AMERICAN ACADEMY OF PEDIATRICS

POLICY STATEMENT

Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of All Children

Committee on Sports Medicine and Fitness

Promotion of Healthy Weight-Control Practices in Young Athletes

ABSTRACT. Children and adolescents are often involved in sports in which weight loss or weight gain is perceived as an advantage. This policy statement describes unhealthy weight-control practices that may be harmful to the health and/or performance of athletes. Healthy methods of weight loss and weight gain are discussed, and physicians are given resources and recommendations that can be used to counsel athletes, parents, coaches, and school administrators in discouraging inappropriate weight-control behaviors and encouraging healthy methods of weight gain or loss, when needed. ***Pediatrics*** **2005;116:1557–1564;** ***athlete, weight gain, weight loss, wrestling, eating disorders.***

ABBREVIATION. NWCA, National Wrestling Coaches' Association.

INTRODUCTION

With the growth and advancement of youth sports, children and adolescents are becoming more involved in sports in which weight control is perceived to be advantageous for the individual and/or team. Bodybuilding, cheerleading, dancing, distance running, cross-country skiing, diving, figure skating, gymnastics, martial arts, rowing, swimming, weight-class football, and wrestling all emphasize thinness, leanness, and/or competing at the lowest possible weight. Other sports, such as football, rugby, basketball, and power lifting emphasize gaining weight by increasing lean muscle mass. In their attempt to lose weight and body fat or gain weight and muscle mass, some athletes resort to unhealthy weight-control practices,[1–5] which can potentially be harmful to their performance and/or their health. Pediatricians need to be able to recognize the young athlete who is at risk of developing unsafe weight-control practices and provide the athlete, family members, coaches, athletic trainers, and athletic directors with accurate information about healthy weight-control practices.

WEIGHT LOSS

Many athletes attempt to lose weight or body fat, hoping to improve performance, improve appearance, or meet weight expectations. Practices that are used to reduce weight include food restriction, vomiting, overexercising, diet-pill use, inappropriate use of prescribed stimulants or insulin, nicotine use, and voluntary dehydration (Table 1). Voluntary dehydration practices include fluid restriction, spitting, and the use of laxatives and diuretics, rubber suits, steam baths, and saunas. Weight loss becomes a problem when nutritional needs are not met or adequate hydration is not maintained.

Athletes may practice weight-control methods during the sports season only or year-round. These practices can impair athletic performance and increase injury risk. They also may result in medical complications including delayed physical maturation; oligomenorrhea and amenorrhea in female athletes; development of eating disorders; potential permanent growth impairment; an increased incidence of infectious diseases; changes in the cardiovascular, endocrine, gastrointestinal, renal and thermoregulatory systems; and depression.[1,4,6–9]

Dehydration

Hypohydration and dehydration are used by athletes in weight-sensitive sports in an attempt to lose weight or appear more lean and, thus, obtain a perceived advantage. Because the body does not store fluid or electrolytes before exercise, it is predisposed to dehydration.[10] The extent of the dehydration is determined by sweat loss and the inability or refusal to replace those losses with oral fluids.[11] On the basis of studies in adults, weight loss by dehydration results in suboptimal performance because of impaired strength, reaction time, endurance, and electrolyte imbalance and acidosis. It also may result in temporary learning deficits,[4,12–14] inability to concentrate, lethargy, mood swings, and changes in cognitive state.[15–20]

Hypohydration affects prolonged aerobic exercise more than it affects short, high-intensity anaerobic exercise.[10,21] In adults, a decrease in performance is seen when hypohydration is 2% or more (Table 2). Two to 3% hypohydration results in decreased reflex activity, maximal oxygen uptake, physical work capacity, and muscle endurance and impaired temperature regulation.[22] With additional hypohydration,

TABLE 1. Definition of Hydration

Euhydration: a normal state of body-water content
Dehydration: the process of incurring water deficit
Hypohydration: the extent (or level) of this deficit (usually described as percent of initial body weight)
Voluntary dehydration: purposeful restriction of fluids or use of measures to dehydrate oneself, often to produce weight loss

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TABLE 2. Effects of Various Levels of Hypohydration

Adults
2–3% hypohydration
Decreases reflex activity
Maximal oxygen uptake decreases by 10%[22]
Physical work capacity decreases by 22%[22]
Muscle strength decreases
Muscle endurance decreases
Impairment in temperature regulation
4–6% hypohydration
Maximal oxygen uptake decreases by 27%[22]
Physical work capacity decreases by 48%[22]
Muscle strength decreases more
Endurance time is reduced
Severe impairment in temperature regulation
Headaches, difficulty with concentration, impatience, sleepiness
>8% hypohydration
Heat cramps
Heat exhaustion
Heat stroke
Children
1% hypohydration
Reduces aerobic performance[25]
Increases core temperature[26]
No studies in children for higher levels of hypohydration exist

these parameters decrease even more,[22] and additional symptoms including reduced muscle strength, headache, difficulty concentrating, impatience, and sleepiness occur.[23] Dehydration retards the acclimation process and affects thermoregulation during exercise. The thermoregulatory effect of dehydration intensifies when athletes exercise. For every 1% hypohydration in adults, there is an associated increase of 0.1 to 0.4°C in body temperature.[23,24] When hypohydration exceeds 8%, heat cramps occur, followed by heat exhaustion and heat stroke (body temperature of more than 40.5°C or 105°F). These are serious, life-threatening events.

In children, 1% hypohydration is enough to induce a reduction in aerobic performance.[25] For ethical reasons, studies have not been performed in young children with greater levels of hypohydration. A study with 10- to 12-year-old boys who exercised intermittently in the heat suggested that the increase in their core temperature, at any level of hypohydration, was greater than in adults.[26]

Children have the following characteristics that are similar to adults:

1. Involuntary dehydration can occur with prolonged exercise even if the child is given fluids ad libitum.[11,26,27] This occurs principally when the fluids are unflavored.[28,29]
2. Dehydration causes greater body heat storage (excessive increase in core body temperature),[21,30] decreases blood volume, and results in reduced exercise tolerance,[28] increasing the risk of heat-related illness.[21,30–34]
3. Heat acclimation and training result in an increased sweating rate, which may provide heat dissipation by evaporation but also produces greater fluid loss.[28]
4. The likelihood of heat intolerance increases with conditions that are associated with excessive fluid loss (febrile state, gastrointestinal infection, diabetes insipidus, and diabetes mellitus), suboptimal sweating (spina bifida, sweating-insufficiency syndromes), excessive sweating (selective cyanotic congenital heart disease), abnormal sweating (cystic fibrosis), inadequate drinking (people with mental retardation and young children), abnormal hypothalamic thermoregulatory functions (anorexia nervosa, advanced undernutrition, previous heat-related illness), and obesity.[30,35,36]

Children have certain characteristics that, when compared with adults, predispose them to dehydration and heat illness, including the following:

1. Children produce more heat relative to body mass for the same exercise.[21,30,33]
2. Children have lower cardiac output for any given metabolic level.[30,33]
3. Children have higher thresholds before beginning to sweat.[34,35,37]
4. Sweating capacity is considerably lower in children,[30] reducing their ability to dissipate body heat by evaporation.[30,34,35,37]
5. Children become slightly more dehydrated with lower climatic and metabolic heat stress.
6. Children have a greater ratio of body surface area to body mass, which causes them to absorb heat more quickly when the ambient temperature exceeds skin temperature. Thus, a high level of solar radiation can be more detrimental to children.[28,30]
7. Children's ability to maintain thermohomeostasis during prolonged running in very hot or very cold environments is less efficient.[30,34,38]
8. Children are less efficient in dissipating heat in very hot environments.[11]
9. Children take longer to acclimate to hot, humid environments (2 weeks versus 1 week),[11,30] which increases their risk of heat-related disorders.[38,39]
10. Core body temperature increases more in children for the same level of hypohydration.[11,26]
11. Recent studies indicate that children's thirst is inadequate and that they become dehydrated easier (O. Bar-Or, MD, McMaster University and Chedoke Hospital, Hamilton, Ontario, Canada, verbal communication, October 1, 2003).

Children have a few characteristics that are beneficial in protecting them from dehydration in comparison with adults, including the following:

1. Children have shorter performance times in hot environments, and when exercising at the same intensity as adults. With shorter performance times, children are less likely to dehydrate themselves.[11,30]
2. Sodium and chloride concentrations in the sweat of prepubescent children are lower than those of pubescent children, who in turn have lower sodium losses than adults.[11]
3. Children's sweat rates are reduced, resulting in less sodium and chloride loss.

Dehydration over several days may be cumulative when the athlete who is dehydrated does not suffi-

ciently replace the fluid loss. An athlete may develop 2% to 3% hypohydration one day, not fully rehydrate overnight, and then on subsequent days dehydrate further by repeating the previous day's experience. This process leads to progressive dehydration, to the extent that the athlete becomes 5% to 8% hypohydrated. The greater the body-fluid deficit, the longer it takes to restore this deficit completely.[23] Replacement of intracellular fluids, when dehydration has occurred over 2 or 3 days, requires 48 hours.[40]

When children are given plain water, they will not replace their fluid losses completely. However, when children are given flavored drinks such as grape-, tropical-, or orange-flavored water, voluntary drinking increases by 44.5%,[28,41] a sufficient amount to replace their fluid losses completely.[11,28–30,32] When 6% carbohydrate and 18 mmol/L of sodium are added to flavored water, voluntary drinking is increased by an additional 45.5%.[28–30,41]

Prevention and Treatment of Dehydration

Sweat rates vary among athletes; therefore, one must consider each athlete individually and rely on previous experience with a particular athlete to estimate how much fluid he or she will require.[42]

Fluid ingested before, during, and after exercise reduces dehydration, core temperature, heart rate, and cardiac strain[6]; it maintains skin blood flow and increases exercise performance.[43,44] Thirst is a late indicator of dehydration in adolescents and adults; therefore, efforts must be made to maintain euhydration. The best way to assess hypohydration is to weigh the athlete before and after exercise. The amount of weight lost should be replaced with an equal volume of fluids before the next exercise session. The fluid should contain carbohydrates to replenish glycogen stores as well as sodium chloride.[11,21,45] The concentration of sodium in sports drinks is lower than the sodium concentration in the sweat of both adults and children.[41] Even if children drink enough sports drinks to maintain euhydration, their total body sodium would be decreased and their total sodium loss would not be replaced.[45] If this is repeated over several days and the sodium is not replaced in food or drink, symptomatic hyponatremia may develop.[45]

Food Restrictions/Binge-Purge Behavior

The most common way for athletes to attempt weight loss is by restricting food intake. They may develop other disordered eating behaviors such as purging, with or without bingeing, to decrease total energy (caloric) intake. Compulsive exercise or excessive exercise in addition to the normal training regimen also would be considered a form of purging. The spectrum of these disordered eating behaviors ranges from mild to severe, with the risk of development of an eating disorder and the associated morbidity and mortality increasing as the severity of the behavior increases.[46]

Disordered eating behaviors are prevalent in male and female athletes. Ten to 15% of high school boys who participate in "weight-sensitive sports" practice unhealthy weight-loss behaviors.[1,4,47] Numerous studies have reported these practices in wrestlers, with 1 study revealing that 80% of wrestlers lost weight for the wrestling season.[48] Eleven percent of wrestlers were found to have an eating disorder in 1 study,[49] and as many as 45% of wrestlers were found to be at risk of developing an eating disorder in other studies.[4,19,47]

Many studies have revealed an increased incidence of disordered eating behavior (food restriction, vomiting, laxative and diuretic use) in female athletes involved in weight-sensitive sports such as figure skating, gymnastics, diving, long-distance running, rowing, and swimming.[2,5,46] One study of young swimmers reported that 60% of average-weight girls and 18% of underweight girls were trying to lose weight.[50] Most of these swimmers were restricting food intake to lose weight; however, 15% were vomiting or using laxatives or diuretics. In the female athlete, decreased energy availability (calculated as dietary energy intake minus exercise energy expenditure) can lead to menstrual dysfunction, which can result in potential bone mineral density loss. This has been termed the "female athlete triad" (decreased energy availability or disordered eating, menstrual dysfunction, and bone mineral density loss).[3,51] All female athletes with oligomenorrhea or amenorrhea should be evaluated thoroughly to determine the underlying etiology. If low energy availability is the cause, the athlete should be counseled on increasing energy intake enough to resume normal menses.[3,51] If an eating disorder is suspected, referral to a multidisciplinary team of experts in this field is appropriate.

Healthy Weight Loss

Athletes usually require a greater energy (caloric) intake than do nonathletes.[21] The actual energy intake (number of calories) needed depends on the athlete's body composition, weight, height, age, stage of growth, and level of fitness as well as the intensity, frequency, and duration of exercise activity.[52] Athletes need to eat enough to cover the energy costs of daily living, growth, building and repairing muscle tissue, and participating in sport.[53] Athletes who want to lose weight should be counseled on the harmful effects of unhealthy weight-loss practices and inappropriate weight loss. They need to be informed that weight is not an accurate indicator of body fat or lean muscle mass and that body composition measurements can be much more helpful.[54]

Studies have shown that physique does not markedly influence performance except at the extreme ranges (ie, significant endomorphy or ectomorphy).[55] An excessive amount of body fat interferes with acclimation to heat and can decrease speed, endurance, and work efficiency.[4,56] Therefore, weight loss may be beneficial when it is achieved by healthy means and involves losing excess fat without reducing lean muscle mass or causing dehydration.[4] When weight is lost too rapidly or by significant reduction in energy (caloric) intake, lean muscle mass will be lost, which can affect performance negatively.[57]

Weight loss, when necessary, should be gradual

and should not exceed 1.5% of the total body weight, or 1 to 2 lb, each week.[52,56–59] Weight loss beyond these guidelines results in the breakdown and metabolism of muscle, making an athlete weaker.[52,56–60] To lose 1 lb of fat in 1 week, one must expend 14 700 kJ (3500 kcal) more than one consumes.[60] The ideal way to do this is to consume 7350 kJ (1750 kcal) fewer per week and expend 7350 kJ (1750 kcal) more per week by exercising.[56,60] An appropriate diet for most athletes consists of a minimum of 8400 kJ (2000 kcal) each day. Approximately 55% to 65% of the daily energy (caloric) intake should be from carbohydrates, 15% to 20% should be from protein, and 20% to 30% should be from fat.[52,57] The diet should be well balanced, consisting of foods from all groups of the food pyramid. When possible, the athlete should be counseled by a registered dietitian who has experience working with athletes and their families. Sports and Cardiovascular Nutritionists (SCAN), a practice group of the American Dietetic Association, can provide names of registered dietitians with expertise in nutrition and exercise (see www.eatright-.org, or call 800-877-1600, extension 5000).

Once weight has been lost and the desired weight is obtained, that weight should be maintained. Studies have shown that athletes who maintain their desired weight have higher resting metabolic rates than do athletes who are "cyclic" weight losers (177.2 vs 154.6 kJ/m^2 per hour, respectively).[61] They also have higher resting energy expenditures (7702.8 vs 6631.8 kJ/day, respectively) and oxygen consumption (266.5 vs 230.4 mL/minute, respectively).[61] Therefore, athletes who maintain a constant weight can eat more calories than the "cyclic" weight losers and maintain the same weight.[61]

With the exception of sports that require mandatory weigh-ins, coaches of most sports should not discuss weight or weight loss with an athlete. Many coaches inappropriately focus on weight instead of body composition and performance, and most coaches do not have an adequate nutritional background to counsel an athlete about weight loss. In addition, when a coach mentions weight loss to an athlete, that athlete is much more likely to begin harmful practices of weight control rather than consult with the appropriate professionals. Any weight loss desired by an athlete should be discussed with a health care professional, a registered dietitian, an athletic trainer (when appropriate), and the family. Athletes involved in sports that require mandatory weigh-ins should be discouraged from using harmful weight-loss practices and should be encouraged to compete at a weight that is appropriate for their age, height, physique, and stage of growth and development. Weigh-ins should take place in such a manner as to encourage good hydration and competing at a healthy weight. It has been determined that the safest and fairest procedure for wrestlers, to ensure that they are well hydrated at all times, is to have mat-side weigh-ins immediately before their matches.[62] This procedure ensures that competing wrestlers will be at or near the same weight during the match. A wrestler is prevented from dehydrating and weighing in at one weight, and then rehydrating and wrestling at a significantly higher weight while his or her opponent weighs in at his or her natural weight and wrestles at that weight. Mat-side weigh-ins would prevent wrestlers from competing when they are weak from dehydration and prevent the temptation of dehydrating themselves to the degree that is life threatening.

Weight and Body-Composition Measurement

An athlete's weight should typically fall between the 25th and 75th percentiles of weight for height for age (by National Center for Health Statistics guidelines),[63] although some athletes weigh more because of increased muscle mass. The use of body mass index (BMI) in athletes is not recommended; however, if used, most athletes should be between the 50th and 75th percentile for BMI.[64] BMI is a measure of one's weight relative to height and has been used as a fairly reliable indicator of total body fat (obesity) in adults. In 2000, the Centers for Disease Control and Prevention published guidelines for BMI in children and adolescents 2 years and older to aid in diagnoses of overweight and underweight.[64] BMI is not a perfect indicator of body fatness and may falsely classify some children, particularly adolescents, who are of normal fatness as being overweight.[65] Because weight and height velocities do not coincide exactly during the growth spurt and individual patterns of growth vary during this time, care must be taken to avoid a false diagnosis of overweight during puberty.[65] BMI also can be falsely elevated in an athlete or nonathlete with a muscular build as well as in someone who has a high torso-to-leg ratio.[65] Therefore, body-composition measurements (body fat and lean muscle mass), in addition to height-for-weight for age measurements, may be more useful in determining the physical status of an athlete.[54,57]

Anthropometric measurements can be performed to estimate lean muscle mass. For most well-nourished athletes, lean muscle mass should be greater than the 25th percentile.[57] Many methods are available to determine body fat.[4] The most precise method is underwater weighing; however, the equipment for underwater weighing is expensive and of limited availability. Other commonly used methods include skinfold-thickness measurements, air displacement, bioelectrical impedance measurements, girth measurements, and computerized calipers.[4,58] Skinfold measurements are easily performed by someone with experience using high-quality calipers (approximately $200). When performed in the correct manner, published reports on skinfold calibration show an error margin of ±3%.[66] Skinfold measurements can be taken from 3, 4, or 5 sites (right biceps, right triceps, right subscapular, right suprailiac, and right abdominal sites [regardless of whether the athlete is right-handed or left-handed, measurements are always performed on the right side]). The more sites used, the more accurate the results are. Instructions on how to perform skinfold measurements are available.[58,59]

No optimal values for body composition have been established for any sport. The association be-

tween performance and body composition must be individualized for each athlete. A specific percentage of body fat should never be recommended for an individual athlete, but rather a range that is realistic and appropriate.[67] The body fat of "reference adolescents" ranges from 12.7% to 17.2% for males and 21.5% to 25.4% for females.[68] "Low fat" is considered to be 10% to 13% for males and 17% to 20% for females. "Very low fat" is considered to be 7% to 10% for males and 14% to 17% for females.[69,70] Adolescent females who are meeting their energy (caloric) needs will be eumenorrheic.[51]

WEIGHT GAIN

Sports such as football, rugby, basketball, power lifting, and bodybuilding often motivate athletes to gain weight. If weight is gained improperly, it will lead to excess fat, resulting in decreased speed, endurance, and agility and poor acclimation to heat. Overweight athletes, later in life, are at an increased risk of hypercholesterolemia, gall bladder disease, cardiovascular disease, hypertension, and type 2 diabetes mellitus. Often, athletes use supplements (which may be of unproven value and potentially harmful) or anabolic compounds (which are harmful to athletes' health) to gain weight instead of evaluating their nutritional and training programs.

Before trying to change body composition, athletes must understand potential genetic limitations.[71] Athletes with a solid body build (mesomorphy) can expect to gain more weight than athletes with a slender body build (ectomorphy). Inadequate energy intake is often the limiting factor for athletes trying to increase muscle mass. They may overestimate the protein requirements and underestimate the need for carbohydrates.[71]

Healthy Weight Gain

The rate and amount of weight gained and specific muscles developed are determined by an athlete's genetic predisposition, training program, diet, and motivation.[71] To build 1 lb of muscle in 1 week, one must (1) consume 8400 to 10 500 kJ (2000–2500 kcal) more than one expends, (2) consume 1.5 to 1.75 g of protein per kg of body weight per day, and (3) participate in strength training. Consuming 1.5 to 1.75 g of protein per kg of body weight per day rarely is a problem; the average American diet contains 2 to 3 times that amount of protein.[56] If the athlete has not gained the desired weight despite an appropriate training program, adequate rest, and a nutritionally sound diet, it is appropriate to make a recommendation that he or she increase dietary fat.[71] Studies of elite athletes report dietary fat intakes ranging from 29% to 41% in males and 29% to 34% in females.[71] Increased energy (caloric) intake should always be combined with strength training to induce muscle growth and, therefore, increase muscle mass. Gains in muscle hypertrophy are best achieved by performing multiple sets of weight lifting with a relatively high number of repetitions (8–15 repetitions per set).[72] Young athletes should lift lighter weights with an increased number of repetitions under the supervision of a trained adult.[72] Weight gain needs to be gradual, because a gain in excess of 1.5% of body weight per week may result in unwanted fat.[56,60]

RECOMMENDATIONS

1. Physicians who care for young athletes should have knowledge of healthy weight-gain and weight-loss methods. They should understand minimal recommended weight, normal growth curves, and body composition measurements and be willing to educate athletes, families, coaches, athletic trainers, school administrators, and state and national organizations when appropriate. Physicians should understand that all athletes are unique and each athlete must be evaluated individually.
2. All physical examinations of young athletes should include a weight history and a history of eating patterns, hydration practices, eating disorders, heat illness, and other factors that may influence heat illness or weight control.
3. Physicians should be able to recognize early signs and symptoms of an eating disorder and obtain appropriate medical, psychological, and nutritional consultation for young athletes with these symptoms.
4. Nutritional needs for growth and development must be placed above athletic considerations. Fluid or food deprivation should never be allowed. There is no substitute for a healthy diet consisting of a variety of foods from all food groups with enough energy (calories) to support growth, daily physical activities, and sports activities. Daily caloric intake for most athletes should consist of a minimum of 8400 kJ (2000 kcal). Athletes need to consume enough fluids to maintain euhydration. Physicians should engage the services of a registered dietitian familiar with athletes to help with weight-control issues.
5. In sports for which weigh-ins are required, athletes' weight and body composition should be assessed once or twice per year. The most important assessment is obtained before the beginning of the sport season. This should include a determination of body fat and minimal allowable weight when the athlete is adequately hydrated (the National Wrestling Coaches' Association [NWCA] Internet Weight Classification Program is available at www.nwcaonline.com[58] or by calling 717-653-8009 [see Fig 1 and Appendix]). Weigh-ins for competition should be performed immediately before competition.[62] Athletes should be permitted to compete in championship tournaments only at the weight class in which they have competed for most other athletic events that year.[58,59,62]
6. Male high school athletes should not have less than 7% body fat. This minimal allowable body fat may be too low for some athletes and result in suboptimal performance. Female athletes should consume enough energy (calories) and nutrients to meet their energy requirements and experience normal menses. There are no recommendations on body-fat percentages in female athletes.

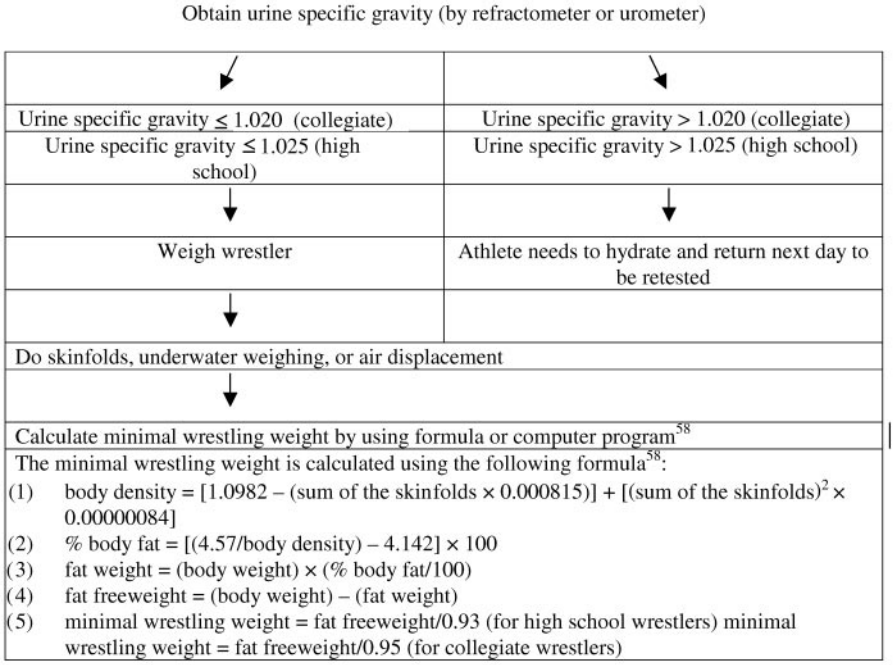

Fig 1. Calculating minimal wrestling weight.

Alternatively, the skinfold measurements may be entered into the NWCA Internet weight certification program at www.nwcacalculator.com/certification.

The minimal wrestling weight is calculated for the minimal allowable percent of body fat. As defined by the NWCA, the minimal allowable percent body fat is 7% for male high school wrestlers and 12% for female high school wrestlers. The National Collegiate Athletic Association (NCAA) has determined the minimal allowable percent body fat to be 5% for male collegiate wrestlers. The wrestler may not be able to attain these levels of body fat without resorting to unhealthy weight-control practices. He or she will often perform better at a higher percent body fat than the calculated minimal allowable body fat. Female wrestlers should not permit their weight or percent body fat to be below that level at which they have normal monthly menstrual periods.

7. A program for the purpose of gaining or losing weight should (*a*) be started early to permit a gradual weight gain or loss over a realistic time period, (*b*) permit a change of 1.5% or less of one's body weight per week, (*c*) permit the loss of weight to be fat loss and the gain of weight to be muscle mass, (*d*) be coupled with an appropriate training program (both strength and conditioning), and (*e*) incorporate a well-balanced diet with adequate energy (calories), carbohydrates, protein, and fat. After athletes obtain their desired weight, they should be encouraged to maintain a constant weight and avoid fluctuations of weight. A weight-loss plan for athletic purposes should never be instituted before the 9th grade.
8. Any athlete who loses a significant amount of fluid during sports participation should weigh in before and after practices, games, meets, and competitions. Each pound of weight loss should be replaced with 1 pt of fluid containing carbohydrates and electrolytes before the next practice or competition. Fluids should be available, and the drinking of such should be encouraged at all practices and competitions.
9. Weight loss accomplished by overexercising; using rubber suits, steam baths, or saunas; prolonged fasting; fluid reduction; vomiting; or using anorexic drugs, laxatives, diuretics, diet pills, insulin, stimulants, nutritional supplements, or other legal or illegal drugs and/or nicotine should be prohibited at all ages.[73,74]
10. Athletes who need to gain weight should consult their physician for resources on healthy weight gain and referral to a registered dietitian. They should be discouraged from gaining excessive weight, which may impair performance, increase the likelihood of heat illness, and increase the risk of developing complications from obesity.
11. Ergogenic aids and nontherapeutic use of supplements for weight management should be prohibited.[73,74]
12. Young athletes should be involved in a total athletic program that includes acquisition of athletic skills and improvement in speed, flexibility, strength, and physical conditioning while maintaining good nutrition and normal hydration. This should be done under the supervision of a coach who stresses a positive attitude, character building, teamwork, and safety.[75]

APPENDIX: CALCULATING MINIMAL WRESTLING WEIGHT

Calculation of a minimal safe wrestling weight using body-fat measurements was first performed in high school athletes.[18,76–80] In 1998, the National Collegiate Athletic Association[59] and the NWCA[58] incorporated this technique into a mandatory program

designed to establish the minimal safe wrestling weight for collegiate wrestlers.[58] This program includes hydration testing, body-composition assessment, calculation of a lowest allowable weight class for each wrestler, development of a weight-loss plan for each wrestler (if appropriate), and a nutrition education program specific to wrestling. The wrestler's minimal wrestling weight is established by determining percent body fat when the wrestler is adequately hydrated (urine specific gravity of 1.020 or less for college wrestlers and 1.025 or less for high school wrestlers). If the wrestler is not well hydrated, the body-fat calculations will result in a low and unsafe minimum weight recommendation.[81] The National Federation of High Schools medical advisory committee has recommended that high school wrestling programs adopt the program of the NWCA by the 2004–2005 academic year.[4]

In establishing minimal weight, skinfold calipers (Lange skinfold calipers; Beta Technology Corp, Cambridge, MD), bioimpedance (Tanita, Arlington Heights, IL), air displacement (Bod Pod; Life Measurement, Inc, Concord, CA), and hydrostatic weighing are the only methods currently approved for body-composition measurements.[58,59] The NWCA formula requires skinfold measurements to be taken at the right triceps, right subscapular, and right abdominal sites (regardless of whether the athlete is right-handed or left-handed, measurements are always performed on the right side).[58]

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