

The Importance of Body Weight and Weight Management for Military Personnel

Guarantor: Mohammad Reza Naghii, PhD

Contributor: Mohammad Reza Naghii, PhD

Weight or fat reduction and maintenance among military personnel and attainment of desired body composition and physical appearance are considered important. A high level of body fat has been shown to have an adverse effect on performance in a number of military activities. The effect of rapid weight loss on performance appears to depend on the method of weight loss, the magnitude of weight loss, and the type of exercise or activity performance test used. Personnel who undertake imprudent weight-loss strategies, that is, personnel who try to change their usual body size by chronically restricting their food and fluid intake, may suffer a number of problems. Overweight personnel and their military coaches are just as susceptible to false ideas about weight loss and dieting as the rest of the community. Inappropriate weight loss causes a loss of lean tissue and can reduce, rather than enhance, performance. The understanding and promotion of safe, effective, appropriate weight-loss and weight-maintenance strategies represent important functions of the military system and officials. The greatest likelihood of success requires an integrated program, both during and after the weight-loss phase, in which assessment, increased energy expenditure through exercise and other daily activities, energy intake reduction, nutrition education, lifestyle changes, environmental changes, and psychological support are all components.

Introduction

The primary purpose of fitness and body composition standards in the military has always been to select individuals best suited to the physical demands of military service based on the assumption that proper body weight supports good health, physical readiness, and appropriate military appearance. Advances in health care and improved nutrition over the recent century in the United States have resulted in increases in mean height, weight, and fat-free mass of soldiers and the population as a whole. However, increases in food consumption and decreases in daily activity have raised new concerns about the impact of overnutrition and fatness on overall health, physical fitness, and military performance.¹ Maintaining a healthy body weight is an extremely complex issue. Maintenance of fitness and appropriate body fat standards by military personnel is affected by each individual's genetic factors, developmental history, and social background. Some of these factors are biologically programmed (e.g., physiological features, genetic constitution, and age). Other factors can be manipulated by the individual (e.g., physical activity and diet), whereas still other factors may require institutional, systemic, or environmental changes (e.g., worksite and community design and availability

of facilities). Individuals appear to show significant heterogeneity in their body weight and body fatness responses to altered energy balance, dietary components, and changes in activity levels, although little is known about the specific causes of heterogeneity.^{2,3}

The effects of excess body weight are widespread and raise a variety of concerns relevant to the health and performance of members of the military. Obesity also has a variety of adverse physiological effects. It was observed that the prevalence of type 2 diabetes mellitus, hyperlipidemia, hypertension, and heart disease increased with the severity of obesity and that prevalence ratios were generally greater among younger adults, compared with older adults. Approximately 70% of overweight individuals have at least one of these complications, and >30% have two or more.⁴⁻⁶ Obesity is also associated with increased mortality rates.^{7,8} The distribution of adipose tissue influences the risk of excess weight. Upper body fat (more specifically, abdominal adipose tissue or fat) carries a higher morbidity risk than adipose tissue deposited in the subcutaneous compartments of the buttocks, thighs, and lower extremities.⁹ Individuals with abdominal adiposity may be predisposed to other obesity-related conditions, such as insulin resistance, glucose intolerance, dyslipidemias, and high blood pressure, often referred to collectively as syndrome X or the metabolic syndrome; factors that increase the deposition of abdominal adipose tissue include male gender, lack of physical activity, alcohol use, and smoking.¹⁰⁻¹³ The major possible comorbidities associated with obesity are shown in Table I.^{14,15} In a cohort study, the heaviest individuals had death rates from all cancers combined that were 52% higher (for men) and 62% higher (for women) than the rates for men and women of normal weight. For both men and women, body mass index (BMI) was also significantly associated with higher rates of death attributable to cancer of the esophagus, colon and rectum, liver, gallbladder, pancreas, and kidney; the same was true for death attributable to non-Hodgkin's lymphoma and multiple myeloma. Significant trends of increasing risk with higher BMI values were observed for death resulting from cancers of the stomach and prostate among men and for death resulting from cancers of the breast, uterus, cervix, and ovary among women.¹⁶

The distribution of upper body adipose tissue may also affect appearance, which is relevant to military standards. Early identification of personnel at risk and implementation of prevention strategies are important. To identify those at risk of overweight or obesity, a set of potential risk factors for weight gain (e.g., overweight at the time of accession to the military or training programs, family history of obesity, initial performance on the physical training test, or a gain of >5% over initial entry training weight) should be developed. The effectiveness of educating these individuals during initial entry training or whenever they

Baqiyatallah (a.s.) University of Medical Sciences, Faculty of Health, Nutrition Group, Tehran, Islamic Republic of Iran.

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TABLE I
CONSEQUENCES OF ADULT OBESITY

Psychosocial consequences
Low self-esteem
Disordered eating behavior
Discrimination
Medical consequences
Some cancers
Diabetes mellitus
Gallbladder disease
Gastroesophageal reflux disease
Heart disease
Hyperlipidemia
Hypertension
Osteoarthritis
Polycystic ovary disease
Pseudotumor cerebri (intracranial hypertension)
Sleep apnea
Urinary incontinence
Increased maternal and fetal complications during pregnancy and after birth
Early death

are identified as being at risk of becoming overweight should be evaluated. Initial entry training is a time of learning for individuals new to the military. Just as these individuals learn military tasks (e.g., how to fire a weapon), they could learn nutritional principles, particularly the importance of energy balance, appropriate portion sizes, and caloric contents of frequently consumed foods. Nutrition and lifestyle education is paramount and should be provided early in the initial entry training period and reinforced periodically. The effective strategies for a weight/fat-loss program would be the same regardless of whether the setting is military or civilian. Maintaining desirable body composition is an integral part of physical fitness, general health, and military appearance, and the first line of body composition evaluation is through weight-for-height values and appearance.³ Although appearance is associated slightly with percentage of body fat, it is associated more significantly with abdominal circumference.¹⁷ The relative role that appearance should play in relation to weight and body fat programs in the military is a multifaceted issue. For several psychosocial reasons, the military embraces a policy on appearance, which is perceived to be an indication of fitness; it may affect how the general public views the military, the appearance of military personnel is thought by some to be a factor in esprit de corps, and it may have some impact on how a country's military is perceived internationally. The issue of appearance also influences individuals' self-esteem and acceptance by peers. Another issue considering the direct (increased medical care) and indirect (lost workdays) costs of excess body weight among active duty Air Force personnel was determined. It was found that 20.4% of men and 20.5% of women had body weights that exceeded their official maximal allowable weight for height. The excess body weight-attributable costs were estimated at \$22.8 million per year, with annual direct and indirect costs estimated at \$19.3 million and \$3.5 million, respectively. The estimation of lost workdays was 28,351 per year.¹⁸

Fitness, Body Weight, and Body Composition

Throughout history, it has been demonstrated that stronger, more fit, mentally sound soldiers are better able to perform their assigned duties at optimal levels of proficiency. This proficiency has been measured in various ways, by quality of work, productivity, promotion success, and test scores. It may also have been measured, at times, simply by survival. Measurable attributes affecting performance include physical characteristics, medical and mental illness, behaviors of risk, intelligence level, athletic ability, and endurance.¹⁹ Advances in health care and improved nutrition in recent decades have resulted in increases in mean height, weight, and fat-free mass of U.S. soldiers.¹ However, the likelihood of overnutrition leading to overweight and obesity and increases in inactivity have raised new concerns about the impact of fatness on health and military performance. One of the considerations most relevant to the issue of fitness in the military is how fitness should be assessed. As described in the recently revised U.S. Department of Defense Physical Fitness and Body Fat Program Procedures,²⁰ the four components of fitness assessment are (1) aerobic capacity, (2) muscular strength, (3) muscle endurance, and (4) body composition, which is influenced by other measures of fitness. Fatness, as defined by Department of Defense, means a body fat content in excess of 26% of total weight for men and 36% of total weight for women.

In a study, the relationship of fitness and fatness (percentage of body fat) to injury rates among recruits during entry training was evaluated.²¹ Fitness was defined on the basis of 1- or 2-mile run times and the numbers of sit-ups and push-ups completed in 2-minute periods. All three fitness measures were highly correlated with fatness for both men and women. For men, percentage of body fat, determined from four skinfold measurements, was significantly and positively correlated with 1- and 2-mile run times and inversely correlated with numbers of sit-ups and push-ups. Fitness was positively correlated with BMI, except that no significant relationship was found for the number of push-ups. Among women, the results of the three fitness tests were also positively correlated with percentage of body fat, although the relationships were weaker. BMI was positively, but weakly, correlated with 1-mile run times and weakly, but inversely, correlated with numbers of push-ups.²¹

The first component of an effective weight/fat-loss program is appropriate assessment. In most cases, body weight and height measurements should be taken and the individual's BMI calculated from these data (BMI = weight [kg]/height [m²]). If the BMI is within the acceptable range, then no further measurement is necessary.²¹⁻²³ A BMI of <18.5 constitutes underweight, a BMI of 18.5 to 24.9 constitutes healthy weight, a BMI of 25.0 to 29.9 constitutes overweight, and a BMI of >30.0 constitutes obesity. A BMI consistent with overweight does not by itself indicate that an individual is overfat.^{22,23} Additional testing must be performed to determine whether the excess weight in such individuals consists of fat or lean mass. This is especially relevant because research has linked BMI to injury rates in initial entry training. Therefore, from both appearance and health perspectives, abdominal circumference should be used as an objective measure. Abdominal adiposity, measured as abdominal circumference, has been shown to be a separate risk factor for death and heart disease. Current National Institutes of Health guide-

lines for maximal abdominal girth are 102 cm (~40 in) for men and 89 cm (~35 in) for women.⁹ The evaluation of waist circumference to assess the risks associated with obesity or overweight is supported by research. Measurement of the waist:hip ratio provides no advantage over waist circumference alone. Waist circumference measurements are particularly useful for patients who are categorized as normal weight or overweight.²⁴ It is not necessary to measure waist circumference for individuals with BMI values of ≥ 35 kg/m², because it adds little to the predictive power of the disease risk classification of BMI. There are ethnic- and age-related differences in body fat distribution that modify the predictive validity of waist circumference as a surrogate for abdominal fat.²⁵ In some populations (e.g., Asian American individuals or persons of Asian descent), waist circumference is a better indicator of relative disease risk than is BMI.²⁶ For older individuals, waist circumference assumes greater value for estimating the risk of obesity-related diseases.

Body fat standards for men shall be not more stringent than 18% and not more liberal than 26%. For women, the fat standards shall be not more stringent than 26% and not more liberal than 36%. Individuals who exceed these limits must be referred to a weight-management program.²⁷

Relevant Strategies for Weight Loss and Maintenance

The most important component of an effective weight-management program must be the prevention of unwanted weight gain from excess body fat. The military is in a unique position to address prevention from the first day of an individual's military career. There is significant evidence that losing excess body fat is difficult for most individuals and the risk of regaining lost weight is high.²⁸ From the first day of initial entry training, an understanding of the fundamental causes of excess weight gain must be communicated to each individual, along with a strategy for maintaining a healthy body weight as a way of life. The principle of weight gain is simple, i.e., energy intake exceeds energy expenditure. However, overweight and obesity are clearly the result of a complex set of interactions among genetic, behavioral, and environmental factors. The percentage of individuals who lose weight and successfully maintain the loss has been estimated to be <10%.^{29,30} Military personnel who are identified as exceeding body composition standards are mandated to enter a military weight-management program for treatment. A good weight-management program must include two phases, weight loss and weight maintenance. Based on recommendations, the critical components of the programs should be uniform across the services.

Physical Activity

Increased physical activity is an essential component of a comprehensive weight-reduction strategy for overweight adults who are otherwise healthy. One of the best predictors of success in the long-term management of overweight and obesity is the ability to develop and to sustain an exercise program.^{31,32} Physical activity represents an important component of volitional energy expenditure. Modern transportation and other conveniences have reduced the need for energy expenditure in the form of physical exertion. The availability of exercise facilities at military bases can reinforce exercise and fitness programs. For

a given individual, the intensity, duration, frequency, and type of physical activity depend on existing medical conditions, the degree of previous activity, physical limitations, and individual preferences. The benefits of physical activity are significant and occur even in the absence of weight loss.^{33,34} For previously sedentary individuals, a slow progression in physical activity has been recommended, so that 30 minutes of exercise daily is achieved after several weeks of gradual increase. The activity goal has been expressed as an increase in energy expenditure of 1,000 kcal/week, although this quantity may be insufficient to prevent weight regain. For that purpose, a weekly goal of 2,000 to 3,000 kcal of added activity may be necessary.³⁵ Therefore, mental preparation for the amount of activity necessary to maintain weight loss must begin while the individual is losing weight.^{36,37}

When strength training or resistance exercise is combined with aerobic activity, long-term results may be better than those with aerobic activity alone.³⁸ Because strength training tends to build muscle, loss of lean body mass may be minimized and the relative loss of body fat may be increased. Although exercise programs can result in an average weight loss of 2 to 3 kg in the short term, outcomes improve significantly when physical activity is combined with dietary intervention.³⁹ For example, when physical activity was combined with a reduced-calorie diet and lifestyle changes, a weight loss of 7.2 kg was achieved after 6 months to 3 years of follow-up monitoring.⁴⁰

An average of 80 minutes/day of moderate activity or 35 minutes/day of vigorous activity is needed for a sedentary lifestyle to maintain weight.⁴¹ This would be considered the threshold level, and levels would likely need to be higher (either longer time periods or greater intensity) to effect weight loss. There is good evidence that peak rates of lipid oxidation are achieved at exercise intensities of ~45% of maximal oxygen consumption.⁴² An initial weight loss of 10% of body weight achieved over 6 months is a recommended target. The rate of weight loss should be 1 to 2 pounds each week. Greater rates of weight loss do not achieve better long-term results. After the first 6 months of weight-loss therapy, the priority should be weight maintenance; additional weight loss can be considered after a period of weight maintenance.

Behavior and Lifestyle Modification

The use of behavior and lifestyle modification in weight management is based on a body of evidence that people become or remain overweight as the result of modifiable habits or behaviors and that, with changes in those behaviors, weight can be lost and the loss can be maintained.⁴³ The primary goals of behavioral strategies for weight control are to increase physical activity and to reduce caloric intake by altering eating habits.⁴⁴ More recently, these treatments have been used in combination with low-calorie diets, medical nutrition therapy, nutrition education, exercise programs, monitoring, pharmacological agents, and social support to promote weight loss and as a component of maintenance programs.⁴⁵ Self-monitoring of dietary intake and physical activity, which enables the individual to develop a sense of accountability, is one of the cornerstones of behavioral treatment. Patients are asked to keep a daily food diary in which they record what and how much they have eaten, when and where the food was consumed, and the context in which the food was consumed (e.g., what else they were doing at

the time, what they were feeling, and who else was there). In addition, clients may be asked to keep a record of their daily physical activities. Self-monitoring of food intake is often associated with a relatively immediate reduction in food intake and consequent weight loss.^{46,47} Particular attention must be directed toward increasing activity, decreasing energy intake, and improving food quality for consumption.

Diet

Weight-management programs may be divided into two phases, weight loss and weight maintenance. Although exercise may be the most important element of a weight-management program, it is clear that dietary restriction is the critical component of a weight-loss program that influences the rate of weight loss. Activity outcome accounts for only approximately 15 to 30% of daily energy expenditure, but food intake accounts for 100% of daily energy intake. Therefore, the energy balance equation may be affected most significantly by reducing energy intake.⁴⁸ The diets that have been proposed are almost innumerable but, whatever the name, all diets consist of reductions of some proportions of protein, carbohydrate, and fat.

General criteria for a diet that provides reasonable and steady weight loss are based on the principle of a hypocaloric balanced diet. However, there is recent evidence that, among obese individuals, use of very-low-calorie diets, coupled with behavior modification, may be more successful in initial weight loss and maintenance of weight loss than hypocaloric balanced diets.⁴⁹ The most important dietary considerations recommend the following.⁵⁰ (1) Energy intake should be sufficient but must be less than the individual's energy expenditure. The level of other essential nutrients should be adequate to allow individuals to pursue their regularly scheduled activities and to maintain appropriate levels of fitness. (2) The diet program should promote a new set of eating habits that can help to maintain weight loss over time and should emphasize changes in what, how much, and how often the individual eats. (3) At least five servings of fruits and vegetables per day should be included and incorporated into the individual's lifestyle. (4) The diet should be palatable and familiar, with sufficient volume to promote feelings of satiety. The foods provided must be readily available and affordable, and the diet must be easily adaptable to a variety of situations, including living in barracks or at home and married or single. Although the etiology of obesity is multifactorial, the common characteristic of all obese people is excessive energy storage in the form of body fat. An appropriate weight-loss diet is energy deficient by 350 to 1,000 kcal/day, in comparison to the habitual daily diet. Protein intake should be no less than 60 g/day for women and no less than 75 g/day for men. Fat content should be no greater than 30% of total calories, and carbohydrate intake should be no less than 130 g/day. In general, diets containing 1,000 to 1,200 kcal/day should be selected for most women; a diet of 1,200 to 1,600 kcal/day should be chosen for men and may be appropriate for women who weigh ≥ 165 pounds or who exercise.⁵¹ For military purposes, use of low-carbohydrate diets is not recommended. Such diets have potential side effects, such as physiological dehydration, nausea, hyperuricemia, ketosis, and fatigue accompanied by the depletion of glycogen stores, with deteriorating effects on performance. The recently released Dietary Reference Intakes for macronutrients concluded that the adult requirement for carbohydrate to

supply adequate glucose for proper brain function is 100 g/day, with a recommended daily intake of 130 g/day. Therefore, it is recommended that under no circumstances should weight-loss diets recommended for military personnel contain < 130 g/day of carbohydrate.⁵² A daily multivitamin and mineral supplement may be useful.

Negative Consequences of Improper Weight Loss

Weight management is the adoption of healthful and sustainable eating and exercise behaviors indicated for reduced disease risk and improved feelings of energy and well-being.⁵³ Military personnel are open to just as much misinformation about weight loss and dieting as the rest of the community. Unfortunately, this often results in the use of unbalanced dietary regimens, nutritional supplements, and drugs that lack scientific support or are not permitted by health authorities and officials. Such approaches may result in decreased performance and may have negative health consequences. The promotion of safe, effective, weight-loss strategies is an important function of the military health staff and nutrition team. Rapid weight loss during the first few days of caloric deficit results primarily from a loss of body water and stored glycogen. As weight loss continues, a greater loss of fat occurs per unit of weight lost.⁵⁴ An unrealistic perception of optimal body weight, and a belief that weight loss is necessary for improved performance, can contribute to unhealthy weight-loss practices.⁵⁵ Undesirable weight-loss programs are defined as those that are not nutritionally sound, that result in large losses of fat-free tissue, that pose potential serious medical complications, and that cannot be followed for long-term weight maintenance. The effect of rapid weight loss on performance appears to depend on the method of weight loss, the magnitude of weight loss, and the type of exercise performance test used.⁵⁶

Clients may often resort to pathogenic weight-control behaviors such as fasting, sweating, fluid restriction, and use of diuretics and laxatives. Repeated cycles of rapid weight loss and subsequent regain increase risks of disordered eating, fatigue, psychological distress (anger, anxiety, and depression), dehydration, and macronutrient and micronutrient imbalances.^{57,58} Such cycles may increase the body's ability to conserve energy, although controversy exists on this topic. Thus, "yo-yo" dieting may lead to greater difficulty achieving weight loss with subsequent dieting; it also may facilitate regaining lost weight.⁵⁹ Energy restriction and dieting can pose difficulties when individuals are attempting to consume adequate levels of macronutrients and micronutrients. Carbohydrate, iron, calcium, zinc, folate, and B vitamins are nutrients particularly affected by energy restriction.⁶⁰ All of these nutrients are critical for optimal health and performance. Chronic underconsumption of these nutrients can lead to glycogen depletion, decreased oxygen-carrying capacity, increased incidence of bone fractures, and higher injury rates attributable to fatigue and impaired cell growth and repair. Fluid losses during exercise and military training can be quite large, and personnel must replenish fluids to maintain health and performance. Achieving rapid weight loss through dehydration and other pathogenic purging strategies can adversely affect thermoregulation, renal and cardiovascular function, nerve conduction, and electrolyte balance.⁶¹

In general, the diets of most subjects attempting rapid weight

loss are likely to be low in many nutrients. A single weight-loss effort is unlikely to cause problems in nutrient status, but repeated weight loss over a period of time is more likely to cause deterioration of nutritional status. Counseling with personnel to choose micronutrients and protein can decrease the likelihood of nutritional deficiencies.

Conclusions

Treatment of overweight and obese people and military personnel is a two-step process, i.e., assessment and management. Assessment requires determination of the degree of obesity and the absolute risk status. Management includes reduction of excess weight and maintenance of this lower body weight, as well as institution of additional measures to control any associated risk factors.⁶² Those seeking help need to understand that successful treatment requires a lifelong effort.

Many obesity experts think that preventing obesity or treating it in the initial stages of overweight is more effective than attempts to lose significant amounts of weight. Inviting individuals at risk (e.g., those who have gained weight or body fat since their last assessment but are still within standards) and those who have only recently become overweight to enroll in weight-management programs may reduce the prevalence of personnel who later become significantly overweight. Identifying potential risk factors for weight gain (e.g., overweight at time of accession, family history of obesity, poor initial performance on physical fitness tests, or weight gain of >5% over the initial entry training weight) may help identify individuals who are at risk.⁶³ Educating these individuals during initial entry training, or whenever risk factors are identified, about their risk of becoming overweight might allow self-directed preventive measures.

The military appearance policy raises several concerns. Individuals differ anatomically and some accumulate adipose tissue in the abdomen (upper body adiposity), whereas others tend to have a more even distribution of fat over several regions of the body. From an appearance perspective, however, an individual with abdominal fat may attract negative attention, whereas an individual with an even distribution of fat may not. The emphasis on abdominal circumference is appropriate and noteworthy, because it represents the site of human body fat deposition most strongly associated with health risks⁶⁴ and it corresponds most closely to military goals regarding appropriate appearance. The key components of military weight-control programs are diet/nutrition, physical activity/exercise, behavior modification, and weight-loss aids or follow-up support (e.g., counseling, mentoring, and psychological support). An important aspect of implementation of any weight-management program is evaluation of the program results. The effectiveness of a weight-management program is determined by the success of the participants in losing the necessary amount of weight and being able to maintain that weight loss. This requires long-term tracking of these individuals in a military environment.

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