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GLIM Criteria for the Diagnosis of Malnutrition: A Consensus Report From the Global Clinical Nutrition Community

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Abstract

Background: This initiative aims to build a global consensus around core diagnostic criteria for malnutrition in adults in clinical settings. *Methods:* The Global Leadership Initiative on Malnutrition (GLIM) was convened by several of the major global clinical nutrition societies. Empirical consensus was reached through a series of face-to-face meetings, telephone conferences, and e-mail communications. *Results:* A 2-step approach for the malnutrition diagnosis was selected, that is, first screening to identify at risk status by the use of any validated screening tool, and second, assessment for diagnosis and grading the severity of malnutrition. The malnutrition criteria for consideration were retrieved from existing approaches for screening and assessment. Potential criteria were subjected to a ballot among GLIM participants that selected 3 phenotypic criteria (non-volitional weight loss, low body mass index, and reduced muscle mass) and 2 etiologic criteria (reduced food intake or assimilation, and inflammation or disease burden). To diagnose malnutrition at least 1 phenotypic criterion and 1 etiologic criterion should be present. Phenotypic metrics for grading severity are proposed. It is recommended that the etiologic criteria be used to guide intervention and anticipated outcomes. The recommended approach supports classification of malnutrition into four etiology-related diagnosis categories. *Conclusions:* A consensus scheme for diagnosing malnutrition in adults in clinical settings on a global scale is proposed. Next steps are to secure endorsements from leading nutrition professional societies, to identify overlaps with syndromes like cachexia and sarcopenia, and to promote dissemination, validation studies, and feedback. The construct should be re-considered every 3–5 years. (*JPEN J Parenter Enteral Nutr.* 2018;0:1–9)

Keywords

assessment; diagnosis; malnutrition; screening

Introduction

Malnutrition due to disease, poverty, hunger, war, and natural catastrophe is a fate suffered by >1 billion of the world's population. Historically, starvation and famine were prevalent causes of malnutrition, and they remain so today. However, with improvements in agriculture, education, public health, healthcare, and living standards, nutrition disorders and related conditions now encompass the full scope of undernutrition, micronutrient abnormalities, obesity, cachexia, sarcopenia, and frailty.[1,2]

Malnutrition, for example, undernutrition, may be caused by compromised intake or assimilation of nutrients, but there is growing appreciation that malnutrition

may also be caused by disease-associated inflammatory or other mechanisms. The malnutrition that is associated with disease or injury invariably consists of a combination of reduced food intake or assimilation and varying degrees of acute or chronic inflammation, leading to altered body composition and diminished biological function.[1-3] Inflammation contributes to malnutrition through associated anorexia and decreased food intake, as well as altered metabolism with elevation of resting energy expenditure and increased muscle catabolism. Altered body composition manifests as a decrease in any marker of muscle mass (fat-free mass, muscle mass index, or body cell mass). Thus, malnutrition is associated with adverse functional and clinical outcomes.

Although malnutrition is a global concern associated with incremental morbidity, mortality, and cost, there

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has been a fundamental lack of consensus on diagnostic criteria for application in clinical settings. No single existing approach has secured broad global acceptance.[1,4-8] Our evolving understanding of the contributions of disease/inflammation may render some concepts of malnutrition in the current International Classifications of Diseases (ICD-10) (http://www.who.int/classifications/icd/en/) inconsistent with approaches or nomenclature currently used in clinical practice and research. Thus, there is an urgent need to establish a global consensus to be used in clinical care settings for adults.

In order to respond to the needs of the clinical nutrition and medical communities, the Global Leadership Initiative on Malnutrition (GLIM) was convened in January 2016. GLIM has engaged several of the clinical nutrition societies, with global reach to focus on standardizing the clinical practice of malnutrition diagnosis. We also sought to clarify overlaps with related disease classifications, including cachexia. The purpose of this specific initiative is to reach global consensus on the identification and endorsement of criteria for the diagnosis of malnutrition in clinical settings.

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Materials and Methods

The Consensus Procedure

On January 19, 2016, the Global Leadership Conversation: Addressing Malnutrition was held at the American Society for Parenteral and Enteral Nutrition (ASPEN) Conference.[9] Key breakthroughs at that meeting led to the development of GLIM:

1. It was recognized that there was considerable consensus among stakeholders around many malnutrition diagnosis issues.
2. There was strong commitment for reaching broader global consensus in defining and characterizing malnutrition.
3. A core leadership committee with representatives of several of the global clinical nutrition societies—ASPEN (www.nutritioncare.org), European Society for Clinical Nutrition and Metabolism (ESPEN) (www.espen.org), Federacion Latinoamericana de Terapia Nutricional, Nutricion Clinica y Metabolismmo (FELANPE) (www.felanpeweb.org), and Parenteral and Enteral Nutrition Society of Asia (PENSA) (www.pensa-online.org)—was constituted to form GLIM. The core GLIM leadership committee then created a larger supporting working group comprised of invited members that brought additional global diversity and expertise to the consensus effort.
4. It was agreed that a series of face-to-face meetings, telephone conferences, and email communications would be used to delineate the GLIM approach.

The first full meeting of the GLIM extended working group was held September 19, 2016, at the ESPEN Congress.[10] Highlighted objectives included consensus development of evidence-based criteria suitable to diverse clinical settings, global dissemination of consensus criteria, and the priority to seek adoption by leading diagnosis classification and coding entities across the globe. It was also agreed that the desired approach to malnutrition diagnosis should be simple and include clinically relevant diagnostic criteria that will be appropriate for application by all healthcare professionals using methods that are widely available. The intent was also to promote global use of consensus criteria that can be readily used with other approaches and additional criteria of regional preference.

Results

Consensus was gradually achieved over the course of the GLIM meetings held February 20, 2017, at the ASPEN Conference[11]; September 11, 2017, at the ESPEN Congress; and January 25, 2018, at the ASPEN Conference. Meanwhile, discussions were also held with the leadership of The Society on Sarcopenia, Cachexia and Wasting Disorders.

A Two-Step Model for Risk Screening and Diagnosis Assessment

There was strong consensus that the key first step in the evaluation of nutrition status is malnutrition risk screening to identify at-risk status by the use of any validated screening tool[12-14]; some of these tools are noted in Table 1 and Appendix 1 (available online). This is followed by the second step of assessment for diagnosis and severity grading, as described below.

Criteria Selected for Malnutrition Diagnosis

A comprehensive survey of existing approaches used in screening and assessment of malnutrition was conducted to identify criteria worthy of consideration (Table 1) (Appendix 1; available online). It was recognized that these approaches incorporate multiple common criteria. For example, the presence of weight loss and disease burden or inflammation is common to most of them, as is reduced food intake (Table 1). Potential consensus criteria from existing approaches, as well as additional criteria suggested by participants, were subject to further consideration.

In order to establish consensus and endorsement of a minimum set of diagnostic criteria by the core leadership committee and the supporting working group, a formal ballot was administered whereby participants ranked proposed diagnosis criteria. The top 5 ranked criteria by an overwhelming majority of GLIM participants were as follows:

- Nonvolitional weight loss
- Low body mass index (BMI)
- Reduced muscle mass
- Reduced food intake or assimilation
- Disease burden/inflammation

Nonvolitional weight loss. There was strong GLIM consensus for the inclusion of nonvolitional weight loss as a phenotypic criterion. Validity is well established, and there is a robust literature on which threshold selection could be based (Appendix 1; available online). There must be priority to obtain repeated weight measures over time to identify trajectories of decline, maintenance, and improvement. GLIM participants felt that it is especially important to recognize the pace of weight loss early in the course of disease or injury and to highlight that many patients will have lost appreciable weight prior to presenting to healthcare.

Table 1. Survey of Existing Approaches Used in Screening and Assessment of Malnutrition and Cachexia.

	NRS-2002[12,a]	MNA-SF[21,a,b]	MUST[22,a]	ESPEN 2015[8,a]	ASPEN /AND[7,a]	SGA[4,a]	Evans 2008[5,c]	PEW 2008[23,d]	Fearon 2011[6,c]
Etiologies									
Reduced food intake	X	X	X	X	X	X		X	X
Disease burden/inflammation	X	X	X	X	X	X	X	X	X
Symptoms									
Anorexia		X				X	X		X
Weakness		X				X	X		
Signs/phenotype									
Weight loss	X	X	X	X	X	X	X	X	X
Body mass index	X	X	X	X			X	X	X
Lean/fat-free mass/muscle mass		X		X	X	X	X	X	X
Fat mass					X	X		X	
Fluid retention/ascites					X	X			
Muscle function (e.g., grip strength)					X	X	X		
Biochemistry							X	X	

AND, Academy of Nutrition and Dietetics; ASPEN, American Society of Parenteral and Enteral Nutrition; ESPEN, European Society for Clinical Nutrition and Metabolism; MNA-SF, Mini Nutritional Assessment-Short Form; MUST, Malnutrition Universal Screening Tool; NRS-2002, Nutritional Risk Screening-2002; PEW, protein-energy wasting; SGA, subjective global assessment.
[a]Malnutrition approach.
[b]Adapted for older adults.
[c]Cachexia approach.
[d]Adapted for chronic kidney disease.

Low BMI. There is substantial regional variation in the use of low BMI as a phenotypic criterion for malnutrition diagnosis. North American GLIM representatives indicated that low BMI is seldom used as a clinical malnutrition marker in those regions. The experience from the current U.S. population is that people are often overweight or obese and would need to lose substantial weight before low BMI designation would occur. Because other regions of the world currently make use of BMI as a criterion for recognition of malnutrition, the GLIM consensus includes low BMI. However, further research is needed to secure consensus reference BMI data for Asian populations in clinical settings.

Reduced muscle mass. Reduced muscle mass is a phenotypic criterion with strong evidence to support its inclusion in the GLIM consensus criteria. However, there is not consensus regarding how best to measure and define reduced muscle mass, particularly in clinical settings. Therefore, GLIM recommends measurement by dual-energy absorptiometry or other validated body composition measures such as bioelectrical impedance, ultrasound, computed tomography, or magnetic resonance imaging; however, these methods are still not available in most settings for nutrition assessment throughout the globe. Physical examination or anthropometric measures of calf or arm muscle circumference are therefore included as alternative measures. Recommendations are likely to evolve as portable and less costly body composition technologies are developed and become widely available.

For the purpose of recommended cutoff values for muscle mass reductions, GLIM refers to recommendations from the European Working Group on Sarcopenia in Older People,[15] The Foundation of National Institute of Health initiative,[16] and the Asian Working Group on Sarcopenia.[17] Reference standards for muscle mass may warrant adjustment for race and sex. Additional research is warranted to establish general reference standards as well as for some specific populations, for example, in Asia. Examples of recommended thresholds are found in Table 2.

Assessment of muscle function using grip strength or other validated procedures is recommended as a supportive measure in the GLIM consensus (Tables 3 and 4). Decline in muscle strength generally exceeds changes in muscle size.[18] However, irrespective of etiology, appreciable loss of muscle mass is generally accompanied by reduced muscle function. In situations where muscle mass cannot be readily assessed then muscle strength, for example, hand grip strength, is an appropriate supporting proxy.

Reduced food intake or assimilation. Reduced food intake is a well-established etiologic criterion for malnutrition that

Table 2. Examples of Recommended Thresholds for Reduced Muscle Mass.

	Males	Females
Appendicular Skeletal Muscle Index (ASMI, kg/m^2)[15]	<7.26	<5.25
ASMI, (kg/m^2)[24,a]	<7	<6
ASMI, (kg/m^2)[17,b]		
DXA	<7	<5.4
BIA	<7	<5.7
Fat free mass index (FFMI, kg/m^2)[8]	<17	<15
Appendicular lean mass (ALM, kg)[25]	<21.4	<14.1
Appendicular lean mass adjusted for BMI = ALM/BMI[26]	<0.725	<0.591

DXA = dual energy x-ray absorptiometry, BIA = bioelectrical impedance analysis BMI = body mass index
[a]Recommendations from European Working Group on Sarcopenia in Older People 2 (EWGSOP2); personal communication Alfonso Cruz-Jentoft.
[b]Recommendations from Asian Working Group for Sarcopenia (AWGS) for Asians.

has strong validity. It can have multiple causes, including poor oral health, medication side effects, depression, dysphagia, gastrointestinal complaints, anorexia, and inadequate nutrition support. Thresholds for relevant impairment of food intake are widely reported (Appendix 1), and GLIM participants sought to empirically provide a practical synthesis. Reduced assimilation of food/nutrients is associated with malabsorptive disorders such as short bowel syndrome, pancreatic insufficiency, and after bariatric surgery. It is also associated with disorders such as esophageal strictures, gastroparesis, and intestinal pseudo-obstruction, as well as gastrointestinal symptoms such as dysphagia, nausea, vomiting, diarrhea, constipation, and abdominal pain. These symptoms have been incorporated as supportive indicators into this GLIM consensus criterion to help to identify poor food intake or assimilation.

Disease burden/inflammation. GLIM members recognized that disease burden/inflammation has become a widely

Table 3. Phenotypic and Etiologic Criteria for the Diagnosis of Malnutrition.

Phenotypic Criteria[a]			Etiologic Criteria[a]	
Weight Loss (%)	Low Body Mass Index (kg/m^2)	Reduced Muscle Mass[b]	Reduced Food Intake or Assimilation[c,d]	Inflammation[e,f,g]
>5% within past 6 months, or >10% beyond 6 months	<20 if <70 years, or <22 if >70 years Asia: <18.5 if <70 years, or <20 if >70 years	Reduced by validated body composition measuring techniques[b]	≤50% of ER > 1 week, or any reduction for >2 weeks, or any chronic GI condition that adversely impacts food assimilation or absorption[c,d]	Acute disease/injury[e,g] or chronic disease-related[f,g]

ER, energy requirements; GI, gastrointestinal.
[a]Requires at least 1 phenotypic criterion and 1 etiologic criterion for diagnosis of malnutrition.
[b]For example, fat-free mass index (kg/m^2)) by dual-energy absorptiometry or corresponding standards using other body composition methods such as bioelectrical impedance analysis, computed tomography, or magnetic resonance imaging. When not available or by regional preference, physical examination or standard anthropometric measures such as mid-arm muscle or calf circumferences may be used. Thresholds for reduced muscle mass need to be adapted to race (Asia). Functional assessments such as hand-grip strength may be considered as a supportive measure.
[c]Consider gastrointestinal symptoms as supportive indicators that can impair food intake or absorption (e.g., dysphagia, nausea, vomiting, diarrhea, constipation, or abdominal pain). Use clinical judgement to discern severity based on the degree to which intake or absorption is impaired. Symptom intensity, frequency, and duration should be noted.
[d]Reduced assimilation of food/nutrients is associated with malabsorptive disorders such as short bowel syndrome, pancreatic insufficiency, and after bariatric surgery. It is also associated with disorders such as esophageal strictures, gastroparesis, and intestinal pseudo-obstruction. Malabsorption is a clinical diagnosis manifest as chronic diarrhea or steatorrhea. Malabsorption in those with ostomies is evidenced by elevated volumes of output. Use clinical judgement or additional evaluation to discern severity based on frequency, duration, and quantitation of fecal fat and/or volume of losses.
[e]Acute disease-/injury-related. Severe inflammation is likely to be associated with major infection, burns, trauma, or closed head injury. Other acute disease-/injury-related conditions are likely to be associated with mild to moderate inflammation.
[f]Chronic disease-related. Severe inflammation is not generally associated with chronic disease conditions. Chronic or recurrent mild to moderate inflammation is likely to be associated with malignant disease, chronic obstructive pulmonary disease, congestive heart failure, chronic renal disease, or any disease with chronic or recurrent Inflammation. Note that transient inflammation of a mild degree does not meet the threshold for this etiologic criterion.
[g]C-reactive protein may be used as a supportive laboratory measure.

Table 4. Thresholds for Severity Grading of Malnutrition Into Stage 1 (Moderate) and Stage 2 (Severe) Malnutrition.

	Phenotypic Criteria[a]		
	Weight Loss (%)	Low Body Mass Index (kg/m^2)[b]	Reduced Muscle Mass[c]
Stage 1/moderate malnutrition (requires 1 phenotypic criterion that meets this grade)	5%−10% within the past 6 months, or 10%−20% beyond 6 months	<20 if <70 years, <22 if ≥70 years	Mild-to-moderate deficit (per validated assessment methods; see below)
Stage 2/severe malnutrition (requires 1 phenotypic criterion that meets this grade)	>10% within the past 6 months, or >20% beyond 6 months	<18.5 if <70 years, <20 if ≥70 years	Severe deficit (per validated assessment methods; see below)

[a]Severity grading is based on the noted phenotypic criteria, whereas the etiologic criteria described in the text and Figure 1 are used to provide the context to guide intervention and anticipated outcomes.
[b]Further research is needed to secure consensus reference body mass index data for Asian populations in clinical settings.
[c]For example, appendicular lean mass index (kg/m^2) by dual-energy absorptiometry or corresponding standards using other body composition methods such as bioelectrical impedance analysis, computed tomography, or magnetic resonance imaging. When not available or by regional preference, physical examination or standard anthropometric measures such as mid-arm muscle or calf circumferences may be used. Functional assessments such as hand-grip strength may be used as a supportive measure.[15]

accepted etiologic criterion in existing screening and assessment tools (Table 1). Clinical diagnosis provides a simple approach to recognition of severe, chronic, or frequently recurrent inflammation.[1,2,19] For example, major infections, burns, trauma, and closed head injury are associated with acute inflammation of a severe degree. Indicators of inflammation may include fever, negative nitrogen balance, and elevated resting energy expenditure. Most chronic organ diseases, such as congestive heart failure, chronic obstructive pulmonary disease, rheumatoid arthritis, chronic kidney or liver disease, and cancer, are associated with chronic or recurrent inflammation of a mild to moderate degree. Although severe inflammation is generally easy to discern, clinical judgement is often required to recognize that of lesser degree. Supportive proxy measures of inflammation can include laboratory indicators such as serum C-reactive protein, albumin, or pre albumin.

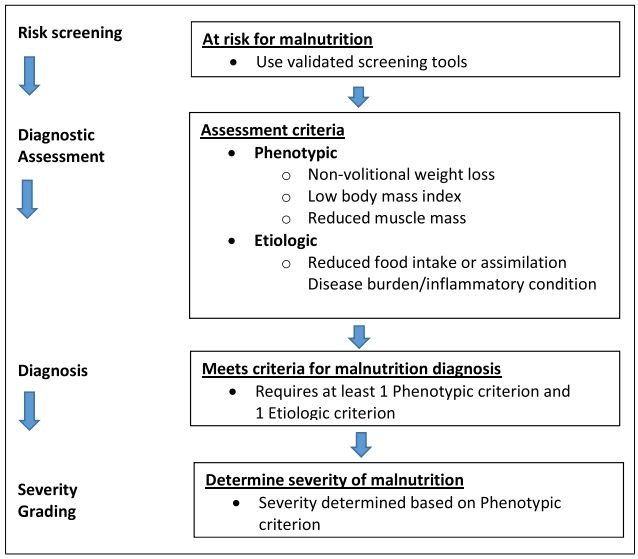

Figure 1. GLIM diagnostic scheme for screening, assessment, diagnosis, and grading of malnutrition.
GLIM, Global Leadership Initiative on Malnutrition.

Approach to Using Combined Phenotypic and Etiologic Criteria for Malnutrition Diagnosis

Weight loss, reduced BMI, and reduced muscle mass were categorized as phenotypic criteria. Reduced food intake/assimilation and disease burden/inflammation were categorized as etiologic criteria (Table 3) (Figure 1). For the diagnosis of malnutrition, GLIM recommends that the combination of at least 1 phenotypic criterion and 1 etiologic criterion is required (Table 3) (Figure 1). The selection of threshold values for the consensus diagnostic criteria was guided by review of existing approaches used in screening and assessment, as was the selection of threshold values for severity grading described below (see Appendix 1). The selected threshold values for diagnosis of malnutrition are shown in Table 3. Although only the phenotypic criteria are proposed for the severity grading that follows, the inclusion of the etiologic criteria for malnutrition diagnosis is deemed a priority to guide appropriate intervention and anticipated outcomes.

Severity grading of malnutrition. It is clinically useful to categorize the severity of malnutrition depending on the degree of aberration from established thresholds. Suggested phenotypic metrics for grading severity as stage 1 (moderate) and stage 2 (severe) malnutrition are shown in Table 4.

Table 5. Diagnosis Category According to Underlying Etiology.

Malnutrition related to:
Chronic disease with inflammation
Chronic disease with minimal or no perceived inflammation
Acute disease or injury with severe inflammation
Starvation including hunger/food shortage associated with socioeconomic or environmental factors

Etiology-based diagnosis classification. An etiology-based diagnosis classification is endorsed by GLIM consistent with those suggested previously by the International Consensus Guideline Committee,[1] the Academy of Nutrition and Dietetics/ASPEN guidelines,[7] and the ESPEN guidelines.[2] The classification includes malnutrition related to chronic disease with inflammation; malnutrition related to chronic disease with minimal or no perceived inflammation; malnutrition related to acute disease or injury with severe inflammation; and malnutrition related to starvation, including hunger/food shortage associated with socioeconomic or environmental factors (Table 5).

Discussion

This GLIM initiative targets the priority to adopt global consensus criteria so that malnutrition prevalence, interventions, and outcomes may be compared throughout the world. A common malnutrition language is a paramount necessity in order to support the development of global standards of care that will promote improved outcomes. The proposed approach for diagnosing malnutrition is based on a strong consensus endorsing core phenotypic and etiologic criteria that are already in widespread use throughout the world. The intent is to promote global use of these criteria, which may in turn be readily used with other approaches and additional criteria of regional preference. The consensus criteria are intended to be simple and readily applied by clinicians and other health practitioners using tools and methods that are readily available. Only modest training should be required. The proposed approach encompasses risk screening and diagnosis but does not entail the robust detail of comprehensive nutrition assessment. It will provide a malnutrition diagnosis, which may then be complemented by more comprehensive assessments to provide the basis for individualized care and treatment plans. Consultation of skilled nutrition practitioners such as dietitians is recommended for comprehensive assessment based on regional preferences and availability. Repeated criterion measures over time are recommended so that trajectories of decline, maintenance, and improvement may be identified.

The recommended GLIM approach encompasses both phenotypic and etiologic criteria for the diagnosis of malnutrition but uses only phenotypic criteria cut points to provide for severity grading. Although etiology has not generally been included in criteria supporting the diagnosis of medical conditions in the ICD construct, the inclusion of etiology has been widely adopted in the clinical nutrition community because it serves to guide appropriate interventions and expected outcomes.[1] For example, the presence of disease-associated inflammatory response has the potential for major impacts on treatment approach and anticipated outcome. The GLIM approach acknowledges the diversity and the multifactorial etiologies underlying the development of the malnourished phenotype irrespective of body morphology: lean, normal, or obese.

Impairment of muscle strength and function are core phenomena in conditions such as sarcopenia,[15,16] cachexia,[5,6] and frailty.[20] Assessment of muscle strength should be an integral measure in assessment of patients with suspected sarcopenia because impairment of muscle strength is now recognized as a key component for the diagnosis of sarcopenia.[15,16] Although inflammatory mediators and other mechanisms besides malnutrition are at play, it is recommended that the GLIM consensus criteria be applied to diagnose malnutrition in persons with sarcopenia, cachexia, and frailty so that the priority to undertake appropriate nutrition interventions may be recognized. However, the most helpful approaches for these conditions will require combined multimodal interventions beyond nutritional supplements, such as pharmacological agents and exercise.

Similarly, patients with cachexia will meet GLIM consensus criteria for malnutrition related to chronic disease with inflammation. Because there is concern that the inclusion of cachexia with other disease-related malnutrition conditions may diminish appreciation for some distinctive features of cachexia, there has been understandable hesitation by some to equate cachexia with this GLIM diagnosis category. The GLIM consensus criteria for malnutrition are thus intended to be used in parallel with established concepts and nomenclature, including cachexia, sarcopenia, and frailty.

Conclusion

A strong GLIM consensus endorsed the selected core phenotypic and etiologic criteria that are already in widespread use throughout the world. Many studies provide clear evidence that the agreed upon criteria for diagnosis of malnutrition are highly relevant, and each of them alone is able to predict adverse clinical outcomes. Because these criteria may be readily used with other approaches and additional criteria of regional preference, their global adoption is more likely. As the initiative moves forward, the creation of databases that use the selected criteria will facilitate the comparison of malnutrition prevalence, interventions, and outcomes throughout the world. Such observations can be

used to support the development of global standards of care that will promote improved outcomes.

After the launch of the GLIM consensus, it is important that the nutrition community use the criteria both in prospective and retrospective cohort studies as well as clinical trials to validate its relevance for clinical practice. The next steps are to secure endorsements from leading nutrition professional societies and to promote dissemination, validation testing, and feedback. The GLIM consensus should be reevaluated based on review of new studies and advances in screening and assessment every 3–5 years. We will also seek to share the GLIM consensus recommendations with the World Health Organization (WHO) in the context of the ICD revision process (ICD-11). This is a high priority because this classification scheme guides clinical diagnosis and reimbursement across much of the world. The proposed GLIM consensus criteria target adults in clinical settings, but it will also be a priority to work with the WHO and the United Nations to explore the potential for use in other global settings such as famine.

Supplementary Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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