37 Nutrition and Family Medicine

MARGARET THOMPSON and MARY BARTH NOEL

CHAPTER OUTLINE

Overview

The goal of improving the health of the U.S. population through approaches such as physical activity and nutrition has come to the forefront of public and medical attention. The efforts of public health and other health care professionals in promoting nutrition's potential to improve health are beginning to result in constructive action, but the majority of the public still reports being confused by what a healthy diet is. The public health approach to improving diet through education is part of the focus on preventing chronic diseases in an aging population, and clinical medicine should join in this effort. Additionally, the clinical medicine approach to nutrition may implement nutritional therapies as part of disease management. For these approaches to work for the public, a unified approach between public health and clinical medicine for improving the nutritional health of the public is necessary. This chapter discusses both approaches.

CURRENT DIETARY GUIDANCE

The latest version of the public health dietary program was introduced in 2013. This is in connection with the MyPlate food system (www.MyPlate.gov).

The new ChooseMyPlate.gov incorporates food choices and other ways to customize the food plan, as well as key concepts, into a visual image (see Web Resources). Although there is general agreement, many argue that the recommendations are vague and that food amounts and groupings are inappropriate. The major omission in this version of the dietary system has been *physical activity*, which the last version (MyPyramid.gov) had and seems to be critical in the considerations of diet and the balancing of energy needs with intake. The overarching concepts of the 2010 Dietary Guidelines (www.dietaryguidelines.gov) explain the educational framework for the MyPlate, as follows:

- Maintain calorie balance over time to achieve and sustain a healthy weight.
- Focus on consuming nutrient-dense foods and beverages.

There are more than 23 key recommendations in the latest 2010 Dietary Guidelines (which will be revised in 2015) for the general population and six additional key recommendations for specific populations. The Dietary Guidelines that are emphasized in this version of the public guidance are as follows:

- Build a healthy plate.
- Cut back on foods high in solid fats, added sugars, and salt.
- Eat the right amount of calories for you.
- Be physically active your way.

Along with providing the 10 tips to help the public and professionals who educate the public, the goal is to improve the nutritional quality of the American diet to prevent the leading chronic diseases of obesity, heart disease, and type 2 diabetes. The 10 tips that go along with ChooseMyPlate are as follows:

1. Balance calories.
2. Enjoy your food but eat less.
3. Avoid oversized portions.
4. Foods to eat more often include vegetables, fruits, whole grains, and low-fat milk and dairy products.
5. Make half your plate fruits and vegetables.
6. Switch to fat-free or low-fat (1%) milk.
7. Make half your grains whole grains.
8. Foods to eat less often include foods high in solid fats, added sugars, and salt.
9. Compare sodium in foods.
10. Drink water instead of sugary drinks.

There are additional recommendations for women capable of becoming pregnant, women who are pregnant or breastfeeding, infants and children, and individuals ages 50 years and older.

The specifics of the ChooseMyPlate are many, and the latest dietary guidelines might be as confusing as previous guidelines. The American plans are a combination of food- and nutrient-based recommendations, the latter of which are often difficult to explain to and are not well understood by the public. Both the professional community and the general public recognize the important role of proper nutrition in maintaining health, but neither always heeds current evidence. Physical activity also needs to be part of any discussion about nutrition. This chapter highlights the current evidence for supporting nutritional approaches to

common medical and health concerns. Recent research emphasizes that the whole-food diet (rather than specific nutrients or supplements) seems to be most important to influencing positively the prevention and treatment of chronic diseases.

Nutrition Assessment

A nutrition assessment is the process of determining an individual's nutritional status or whether adequate amounts of required nutrients are available to and absorbed by the body. Every patient in a family medicine practice deserves some level of nutrition assessment. This assessment can be a brief screen when the patient is relatively healthy or more in-depth if the patient appears to have nutritional inadequacy or risk factors for malnutrition. The depth of the assessment is based on the patient and the presenting situation. Those who may require a more in-depth evaluation include patients who are grossly overweight or underweight, patients with a chronic or severe acute illness, growing infants and children, patients in poverty or otherwise unable to obtain a variety of foods, most frail older adults, and patients who maintain nontraditional diets such as recent immigrants or fad dieters (American Dietetic Association, 2012).

HISTORY

Patients with chronic illness deserve a more thorough history assessment, as do patients with symptoms or signs potentially related to poor nutrition (Table 37-1). Physicians should review gastrointestinal (GI) symptoms and elicit information about supplemental vitamins and other nutritional products, alcohol and illicit drugs, appetite suppressants or stimulants, glucocorticoids, and laxatives. In at-risk patients and those with clinical evidence of poor nutrition, clinicians should consider the presence of conditions that may increase nutritional requirements. Physicians should also investigate the patient's ability to obtain, ingest, digest, metabolize, and absorb nutrients; consider whether a treatment or medication will require modification of the diet; and use information obtained in the history to plan for that change.

Conditions That May Increase Nutritional Requirements

Any condition that increases the metabolic rate of the patient is likely to increase nutritional requirements (Table 37-2).

Ability to Obtain Food. Patients in poverty and who cannot or do not receive financial assistance are at risk for poor nutrition because of an inability to obtain enough food or a variety of foods. Those who lack transportation or have other shopping access issues, such as language barriers or distance from a store, may also not be able to acquire sufficient food. Patients who rely on others to provide food, prepare food, or both may have inadequate dietary intake. Many patients, because of poor mobility and declining health, gradually lose the ability to perform activities of daily living, such as shopping, cooking, and cleaning, so the history should contain specific questions directed at these activities. Individuals with substance abuse problems or poor mental health may lack the initiative or ability to acquire healthy foods.

Ability to Ingest Nutrients. Various conditions may contribute to a patient's inability or lack of desire to eat (see Table 37-2).

Digestion. A number of processes can affect the normal digestive process. Any factor that interferes with the secretion of acid or enzymes into the stomach or small intestine may impair digestion. For example, patients with partial gastrectomy or even vagotomy for peptic ulcer disease may have maldigestion and nutritional deficiencies. Similarly, patients with chronic pancreatitis or on chronic acid-suppressing medicines may lack acid and certain digestive enzymes and thus cannot absorb all nutrients.

Absorption. Patients may demonstrate poor absorption of nutrients for a variety of reasons, including loss of absorptive surface area in the intestinal tract from surgery; Crohn disease; infectious processes; or other inflammatory conditions, such as celiac disease. It is important to be aware of hidden sources of gluten in a variety of foods (National Digestive Diseases Information Clearinghouse, 2008) (Table 37-3). Incomplete digestion and processing of fats, carbohydrates, proteins, and vitamins can also lead to decreased absorption of those nutrients. Table 37-4 lists various nutrients and their sites of metabolism and absorption.

Metabolism and Excretion. Many chronic diseases result in poor metabolism of foods, which leads to poor availability of calories and other nutrients. Additionally, any condition that results in excessive losses of nutrients through the intestinal tract or kidneys may also result in malnutrition. Certain foods, such as nonabsorbable fat substitutes, cause excessive loss of fat-soluble vitamins, with steatorrhea caused by the fat not being absorbed (Table 37-5).

Dietary History

It is important to obtain information about the patient's usual and recent diet as part of the history. The dietary history refers to a patient's usual pattern of food intake and any factors that may influence food choices and availability. Screening questions include number of daily meals and examples of food consumed. A more thorough evaluation delves into cultural or religious food practices, personal preferences, and use of a table or picture of the food groups as a tool to help patients identify food groups from which they may be consuming too few or too many servings.

A specific part of the dietary history is a *nutrient intake* analysis. This history relies on a food diary kept by the patient for a specific period, usually 3 to 7 days, including times, food and beverages consumed, and activity. Clinicians also use *dietary recall* as a method to assess nutrient intake. With this tool, patients report foods and beverages consumed over the past 24 to 48 hours. This retrospective analysis has less validity than the prospective food diary because people typically are unable to remember the details

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Table 37-1 Summary of Major Nutrients

Nutrient	Major Dietary Sources	Major Functions	Signs of Deficiency	Usual Causes of Deficiency	Effects of Excess	Normal Laboratory Value
Protein (supplies 4 kcal/g)	Fish, chicken, beef, other animals; lentils, seeds, legumes, dried beans; dairy products; eggs; nuts	Building materials (AAs) for growth, maintenance, repair of all cells; regulates fluid balance between blood and cells; provides energy; essential AAs are threonine, tryptophan, histidine, lysine, leucine, isoleucine, methionine, valine, and phenylalanine	Kwashiorkor (protein malnutrition); decreased immune response; edema; stunted growth and development; poor musculature; marasmus (protein-energy malnutrition)	Poor intake of protein, especially high-quality protein; too few calories so that protein is used for energy; malabsorption; genetic diseases of protein, AAs (e.g., PKU)	Reduced calcium retention; weight gain; obesity	Albumin, 3.5-5.0 g/dL; BUN, 9-20 mg/dL; creatinine, 0.3-1.3 mg/dL; prealbumin, 10-40 mg/dL; total protein, 6.0-8.0 g/dL
Carbohydrates (CHO) (supply 4 kcal/g)	Cereal grains, dried peas and beans, bread, pasta, vegetables, fruits, dairy products, sugar, jellies, other sweets	Provide energy for body processes and physical activity; aid in use of fat and spare protein; provide energy; many vitamins and most fibers are CHO	Growth retardation; weight loss	Poor intake; malabsorption; genetic diseases of CHO (e.g., glycogen storage disease)	Weight gain; obesity; increased blood triglyceride levels	None
Fat (supplies 9 kcal/g)	Saturated fats: meats, dairy fats (e.g., ice cream, sour cream, butter), bacon, sausages Unsaturated fats: avocado, oils (e.g., corn, safflower, vegetable) Monounsaturated fats: olive oil, canola oil	Supplies concentrated source of energy; carries fat-soluble vitamins; supplies essential fatty acids (e.g., linoleic, linolenic, arachidonic acids); membrane structures; transport processes of cells	Flaky, scaly skin; poor growth; hair loss; impaired wound healing and immune functioning	Poor intake; malabsorption; extreme diets or supplementary feedings for long periods (e.g., IV lines, TPN without fats)	Increased blood cholesterol or triglyceride levels; weight gain; obesity	Total cholesterol, <200 to >140 mg/dL; HDL >45 mg/dL; LDL <100-130 mg/dL
Water	Water, beverages, fruits; almost all foods contain some water	Provides substrate for most of body's reactions; helps move materials to and waste from cells; helps control body temperature; lubricates joints in body	Dehydration; death	Poor intake; medications; diarrhea; vomiting; high temperatures	Excess retention of fluid related to imbalance of minerals; overconsumption is rare but can result in death	Dehydration: increased albumin, BUN Fluid overload: decreased albumin, BUN
VITAMINS						
Water-Soluble Vitamins						
Vitamin B_1 (thiamin)	Lean pork, wheat germ, whole or fortified cereals, legumes, bread products	Assists in use of CHO and fat for energy; promotes growth, appetite, and muscle tone; promotes normal functioning of nervous system; coenzyme in metabolism of CHO branched-chain AAs	Beriberi; changes in nerves; excessive water retention; loss of appetite; depression; muscle tenderness; high-output cardiac failure; polyneuritis	Poor intake; malabsorption; hemodialysis	None reported	Thiamine pyrophosphate (TPP); stimulation >20% (index >0.2% indicates deficiency)

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Table 37-1 Summary of Major Nutrients (Continued)

Nutrient	Major Dietary Sources	Major Functions	Signs of Deficiency	Usual Causes of Deficiency	Effects of Excess	Normal Laboratory Value
Vitamin B_2 (riboflavin)	Dairy products, liver and other organ meats, meat, fish, dark green vegetables, fortified grain products	Functions as part of energy release; essential for growth; part of flavin coenzymes required in cellular oxidation	Cheilosis; photophobia; angular stomatitis; magenta tongue; glossitis; seborrhea; corneal vascularization	Poor intake; malabsorption	None reported	FAD; stimulation >40% (index >1.4% indicates deficiency)
Vitamin B_6 comprises six compounds: pyridoxal, pyridoxine, pyridoxamine, and three 5′-phosphates: pyridoxal (PLP), pyridoxine (PNP), and pyridoxamine (PMP)	Liver, pork, poultry, whole or fortified grain products, bananas, legumes, lentils, fortified soy-based meat substitutes, nuts	Cofactor for many enzymes in metabolism of protein and AAs; functions in hemoglobin synthesis	Anemia; irritability; convulsions (in infants); skin lesions; smooth red tongue (glossitis); peripheral neuropathies; impaired all-mediated immunity	Poor intake; malabsorption; aging (increased need); medications	Sensory neuropathy marked by changes in gait and peripheral sensation	—
Vitamin B_{12}* (cobalamin)	Liver, beef, poultry, fish, eggs, brewer's yeast (not present in plant foods) Oral initial dose: 1000-2000 µg per 1-2 weeks Maintenance: 1000 µg daily for life IM initial dose: 100-1000 µg daily or every other day for 1-2 weeks Maintenance: 100-1000 µg every 1-3 months	Maintenance of nervous tissue and blood formation; nucleic acid synthesis; recycling of tetrahydrofolate	Megaloblastic anemia (pernicious anemia); permanent damage to nervous system; peripheral neuropathy; weight loss; glossitis	Deficiency of hydrochloric acid in stomach (as occurs with aging); strict vegetarians; high intakes of folate can mask deficiency of vitamin B_{12}	None reported	Schilling test: 8% of radioactivity per 24-hour urine†
Vitamin C (ascorbic acid)	Citrus fruits and juices, tomatoes, potatoes, cabbage, broccoli, strawberries, spinach	Cofactor for reactions requiring reduced copper or iron metalloenzymes; protective antioxidant	Scurvy; easy bruising; slow wound healing; degeneration of skin, teeth, gums, blood vessels	Smokers have increased need, poor intake	GI disturbances; kidney stones; excess iron absorption	Plasma or leukocyte vitamin C measured by chromatography; plasma vitamin C, 0.50-1.40 mg/dL (30-80 µmol/L)
Folate (folic acid, folacin, pteroylpolyglutamates)	Dark-green leafy vegetables, whole grains, legumes, nuts, organ meats, orange juice, fortified cereal products	Assists in red blood cell maturation; cofactor for synthesis of purine and pyrimidine; coenzyme in metabolism of nucleic acids and AAs	Megaloblastic anemia; general weakness; depression; polyneuropathy; GI upsets; poor growth; maternal deficiency linked to neural tube defects in fetus (400 µg/day recommended prepregnancy)	Poor intake; malabsorption	Masks deficiency of vitamin B_{12}	Red blood cell folate, 4-20 ng/mL
Niacin (includes nicotinic acid amide, nicotinic acid, nicotinamide)	Liver, meat, bran or fortified cereal products, fish, poultry, whole or fortified grains, peanuts, tuna	Part of coenzymes for oxidation-reduction reactions; active in release of energy and biosynthesis of fatty acids	Pellagra; pigmented dermatitis; dementia; diarrhea; inflammation of mucous membranes; weakness; tremors	Poor intake; malabsorption; consumption of processed grains that have niacin removed; hemodialysis	Flushing, burning, tingling around face, neck, hands; liver damage; GI distress	—

Nutrient	Major Dietary Sources	Major Functions	Signs of Deficiency	Usual Causes of Deficiency	Effects of Excess	Normal Laboratory Value
Pantothenic acid	Liver, egg yolks, meat, mushrooms, whole grains, brewer's yeast, broccoli, skim milk, sweet potatoes, avocados	Component of coenzyme A; functions in release of energy from CHO, protein, and fat; coenzyme in fatty acid metabolism	Fatigue; malaise; insomnia; burning paresthesias; depression; weakness (rare)	Poor intake; malabsorption; incomplete PEN or TPN formulas	Unknown	—
Biotin	Nuts, soy, eggs, nonfat milk, sweet potatoes	Coenzyme for carboxylation reactions; plays a role in CHO and fat metabolism; coenzyme in synthesis of fat, glycogen, and AAs	Dermatitis; neuritis; appetite loss; nausea; glossitis; insomnia; thin hair; depression; hypercholesterolemia (few known cases)	Incomplete PEN or TPN formulas	Unknown	—
Fat-Soluble Vitamins						
Vitamin A (includes provitamin A such as retinols, carotenoids)	Liver, dairy products, fish; turkey (carotene), carrots, dark-green leafy vegetables, sweet potatoes, cantaloupe, apricots, broccoli, tomatoes	Maintenance of skin and mucous membranes; component in visual process; particular adaptation to darkness; immune function	Night blindness; xerophthalmia; keratomalacia; Bitot spots; follicular hyperkeratosis; reduced immunity; poor growth	Poor intake; malabsorption with steatorrhea; liver disease	Loss of appetite; headache; vomiting; blurred vision with eventual eye damage; liver toxicity; teratogen in fetal growth	Serum retinol and retinol ester vitamin A, 30-80 µg/dL (1.0-2.8 µmol/L)
Vitamin D (calciferol) uptake; glucocorticoid	Fortified dairy products,‡ fish, eggs; sunlight (15 min/day for 3-4 days/wk)	Mineralization of bones and teeth; intestinal regulation of calcium and phosphorus	Rickets (children); osteomalacia (adults); costochondral beading; muscle weakness and twitching; low serum calcium	Poor sunlight exposure; poor intake; with aging, poor uptake glucocorticoid therapy may need additional vitamin D	Poor growth; weight loss; poor appetite; calcium deposits in soft tissues	25-hydroxy-vitamin D test, costochondral
Vitamin E (also called α-tocopherol)	Nuts, fats, polyunsaturated vegetable oils, margarine, seeds, whole grains	Antioxidant; prevents peroxidation of polyunsaturated lipids; free radical scavenger	Hemolytic anemia of newborn; increased fragility of red blood cells; nerve and muscle disturbances in severe malabsorption	Lipid malabsorption	Interferes with vitamin K (risk of bleeding, especially in trauma); hemorrhagic toxicity; monitor patients taking anticoagulants and vitamin E supplements	Serum tocopherol measured by chromatography, 0.5-1.8 mg/dL (12-42 µmol/L)
Vitamin K	Dark-green leafy vegetables, liver, vegetable oils, margarines, cabbage family	Synthesis of prothrombin and clotting factors II, VII, IX, and X	Bleeding (especially in newborns); ecchymosis; epistaxis; prolonged clotting time	Bacteria destroyed in gut that produce vitamin K; liver disease; lipid malabsorption	Unknown; monitor patients taking anticoagulants with vitamin K intake	PT to assess vitamin K indirectly
MINERALS						
Calcium	Dairy products, fish with small bones, dark-green leafy vegetables (mustard greens, kale), corn tortillas, calcium-set tofu	Structure of bones and teeth; nerve transmission; muscle contraction; essential role in blood clotting	Stunted growth; bone loss; rickets; osteomalacia; osteoporosis; tetany; possibly hypertension	Poor intake; poor consumption of vitamin D; poor sunlight exposure; lack of physical activity; high phosphorus intake	Decreased absorption of other minerals; kidney stones; hypercalcemia; milk-alkali syndrome; renal insufficiency	8.5-10.5 g/dL

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Table 37-1 Summary of Major Nutrients (Continued)

Nutrient	Major Dietary Sources	Major Functions	Signs of Deficiency	Usual Causes of Deficiency	Effects of Excess	Normal Laboratory Value
Chloride	Table salt, seafood, meat	Acid–base balance; constituent of gastric juice; major anion of ECF	Rare; mental apathy, muscle cramps, usually seen with sodium depletion	Rare in United States (has occurred in babies whose formula did not have chloride)	None reported	96-106 mEq/L
Chromium	Fish, cheese, meat, poultry, whole-grain cereals, beer	Insulin cofactor; glucose and energy metabolism	Insulin resistance; glucose intolerance	Unknown	None reported	—
Cobalt	Organ and muscle meats, dairy products	Constituent of vitamin B_{12}	Only as vitamin B_{12} deficiency; pernicious anemia	Those associated with vitamin B_{12}	None reported	—
Copper	Liver, shellfish, nuts, whole grains, cereals, legumes, cocoa products	Absorption and use of iron; enzyme cofactor; in myelin nerve sheath	Anemia; kinky hair; neutropenia; disturbance of bone formation	Usually genetic	Wilson disease (genetic); iron-deficiency anemia; chronic renal failure	—
Fluoride	Fluoridated drinking water, fluoridated dental products, seafood	Structure of bone and teeth enamel; reduces dental caries	Dental caries	Nonfluoridated water or dental products	Mottled teeth; enamel and skeletal fluorosis	—
Iodine	Iodized salt, seafood, saltwater fish	Constituent of thyroid hormone	Goiter; cretinism	Lack of iodine in food or in soil where food is grown	Rare; goiter may be caused by excess iodine; elevated TSH	—
Iron	Liver, lean meats, legumes, egg yolk, fortified cereals and breads	Constituent of hemoglobin; involved in oxygen and electron transport	Microcytic hypochromic anemia; fatigue; decreased immune response	Poor intake; blood loss	Liver and pancreas damage; large dose at one time: shock, death; GI distress	Serum iron, 50-150 µg/dL
Magnesium	Bran cereals, nuts, legumes, green leafy vegetables, meat	Part of protein synthesis; helps muscles contract and helps nerve impulse transmission	Rare; behavioral disturbances, tremor, spasms, neuromuscular irritability	Rare	Rare; diarrhea; fatigue; nervous system disturbances (usually from pharmacologic agents, not food sources)	1.5-2.5 mEq/dL
Manganese	Nuts, legumes, whole-grain cereals	Involved in formation of bone and enzymes in AAs, cholesterol, and CHO metabolism	Rare; dermatitis; weight loss	Rare	Rare; inhaled manganese linked to CNS disorders, neurotoxicity	—

Nutrient	Major Dietary Sources	Major Functions	Signs of Deficiency	Usual Causes of Deficiency	Effects of Excess	Normal Laboratory Value
Molybdenum	Whole-grain cereals, legumes, nuts	Oxidation-reduction reactions; enzyme helps in catabolism of sulfur AAs; metabolism of purine, pyrimidines	None	None	Unknown	—
Phosphorus	Dairy products, eggs, meat, whole-grain cereals, soda	Structure of bone and teeth; component of phospholipids; helps regulate acid–base balance; energy metabolism	Rare; demineralization of bone; weakness; poor growth; paresthesias of hands and feet	Rare in United States	May cause deficiency of calcium, skeletal porosity; interference with calcium absorption	2.5-4.5 mg/dL
Potassium	Fruits (particularly bananas, citrus juices), dairy products, potatoes, vegetables	Major component of intracellular fluid; regulates acid–base and water balance; maintains heart and nerve function	Muscle weakness; rapid, irregular heart rate; paralysis; death	Medications (e.g., diuretics), especially with poor intake	Electrolyte imbalance; muscle weakness; disturbed heart function; death	3.5-5.0 mEq/dL
Selenium	Organ meat, seafood, plants from selenium-containing soil	Antioxidant; constituent of glutathione oxidase	Rare; cardiac myopathy; muscle tenderness	Rare	Rare; hair and nail brittleness and loss	—
Sodium	Table salt, processed foods, in most foods except fruits	Maintains water balance; influences muscle contraction and nerve irritability	Rare; muscle cramps; reduced appetite	Rare; restricted diet with excessive medication	In some people, retention of fluids and hypertension	135-145 mEq/dL
Sulfur	Protein foods (e.g., meat, dairy, legumes)	Constituent of coenzyme A, AAs, hair, cartilage	No dietary deficiency with adequate protein	Rare	Rare	—
Zinc	Meat, seafood, dark meat of poultry, whole grains, legumes	Component of enzymes and proteins; involved in regulation of gene expression	Growth failure; impaired wound healing; taste changes; decreased immune response	Poor consumption of protein foods; phytate consumption inhibits absorption	Fever, nausea, vomiting, diarrhea; reduction in copper	115 ± 12 ng/dL

*Dosages from Lederle FA. Oral cobalamin for pernicious anemia: medicine's best kept secret? *JAMA*. 1991;265:94-95.
†From Mahan LK, Escott-Stump S. *Krause's Food and Nutrition Therapy*. 11th ed. Philadelphia: Saunders; 2003:1208-1219.
‡Not all dairy products are fortified.
AA, Amino acid; *BUN,* blood urea nitrogen; *CNS,* central nervous system; *ECF,* extracellular fluid; *FAD,* flavin adenine dinucleotide *GI,* gastrointestinal; *HDL,* high-density lipoprotein; *IM,* intramuscular; *IV,* intravenous; *LDL,* low-density lipoprotein; *PEN,* peripheral enteral nutrition; *PKU,* phenylketonuria; *PT,* prothrombin time; *TPN,* total parenteral nutrition; *TSH,* thyroid-stimulating hormone.
Modified from Noel T. Nutrition and obesity. In Paulman PM, Susman J, Harrison J, et al, eds. *Family medicine clerkship guide*. St. Louis: Mosby-Elsevier; 2005.

Table 37-2 Select Conditions That Increase Nutrient Requirements

Pregnancy
Lactation
Healing wounds, including skin ulcers
Surgery
Trauma
Burns
Chronic lung disease
Cancer
AIDS
Infection
Inflammatory diseases
Hyperthyroidism

Table 37-3 Celiac Disease: Grains with and without Gluten

Grains or Flours Allowed		Grains or Flours with Gluten: Not Allowed
Rice	Millet	Wheat (e.g., durum, semolina, kamut, spelt)
Soy	Buckwheat	Rye
Potato	Arrowroot	Barley
Tapioca	Amaranth	Triticale
Beans	Tef	Oats (most likely because of contamination)
Garfava	Wild grass seeds (Montina)	
Sorghum	Nut flours	
Quinoa		

Table 37-4 Nutrients and Sites of Metabolism and Absorption

Nutrient	Site of Absorption
MACRONUTRIENTS	
Amino acids	Throughout small intestine (more rapid proximally)
Sugars	Throughout small intestine
FATS	
Fatty acids	Throughout small intestine (mostly proximal)
Bile acids	Ileum
Short-chain fatty acids	Colon
MINERALS	
Calcium	Duodenum, jejunum
Iron	Duodenum
Magnesium	Small intestine
VITAMINS	
Folic acid	Proximal small intestine
Vitamin B_{12}	Ileum
Fat-soluble vitamins (A, D, E, K)	Small intestine

Table 37-5 Conditions Affecting Metabolism and Excretion

Type of Impairment	Possible Contributing Condition
Impaired dietary intake	AIDS Anorexia nervosa Cancer Depression Dental problems Hyperemesis gravidarum Poverty Stroke Substance abuse
Maldigestion	Cholestasis Enzyme deficiencies Intestinal bacterial stasis Pancreatitis or insufficiency Radiation enteritis Short bowel syndrome
Malabsorption	AIDS Celiac disease Intestinal lymphoma Radiation enteritis
Impaired metabolism	AIDS Cancer Chronic disease (liver, kidney) Corticosteroid use
Increased excretion of nutrients	Diarrhea (zinc, magnesium) Glucosuria Inflammatory bowel disease Protein-losing enteropathy GI bleeding (iron)
Increased requirements	Burns Trauma Surgery Chronic infection Inflammation Chronic lung disease Hyperthyroidism Sepsis

AIDS, Acquired immunodeficiency syndrome; *GI,* gastrointestinal.
Modified from Newton JM, Halsted CH. Clinical and functional assessment of adults. In Shils ME, Olson JA, Shike M, Ross AC, eds. *Modern nutrition in health and disease.* 9th ed. St. Louis: Lippincott-Williams & Wilkins; 1999.

of their past eating habits accurately (Hammond, 2004). There are currently several smartphone applications and software programs that allow patients to track their own food intake. A recent study evaluated the content of several of these apps to determine which best aligned with weight loss theory, including providing motivation, diet tracking, healthy cooking, wise grocery shopping choices, and weight and body mass index (BMI) tracking. Lose It by FitNow, Inc. best fulfills those criteria (Azar et al., 2013). Another useful app is the eTools app from Weight Watchers, which allows members to track meals online or through the app, as well as document activity, find ideas for healthy recipes, and read tips on how to choose healthy options while eating out. A recent study demonstrated that individuals enrolled in Weight Watchers with access to the eTools mobile app and online system as well as the support meetings were more successful with weight loss than individuals enrolled in a self-help system (Johnston et al., 2013). Both Lose It and eTools include bar code scanner capability, which allows automatic logging of nutritional information on packaged foods.

HealthyOut is an app and website that was developed for New York City and is now available as a resource listing different restaurant food options throughout the country. HealthyOut allows the user to select a type of dietary pattern (healthy, low carbohydrate, vegan, and many others) and find nearby restaurants offering appropriate foods. The application gives ideas for what to order at a particular restaurant, as well as nutritional information (see Web Resources).

Although these apps and websites facilitate the process, studies have shown that patients continue to struggle to accurately determine portion size when reporting (Nelson et al., 1994).

PHYSICAL EXAMINATION

Key Points

- Significant weight loss—5% in 1 month, 7.5% in 3 months, or 10% in 6 months, from usual weight—indicates the need for further evaluation to determine the cause.
- Although BMI is a validated independent measure of body fat, it may not accurately reflect body composition in certain subsets of individuals, such as trained athletes and elderly adults.

Table 37-6 Weight Categories According to Body Mass Index (BMI)

Category	BMI (kg/m^2)
Underweight	<18.5
Normal	18.5-24.9
Overweight	25-29.9
Obese	≥30

From National Heart, Lung, and Blood Institute (NHLBI). Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults, BMI calculator. http://www.nhlbisupport.com/bmi/bmicalc.htm.

A systematic physical examination is important in evaluating nutritional status. General inspection may immediately reveal obvious overweight or underweight. Anthropometry, or physical measurements of an individual that are compared with reference standards, plays a role as well. These parameters include height, weight, skinfold thickness, head circumference (especially in infants and children), and waist and hip circumferences. These measurements are most helpful when taken at several intervals over time.

Height and Weight

It is useful to measure height and weight to assess nutrition. Patients tend to overestimate their height and underestimate their weight. In considering weight alone in adults, the *usual body weight* is a more useful parameter than ideal body weight obtained from published tables. In children, body weight is more useful than height in estimating body fat and provides information about recent nutrient intake (Hammond, 2004). Changes in weight over time from the usual body weight may reflect a change in nutritional status. However, it is important to remember that acutely, weight loss or gain may signify a change in fluid status rather than in nutritional well-being. In an obese individual or older adult, loss of lean body mass indicating malnutrition may be masked by the presence of excess body fat.

Significant weight loss is defined as a 5% loss in 1 month, a 7.5% loss in 3 months, or a 10% loss in 6 months. A severe weight loss is defined as any loss higher than those percentages in the same interval. The following method is also used to assess nutritional status as a function of weight loss (Hammond, 2004):

- Weight within 85% to 90% of usual body weight—*mild* malnutrition
- Weight within 75% to 84% of usual body weight—*moderate* malnutrition
- Weight less than 74% of usual body weight—*severe* malnutrition

Both height and weight are needed to calculate BMI, which is highly correlated with independent measures of body fat in adults (Balcombe et al., 2001; Keys et al., 1972). The formula for calculating BMI is Weight (kg)/[Height (m)]^2. Table 37-6 lists parameters for overweight, obesity, and underweight according to the BMI (see Web Resources for a BMI calculator).

It is important to note the limitations of the BMI as a nutritional assessment tool. It may overestimate body fat in trained athletes, and it may underestimate body fat in older patients and in those who have lost lean body mass because of nutritional deficiency. Studies show that body composition is probably more predictive than BMI of chronic diseases such as metabolic syndrome (Gomez-Ambrosi et al., 2012). Additionally, there is fairly strong evidence that individuals who are overweight by National Heart, Lung and Blood Institute (NHLBI) guidelines (BMI, 25 to <30 kg/m^2) actually have lower age-related all-cause mortality than individuals at normal BMI (18.5 to <25 kg/m^2) (Flegal et al., 2012; Flegal et al., 2013; Ogden et al., 2012).

Body Composition

Assessment of body composition reveals the relative amount of body fat and lean body mass. One common method for assessing subcutaneous fat is the measurement of *skinfold thickness.* Several areas of the body have demonstrated good correlation with body fat, including the triceps, biceps, subscapular tissue, and tissue above the iliac crest. Measurements are taken with calipers and compared with standardized tables to determine the percentage of body fat. This type of assessment can be limited by the accuracy of the measuring technique. Changes in skinfold thickness take place over 3 to 4 weeks, so this measurement is not a useful gauge for determining acute changes in nutritional status.

Circumference measurements are useful in assessing nutritional status. The waist circumference correlates with abdominal fat content. Increased waist circumference has been associated with cardiovascular disease risk factors (Dalton et al., 2003). The correct method for waist circumference is to measure the distance around the smallest area below the rib cage and above the umbilicus. Waist measurements of more than 40 inches in men and 35 inches in women are independent risk factors for disease (NHLBI, 2005). The waist circumference has less predictive value in patients shorter than 5 feet tall and in those with BMI greater than 35.

General Physical Examination

Certain findings on physical examination may alert the physician to the potential for malnutrition. Many of the physical signs of nutritional deficiency are age dependent. General findings include loss of subcutaneous fat (orbital or in triceps area), temporal wasting, decreased muscle mass in general, proximal muscle weakness, reduced grip strength, and certain skin changes (e.g., scaling, poor wound healing, bruising). Tissues in the body that undergo rapid cell turnover, such as mucous membranes, skin, and hair, may be the first to show signs of nutritional

insufficiency (see Table 37-1). In children, decelerating linear growth, lethargy, and fat depletion may signal malnutrition.

Macronutrient deficiencies present with specific signs, depending on the nutrient. For example, dietary fat deficiency, which may be seen with disordered eating, may be evidenced through flaky skin, hair loss, or poor wound healing. A deficiency of protein (kwashiorkor) that is severe will present with a protuberant abdomen, hair loss, loss of skin pigmentation, and growth retardation (Hoffer, 2012).

Overall, most vitamin deficiencies are uncommon in the United States, but some signs should alert physicians to evaluate for those nutritional deficits or malabsorption. For example, several B vitamin deficiencies may result in glossitis, or a smooth tongue appearance. A niacin deficiency (seen in individuals with alcoholism or malabsorption) may cause diarrhea, inflamed mucous membranes, and skin ulcerations. Thiamine deficiency (most commonly seen in those with alcoholism) may present with peripheral neuropathy, gait disturbance, and nystagmus. Iron deficiency from nutritional or non-nutritional causes may present with koilonychias (spooning of the nails).

LABORATORY EVALUATION

Key Points

- Albumin and transferrin can be artificially low when C-reactive protein (CRP) level (inflammation) is high. Prealbumin is a more accurate marker of nutritional status with systemic inflammation.

Physiologic changes related to adequacy of nutrition occur slowly; the first signs of a change in nutritional status usually appear at the cellular level. These changes may be detected by a variety of laboratory tests. Single laboratory tests may have value in screening for nutritional problems, but a series of values is important for assessing ongoing nutritional problems and treatment.

What to Order to Assess Malnutrition

No general laboratory studies will diagnose malnutrition. Laboratory investigation should be directed toward specific nutrients that the physician suspects may be missing from a patient's diet, for which the patient may be at risk based on disease or because of history or physical examination findings that suggest a nutritional deficiency (see Table 37-1).

Unexplained weight loss with no other specific symptoms is often associated with inflammation, and inflammatory markers such as CRP and erythrocyte sedimentation rate may be elevated. Table 37-7 lists common laboratory evaluations for frequently encountered micronutrient deficiencies.

Table 37-7 Laboratory Tests for Nutritional Deficiencies

Nutrient Deficiency	Laboratory Evaluation
Vitamin A	Serum retinol
Vitamin D	25(OH)D
Vitamin E	Not usually assayed for diagnosis
Vitamin K	PT, INR
Vitamin B_{12}	MMA, tHcy
Folate	MMA, tHcy
Vitamin B_2 (riboflavin)	Serum EGRAC
Vitamin B_1 (thiamine)	Erythrocyte thiamine diphosphate level
Iron	CBC, serum ferritin, total iron binding capacity
Zinc	Serum or plasma zinc level (not good assessment of zinc stores)

CBC, Complete blood count; *ECGRAC,* erythrocyte glutathione reductase activity coefficient; *INR,* international normalized ratio; *MMA,* methylmalonic acid; *PT,* prothrombin time; *tHcy,* total homocysteine; *25(OH)D,* 25-hydroxy-vitamin D.

Measuring Visceral Protein: Albumin. The protein contained in visceral organs constitutes about 10% of total body protein, and the protein in plasma and extravascular body fluids makes up about 3% of total protein. *Albumin* is a plasma protein produced by the liver that can be used as an indicator of visceral protein balance. The measurement of serum albumin reflects changes in the protein status over time because albumin has a serum half-life of 2 to 3 weeks.

Using serum albumin as a marker for protein nutrition status has limitations. Albumin is a negative acute-phase reactant and tends to decrease in concentration under conditions of inflammation. Because of its long half-life, this change may be misleading. In protein-calorie starvation, albumin levels tend to decrease, but in total-calorie deprivation, albumin levels may remain more stable (Hammond, 2004). Finally, there is a large extravascular albumin pool, which tends to equilibrate by entering the vascular system when plasma concentration of albumin decreases.

Transferrin. Transferrin is another plasma protein that reflects overall protein balance. Similar to albumin, transferrin is a negative acute-phase reactant, but because of its shorter half-life (8 days), it may be somewhat more accurate than albumin as a tool for assessing nutritional status. Transferrin has limitations, however, in that its concentration is related to the patient's overall iron status. Also, as with albumin, serum concentration of transferrin does not change rapidly with changes in protein-calorie intake.

Other Plasma Proteins. Several other plasma proteins have been proposed as good markers for protein energy status. The level of transthyretin (TTY), also known as *prealbumin,* has been shown to correlate with visceral protein status, but it is an acute-phase reactant and is also affected by zinc concentrations. It has a half-life of 2 to 3 days. Retinol-binding protein (RBP) has a short serum half-life (12 hours) and correlates with protein energy status in some patients with malnutrition, but it also is a negative acute-phase reactant and has limitations for the assessment of nutritional status.

It is possible to circumvent the problems raised by inflammation in interpreting the plasma levels of the proteins mentioned. CRP level provides an indication of the amount of inflammation present at a given time. Some clinicians

may ascribe more usefulness to levels of albumin, transferrin, TTY, and RBP when the CRP level is low.

Urinary Creatinine and Creatinine-to-Height Ratio

The urinary creatinine level reflects the amount of ongoing muscle metabolism. The amount of creatinine excreted in the urine is proportional to the muscle mass of an individual. Using a mathematical formula, it is possible to derive an expected amount of creatinine excretion over 24 hours based on a person's height. This formula is limited in the case of a tall, thin subject or short, muscular subject. The amount of urinary creatinine also varies depending on the diet; diets high in meat will result in increased urinary creatinine excretion.

Vitamin and Mineral Assays

In general, protein-calorie malnutrition is associated with low levels of vitamin A, zinc, and magnesium. Fat-soluble vitamins may be deficient in conditions of malabsorption of fat. Folic acid and iron are not well absorbed in celiac disease.

Hematologic Tests

Changes in red blood cell production may result from insufficient levels of iron, vitamin B_1, folic acid, and other vitamins. It is important to note that determining the complete blood count (CBC) is important in assessing nutritional status. Patients with poor nutritional status may also demonstrate weak immune status. T cell–mediated responses are more severely affected by nutritional inadequacy than B-cell functions, such as immunoglobulin function. Evaluating the total lymphocyte count can be helpful in assessing T cells. Using skin testing for anergy is one method of testing T-cell immune competence.

Nutrition in the Life Cycle

Key Points

- Recommendations regarding vitamin D and calcium supplements for prevention of osteoporosis continue to evolve, but the United States Preventive Services Task Force (USPSTF) currently recommends against routine supplementation in healthy men and premenopausal women.
- The USPSTF finds insufficient evidence to determine the benefits and harms of daily supplementation with more than 400 IU of vitamin D_3 and more than 1000 mg of calcium for primary prevention of fractures in healthy men and postmenopausal women.

PREGNANCY AND LACTATION

Pregnancy has long been recognized as a time of increased nutritional needs. Recommendations vary, but one constant remains: with adequate caloric intake comes a greater likelihood of ingesting adequate nutrients. Weight checks are a standard part of all prenatal visits. In recent years, concern has focused on the woman's health status after the pregnancy. As Table 37-8 demonstrates, in older pregnant women or biologically immature women (those who become pregnant within 5 years of starting to menstruate), the caloric intake and weight gain are specific to the particular health needs of the woman during as well as after the pregnancy. The usual weight retained with each pregnancy by women in the United States is 10 lb (McGanity et al., 1999). This retained weight may have a significant influence on future chronic disease development for women.

Table 37-8 Pregnancy Outcomes Linked to Weight Gain

Increased Risk of LBW Infant	Best Outcomes		Increased Risk of Gestational Diabetes*
Biologically immature or too thin (BMI <18.5 kg/m^2)	BMI 18.5-24.9 kg/m^2	BMI 25-29.9 kg/m^2	BMI ≥30 kg/m^2 *or* older than 35 years
RECOMMENDED WEIGHT GAIN			
≈28-40 pounds (1.1 lb/wk)	25-30 lb (0.7 lb/wk) Not nursing: 0.8 lb/wk Nursing: 0.9 lb/wk Twins: 1.4 lb/wk	15-25 lb	11-20 lb

*Increased risk of low-birth-weight (LBW) infant or infant too large.
BMI, Body mass index.
Data from Institutes of Medicine. *Report on weight gain during pregnancy: reexamining the guidelines*. Washington, DC: Institutes of Medicine; 2009.

It is now known that the nutritional needs for pregnancy begin before conception. The state of nutrition 60 to 90 days before conception influences pregnancy outcomes. The major nutrient changes from conception through the first trimester are increases in folic acid, iron, and calories. The overall nutritional needs throughout the pregnancy are as follows:

1. Adequate calories for development of the fetus, placenta, and lactation after delivery (with adequate calories increasing the opportunity for adequate nutrients)
2. Adequate protein
3. Adequate iron
4. Adequate folic acid, vitamin C (especially critical if the woman is a smoker because there is a much higher need in smokers), and vitamin B_{12}
5. Adequate calcium and iodine

Community-based programs such as Women, Infants, and Children (WIC) can be resources for helping women in need. It has been demonstrated that infants of women who participate in these programs have higher birth weights than those who were not in the programs and who are in the same social, economic, or other problematic circumstances.

Although not well understood yet, there seems to be some evidence indicating that what occurs nutritionally before pregnancy and during pregnancy for the mother may affect the potential for chronic diseases later in the life of the child. Such diseases as hypertension and diabetes may have their start in the embryonic stage of life (Roseboom et al., 2006, 2011).

Many of the nutritional issues in *lactation* are influenced by the nutritional status of the pregnant woman. The

nutritional stores of the postpartum woman are an important source of supplies for her and the infant. Certain nutrients are stable regardless of the maternal diet. Studies of lactation have found that after about 6 months of breastfeeding, maternal weight decreases by about 10 lb without any changes in the composition or production of breast milk (Barbosa et al., 1997). This may be important when considering that the average weight retained with each pregnancy is about 10 lb.

INFANCY AND CHILDHOOD

An excellent summary of the nutrients and development needs for food in this age group is available in Figure 37-1. This figure provides guidance about major nutrient needs and how the infant and child can meet these needs. These evidence-based guidelines were developed by a panel of pediatricians, nutritionists, and the U.S Department of Agriculture (USDA) after comprehensive review of the literature.

It is important to help parents understand that the introduction of new foods takes time. Researchers have found that it takes at least eight different attempts of introducing a new food before a child will show true acceptance or rejection (Birch et al., 1991; Satter, 2000). Parents must understand that their role is to provide a healthy range and variety of foods in a pleasant eating environment, and the child's role is to consume the food in the amounts that he or she needs and wants. This foundation of good food habits will carry through to the adolescent stage, in which independence and finding ways of expressing this independence are achieved not only in social functioning but also in food and health habits.

ADOLESCENCE

Adolescents gain independence by taking a greater role in food choices and amounts eaten. It is frustrating for parents who worked to establish standards to see the young person seek independence even with foods consumed. This is a stage in life that demands high caloric intake because growth needs are second only to those in infancy—more kilocalories per kilogram are required than in any other life stage. This high caloric consumption is favorable to nutritional status because with high calories comes the increased likelihood of taking in more nutrients. Parents must remain hopeful that good health habits will guide the teenager. There may be concern over peer pressure leading to "strange" or different food habits, such as disordered eating, sports nutrition, and vegetarian diets, which many teens attempt. Such exploration is often a natural part of expressing independence. These food patterns can be healthy, such as improving food habits with vegetarianism or sports nutrition. The family physician needs to determine when the teen's exploration could become harmful. Nutrition assessment is appropriate in this life stage in regard to determining whether a nutritional problem is present.

ADULTHOOD

The study of adult nutrition tends to focus on prevention and treatment of chronic diseases. There is new interest in optimizing nutrition during this stage to enhance older adults' quality of life. Many individuals attempt to use foods and nutritional products as a type of alternative medicine. Some of these developments, such as increased ingestion of supplemental antioxidant vitamins, plant-based estrogens, and other functional foods, have not had the desired outcomes (i.e., longer life, enhanced functional status). The *Dietary Reference Intakes* (National Academy of Sciences, 2005) has addressed the concept of enhanced nutrient intakes through supplements and other products by introducing a new category called *tolerable upper intake levels* (see Terminology). Many values in this category of nutrient levels are still under investigation.

Osteoporosis ("Holes in Bones")

With the possibility of a 20% bone mass loss in the 5 to 7 years after menopause, the best treatment for osteoporosis (reduction in amount of bone mass) is the prevention of bone loss. The following three steps are recognized as most helpful for women (80% of osteoporosis population). It is important to realize that all foods that have calcium (e.g., cheeses) do not necessarily have vitamin D unless they are fortified (see Table 37-1).

1. Balanced diet rich in calcium and vitamin D (see Table 37-1)
2. Weight-bearing exercise, such as walking
3. Healthy lifestyle, with no smoking or excessive alcohol intake

Peak bone development occurs throughout adolescence, with smaller bone gain during the 20s, and thus less calcium is needed at this age. Bone loss starts with menopause for women, which increases the need for calcium and vitamin D to prevent bone loss. High dietary intake of calcium does not seem to present any risk; previous concern about kidney stone formation with increased calcium intake appears to be unfounded (Curhan et al., 1997). Side effects of high amounts of calcium supplement intake include constipation and dyspepsia. There is evidence that high supplemental calcium intake is associated with cardiovascular disease (Xiao et al., 2013).

Calcium supplementation with more than 2000 mg/day of vitamin D may lead to soft tissue calcification. Currently, the USPSTF recommends *against* supplementation with 400 IU or less of vitamin D_3 and 1000 mg of calcium or less per day for primary prevention of fractures in postmenopausal women (level D recommendation). The USPSTF finds insufficient evidence to determine the benefits and harms of greater amounts of supplementation in postmenopausal women or any supplementation in premenopausal healthy women (USPSTF, 2013).

Osteomalacia ("Soft Bones")

Adult-onset osteomalacia (adult form of rickets) is being studied more and seems to be identified more frequently. This is of concern in northern climates with low sunlight and in climates where intense sun blocks are used because of low levels of vitamin D.

Cancer Prevention Through Nutrition

Caloric Restriction. In animal studies, caloric restriction has shown promise in increasing the life span of the animals

Development stage	Newborn	Head up	Supported sitter	Independent sitter	Crawler	Beginning to walk	Independent toddler
							
Physical skills	• Needs head support	• More skillful head control with support emerging	• Sits with help or support • On tummy, pushes up on arms with straight elbows	• Sits independently • Can pick up and hold small object in hand • Leans toward food or spoon	• Learns to crawl • May pull self to stand	• Pulls self to stand • Stands alone • Takes early steps	• Walks well alone • Runs
Eating skills	• Baby establishes a suck-swallow-breathe pattern during breastfeeding or bottle feeding	• Breastfeeds or bottle feeds • Tongue moves forward and back to suck	• May push food out of mouth with tongue, which gradually decreases with age • Moves pureed food forward and backward in mouth with tongue to swallow • Recognizes spoon and holds mouth open as spoon approaches	• Learns to keep thick purees in mouth • Pulls head downward and presses upper lip to draw food from spoon • Tries to rake foods toward self into fist • Can transfer food from one hand to the other • Can drink from a cup held by feeder	• Learns to move tongue from side to side to transfer food around mouth and push food to the side of the mouth so food can be mashed • Begins to use jaw and tongue to mash food • Plays with spoon at mealtime, may bring it to mouth but does not use it for self-feeding yet • Can feed self finger foods • Holds cup independently • Holds small foods between thumb and first finger	• Feeds self easily with fingers • Can drink from a straw • Can hold cup with two hands and take swallows • More skillful at chewing • Dips spoon in food rather than scooping • Demands to spoon-feed self • Bites through a variety of textures	• Chews and swallows firmer foods skillfully • Learns to use a fork for spearing • Uses spoon with less spilling • Can hold cup in one hand and set it down skillfully
Baby's hunger and fullness cues	• Cries or fusses to show hunger • Gazes at caregiver, opens mouth during feeding indicating desire to continue • Spits out nipple or falls asleep when full • Stops sucking when full	• Cries or fusses to show hunger • Smiles, gazes at caregiver, or coos during feeding to indicate desire to continue • Spits out nipple or falls asleep when full • Stops sucking when full	• Moves head forward to reach spoon when hungry • May swipe the food toward the mouth when hungry • Turns head away from spoon when full • May be distracted or notice surroundings more when full	• Reaches for spoon or food when hungry • Points to food when hungry • Slows down in eating when full • Clenches mouth shut or pushes food away when full	• Reaches for food when hungry • Points to food when hungry • Shows excitement when food is presented when hungry • Pushes food away when full • Slows down in eating when full	• Expresses desire for specific foods with words or sounds • Shakes head to say "no more" when full	• Combines phrases with gestures, such as "want that" and pointing • Can lead parent to refrigerator and point to a desired food or drink • Uses words like "all done" and "get down" • Plays with food or throws food when full
Appropriate foods and textures	• Breastmilk or infant formula	• Breastmilk or infant formula	• Breastmilk or infant formula • Infant cereals • Thin pureed baby foods	• Breastmilk or infant formula • Infant cereals • Thin pureed baby foods • Thicker pureed baby foods • Soft mashed foods without lumps • 100% juice	• Breastmilk or infant formula • 100% juice • Infant cereals • Pureed foods • Ground or soft mashed foods with tiny soft noticeable lumps • Foods with soft texture • Crunchy foods that dissolve (such as baby biscuits or crackers) • Increase variety of flavors offered	• Breastmilk, infant formula, or whole milk • 100% juice • Coarsely chopped foods, including foods with noticeable pieces • Foods with soft to moderate texture • Toddler foods • Bite-sized pieces of foods • Bites through a variety of textures	• Whole milk • 100% juice • Coarsely chopped foods • Toddler foods • Bite-sized pieces of foods • Becomes efficient at eating foods of varying textures and taking controlled bites of soft solids, hard solids, or crunchy foods by 2 years

Figure 37-1 Summary of physical and eating skills, hunger and fullness cues, and appropriate food textures for infants and children. (From Butte N, Cobb K, Dwyer J, et al. The Start Healthy feeding guidelines for infants and toddlers. *J Am Diet Assoc.* 2004;104:455-467.)

studied, but human studies have not been as encouraging. This may be an extremely difficult area to investigate because there is no clear understanding of where in the human life span caloric restriction would be the most beneficial. In humans, the balance between starvation and overnutrition seems to be more difficult to determine. People with a BMI less than 18 kg/m^2 seem to have a higher mortality rate, but those who are obese (BMI >30) also probably do less well. Currently, there is insufficient evidence to recommend caloric restriction as a means of treatment or prevention of cancer, although evidence does suggest that a high BMI (>30) may be a cancer-promoting factor. Physical activity to balance the energy intake is probably the best preventive measure against cancer at this time.

Vitamin Supplementation. Epidemiologic studies note that populations who consume diets high in vitamins and minerals have a lower incidence of cancer. Three studies, the Alpha-Tocopherol Beta-Carotene Cancer Prevention Study Group (1994), β-Carotene and Retinol Efficacy Trial (CARET; Omenn et al., 1996), and Physicians' Health Study (Hennekens et al., 1996), investigated smokers and asbestos workers to see whether provitamin A and beta-carotene supplementation would decrease the incidence of cancer. Those who received supplementation developed cancers earlier than those who did not, and the studies were suspended. The USPSTF currently recommends against supplementation with beta-carotene, either alone or in combination with other supplements, for the prevention of cardiovascular disease and cancer (USPSTF, 2003). It is important to understand that current research on the importance of these nutrients is furthering the understanding that the individual nutrients have a food basis of enhancement of health. The disease–mortality response curves are U-shaped for many nutrients (i.e., there is an increased risk of adverse outcomes if the nutrient is ingested in either too low or too high amounts) (Alexander et al., 2013; Ohlhorst et al., 2013).

Therefore, the dietary elements that seem to be the most favorable, according to epidemiologic studies, are as follows:

- *More* fruits, vegetables, whole-grain products, and calcium-containing foods
- *Less* saturated fats, particularly those found in red meats

Aging

The only difference in the nutritional needs of older adults was long thought to be the decrease in caloric needs, about a 2% to 5% decrease with each decade of life. The smaller decrease in caloric need (2%) is for those who exercise and the higher decrease (5%) is for those who do not exercise. A decrease in caloric need is complicated by the well-established phenomenon that weight gain tapers as humans age. Peak weights for men are at around 55 years, with weight loss after that age (slowly because rapid weight loss has significant risks in the older adult) (Sperrin et al., 2013). Peak weights for women are at around 65 years with decreases after that age. Rapid weight loss can identify critical problems; one of the first signs of dementia is often unintended weight loss. Additional changes in nutrient needs occur mainly because of the physiologic changes of aging (Table 37-9). The Tufts University USDA Human Nutrition Center on Aging has developed a food pyramid based on the different nutrient needs that are critical to older adults (Russell et al., 1999). A part of aging is muscle loss, and fat stores increase. Current research supports the need for adequate (not excessive) calorie intake for protein sparing, as well as adequate protein intake (0.9-1.0 g/kg body weight) and muscle-retaining exercise to retain or lessen loss of muscle mass with aging. Diet with protein alone, or exercise alone, does not seem to retain muscle as well as the combination of exercise and protein intake.

Table 37-9 Different Nutrient Needs in Aging

Decreased Need	Calories Vitamin A
Increased Need	Fluid needs Protein (slightly increased) Vitamin D Calcium Vitamin B_{12} Vitamin B_6 (pyridoxine)

Because psychosocial components are so important in determining nutritional status in older adults, reliable nutrition assessment includes consideration of these elements for evaluation (Figure 37-2). Functional status and mental status influence nutrition and well-being. Undernutrition in older individuals is defined by the type of body tissue loss. *Wasting* is an unintentional weight loss caused by insufficient intake of calories. *Cachexia* is loss of fat-free body mass (from muscle, bone, organs) caused by catabolism (e.g., in cancer or heart failure) and results in a change of body composition accompanied by an ongoing inflammatory process. *Sarcopenia* is the loss of skeletal muscle mass and is a common condition in aging adults. The causes of sarcopenia are multifactorial, including a decline in physical activity, changes in anabolic hormone levels, and chronic inflammation (Hoffer, 2012).

Dietary Patterns in Prevention and Management of Major Diseases

Key Points

- The Mediterranean diet has been shown to be more effective than a low-fat diet in primary prevention of cardiovascular events in patients at high risk (SOR: A).
- Consuming a Mediterranean diet is associated with a decrease in all-cause mortality as well as a reduced risk for cardiovascular disease, neurodegenerative disease, and cancer (SOR: B).
- The DASH (Dietary Approaches to Stopping Hypertension) diet significantly reduces systolic (>11 mm Hg) and diastolic (>5 mm Hg) blood pressure (BP) in persons with stage I hypertension (Appel et al., 1997; Svetkey et al., 1999) (SOR: A).
- Patients following the DASH diet may have a lower risk of developing stroke and myocardial infarction and may have a lower risk of cardiovascular mortality (SOR: B).
- A low-carbohydrate diet (high protein and fat) is as effective as low-fat diets in weight loss and may be associated with a better lipid profile.

NESTLÉ NUTRITION SERVICES

Updated Version

Mini Nutritional Assessment MNA®

Last name: First name: Sex: Date:

Age: Weight, kg: Height, cm: I.D. Number:

Complete the screen by filling in the boxes with the appropriate numbers.
Add the numbers for the screen. If score is 11 or less, continue with the assessment to gain a Malnutrition Indicator Score.

Screening

A Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?
0 = severe loss of appetite
1 = moderate loss of appetite
2 = no loss of appetite ☐

B Weight loss during last months
0 = weight loss greater than 3 kg (6.6 lbs)
1 = does not know
2 = weight loss between 1 and 3 kg (2.2 and 6.6 lbs)
3 = no weight loss ☐

C Mobility
0 = bed or chair bound
1 = able to get out of bed/chair but does not go out
2 = goes out ☐

D Has suffered psychological stress or acute disease in the past 3 months
0 = yes 2 = no ☐

E Neuropsychological problems
0 = severe dementia or depression
1 = mild dementia
2 = no psychological problems ☐

F Body Mass Index (BMI) (weight in kg)/(height in m)^2
0 = BMI less than 19
1 = BMI 19 to less than 21
2 = BMI 21 to less than 23
3 = BMI 23 or greater ☐

Screening score (subtotal max. 14 points) ☐☐

12 points or greater — Normal – not at risk – no need to complete assessment

11 points or below — Possible malnutrition – continue assessment

Assessment

G Lives independently (not in a nursing home or hospital)
0 = no 1 = yes ☐

H Takes more than 3 prescription drugs per day
0 = yes 1 = no ☐

I Pressure sores or skin ulcers
0 = yes 1 = no ☐

J How many full meals does the patient eat daily?
0 = 1 meal
1 = 2 meals
2 = 3 meals ☐

K Selected consumption markers for protein intake
- At least one serving of dairy products (milk, cheese, yogurt) per day? yes ☐ no ☐
- Two or more serving of legumes or eggs per week? yes ☐ no ☐
- Meat, fish or poultry every day yes ☐ no ☐

0.0 = if 0 or 1 yes
0.5 = if 2 yes
1.0 = if 3 yes ☐.☐

L Consumes two or more servings of fruits or vegetables per day?
0 = no 1 = yes ☐

M How much fluid (water, juice, coffee, tea, milk…) is consumed per day?
0.0 = less than 3 cups
0.5 = 3 to 5 cups
1.0 = more than 5 cups ☐.☐

N Mode of feeding
0 = unable to eat without assistance
1 = self-fed with some difficulty
2 = self-fed without any problem ☐

O Self view of nutritional status
0 = view self as being malnourished
1 = is uncertain of nutritional state
2 = views self as having no nutritional problem ☐

P In comparison with other people of the same age, how do they consider their health status?
0.0 = not as good
0.5 = does not know
1.0 = as good
2.0 = better ☐.☐

Q Mid-arm circumference (MAC) in cm
0.0 = MAC less than 21
0.5 = MAC 21 to 22
1.0 = MAC 22 or greater ☐.☐

R Calf circumference (CC) in cm
0 = CC less than 31 1 = CC 31 or greater ☐

Assessment (max. 16 points) ☐☐.☐

Screening score ☐☐

Total Assessment (max. 30 points) ☐☐.☐

Malnutrition Indicator Score

17 to 23.5 points — at risk of malnutrition ☐

Less than 17 points — malnourished ☐

06.98 USA

Figure 37-2 The mini nutritional assessment (MNA). (From Vellas B, Garry PJ, Guigoz V, eds. *Mini nutritional assessment [MNA]: research and practice in the elderly*. vol 1. Nestlé Nutrition Workshop Series. Basel, Switzerland: Karger; 1999:158.)

- Diet as a whole should be considered in the balanced food intake (with energy expenditure and basal metabolic rate) for determining needs of patients with diabetes. Diet should be individualized to the patient's unique needs (American Diabetes Association [ADA], 2008) (SOR: A).
- Lifestyle changes (increased activity, weight loss, smoking cessation, decreased saturated fat and increased fiber intake, moderation in alcohol intake) are the only treatments shown to affect all components of the metabolic syndrome and should be implemented in all patients (Finnish Medical Society, 2007) (SOR: A).

MEDITERRANEAN DIET

The Mediterranean diet is used extensively as a regional diet in southern Europe, northern African, and the Middle Eastern countries. Although it has many cultural variations, such as the types of seasonings, use of different starches (rice to pasta to couscous), and use or non-use of alcohol, most of the research and popular use of the term Mediterranean diet relates to the diet commonly found in southern Italy, Sicily, and Corsica during the late 1950s to 1960s. It is not currently what is practiced in these regions to the extent it was during the research of Ancel Keyes, who first described its effects on prevention of many of the chronic diseases common to Western countries. Currently, research has shown positive effects on the prevention and to a lesser extent treatment of diseases such as cardiovascular, diabetes, Parkinson disease, dementia, and cancer.

The foods commonly used in the Mediterranean diet are as follows:

- Eating primarily plant-based foods, such as fruits and vegetables, whole grains, legumes, and nuts as the basis of the diet
- Replacing butter with healthy fats, such as olive oil
- Eating fish and poultry at least twice a week
- Drinking red wine in moderation (optional)
- Including regular exercise and physical activity
- Limiting red meat and sweets to no more than a few times a month

Several Mediterranean Diet Pyramid schematics may be helpful in directing patients toward this type of eating pattern. In most representations of the Mediterranean diet, exercise is considered an important component to the diet to maintain energy balance. This is critical to the health outcomes with the diet (see Web Resources).

The Mediterranean diet has been shown to reduce cardiovascular events compared with a traditional low-fat diet in patients at high risk for disease (Estruch et al., 2013). Several observational studies have strongly suggested a decrease in all-cause mortality and in morbidity. These studies include evidence of reduction in cardiovascular disease, neurodegenerative disease, and cancer (Sofi et al., 2010). Another study has shown that when patients with cardiovascular risk factors and at risk for developing type 2 diabetes followed the Mediterranean diet, the risk of developing type 2 diabetes actually decreased (Salas-Salvado et al., 2011). In fact, the Mediterranean diet can be very effective in helping patients with diabetes maintain appropriate blood glucose control. Specific studies have demonstrated that following a Mediterranean diet may decrease the risk for developing cancer (Cottet et al., 2005; Couto et al., 2011). There is also evidence that patients who adhere to the Mediterranean diet have a decreased risk of developing dementia, especially when the diet is combined with physical activity (Scarmeas et al., 2009). The risks of following a Mediterranean diet are few and include deficiencies in calories (because of the filling nature of high-fiber foods).

Dietary Approaches to Stopping Hypertension Diet

A combination diet known as DASH is low in saturated fat, high in fruits and vegetables (8-10 servings, or 4-5 cups/day), and high in low-fat dairy products, with physical activity and some salt restriction. DASH resulted in significant reductions in systolic (>11 mm Hg) and diastolic (>5 mm Hg) BP in persons with stage I hypertension (Appel et al., 1997; Svetkey et al., 1999). With the addition of sodium restriction (<2 g daily), further BP reductions have been observed (He and MacGregor, 2004; National Institutes of Health [NIH], 2006). A recent meta-analysis confirmed the finding that low-sodium diets result in lowered BP but also found that sodium-restricted diets were associated with an increase in plasma levels of renin, aldosterone, cholesterol, and triglycerides compared with a non–sodium-restricted diet (Graudal et al., 2011). The DASH diet, or a similar combination, with modest sodium restriction should be considered as first-line treatment for prehypertension and early stage I hypertension. There is some evidence that patients following the DASH diet have lower risk of stroke, cardiovascular mortality, and myocardial infarction (Fung et al., 2008).

The foods commonly used in the DASH diet are as follows (serving range is because of different calorie consumption—lower number of servings for lower caloric intake and higher number for higher caloric consumption):

- Whole grains: 6 to 11 servings per day (1 serving = 1 slice bread; 1 oz dry cereal; ½ cup cooked rice, pasta or cereal)
- Vegetables: 3 to 6 servings/day (1 serving = ½ cup cut up raw or cooked; 1 cup leafy green)
- Fruits: 4 to 6 servings/day (1 serving = 1 medium piece; ½ cup juice or cut up)
- Low-fat dairy: 2 to 3 servings/day (1 serving = 1 cup yogurt, milk; 1½ oz cheeses)
- Lean meats: 3 to 6 servings (1 serving = 1 oz meat or 1 egg for a total of 3 to 6 oz/day)
- Nuts and legumes: 1 serving per day to 3 servings per week (1 serving = 1/3 cup nuts; 2 Tbsp peanut butter; ½ cup legumes)
- Fats and oils: 2 to 3 servings per day (1 serving = 1 tsp oils or soft margarine; 2 Tbsp salad dressings)
- Sweets: 0 to no more than 2 per day (1 serving = 1 Tbsp sugar or jam or jelly; ½ cup gelatin or sorbet; 1 cup lemonade)

There are many similarities between the Mediterranean and DASH diets, such as the high use of whole grains, vegetables, fruits, nuts, and legumes and the limited use of red meats and sweets. The DASH plan does include the consumption of more dairy products than does the Mediterranean diet. The DASH diet does not explicitly include fish or olive oil as the Mediterranean plan does. Whether these are significant differences is yet to be determined.

Low-Carbohydrate Diets (Higher in Fat and Protein)

The low-carbohydrate diet plan—for example, the Atkins Diet (and variations) or the South Beach Diet—has few similarities to either the DASH diet or the Mediterranean diet. It prescribes much more protein than either of the previously discussed dietary patterns. The South Beach Plan is not as high in saturated fat because the protein source is mainly fish. Research actually shows that low-carbohydrate diets may have a more favorable effect on serum lipids than do low-fat diets (Foster et al., 2010; Shai et al., 2008). Some evidence indicates that recommending an increase in some types of dietary fat, such as olive oil and fish oil, may be helpful in managing diabetes (Shai et al., 2008). There are a few hypotheses as to why low-carbohydrate diets confer less cardiovascular risk than low-fat diets. One idea is that low-fat diets are high-carbohydrate diets, which often means that individuals substitute refined carbohydrates for fat. This type of carbohydrate consumption contributes to the risk of type 2 diabetes and hence cardiovascular disease. A second hypothesis is that energy balance is more important than the specific macronutrient in the diet (Schwingshackl & Hoffman, 2013). This means that whether the diet is high in fat, protein, or carbohydrate, the important issue is that the patient maintains energy balance by not consuming more calories than are expended each day. Energy balance is more important to chronic disease prevention than is consumption of a high- or low-macronutrient content diet (Sacks et al., 2009).

Risks of the low carbohydrate diets include potential deficiencies in the B vitamins, vitamin C, and possibly fat-soluble vitamins D and K, depending on the sources of fat and protein in the diet.

Vegetarian Diets

For a variety of reasons, many people follow a vegetarian dietary pattern. These dietary patterns may or may not include animal products such as milk (lactovegetarians), cheese, or eggs (lacto-ovo vegetarians). Strict vegans consume no animal products at all. Children and adolescents are at a particular risk for micronutrient deficiencies when adhering to vegetarian dietary practices. For example, adolescents may consume too little zinc, iron, and vitamin C and are also at risk for having low vitamin B_{12} levels. Individuals who completely exclude animal and fish food sources from their diets may be at risk for deficiencies of essential fatty acids and vitamin D, although there are some mushroom sources as well as sunlight for vitamin D. Family physicians should ask about specifics of dietary intake in patients who claim to be vegetarian to ensure that adequate levels of calcium, micronutrients, and an adequate mix of plant proteins are being consumed. Additionally, adolescents and young adults who follow a restrictive vegetarian diet may have a higher prevalence of unhealthy dieting behaviors and disordered eating (American Dietetic Association, 2009).

When properly incorporated, vegetarian diets have been shown to be effective in lowering total cholesterol and low-density lipoprotein cholesterol in patients with hyperlipidemia (American Dietetic Association, 2009). Vegetarian diets can also be effective for weight loss.

Nutrition Decisions in the Hospitalized Patient

Key Points

- The Joint Commission requires a nutritional screen be completed on each patient within 24 hours of admission (SOR: C).
- If nutrition screening and assessment indicate that a patient is at risk for malnutrition or malnourishment, then nutrition support intervention is indicated (SOR: B).

Patients who are hospitalized require appropriate nutritional support to heal wounds and recover from illness. Up to 40% of hospitalized patients have some degree of malnutrition (Coates et al., 1993). Clinical studies have shown that length of stay and hospital costs are higher in patients at risk for poor nutrition than patients who are not at risk (Chima et al., 1997). The Joint Commission (formerly Joint Commission on Accreditation of Healthcare Organizations, JCAHO) requires a nutritional screen to be completed on each patient within 24 hours of admission, although evidence to support this practice is not of top quality (Mueller et al., 2011). The Malnutrition Screening Tool (MST) and the Short Nutritional Assessment Questionnaire (SNAQ) have both been shown to have specificities and sensitivities of greater than 70% (Neelemaat et al., 2011) and are considered "quick and easy" screening tools, as is the Mini Nutritional Assessment (see Figure 37-2). When a screen indicates that a patient is at nutritional risk, the patient should undergo a complete nutrition assessment. The rationale for this is that malnourished patients tend to have longer hospital stays and more complications as well as potentially higher mortality rates. Often, patients with chronic illness are nutritionally depleted before hospitalization, and trauma and surgery increase nutritional demands significantly. Patients, particularly older adults, may rapidly fall behind in caloric and nutrient intake.

SUBJECTIVE GLOBAL ASSESSMENT

A useful instrument for the more detailed assessment of nutritional status in hospitalized patients is the subjective global assessment (SGA) (Brugler et al., 2005). The SGA incorporates five features of the history and four components of the physical examination findings, enabling the physician to make a rapid determination of a patient's nutritional status (Figure 37-3). The history components are weight loss, food intake, presence of significant GI symptoms, functional status or energy level, and metabolic demand of the underlying disease state. The physical components are depletion of subcutaneous fat, muscle wasting in the quadriceps and deltoid muscles, edema, and ascites. Each component is evaluated as category A (patient well nourished), B (mildly malnourished), or C (severely malnourished).

Weight loss is one of the most important components of the assessment. Generally, if the patient loses at least 5% of

SUBJECTIVE GLOBAL ASSESSMENT SCORING SHEET

Patient name: _____ Patient ID: _____ Date: _____

Part 1: Medical history

1. **Weight change**

A. Overall change in past 6 months: _____ kgs.

B. Percent change: _____ Gain < 5% loss
_____ 5–10% loss
_____ > 10% loss

C. Change in past 2 weeks: _____ Increase
_____ No change
_____ Decrease

2. **Dietary intake**

A. Overall change: _____ No change
_____ Change

B. Duration: _____ Weeks

C. Type of change:

_____ Suboptimal solid diet _____ Full liquid diet
_____ Hypocaloric liquid _____ Starvation

3. **Gastrointestinal symptoms (persisting for >2 weeks)**

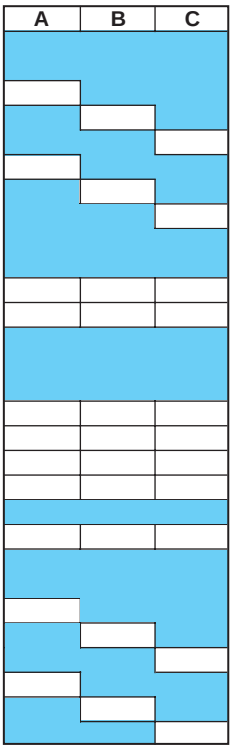
____ None ____ Nausea ____ Vomiting ____ Diarrhea ____ Anorexia

4. **Functional impairment (nutritionally related)**

A. Overall impairment: _____ None
_____ Moderate
_____ Severe

B. Change in past 2 weeks: _____ Improved
_____ No change
_____ Regressed

SGA Score



Part 2: Physical examination

5. **Evidence of:**
Loss of subcutaneous fat
Muscle wasting
Edema
Ascites (hemo only)

SGA Score

Normal	Mild	Moderate	Severe

Part 3: SGA rating (check one)

A. ☐ Well-nourished B. ☐ Mildly-moderately malnourished C. ☐ Severely malnourished

Figure 37-3 The subjective global assessment (SGA). (From Kalantar-Zadeh K, Kleiner M, Dunne E, et al. Total iron-binding capacity-estimated transferring correlates with nutritional subjective global assessment in hemodialysis patients. *Am J Kidney Dis*. 1998;31:263-272; and Brugler L, Stankovic AK, Schlefer M, Bernstein L. A simplified nutrition screen for hospitalized patients using readily available laboratory and patient information. *Nutrition*. 2005;21:650-658.)

body weight over 2 weeks, the ranking in that category is B; a 10% loss puts the patient in category C.

After completing the assessment, the clinician makes a global judgment about the overall status. This is not a numeric assessment but rather is based on the clinician's sense of the overall nutritional picture, mainly through evidence of weight loss, poor intake, muscle wasting, and loss of subcutaneous fat. This instrument has been validated with trained clinicians (Baker et al., 1982a, 1982b; Detsky et al., 1984) but not with untrained physicians.

Other assessment tools have been proposed and may eventually be validated (Brugler et al., 2005). Most of these take into account the same key factors: risk for malnutrition based on preexisting conditions, oral intake, need to heal wounds, and biochemical or hematologic parameters (e.g., serum albumin level and total lymphocyte count). The family physician can find most of these data readily and obtain a reasonable assessment of nutritional status. If nutrition screening and assessment suggest that a patient is at risk for malnutrition or malnourishment, then nutrition support intervention is indicated.

DETERIORATION OF NUTRITIONAL STATUS AND NEED FOR SUPPORT

Caloric Requirements

Even previously healthy patients may lose nutritional ground rapidly when they are hospitalized. Surgery and the stress of disease increase caloric requirements. The amount of these increases can be calculated using one of a number

Table 37-10 Estimated Caloric Need*

Weight Goal	Level of Activity or Severity of Illness: Low kcal/kg	Moderate kcal/kg	High kcal/kg
Lose weight	15	20	25
Maintain weight	20	25	30
Gain weight	25	30	35

Examples: A 165-lb woman (height 5 ft, 2 in; BMI, 30.2) needs to lose weight but does not want to do any physical activity (low activity, lose weight); 165 lb = 75 kg, 75 × 15 = 1125 kcal estimated. A 200-lb man (height 6 ft, 4 in; BMI, 24.3) is hospitalized with sepsis and needs to maintain his weight (moderate activity, maintain weight); 200 lb = 91 kg, 91 × 25 = 2275 kcal estimated.
BMI, Body mass index.

Table 37-11 Determining Total Daily Needs

- To determine total daily calorie needs, multiply the BMR by the appropriate activity factor:
  - Sedentary (little or no exercise; mild stress): BMR × 1.2
  - Light activity (light exercise, sports 1-3 days/wk; moderate stress): BMR × 1.4
  - Moderately active (moderate exercise, sports 3-5 days/wk; severe stress): BMR × 1.6
  - Very active (hard exercise, sports 6-7 days/wk): BMR × 1.725
  - Extra active (very hard exercise, sports + physical job or cross-training): BMR × 1.9
- To determine the BMR or BEE, use the online calculator (http://www.calculator.org/bmr.html).
- Whenever possible, nutritional supplementation should be through the enteral route rather than parenteral.

BEE, Basal energy expenditure; *BMR,* basal metabolic rate.

of predictive equations for determining *resting metabolic rate* (RMR) in kilocalories per day (kcal/day), which is the largest component of overall calorie expenditure. One frequently used model is the *Harris-Benedict equation* (1919), as follows:

$$\text{For men: RMR} = 66.47 + (13.75 \times \text{Weight [kg]}) + (5.0 \times \text{Height [cm]}) - (6.75 \times \text{Age [yr]})$$

$$\text{For women: RMR} = 665.09 + (9.56 \times \text{Weight [kg]}) + (1.84 \times \text{Height [cm]}) - (4.67 \times \text{Age [yr]})$$

Frankenfield and colleagues (2005) compared validation studies on several equations and found that the *Mifflin–St. Jeor equation* performed best in terms of predicting RMR compared with calorimetry. Although all the equations are less accurate for obese subjects, the following Mifflin–St. Jeor equation is least affected by obesity.

$$\text{For men: RMR} = (9.99 \times \text{Weight [kg]}) + (6.25 \times \text{Height [cm]}) - (4.92 \times \text{Age [yr]}) + 5$$

$$\text{For women: RMR} = (9.99 \times \text{Weight [kg]}) + (6.25 \times \text{Height [cm]}) - (4.92 \times \text{Age [yr]}) - 161$$

In critically ill patients (on ventilators), the Penn State 2003 equation or the Penn State 2010 equation for obese patients is most appropriate (Academy of Nutrition and Dietetics, 2012). (See Web Resources for RMR/BMR and resting energy/basal energy expenditure calculators.) Many online and handheld device BMR and RMR calculators are available (Table 37-10).

These predictive equations do have weaknesses. They have not been validated in all subsets of the population, such as elderly adults and nonwhite ethnic groups. Chronic illness can affect the relationship between RMR and body size, with loss of lean body mass in chronic illness.

These equations predict the *resting* metabolic rate, and caloric requirements increase beyond this figure, based on the patient's illness and other metabolic demands. The *resting energy expenditure* (REE) is 1.2 to 1.3 multiplied by the RMR. This figure is further altered by the level of stress. An example is to multiply REE by 1.1 by the number of degrees (Celsius) above normal in a patient with fever. Other multiples are 1.2 for mild stress, 1.4 for moderate stress, and 1.6 for severe stress. It is important to remember that all these calculations only *estimate* caloric requirements and should be considered as a starting point in nutrition repletion rather than the goal (Table 37-11).

Macronutrient Requirements

Hospitalized patients, and especially surgery and trauma patients, often develop *protein-calorie malnutrition*. It is important that patients in the hospital receive adequate calories to meet energy needs and adequate protein to maintain cellular integrity. Caloric requirement can be estimated by a formula, as noted earlier. Protein should make up 1.5 to 2 g/kg/day of that caloric requirement. Specific amino acids (e.g., glutamine, arginine) may be especially important in catabolic states (e.g., cancer, burns). These amino acids are therefore called *conditionally essential* amino acids. Carbohydrates make up about 70% of the remaining total caloric requirement and lipids about 30%.

When to Start Nutritional Supplementation

There is a general trend to delay nutritional supplementation in hospitalized patients in the belief that oral intake will improve imminently, but this may exacerbate the existing malnutrition. The decision to initiate supplemental feeding (over what the patient willingly consumes at meals) must be individualized according to the patient's overall health and likely clinical outcome.

Calorie counts can be obtained for patients receiving oral nutrition. If the patient is falling short on caloric or protein intake, oral supplements are appropriate, given one to three times daily. The commercially available, canned oral supplements provide about 250 kcal and 9 g of protein per can.

For a variety of reasons, hospitalized patients are often unable to consume the calories and protein required to maintain nutrition. At some point, a patient may require enteral or parenteral nutrition. The American Society for Enteral and Parenteral Nutrition has published evidence-based guidelines for assessment and management of supplemental nutrition in patients with various disease states and surgical procedures (available through the National Guideline Clearinghouse, http://www.guideline.gov). Depending on the disease state, these guidelines recommend that hospitalized patients begin *specialized nutrition support* (SNS) (enteral or parenteral feeding) when it is anticipated that patients will not otherwise be able to meet their nutritional needs for 7 to 10 days and within 24 to 48 hours

of admission to an intensive care unit as long as enteral nutrition is not contraindicated (Academy of Nutrition and Dietetics, 2012).

Enteral Nutrition

Most experts agree that when SNS is required, enteral feeding is the most appropriate method as long as the GI tract is competent (ADA, 2006; SOR: A). This is partly because enteral feeding can supply complex nutrients such as fiber and intact proteins that parenteral nutrition cannot supply. Also, evidence indicates that enteral feeding has beneficial effects on the GI mucosa. Some cells lining the GI tract rely on luminal nutrients to flourish, and enteral feeding maintains the absorptive capacity of the epithelial cells. Enteral feeding also stimulates the immune function of the gut. Enteral feeding is usually safer and less expensive than parenteral feeding.

Delivery Methods. Nasogastric feeding is the least invasive form of enteral feeding and is appropriate when there is no gastric outlet obstruction, delayed gastric emptying, or elevated risk for aspiration. If a patient does not tolerate gastric feeding, has one of the previous contraindications, or requires prolonged nutritional supplementation, as is often the case with head and neck cancers, a *postpyloric feeding method* such as duodenal or jejunal tube placement is appropriate. Jejunal tubes are preferred to duodenal tubes because the latter still pose a reasonably high risk for aspiration.

FORMULAS. One type of tube-feeding formula is blenderized food, which can be any type of food that can be successfully liquefied. There are also nutritionally complete commercial formulas that are sterile, easy to use, and appropriate for patients with normal digestive and absorptive function. Elemental formulas contain predigested, chemically formulated nutrients in low-molecular-weight form and may be useful in patients with stressed GI tracts that cannot digest and absorb nutrients in a more complex form. Specialized modular formulas are available for specific disease states, such as a formula appropriate for a patient with chronic kidney or lung disease.

Complications. Clinicians should be aware of the potential complications of enteral feeding, such as aspiration (especially with gastric feeding), gut perforation, and functional problems (e.g., gastric distention, nausea, vomiting, diarrhea). Current guidelines recommend that unless contraindicated, the head of the bed should be elevated 30 to 40 degrees for a patient receiving enteral nutrition (Academy of Nutrition and Dietetics, 2012). Serum electrolyte and glucose level abnormalities are common in patients receiving enteral nutrition, and monitoring of these parameters is important.

Parenteral Nutrition

Most hospitals now use multidisciplinary teams to help plan and implement parenteral nutrition when it is deemed appropriate. *Peripheral parenteral nutrition* (PPN), using a peripheral vein, is appropriate for short-term administration of nutrients (7-10 days) when the GI tract is not functional. *Total parenteral nutrition* (TPN) is administered through a more central vein and is used longer term (>10 days). TPN may be used to administer higher concentrations of glucose and protein than PPN, as well as for infusion of lipids.

Complications. The complications of PPN and TPN include phlebitis and other local reactions to infusion, maintenance of venous access, infection, air embolism, and refeeding syndrome. The *refeeding syndrome* is more common with TPN and may result in sudden death, more often affecting severely malnourished patients as they transition suddenly from deriving energy from stored fat to obtaining energy from infused glucose. This can cause a sudden depletion of phosphate stores, resulting in cardiac dysfunction. Patients who have lost more than 30% of their body weight should undergo gradual repletion of nutrients, with a slow increase in the rate of TPN over several days.

Future in Nutrition

MICROBIOME: GUT BACTERIA AND NUTRITION

Recent research on the synergistic relationship between the hundreds of bacteria that live symbiotically with each human has taken on new understandings with the NIH Human Microbiome Project (The NIH HMP Working Group, 2009). The understanding that different bacteria may have different effects on diseases, such as obesity, antibiotic resistance, and other conditions, has led to revision in how diseases are treated. In the past, we have seen such a paradigm shift with ulcers going from a disease related to stress (and bland diets) to a disease of bacterial origin, resulting in the appropriate change in focus of the treatment. The microbiome of an individual changes with age and diet, and there is ongoing research into how diet and disease influence and are influenced by the individual's microbiotic makeup.

CONSUMER TECHNOLOGY AND NUTRITION

With the wide availability of smartphones and just-in-time information, there has also been a proliferation of applications designed to help with health and fitness, including weight loss. The appropriate research to determine the effectiveness of these applications to affect sound nutrition is just beginning. A recent study has determined that of the more than 10,000 weight loss and fitness applications, none is very strong at incorporating theory-based behavior change concepts. Food tracking has been shown to be effective for people attempting to lose weight, and many tracking applications are available. However, these apps are currently weak at providing motivation (other than positive reinforcement) or helping dieters identify eating triggers (Azar et al., 2013).

In addition to consumer-based technology, there is currently a great deal of research underway to look for better ways for professionals (nurses, physicians, dieticians) to assess nutrition in vulnerable groups. The use of digital photography and electronic databases has the potential to enhance customization of diets for community-dwelling patients by more accurately documenting intake and micronutrient content.

Terminology

The following list of definitions is taken from *Dietary Reference Intakes* (National Academy of Sciences, 2004).

- *Recommended daily allowance* (RDA): Average daily nutrient intake level sufficient to meet the nutrient requirements of nearly all those (97%-98%) in a life stage and gender group. It is intended to be used for assessing the diets of healthy subjects, not for assessing or planning diets for groups.
- *Estimated energy requirement* (EER): Dietary energy intake that is predicted to allow for a level of physical activity consistent with normal health and development and for the deposition of tissues at a rate consistent with growth
- *Acceptable macronutrient distribution range* (AMDR): Range of macronutrient intakes for a particular energy source associated with reduced risk of chronic disease while providing adequate intakes of essential nutrients
- *Tolerable upper intake levels* (TULs): Highest average daily nutrient intake likely to pose no risks of adverse health effects to almost all those in a life stage and gender group
- *Adequate intake* (AI): Recommended average daily nutrient level based on observed or experimentally determined estimates of average nutrient intakes by a group of healthy subjects. It is used when an RDA cannot be determined and may be used to plan and evaluate diets of individual subjects or groups.
- *Estimated average requirement* (EAR): Nutrient intake value estimated to meet the requirement defined by a specific indicator of adequacy in 50% of those in a life stage and gender group, expressed as a daily value over time (for most nutrients, at least 1 week). It includes an adjustment for bioavailability, is intended to be used as one factor in assessing the adequacy of intake of groups or individual subjects, and should not be used as an intake goal for just one person.

Conclusion

Nutrition is a foundation for human health. In the future, as more is understood about genetics, nutritional needs will become more tailored to individual diverse needs. In the review of a person's nutritional status, the clinician should consider food and supplements, as well as how these balance with exercise, diseases, and other environmental factors (e.g., smoking). Overweight, normal-weight, and underweight people are not necessarily well nourished, and weight may not be an indicator of healthy eating. *Biologic balance* involves energy balance (between what is needed or eaten and what is used) and nutrient balance; too few nutrients can cause malnutrition and even chronic diseases, and too many nutrients may be toxic or may even cause chronic disease.

References

The complete reference list is available at www.expertconsult.com.

Web Resources

diabetes.niddk.nih.gov/dm/pubs/eating_ez/ National Institutes of Health. Information on diabetes and diet for the public.

mayoclinic.com/health/weight-loss/NU00595 Mayo Clinic Healthy Weight Pyramid Tool.

ndb.nal.usda.gov/ U.S. Department of Agriculture National Nutrient Database for Standard Reference. Lists the nutrient content of foods.

www.aafp.org/afp/20000301/1409.html American Association of Family Physicians. A "stages of change" approach for helping patients change their behavior.

www.calculator.org/bmr.html For calculating basal metabolic rate for adults.

www.cdc.gov/healthyweight/assessing/bmi/index.html Body Mass Index calculator from the Centers for Disease Control and Prevention.

www.ChooseMyPlate.gov Current food guidance.

www.diabetes.org The American Diabetes Association.

www.dietaryguidelines.gov Dietary Guidelines for Americans.

www.eatright.org The Academy of Nutrition and Dietetics (formerly the American Dietetic Association) public information site.

www.healthfinder.gov/prevention Health Topics A to Z.

www.healthyout.com/ Site for researching restaurants for particular dietary patterns and nutritional needs.

www.heart.org/HEARTORG/Getting-Healthy/NutritionCenter/Mediterranean_Diet_UCM_306004_Article.jsp Information on the Mediterranean diet from the American Heart Association.

www.iom.edu/Global/Topics/Food-Nutrition.aspx Institute of Medicine reference on topics related to food and nutrition.

www.mayoclinic.com/health/healthy-diet/NU00190 Different healthy food pyramids from the Mayo Clinic (Asian diet, Latin American diet, Mediterranean diet, MyPlate, vegetarian diet).

http://www.nhlbi.nih.gov/health/health-topics/topics/dash/ The DASH diet.

www.nlm.nih.gov/medlineplus National Library of Medicine, National Institutes of Health (MedlinePlus). Reliable health information on nutrition, diet, and dietary supplements.

www.nutrition.gov Portal for all government websites on nutrition information. Available through the U.S. Department of Agriculture, National Agricultural Library.

www-users.med.cornell.edu/~spon/picu/calc/beecalc.htm Basal energy expenditure (Harris-Benedict equation) calculator from Weill Medical College, Cornell University.