

THE UNDERWEIGHT ADOLESCENT

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Underweight status represents depleted body fat and/or lean tissue stores. Although there are no expert guidelines for classifying underweight based on body mass index (BMI), the World Health Organization defines underweight as a BMI below the 5th percentile for age and gender.¹ Many adolescents, however, may appear very thin and have a low percentage of body fat and muscle depletion with BMI's below the 15th percentile.

Significance

Underweight status has been associated with higher rates of morbidity and mortality, although to a lesser extent than obesity.

- Canadian and US studies have demonstrated higher rates of hospitalizations and mortality in underweight adults, compared to those with weights within normal ranges.^{2,3}
- Higher rates of asthma, scoliosis, intestinal problems and emotional disorders were found in underweight 17 year olds.⁴
- Abnormal menses and subfertility has been demonstrated in underweight females.⁵
- Amenorrhea may also occur, as a result of low leptin levels, decreased body fat, emotional stress or anxiety.⁶
- Underweight adolescents who become pregnant may be at increased risk for pregnancy complications and poor fetal outcomes, including prematurity and low birth weight.
- The onset of puberty may be delayed in male and female adolescents with a low BMI.⁷
- The risk for osteoporosis may be increased in youth who remain lean as adults.
- Underweight adolescents may have a negative body image, particularly males who may desire a muscular physique.
- Fatigue, lack of energy and increased susceptibility to infection may be experienced in youth with a low BMI.

Etiology

Underweight status may be related to genetics, acute or chronic undernutrition, or illness.

- Some adolescents may be genetically lean with an efficient metabolism and low propensity to store body fat. Although the percentage of body fat may be low, lean tissue is usually within normal ranges and they are proportionately small.
- Youth with chronic illnesses affecting the absorption, metabolism or loss of nutrients may lose a significant amount of weight resulting from the catabolism of fat and muscle tissue.

- Psychiatric disorders such as obsessive-compulsive disorder, schizoid personality disorder and Asperger's disorder are associated with a low body mass index, which may be the result of neuroendocrine dysfunction and/or disturbed eating behaviors.^{8,9}
- Inadequate energy and nutrient intake, which may be associated with limited food resources, emotional stress, restricted diets, (multiple food allergy) or lifestyle habits, is the most common cause of a low weight-for-height status in adolescents.

Assessment

After ruling out psychiatric disorders, disordered eating behaviors and chronic illnesses associated with underweight status (such as malignancies, hyperthyroidism, AIDS, renal disease, inflammatory bowel disease), a review of the parameters listed in Table 1 is useful in evaluating underweight adolescents.

Intervention

Adequate nutrition is critical for underweight adolescents to progress normally through puberty and achieve their full genetic growth potential.

- Choosing nutrient-dense foods for meals and snacks will increase energy intake. An additional 500 calories per day above usual energy needs for growth and activity will help promote weight gain at a rate of about one pound per week. Females may require a daily energy intake of about 3000 calories, and males, 3500 calories, to promote weight gain.
- For health promotion, dietary fat should be limited to 30% of total calories, and mono and unsaturated fats (e.g., olive oil, canola oil, soft margarines) emphasized. A high consumption of sugar-containing foods and beverages is also discouraged since displacement of more nutrient-dense foods can result.

A daily food guide for underweight adolescents is listed in Table 2.

TABLE 1
Evaluation of Underweight Status in Adolescents

Weight

Weight, height without shoes
 Current BMI (wt/ht²)
 BMI percentile for gender and age
 Normal body weight for height, age and gender (weight corresponding to the 50th BMI percentile)
 Weight history (long term thinness/recent weight loss)
 Highest and lowest weight in the past year
 Growth pattern
 Percentage of body weight lost
 Desired weight
 Weight associated with normal menses
 Body fat estimate (calculated from triceps and subscapular skinfold measurements)
 Muscle mass estimate (calculated from mid upper arm muscle circumference: Midarm circumference cm-{3.14 x triceps skinfold mm} (60-90% of median indicates moderate depletion)
 Body size and shape of family members

Psychosocial Aspects

Traumatic events that may be precipitating factors in weight loss (e.g., family death, parental separation or divorce, illness or injury, abuse, move or change of school)
 Depression, stress, anxiety
 Teasing about body size or shape
 Body image, self esteem level (perception/acceptance of current weight, body size and shape, specific body parts and impact on self evaluation)
 Level of readiness to change behaviors (e.g., smoking cessation, increasing meal frequency, begin strength training program)

Physical activity patterns

Exercise type, intensity, frequency and duration, including organized and recreational sports, physical education classes and use of health clubs, community centers and home exercise equipment
 Physically active daily routines and employment
 Fidgeting

Chewing or swallowing difficulties**Eating patterns (current/prior to weight loss)**

Meals and snacks pattern, frequency and interval between food intake
 Types and amounts of foods eaten and method of preparation
 Types, amounts and frequency of fluid intake
 Caffeine intake
 Use of energy, fat, sugar-reduced foods/beverages
 Nutritional adequacy of current intake, particularly energy, protein, zinc, calcium, essential fatty acids
 Nutrient excesses (e.g., fat, sugar, supplemental vitamins)
 Food preferences, aversions
 Food intolerances
 Vitamin/mineral/herbal supplement use
 Schedule affecting intake (e.g., school activities, employment)
 Adolescent's/caregiver's perception of eating habits
 Hunger and satiety level and response to cues
 Access to and use of free/reduced school meals, snack bar, school store, vending machine
 Adequacy of food resources
 Adequacy of living situation, food storage and preparation facilities
 Eating environment, including who the adolescent lives and eats with, who purchases and prepares food, meals eaten together, use of convenience, restaurant and fast foods, food preparation skills, food storage and cooking facilities

Attempts at weight gain (current/past)

Dietary changes
 Strength training
 Use of steroids, creatine, protein supplements, etc.

Sexual maturity rating (Tanner stage)**Nutrient losses (vomiting, diarrhea, substance use)****Tobacco, alcohol and illicit drug use****Clinical signs of nutritional deficiencies**

Use of medications affecting appetite or associated with weight loss (e.g., Adderall, antidepressants)

Sleep adequacy, including duration and quality

TABLE 2
Daily Food Guide for Underweight Adolescents

Foods	Servings Per Day
Grains	11
Vegetables	5
Fruits	4
Dairy products	4
Meats and substitutes	3
Fats and oils	6
Sweets and desserts	2

Snack choices that are energy and nutrient-rich can help underweight teens gain weight in a healthy way. Snack suggestions are listed in Table 3.

TABLE 3
Snack Suggestions for Underweight Adolescents

Instant oatmeal (made with milk), raisins and nuts	Raw veggies with bean dip or hummus
Waffle with yogurt and fruit	Bagel, graham crackers or toast with peanut butter
Fruit smoothie	Fruit smoothie
Fruit bread or muffins	Dried fruit
Chex® mix	Apple crisp
Granola bars	Trail mix
Tortilla with melted cheese and salsa	Soy nuts and dried cranberries
Baked tortilla chips with guacamole	Pistachio nuts, almonds, cashews or sunflower seeds
Shake made with instant breakfast drink, banana, peanut butter and chocolate milk	Flavored milks, cocoa
Pizza (cheese or vegetable)	Frozen yogurt
Peanut butter and banana sandwich	Yogurt, fruit and granola sundae
Cornbread and honey	Pudding
Rice pudding	Soup made with milk
Macaroni and cheese	Orange Julius®
Oatmeal, peanut butter or molasses cookies	Taco
Baked potato or broccoli with cheese	Cottage cheese and canned fruit

To achieve an increase in lean body mass, strength training is recommended, which works all of the major muscle groups.

- Teens should be advised to work out 3 times per week, allowing a day of rest between working the same muscle groups to reduce soreness and promote muscle growth.
- Teens should be counseled to lift an amount of weight that results in muscle tiredness after 12 repetitions, to lift slowly, and to avoid holding breath. Gallon milk jugs partially filled with water can be used if hand weights are not available.

Counseling the Underweight Adolescent

Encourage the adolescent attempting weight gain to achieve the following:

- A daily intake of 3 meals and 3 snacks, with an interval of no longer than 4 hours between eating occasions during the day.
- A bedtime snack, since growth hormone levels are highest during early sleep.¹⁰
- Limited intake of foods high in sugar and fat but low in nutrient value (e.g., soft drinks, chips, candy).
- Limited water and carbonated beverage intake with meals to prevent early satiety.
- Avoidance of tobacco, alcohol and illicit drugs.
- Adequate rest and sleep (8-10 hours/night).
- Strength training every other day, with gradual increase in weight size and number of repetitions.
- Limited aerobic exercise, to reduce energy expenditure.
- Stress management and relaxation techniques.
- Avoidance of potentially harmful supplement use, including excessive vitamin and mineral supplements, protein supplements, creatine, DHEA, and anabolic steroids.
- Acceptance of genetically determined body size and shape and realistic expectations for gradual weight change.
- Promotion of a positive body image (see Chapter 13).

UNDERWEIGHT AND NUTRITIONAL DEPLETION IN ILLNESS**Significance**

Chronic diseases often become more severe during adolescence, further increasing nutrient and energy demands. Undernutrition, growth failure and pubertal delay are common, which may negatively impact the adolescent's body image and self esteem.¹¹⁻¹³

Etiology

Underweight status and nutritional depletion may result from:

- A reduced or unusual pattern of food intake.
- Increased turnover of nutrients.
- Malabsorption.
- Effect of medications on appetite or nutrient ingestion.
- Reduced ability to utilize nutrients (see Table 4).

TABLE 4
Causes of Nutritional Depletion/Underweight in Adolescents with Chronic Medical Conditions

<p>Inadequate Intake</p> <p>Anorexia Abdominal pain Early satiety Altered taste, side effects of medication Diarrhea/constipation Psychological stress</p> <p>Excessive Losses</p> <p>Protein-losing enteropathy Gastrointestinal bleeding Inadequate control of blood glucose levels Bile salt-losing enteropathy</p>	<p>Malabsorption</p> <p>Fat Minerals Bacterial overgrowth Fat soluble vitamins Carbohydrates Luminal and mucosal absorptive defects</p> <p>Increased Requirements</p> <p>Exacerbation of lung infection in cystic fibrosis Increased cell turnover, repair Catch-up growth and weight gain Fever, sepsis Repletion of body stores Metabolic stress Fast-growing tumors</p>
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Assessment

In addition to those listed in Table 1, evaluation of the underweight adolescent with chronic illness includes the parameters summarized in Table 5.

TABLE 5
Evaluation of Underweight Status in Adolescents With Chronic Medical Conditions

Diagnosis and level of severity of disease	Changes in appetite, nutrient and energy intake
Weight and growth changes in the past 2-6 months	Effects of treatment on nutrient demands and intake
Level of metabolic demand	Loss of subcutaneous fat
Gastrointestinal symptoms	Muscle wasting
Functional capacity (e.g., school attendance, performance; fatigue)	Relationship of medical condition to nutritional requirements
Edema	

Intervention

The primary goals of nutrition therapy are the promotion of normal physical and emotional growth and development and the prevention of nutrient deficiencies. These are accomplished through:

- Replacement of nutrient losses.
- Correction of lean body mass deficits.
- Provision of sufficient nutrients to promote energy and nitrogen balance for normal metabolic functions.

Nutrient needs

- Energy is usually the major deficit, but protein, vitamins and minerals including calcium, zinc, iron, and folate must be adequate to permit catch up growth to occur.
- Energy requirements are influenced by the level of nutritional depletion and metabolic stress of the disease. Individual caloric needs may vary from 100% to more than 150% of the RDI (see Chapter 4).
- Catch-up growth and weight gain may require 140-150% of recommended energy and protein intakes for age or height (see Chapter 3).
- Most underweight adolescents with a chronic disease will benefit from a multivitamin and mineral supplement.
- If malabsorption is present, supplements of fat soluble vitamins are indicated.

Nutrient delivery

- Increased dietary intake of foods which the adolescent tolerates and finds appealing.
- Commercial or oral supplements prepared at home (e.g., liquid meal replacements, milkshakes, puddings) added to the usual diet can be used to further increase nutrient intake.
- Supportive nutrition intervention (enteral nutrition) may be needed if weight velocity declines.
- Addition of 1-3 tablespoons of dry milk powder to foods such as fluid milk, mashed potatoes, casseroles, and soups.

Nutritional rehabilitation by enteral nutrition

- Enteral nutrition can result in improved body composition and strength, increased sense of well-being and control over body weight, enhanced growth and development, and improved body image.^{11,13}
- Nasogastric or gastrostomy infusions are preferred to the parenteral route.
- Malabsorption or secretory defects of intestinal function do not preclude the use of the intestine for enteral nutrition.
- For short-term nutritional support, liquid formula can be infused overnight and the nasogastric tube removed in the morning.
- For long-term support, a button gastrostomy tube is preferable since the tube does not need to be removed during the day, is cosmetically acceptable, easily cared for and does not interfere with school attendance or social development.
- 1200-1500 ml of a commercial formula via nasogastric or gastrostomy tube administered nightly for 8-10 hours is usually well tolerated. In addition to usual meals and snacks, this volume of formula provides approximately 2-3 g of protein/kg/day and 85-95 calories/kg/day.

Counseling the underweight adolescent with disease

- Encourage regularly scheduled, nutrient-dense meals and snacks.
- Direct nutrition counseling to the adolescent as well as the parent.
- Emphasize increased strength and/or enhanced body image rather than weight gain.
- Involve the adolescent and parent(s) in the decision to initiate enteral nutrition.

Referral

Adolescents who are homeless or have inadequate living situations can be referred to social services. Those with significant stress, depression, or anxiety will benefit from psychological assessment and intervention. Referral to smoking cessation programs and substance use assessment and treatment programs is indicated for adolescents abusing substances. If food access is inadequate, referrals can be made to food assistance programs, which include free/reduced cost school meals, summer feeding programs, food cooperatives, food shelves, community meals, and the Food Stamp Program. Adolescents or household members who are pregnant, postpartum, lactating, or under the age of 5 years can be referred to the WIC program.

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