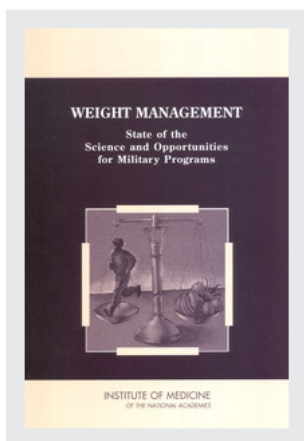


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Weight Management: State of the Science and Opportunities for Military Programs (2003)

DETAILS

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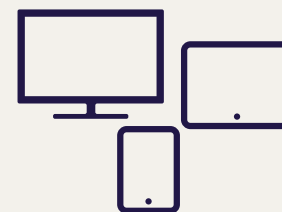
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Background and Context of the Overweight Problem

Considerable attention has been given to the alarming rise in the incidence of overweight and obesity in the U.S. population, both in the scientific literature and in the popular press. The prevalence of overweight and obesity, defined as a body mass index (BMI = weight [kg] divided by height [m]²) from 25 to 29.9 and 30 or higher, respectively, was relatively stable from 1960 to 1980. However, data from the Third National Health and Nutrition Examination Survey (NHANES III) from 1988–1994 showed an increase in the prevalence of overweight and obesity from 47 percent to 56 percent and a rise in the prevalence of obesity from approximately 15 percent to 23 percent (Flegal et al., 1998; Kuczmarski et al., 1994). More recent data indicate that these trends have continued.

THE CURRENT NATIONAL SITUATION

The latest NHANES data from 1999–2000 (Flegal et al., 2002) show that 64.5 percent of the U.S. population 20 years of age and older is now classified as overweight or obese. The prevalence of obesity (BMI \geq 30) has risen from 23 percent to 30.5 percent. These trends are seen across both sexes and all ethnic groups, with the greatest increases occurring in non-Hispanic Black females. Furthermore, since 1980, the percentage of adolescents (ages 12–19 years) who are overweight has tripled from 5 percent to 15.5 percent (Ogden et al., 2002). There are some disparities however; overweight and obesity are particularly common among minority groups and those with lower family income and less education (HHS, 2001).

The epidemic of overweight and obesity in the civilian population, which many experts attribute to the ready availability of a vast array of foods combined with an increasingly sedentary lifestyle, affects the military services of the United States in two significant ways. First, it decreases the pool of individuals eligible for recruitment into the military services, and second, it decreases retention—almost 80 percent of recruits who exceed the accession weight-for-

height standards at service entry leave the military early (i.e., by year 2 of a 3–4 year term of enlistment).

Another important consideration of the impact of overweight and obesity is their effect on chronic disease. Studies of the relationship between health and disease have used the premise that a BMI of less than 18.5 constitutes underweight, and a BMI of 18.5 to 24.9 constitutes healthy weight.

NOTE: A BMI consistent with overweight (25.0–29.9) does not by itself indicate that an individual is over-fat, nor does a BMI consistent with underweight indicate that an individual is *not* over-fat. There are some instances where an individual could be misclassified as overweight due to body composition (e.g., individuals with a large amount of lean muscle tissue, as might be found in the military). Additional testing must be done to determine whether the excess weight in such individuals consists of fat.

Overweight and Health

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. The major comorbidities associated with obesity and the implications of these comorbidities for the military services are briefly reviewed below. (For an extensive review of the major health effects of overweight, see Bray, 1996 and Must et al., 1999).

Overweight and obesity have also been associated with a variety of adverse social and economic consequences. These appear to be more significant among women than among men. For example, one study showed that obese women completed fewer years of school, married less frequently, and had lower earnings than women who were not obese (Gortmaker et al., 1993). Although these data were obtained before obesity achieved its current prevalence, they suggest a variety of long-term effects on material and psychological well-being.

Obesity also has a variety of adverse physiological effects. The major comorbidities associated with obesity are shown in Box 1-1. It has been 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 in younger than in older adults (Must et al., 1999). Approximately 70 percent of overweight individuals have at least one of these complications, and over 30 percent have two or more (Must et al., 1999).

Obesity is also associated with increased mortality rates. In one study by Allison and colleagues (1999), obesity-related mortality was estimated from data collected in five prospective cohort studies. The estimated number of annual deaths in the United States attributable to obesity ranged from 280,000 to

BOX 1-1 Consequences of Adult Obesity

Psychosocial consequences

- Low self-esteem
- Disordered eating behavior
- Discrimination

Medical consequences

- Cancer
- Diabetes mellitus
- Gall bladder disease
- Gastro-esophageal reflux disease
- Heart disease
- Hyperlipidemia
- Hypertension
- Osteoarthritis
- Polycystic ovary disease
- Pseudotumor cerebri
- Sleep apnea
- Urinary incontinence
- Increased maternal and fetal complications during pregnancy and postpartum
- Early mortality

325,000, depending on whether the analysis controlled for smoking rates. Approximately 80 percent of the deaths attributable to overweight occurred in persons with a BMI \geq 30, which is the lower limit for obesity. The estimates of the effects of obesity on mortality rates are quite consistent with earlier published estimates by McGinnis and Foege (1993), who suggested that approximately 300,000 deaths per year could be attributed to poor diet and inactivity patterns, which are the major contributors to obesity.

The comorbidities associated with obesity substantially increase health care costs. For example, total costs associated with obesity-related type 2 diabetes mellitus; coronary heart disease; hypertension; gall bladder diseases; breast, endometrial, and colon cancer; and osteoarthritis in 2000 were estimated at almost \$117 billion per year (HHS, 2001). Approximately half of these costs were medical costs directly associated with the treatment of obesity and its comorbidities; the other half were indirect costs associated with increased absenteeism and decreased economic productivity. In one managed care organization, obesity was clearly associated with increased outpatient visits, inpatient days, and use of pharmacy and radiology services (Quesenberry et al., 1998).

Upper Body Adiposity

BMI does not account for all of the increased morbidity associated with obesity; the distribution of adipose tissue also influences the risk of excess weight. Upper body, or more specifically, visceral adipose tissue, carries a higher morbidity risk than adipose tissue deposited in the subcutaneous compartments of the buttocks, thighs, and lower extremities (NHLBI, 1998).

Individuals with upper body 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” (Bjorntorp, 1992a, 1992b; Hjermann, 1992). Factors that increase the deposition of visceral adipose tissue include male gender, lack of physical activity, alcohol use, and smoking (Emery et al., 1993; Han et al., 1998). The distribution of upper body adipose tissue may also impact appearance, which is relevant to military standards.

In order to clinically evaluate adipose tissue distribution, an individual’s waist circumference (W) is evaluated as a measure of visceral obesity, with $W > 102$ cm (40 in) in men and $W > 88$ cm (35 in) in women considered high risk for heart disease (NHLBI, 1998). Waist circumference measurements are supplementary to BMI when diagnosing overweight and obesity; waist measurements lose their predictive value for increased risk of heart disease with a $BMI \geq 35$.

UNIQUENESS OF THE MILITARY ENVIRONMENT

Among active duty military personnel, diabetes, hypertension, and ischemic heart disease accounted for less than 1 percent of visits made to ambulatory care clinics in 1998. These findings should not be surprising given that active duty personnel are younger, are less likely to be obese, and are more physically fit than the average civilian adult. However, overweight and obesity do exist in the military, and chronic health risk is a concern, especially among older, more senior personnel. For example, Robbins and coworkers (2002), in a retrospective cohort study design of active duty Air Force personnel, found that approximately 20 percent of these men and women exceeded their official maximum allowable weight-for-height. Based on a review of health records, they estimated excess weight-attributable medical costs were \$19.26 million, with an additional \$3.5 million attributable to lost productivity and 28,351 lost workdays. Although the primary concern of the Department of Defense (DOD) has been the effects of weight and body composition on the fitness and performance of military personnel, recent changes in the laws regarding health care for veterans have added the costs of obesity-related comorbidity coverage as another area of concern.

Also of special relevance to the military are the effects of fatness and of the lack of fitness on injury rates during initial entry training. In several small

studies, an increased BMI was associated with an increased injury rate during initial entry training and with performance in the 1- and 2-mile runs, sit-ups, and push-ups by men (Jones et al., 1992).

Demographics

There are a number of important demographic differences between the military and the general population. While the general population is fairly evenly split between genders (49.1 percent men versus 50.9 percent women) (U.S. Census Bureau, 2003), the military is largely comprised of men (85 percent versus 15 percent women) (Personal communication, B. Maxfield, Office of the Deputy Chief of Staff for Personnel, March 7, 2003), although this varies somewhat with the individual services. For example, the Air Force is comprised of 80.6 percent men and 19.4 percent women, while the Marine Corps is comprised of 94 percent men and only 6 percent women (Personal communication, B. Maxfield, Office of the Deputy Chief of Staff for Personnel, March 7, 2003).

Ethnic demographics also differ somewhat between the general U.S. population and the active-duty military population. Although the proportion of Whites, American Indian/Alaska Natives, and Asian American/Pacific Islanders in the military tend to reflect the general U.S. population, the percentage of Black men is higher in the military than in the general population (17.7 percent vs. 12.3 percent), while the percentage of Hispanic men is lower (9 percent vs. 13.4 percent) (Tables 1-1 and 1-2). There is also a notable difference in the distribution of ethnicity by gender in the military compared with the general population. A greater proportion of women in the military are ethnic minorities. For example, 41.7 percent of Army women are Black and 9.7 percent are Hispanic, while 21 percent of Marine Corps women are Black and 16.6 percent are Hispanic (Table 1-2).

Another significant demographic that differs between the general U.S. population and the active-duty military population is that of age. While only 31.5 percent of the U.S. population is between the ages of 18 and 40 years (U.S. Census Bureau, 2003), this age range encompasses nearly 80 percent of the active-duty military population.

Health and Fitness

Table 1-3 presents a comparison of the percentage of the general population (Flegal et al., 2002; Freedman et al., 2002) versus the military service population in four BMI categories. While the percentage of military men and women in the BMI category of 25 to 29.9 is higher than the general population, the percentage in the BMI category of ≥ 30 is much lower. Also, the percentage of women with a BMI of less than 25 is higher for military women than for civilian women. The

TABLE 1-1 Percent Gender and Race/Ethnicity of the U.S. Population Compared with the Department of Defense (DOD) Population

Gender/Race/Ethnicity ^a	U.S. Population (%)	DOD Population (%)
Men (% of total population)	49.1	85
Race/Ethnicity		
White	68.7	66.4
Black	12.3	17.7
Hispanic	13.4	9.0
AA/PI	4.0	4.0
AI/AN	0.9	1.0
Women (% of total population)	50.9	15
Race/Ethnicity		
White	69.1	51.6
Black	13.1	31.4
Hispanic	12.2	9.2
AA/PI	3.8	4.0
AI/AN	1.2	1.1

^a AA = Asian American, PI = Pacific Islander, AI = American Indian, AN = Alaska Native.

SOURCE: U.S. data: 2001 U.S. population estimates, U.S. Census Bureau (2003);

DOD data: 2002 Distribution of Active Duty Forces, Personal communication, B.

Maxfield, Office of the Deputy Chief of Staff for Personnel, March 7, 2003.

high prevalence of military personnel in the 25 to 29.9 BMI category reflects the fact that until late 2002, the military maximum weight-for-height standards were not based on the standard BMI categories (NHLBI, 1998).

The military environment has both positive and negative aspects associated with it in terms of maintaining physical fitness and healthy weight. On the positive side, military personnel have ready access to health care providers. In addition, DOD has the potential for centralized, longitudinal record-keeping on all active duty personnel, the unusual ability to provide incentives and consequences for weight change, and the potential ability to modify environmental factors that are important for weight control. Possible negative aspects of the military environment include a very mobile population and the potential for inappropriate weight-loss activities fostered by the need to meet weight, fitness, and fatness standards.

Weight and Body Composition

At present, all active-duty personnel must be weighed and assessed for physical fitness annually or semiannually. If an individual's weight exceeds the maximum for his or her height according to the screening tables for his or her

TABLE 1-2 Percent Gender and Race/Ethnicity of the Military Branches

Military Branch	White	Black	Hispanic	AA/PI ^a	AI/AN ^b	Total
Men						
Army	61.9	22.1	9.5	3.2	0.8	84.6
Navy	63.3	17.4	9.8	6.5	1.9	85.6
Marine Corps	68.2	13.9	13.1	2.6	0.9	94.0
Air Force	75.4	13.8	5.2	2.9	0.5	80.6
Women						
Army	41.2	41.7	9.7	3.8	1.2	15.4
Navy	51.6	28.1	11.1	5.2	2.8	14.4
Marine Corps	55.6	21.0	16.6	3.2	1.7	6.0
Air Force	61.8	24.7	6.0	3.8	0.7	19.4

^a AA = Asian American, PI = Pacific Islander.

^b AI = American Indian, AN = Alaska Native.

SOURCE: 2002 Distribution of Active Duty Forces, Personal communication, B. Maxfield, Office of the Deputy Chief of Staff for Personnel, March 7, 2003.

service, the individual is referred for a second-tier assessment (a determination of percent body fat), to ascertain whether the increased weight is due to fat or to lean tissue. In addition, a commander may order an individual in his or her command to be weighed at any time if the commander believes that the individual presents an overweight appearance in uniform. Personnel whose percent body fat exceeds the limit for their service and who do not qualify for a medical waiver are referred to a weight-management program (at the discretion of the commander), which carries professional consequences.

Administration of military weight-management programs is left to each service individually. These programs, which are described in greater detail in Chapter 2, generally require a single visit to a health professional followed by regular weigh-ins until weight and/or body fat goals are reached. Individuals are required to demonstrate continuing progress toward these goals by losing a prescribed number of pounds per month. Failure to show continued progress in weight loss or continued failure to comply with body-fat standards without a medical waiver can result in separation from the service. Similar attention is not devoted to personnel who are underweight.

Appearance

The DOD appearance standard is articulated by DOD (1995) Directive 1308.1, *DOD Physical Fitness and Body Fat Programs*. This policy is shared, but described slightly differently, by each of the service branches. According to the Directive, “maintaining desirable body composition is an integral part of

TABLE 1-3 Percent Body Mass Index (BMI) of Military Branches^a by Gender Compared with the General U.S. Population

BMI	Army		Navy	
	Men	Women	Men	Women
< 18.5	0.3	0.6	0.5	1.8
18.5–24.9	39.6	58.8	30.4	52.2
25.0–29.9	46.0	34.4	52.9	38.6
30.0–34.9	13.2	5.6	14.3	6.5
35.0–39.9	0.9	0.5	1.7	0.8
≥ 40	< 0.1	< 0.1	0.2	0.1

^a No data available for U.S. Marine Corps.

^b Adapted from Flegal et al. (2002); Freedman et al. (2002). BMI categories for U.S. population data are < 25, 25.0–29.9, 30.0–39.9, ≥ 40.

SOURCE: Army data: Personal communication, G. Bathalon, U.S. Army Medical

physical fitness, general health, and military appearance” (p. 2), and the first line of body composition evaluation is by weight-for-height and appearance. For example, according to Army Regulation 600-9 (U.S. Army, 1987), one of the two goals of military weight standards is for soldiers to present a physical appearance in uniform “which is neat and trim.” The regulation goes on to describe the standard further by emphasizing that “excessive body fat connotes a lack of personal discipline, detracts from military appearance, and may indicate a poor state of health, physical fitness, or stamina.” No objective criteria (rating scales) have been associated with the appearance standard as it is enforced, although development of objective criteria has been recommended previously (IOM, 1992a, 1998).

Although appearance is associated slightly with percent body fat, it is associated more significantly with abdominal circumference (Hodgdon et al., 1990; U.S. Army, 1987; Vogel and Friedl, 1992). Army and Marine Corps personnel must supply recent photos of themselves to their promotion boards (this practice has been eliminated by the Air Force and Navy), but appearance judgments can be rendered by commanding officers at any time. When these judgments involve a suspicion of overweight (as opposed to an untidy uniform or other details of appearance), the individual must be weighed and may be required to have a body-fat determination and enter a weight-management program if standards are exceeded. In essence, the Directive considers appearance as important as weight-for-height standards, but it does not provide any objective criteria for assessing appearance. Instead, the Directive defers implementation of the policy to the individual services, which in turn defer to the individual units to establish criteria and implement the policy. This results in uneven application of the policy among units and across the services.

Air Force		U.S. Population ^b	
Men	Women	Men	Women
0.9	3.0	—	—
6.7	62.2	32.8	38.1
52.7	31.4	39.8	28.5
10.5	2.8	26.0	30.6
0.7	0.4	—	—
< 0.1	< 0.1	1.5	2.8

Research and Materiel Command, 2003; Navy data: Personal communication, T. Cepak, Navy Physical Readiness Program, April 25, 2003; Air Force data: Personal communication, J. Spahn, Population Health Support Branch, May 15, 2003.

The relative role that appearance should play in relation to weight and body-fat programs in the military is a multifaceted issue. The military embraces a policy on appearance for several psychosocial reasons:

- It is perceived to be an indication of fitness.
- It may affect how the general public views the military.
- The appearance of military personnel is believed by some to be a factor in esprit de corps (Bauer et al., 1976; USMC, 1995).
- It may have some impact on how a country's military is perceived internationally.

The issue of appearance also influences the individual's self-esteem and acceptance by peers.

PREVIOUS RECOMMENDATIONS ON BODY FAT AND FITNESS

In 1992, the Committee on Military Nutrition Research (CMNR) was asked to evaluate whether the body composition, fitness, and appearance standards of the military were consistent with optimum job performance. Their report, *Body Composition and Physical Performance: Applications for the Military Services* (IOM, 1992a), provided five major recommendations:

1. All the services should develop job-related physical performance tests.
2. The differences between accession and retention standards need reevaluation for all services.
3. The inequities in the body composition standards for men and women need to be addressed.

4. Body composition standards need to be validated relative to the ethnic diversity of the military population.

5. If the military deems appearance standards necessary (although no relationship between military appearance and military performance could be identified), these standards should be objective.

Following the lifting of the combat exclusion rule in 1993 (which opened to women a large number of occupational specialties that were previously closed to them) and the increased frequency of deployments, the percentage of female active-duty personnel has steadily increased. Concerned that the body composition, appearance, and fitness policies might be negatively impacting the health of female service personnel, the U.S. Army Medical Research and Materiel Command (USAMRMC) requested that CMNR revisit these issues specifically as they pertained to military women. In response to this request, the CMNR Subcommittee on Body Composition, Nutrition, and Health of Military Women published a report (IOM, 1998). This report examined the body composition and fitness standards of the four service branches in light of recent research that explored the relationships among body composition, fitness, performance, nutrition status, and health. To assess the implications of meeting the body composition and appearance standards for women, military weight-management programs and dieting practices were examined and compared with those in the civilian sector. The report also explored the potential health risks of chronic dieting in light of the high performance level expected of military personnel since underweight may be as much of a medical concern as overweight. This review (IOM, 1998) provided several key recommendations for military women:

- BMI and fitness assessment should be incorporated into the current two-tiered system of body composition assessment procedures.
- The maximum allowable BMI should be set at 25, based on considerations of health and chronic disease risk, with a maximum body fat of 36 percent for women if the fitness test is passed.
- A single, service-wide circumference equation should be developed and validated for the assessment of women's body fat.
- Military women should be strongly encouraged to achieve and maintain healthy weights through a continuous exercise and fitness program and should be provided nutrition education and ongoing counseling if weight loss is a goal.

THE CURRENT TASK

In July 1999, CMNR was requested to (1) review the data on optimal components of a weight-management program, (2) review the data on the role of age, gender, and ethnicity in weight management, (3) review current DOD activities in weight management, and (4) provide recommendations for military

weight-management programs. This request originated from the Director of Military Operational Medicine Research at USAMRMC. The Subcommittee on Military Weight Management was appointed in September 1999; on October 24–27, 1999, the committee convened a workshop in response to a request from Army representatives. The workshop brought together the personnel responsible for both DOD-wide and service-specific weight-control program policies; a representation of military weight-control program leaders and innovators; and key military, academic, and industry researchers to:

- Share knowledge and experience in managing weight-control programs within the services.
- Gain relevant knowledge and experience from industry and academia.
- Examine current interventions and those under development for weight loss, particularly in the pharmaceutical industry.
- Evaluate the appropriateness of weight-loss interventions for military application or the need for further research.
- Develop a consensus toward a more standard DOD-wide approach to weight management that utilizes state-of-the-art knowledge and practices.

The subcommittee was charged to identify the most effective interventions for weight loss and maintenance, particularly those most effective for the non-obese overweight individuals found in the military setting. Specifically, this subcommittee was asked to address the following questions:

1. What are the essential components of an effective weight/fat-loss program, and the most effective strategies for sustaining weight loss?
2. How do age and gender influence success in weight-management programs? Should age be considered in weight/fat standards and in weight-management programs and interventions?
3. Which strategies would be the most and least effective in a military setting? Should military weight/fat loss programs involve direct participation interventions or only monitoring and guidance? Should military programs be more proactive in identifying and discouraging ineffective or dangerous weight-loss practices? Is a warning or cautionary zone prior to enrollment into a weight-control program an effective strategy? When should duty time be authorized for participation in intervention strategies for weight/fat loss?
4. To what extent should weight-control programs/policies be standardized across the services versus tailored to the individual service, installation, or unit? What are the advantages and disadvantages of standardization? Is the provision of state-of-the-art techniques and knowledge a rationale for standardization?
5. How can diet be effectively dealt with as a weight-management component in the military setting? Should pharmacological treatment (anorexiant)

be considered for use in the military? In what cases? What factors bear on this decision?

6. How should resistiveness to weight/fat control be dealt with?
7. What are the knowledge gaps in weight-management programs relative to the military? What research is needed?

SUMMARY

The rise in prevalence of overweight and obesity in the general population as defined by specific BMI cut-off of ≥ 25 for overweight and ≥ 30 for obesity has been associated with a significant increase in chronic diseases and mortality. However, among active-duty military personnel, 80 percent of whom are between 18 and 40 years of age, chronic obesity-related diseases are less of an issue than the impact of overweight on physical fitness, performance of jobs that require physical exertion, injury rates, and appearance.