

Table 30-1 Definitions of Malnutrition

CLASSIFICATION	DEFINITION	GRADING	
Gomez	Weight below % median WFA	Mild (grade 1) Moderate (grade 2) Severe (grade 3)	75%–90% WFA 60%–74% WFA <60% WFA
Waterlow	z-scores (SD) below median WFH	Mild Moderate Severe	80%–90% WFH 70%–80% WFH <70% WFH
WHO (wasting)	z-scores (SD) below median WFH	Moderate Severe	$-3 \leq z\text{-score} < -2$ $z\text{-score} < -3$
WHO (stunting)	z-scores (SD) below median HFA	Moderate Severe	$-3 \leq z\text{-score} < -2$ $z\text{-score} < -3$
Kanawati	MUAC divided by occipitofrontal head circumference	Mild Moderate Severe	<0.31 <0.28 <0.25
Cole	z-scores of BMI for age	Grade 1 Grade 2 Grade 3	BMI for age z-score < -1 BMI for age z-score < -2 BMI for age z-score < -3

From Grover Z, Ee LC: Protein energy malnutrition, *Pediatr Clin North Am* 56:1055–1068, 2009

BMI, Body mass index; HFA, height for age; MUAC, mid-upper arm circumference; NCHS, U.S. National Center for Health Statistics; SD, standard deviation; WFA, weight for age; WFH, weight for height; WHO, World Health Organization.

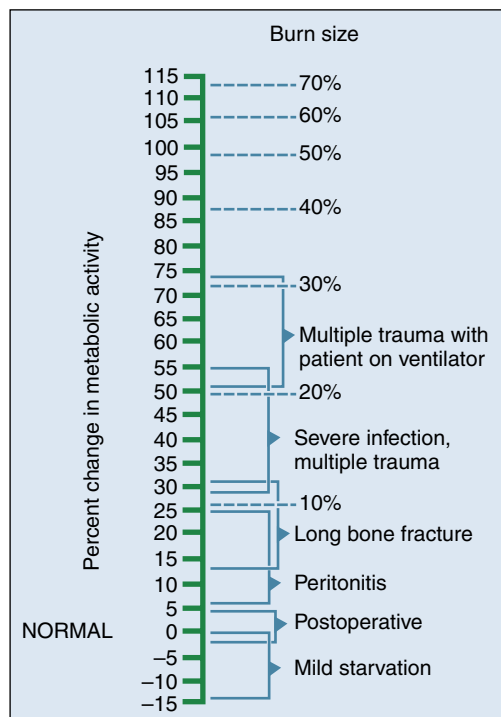


Figure 30-1 Increased energy needs with stress. (Adapted from Wilmore D: *The Metabolic Management of the Critically Ill*, New York, 1977, Plenum Publishing. Revised in Walker W, Watkins J, editors: *Nutrition in Pediatrics: Basic Science and Clinical Application*. Boston, 1985, Little, Brown.)

be associated with other nutrient deficiencies, which may be evident on physical examination (Table 30-2).

FAILURE TO THRIVE



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Failure to Thrive

Pediatric **undernutrition** in the United States is often termed **failure to thrive** and describes circumstances in which a child fails to gain weight appropriately or, in more severe cases, experiences failure in linear growth or head circumference. The terms **organic** and **nonorganic** failure to thrive have lost favor in recognition of the frequent interplay between underlying medical conditions that may cause maladaptive behaviors. Similarly, social and behavioral factors that initially may have been associated with feeding problems (see Chapter 21), and poor growth also may be associated with medical problems, including frequent minor acute illnesses.

MARASMUS

Marasmus results from the body's physiologic response to inadequate calories and nutrients. Loss of muscle mass and subcutaneous fat stores can be confirmed by inspection or palpation and quantified by anthropometric measurements. The head may appear large but generally is proportional to the body length. Edema usually is absent. The skin is dry and thin, and the hair may be thin, sparse, and easily pulled out. Marasmic children may be apathetic, weak, and may be irritable when touched. Bradycardia and hypothermia signify severe and life-threatening malnutrition. Inappropriate or inadequate weaning practices and chronic diarrhea are common findings in developing countries. Stunting (impaired linear growth) results from a combination of malnutrition, especially micronutrients, and recurrent infections.

KWASHIORKOR

Kwashiorkor results from inadequate protein intake in the presence of fair to good caloric intake. The hypoalbuminemic state results in pitting edema that starts in the lower extremities and ascends with increasing severity. Other factors, such as acute infection, toxins, and possibly specific micronutrient or amino acid imbalances, are likely to contribute to the etiology. The major **clinical manifestation** of kwashiorkor is that the body weight is near normal for age; weight alone does not accurately reflect the nutritional status because of edema. **Physical**