

# Obesity in older adults: technical review and position statement of the American Society for Nutrition and NAASO, The Obesity Society<sup>1-5</sup>

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## ABSTRACT

Obesity causes serious medical complications and impairs quality of life. Moreover, in older persons, obesity can exacerbate the age-related decline in physical function and lead to frailty. However, appropriate treatment for obesity in older persons is controversial because of the reduction in relative health risks associated with increasing body mass index and the concern that weight loss could have potential harmful effects in the older population. This joint position statement from the American Society for Nutrition and the NAASO, The Obesity Society reviews the clinical issues related to obesity in older persons and provides health professionals with appropriate weight-management guidelines for obese older patients. The current data show that weight-loss therapy improves physical function, quality of life, and the medical complications associated with obesity in older persons. Therefore, weight-loss therapy that minimizes muscle and bone losses is recommended for older persons who are obese and who have functional impairments or medical complications that can benefit from weight loss. *Am J Clin Nutr* 2005;82:923-34.

**KEY WORDS** Obesity, older adults, aging, weight-loss therapy, physical function

## INTRODUCTION

The prevalence of obesity is increasing in all age groups, including older persons, defined as those  $\geq 65$  y old. However, the appropriate clinical approach to obesity in older persons is controversial because of the reduction in relative health risks associated with increasing body mass index (BMI) in older adults, the uncertain effectiveness of obesity treatment in this group, and the potential harmful effects of weight loss on muscle and bone mass. These concerns affect healthcare providers, policymakers, and the public.

The purpose of this position statement is to review the clinical issues related to obesity in older persons and to provide health professionals with appropriate weight-management guidelines for this population. The published articles that were reviewed to develop this position statement were identified by a literature search of Index Medicus between 1966 and April 2005, a search of journals that focus on geriatrics or obesity, and a search of

references listed in relevant research and review articles. Guidelines presented in this review should be considered interim recommendations on the basis of currently available evidence. Recommendations may change as further research and information become available (*see* Future Research Directions).

## CHANGES IN BODY WEIGHT AND BODY COMPOSITION WITH AGING

Data from large population studies show that mean body weight and BMI gradually increase during most of adult life and reach peak values at 50-59 y of age in both men and women (1-5). After the age of 60 y, mean body weight and BMI tend to decrease. However, these observations, which were obtained from cross-sectional studies, can be affected by survival bias, because obese persons have higher mortality rates at younger ages (6). Therefore, premature mortality of obese young and middle-aged adults would tend to decrease mean body weight and BMI in surviving older adults. In fact, data from longitudinal cohort studies suggest that body weight and BMI do not change, or decrease only slightly, in older adults (60-70 y old at study entry) (7-10).

Aging is associated with considerable changes in body composition. After 20-30 y of age, fat-free mass (FFM) progressively decreases, whereas fat mass increases. FFM (primarily

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skeletal muscle) decreases by up to 40% from 20 to 70 y of age (11–14). Maximal FFM is usually reached at  $\approx 20$  y of age, and maximal fat mass is usually reached at  $\approx 60$ –70 y of age; both fat measures subsequently decline thereafter (11, 12). Therefore, both FFM and fat mass decrease during old age ( $>70$  y). Aging is also associated with a redistribution of both body fat and FFM. With aging there is a greater relative increase in intraabdominal fat than in subcutaneous or total body fat, and there is a greater relative decrease in peripheral than in central FFM because of the loss of skeletal muscle (15). In addition, increases in intramuscular and intrahepatic fat in older persons are associated with insulin resistance (16).

## DEFINITION OF OBESITY

Obesity is defined as an unhealthy excess of body fat, which increases the risk of medical illness and premature mortality. However, it is difficult to accurately measure body fat mass in most clinical settings, because this assessment requires the use of sophisticated technologies that are not readily available. Therefore, BMI, calculated as body weight (in kg) divided by the square of height (in m), has been widely used and accepted as a simple method to classify medical risk by weight status (17–19). This index provides a measure of the relation between height and weight and correlates with percentage body fat in young and middle-aged adults (20).

In older adults, age-related changes in body composition (ie, decreases in FFM and increases in fat mass) and loss of height caused by compression of vertebral bodies and kyphosis (posterior convex angulation of the spine) (21) alter the relation between BMI and percentage body fat. Therefore, at any given BMI value, changes in body composition would tend to underestimate fatness, whereas the loss of height would tend to overestimate fatness. Although it has been suggested that the use of alternative methods to estimate height, such as knee height (22) or arm span (23), may provide more reliable estimates of BMI, these approaches have not been adequately validated. Another limitation of using BMI to estimate disease risk is the effect of aging on fat distribution. Visceral fat (omental and mesenteric adipose tissue), subcutaneous abdominal fat, intramuscular fat, and intrahepatic fat, which are risk factors for insulin resistance and metabolic diseases, increase with aging (15). Therefore, the size of these depots is likely greater in older than in young adults at any given BMI value.

## PREVALENCE OF OBESITY

The prevalence of obesity (defined as a BMI  $\geq 30$ ) in all age categories has increased during the past 25 y in the United States (1, 4, 24). The number of obese older persons has markedly increased because of both an increase in the total number of older persons and in the percentage of the older population that is obese. In 1991, 14.7% of persons in the United States who were 60–69 y of age and 11.4% of those who were  $>70$  y old were obese (25). In 2000, the prevalence of obesity in these age groups increased to 22.9% and 15.5%, respectively, which represents increases of 56% and 36%, respectively, in  $<10$  y (2).

Data from population surveys in the United States have shown that the prevalence of obesity increases progressively from 20 to 60 y of age and decreases after age 60 y (1, 2). In persons who are  $>80$  y old, the prevalence rate of obesity is about one-half that

observed in 50–59-y-olds. The relatively low prevalence of obesity after age 80 y could be due to the survival advantage of being lean, which makes obesity less likely to develop in the very old (26). Nonetheless,  $\geq 15\%$  of the older American population is obese (2, 5), and obesity is more common in older women than in men (5). Moreover, the prevalence of obesity is also increasing in older populations throughout the world (27).

## PATHOGENESIS

The relation between energy intake and expenditure is an important determinant of body fat mass. Therefore, the increase in total fat mass that occurs with aging must be due to an increase in energy intake, a decrease in energy expenditure, or both. The results from most studies suggest that energy intake does not change or even declines with advancing age (28, 29). Therefore, it is likely that a decrease in total energy expenditure (TEE) is an important contributor to the gradual increase in body fat with advancing age.

Aging is associated with a decrease in all major components of TEE, including resting metabolic rate (RMR; which accounts for  $\approx 70\%$  of TEE), thermic effect of food (which accounts for  $\approx 10\%$  of TEE), and physical activity (which accounts for  $\approx 20\%$  of TEE) (30). Normally, RMR decreases by 2–3% every decade after age 20 y. About three-fourths of this decline can be accounted for by a loss in FFM (31). The thermic effect of food is  $\approx 20\%$  lower in older men than in younger men (32). Physical activity decreases with increasing age (33), and it has been estimated that decreased physical activity accounts for about one-half of the decrease in TEE that occurs with aging (30).

Hormonal changes that occur during aging can also enhance the accumulation of fat, the reduction of FFM, and energy balance. Aging is associated with a decrease in growth hormone secretion (34), reduced responsiveness to thyroid hormone, decline in serum testosterone (35), and resistance to leptin (36). The decline in growth hormone and testosterone production with increasing age decreases FFM and increases fat mass (37). Thyroid hormone-induced oxidative bursts are blunted with aging (38). Resistance to leptin could result in a decreased ability to down-regulate appetite (36).

## ADVERSE EFFECTS OF OBESITY

### Mortality

Obesity is associated with decreased survival. Data from the Framingham Heart Study found that adults who were obese (BMI  $\geq 30$ ) at age 40 y lived 6–7 y less than did their normal-weight counterparts (39). Another study based on several data sets [US Life Tables (1999), the third National Health and Nutrition Examination Survey (NHANES III), NHANES I and II, and the NHANES II Mortality Study] also found that obesity lessens life expectancy, particularly in younger adults. For example, in white men and women aged 20–30 y with severe obesity (BMI  $\geq 45$ ), the minimum years of life lost was 13 and 8, respectively (40).

Men and women who have a BMI  $\geq 30$  are considered obese and generally have a higher mortality risk than do those who are considered overweight (BMI: 25.0–29.9) (6, 41, 42). In adults, the relative risk of death associated with increasing BMI decreases with increasing age, and the BMI value associated with



the lowest mortality is slightly higher in older than in younger adults (41, 43–46). These data have been misinterpreted as showing that obesity is less harmful in older than in young and middle-aged adults (47). However, the absolute mortality risk associated with increased BMI actually increases with age, up to the age of 75 y, because of the marked increase in mortality with advancing age. Therefore, from a clinical standpoint, the health complications associated with obesity increase linearly with increasing BMI until the age of 75 y (48). The reason for the absence of an association between BMI and mortality after age 75 y is not known, but it is possible that the effect of obesity on mortality may be less evident because the shortened future life span can make it difficult to show the effects of obesity on mortality. In addition, persons who are prone to the complications of obesity may have already died, so older obese persons may represent the subgroup of survivors who are resistant to the adverse effects of obesity.

### Medical complications

Obesity causes serious medical complications, which lead to considerable morbidity, impaired quality of life, and premature death. However, most studies that have evaluated obesity-related complications have been conducted in middle-aged, not in older, adults. The prevalence of many of the medical complications associated with obesity—such as hypertension, diabetes, cardiovascular disease, and osteoarthritis—increases with age. Therefore, excess body weight and weight gain during middle age may contribute to medical complications and increased Medicare expenditures that occur during old age (49).

### Metabolic abnormalities

All components of the metabolic syndrome (excess abdominal fat, insulin-resistant glucose metabolism, dyslipidemia, and high blood pressure) (50) are prevalent in older populations. Data from NHANES III showed that 23% of the US population met criteria for the metabolic syndrome. Moreover, the prevalence of the metabolic syndrome increased with age, rising steeply after the third decade and reaching a peak in men aged 50–70 y and in women aged 60–80 y (51). The odds ratio for developing the metabolic syndrome in those who are  $\geq 65$  y of age compared with those who are 20–34 y of age was 5.8 in men and 4.9 in women. In addition, increased abdominal fat mass is independently associated with the metabolic syndrome in men and women aged 70–79 y (52).

Fasting plasma glucose increases by 1–2 mg/dL and postprandial glucose by 10–20 mg/dL for each decade after age 30 y (53). Accordingly, the prevalence of type 2 diabetes mellitus, based on standard criteria (54), is high in persons aged  $\geq 65$  y. The Centers for Disease Control and Prevention estimated that, in 1998, 12.7% of persons aged  $> 70$  y had a diagnosis of type 2 diabetes mellitus, which reflects an increase of 11.6% since 1990 (55). There are also large numbers of older adults, almost 11% of the US population aged 60–74 y, with previously undiagnosed type 2 diabetes mellitus (56). Although the high prevalence of type 2 diabetes mellitus and glucose intolerance has been previously attributed to aging itself, data suggest that the age-related decline in insulin sensitivity is associated with abdominal obesity and inactivity, and older persons who are physically active and do not have increased abdominal girth are much less likely to develop type 2 diabetes mellitus (57).

Hypertension is common in the older population, affecting  $\approx 30$ –50% of all persons aged  $> 65$  y (58). Data from the Honolulu Heart Program (59) and the Japanese Data Bank Survey (60) indicate that obesity and high blood pressure continue to be correlated, even in old age. Waist circumference is an independent predictor of hypertension, and in some studies was a better predictor of hypertension than was BMI (61).

Dyslipidemia (ie, low HDL-cholesterol and high serum triacylglycerol concentrations) is associated with abdominal obesity in both young and old adults (62–64). In the United States, 35–42% of white men and women who are  $\geq 65$  y of age and who have the metabolic syndrome have low HDL-cholesterol ( $\leq 40$  mg/dL in men and  $\leq 50$  mg/dL in women) and high triacylglycerol ( $\geq 150$  mg/dL) concentrations (51).

Data from longitudinal population studies suggest that obesity increases the risk of cardiovascular disease in older men, but not necessarily in older women. Increased BMI in older men was associated with an increase in new cases of coronary heart disease (65), fatal and nonfatal myocardial infarction (66), and cardiovascular disease mortality (48) during 12–15 y of subsequent observation. However, no increased cardiovascular disease risk was observed in obese older women in some (48, 66), but not all (67), studies.

### Arthritis

Arthritis is the leading cause of physical disability in older adults. High BMI is associated with an increased risk of knee osteoarthritis (OA) in older persons (68–70), presumably because body weight exerted across the knee is much greater than that exerted across the hips during weight-bearing activities. In addition, obesity can precede OA by decades, supporting the notion that obesity is involved in the pathogenesis of OA (70). Symptoms of OA usually appear after the age of 40 y (71), and by  $\geq 65$  y of age the prevalence of OA is 68% in women and 58% in men (72). The age-related increase in prevalence of OA presumably reflects bodily changes as a result of a lifetime of being overweight, which results in chronic mechanical strain on weight-bearing joints.

### Pulmonary abnormalities

Obesity, particularly abdominal obesity, is associated with pulmonary function abnormalities, obesity-hypoventilation syndrome, and obstructive sleep apnea (73, 74). Increased weight on the chest wall decreases respiratory compliance, increases the work of breathing, and restricts ventilation. Older obese men may be particularly predisposed to developing weight-related sleep apnea. In a 5-y prospective study, older heavier men had the greatest increase in the respiratory disturbance index (RDI; the number of apneas and hypopneas divided by the estimated hours of sleep) (75); for example, a 5% increase in BMI was associated with a 2% increase in the RDI in 20-y-old lean women and a 27% increase in the RDI in 60-y-old obese men. In another study, both midlife waist circumference and the increase in waist circumference over 30 y of adult life were independently associated with sleep-disordered breathing in old age (75–91 y) (76).

### Urinary incontinence

The prevalence of urinary incontinence increases with age and affects  $> 15$ –30% of persons aged  $\geq 65$  y. Obesity contributes to

the increase in prevalence of urinary incontinence in older persons (77–79), and the increase in urinary incontinence is directly associated with increased BMI.

### Cataracts

Visual impairment due to cataracts affects  $\approx 20\%$  of persons aged  $\geq 65$  y. Data from several epidemiologic studies conducted in middle-aged and older subjects (ages 40–84 y at baseline and followed for 5–14 y) indicate that overweight and obesity are associated with an increased prevalence of cataracts and cataract surgery (80–82). It is not known whether obesity causes or is simply associated with premature cataracts, and several obesity-related abnormalities, such as insulin resistance, elevated serum uric acid concentrations, and increased circulating inflammatory mediators, may contribute to cataract formation.

### Cancer

Obesity is associated with an increased risk of several types of cancer that occur more commonly in older than in young adults, including breast, colon, gallbladder, pancreas, renal, bladder, uterine, cervical, and prostate cancers (83, 84). In one study, the incidence of breast cancer in older obese women ( $\geq 60$  y of age, BMI  $\geq 30$ ) was higher than the expected incidence of breast cancer in all older women (83).

### Physical function and quality of life

Aging causes a progressive decrease in physical function because of a continued decline in muscle mass and strength and an increase in joint dysfunction and arthritis (85, 86). These impairments affect activities of daily living and quality of life. Frailty occurs when impairment in function and reduction in physiologic reserves are severe enough to cause disability (87). Frailty is associated with limitations in basic activities of daily living such as grooming, eating, and bathing or instrumental activities of daily living such as shopping and climbing stairs. Among older persons living in the community,  $\approx 20\%$  of those  $>65$  y of age and 46% of those  $>85$  y of age are considered to be frail (88).

Obesity has important functional implications in the older population, because it can exacerbate the age-related decline in physical function. Self-reported functional capacity, particularly mobility, is markedly diminished in overweight and obese compared with lean elderly adults (86, 89–92). BMI is inversely related to measured physical performance in older persons; a 3-unit increase in BMI is associated with a 1-point decrease in physical performance test score (93). In addition, excess body fat mass and a BMI  $\geq 30$  in older subjects are associated with physical dysfunction and are predictive of a decline in functional status and future disability (94–96). Moreover, older persons who are obese (BMI  $\geq 30$ ) have a greater rate of nursing home admissions than do those who are not obese (BMI: 18.5–24.9) (97).

Older persons are particularly susceptible to the adverse effects of excess body weight on physical function because of decreased muscle mass and strength, which occur with aging (98, 99). Data from several recent studies found that obesity is an important cause of frailty in older persons (100, 101). In one study (100), 96% of community-living older subjects (65–80 y old) with BMIs  $\geq 30$  were frail, as determined by physical performance test scores (102), peak oxygen consumption (103), and self-reported ability to perform activities of daily living

(104). In another study, which was conducted in older women (70–79 y old), obesity was associated with a marked increased risk of frailty (odds ratio = 3.5), determined by weakness, slowness, weight loss, low physical activity, and exhaustion (101). Sarkisian et al (105) identified obesity as 1 of the 5 modifiable risk factors that predict functional decline in both vigorous and basic activities among older women.

Obesity impairs quality of life in older persons. Data from the Nurses' Health Study found that both BMI and age were inversely associated with physical function, freedom from bodily pain, and limitations due to physical problems (106). Obesity is also associated with significant impairment in health-related quality of life in older subjects, as assessed by the SF-36 physical function domains (eg, physical functioning, role limitations due to physical problems, and vitality) (100).

### BENEFICIAL EFFECTS OF OBESITY

Obesity is associated with increased bone mineral density (BMD) and decreased osteoporosis and hip fracture in older men and women (107–111). Both body fat mass and FFM are directly correlated with BMD; the relation between fat mass and BMD is stronger in women than in men. In addition, high BMI values are associated with a slower rate of bone loss induced by estrogen deficiency after menopause, presumably because of increased conversion of adrenal precursors to estrogen in adipose tissue (112, 113). Although the increase in BMD in obese subjects has been attributed to mechanical burden, the protective effects have also been observed in non-weight-bearing bones (114). Therefore, hormonal factors that are increased in obese persons, such as circulating estrogens, insulin, and leptin, might contribute to the beneficial effects of obesity on BMD, by stimulating bone growth and inhibiting bone remodeling (115–117). Both the increase in BMD and the extra cushioning around the trochanter (outer prominence of the femur) might provide protection against hip fracture during a fall in obese older persons. Data from a prospective cohort study found that a 1-SD decrease in fat mass was associated with a 30% increase in the risk of hip fracture (118). In addition, weight loss, body fat loss, and low BMI are associated with an increased risk of hip fracture (119, 120).

### EFFECTS OF WEIGHT LOSS

#### Mortality

Several population studies evaluated the effect of weight loss on mortality in middle to older age groups (121–125). The data from most studies indicate that weight loss is associated with increased, rather than decreased, mortality. However, none of these studies were randomized controlled trials, and most used self-reported weight change and did not distinguish between weight loss in obese and lean subjects. In addition, unintentional weight loss is a common complication of many serious diseases, which could confound the interpretation of weight-loss effects on mortality. Several studies, conducted primarily in middle-aged persons (age 40–65 y at baseline), differentiated between the effects of intentional and unintentional weight loss (126–132). The results from some of these studies found that intentional weight loss was associated with reduced mortality rates in persons with diabetes, impaired glucose tolerance, and other health conditions (126–128),



whereas the results from the other studies found no effect of intentional weight loss on mortality rates (129–131).

Several population studies, conducted in thousands of older, community-dwelling men and women evaluated the effect of weight loss or weight cycling on mortality (133–135). Data from all studies found that older men and women who lost weight, or who experienced weight variability, had an increased relative mortality risk compared with those who were weight stable (133–135). However, none of these studies determined whether the observed weight changes were intentional or unintentional.

Recently, data from 2 studies suggest that weight loss induced by bariatric surgery increases survival in extremely obese patients (136, 137). However, it is not possible to make definitive conclusions about the effect of bariatric surgery on long-term mortality, because these studies were retrospective analyses and not randomized controlled trials.

### Body composition

Weight loss results in a decrease in both fat mass and lean body mass (138). Therefore, it is possible that weight loss in obese older persons could worsen the age-related loss of muscle mass and increase sarcopenia [usually defined as an appendicular skeletal muscle mass lower than 2 SDs below the sex-specific mean of a young healthy reference population (5.45 kg/m<sup>2</sup>)] (139). In young adults, ≈75% of diet-induced weight loss is composed of fat tissue and ≈25% is composed of FFM (138). The relative amount of diet-induced weight lost as FFM and fat mass in older men and women is similar to that observed in younger adults (140, 141). Therefore, diet-induced weight loss does not produce a proportionally greater loss of lean tissue in old persons.

Adding endurance or resistance exercise training to a diet program helps preserve FFM during weight loss (142–145). A meta-analysis that pooled data from a large number of studies found that exercise reduced the percentage of weight lost as FFM from ≈25% to 12% (146). However, these studies were conducted primarily in young and middle-aged adults. Data from a recent randomized controlled trial (147), conducted in obese older subjects (age: 65–80 y), found no significant difference in loss of FFM after a 10% diet-induced weight loss plus regular exercise compared with the control group who did not lose weight. These data suggest that regular exercise can attenuate a diet-induced loss of FFM in older persons.

### Bone mineral density

Weight loss can have adverse effects on bone status. Data from most (148–153), but not all (141, 154), studies conducted in obese pre- and postmenopausal women between 37 and 72 y of age found that diet-induced weight loss caused clinically significant decreases in total BMD (ie, ≈1–2% bone loss with a weight loss of ≈10% over a 4–18-mo period). Moreover, bone loss may be proportional to the amount of weight loss (149, 155). Weight loss alters the plasma concentration of hormones involved in bone metabolism and increases markers of bone turnover (148). Although unintentional weight loss of ≥10% in community-dwelling older men and women is associated with an increased risk of hip fracture (156, 157), it is not known whether the bone loss associated with intentional weight loss increases the risk of osteoporotic fractures in obese persons.

Regular exercise can attenuate weight loss-induced bone loss, and this beneficial effect may be specific for sites involved in

weight-bearing exercise. In one study, regular weight-bearing aerobic exercise prevented femoral neck bone loss but did not alter the normal weight loss-induced decreases in total and lumbar spine BMD (158). Therefore, including exercise as part of a weight-loss program is particularly important in older persons to reduce bone loss. In addition, because inadequate dietary calcium and vitamin D can contribute to bone resorption associated with weight loss, ensuring sufficient calcium and vitamin D intakes (1500 mg Ca/d and 1000 IU vitamin D/d) (159) might help preserve BMD (151, 160).

### Medical complications

Although most studies that evaluated the effects of weight loss on obesity-related medical complications were conducted in middle-aged adults, there is no reason to believe that the results would differ in older subjects. Weight loss improves or completely normalizes many of the metabolic abnormalities associated with obesity (161, 162). Moreover, moderate weight loss (5–10%) improves the entire cluster of metabolic abnormalities that increases the risk of coronary heart disease (163–167).

### Physical function and quality of life

Moderate weight loss in conjunction with physical activity improves physical function and health-related quality of life in obese older persons. Data from studies conducted in overweight and obese older persons with either knee osteoarthritis or without joint disease have shown that the combination of moderate diet-induced weight loss and exercise therapy improved both subjective and objective measures of physical function and health-related quality of life and had a greater beneficial effect than did either diet or exercise interventions alone (147, 168–172). These findings indicate that obesity is a remediable cause of frailty and impaired quality of life in older persons.

### TREATMENT GUIDELINES

Although weight loss in obese persons of any age can improve obesity-related medical complications, physical function, and quality of life, the primary purpose for weight-loss therapy may differ across age groups. Preventing and treating the medical complications of obesity may be the most important goal of therapy in young and middle-aged adults, whereas improving physical function and quality of life may be the most important goal of therapy in older adults. In addition, the therapeutic approach may differ between younger and older adults, because of the increased importance of preventing loss of muscle and bone mass that occurs with weight loss in older persons.

#### Treatment options

The current therapeutic tools available for weight management in older persons are 1) lifestyle intervention involving diet, physical activity, and behavior modification; 2) pharmacotherapy; and 3) surgery.

#### *Lifestyle intervention*

A combination of an energy-deficit diet, increased physical activity, and behavior therapy, including self-monitoring, goal setting, social support, and stimulus control, cause moderate weight loss and is associated with a lower risk of treatment-induced complications than are other effective weight-loss therapies. A low-calorie diet that reduces energy intake by 500–1000



kcal/d results in a weight loss of  $\approx 0.4$ – $0.9$  kg (1–2 lb)/wk and a weight loss of  $\approx 8$ – $10\%$  by 6 mo. Regular exercise is not essential for achieving initial weight loss, but it can help maintain weight loss and prevent weight regain (161, 173). Nonetheless, introduction of an exercise component early in the treatment course, including aerobic and resistance training, may be particularly beneficial for older persons because endurance and resistance exercises improve physical function and can ameliorate frailty (147, 174, 175). The results from several studies conducted in late middle-aged and older subjects ( $>60$  y old) suggest that lifestyle intervention is just as effective in older as in younger subjects (147, 165, 169, 170).

Data from the Diabetes Prevention Program found that older adults were more compliant with lifestyle therapy and achieved greater weight loss than did younger adults (176). At the end of 24 wk, 60% of subjects who were  $\geq 65$  y old met the 7% weight-loss goal compared with 43% of those who were  $<45$  y old; at the end of 3 y, 63% of those  $\geq 65$  y old but only 27% of those  $<45$  y old met the weight-loss goal.

### Pharmacotherapy

Most randomized controlled trials that evaluated the use of pharmacotherapy for obesity excluded older persons, and the remaining studies included only a small number of older subjects (177–181). Data from a recent meta-analysis of pharmacotherapy and obesity clinical trials found that the average age of subjects ranged from 34 to 54 y (182). Therefore, the available data are insufficient to determine the efficacy and safety of pharmacotherapy for obesity in older persons.

The use of pharmacologic agents to treat obesity can cause additional burdens in older patients. Many obese older patients are already taking several medications for other diseases, which would increase the likelihood of nonadherence or errors with obesity pharmacotherapy (183). In addition, weight-loss drugs are not often covered by health insurance or Medicare, which can cause a financial burden in older patients who are living on a fixed income. Of the prescription drugs that are currently approved by the US Food and Drug Administration to treat obesity, only sibutramine and orlistat are approved for long-term use. The Food and Drug Administration–approved indications for drug therapy are a BMI between 27.0 and 29.9 in patients with an obesity-related medical complication or a BMI  $\geq 30$ .

Sibutramine, which blocks the neuronal reuptake of norepinephrine, serotonin, and dopamine, causes weight loss by increasing satiety and decreasing food intake. A 1-y randomized controlled trial conducted in subjects without diabetes found that those treated with sibutramine lost 7%, whereas those treated with placebo lost 2% of their initial body weight (184). A meta-analysis of randomized controlled trials of sibutramine found that this drug caused a 4.5-kg greater weight loss than did the placebo at 1 y (182). Sibutramine therapy causes much greater weight loss when given in combination with behavior therapy and meal replacements (185).

Although the pharmacokinetics of sibutramine are similar in young and older subjects (186), its side effects could have more serious implications in older than in young and middle-aged adults. Some of the most common side effects of sibutramine, constipation and insomnia, are already common problems in the older population (187, 188). Sibutramine also increases heart rate and blood pressure, which may be particularly worrisome in older patients because of underlying cardiovascular disease.

Orlistat, which binds to intestinal lipases, causes weight loss by blocking digestion and absorption of dietary fat. Data from several randomized controlled trials conducted in subjects without diabetes found that, at 1 y of therapy, those randomly assigned to receive orlistat therapy lost 8–10% of their body weight compared with a 4–6% weight loss in those randomly assigned to receive placebo therapy (189–192). An analysis of a subpopulation of older subjects in one randomized controlled trial found that orlistat therapy was just as effective in older adults ( $\geq 65$  y old) as in younger adults (178, 193). A recently published meta-analysis of randomized controlled trials of orlistat found that orlistat caused a 2.9-kg greater weight loss than did placebo at 1 y (182). Orlistat therapy causes gastrointestinal side effects, such as flatulence, oily spotting, and fecal incontinence. Orlistat increases stool fat, water, and volume, so patients with subclinical anorectal dysfunction are particularly susceptible to experiencing spotting (194). Therefore, older subjects treated with orlistat may be at increased risk of fecal incontinence, because both external and internal sphincter function decline with age (195, 196). In fact, fecal incontinence is more common in old than in young adults and occurs in 3–7% of those who are  $>64$  y old (197, 198). However, constipation is also a common problem in older persons and occurs in 26% of older men and 34% of older women (188). Therefore, orlistat therapy could have beneficial gastrointestinal effects in this subpopulation of older patients. A retrospective analysis of the data from one randomized controlled trial found that the gastrointestinal side effects of orlistat therapy were no different in older than in younger subjects (178).

### Surgery

Bariatric surgery is the most effective weight-loss therapy for obesity. The indications for bariatric surgery were established at a National Institutes of Health Consensus Conference held in 1991 (199). The panel concluded that patients with morbid obesity, defined as a BMI of 35.0–39.9 plus at least one severe obesity-related medical complication (eg, heart failure, type 2 diabetes, hypertension, or sleep apnea), or a BMI  $\geq 40$  and a low probability of success with nonsurgical therapy were potential candidates for surgery. In addition, preoperative evaluation and postoperative management of patients should be performed by a multidisciplinary team with access to medical, surgical, psychological, and nutritional expertise. No age guidelines were provided.

The most common bariatric surgical procedures performed in the United States are the Roux-en-Y gastric bypass and the laparoscopic adjustable gastric band procedures. Most of the available data regarding the effectiveness and safety of bariatric surgery are derived from case series and trials conducted in young and middle-aged adults; very few studies have provided information on older subjects. The results from several case series that evaluated the effect of bariatric surgery in patients who were  $>60$  y old were recently reported (200–202). The composite of data from these studies suggests that perioperative morbidity and mortality is greater, whereas relative weight loss and improvement in obesity-related medical complications are lower, in older than in younger patients. Nonetheless, bariatric surgery resulted in considerable weight loss and marked improvements in obesity-related medical complications and physical dysfunction in the older patients. The laparoscopic-adjustable gastric band may be a better choice than the Roux-en-Y gastric bypass for selected older patients, because the laparoscopic-adjustable gastric band is



associated with fewer serious complications and a lower mortality rate. However, the safety and efficacy of these procedures have not been compared in randomized trials in older subjects.

## RECOMMENDATIONS

Weight-loss therapy that minimizes muscle and bone losses is recommended for older persons who are obese and who have functional impairments or metabolic complications that can benefit from weight loss. A thorough medical history, physical examination, appropriate laboratory tests, review of medications, and assessment of readiness to lose weight are essential before weight-loss therapy is initiated.

The primary approach is to achieve sustained lifestyle change. Lifestyle modification includes strategies that aid older individuals overcome barriers to comply with dietary changes and physical activity. Clinicians should help obese older persons set personal goals, monitor progress, and use motivational strategies to improve adherence to the weight-loss program. Specific cognitive behavioral therapy strategies, including self-monitoring, goal setting, social support, and stimulus control, should be considered. Lifestyle and behavior modification can be facilitated by counseling from a dietitian, exercise specialist, or behavioral therapist who has weight-management experience.

A modest reduction in energy intake (500–750 kcal/d) is recommended. The diet should contain  $\approx 1.0$  g/kg high-quality protein/d (203) and multivitamin and mineral supplements to ensure that all daily recommended requirements are met, including 1500 mg Ca/d and 1000 IU vitamin D/d. Very-low-calorie diets (<800 kcal/d) should be avoided because of an increased risk of medical complications. Referral to a registered dietitian, who has weight-management experience, is often necessary to ensure that appropriate nutritional counseling is provided.

Changes in the diet and activity habits of older persons present special challenges. An increasing burden of disease, adverse quality of life, depression, and cognitive dysfunction may make it difficult to change lifestyle. The increase in chronic disabilities with aging reduces physical activity and exercise capacity. Common geriatric situations, such as dependency on others, cognitive impairment, institutionalization, widowhood, loneliness, isolation, and depression should be addressed, because these factors can make it more difficult to lose weight. Because dependency may be common, lifestyle-change programs must include participation by family members and care providers. Consideration must also be given to obstacles to learning faced by older adults, such as impaired vision and hearing, multiple comorbidities, and limited financial resources.

Regular physical activity is particularly important in obese older persons to improve physical function and help preserve muscle and bone mass. Older patients should be assessed regarding the need to undergo exercise stress testing before participating in regular exercise (204). The exercise program should be started gradually and must be individually determined with consideration of diseases and disability. To avoid musculoskeletal injuries and promote adherence, exercise should start at a low-to-moderate intensity, duration, and frequency and gradually progress over the course of several weeks or months to longer, more frequent, and more vigorous efforts, if possible. The goals of regular exercise in obese older persons are to increase flexibility, endurance, and strength; therefore, a multicomponent exercise program that includes stretching, aerobic activity, and

strength exercises is recommended. Even very old or frail persons can participate in these types of activities (174, 175).

The use of medications is common in older persons, and this population has the highest risk of medication-related problems. All medications should be carefully reviewed, particularly because some may cause weight gain (eg, steroids, anticonvulsants, antidepressants, and antipsychotics). Furthermore, weight loss-induced clinical improvements might require changes in medications to prevent iatrogenic complications.

Experience in the use of obesity pharmacotherapy in obese older persons is limited. Of the currently available medications, orlistat may be the safest for older persons. Orlistat therapy in a selected group of obese older persons, particularly those with constipation, might be a useful adjunct to lifestyle modification.

Bariatric surgery should be considered in selected older subjects who have disabling obesity that can be ameliorated with weight loss and who meet the criteria for surgery. The specific bariatric surgical procedure that is performed will depend on the skill and experience of the surgeon. Potential surgical candidates should be carefully evaluated by a multidisciplinary team to ensure that the risk of postoperative morbidity and mortality is acceptable and that the perceived benefits of the procedure warrant the risk of potential complications. Preoperative evaluation should include an assessment for clinical depression, which occurs in up to 25% of older subjects (205) and could influence outcome. Postoperative management should include monitoring for nutrition-related abnormalities, particularly iron deficiency, vitamin B-12 deficiency, and osteoporosis.

## SUMMARY


The number of obese older persons has increased markedly because of an increase in both the total number of older persons and the percentage of the older population who are obese. Obesity has important functional implications in older men and women because it exacerbates the age-related decline in physical function and causes frailty or sarcopenic obesity. Therefore, it is particularly important to consider weight-loss therapy to improve physical function in obese older persons, in addition to possibly preventing or improving the medical complications associated with obesity, which is the major goal of weight-loss therapy in obese young adults. In addition, the therapeutic approaches must consider the potential adverse effects of weight loss on muscle and bone masses.

## FUTURE RESEARCH DIRECTIONS

Long-term randomized controlled clinical trials are needed in older persons to 1) evaluate the clinical effectiveness (particularly physical function, quality of life, and obesity-related diseases), weight-loss effectiveness, and safety (particularly the adverse effects of muscle and bone loss) of standard weight-loss therapy (diet and physical activity); 2) determine the best therapeutic approach for losing body fat while retaining muscle and bone mass; and 3) determine the independent and additive effects of diet-induced weight loss and exercise on clinical outcomes.

Additional studies are needed to 1) understand the complex interrelations between muscle mass, muscle strength, body weight, and physical function; 2) define the relation between muscle mass and body weight that leads to impaired physical

function and frailty; and 3) establish criteria for sarcopenic obesity.

Clinical studies are needed to evaluate the use of pharmacotherapy to treat obesity in elderly persons, including mortality risk, complication rate, weight-loss efficacy, clinical outcomes, and cost-effectiveness associated with specific pharmacologic agents. Clinical studies are also needed to evaluate the use of bariatric surgery to treat extreme obesity in older persons, including mortality risk, complication rate, weight-loss efficacy, clinical outcomes, and cost-effectiveness associated with specific surgical procedures and appropriate preoperative evaluation and postoperative monitoring. 

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