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Health Professional's Guide *to* Gastrointestinal Nutrition

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Contents

SECTION 3 Nutrition and Gastrointestinal-Related Systemic Disorders

SECTION 4 Overview of the Intestinal Microbiome

SECTION 5 Surgical and Therapeutic Interventions for Gastrointestinal Disorders

Preface

The gastrointestinal (GI) system is often underappreciated despite its vast complexity, which includes the mouth, pharynx, esophagus, stomach, biliary system, pancreas, liver, small intestine, large intestine, rectum, and anus. Functionally, the GI system is essential for the digestion and absorption of nutrients that sustain us, the immunity that protects us, and the metabolism that fuels us. Further, the GI system orchestrates function among distant organs and communicates with our central nervous system. An additional ecosystem is now known to exist within the GI system that provides and impacts many physiological processes. Despite all these critical, ongoing actions, we often take the GI system for granted until there is a problem.

With the success of the first edition of the *Health Professional's Guide to Gastrointestinal Nutrition*, we were asked to lead the development of a second edition. The book's purpose is to help registered dietitian nutritionists (RDNs) and other health care providers understand both the complexities of the GI system and the changes that occur in various disease states, with the goal of providing the best nutrition care for their patients. As a practice-oriented guide, this book is intended to help RDNs, physicians, interns, and students identify and alleviate or resolve the nutritional problems related to the GI tract that affect the health and quality of life of our patients.

For ease of use, the book is divided into five sections. **Section 1: Gastrointestinal Nutrition Assessment and Diagnostics** begins with a comprehensive chapter on nutrition assessment of the patient with GI disorders, which is the first step in the Nutrition Care Process. These patients frequently experience nutrition-related problems, including nutrient deficiencies due to the inability to digest and absorb nutrients. An overview of tests and procedures commonly performed for patients with GI disorders is provided in a separate chapter to identify the indications, preparation, and risks involved in diagnosing various disease states.

Section 2: Nutrition and Gastrointestinal-Related Disorders includes 10 chapters that examine specific GI tract diseases. There is a wealth of information on disease etiologies, symptoms, diagnostic techniques, and nutritional implications. These chapters also offer practical suggestions about selecting nutrition interventions that are appropriate for specific patients. The specific topics in this section include inflammatory bowel disease (Chapter 3), short bowel syndrome (Chapter 4), irritable bowel syndrome (Chapter 5), celiac disease (Chapter 6), liver disease (Chapter 7), pancreatic disease (Chapter 8), pediatric-originating gastrointestinal disorders (Chapter 9), and gastrointestinal oncology (Chapter 10).

Section 3: Nutrition and Gastrointestinal Related Systemic Disorders focuses on nutrition intervention for common systemic conditions with gastrointestinal implications. This section covers medical treatment of obesity (Chapter 11), eating disorders (Chapter 12), and food allergies and intolerances (Chapter 13).

With the emergence of evidence on the critical role of the gut microbiome in health and disease, a new **Section 4: Overview of the Intestinal Microbiome** addresses this area of critical knowledge for health care professionals. Physiological functions of the intestinal microbiome, diagnoses related to altered microbial communities, and nutritional strategies for optimizing the microbial community are included in chapters on the intestinal microbiome (Chapter 16), prebiotics (Chapter 17), and probiotics (Chapter 18).

Section 5: Surgical and Therapeutic Interventions for Gastrointestinal Disorders includes ten chapters. Chapters 17 and 18 focus on GI surgeries (bariatric and other GI surgeries), which explore how surgical interventions are used to address serious health

problems and how these might alter digestion and absorption. Chapters 19 to 22 focus on nutrition support, including the uses of enteral and parenteral nutrition in adult and pediatric patients, as well as the special challenges of administering nutrition support in the home care setting. The information in these chapters complements and expands upon the coverage of nutrition support interventions for specific GI disorders found in many of the earlier chapters of this book. Chapter 23 is a guide to drug-nutrient interactions that may occur with the medications used to treat GI disorders. Chapter 24 address the use of nutraceutical supplements. Although further rigorous, scientific investigation of the use of nutraceuticals is needed, this chapter can help readers separate the more promising options from those that have not demonstrated efficacy. Chapter 25 frames the ethical and legal issues that health care professionals may face when providing GI nutrition interventions, particularly when a patient or authorized caregiver chooses to refuse artificial nutrition and hydration.

There are many ways to use this book. You may wish to start at the beginning and read from cover to cover. Alternatively, we encourage you to turn to the chapters that are most relevant to the types of care you provide or begin with the topics that are least familiar to you. Whatever your strategy, our goal is that you find this *Health Professional's Guide to Gastrointestinal Nutrition* to be an essential evidence-based professional resource in your clinical practice.

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CHAPTER

1

Nutrition Assessment for Patients With Gastrointestinal Disorders

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KEY POINTS

- Disorders of the gastrointestinal system can have a significant adverse impact on nutritional status by impairing ingestion, digestion, and absorption of food and nutrients, increasing nutritional losses and nutrient requirements, and ultimately influencing morbidity and mortality.
- The nutrition assessment is a comprehensive evaluation of the nutritional status of an individual. Nutrition screening occurs before the comprehensive nutrition assessment to identify patients who are malnourished or at risk for developing malnutrition.
- A complete nutrition assessment includes evaluating dietary data, biochemical test and procedure results; anthropometric measures; nutrition focused physical findings; and a personal, medical, and social history with the ultimate goal of improving clinical outcomes in patients with gastrointestinal disorders.

Introduction

Disorders of the gastrointestinal (GI) system can have an adverse impact on nutritional status by impairing ingestion, digestion, and absorption of food and nutrients and increasing nutritional losses and nutrient requirements.[1] Nutritional status has a profound influence on morbidity and mortality from illness in the acute care setting in both patients who are non-critically ill and critically ill.[2-6] In the clinical setting, nutrition assessment is a comprehensive evaluation of the nutritional status of an individual patient. Nutrition screening occurs before the comprehensive nutrition assessment to help identify patients who are malnourished or at risk for developing malnutrition to assure timely and appropriate nutrition assessment.[7] Once a patient is identified as at risk, the patient should then undergo nutrition assessment.

As the first step of the Nutrition Care Process, nutrition assessment is defined as "a systematic method for obtaining, verifying, and interpreting data needed to identify nutrition-related problems, their causes, and significance."[8] Nutrition assessment involves an initial evaluation of the patient, and ongoing monitoring and periodic reassessment is important to refine the individualized nutrition care plan to help maintain or improve the assessed status. The types of data collected during the assessment vary on a case-by-case basis but are organized into five general categories (see Box 1.1).[8] No single method is ideal for nutrition assessment; the use of a combination of methods is needed to effectively characterize nutritional status. All nutrition assessment methods provide indirect estimates of the process measured. Thus, the data obtained are usually compared to reference data to determine indicators of nutritional status.

BOX 1.1

Components of a Nutrition Assessment[8]

Food/nutrition-related history

- Food and nutrient intake
- Medication and dietary supplement intake, including herbs and other botanicals
- Knowledge, beliefs, and attitudes
- Food availability
- Physical activity
- Nutrition-related quality of life

Biochemical data, medical tests, and procedures

- Laboratory data (eg, electrolytes, glucose, renal, liver, gastrointestinal profiles)
- Tests (eg, gastric emptying time, resting metabolic rate)

Anthropometric measurements

- Height
- Weight
- Body mass index
- Weight history
- Weight change

Nutrition focused physical findings

- Physical appearance
- Skin, hair, and nail assessment
- Muscle and fat wasting
- Edema assessment
- Swallow function
- Abdominal exam
- Evaluation of enteral access devices (eg, gastrostomy or jejunostomy), if present
- Stool frequency and consistency
- Ileostomy or colostomy output, including volume and consistency
- Appetite
- Affect

Client history

- Personal history (eg, age, gender, race, language, education)
- Medical, health, and family history
- Treatments and use of complementary and alternative medicine
- Social history (eg, socioeconomic status, housing situation)

Nutrition Screening

Nutrition screening is a vital first step in determining which patients should be referred to the registered dietitian nutritionist (RDN) for nutrition assessment and care plan development. The American Society for Parenteral and Enteral Nutrition (ASPEN) defines nutrition screening as "a process to identify an individual who may be malnourished or at risk for malnutrition to determine if a comprehensive nutrition assessment and appropriate intervention are indicated."[9] The Academy of Nutrition and Dietetics expands this definition to include nutrition concerns beyond malnutrition, defining nutrition screening as "the process of identifying and referring those individuals and populations who are at risk for nutrition-related problems, are appropriate for nutrition care services, and would benefit from the Nutrition Care Process."[10]

Nutrition screening may be done by many health care professionals, including medical assistants, nurses, and nutrition and dietetics technicians, registered.[11] Physicians may also do nutrition screenings, particularly in the critical care setting.[12] Screening tools should be quick and easy for the clinician to use. More importantly, the tool should be valid and reliable for the population or care setting. In 2020, the Academy of Nutrition and Dietetics published a position paper on nutrition screening tools and recommended that the Malnutrition Screening Tool (MST) be used in all care settings to screen adults for malnutrition.[11,13] Although the MST was initially developed for the acute care setting, it has been validated in acute care, long-term care, and outpatient settings.[11] It has a moderate degree of validity, a moderate degree of agreement, and a moderate degree of inter-rater reliability in identifying malnutrition risk in adults, supported by Grade 1 evidence with good generalizability. Other screening tools performed well in some areas of validity but did not have Grade 1 evidence.[11] An MST score of 2 or greater means that the patient is at nutritional risk and should be promptly referred to an RDN for a full nutrition assessment.[13]

In the critical care setting, a more in-depth screening process is recommended to capture the risk of malnutrition and severity of illness, recognizing the impact of inflammation and the hypermetabolic and hypercatabolic state on nutritional status.[12] In the Society of Critical Care Medicine (SCCM)/ASPEN critical care guidelines, two screening tools are recommended: the Nutrition Risk Screening 2002 (NRS-2002) and the Nutrition Risk in the Critically Ill (NUTRIC) score, both of which are acceptable for use in the intensive care unit (ICU).[12] The NRS-2002 has two parts: The initial screening is used to identify the presence of malnutrition or risk of nutritional compromise. If the patient has a positive indicator for one of four initial screening questions, the final screening is done, which includes an assessment of nutritional risk and severity of illness to generate a risk score.[14] A score of 3 or higher indicates that the patient requires a full nutrition assessment and development of a nutrition care plan; a score of 5 or higher suggests that the patient is at high risk.[12,14] Those with high nutritional risk benefit from the initiation of early nutrition support therapy.[12] The NUTRIC score does not include specific nutritional measures, but it is a scoring system that includes age, Acute Physiology and Chronic Health Evaluation II (APACHE II) score, sequential organ failure assessment (SOFA) score, number of comorbidities, days from hospital admission, and interleukin-6 (IL-6) level.[15] A score is generated from these parameters. Because IL-6 is not available at all institutions, a modified NUTRIC score has been validated for use without IL-6 to allow institutions without the means to measure this inflammatory marker to use the scoring system.[16] A NUTRIC score of 6 to 10, or a modified NUTRIC score of 5 to 9, suggests that the patient is at high risk for worse clinical outcomes and would benefit from aggressive nutrition support intervention.[15,16] The NRS-2002, NUTRIC score, and modified NUTRIC score have been validated in the ICU population, demonstrating that those at high nutritional risk benefit from early nutrition intervention with improved clinical outcomes including reduced complications (including infectious complications) and mortality.[15-20] Box 1.2 summarizes key elements and populations of the screening tools discussed in this section.

BOX 1.2

Nutrition Screening Tools[13-16]

Malnutrition Screening Tool (MST)

Screening elements

Weight loss, including amount lost

Change in appetite

Recommended populations

Adults in all care settings

Nutrition Risk Screening 2002 (NRS-2002)

Screening elements

Initial screening:

- BMI less than 20.5
- unintentional weight loss in the past 3 months
- reduced intake in the past week
- severe illness (in the intensive care unit [ICU])

If any element of the initial screen is positive, final screening is conducted to evaluate:

- degree of impaired nutritional status, based on degree and time frame of unintentional weight loss, BMI, and reduced intake
- severity of illness

Recommended populations

European Society for Clinical Nutrition and Metabolism (ESPEN) recommends for hospitalized patients; American Society for Parenteral and Enteral Nutrition (ASPEN) recommends for patients who are critically ill

Nutrition Risk in the Critically Ill (NUTRIC)

Screening elements

Age

Acute Physiology and Chronic Health Evaluation II (APACHE II) score

Sequential organ failure assessment (SOFA) score

Number of comorbidities

Days from hospital admission to ICU admission

Interleukin-6 (IL-6) level

Recommended populations

Patients who are critically ill; validated with and without IL-6 level

Food/Nutrition-Related History

The food/nutrition-related history can include data related to dietary intake as well as such diet-related information as knowledge and beliefs about food and nutrition, medication and supplement use, and physical activity. Evaluation of usual dietary intake (ie, diet history) is an important part of the nutrition assessment. Commonly used methods for assessing food/nutrition-related history include the following:

- diet history
- 24-hour recall

- food record or diary
- food frequency questionnaire (FFQ)
- mobile health tracking applications

Each method has its advantages and disadvantages. In addition, the accuracy of these methods for predicting actual dietary intake is a matter of debate.[21-23]

Diet recall methods, such as the diet history and 24-hour recall, are commonly used in the clinical setting. The diet history helps the clinician assess a patient's usual dietary intake over an extended period of time, such as the past month or the past year. The 24-hour recall method estimates the patient's usual intake based on reported dietary intake in the past 24 hours. Multiple 24-hour recalls are sometimes necessary because 1 day of intake is not typically representative of usual intake.[24]

With food records, the patient records the types and amounts of food and beverages consumed for a predefined period of time, usually 1 to 7 days, and the clinician estimates the usual intake based on this information. Unlike the diet history and 24-hour recall methods, food records do not rely on memory.

The FFQ asks patients how many times a day, week, or year they consume certain foods (depending on the dietary component of interest). The clinician can use a patient's responses to the questionnaire to estimate intake of the dietary parameter of interest. The FFQ is often used in the research setting.

Mobile health tracking devices, including apps that can be installed on smartphones, are gaining in popularity.[25] A review noted that in 2017 there were 325,000 mobile health apps available in major app stores for download.[26] The available apps cover a wide range of monitoring tools including fitness, sleep, and food intake. Apps for tracking food intake can be much more convenient than a pen-and-paper food record or diary. Some apps offer nutrient analysis of food items by allowing the consumer to take a digital picture of the food item to be consumed, but these are still in development, and research is ongoing in this area. The apps vary in accuracy, so clinicians should be careful when using food tracking apps in a research setting.[25] Clinicians should also consider the patient's resources (eg, type of device and memory available for the app) and comfort level with technology before recommending a specific app for monitoring intake.[27,28] Knowledge of a variety of apps with different levels of complexity will allow RDNs to make app recommendations tailored to their patients' needs.

All these data-gathering methods can provide valuable information about a patient's dietary intake, which can then be compared to the patient's nutritional requirements to estimate adequacy of the diet. For patients who cannot participate in an interview (eg, patients who are critically ill requiring mechanical ventilation or patients with neurologic disorders), clinicians may need to rely on family members or caretakers to provide information about a patient's food/nutrition-related history. For patients receiving home nutrition support therapy—home enteral nutrition (EN) or parenteral nutrition (PN), or both—the home-infusion clinician may provide valuable insight into the patient's home-infusion history, including tolerance to the EN or PN regimen and ability to adhere to the infusion prescription.

In the acute care setting, calorie counts may be used to quantify oral intake. The patient may keep a food record or food diary during the hospital stay, but for patients who are ill and unable to keep these records, a family member, bedside nurse, patient care assistant, or other professional (eg, a trained food service professional) may do the monitoring. Extensive training or other innovations, such as taking pictures of food trays after a meal, may improve accuracy.[29] The RDN or designee then calculates energy and protein intake of the food consumed. The reliability of intake data depends on accuracy of the recorded food intake. For hospitalized patients receiving EN, monitoring of intake and output records can help identify interruptions in infusion and the need to adjust the infusion time to ensure consistent and adequate feeding.

Biochemical Data, Medical Tests, and Procedures

Biochemical tests using blood and urine provide quantitative data about nutritional status. They can supply useful information about recent nutrient intakes and nutrient deficiencies. However, because the results of biochemical tests can be influenced by non–nutrition-related factors, such as medications, fluid status, and other metabolic processes (eg, inflammation[30]), these findings should be evaluated in conjunction with other nutrition assessment methods. Biochemical assessment can include the following tests[8]:

- protein profile (eg, albumin, prealbumin, transferrin, C-reactive protein)
- vitamin and mineral profiles
- acid-base balance
- electrolyte and renal profile
- essential fatty acid profile
- nutritional anemia profile (eg, hemoglobin, hematocrit, mean corpuscular volume, vitamin B12, folate, and iron panel)
- lipid profile
- GI profile (eg, total bilirubin, direct bilirubin, alanine aminotransferase, aspartate aminotransferase, amylase, lipase)

Malabsorptive disorders are common with GI diseases. Malabsorption can involve defective digestion and absorption of carbohydrate, protein, fat, vitamins, and minerals, either in combination or independently. Biochemical tests and other procedures used in the diagnosis of malabsorptive disorders in patients with GI diseases are described in Chapter 2. Patients with malabsorptive disorders are at increased risk for vitamin and trace element deficiencies and, therefore, often require supplementation with a multivitamin, multivitamin with minerals, or individual micronutrients, depending on the location of the disorder (eg, vitamin B12 supplementation is usually required for patients with disorders that affect the terminal ileum). See Table 1.1 for laboratory tests used to assess vitamin and trace element status.[31-34]

Medical tests and procedures are an important part of the nutrition assessment process. For example, a computed tomography (CT) scan of the abdomen may help to identify GI complications, such as ileus or obstruction, which will help determine the patient's ability to start an oral diet or EN or the need to consider PN. A video swallow examination in a recently extubated patient can provide valuable information about the patient's ability to take an oral diet, need for a texture-modified diet, or need to continue taking nothing by mouth. The RDN should monitor for results of tests and procedures that will help develop and refine the nutrition care plan.

TABLE 1.1 Assessment of Vitamin and Trace Element Status[31-34]

Nutrient	Laboratory assay	Normal values[a]	Signs of deficiency	Toxicity symptoms
Water-soluble vitamins				
Thiamin (B1)	Whole blood	>3.0-7.7 mcg/dL	Beriberi, mental confusion, Wernicke encephalopathy, congestive heart failure	Rare: irritability, headache, insomnia
Riboflavin (B2)	Erythrocyte glutathione reductase activity coefficient	<1.2	Mucositis, dermatitis, photophobia, cheilosis, normocytic anemia	Unknown
Niacin (B3)	Urinary niacin metabolites	>2 mg per g creatinine	Headaches, diarrhea, dermatitis, pellagra, memory loss	Flushing, rash, irritation, vasodilation

Table continues

TABLE 1.1 Assessment of Vitamin and Trace Element Status[31-34] (continued)

Nutrient	Laboratory assay	Normal values[a]	Signs of deficiency	Toxicity symptoms
Pantothenic acid (B5)	Urinary pantothenic acid	>1 mg/dL	Fatigue, malaise, headache, insomnia	Diarrhea
Pyridoxine (B6)	Plasma pyridoxal 5'-phosphate (PLP) Urinary excretion of B6 metabolite	39-98 nmol/L >3 mcmol/d	Dermatitis, neuritis, microcytic anemia	Peripheral neuropathy
Biotin (B7)	Whole blood or serum biotin	>200 pg/mL	Dermatitis, lethargy, anorexia, alopecia, paresthesia, conjunctivitis	Unknown
Folate (B9)	Serum folate	>3 ng/mL	Megaloblastic anemia, diarrhea, lethargy	Pernicious anemia, convulsive seizures
Cyanocobalamin (B12)	Serum B12[b]	170-250 pg/mL	Megaloblastic anemia, neuropathy, stomatitis, glossitis, pernicious anemia	Unknown
Ascorbic acid (C)	Plasma ascorbic acid	>0.4 mg/dL	Hemorrhaging skin, nose, gastrointestinal tract; weakness; bleeding gums; impaired wound healing	Osmotic diarrhea, oxalate kidney stones, interferes with anticoagulation therapy
Choline[c]	Plasma choline	≥10 mcmol/L	Fatty liver, liver damage, elevated aminotransferase	Fishy body odor, sweating, salivation, hypotension
Fat-soluble vitamins				
A	Serum retinol	30-100 mcg/dL	Night blindness, dermatitis, xerophthalmia, keratomalacia	Acute: nausea, vomiting, headache, dizziness, chronic peeling skin, gingivitis, alopecia
D	Serum 25-hydroxyvitamin D	≥20 ng/mL	Osteomalacia, rickets, muscle weakness	Excess bone and soft tissue calcification, kidney stones, hypercalcemia
E	Plasma or serum α-tocopherol	0.5-2.0 mg/dL	Increased platelet aggregation hemolytic anemia, neuronal axonopathy, myopathy	Impaired neutrophil function, thrombocytopenia
K	Plasma phylloquinone	0.15-1.0 mcg/L	Bleeding, purpura, bruising	Bruising, bleeding, jaundice
Trace elements				
Chromium	Serum value	0.05-5.0 mcg/L	Glucose intolerance, peripheral neuropathy, increased serum cholesterol, hyperlipidemia, insulin resistance	Unknown

Table continues

TABLE 1.1 Assessment of Vitamin and Trace Element Status[31-34] (continued)

Nutrient	Laboratory assay	Normal values[a]	Signs of deficiency	Toxicity symptoms
Copper	Serum value Ceruloplasmin level	70-140 mcg/dL 20-35 mg/dL	Neutropenia, microcytic anemia, osteoporosis, decreased hair and skin pigmentation, dermatitis	Uncommon: nausea, vomiting, epigastric pain, diarrhea
Iodine[d]	Urine	100-199 mcg/L	Hyperplasia of thyroid, goiter, reduced metabolic rate, hypercholesterolemia	Rhinorrhea, headache, parotitis, acne
Iron	Serum ferritin	M: 40-300 mcg/L F: 20-200 mcg/L	Microcytic hypochromic anemia, pallor, koilonychia, glossitis, impaired behavioral and intellectual performance, fatigue	Cirrhosis, cardiomegaly, pancreatic damage
Manganese	Serum value	5-15 mcg/L	Nausea, vomiting, dermatitis, changes in hair color, hypocholesterolemia	Extrapyramidal symptoms, encephalitis-like symptoms, hyperirritability
Molybdenum	Neutron	0.58-0.8 mcg/L	Tachycardia, tachypnea, altered mental status, vision changes, headache, nausea, vomiting	Increased copper excretion
Selenium	Plasma or serum value	63-160 mcg/L	Muscle weakness and pain, cardiomyopathy	Hair loss, dermatitis, brittle nails, tooth decay, fatigue
Zinc	Serum value[e]	80-120 mcg/dL	Dermatitis, hypogeusia, diarrhea, apathy, depression, impaired wound healing	Nausea, vomiting, headache

[a] Reference ranges for adult patients. Reference values may vary by laboratory.
[b] Metabolites that result from vitamin B12 deficiency (ie, methylmalonic acid and homocysteine) may be sensitive indicators of B12 deficiency. Normal serum methylmalonic acid levels are 0.08 to 0.56 mcmol/L, and normal homocysteine levels are 5 to 15 mcmol/L.
[c] Although not a vitamin, choline is an essential nutrient and is, therefore, included in this table.
[d] Serum thyroid-stimulating hormone and free thyroxine can be used as initial screening. These surrogate markers for iodine deficiency can be used initially in place of a 24-hour urine iodine study.
[e] During systematic inflammatory response syndrome, serum zinc will decrease to about half of normal and remain depressed until the syndrome resolves.

Anthropometric Measurements

Anthropometry includes measurements of body size, weight, and proportions. Anthropometric measurements used for nutrition assessment can include the following parameters[8]:

- height or length
- weight
- frame size
- weight change
- BMI
- growth pattern indexes or percentile ranks
- body compartment estimates (eg, fat mass, fat-free mass)

Anthropometric measures can be used, in conjunction with other assessment methods, as indicators of overall nutritional status. However, these measures are not useful for identifying specific nutrient deficiencies. Anthropometric assessments are particularly important in patients with GI disorders because wasting syndrome is a common adverse effect of the disease process.[1]

Body Weight

Body weight provides a gross evaluation of overall fat and muscle stores. Ideal body weight (IBW) is often calculated using the Hamwi method[35]:*

- Males: 106 lb for the first 5 ft in height, 6 lb for each inch taller than 5 ft
- Females: 100 lb for the first 5 ft in height, 5 lb for each inch taller than 5 ft

Usual body weight (UBW) may be a more applicable parameter to use when evaluating patients with GI dysfunction. A report of weight change may be subject to the patient's memory but can be confirmed with measured weights if a clinician has access to outpatient records. The UBW provides a useful tool for assessing changes in weight status over time. IBW and UBW may be used to evaluate the degree of overnutrition or undernutrition. Recent unintentional weight loss is a strong indicator of declining nutritional status.[36] Weight loss of more than 10% of UBW within a 6-month period is considered clinically significant.[37] Weight gain could indicate repletion of lean and fat tissue, overnutrition, or presence of edema. Percentages of IBW, UBW, and recent weight can all be used to evaluate weight status.[38] Assessment of weight status can be difficult in patients who are critically ill because of changes in fluid status and the challenges of correlating weight changes to fluid balance.[39,40] Patients who are critically ill requiring mechanical ventilation may not be able to communicate a weight history. Careful review of outpatient records, if such records are available, is essential to obtaining a weight history and determining the optimal weight to use for the nutrition assessment. For patients who are critically ill who were not weighed before volume resuscitation (eg, in severe pancreatitis), an outpatient weight that was measured closest to the ICU admission date may be a more appropriate weight to use for assessment.

Percentage of Ideal Body Weight

To calculate a patient's percentage of IBW, divide the current weight by the IBW and multiply the result by 100. The results are interpreted as follows[38]:

- mild malnutrition: 80% to 90% of IBW
- moderate malnutrition: 70% to 79.9% of IBW
- severe malnutrition: less than 70% of IBW

Percentage of Usual Body Weight

To calculate a patient's percentage of UBW, divide the current weight by the UBW and multiply the result by 100. The results are interpreted as follows[38]:

- mild malnutrition: 85% to 95% of UBW
- moderate malnutrition: 75% to 84.9% of UBW
- severe malnutrition: less than 75% of UBW

* Specific recommendations for transgender people were not provided.

Time Frame of Weight Change

The time frame of weight loss is an important part of the assessment of percentage of UBW. The clinician should obtain the time frame of the weight change either from the patient interview or from documented weight records. After calculating the percentage of UBW, the time frame of weight change should be interpreted as follows:

$$\%\ \text{Weight Change} = \frac{(\text{Usual body weight} - \text{Current body weight})}{\text{Usual body weight}} \times 100$$

The results are interpreted as follows[38]:

- *Significant weight loss* is defined as 1% to 2% in 1 week; 5% in 1 month; 7.5% in 3 months; or 10% in 6 months.
- *Severe weight loss* is defined as weight loss that exceeds the preceding amounts.

BMI

BMI is commonly used to classify weight status and assess healthy weight, malnutrition, and obesity. It is calculated using relative weight for height (as shown in the following equations) and is significantly correlated with total body fat content.[41]

$$\text{BMI} = \frac{\text{Weight in kg}}{(\text{Height in m})^2}$$

or

$$\text{BMI} = \frac{\text{Weight in lb}}{(\text{Height in inches})^2} \times 703$$

Guidelines for interpretation of BMI in adults are presented in Table 1.2.[41,42] For children and adolescents aged 19 years and younger, assessment of BMI is age- and gender-specific. Refer to the appropriate reference tables available from the Centers for Disease Control and Prevention (www.cdc.gov/growthcharts).

TABLE 1.2 Interpretation of Body Mass Index in Adults[41,42]

BMI	Classification
≤15.9	Severe thinness
16.0-16.9	Moderate thinness
17.0-18.4	Mild thinness
18.5-24.9	Normal weight
25.0-29.9	Overweight
30.0-34.9	Obesity class I
35.0-39.9	Obesity class II
≥40	Obesity class III

Body Composition

Historically, body composition (ie, fat mass and fat-free mass) has been estimated using skinfold measurements, such as midarm circumference, midarm muscle circumference, and skinfold thickness. Although not frequently used in the clinical setting, skinfold measurements (serial measures) can be used to evaluate changes in lean and fat mass over time in individual patients. Other methods for clinical evaluation of body composition include dual-energy x-ray absorptiometry (DXA), ultrasound (US), and bioelectrical impedance analysis (BIA). Recent clinical guidelines published by ASPEN recommend DXA for the evaluation of fat mass only, because validity of use for the evaluation of lean body mass is still unknown. Guidelines for the use of US and BIA could not be provided.[43] CT has been used in the research setting and may also be used in the clinical setting, by appropriately trained practitioners, to evaluate fat and muscle mass.[44]

Waist Circumference

Waist circumference is an assessment of abdominal fat. It is measured (in inches or centimeters) by placing a standard measuring tape around the bare abdomen just above the hip bone. Independent of BMI, a high waist circumference is a risk factor for several diseases, including diabetes, hyperlipidemia, hypertension, and cardiovascular disease. A waist circumference of more than 40 inches (102 cm) in men and more than 35 inches (88 cm) in women is associated with increased disease risk.[45]

Nutrition Focused Physical Findings

Nutrition focused physical findings are described as "nutrition-related physical characteristics associated with pathophysiological states derived from a nutrition focused physical examination, interview, or the medical record." These findings are examined to assess overall physical appearance, muscle and subcutaneous fat wasting, swallow function, appetite, and affect. Signs and symptoms of micronutrient deficiencies as well as essential fatty acid deficiency, which may be of significant concern in patients with GI disorders, may be identified during the nutrition focused physical examination. See Box 1.3 for clinical findings from the physical examination associated with nutrient deficiencies. Both subjective and objective physical findings are assessed during the nutrition focused physical examination, which includes evaluations of the following factors and systems[8]:

- overall appearance
- body language
- cardiovascular-pulmonary system (eg, edema, shortness of breath)
- extremities, muscles, and bones
- GI system (mouth to rectum)
- head and eyes
- nerves and cognition
- skin
- vital signs (eg, blood pressure, heart rate, temperature)

The nutrition focused physical examination may be limited in patients who are critically ill, particularly the evaluation of extremities, muscles, and bones. The presence of an endotracheal tube, tracheostomy, central venous catheters, orogastric or nasogastric tubes, or compression boots may make it difficult for the RDN to conduct a comprehensive evaluation. Coordination with the patient's bedside nurse to assist with the examination or to plan the examination for times when the patient is being turned to evaluate for pressure injuries or while being washed may allow for a more comprehensive examination.

BOX 1.3

Clinical Findings From Physical Examination Associated With Nutrient Deficiencies

Hair

Clinical findings	*Possible deficiency*
Alopecia	Protein
Dry, dull, lackluster, brittle, sparse	Protein, iron, zinc, essential fatty acids
Dyspigmentation	Biotin, protein
Flag sign (alternating bands of light and dark hair)	Protein

Skin and nails

Clinical findings	*Possible deficiency*
Xerosis	Vitamin A, essential fatty acids
Follicular hyperkeratosis	Vitamin A, essential fatty acids
Perifollicular petechiae	Vitamin C, vitamin K
Dermatitis	Essential fatty acids, niacin, riboflavin, zinc
Pallor	Iron, folate, vitamin B12
Nasolabial seborrhea	Niacin, riboflavin, vitamin B6
Koilonychia	Iron

Eyes

Clinical findings	*Possible deficiency*
Xerophthalmia	Vitamin A
Bitot spots	Vitamin A
Night blindness	Vitamin A
Angular palpebritis	Riboflavin

Mouth

Clinical findings	*Possible deficiency*
Cheilosis	Vitamin B6, riboflavin, niacin
Angular stomatitis	Riboflavin, vitamin B6, iron
Bleeding or spongy gums	Vitamin C
Magenta tongue	Riboflavin
Atrophic papillae	Iron, niacin, folate, vitamin B12
Glossitis	Niacin, folate, iron, vitamin B6, vitamin B12
Dysgeusia	Zinc

Box continues

BOX 1.3 (CONTINUED)

Cardiovascular

Clinical findings	*Possible deficiency*
Irregular or abnormal rhythm or rate	Potassium excess or deficiency, calcium or phosphorus deficiency, magnesium deficiency or excess

Musculoskeletal

Clinical findings	*Possible deficiency*
Muscle wasting	Protein-energy malnutrition
Bowlegs	Vitamin D, calcium
Beading of ribs	Vitamin D, protein-energy malnutrition

Neurologic

Clinical findings	*Possible deficiency*
Mental confusion	Thiamin, vitamin B12, vitamin B6
Dementia	Niacin, vitamin B12

Client History

The client history includes information related to personal, medical, family, and social history with the potential to affect nutritional status. Box 1.4 outlines the data to be included in the client history.[8]

Assessment of Energy Requirements

Patients Who Are Critically Ill

Patients who are critically ill have unique metabolic alterations compared to patients who are noncritically ill and ambulatory. These changes are summarized in Box 1.5. Patients who are critically ill have higher protein losses and increased metabolic demand for protein. Protein losses can be minimized but not completely abolished with nutrition support therapy alone.[46] The goals of nutrition support therapy for the patient who is critically ill are to minimize protein loss, maintain immune function, avoid metabolic complications, and attenuate the metabolic response to stress.[12] An accurate assessment of energy requirements is an important step in meeting these goals.

Underfeeding or overfeeding patients who are critically ill can lead to significant complications. Underfeeding calories can lead to impaired immune response, muscle catabolism, poor wound healing (particularly for surgical patients), and development of pressure injuries. Overfeeding can lead to hyperglycemia, hyperinsulinemia, hypokalemia, hypophosphatemia, excess carbon dioxide production, difficulty weaning from the ventilator, hepatic steatosis, and azotemia.[47,48] Indirect calorimetry is used to calculate energy expenditure by measurement of respiration gas exchange (oxygen consumption and carbon dioxide production) and is considered the gold standard for assessing energy requirements, particularly in patients who are critically ill.[49] Measuring energy expenditure can help to avoid the complications associated with underfeeding or overfeeding. Because the equipment used to conduct indirect calorimetry is expensive and requires technical expertise, its use in the clinical setting is limited. For clinicians without access to indirect calorimetry, predictive equations are necessary to determine energy requirements for the patient who is critically ill.

BOX 1.4

Data to Include in a Client History[8]

Personal history

- Age, gender, sex, race
- Ethnicity
- Language
- Literacy factors
- Education
- Role in family
- Tobacco use
- Physical disability
- Mobility

Medical history

- Chief nutrition complaint
- Cardiovascular
- Endocrine, metabolic
- Excretory
- Gastrointestinal
- Gynecologic
- Hematologic, oncologic
- Immunologic
- Musculoskeletal
- Neurologic
- Psychological

Treatments and therapy

- Medical treatment, medical therapy
- Surgical treatment
- Palliative care, end-of-life care

Family and social history

- Socioeconomic status
- Living and housing situation
- Domestic issues
- Social and medical support
- Geographic location of home
- Occupation
- Religion
- History of recent crisis
- Daily stress level

BOX 1.5

Metabolic Changes During Critical Illness

Shock or resuscitation phase

- Low cardiac output
- Hypotension
- Poor tissue perfusion
- Reduced oxygen consumption

Acute catabolic phase

- Glycogenolysis
- Gluconeogenesis
- Proteolysis
- Increased oxygen consumption
- Increased carbon dioxide production
- Hypermetabolism
- Hyperglycemia
- Overall catabolism

Anabolic phase

- Energy expenditure returns to normal
- Normoglycemia
- Anabolism

According to the Academy of Nutrition and Dietetics 2012 Critical Illness Evidence-Based Nutrition Practice Guideline,[50] the Penn State University (PSU) 2003b equation for resting metabolic rate (RMR) has the highest prediction accuracy and should be used in nonobese, critically ill, mechanically ventilated adults. See Box 1.6 for this equation.[51]

BOX 1.6

Estimating Energy Requirements for Adults Who Are Mechanically Ventilated and Without Obesity[51]

Penn State University 2003b Equation

$$RMR = Mifflin\ (0.96) + V_E\ (31) + T_{max}\ (167) - 6{,}212$$

Where RMR is resting metabolic rate, Mifflin is Mifflin-St. Jeor RMR equation (see Box 1.9), V_E is minute ventilation in L/min, and T_{max} is maximum temperature over previous 24 hours in degrees Celsius.

According to the Academy of Nutrition and Dietetics 2012 Critical Illness Evidence-Based Nutrition Practice Guideline, the PSU 2003b equation has the highest prediction accuracy in critically ill, mechanically ventilated adults with obesity who are aged 60 years or less. However, for patients who are obese aged 60 years or older, the PSU 2010 equation has the highest prediction accuracy.[50] See Box 1.7 for the PSU 2010 equation.[52]

BOX 1.7

Estimating Energy Requirements for Adults With Obesity Who Are Mechanically Ventilated[52]

Penn State University 2010 Equation

$$RMR = Mifflin\ (0.71) + V_E\ (64) + T_{max}\ (85) - 3{,}085$$

Where RMR is resting metabolic rate, Mifflin is Mifflin-St. Jeor RMR equation (see Box 1.9), V_E is minute ventilation in L/min, and T_{max} is maximum temperature over previous 24 hours in degrees Celsius.

The SCCM and ASPEN have published guidelines for estimating energy requirements in patients who are critically ill as well. Both societies advocate the use of indirect calorimetry, but many institutions do not have access to this technology. The societies recommend a simplified, weight-based method for determining energy requirements. For nonobese adults, 25 to 30 kcal/kg is recommended. Hypocaloric, high-protein feeding is recommended for critically ill obese patients to help avoid specific complications, such as hyperglycemia and excessive carbon dioxide production while preserving lean body mass.[12] For patients with a BMI of 30 to 50, energy requirements should be calculated using 11 to 14 kcal/kg of actual weight, and for patients with a BMI of greater than

50, energy requirements should be calculated using 22 to 25 kcal/kg of IBW.[12,53] Interestingly, a secondary data analysis found no significant difference in mortality or time to discharge alive in a large cohort (n=5,672) of patients who are critically ill whose energy requirements were calculated using complex equations vs weight-based equations.[54]

Patients Who Are Noncritically Ill

In patients who are noncritically ill, basal energy expenditure (BEE) can be estimated using predictive equations, as an alternative to indirect calorimetry. The Harris-Benedict equation[55] is one of the oldest and most widely used predictive equations for calculating BEE. See Box 1.8.

BOX 1.8

Harris-Benedict Equation

Male: $BEE = 66 + (13.7 \times W) + (5 \times H) - (6.8 \times A)$

Female: $BEE = 655 + (9.6 \times W) + (1.7 \times H) - (4.7 \times A)$

Where BEE is basal energy expenditure, W is body weight in kg, H is height in cm, and A is age in years.

In addition, estimated energy needs may be based on RMR, as calculated by the Mifflin-St. Jeor equation.[6] See Box 1.9.

BOX 1.9

Mifflin-St. Jeor Equation

Male: $RMR = (9.99 \times W) + (6.25 \times H) - (4.92 \times A) + 5$

Female: $RMR = (9.99 \times W) + (6.25 \times H) - (4.92 \times A) - 161$

Where W is body weight in kg, H is height in cm, and A is age in years.

This equation seems to be the most accurate for estimation of energy needs among individuals who are obese and nonobese who are not critically ill.[57]

Assessment of Protein Requirements

Protein Requirements

In healthy individuals, the Recommended Dietary Allowance for protein in men and women* is 0.8 g/kg/d.[58] Estimated protein requirements may be based on specific disease states or metabolic stress states and may increase to levels of up to 2 g/kg/d depending on level of

* Specific recommendations for transgender people were not provided.

hypermetabolism, stress, and exogenous losses.[59] The body of a 70-kg male includes approximately 11 kg protein, with about 43% of it in the form of skeletal muscle.[60]

The rate of endogenous protein breakdown (catabolism) decreases during energy deprivation. An unstressed individual loses approximately 12 to 18 g protein per day after about 10 days of starvation, which equates to approximately 2 oz (57 g) of muscle tissue (2 to 3 g nitrogen). During metabolic stress, protein breakdown increases exponentially to approximately 30 to 60 g/d after surgery, 60 to 90 g/d with infection, 100 to 130 g/d with severe sepsis, and more than 175 g/d with burns or head injuries.[61] In chronic illness, skeletal muscle becomes the largest single contributor to protein loss.[62] The SCCM and ASPEN recommend a protein intake of 1.2 to 2 g/kg for patients who are critically ill. For patients who are critically ill who are obese, the societies recommend using IBW for calculations and providing at least 2 g/kg IBW for patients with class I and II obesity and at least 2.5 g/kg IBW for patients with class III obesity.[12]

Nitrogen Balance

Nitrogen balance studies are sometimes used to evaluate the adequacy of protein intake. Nitrogen balance studies indicate the relationship between protein intake and nitrogen removal from the renal system. Positive nitrogen balance cannot confirm anabolism because it lacks the specificity of stable isotopic amino acid studies.[63,64] The conversion factor commonly used for dietary protein is 6.25 g nitrogen per 1 g protein. Accurate 24-hour urine collection is difficult to obtain, and significant error may consequently be introduced into nitrogen balance calculations. See Box 1.10.

BOX 1.10

Nitrogen Balance Calculation

$$\text{Nitrogen balance (g/d)} = \text{nitrogen intake (g/d)} - \text{nitrogen loss (g/d)}$$

$$= \frac{\text{(Protein Intake)}}{6.25} - \left[\frac{\text{UUN (g/d)}}{0.8} + 2.5\ \text{g}\right]$$

Where UUN = urine urea nitrogen, UUN/0.8 represents UUN + urinary nonurea nitrogen, and 2.5 is the sum of fecal and integumental nitrogen.

Hepatic Transport Proteins

Historically, hepatic transport proteins have been used as markers of malnutrition. Low levels of these acute-phase proteins are correlated with morbidity and mortality.[30] These proteins are useful prognostic indicators of severity of illness, but they should not be used routinely as the primary diagnostic marker of malnutrition. Synthesis of acute-phase proteins (eg, albumin, transferrin, prealbumin, and retinol-binding protein) decreases precipitously during inflammatory conditions. Positive acute-phase proteins (C-reactive protein) increase in concentration during acute and chronic inflammatory states. Elevation of C-reactive protein may be used to confirm inflammatory status.[30,65]

Nutrition Assessment Tools

Numerous tools are available for general assessment of nutritional status. In the clinical setting, one of the most commonly used and validated assessment tools is the subjective global assessment (SGA).

The SGA (see Figure 1.1) is a nutrition assessment tool used to measure nutritional status on the basis of weight, dietary intake, GI symptoms, functional capacity, and physical examination findings.[37] Nutritional status is categorized as well-nourished, moderately

FIGURE 1.1 The subjective global assessment

(Select appropriate category with a checkmark, or enter numerical value where indicated by "#.")

A. History
1. Weight change
Overall loss in past 6 months: amount = # _____ kg; % loss = # _____
Change in past 2 weeks: _____increase,
_____no change,
_____decrease.

2. Dietary intake change (relative to normal)
_____No change,
_____Change _____duration = #_____weeks
_____type: _____suboptimal liquid diet,_____full liquid diet
_____hypocaloric liquids, _____starvation.

3. Gastrointestinal symptoms (that persisted for >2 weeks)
_____none, _____nausea, _____vomiting, _____diarrhea, _____anorexia.

4. Functional capacity
_____No dysfunction (eg, full capacity),
_____Dysfunction _____duration = # _____weeks.
_____type: _____working suboptimally
_____ambulatory,
_____bedridden.

5. Disease and its relation to nutritional requirements
Primary diagnosis (specify) _____
Metabolic demand (stress): _____no stress, _____low stress,
_____moderate stress, _____high stress.

B. Physical (for each trait specify: 0 = normal, 1+ = mild, 2+ = moderate, 3+ = severe).
_____loss of subcutaneous fat (triceps, chest)
_____ muscle wasting (quadriceps, deltoids)
_____ ankle edema
_____ sacral edema
_____ ascites

C. SGA rating (select one)
_____A = Well nourished
_____B = Moderately (or suspected of being) malnourished
_____C = Severely malnourished

Adapted with permission from Detsky AJ, McLaughlin JR, Baker JP, et al. What is subjective global assessment of nutritional status? *JPEN J Parenter Enteral Nutr.* 1987;11:8-14.[37]

malnourished (or suspected of being malnourished), or severely malnourished. The SGA was originally developed for patients with GI disease.[14] It has since been validated and used clinically for many patient populations and is widely accepted as a practical and reliable tool for nutrition assessment.[66]

Documenting Malnutrition

Malnutrition is a diagnosis known to be associated with poor outcomes in individuals who are hospitalized and nonhospitalized. A joint task force of the Academy of Nutrition and Dietetics and ASPEN has recommended a standardized set of diagnostic characteristics to identify and document adult malnutrition (see Table 1.3).[67] A 2019 review evaluated the usability of these diagnostic characteristics in day-to-day practice and their association with clinical outcomes.[68] Many of the diagnostic characteristics are readily available to clinicians during nutrition assessment, and the use of this framework to assess the presence of malnutrition has been predictive of length of hospital stay, morbidity, and mortality. A large validation study led by the Academy of Nutrition and Dietetics is in progress.

TABLE 1.3 Clinical Characteristics That Support a Diagnosis of Malnutrition[a,67]

Clinical characteristic	Malnutrition in the context of acute illness or injury				Malnutrition in the context of chronic illness				Malnutrition in the context of social or environmental circumstances			
	Moderate malnutrition		**Severe malnutrition**		**Moderate malnutrition**		**Severe malnutrition**		**Nonsevere (moderate) malnutrition**		**Severe malnutrition**	
(1) **Energy intake** Malnutrition is the result of inadequate food and nutrient intake or assimilation; thus, recent intake compared to estimated requirements is a primary criterion defining malnutrition. The clinician may obtain or review the food and nutrition history, estimate optimum energy needs, compare them with estimates of energy consumed, and report inadequate intake as a percentage of estimated energy requirements over time.	<75% of estimated energy requirement for >7 d		≤50% of estimated energy requirement for ≥5 d		<75% of estimated energy requirement for ≥1 mo		≤75% of estimated energy requirement for ≥1 mo		<75% of estimated energy requirement for ≥3 mo		≤50% of estimated energy requirement for ≥1 mo	
(2) **Interpretation of weight loss** The clinician may evaluate weight in light of other clinical findings, including the presence of under- or overhydration. The clinician may assess weight change over time reported as a percentage of weight lost from baseline.	*%*	*Time*	*%*	*Time*	*%*	*Time*	*%*	*Time*	*%*	*Time*	*%*	*Time*
	1-2	1 wk	>2	1 wk	5	1 mo	>5	1 mo	5	1 mo	>5	1 mo
Physical findings: Malnutrition typically results in changes to the physical examination. The clinician may perform a physical examination and document any one of the findings below as an indicator of malnutrition.												
(3) **Body fat** Loss of subcutaneous fat (eg, orbital, triceps, fat overlying the ribs)	Mild		Moderate		Mild		Severe		Mild		Severe	

Table continues

TABLE 1.3 Clinical Characteristics That Support a Diagnosis of Malnutrition[a,67] (continued)

	Malnutrition in the context of acute illness or injury		Malnutrition in the context of chronic illness		Malnutrition in the context of social or environmental circumstances	
Clinical characteristic	**Moderate malnutrition**	**Severe malnutrition**	**Moderate malnutrition**	**Severe malnutrition**	**Nonsevere (moderate) malnutrition**	**Severe malnutrition**
(4) **Muscle mass** Muscle loss (eg, wasting of the temples [temporalis muscle]; clavicles [pectoralis and deltoids]; shoulders [deltoids]; interosseous muscles; scapula [latissimus dorsi, trapezius, deltoids]; thigh [quadriceps]; and calf [gastrocnemius])	Mild	Moderate	Mild	Severe	Mild	Severe
(5) **Fluid accumulation** The clinician may evaluate generalized or localized fluid accumulation evident on examination (extremities; vulvar or scrotal edema or ascites). Weight loss is often masked by generalized fluid retention (edema), and weight gain may be observed.	Mild	Moderate to severe	Mild	Severe	Mild	Severe
(6) **Reduced grip strength** The clinician should consult normative standards supplied by the manufacturer of the measurement device.	N/A[b]	Measurably reduced	N/A	Measurably reduced	N/A	Measurable reduced

[a] The presence of at least two of the six characteristics is recommended for diagnosis of either severe or nonsevere malnutrition. Height and weight should be measured rather than estimated to determine body mass index. Usual weight should be obtained to determine the percentage and interpret the significance of weight loss. Basic indicators of nutritional status, (eg, body weight, weight change, and appetite) may substantively improve with refeeding in the absence of inflammation. Refeeding or nutrition support, or both, may stabilize but not significantly improve nutrition parameters in the presence of inflammation. The National Center for Health Statistics defines a chronic disease or condition as one lasting 3 months or longer. Serum proteins, such as albumin and prealbumin, are not included as defining characteristics of malnutrition because recent evidence analysis shows that serum levels of these proteins do not change in response to changes in nutrient intake.

[b] N/A = not applicable.

Adapted with permission from White JV, Guenter P, Jensen G, et al. Consensus statement of the Academy of Nutrition and Dietetics/American Society for Parenteral and Enteral Nutrition: characteristics recommended for the identification and documentation of adult malnutrition (undernutrition). *J Acad Nutr Diet.* 2012;112(5):730-738.[67]

A modified tool for assessing malnutrition has been developed by a working group spearheaded by ASPEN and the European Society for Clinical Nutrition and Metabolism.[69] The group found that there was no framework for identifying malnutrition that was accepted on a global scale. The members evaluated various malnutrition criteria to develop a simplified framework for identifying malnutrition that was then developed and accepted by a global group of clinical nutrition experts. The key characteristics include the evaluation of phenotypic criteria (weight change, BMI, and reduced muscle mass) and etiologic criteria (reduced food intake or assimilation, and inflammation). After identifying the initial phenotypic and etiologic criteria, clinicians can then determine severity of malnutrition (See Boxes 1.11 and 1.12). Validation studies are in progress to determine if this assessment framework can identify such clinically relevant outcomes as prolonged length of hospital stay, morbidity, and mortality on a global scale.[70]

BOX 1.11

Global Leadership Initiative in Malnutrition: Phenotypic and Etiologic Criteria for the Diagnosis of Malnutrition[69]

Phenotypic criteria	Etiologic criteria
Weight loss (%) More than 5% within past 6 months or more than 10% beyond 6 months	*Reduced food intake or assimilation* 50% or less of energy requirements for more than 1 week, or any reduction for more than 2 weeks, or any chronic gastrointestinal condition that adversely affects food assimilation or absorption
Low BMI Less than 20 if aged 70 years or less, or less than 22 if aged more than 70 years Asian populations: Less than 18.5 if aged 70 years or less, or less than 20 if aged more than 70 years	*Inflammation* Acute disease or injury, or chronic disease-related
Reduced muscle mass Reduced by validated body composition measuring techniques	

BOX 1.12

Thresholds for Severity Grading of Malnutrition Into Stage 1 (Moderate) and Stage 2 (Severe) Malnutrition[69]

	Phenotypic criteria[a]
Stage 1 (moderate)	
Weight loss (%)	5% to 10% within the past 6 months, or 10% to 20% beyond 6 months
Low BMI[b]	Less than 20 if aged 70 years or less or less than 22 if aged 70 years or more
Reduced muscle mass	Mild-to-moderate deficit (using validated assessment methods)
Stage 2 (severe)	
Weight loss (%)	More than 10% within the past 6 months, or more than 20% beyond 6 months
Low BMI[b]	Less than 18.5 if aged 70 years or less, or less than 10 if aged 70 years or more
Reduced muscle mass	Severe deficit (using validated assessment methods)

[a] One phenotypic criterion is required to meet a particular grade of malnutrition.
[b] Further research is needed to secure consensus reference BMI data for Asian populations in clinical settings.

Summary

The GI tract is essential for the absorption and digestion of foods, and disorders of the GI system can have a significant impact on dietary intake and nutritional status. Nutrition assessment plays a vital role in identifying nutrition-related problems in patients with GI disorders and in developing appropriate nutrition interventions. A complete nutrition assessment includes evaluating dietary data, biochemical test and procedure results, anthropometric measures, nutrition focused physical findings, and the personal, medical, and social history, with an ultimate goal of improving clinical outcomes in patients with GI disorders.

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Index

Letters *b*, *f* and *t* after page number indicate box, figure, and table, respectively.

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Z