pacientes com AVC. Estudo avaliou a validade da ferramenta em pacientes com tuberculose e demonstrou que pontuações > 6 foram fator de risco para lesões hepáticas e para mortalidade nesses pacientes (62). Outro estudo avaliou a associação da desnutrição, segundo a ASG-PPP, com desfechos desfavoráveis em pacientes hospitalizados com acidente vascular agudo. Em comparação com pacientes bem nutridos, os pacientes desnutridos apresentaram maior tempo de internação (13 *vs.* 8 dias), aumento de complicações (50% *vs.* 14%), aumento da frequência de disfagia (71% *vs.* 32%) e uso de nutrição enteral (93% *vs.* 59%) (63).

Em 2021, a Sociedade Brasileira de Nutrição Oncológica (SBNO) em sua diretriz recomenda o uso da ASG-PPP como padrão ouro para pacientes oncológicos (21). Em uma revisão sistemática que avaliou 29 estudos em pacientes hospitalizados com câncer (n = 20,441) demonstrou que o ASG-PPP foi um instrumento eficaz para avaliar desfechos clínicos desfavoráveis como tempo de internação prolongada e mortalidade (20). Estudo de coorte que acompanhou por 12 meses mulheres com câncer ginecológico, demonstrou que o maior tempo de hospitalização e as maiores taxas de mortalidade foram observadas em pacientes com desnutrição moderada ou grave, segundo a ASG-PPP, em comparação com pacientes bem nutridas (64). Mais recentemente, em 633 idosos com câncer, estudo

multicêntrico mostrou que pacientes avaliados pela ASG-PPP e com diagnóstico de desnutrição moderada e severa, tiveram 24 vezes mais chance de ter infecções locais e sistêmicas, quando comparados a pacientes bem nutridos (65).

5.3 Global Leadership Initiative on Malnutrition (GLIM)

Os critérios para diagnóstico de desnutrição do *Global Leadership Initiative on Malnutrition* (GLIM) foram estabelecidos a partir de um consenso entre representantes das principais sociedades de nutrição clínica globais: *American Society for Parenteral and Enteral Nutrition* (ASPEN), *European Society for Clinical Nutrition and Metabolism* (ESPEN), *Federación Latinoamericana de Terapia Nutricional, Nutrición Clínica y Metabolismo* (FELANPE) e *Parenteral and Enteral Nutrition Society of Asia* (PENSA), ao longo de diversos encontros entre os anos 2016 -2018. O objetivo foi desenvolver critérios globais, baseados em evidência e de fácil aplicação por todos os profissionais de saúde para o diagnóstico de desnutrição em pacientes adultos no cenário clínico (66).

A aplicação dos critérios GLIM é feita em duas etapas. Inicialmente é realizada a triagem nutricional do paciente, utilizando ferramenta validada que mais se adapte ao contexto clínico. Posteriormente é realizada avaliação diagnóstica e classificação da gravidade da desnutrição. Os critérios de classificação da desnutrição são divididos em três fenotípicos (perda de peso não voluntária, índice de massa corporal (IMC) e massa muscular reduzida) e dois etiológicos (ingestão alimentar reduzida e inflamação ou gravidade da doença). Sendo necessária presença de pelo menos um critério fenotípico e um critério etiológico para diagnóstico de desnutrição. Finalmente, os critérios fenotípicos são utilizados para classificação do grau de

desnutrição (66). Mais recentemente, o GLIM discute técnicas de avaliação, em pacientes hospitalizados, da massa muscular nos seus critérios fenotípicos (67).

Os critérios do GLIM foram validados em diferentes grupos. Em pacientes hospitalizados com diferentes diagnósticos clínicos a prevalência da desnutrição, segundo o GLIM foi de 41,6% e este instrumento apresentou validade satisfatória para diagnosticar desnutrição neste grupo de pacientes (68). A presença de desnutrição diagnosticada pela ferramenta foi associada ao risco de mortalidade intra-hospitalar e tempo de hospitalização prolongado (68). Em pacientes com câncer, o GLIM foi uma ferramenta eficaz para avaliar o estado nutricional e prever a sobrevida (12, 69). Além disso, o diagnóstico de desnutrição de acordo com o GLIM foi associado a maiores custos de internação e tempo de internação (70). Já em pacientes idosos com câncer, a desnutrição, usando os critérios GLIM, foi associada a uma taxa de sobrevida diminuída (69).

6. Complementariedade de instrumentos de avaliação nutricional

Estudos recentes têm demonstrado que pode ser mais eficaz e eficiente usar uma combinação de instrumentos para obter uma avaliação mais completa e precisa do risco e do estado nutricional em diferentes grupos de pacientes.

De acordo com estudo em pacientes adultos hospitalizados que avaliou o uso da NRS-2002 e do MUST como ferramenta de risco nutricional para primeira etapa dos critérios GLIM, mostrou que a NRS-2002 é mais precisa em identificar desnutrição que o MUST (71). Isso pode ser explicado pelo fato que há quatro indicadores na ferramenta que estão relacionadas ao GLIM, enquanto somente três indicadores do MUST estariam relacionados aos critérios propostos pelo GLIM (71). Já em pacientes idosos hospitalizados, o instrumento de triagem nutricional MUST

foi considerado superior a NRS-2002 na detecção de desnutrição em pacientes idosos hospitalizados diagnosticados pelos novos critérios GLIM (37).

Um estudo prévio desenvolvido em 705 pacientes com diferentes doenças que avaliou a complementaridade da NRS-2002 com a ASG, demonstrou que a aplicação concomitante destes dois instrumentos pode aumentar a capacidade de prever desfechos clínicos ruins em pacientes hospitalizados (72). Em 384 pacientes criticamente doentes estudo prospectivo demonstrou que a ferramenta, NRS-2002 combinada com o instrumento específico para esta população, o *Nutrition Risk in the Critically ill* (NUTRIC), demonstrou um bom desempenho para predizer o desfecho mortalidade hospitalar (73).

Mais recentemente, um estudo longitudinal avaliou a complementaridade das ferramentas de triagem nutricional aos critérios GLIM no diagnóstico de desnutrição em pacientes 601 hospitalizados (39). Neste estudo, em sua maioria oncológicos (53,7%), média de idade de 56 anos e 70,2% submetidos a tratamento cirúrgico, a ferramenta MUST apresentou as maiores métricas de acurácia em comparação com os critérios GLIM e foi um preditor independente de piores desfechos clínicos, como tempo de hospitalização prolongado, readmissão e mortalidade, quando o risco nutricional foi combinado ao diagnóstico de desnutrição (39).

A avaliação do risco e estado nutricional, de forma isolada e concomitante possibilitam identificar os indivíduos que necessitam de intervenção nutricional, para que a terapia possa ser iniciada o mais precocemente possível, a fim de reduzir a gravidade do quadro, auxiliar na evolução do tratamento, aliviar os sintomas e reduzir a morbimortalidade, o diagnóstico correto permite tomar as medidas de intervenção adequadas (74). Contudo, poucos estudos em pacientes com câncer, em especial pacientes idosos, avaliaram a complementariedade de instrumentos de risco

nutricional e ferramentas de diagnóstico de desnutrição e sua capacidade de predição de desfechos clínicos desfavoráveis.

7. Justificativa e objetivos

Pacientes com câncer são frequentemente desnutridos, e a desnutrição está associada à localização, estadiamento do tumor e efeitos adversos da terapia antineoplásica. Em idosos, essa manifestação é mais prevalente em decorrência das alterações biológicas típicas do envelhecimento, aliadas à redução da estrutura musculoesquelética, dos órgãos e dos fluidos corporais (75). Para avaliar o estado nutricional dessa população, vários parâmetros devem ser considerados, incluindo avaliação física, laboratoriais, clínicas, dietéticas e antropométrica (76). A importância de rastrear pacientes com câncer para desnutrição desde o início é bem estabelecida, uma vez que a maioria destes pacientes sofrem uma importante perda de peso e de massa muscular, o que pode limitar a resposta aos tratamentos propostos (8).

Diante dos expostos, em pacientes adultos e idosos com câncer, evidências científicas mostram associação positiva entre alto risco e pior estado nutricional, identificado por diferentes ferramentas, com desfechos clínicos desfavoráveis (33, 58, 65). De fato, estudos vêm descrevendo a importância da avaliação nutricional em pacientes idosos com câncer, onde demostraram uma associação da desnutrição com maiores taxas de complicações relacionadas ao câncer, maior tempo internação e periodicidade de reinternação hospitalar (46, 65). Instrumentos como a NRS-2002, ASG e ASG-PPP são eficazes para avaliar desfechos clínicos desfavoráveis em pacientes hospitalizados com câncer (20). No entanto, os dados na população idosa com câncer ainda são limitados (77). Ainda, mais recentemente, estudos vêm

descrevendo a importância da associação de distintos instrumentos para complementar a avaliação nutricional em estudos em diferentes grupos de pacientes (39, 72). Até o momento não há estudo que avaliou a complementariedade dos principais instrumentos de risco e de diagnóstico nutricional em pacientes idosos oncológicos hospitalizados.

Neste sentido, considerando que a desnutrição é frequentemente relatada em pacientes idosos com câncer e está associada a piores desfechos clínicos (37) e que estudos sobre a complementaridade neste grupo de indivíduos ainda estão sendo explorados, este estudo teve como objetivos: [1] analisar a complementaridade de cinco instrumentos de risco nutricional (NRS-2002, MST, MUST, MNA-SF e ASG-PPP SF) combinados com três ferramentas de diagnóstico de desnutrição (ASG, ASG-PPP e GLIM) e, [2] a capacidade destes instrumentos, na sua forma isolada e combinada, de prever os desfechos clínicos como tempo de internação prolongada e reinternação em 60 dias em pacientes idosos com câncer.

Tabela 1. Instrumentos comuns de triagem nutricional para pacientes hospitalizados

Instrumento	População	Características do instrumento	Interpretação do resultado
NRS-2002[23]	Pacientes hospitalizados (adultos e idosos)	Baseada em 2 etapas: (1) IMC < 20,5 kg/m2, perda de peso nos últimos três meses, redução da ingestão alimentar na semana anterior e presença de doenças graves; (2) cálculo dos escores do estado nutricional e da gravidade da doença. Idade ≥ 70 anos 1 ponto é adicionado ao escore. Considerada o critério referência de triagem nutricional.	<3 sem risco nutricional; ≥3 em risco nutricional.
MST[31]	Pacientes adultos	Redução de peso e redução do apetite	≥ 2 pontos = risco nutricional
MUST[36]	Pacientes adultos	IMC, porcentagem de perda de peso não intencional nos últimos 6 meses e estimativas do efeito da doença na ingestão alimentar	1 ponto = risco nutricional médio ≥ 2 pontos = alto risco nutricional
MNA-SF[44,45]	Pacientes idosos	Redução da ingesta alimentar devido perda do apetite, perda de peso nos últimos 3 meses, mobilidade, estresse psicológico, demência ou depressão, IMC ou CP.	12 – 14 pontos = sem risco 8 – 11 pontos = risco nutricional 0 – 7 pontos = desnutrido
ASG-PPP Reduzida[49]	Pacientes com câncer	Histórico de peso em 1 e 6 meses, ingestão alimentar, sintomas de impacto nutricional, atividade e função *(Preenchido pelo Próprio Paciente)*	0 – 3 pontos = baixo risco 4 – 8 = médio risco ≥ 9 pontos = alto risco

Abreviações: NRS-2002: *Nutritional Risk Screening-2002*; MST: *Malnutrition Screening Tool*; MUST: *Malnutrition Universal Screening Tool*; MNA-SF: *Mini Nutritional Assessment Short-Form*; ASG-PPP reduzida: Avaliação Subjetiva Global Produzida Pelo Paciente versão reduzida; IMC: Índice de Massa Corporal; CP: Circunferência da Panturrilha.

Tabela 2. Instrumentos comuns de diagnóstico de nutrição para pacientes hospitalizados

Instrumento	População	Características do instrumento	Interpretação do resultado
ASG[55]	Pacientes adultos e idosos com diferentes contextos clínicos	História clínica (histórico de perda de peso, mudanças na ingestão alimentar, sintomas gastrointestinais persistentes por mais de 2 semanas e capacidade funcional) e exame físico (gordura subcutânea, perda de massa muscular, tornozelo e edema sacral e ascite). Considerado critério referência de diagnóstico de desnutrição.	A = bem nutrido B = moderadamente (ou suspeito de ser) desnutrido C = gravemente desnutrido
ASG-PPP[22]	Pacientes com câncer	Consiste em duas seções: Componentes preenchidos pelo paciente e pelo profissional de saúde. Os componentes preenchidos pelo paciente incluem quatro aspectos: perda de peso, sintomas de impacto nutricional, ingestão de alimentos e capacidade funcional. O componente preenchido pelo profissional de saúde avalia três aspectos (doença e idade, estresse metabólico e exame físico).	A = bem nutrido B = moderadamente (ou suspeito de ser) desnutrido C = gravemente desnutrido
GLIM[66]	Pacientes adultos e idosos em diferentes contextos clínicos.	Critérios fenotípicos: Perda involuntária de peso corporal, IMC, baixa massa muscular. Critérios etiológicos: baixa ingestão alimentar, doença/inflamação	Após a triagem de desnutrição com ferramenta validada, se um paciente for considerado de risco, dever ser realizada uma avaliação clínica mais abrangente. Para diagnosticar a desnutrição, o consenso GLIM considerou a presença de pelo menos um critério fenotípico e um etiológico. A = bem nutrido B = moderadamente (ou suspeito de ser) desnutrido C = gravemente desnutrido

Abreviações: ASG: Avaliação Subjetiva Global; ASG-PPP: Avaliação Subjetiva Global Produzida Pelo Paciente; GLIM: *Global Leadership Initiative on Malnutrition*

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CAPÍTULO II

ARTIGO ORIGINAL

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Complementarity of nutritional assessment tools to predict prolonged hospital stay and readmission in older patients with solid tumors: a secondary analysis of a cohort study.

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Highlights

- To our knowledge, this is the first study to assess the complementarity of five nutritional risk screening tools with three nutritional assessment tools and their ability to predict outcomes in older patients with solid tumors.
- Nutritional Risk Screening 2002 combined with Subjective Global Assessment (SGA) and Malnutrition Screening Tool combined with SGA and Global Leadership Initiative on Malnutrition had the best satisfactory specificity to predict hospitalization.
- The concomitant application of the Mini Nutritional Assessment-Short Form and the Patient-Generated SGA may increase the ability to predict prolonged length of stay and readmission.

Abstract

Objective: To investigate the complementarity of five nutritional risk screening tools (Nutritional Risk Screening 2002 [NRS 2002], Malnutrition Screening Tool [MST], Malnutrition Universal Screening Tool [MUST], Mini Nutritional Assessment-Short Form [MNA-SF], and Patient-Generated Subjective Global Assessment SF [PG-SGA SF]) combined with three malnutrition diagnostic tools (SGA, PG-SGA, and Global Leadership Initiative on Malnutrition [GLIM]) and their ability to predict poor clinical outcomes in older patients with cancer.

Methods: A prospective cohort study was conducted using data collected within 48 hours of hospital admission on nutritional risk (NRS 2002, MST, MUST, MNA-SF, and PG-SGA SF) and presence of malnutrition (SGA, PG-SGA, and GLIM). The patients were grouped according to nutritional risk and malnutrition status. Accuracy tests and logistic regression analysis were used to evaluate the ability of combined tools to predict hospital length of stay (LOS) and readmission.

Results: 248 older patients were evaluated (69.7 ± 7.2 years of age, 59.7% male; 27.4% with gastrointestinal tumor). The median LOS was 4 (3–9) days, and 65.3% of patients remained hospitalized for ≥ 4 days. NRS 2002 combined with SGA and MST combined with SGA and GLIM had the best satisfactory specificity (> 80%) to predict hospitalization. Nutritional risk assessed by MNA-SF and malnutrition by PG-SGA were associated with 2.48- and 6.04-fold increased likelihood of hospitalization (≥ 4 days) and readmission (60 days), respectively.

Conclusion: The concomitant application of MNA-SF (specific for older patients) with PG-SGA (specific for patients with cancer) might enhance the ability to predict LOS and readmission in hospitalized older patients with solid tumors.

Keywords: *Cancer; Malnutrition Complementarity; Nutritional Screening; Nutritional Assessment; Clinical Outcomes.*

Introduction

Cancers such as gastrointestinal and lung are most prevalent in the population aged 60 and over, population aging and the increase in lifestyle risk factors are among the main causes [1]. Furthermore, patients with cancer are at high risk of malnutrition, often associated with the presence of cachexia, sarcopenia, and frailty [2]. In fact, malnutrition is prevalent due to a combination of effects related to disease progression, host response to tumor, and adverse effects of treatment [3]. It is also more common in older patients with solid tumors (~20% – 50%), given that aging is characterized by physiological and body composition changes that result in reduced lean mass and functional capacity [4,5]. This situation can lead to prolonged hospital length of stay (LOS), reduced quality of life, and decreased tolerance to cancer treatment [6].

The American Society for Parenteral and Enteral Nutrition (ASPEN) and the European Society for Clinical Nutrition and Metabolism (ESPEN) recommend screening all patients with cancer for nutritional risk within 48 hours of hospital admission, followed by a comprehensive nutritional assessment if the patient is at high risk of malnutrition [7,8]. The main validated screening tools in hospitalized patients are: (1) Nutritional Risk Screening 2002 (NRS 2002) – designed to include measures of current malnutrition as well as disease severity [9]; (2) Malnutrition Screening Tool (MST) – one of the most widely used screening tools, it is based on only two questions about weight change and loss of appetite [10]; (3) Malnutrition Universal Screening Tool (MUST) – specifically validated in patients with cancer [11]; (4) Mini Nutritional Assessment – Short Form (MNA-SF) – developed to assess nutritional risk particularly in older patients [12]; and (5) Patient-Generated Subjective Global Assessment SF (PG-SGA SF) – specifically designed for patients with cancer [13]. For a comprehensive nutritional assessment in patients with cancer, it is recommended that one of the following tools be used: SGA – considered the reference method [14]; PG-SGA – adapted from the SGA and developed specifically for individuals with cancer [15]; or the Global Leadership Initiative on Malnutrition (GLIM) – a new framework for diagnosing malnutrition [16].

In adult patients with cancer, scientific evidence shows a positive association of high nutritional risk and poor nutritional status, as identified by different tools, with unfavorable clinical outcomes, such as increased LOS and readmission [17,18]. A recent systematic review including 20,441 individuals showed that tools such as the

NRS 2002, SGA, and PG-SGA are effective in assessing unfavorable clinical outcomes in hospitalized patients with cancer [19]. However, data on the older population with cancer are still limited [20].

The complementarity of nutritional assessment tools has been recently considered in studies of general ward patients [21,22] and intensive care unit patients [23]. A prospective study of 705 adult patients evaluating the complementarity of NRS 2002 and SGA showed that these tools were able to predict unfavorable clinical outcomes [21]. A longitudinal study evaluating the use of five nutritional risk screening tools with GLIM in 601 hospitalized patients (50% with cancer) showed that MUST had the best metrics of accuracy compared with the GLIM criteria, suggesting that MUST can be applied in the first step of the GLIM approach for malnutrition diagnosis [22]. A prospective study of 384 critically ill patients demonstrated that the Nutrition Risk in Critically ill (NUTRIC) and NRS 2002 scores performed similarly in predicting in-hospital mortality [23].

Considering that malnutrition is commonly reported in older patients with cancer and associated with poor clinical outcomes [24] and that studies on the complementarity of nutritional assessment tools in this group of patients are still scarce, the current study aimed to analyze the complementarity of five nutritional risk screening tools (NRS 2002, MST, MUST, MNA-SF, and PG-SGA SF) combined with three malnutrition diagnostic tools (SGA, PG-SGA, and GLIM) and their ability to predict unfavorable clinical outcomes, such as LOS and 60-day readmission, in older patients with solid tumors.

Material and methods

Study design and participants

This study is a second part of a cohort study that included patients' adults and older with different types of cancer [25]. Eligible participants were all patients aged ≥ 60 years, of both sexes, with solid tumors who were alert, oriented, speaking coherently, and able to communicate and to undergo anthropometric measurements. Patients in the emergency department or intensive care unit, receiving palliative care, and those with COVID-19 were excluded. The hospital's ethics committee approved the study (protocol number #2019.0708), and all participants included in the study provided written informed consent before data collection. This study was developed

in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement. The patient selection flowchart is shown in **Figure 1**.

Data collection

Data were collected from electronic medical records and at the patient's bedside within the first 48 hours of hospital admission by trained researchers. General and clinical characteristics were collected from the electronic records, including cancer type and stage, treatment, and chronic diseases.

Outcomes

Patients were followed until hospital discharge, and the electronic health records were reviewed to collect data on the outcomes of interest, which included LOS (days), 30-day and 60-day hospital readmission, and 30-day and 60-day in-hospital mortality. LOS was calculated in days from the date of admission to the date of discharge. Prolonged hospitalization was defined as LOS ≥ 4 days (the median value was used for this categorization).

Nutritional characteristics

Patients were weighed on hospital admission and asked about weight loss prior to hospitalization at the time of the interview. Body mass index (BMI) was calculated as weight (kg) divided by the square of the height (m^2). The percentage of body weight loss was calculated as follows: ([usual body weight − current body weight] × 100/usual body weight), and the result was expressed as a percentage.

Nutritional risk screening

Nutritional risk screening was conducted using five tools: NRS 2002 [9], MST [10], MUST [26], PG-SGA SF [13], and MNA-SF [12].

The NRS 2002 rates patients' nutritional risk according to unintentional weight loss in the last 3 months, reduced food intake, BMI < 20.5 kg/m², disease severity, and age > 70 years, which is considered an additional risk factor. The MST considers recent unintentional weight loss, amount of weight loss (kg), and reduced food intake due to decreased appetite. The MUST considers BMI < 20 kg/m², involuntary weight loss in the last 3 to 6 months, and disease impact on food intake. The PG-SGA SF, the abbreviated version of the PG-SGA and therefore used as a nutritional risk

screening tool, is completed by the patient and provides information on weight in the last 6 months, food intake, nutrition impact symptoms, and functional capacity. Finally, the MNA-SF is a specific tool for older patients that includes reduced food intake and amount of weight loss (kg) in the last 3 months, limited mobility, psychological stress or acute disease, neuropsychological problems, and BMI < 23 kg/m² or calf circumference (CC) < 31 cm as an alternative measure. The following cutoff scores were considered to indicate nutritional risk: NRS 2002 ≥ 3 [9], MST ≥ 2 [10], MUST ≥ 1 [26], PG-SGA SF ≥ 4 [27], and MNA-SF ≤ 11 [28]. Supplementary Table S1 presents the main characteristics of each nutritional risk screening tool.

Malnutrition diagnosis

Malnutrition diagnosis was made using three tools: SGA [14], PG-SGA [15], and GLIM criteria [16].

The SGA is considered the reference method for nutritional assessment and classifies patients based on weight loss in the last 6 months, reduced food intake, gastrointestinal symptoms, functional capacity, metabolic demand, and muscle wasting and loss of subcutaneous fat. Patients were assigned a rating of A, B, or C indicating well-nourished, moderately malnourished or suspected malnutrition, and severely malnourished, respectively [14].

The PG-SGA was adapted from the SGA for specific use in oncology. It relies on the patient-generated components (weight history, food intake, nutrition impact symptoms, and functional capacity) and on the professional component completed by the researchers (diagnosis, age, metabolic stress, and physical examination). Patients were categorized as well-nourished (category A), moderately malnourished or suspected malnutrition (category B), or severely malnourished (category C). Considering nutritional assessment, patients moderately and severely malnourished according to the SGA and PG-SGA were grouped as with malnutrition [15].

The GLIM criteria classify as malnourished the patients who present with the combination of at least one of three phenotypic criteria (weight loss >5% within the past 6 months or >10% beyond 6 months; BMI <20kg/m² if <70 years, or <22kg/m² if >70 years; and low muscle mass by reduced CC ≤ 34 cm or ≤ 33 cm for men and woman, respectively (adjusted for BMI) [29, 30]; and at least 1 of the 2 etiological criteria: reduced food intake or assimilation, determined by qualitative evaluation based on patients self-reported percent of actual intake (100%, 75%, 50%, 25%, or

0%) compared to their usual intake, in the last two weeks and/or gastrointestinal symptoms that impact food intake or absorption (nausea, vomiting, diarrhea or constipation); and inflammation by disease burden, in this study, all patients classified due to malignant disease [16]. The remaining participants were classified as well-nourished. **Supplementary Table S1** presents the main characteristics of each malnutrition diagnostic tool.

Assessment of muscle mass and function and functional capacity

Muscle function was measured with a hydraulic dynamometer (Jamar®), and patients underwent three consecutive hand grip strength (HGS) tests, in a seated position, with their elbow bent at a 90° angle. The highest of the three measurements was recorded, and low muscle function was defined as HGS ≤ 16 kg for women and HGS ≤ 27 kg for men [31].

Muscle mass was calculated by CC measurement. With the patient standing upright with legs apart, a non-stretchable measuring tape (Cescorf®, Brazil) was used to measure the calf region of greatest prominence. CC values were adjusted for BMI to help remove the confounding effects of adiposity: the measured value was decreased by 3 cm if BMI 25–30 kg/m² or 7 cm if BMI 30–40 kg/m² [29], and the cutoff value for muscle loss was CC ≤ 33 cm for women and CC ≤ 34 cm for men [30].

Functional capacity was evaluated by the Eastern Cooperative Oncology Group – Performance Status (ECOG-PS) scale, which classifies patients into 5 grades: (0) fully active, (1) restricted in physically strenuous activity, (2) capable of all self-care, (3) capable of only limited self-care, and (4) completely incapable of any self-care [32].

Treatment symptoms, nutritional effects, and diet characteristics during hospitalization

The main symptoms of cancer treatment that can have a nutritional impact were identified during history taking by the researchers: changes in appetite, weight loss, xerostomia, nausea, and constipation.

Information about diet characteristics during hospitalization were collected from the patients' electronic medical records and included route for diet administration, supplementation, and main nutritional composition regarding calories and proteins (kg/weight).

Statistical analysis

This study is a second part of a cohort study that included patients adults and olders with different types of cancer admitted to a university hospital [25].

Continuous variables were expressed as mean and standard deviation (SD) or median (p25–p75). Categorical variables were expressed as absolute (n) and relative (%) frequencies. The normality of the data was assessed by the Kolmogorov-Smirnov test.

The complementarity of nutritional assessment tools was evaluated as follows: (1) patients were grouped as either with or without nutritional risk according to each screening tool, and as either with or without malnutrition according to the malnutrition diagnostic tools; (2) we constructed a variable with three categories referring to the complementarity of nutritional risk and malnutrition diagnosis, eg, NRS 2002 combined with SGA, PG-SGA, and GLIM criteria; as a result, 15 combinations were generated between the tools.

Receiver operating characteristic (ROC) curves with a 95% confidence interval (CI), area under the curve (AUC), sensitivity, specificity, and positive and negative predictive values were estimated to evaluate accuracy of the tools, alone or combined, in predicting LOS ≥ 4 days and 60-day readmission. Prediction accuracy was classified based on the AUC values as follows: 0.5–0.6 as very poor; 0.6–0.7 as poor; 0.7–0.8 as moderate; 0.8–0.9 as good; and > 0.9 as excellent [33]. In addition, sensitivity and specificity values > 80% indicated satisfactory concurrent validity [34].

Logistic regression models were developed considering prolonged hospitalization (LOS ≥ 4 days) and readmission (60 days) as the dependent variables to calculate odds ratio (OR) and respective 95% CIs in order to investigate the association of the tools, alone or combined, with clinical outcomes in hospitalized older patients with cancer. All models were adjusted for age, sex, type of cancer, presence of metastasis, and chronic diseases.

Data were analyzed using MedCalc Software (version 20.116) and IBM SPSS (version 25.0). A *P* value of < 0.05 was considered statistically significant.

Results

General and clinical characteristics and clinical outcomes

A total of 248 hospitalized older patients with solid tumors were included in the study, and their general and clinical characteristics are described in **Table 1**. Mean patient age was 69.7 (SD, 7.2) years, 59.7% were male (n = 148), 89.5% were white (n = 221), and 60.1% had ≤ 8 years of schooling (n = 149). Regarding patients' lifestyle, 52% were smokers and 75% were physically inactive. The most common types of cancer were those of the gastrointestinal tract (27.4%), head and neck (16.9%), liver (8.9%), and lung (7.7%). Other types accounted for 39.1% and included bladder cancer, gynecologic cancer, breast cancer, skin cancer, prostate cancer, kidney cancer, and sarcoma. Regarding cancer treatment, 60.9% of patients underwent surgery, 4.8% received chemotherapy, 1.6% received radiotherapy, and 16.9% received combined treatment (surgery, chemotherapy, and/or radiotherapy). Also, 22.2% of patients were diagnosed with advanced cancer (stage III/IV) and 22.6% had metastatic tumors. As for comorbidities, 62% of patients had hypertension, 24.6% had diabetes, and 16.5% had cardiovascular disease.

Regarding clinical outcomes, patients had a median LOS of 4 (3–9) days, 65.3% remained hospitalized for ≥ 4 days, and 14.1% and 10.3% were readmitted within 30 and 60 days, respectively. The overall in-hospital mortality rate was approximately 2.0%.

Nutritional characteristics

Table 2 describes nutritional characteristics. Mean patient weight was 71.9 (SD, 15.6) kg and BMI was 26.4 (SD, 4.8) kg/m²; 16.9% (n = 42) were malnourished, 44.4% (n = 110) were overweight, and 45.6% (n = 90) had weight loss > 5% in the last 3 months.

A high nutritional risk was observed in 38.7% of patients by NRS 2002, 34.7% by MST, 53.6% by MUST, 66.9% by PG-SGA SF, and 71.0% by MNA-SF. Malnutrition was identified in 52.4% of patients (n = 130) by SGA, 84.7% (n = 210) by PG-SGA, and 72.6% (n = 180) by the GLIM criteria. **Figure 2** shows the prevalence of nutritional risk and malnutrition according to the different assessment tools.

Regarding muscle mass and function, 43.2% of male patients had low HGS and 60.1% had reduced CC. Among women, 66.0% had low HGS and 59.0% had reduced CC. In addition, 15.3% of patients had limited functional capacity, as identified by ECOG-PS (score ≥ 3).

The most common symptoms of cancer treatment that could have a nutritional impact on patients were changes in appetite (31.5%), xerostomia (29.0%), loss of appetite (25.4%), nausea (19.0%), and constipation (16.9%). Regarding diet characteristics during hospitalization, 87.8% of patients received oral nutrition, 70.9% had a regular diet prescription, and 4.1% used nutritional supplements. Only 6.5% of patients received enteral nutrition and 0.8% received oral and enteral nutrition. The mean prescribed energy intake was 27.9 (SD, 9.4) kcal/kg, and the median prescribed protein intake was 1.3 (1.0–1.5) g/kg/day.

Complementarity of nutritional assessment tools for prediction of clinical outcomes

Table 3 shows the accuracy of nutritional risk screening tools alone and combined with malnutrition diagnostic tools in predicting hospitalization (**Figure 3**) and readmission (**Figure 4**). All tools, alone or combined, performed similarly in predicting hospitalization (LOS ≥ 4 days) and readmission (60 days). However, NRS 2002 combined with SGA as well as MST combined with SGA and GLIM had the best satisfactory specificity (> 80%) to predict hospitalization. Regarding 60-day readmission, all tools, alone or combined, had high negative predictive values (> 90%); the MNA-SF alone and in combination with the PG-SGA showed the highest sensitivity (92%). **Supplementary Table S3** summarizes the best specificity and sensitivity values of the tools to predict outcomes.

Association of nutritional risk assessed by five screening tools and malnutrition assessed by three diagnostic tools with clinical outcomes

According to the logistic regression model (**Table 4**) adjusted for age, sex, type of cancer, presence of metastasis, and comorbidities, nutritional risk assessed by NRS 2002 in combination with malnutrition assessed by SGA, PG-SGA, and GLIM was positively associated with LOS ≥ 4 days. A high nutritional risk according to the MST combined with PG-SGA and GLIM was associated with an approximately 2.1-fold increased likelihood of hospitalization. The MUST alone and combined with the PG-SGA also had a positive and significant association with hospitalization. The MNA-SF (specific for older patients) combined with SGA (reference method) and PG-SGA (recommended for patients with cancer) showed the strongest associations. In fact, nutritional risk assessed by MNA-SF and malnutrition by PG-SGA were

associated with 2.48- and 6.04-fold increased likelihood of hospitalization (LOS ≥ 4 days) and readmission (60 days), respectively.

Discussion

To our knowledge, this is the first study to assess the complementarity of five nutritional risk screening tools (NRS 2002, MST, MUST, PG-SGA SF, and MNA SF) with three nutritional assessment tools (SGA, PG-SGA, and GLIM criteria) and their ability to predict LOS and readmission in hospitalized older patients with solid tumors.

The current study demonstrated that NRS 2002 combined with SGA as well as MST combined with SGA and GLIM had the best satisfactory specificity (> 80%) to predict hospitalization. Nevertheless, according to the logistic regression analysis, MNA-SF (specific for older patients) combined with SGA (reference method) and PG-SGA (recommended for patients with cancer) showed the strongest associations with poor clinical outcomes: hospital LOS ≥ 4 days and 60-day readmission.

Prevalence of nutritional risk

The prevalence of nutritional risk as assessed by five screening tools ranged from 34.7% (MST) to 71.0% (MNA-SF). The rate of nutritional risk in hospitalized patients described in previous studies ranges from 15.4% to 81.7% [35,36]. In our study, the MNA-SF was the tool that best identified nutritional risk and it is specific for older patients. Similar data have been reported in studies of hospitalized patients with and without cancer [4,37]. An observational study of 2970 hospitalized patients (mean age, 55 years) showed a nutritional risk assessed by MNA-SF of 60.5% [37]. In 3061 older patients with cancer (aged ≥ 65 years), nutritional risk assessed by MNA-SF was approximately 73% [4]. The PG-SGA SF was the second tool that best identified the presence of nutritional risk (~67% of patients). This tool is specific for patients with cancer and assesses the signs and symptoms that can have a nutritional impact [13]. A cohort study evaluating nutritional risk in older patients with cancer reported that 31.5% of patients were considered malnourished according to the PG-SGA SF and that high nutritional risk was associated with the presence of metastasis, reporting loss of appetite and nausea as the most frequent nutrition impact symptoms [38]. In our study, approximately 22% of patients were diagnosed with tumor stage III/IV and metastasis, with loss of appetite (31.5%) and nausea (19%) also being observed in our group of older patients.

Prevalence of malnutrition

In the current study, the presence of malnutrition was assessed by three tools: SGA, PG-SGA, and GLIM criteria, with the highest rate of malnutrition being identified by PG-SGA. The SGA is considered the reference method and evaluates patients based on clinical history (history of weight loss, changes in dietary intake, gastrointestinal symptoms persisting for > 2 weeks, and functional capacity) and physical examination (loss of subcutaneous fat, muscle wasting, ankle edema, sacral edema, and ascites) [14]. In our sample, the SGA identified 52.4% of older patients as malnourished. Studies of hospitalized patients without cancer have reported a prevalence of malnutrition, assessed by SGA, ranging from 33.9% [39] to 39% [21]. Among patients with cancer, particularly those with advanced cancer (stage III/IV), the malnutrition rate is as high as 81.6% according to the SGA [40]. The PG-SGA is specifically designed for patients with cancer and relies on patient history (weight history, dietary intake, nutrition impact symptoms, physical function, and metabolic stress) and physical assessment (body fat, muscle mass, and fluid retention) [15]. Studies using the PG-SGA have demonstrated the presence of malnutrition in adult patients and older patients with cancer [35,36,40–42]. According to the PG-SGA classification, 42.5% and 43% of older and adult patients with cancer were considered malnourished at the time of hospital admission [35,36,40]. In women with gynecologic cancer, the prevalence of malnutrition was 62.4% by PG-SGA [41]. In a sample of 3777 adult patients with different types of cancer, 63.7% were classified as malnourished by PG-SGA [42]. In the current study, the high rate of malnutrition (~85%) identified by PG-SGA among our patients with cancer may have been influenced by the main types of cancer (gastrointestinal and head and neck cancer), which have an important impact on nutrition, and by the presence of symptoms of cancer treatment that have an impact on food intake, such as loss of appetite (31.5%) and xerostomia (29%). PG-SGA is specifically designed for patients with cancer, and its scores are strongly affected by treatment symptoms: scores increase with the presence of xerostomia, inappetence, odynophagia, or dysphagia [15]. Finally, according to the GLIM criteria, the prevalence of malnutrition was 72.6% in our sample. A prospective study of patients with cancer reported malnutrition rates similar to ours but varying according to the tool used to assess muscle mass, with values of 72.2% using mid-arm circumference, 77.6% using fat-free mass index, and 80% using HGS [40]. The measures to assess muscle mass and function recommended

by the GLIM are particularly important and can improve the diagnosis of malnutrition. Most older patients in our sample, regardless of sex, had low CC and HGS values. In previous studies of adults and older people with cancer, malnutrition was diagnosed in approximately half of these individuals by the GLIM criteria [6,42].

Complementarity of nutritional assessment tools

Studies evaluating the complementarity of nutritional risk screening tools and malnutrition diagnostic tools are still scarce, especially in older patients with cancer. In our study, NRS 2002 combined with SGA as well as MST combined with SGA and GLIM had the best satisfactory specificity (> 80%) to predict hospitalization. Also, MNA-SF alone and in combination with PG-SGA showed the highest sensitivity (92%) in predicting 60-day readmission. Some of these results are consistent with those of previous [21] and more recent studies [22,24,36]. A previous study demonstrated that the concomitant application of SGA in patients at high nutritional risk detected by the NRS 2002 was associated with an increased ability to predict poor clinical outcomes in hospitalized patients [21]. A multicenter observational study showed that NRS 2002 was better correlated with the GLIM criteria in adults with cancer and could be a good candidate for the first-step malnutrition risk screening according to the GLIM diagnostic scheme [36]. More recently, a longitudinal study of 601 hospitalized adult patients, most with cancer (53.7%) and undergoing surgical treatment (70.2%), showed that MUST had the best metrics of accuracy, sensitivity, and specificity with the GLIM criteria, followed by MST [22]. In our study, all included patients had cancer and approximately 61% were treated surgically during hospitalization, but MUST (alone or combined) did not show good accuracy in predicting the clinical outcomes. However, MST with GLIM showed a specificity > 80%. Conversely, MUST performed better than SGA and NRS 2002 in detecting malnutrition in hospitalized older patients diagnosed by the new GLIM criteria [24].

Association between malnutrition and clinical outcomes in hospitalized older patients with cancer

Regarding the association of nutritional risk (assessed by five screening tools) and malnutrition (assessed by three nutritional assessment tools) with clinical outcomes, we observed that the combination of MNA-SF and PG-SGA yielded the best results, identifying an increased likelihood of hospital LOS ≥ 4 days (2.48 times)

and 60-day hospital readmission (6.04 times). These are interesting and robust results, since our sample consisted of older patients with cancer and these tools are widely recommended and used in clinical practice, although alone.

In adult patients without cancer, nutritional risk (NRS 2002) combined with malnutrition (SGA) predicted a significantly increased probability of complications, and this combination was the most suitable one for detecting patients with a probability of unfavorable clinical outcomes [21]. Our results showed a 2.23-fold increased likelihood of hospital LOS ≥ 4 days for patients classified as malnourished by the combination of NRS 2002 and SGA, but the results were not significant for 60-day hospital readmission.

Among hospitalized patients, regardless of diagnosis, application of the MUST or MST in combination with the GLIM criteria increased the likelihood of LOS, in-hospital mortality, 6-month mortality, and hospital readmission, added to the adequate sensitivity, specificity, and accuracy of MUST to identify patients diagnosed as malnourished by the GLIM [22]. In this respect, the authors recommended the combination of MUST with GLIM to assess malnutrition in hospitalized patients [22]. Our results did not demonstrate a significant association between MUST combined with GLIM and LOS or readmission, but the MUST was positively associated with prediction of LOS ≥ 4 days when used alone or in combination with PG-SGA ($P < 0.05$).

Implications for clinical practice

Our findings suggest that MNA-SF combined with PG-SGA is a good option for a comprehensive and individualized nutritional assessment in older patients with cancer. Moreover, the complementarity between nutritional risk screening and malnutrition diagnosis is essential to avoid misclassification. Validated tools are critical for early detection of nutritional risk and status, enabling a specialized nutritional intervention [3,7,8]. Immediate nutritional screening helps reduce mortality, improve quality of life, and reduce hospital costs, mainly because the hospital LOS of malnourished patients is almost twice as long as that of well-nourished patients [3, 5].

According to the 2021 ESPEN guideline, MNA-SF is the most suitable tool to screen older patients for malnutrition and has been widely used in different healthcare settings [3]. The MNA-SF can also quickly detect frailer patients with cancer and

malnutrition [43]. The PG-SGA is one of the few tools that cover all aspects that can cause malnutrition and one of the most comprehensive tools for the assessment of nutrition impact symptoms, and for this reason it is considered a reference tool in patients with cancer [44]. In this respect, combining these two tools permits more effective evaluation, since they complement each other. For example, MNA-SF with PG-SGA can recover weight information from the last 6 months and both tools assess food intake, while the PG-SGA provides complementary data such as diet consistency and use or not of supplements. In our study, 70.9% of patients had a regular diet prescription and only 4.1% used nutritional supplements. The PG-SGA also evaluates the main symptoms that can have a nutritional impact, which is an important factor given that patients with cancer undergoing treatment have a high prevalence of symptoms such as loss of appetite, nausea, vomiting, diarrhea, and constipation [44]. Additionally, MNA-SF evaluates CC as a measure of muscle mass, which is lacking in the PG-SGA. More recently, the assessment of CC has been widely encouraged to monitor loss of muscle mass in hospitalized patients with and without cancer [45].

Our study has some limitations, such as heterogeneity of the study sample. Also, all types of solid tumors were included, but these effects were minimized by adjusting the logistic regression analyses for type of cancer, age, sex, presence of metastasis, and chronic diseases. In fact, 44.3% of our patients had gastrointestinal or head and neck cancer, and both tumors are closely associated with malnutrition due to the combination of effects related to disease progression, host response to tumor, and, particularly in gastrointestinal cancer, to the direct effect of mechanical obstruction by the tumor, with consequent malabsorption of nutrients [46].

Nevertheless, this study provides important data on the complementarity of the various tools currently used for nutritional assessment, as well as their performance and associations for the prediction of clinical outcomes in hospitalized older patients with different types of cancer.

Conclusion

In hospitalized older patients with solid tumors, the concomitant application of MNA-SF (specific for older patients) and PG-SGA (specific for patients with cancer) predicted hospital LOS and hospital readmission, and it is an appropriate combination to evaluate these patients.

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Authorship

TS and GPS conceived and designed the study. MSC, GPS, LMS, and CHS contributed to data acquisition. GPS and TS participated in the analysis and interpretation of the data. GPS, MSC, and TS drafted the initial manuscript. All authors critically revised the manuscript and approved the final version. TS is the guarantor and attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Conflict of interest

The authors declare no conflicts of interest.

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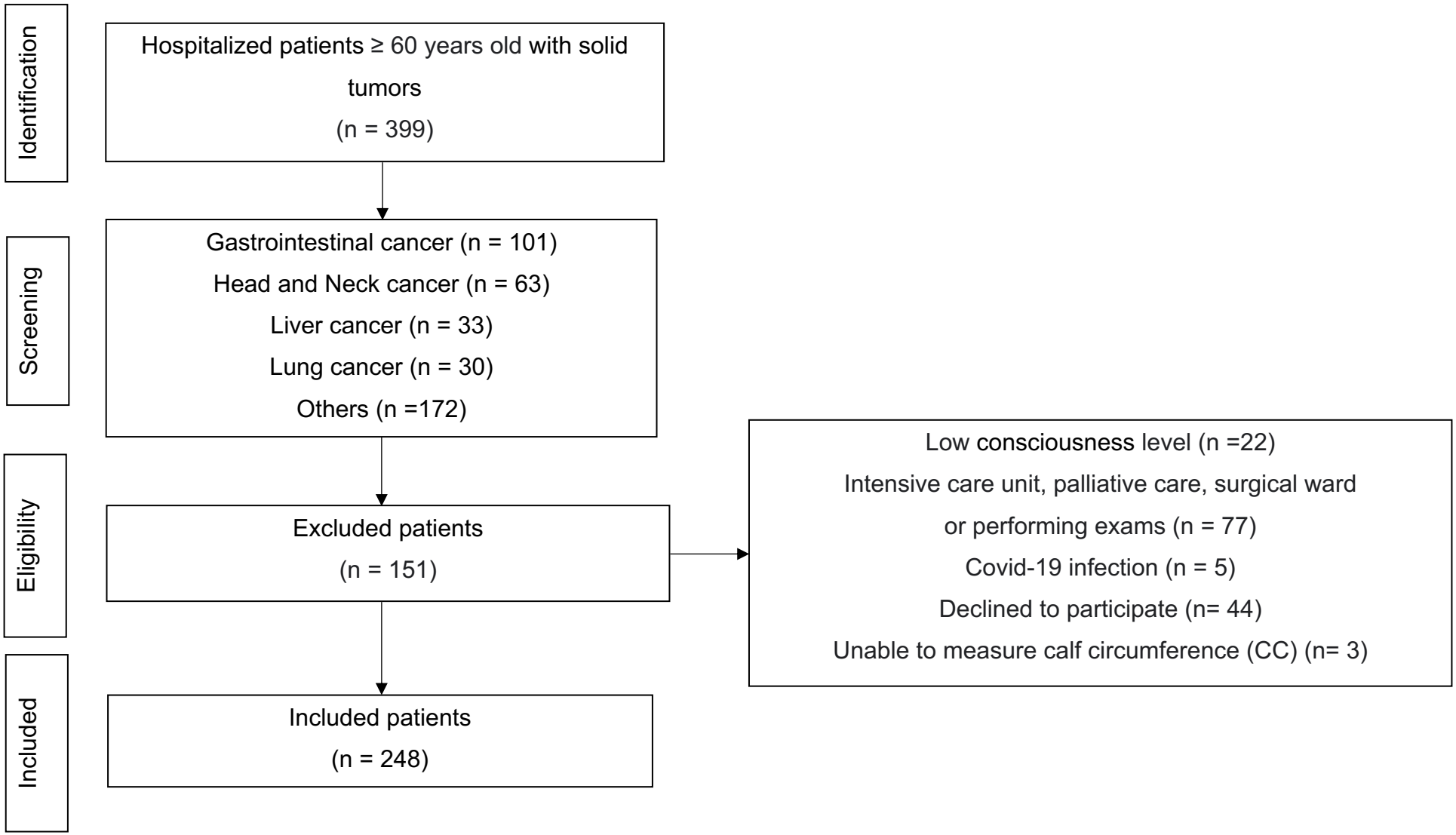


Figure 1. Flowchart of patient selection

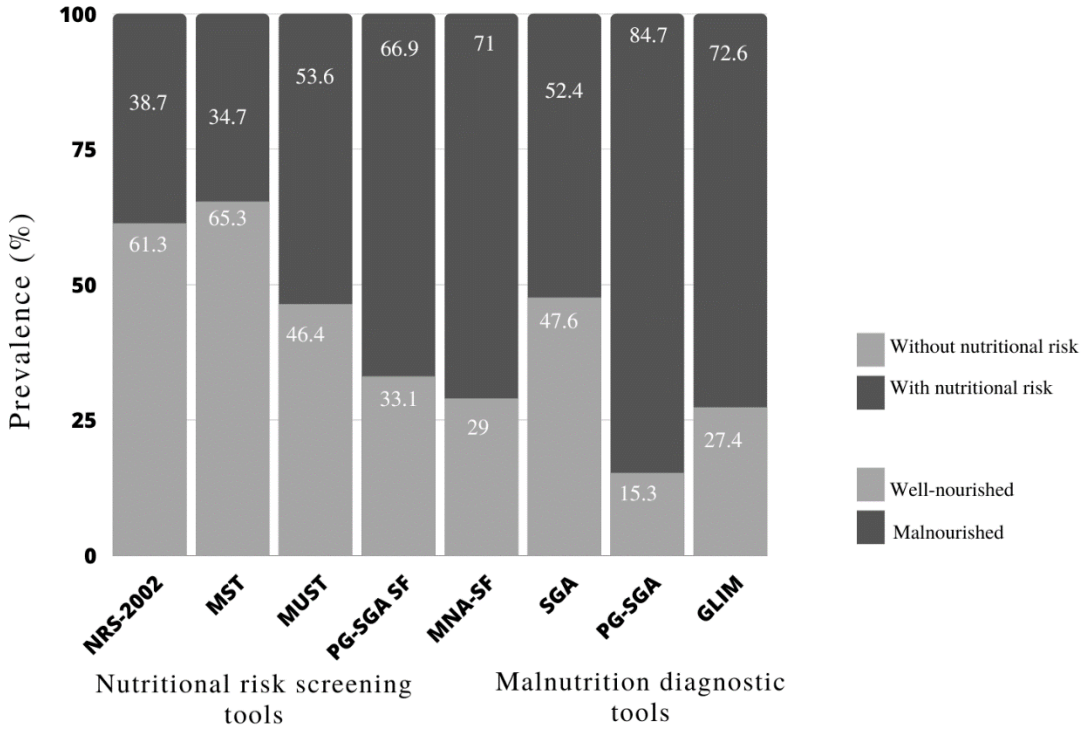
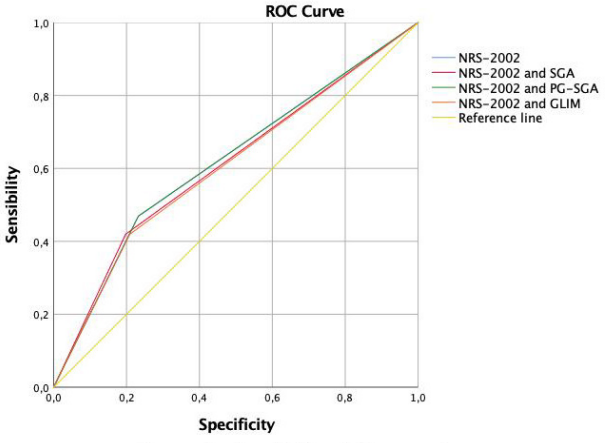


Figure 2. Prevalence of nutritional risk according to NRS-2002, MST, MUST, PG-SGA SF and malnutrition by SGA, PG-SGA and GLIM criteria in elderly cancer patients.

NRS-2002 = Nutritional Risk Screening; MST = Malnutrition Screening Tool; MUST = Malnutrition Universal Screening Tool; PG-SGA SF = Patient- Generated Subjective Global Assessment Short Form; MNA SF Mini Nutritional Assessment Short Form; SGA = Subjective Global Assessment; PG-SGA = Patient- Generated Subjective Global Assessment; GLIM = Global Leadership Initiative on Malnutrition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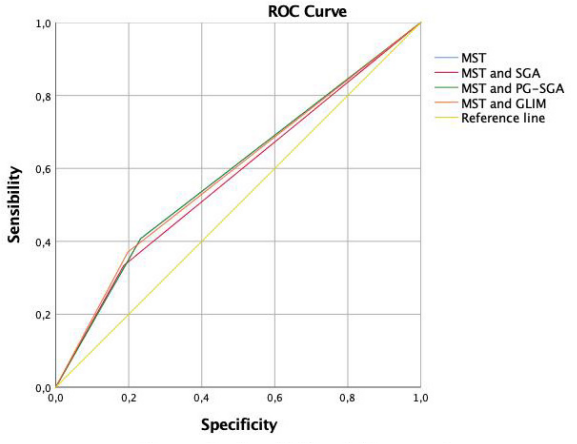
Sensibility
Specificity
NRS-2002
NRS-2002 and SGA
NRS-2002 and PG-SGA
NRS-2002 and GLIM
Reference line

3a.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Sensibility
Specificity
MST
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MST and PG-SGA
MST and GLIM
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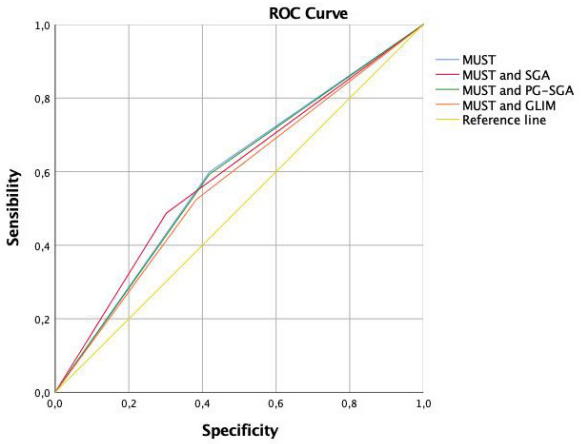
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Sensibility
Specificity
MUST
MUST and SGA
MUST and PG-SGA
MUST and GLIM
Reference line

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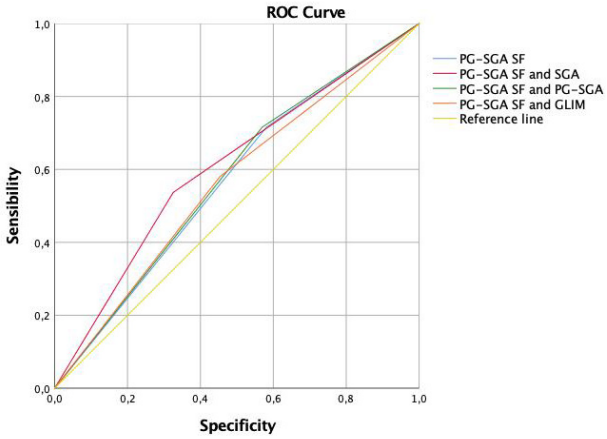
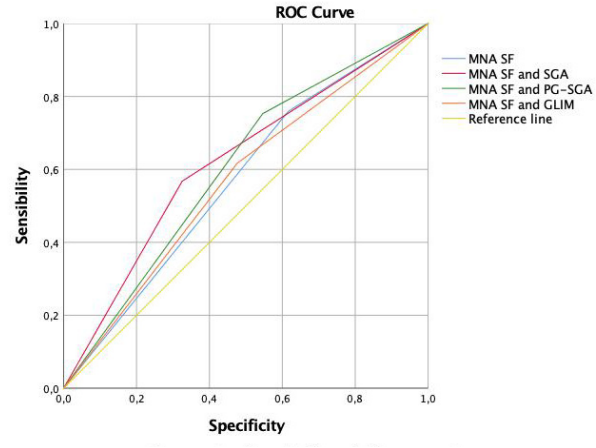

ROC Curve
Sensibility
Specificity
PG-SGA SF
PG-SGA SF and SGA
PG-SGA SF and PG-SGA
PG-SGA SF and GLIM
Reference line

3d.


ROC Curve
Sensibility
Specificity
MNA SF
MNA SF and SGA
MNA SF and PG-SGA
MNA SF and GLIM
Reference line

3e.

Figure 3. Receiver operating characteristic (ROC) curves for prediction of hospitalization ≥ 4 days in elderly cancer inpatients. 3a. NRS-2002 isolated and combined; 3b. MST isolated and combined; 3c. MUST isolated and combined; 3d. PG-SGA SF isolated and combined; 3e. MNA-SF isolated and combined.

NRS-2002 = Nutritional Risk Screening; MST = Malnutrition Screening Tool; MUST = Malnutrition Universal Screening Tool; PG-SGA SF = Patient- Generated Subjective Global Assessment Short Form; MNA SF Mini Nutritional Assessment Short Form; SGA = Subjective Global Assessment; PG-SGA = Patient-Generated Subjective Global Assessment; GLIM = Global Leadership Initiative on Malnutrition

Table 1. Characteristics of 248 hospitalized elderly cancer patients:

General	
Age (years)	69.7 ± 7.2
Sex (male)	148 (59.7%)
Race (white)	221 (89.5%)
Education (≤8 years)	149 (60.1%)
Smoking history (yes)	129 (52.0%)
Sedentary lifestyle (yes)	186 (75.0%)
Clinics	
Prevalence	
Gastrointestinal	68 (27.4%)
Head and neck	42 (16.9%)
Liver	22 (8.9%)
Lung	19 (7.7%)
Others*	97 (39.1%)
Treatment	
Surgery	151 (60.9%)
Chemotherapy	12 (4.8%)
Radiotherapy	4 (1.6%)
Combined treatment	42 (16.9%)
Tumor stage III/IV	55 (22.2%)
Presence of metastasis (yes)	56 (22.6%)
Chronic diseases	
Hypertension	153 (61.7%)
Diabetes	61 (24.6%)
Cardiovascular disease	41 (16.5%)
Outcomes	

Length of stay (LOS; days)	4 (3 – 9)
LOS ≥ 4 days	65.3%
Readmission (yes)	
30 days	35 (14.1%)
60 days**	25 (10.3%)
Hospital death (yes)	
30 days	5 (2.0%)
60 days**	4 (1.6%)

Data expressed as mean ± SD, median (p25-p75) or n (%).
*Other cancer included were bladder, gynecological, breast, skin, prostate, kidney and sarcoma.
** n = 243.

Table 2. Nutritional characteristics of 248 hospitalized elderly cancer patients:

	Values
Weight	
Current/on admission (kg)	71.9 ± 15.6
BMI (kg/m²)	26.4 ± 4.8
Malnourished	42 (16.9%)
Overweight	110 (44.4%)
Weight loss > 5% (3 months)	113 (45.6%)
Nutritional risk	
NRS-2002 (score ≥3)	96 (38.7%)
MST (score ≥ 2)	86 (34.7%)
MUST (score ≥ 1)	133 (53.6%)
PG-SGA SF (score ≥ 4)	166 (66.9%)
MNA SF (score ≤11)	176 (71.0%)
Nutritional status	
SGA (moderately and severely malnourished)	130 (52.4%)
PG-SGA (moderately and severely malnourished)	210 (84.7%)
GLIM (malnourished)	180 (72.6%)
Strength and assessment of muscle mass and functional capacity	
HGS (Kg)*	
Male (low)	64 (43.2%)
Female (low)	66 (66.0%)
CC (cm)**	
Male (low)	89 (60.1%)
Female (low)	59 (59.0%)
ECOG (score ≥ 3)	38 (15.3%)
Treatment symptoms and nutritional effects	

Appetite change (yes)	78 (31.5%)
Xerostomia	72 (29.0%)
Appetite loss	63 (25.4%)
Nausea	47 (19.0%)
Constipation	42 (16.9%)
Diet characteristics during hospitalization	
Oral nutrition	216 (87.8%)
Regular diet	173 (70.9%)
Oral and nutritional supplements	10 (4.1%)
Enteral nutrition	16 (6.5%)
Enteral and oral nutrition	2 (0.8%)
Calorie intake (kg/weight)	27.9 ± 9.4
Protein intake (kg/weight)	1.3 (1.0 – 1.5)

Data expressed as mean ± SD, median (p25-p75) or n (%).
BMI = Body Mass Index; NRS-2002 = Nutritional Risk Screening; MST = Malnutrition Screening Tool; MUST = Malnutrition Universal Screening Tool; SGA = Subjective Global Assessment; PG-SGA = Patient- Generated Subjective Global Assessment; PG-SGA SF = Patient- Generated Subjective Global Assessment Short Form; MNA SF Mini Nutritional Assessment Short Form; GLIM = Global Leadership Initiative on Malnutrition; HGS = hand grip strength; CC = calf circumference; ECOG = Eastern Cooperative Oncology Group.
*Low HGS = Male (≤27 kg); Female (≤16 kg) [27]; ** Low CC: Male (≤34 cm); Female (≤33 cm) [28]; CC values were adjusted by patient's BMI, in order to help to remove the confounding effects of adiposity [29].

Table 3. Accuracy, sensitivity, specificity, predictive positive and negative values of nutritional assessment tools isolated and combined for prediction of hospitalization (≥ 4 days) and readmission (60 days) in elderly cancer inpatients.

Outcomes / nutritional assessment tools	AUC ROC (CI 95%)	Accuracy (%)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Hospitalization (≥ 4 days)						
NRS-2002 isolated	0.618 (0.546 – 0.690)	57.6	46.91	76.74	79.15	43.45
NRS-2002 and SGA	0.611 (0.539 – 0.683)	55.25	42.00	80.23	79.98	42.36
NRS-2002 and PG-SGA	0.618 (0.546 – 0.690)	57.60	46.91	76.74	79.15	43.45
NRS-2002 and GLIM	0.605 (0.533 – 0.677)	54.85	41.98	79.07	79.05	42.00
MST isolated	0.587 (0.514 – 0.660)	53.23	40.74	76.74	76.73	40.76
MST and SGA	0.574 (0.500 – 0.647)	50.01	33.33	81.40	77.13	39.35
MST and PG-SGA	0.587 (0.514 – 0.660)	53.23	40.74	76.74	76.73	40.76
MST and GLIM	0.586 (0.514 – 0.659)	52.03	37.04	80.23	77.90	40.37
MUST isolated	0.590 (0.516 – 0.665)	59.27	59.88	58.14	72.91	43.50
MUST and SGA	0.593 (0.519 – 0.666)	56.05	48.77	69.77	75.22	41.98
MUST and PG-SGA	0.587 (0.512 – 0.662)	58.87	59.26	58.14	72.71	43.13
MUST and GLIM	0.570 (0.496 – 0.645)	55.65	52.47	61.63	72.01	40.79
PG-SGA SF isolated	0.567 (0.491 – 0.643)	61.28	71.60	41.86	69.86	43.93
PG-SGA SF and SGA	0.606 (0.532 – 0.679)	58.47	53.70	67.44	75.63	43.63
PG-SGA SF and PG-SGA	0.573 (0.497 – 0.649)	61.69	71.60	43.02	70.28	44.60
PG-SGA SF and GLIM	0.563 (0.488 – 0.639)	56.85	58.02	54.65	70.66	40.89

MNA SF isolated	0.571 (0.495 – 0.648)	62.89	75.93	38.37	69.87	45.86
MNA SF and SGA	0.621 (0.548 – 0.694)	60.49	56.79	67.44	76.65	45.34
MNA SF and PG-SGA	0.603 (0.528 – 0.679)	64.91	75.31	45.35	72.17	49.39
MNA SF and GLIM	0.570 (0.495 – 0.645)	58.47	61.73	52.33	70.90	42.08
Readmission (60 days)						
NRS-2002 isolated	0.577 (0.457 – 0.696)	62.14	52.00	63.30	13.99	91.99
NRS-2002 and SGA	0.602 (0.481 – 0.722)	66.66	52.00	68.35	15.87	92.54
NRS-2002 and PG-SGA	0.577 (0.457 – 0.696)	62.14	52.00	63.30	13.99	91.99
NRS-2002 and GLIM	0.577 (0.456 – 0.698)	65.43	48.0	67.43	14.47	91.87
MST isolated	0.555 (0.433 – 0.676)	64.61	44.00	66.97	13.27	91.24
MST and SGA	0.592 (0.469 – 0.714)	71.19	44.00	74.31	16.44	92.04
MST and PG-SGA	0.555 (0.433 – 0.676)	64.61	44.00	66.97	13.27	91.24
MST and GLIM	0.576 (0.453 – 0.698)	68.31	44.00	71.10	14.88	91.71
MUST isolated	0.561 (0.444 – 0.678)	49.80	64.00	48.17	12.42	92.10
MUST and SGA	0.603 (0.485 – 0.720)	60.49	60.00	60.55	14.87	92.95
MUST and PG-SGA	0.563 (0.446 – 0.680)	50.21	64.00	48.62	12.51	92.16
MUST and GLIM	0.551 (0.432 – 0.670)	54.32	56.00	54.13	12.29	91.46
PG-SGA SF isolated	0.554 (0.440 – 0.669)	39.10	76.00	34.86	11.81	92.67
PG-SGA SF and SGA	0.602 (0.486 – 0.718)	57.20	64.00	56.42	14.43	93.17
PG-SGA SF and PG-SGA	0.557 (0.442 – 0.671)	39.51	76.00	35.32	11.89	92.76
PG-SGA SF and GLIM	0.541 (0.422 – 0.659)	49.38	60.00	48.17	11.73	91.29

MNA SF isolated	0.621 (0.519 – 0.722)	38.28	92.00	32.11	13.47	97.22
MNA SF and SGA	0.635 (0.525 – 0.746)	56.79	72.00	55.05	15.53	94.48
MNA SF and PG-SGA	0.637 (0.538 – 0.735)	41.16	92.00	35.32	14.04	97.47
MNA SF and GLIM	0.612 (0.502 – 0.722)	49.39	76.00	46.33	13.99	94.39

AUC = Area Under the Curve; ROC = Receiver Operating Characteristic; CI = confidence interval; PPV = Positive predictive value; NPV =Negative predictive value. NRS-2002 = Nutritional Risk Screening; MST = Malnutrition Screening Tool; MUST = Malnutrition Universal Screening Tool; PG-SGA SF = Patient- Generated Subjective Global Assessment Short Form; MNA SF Mini Nutritional Assessment Short Form; SGA = Subjective Global Assessment; PG-SGA = Patient- Generated Subjective Global Assessment;; GLIM = Global Leadership Initiative on Malnutrition.
AUC values = 0.5-0.6 (very bad), 0.6-0.7 (bad), 0.7-0.8 (poor), 0.8-0.9 (good), > 0.9 (excellent) [32]
Sensitivity, specificity, positive predictive value, negative predictive value cutoffs: high: 90% to 100%, moderate: 80% to ≤ 89%; low: ≤ 79% [33]
Prevalence of hospitalization (≥ 4 days) = 65.3%. Prevalence of readmission (60 days) = 10.3%

Table 4. Association of nutritional risk by five screening instruments and malnutrition by three nutritional assessment tools with clinical outcomes in hospitalized elderly cancer patients

	Hospitalization (≥ 4 days)			60 days readmission		
Classification of nutritional tools	**OR[a]**	**95%CI**	**P value**	**OR[a]**	**95%CI**	**P value**
NRS-2002 ≥3[b]	2.36	1.20 – 4.61	**0.012**	1.76	0.67 – 4.58	0.246
NRS-2002 ≥3[b] and SGA (malnourished)[c]	2.23	1.12 – 4.44	**0.022**	2.15	0.83 – 5.59	0.113
NRS-2002 ≥3[b] and PG-SGA (malnourished)[d]	2.26	1.20 – 4.61	**0.012**	1.76	0.67 – 4.58	0.246
NRS-2002 ≥3[b] and GLIM (malnourished)[e]	2.28	1.15 – 4.52	**0.017**	1.79	0.69 – 4.63	0.226
MST ≥2[f]	2.10	1.09 – 4.02	**0.025**	1.73	0.69 – 4.33	0.242
MST ≥2[f] and SGA (malnourished)[c]	1.77	0.88 – 3.57	0.108	2.13	0.84 – 5.38	0.109
MST ≥2[f] and PG-SGA (malnourished)[d]	2.10	1.09 – 4.02	**0.025**	1.73	0.69 – 4.33	0.242
MST ≥2[f] and GLIM (malnourished)[e]	2.11	1.06 – 4.20	**0.032**	1.95	0.77 – 4.90	0.156
MUST ≥1[g]	2.02	1.12 – 3.64	**0.018**	1.73	0.69 – 4.73	0.241
MUST ≥1[g] and SGA (malnourished)[c]	1.79	0.97 – 3.32	0.062	2.25	0.88 – 5.77	0.090
MUST ≥1[g] and PG-SGA (malnourished)[d]	1.96	1.09 – 3.53	**0.023**	1.75	0.69 – 4.41	0.232
MUST ≥1[g] and GLIM (malnourished)[e]	1.70	0.94 – 3.06	0.077	1.60	0.65 – 3.94	0.303

PG-SGA SF ≥4[h]	1.47	0.78 – 2.77	0.226	1.47	0.50 – 4.27	0.479
PG-SGA SF ≥4[h] and SGA (malnourished)[c]	1.83	0.98 – 3.44	0.057	2.10	0.76 – 5.77	0.151
PG-SGA SF ≥4[h] and PG-SGA (malnourished)[d]	1.51	0.80 – 2.83	0.198	1.55	0.53 – 4.54	0.417
PG-SGA SF ≥4[h] and GLIM (malnourished)[e]	1.41	0.77 – 2.58	0.260	1.22	0.47 – 3.14	0.675
MNA SF ≤ 11[i]	1.85	0.98 – 3.46	0.054	5.14	1.13 – 23.37	**0.034**
MNA SF ≤ 11[i] and SGA (malnourished)[c]	2.19	1.18 – 4.04	**0.012**	3.14	1.10 – 8.91	**0.031**
MNA SF ≤ 11[i] and PG-SGA (malnourished)[d]	2.48	1.32 – 4.64	**0.004**	6.04	1.31 – 27.73	**0.021**
MNA SF ≤ 11[i] and GLIM (malnourished)[e]	1.60	0.88 – 2.91	0.117	2.57	0.93 – 7.13	0.068

OR = Odds Ratio; CI = confidence interval; NRS-2002 = Nutritional Risk Screening; MST = Malnutrition Screening Tool; MUST = Malnutrition Universal Screening Tool;PG-SGA SF = Patient- Generated Subjective Global Assessment Short Form; MNA SF Mini Nutritional Assessment Short Form; SGA = Subjective Global Assessment; PG-SGA = Patient- Generated Subjective Global Assessment; GLIM = Global Leadership Initiative on Malnutrition;

[a] Obtained by multiple logistic regression analysis. Models adjusted for age, sex, type of cancer, presence of metastasis, and chronic diseases.

[b] Reference category: Patients with NRS-2002 score ≥3;

[c, d, e] Reference category: Patients well-nourished.

[f] Reference category: Patients with MST score ≥2;

[g] Reference category: Patients with MUST score ≥1;

[h] Reference category: Patients with PG-SGA SF score ≥ 4;

[i] Reference category: Patients with MNA SF ≤ score 11

ANEXOS

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GUIDE FOR AUTHORS

Please note that per 1 January 2019 the Nutrition Guide for Authors has been updated in regards to the requirements for the submission of clinical trials. See further details below.

INTRODUCTION

Nutrition provides an international forum for professionals interested in the **applied and basic** biomedical **nutritional sciences, and publishes papers both of clinical interest and of scientific import.** Investigators are encouraged to submit papers in the disciplines of nutritionally related biochemistry, genetics, immunology, metabolism, molecular and cell biology, neurobiology, physiology, and pharmacology. Papers on nutrition-related plant or animal sciences which are not of direct relevance to man, whereas occasionally of interest are not the main focus of the Journal.

Nutrition publishes a wide range of articles, which includes original investigations, review articles, rapid communications, research letters, case reports and special category manuscripts. Manuscripts must be prepared in accordance with the "Uniform Requirements for Manuscripts Submitted to Biomedical Journals" developed by the International Committee of Medical Journal Editors (*N Engl J Med* 1991;324:424-428). All submissions are peer reviewed.

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BEFORE YOU BEGIN

Ethics in publishing

Please see our information on Ethics in publishing.

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Reporting sex- and gender-based analyses

Reporting guidance

For research involving or pertaining to humans, animals or eukaryotic cells, investigators should integrate sex and gender-based analyses (SGBA) into their research design according to funder/sponsor requirements and best practices within a field. Authors should address the sex and/or gender dimensions of their research in their article. In cases where they cannot, they should discuss this as a limitation to their research's generalizability. Importantly, authors should explicitly state what definitions of sex and/or gender they are applying to enhance the precision, rigor and reproducibility of their research and to avoid ambiguity or conflation of terms and the constructs to which they refer (see Definitions section below). Authors can refer to the Sex and Gender Equity in Research (SAGER) guidelines and the SAGER guidelines checklist. These offer systematic approaches to the use and editorial review of sex and gender information in study design, data analysis, outcome reporting and research interpretation - however, please note there is no single, universally agreed-upon set of guidelines for defining sex and gender.

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[5] Cancer Research UK. Cancer statistics reports for the UK, http://www.cancerresearchuk.org/aboutcancer/statistics/cancerstatsreport/; 2003 [accessed 13 March 2003].
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