Obesity in the Elderly Diabetic Patient

Is weight loss beneficial? No

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Obesity and type 2 diabetes constitute major public health issues in modern societies worldwide. Their prevalence on a global scale is alarming, and efforts to control their spread represent a priority of the public health agenda (1). Obesity is clearly driving a parallel epidemic of associated chronic diseases in all age-groups, including type 2 diabetes, hyperlipidemia, hypertension, atherosclerosis, obstructive sleep apnea, and liver dysfunction. Considerable attention is currently being focused on the consequences of obesity in vulnerable populations at both ends of the age spectrum, namely in youth and in the elderly.

Elderly people, defined as individuals >65 years of age, comprise a substantial and growing part of the population in developed countries. Current demographic data in Western societies report that 12–15% of the general population is over the age of 65 years, and this proportion is projected to reach 20–25% by the year 2030 (2). Moreover, in the last 2 decades, the rate of obesity has risen dramatically among older adults, independently of sex, race, and educational level (3). This obesity epidemic significantly affects the health status of the geriatric population, since excess body weight in the elderly also correlates strongly with chronic ill health, poor quality of life, functional decline, disability, and dependency (4).

Conversely, evidence suggests that obesity in the elderly is probably not associated with the same risks as in younger individuals, while in certain aspects, can even be protective (5). Furthermore, the prevalence of underweight is higher among older adults, who are also more vulnerable to unintentional weight loss either as a result of illness, or due to the aging process itself.

The objective of this article is to assess the benefits relative to risks of weight loss that may be attained in the geriatric population, with special reference to the elderly diabetic patient.

WHAT IS AN APPROPRIATE DEFINITION OF OBESITY IN THE ELDERLY? — "Healthy" or "ideal" body weight is the ultimate objective of obesity treatment guidelines aiming to mitigate obesity-related health risks and improve quality of life (6). However, definitions of "healthy" body weight rely on incidence rates of associated diseases and on total mortality data, which vary across the age spectrum. Currently, the criteria applied to define obesity are based on BMI values, calculated as measured body weight (kg) divided by measured height squared (m^2), which provide a gross evaluation of total body fat.

Defining criteria of "healthy" weight for the elderly poses a challenge in clinical practice because of physiological changes related to aging, primarily in body composition and stature. Indeed, although body weight may remain stable, the proportion of body fat increases with age, while a degree of height loss is common in older adults (e.g., due to narrowed intervertebral disc spaces, osteoporotic vertebral compressions, and kyphosis). Thus, the accuracy of BMI as an indicator of adiposity decreases with increasing age (7).

Radiographic evaluation of body fat depots has been proposed as a more precise method to characterize obesity in the elderly. However, implementing such techniques in regular practice, as well as measuring total body fat mass, is not realistic; hence, anthropometric indexes of fat distribution currently offer the most practical method of evaluating obesity in older adults. Waist circumference, measured in the horizontal plane midway between the superior iliac crest and the lower margin of the last rib, has been shown to positively correlate with abdominal fat mass, providing a simple and reliable assessment of obesity and central adiposity (8). Waist circumference is an independent risk factor for cardiovascular disease (CVD), and assessment of central obesity holds greater prognostic value than BMI alone (9). Waist circumference cutoff points for the diagnosis of central obesity are a matter of debate, and different thresholds must be used based on sex and ethnicity, parameters that significantly affect the associated metabolic risk of central adiposity. According to the National Heart, Lung, and Blood Institute guidelines, women and men with waist circumferences >88 cm and 102 cm, respectively, are considered to be at high risk for CVD. These cutoff points are used in the criteria of the metabolic syndrome by the National Cholesterol Education Program Adult Treatment Panel III (10). The more recent metabolic syndrome definition by the International Diabetes Federation sets ethnicity specific criteria for waist circumference to define central obesity in adults, with cutoff points equal to 80 and 94 cm for Caucasian women and men, respectively (11). However, these thresholds do not take age into account, and further validation of their application in the elderly is essential to define age-specific action levels.

EFFECTS OF AGING ON BODY COMPOSITION AND FAT DISTRIBUTION — Age-related physiological changes have a marked impact on body composition, inducing a decline in lean (muscle and bone) body mass and total body water in parallel with an increase in fat mass (12,13). Thus, although excess weight gain may be absent or limited in older adults, the underlying increase of adiposity can be significant.

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Body weight appears to peak approximately during the 5th or 6th decade of life, with a later peak in women after menopause, and remains rather stable between the ages of 65 and 70 years, whereas a slow weight decline begins after the age of 70 years and continues for the remainder of life (13).

This age-dependent weight loss in later life with stable or increasing adiposity is additionally characterized by a redistribution of the fat mass that favors enhanced visceral and ectopic (e.g., intramuscular, hepatic) adipose tissue accumulation. Longitudinal studies have shown that there is a significant mean increase in waist circumference with age per year, which is of similar magnitude in all age strata, indicating that older adults continue to exhibit progressive increases in waist circumference (14). These data have been confirmed by studies using radiographic techniques to assess regional fat distribution in young and older individuals. The results reported enhanced visceral and ectopic fat deposition in combination with loss of subcutaneous fat mass (e.g., reduced subcutaneous gluteofemoral fat depots) in the elderly (15,16). Thus, although subcutaneous fat increases with rising BMI, it progressively decreases with aging and, additionally, intra-abdominal fat accumulation persists in old age even without total body weight gain. Therefore, it seems that in the elderly, underweight and low lean body mass is better evaluated by measurements of BMI (low BMI more accurately reflects the associated risk of underweight), whereas obesity and adiposity is better evaluated by measurements of waist circumference (increased waist circumference more accurately reflects the associated risk of obesity) (17).

OBESITY AND RISK OF DIABETES

OBESITY AND RISK OF DIABETES— Obesity, particularly of long duration and of the visceral type, is the cornerstone in type 2 diabetes pathogenesis. Depending on ethnicity and sex, 50–90% of type 2 diabetic patients exhibit BMI values >25 kg/m^2, with the higher incidence rates reported in older patients (18). Notably, the relative risk for diabetes in adults appears to increase even at BMI values <25 kg/m^2 and rises exponentially as BMI increases. The pathophysiological pathways behind this association are complex and progressive, leading to development of insulin resistance and secondary impairment of β-cell function. Moreover, type 2 diabetic patients with excess body weight are at particularly increased risk for CVD morbidity and mortality, since additional CVD risk factors (e.g., hypertension and dyslipidemia) tend to cluster with obesity, forming a constellation of metabolic comorbidities, described as the metabolic syndrome.

Adipose tissue accumulation, especially visceral, induces a spectrum of metabolic and hormonal changes, which progressively impair the insulin signal transduction pathway and manifest as increasing insulin resistance in adipose tissue, liver, and skeletal muscle. Altered adipokine production (e.g., increased tumor necrosis factor-α and decreased adiponectin secretion) and increased inflammatory load with expanding obesity have been identified as pathogenetic links to type 2 diabetes (19). Notably, decreased insulin sensitivity at the cellular level is also a natural consequence of aging.

Impaired β-cell function and insulin secretion defects are also essential for the development of type 2 diabetes and progress gradually for years before the clinical onset of the disease (19). Increased β-cell mass is a crucial compensatory mechanism against insulin resistance, with the population of pancreatic β-cells reflecting a dynamic balance between neogenesis, proliferation, and apoptotic processes in the islets of Langerhans that are regulated in an age-dependent manner. Genetic predisposition and aging contribute to β-cell dysfunction, which together with chronic glucotoxic and lipotoxic effects of the insulin-resistant state in obesity lead to dysregulated glycemic control and overt type 2 diabetes.

Another important consideration is that diabetes treatment itself may also contribute to further weight gain. The U.K. Prospective Diabetes Study has clearly demonstrated the weight-increasing effects of insulin and sulfonylureas in patients with type 2 diabetes over time (20), as indeed has been shown for glitazones (21). Paradoxically, weight gain in these diabetic patients has been associated with reduction of the risk of both micro- and macrovascular complications. This paradoxical association appears to depend on various parameters, such as the level of achieved glycemic control, as well as the degree and distribution of weight gain. The balance between treatment-induced weight increases and associated clinical benefits is even more delicate in elderly diabetic patients, who generally represent a population with multiple CVD risk factors.

Table 1—*Potential benefits and risks related to weight loss in older adults*

Health benefits of weight loss
Reduced risk for developing type 2 diabetes in subjects with impaired glucose tolerance
Reduced cardiovascular risk—improved glycemic, lipid, and blood pressure control
Potentially reduced mortality risk from CVD (with intentional weight loss in obese patients)
Improved respiratory function and obstructive sleep apnea control
Improved functional capacity and reduced musculoskeletal comorbidities
Improved depressive symptoms, sense of well-being, and quality of life
Health risks of weight loss
Potentially increased mortality risk (with unintentional weight loss and less with intentional weight loss)
Loss of muscle mass (sarcopenia) if not combined with regular exercise
Loss of bone mineral density, osteoporosis, and increased risk for fractures
Increased risk of specific protein and vitamin deficiencies
Increased risk of gallstone attacks (in rapid weight loss)

WEIGHT LOSS AND DIABETES PREVENTION

WEIGHT LOSS AND DIABETES PREVENTION— Effective treatment of obesity with sustained weight loss collectively improves the metabolic profile and decreases the risk for related complications. Lifestyle modification, including dietary and physical activity interventions, must be the initial step in the weight management plan and should be emphatically encouraged. Pharmacotherapy for tackling obesity should also be initiated early, especially when lifestyle interventions fail to achieve or maintain weight loss, to prevent the onset of metabolic diseases.

Prospective studies have documented that the degree and duration of weight gain in adult life are powerful predictors of type 2 diabetes and CVD, while even moderate sustained weight loss may have a significant impact on metabolic risk reduction, diabetes prevention, and CVD outcomes (Table 1) (22,23). Wannamethee and Shaper (24) studied a large cohort of middle-aged men to examine prospectively the effects of baseline BMI on type 2 diabetes and major CVD outcomes and the effects of documented weight change later in the follow-up period. Their studies confirmed the role of excess weight, especially of long duration, in the development of type 2 diabetes, showing that the associated diabetes risk increased progressively and significantly with rising levels of initial BMI and with the duration of overweight and obesity. Notably, in middle-aged men, weight loss appears to be associated with significant reduction in risk for type 2 diabetes, but not in CVD, indicating that severity and duration of obesity seems to limit the cardiovascular benefits of weight reduction in older men (25).

A growing body of evidence from several intervention (dietary/lifestyle, pharmacological, and surgical) weight management studies supports the notion that the onset of type 2 diabetes can be substantially delayed, and even prevented, by weight reduction in high-risk patients with impaired glucose tolerance. In the Finnish Diabetes Prevention Study, which recruited overweight middle-aged volunteers with impaired glucose tolerance, intensive lifestyle (dietary, exercise, and behavioral) intervention significantly reduced by 58% the risk for developing type 2 diabetes, compared with the control group (26). Furthermore, this effect was at least partly preserved during the long-term follow-up period. Notably, the intervention was most effective among the oldest (age over 61 years) individuals, with a relative risk reduction of 64%, compared with that in the control group (27). The Diabetes Prevention Program Research Group also conducted a large randomized clinical trial in the U.S., designed to evaluate the safety and efficacy of interventions aiming at preventing or delaying development of type 2 diabetes in adults at high risk for the disease (28). Diabetes incidence in this study was also reduced significantly by 58%, with intensive lifestyle intervention compared with placebo. Lifestyle intervention was highly effective in all study subgroups, being similarly effective in older and younger participants, whereas the advantage of the lifestyle intervention over metformin was higher in older individuals.

Initiation of pharmacotherapy for weight management, in addition to lifestyle interventions, may help achieve and maintain even greater body weight loss, and hence can further contribute in reducing the risk for type 2 diabetes in obese individuals. The Xenical in the Prevention of Diabetes in Obese Subjects (XENDOS) study evaluated orlistat versus placebo plus lifestyle intervention in obese patients with either normal glucose tolerance or impaired glucose tolerance. After a 4-year treatment period, the addition of orlistat to lifestyle changes produced greater weight loss in this obese population, compared with lifestyle changes alone. Furthermore, orlistat treatment resulted in a risk reduction of 37% for development of type 2 diabetes, an effect that was significant in patients with baseline impaired glucose tolerance (29).

Bariatric surgery represents the next step in weight management strategies after failure to achieve or maintain weight loss with lifestyle interventions and antiobesity drugs. Following the proposed guidelines, surgical interventions have been shown to effectively treat obesity, leading to prevention or remission of obesity-related complications (30). The Swedish Obese Subjects (SOS) study, a large prospective study, evaluated the long-term effects of bariatric surgery for morbid obesity. In this cohort, the surgically treated group had significantly greater weight reduction and markedly lower 2- and 10-year incidence rates of type 2 diabetes than the conventionally treated control group. These results highlight the primary preventive effect of weight loss on type 2 diabetes, which seems to persist for up to 10 years after surgery (31).

ACHIEVING WEIGHT CONTROL IN TYPE 2 DIABETES: LIFESTYLE AND DRUG INTERVENTIONS

— Weight loss has a well-established role in diabetes prevention, and its recommendation is common practice in the care of type 2 diabetic patients. However, the extent of long-term benefits from obesity treatment after the clinical onset of type 2 diabetes are less precisely documented, since data from large randomized intervention trials directly evaluating this objective are limited (32,33). Evidence in support of this widely accepted notion is mainly derived from cross-sectional and retrospective studies. In 1990, Lean et al. (34) published a retrospective study, reporting that weight loss improves life expectancy in established type 2 diabetes based on data from medical records of deceased type 2 diabetic patients who were followed up in an Aberdeen diabetic clinic and had survived for at least 1 year after diagnosis. The mean age at diagnosis was 65 years (range 57–75), and the authors concluded that the analysis of survival data in these patients provided, for the first time, evidence that weight loss for the treatment of diabetes improves life expectancy. However, precise interpretation of such retrospective nonrandomized studies is difficult, highlighting the need for better and large prospective studies on the association between weight loss and survival in type 2 diabetes, especially in the elderly. The ongoing Look AHEAD trial, assessing the impact of weight loss and medical nutrition therapy on long-term cardiovascular mortality and morbidity in patients 45–75 years old with type 2 diabetes and BMI >25 kg/m^2, is expected to provide valuable data to support evidence-based recommendations (35).

Although intentional weight loss seems to have a positive effect for diabetes outcomes, achieving optimum glycemic control in combination with weight loss may prove difficult in the care of type 2 diabetic patients, especially in the long term. Weight-promoting effects of many essentially used glucose-lowering regimens (e.g., sulfonylureas, glinides, glitazones, insulin, and their combinations) constitute an obvious obstacle for effective weight control and represent a confounding factor regarding the benefits of weight loss in diabetes management trials. Until recently, metformin offered the only reliable treatment option not favoring weight gain. At present, novel classes of antidiabetic agents have become available, namely incretin mimetics (e.g., exenatide) and dipeptidyl peptidase-4 (DPP4) inhibitors (gliptins, e.g., sitagliptin, vildagliptin), which improve glycemic control and protect β-cell function, while at the same time promote weight reduction (36). Adopting regimens favoring weight control should be generally preferred for the management of type 2 diabetes, but not at the expense of hyperglycemia. Notably, type 2 diabetic patients will lose less weight than nondiabetic patients for any given intervention, particularly elderly diabetic subjects who also exhibit a progressive age-related decline in metabolic rates.

Several options for weight loss interventions in diabetes could be applied in clinical practice (37). Lifestyle modifications should rely on small but permanent changes to the daily living of the patient. A healthy diet, including a 500–600 kcal/day calorie deficit, is recommended with the help of a dietitian who can additionally apply techniques (e.g., motivational interviewing) to achieve successful behavior modifications. Reinforcement aiming at realistic increases in physical activity is also essential, since regular exercise reduces abdominal fat and protects lean body mass, which is a crucial parameter for the elderly. This approach improves insulin sensitivity, plasma lipids, and blood pressure profiles; contributes to enhanced general fitness and well-being; and additionally helps long-term weight maintenance (Table 1).

Improvements in measures of glycemic control (e.g., in A1C) with weight reduction appear to be generally proportional to the amount of weight lost. Thus, combined interventions with anti-obesity pharmacotherapy may be particularly advantageous for type 2 diabetic patients, since they promote greater weight loss and encourage long-term lifestyle changes. Anti-obesity drugs should be considered as part of a comprehensive treatment strategy. Pharmacotherapy for weight loss in obese patients with an obesity-related comorbidity (e.g., type 2 diabetes, hypertension) is currently recommended for BMI >27 kg/m^2 (6). The efficacy of pharmacotherapy should be evaluated after an initial 3-month period and subsequently the treatment should be either continued if the achieved weight loss is satisfactory (>3% in type 2 diabetic patients) or discontinued in nonresponders.

Existing data for the licensed anti-obesity drugs (orlistat, sibutramine, and rimonabant in the European Union only) provide limited proof to support an evidence-based choice for the individual patient. All three agents produce moderate and broadly similar absolute and placebo-subtracted weight loss effects. Currently, therapeutic choices are predominantly determined by excluding drugs for which specific contraindications are present (e.g., orlistat: chronic malabsorption syndrome and cholestasis; sibutramine: inadequately controlled hypertension >145/90 mmHg, psychiatric illness, concomitant use of monoamine oxidase inhibitors or of other centrally acting drugs for treatment of psychiatric disorders, history of coronary artery disease; rimonabant: history of major depressive illness and/or ongoing antidepressive treatment, severe hepatic or renal impairment).

Orlistat is a nonsystemic gastric and pancreatic lipase inhibitor that inhibits the absorption of dietary fat by approximately one-third and, in combination with appropriate diet, additionally reduces the daily energy intake by 100–300 kcal. Orlistat has been evaluated in studies with type 2 diabetic patients (38,39). The addition of orlistat generally resulted in greater weight loss than placebo, although the degree of achieved weight reduction was less than that documented in studies with nondiabetic patients (40). A modest placebo-subtracted weight loss of ~2–3 kg was noted; however, almost twice as many patients achieved a weight loss ≥5% of body weight. This effect was associated with significant improvements in glycemic control, blood pressure, and lipid profiles.

Sibutramine is a centrally acting agent that enhances satiety and decreases hunger by inhibiting norepinephrine and serotonin reuptake, whereas it may also slightly increase thermogenesis. Sibutramine treatment has also been evaluated in type 2 diabetic patients treated with diet alone, metformin, or sulfonylureas (39–42). The placebo-subtracted weight loss in these studies was in the range of 4–5 kg, with approximately two to three times as many patients losing ≥5% of body weight compared with placebo. This effect was associated with improved lipid profiles and glycemic control, the latter particularly in responders with greater weight loss. However, small increases in blood pressure and pulse rate were also noted, which in addition to the contraindication in patients having uncontrolled hypertension and established cardiovascular disease, may limit the application of sibutramine in the diabetic population, especially among the elderly.

Rimonabant, a selective antagonist of the type 1 cannabinoid receptors, has been shown to induce significant weight loss in patients with type 2 diabetes and central obesity, while additionally improving glycemic, lipid, and blood pressure control (43). The average placebo-subtracted weight loss was ~4 kg in the rimonabant in obesity diabetes trial (44). The most important adverse effect of rimonabant was an increased incidence of psychiatric disorders (e.g., depression, anxiety, irritability) (40).

METABOLIC SURGERY: ARE THERE BENEFITS IN THE ELDERLY?

— Surgical approaches to obesity management are becoming increasingly sophisticated, and most of the procedures are now performed laparoscopically with markedly improved safety and efficacy. At the moment, bariatric surgery offers the most effective treatment option for morbid obesity regarding long-term sustained weight loss. Surgical interventions in morbidly obese patients have been shown to significantly improve both comorbidity and quality-of-life status and to decrease the overall long-term mortality (30,31).

Currently applied surgical procedures are categorized into purely restrictive (adjustable gastric banding and sleeve gastrectomy), gastric restrictive with some malabsorption (Roux-en-Y gastric bypass), and gastric restrictive with substantial intestinal malabsorption (biliopancreatic diversion without or with duodenal switch). Adjustable gastric banding and Roux-en-Y gastric bypass are now the most common bariatric procedures, with the former being relatively safer. It must be stressed that multidisciplinary skills are needed to support surgical interventions for obesity, especially in high-risk elderly patients. Thus, it is vital that all patients are referred to specialized units that are also able and willing to provide long-term follow-up.

Surgery should be considered for patients with BMI levels >40.0 kg/m^2, or with BMI in the 35.0–39.9 kg/m^2 range and at least one associated comorbidity (e.g., type 2 diabetes, hypertension) that could be improved by weight loss (30).

There is now consensus that bariatric surgery should be considered for treatment of type 2 diabetes in patients with BMI >35 kg/m^2 who are inadequately controlled by lifestyle interventions and pharmacotherapy. Indeed, studies reporting on comorbidities after bariatric surgery showed significant improvement or even resolution of type 2 diabetes, and of coexisting metabolic syndrome manifestations (45). Benefits of bariatric surgery remain controversial in geriatric populations, and currently there is no consensus regarding the safety and efficacy of surgical weight management interventions in this age-group. However, the demand for such procedures in older adults is rising because of the growing prevalence of obesity in this age-group. Several studies have reported that gastric banding and gastric bypass procedures can be performed safely in patients over the age of 60 years. The achieved weight loss in elderly patients seems less satisfactory compared with younger adults, but still the majority of these patients show benefits regarding obesity-related comorbidities and quality of life (46).

HEALTH RISKS ASSOCIATED WITH WEIGHT LOSS IN THE ELDERLY

— Current health trends and increasing life expectancy in Western societies are expected to inevitably result in progressively escalating obesity rates among the older population. However, the ultimate health consequences of this phenomenon still remain somewhat unspecified; thus, it is no surprise that the topic of obesity and aging is one of growing discussion and intensive new research.

Extrapolating from established detrimental effects of excess adiposity in young and middle-aged adults, one would conclude that significant increases in obesity-related morbidity and mortality should be expected in the elderly obese population. Surprisingly, most epidemiological data, mainly from cross-sectional, but also from longitudinal, studies, argue in favor of beneficial or neutral, rather than detrimental, effects of increased BMI on life expectancy after the age of 65 years. Furthermore, weight loss in the elderly appears to hold various risks related mainly to loss of lean body mass and potential nutritional deficiencies (Table 1) (4,5,47).

Weight reduction inevitably incorporates loss of muscle and bone mass, which appears to be proportionately similar in young and old adults. However, the impact of this effect on body composition can be significantly greater in the elderly because of the additional age-dependent gradual decline in lean body mass. Furthermore, data in this age-group support the notion that significantly more muscle and bone mass is lost with weight loss compared with lean mass obtained with weight gain of a similar degree (48). Such body composition changes in the aging individual may have serious implications, particularly if weight is periodically lost and regained, since they could accelerate sarcopenia and result in sarcopenic obesity and frailty.

Dietary restriction in older adults holds greater risk of inadequate macro- and micronutrient intake that could cause specific protein and vitamin deficiencies (47). Thus, dietary interventions in this age-group should address nutritional needs relating to age-associated physiologic and metabolic changes, as well as to potential drug-associated nutritional deficiencies. Balanced protein intake is crucial in older individuals, especially during calorie restriction, to maintain levels that help preserve muscle and bone mass, and at the same time, do not increase the risk of renal impairment (e.g., excessive protein intake in older adults is associated with glomerular sclerosis). Administration of specific vitamins and minerals, such as calcium and vitamin D, has been advocated in the elderly, since they potentially protect against bone mineral density decline and reduce the risk of bone fractures. Other micronutrients at risk of deficient intake in the elderly include vitamin B12, iron, and zinc, which may also require supplementation.

It becomes evident that when weight loss is considered essential in elderly obese patients, weight management interventions should also aim at minimizing the associated lean body mass loss. Physical activity is crucial for this goal, by increasing energy expenditure and offering multiple benefits beyond weight reduction (6). Data from studies in older obese patients suggest that regular exercise protects against muscle and bone mass loss during dietary restriction.

To date, several questions remain unresolved regarding benefits and risks of weight loss in the elderly. To provide evidence-based answers, well-designed randomized intervention studies are needed in large groups of older overweight and obese subjects, which could evaluate the long-term safety and efficacy of controlled weight management interventions.

SUMMARY

— Obesity and weight loss in the geriatric population exhibit rather distinct characteristics that can be briefly summarized in the following key points:

1. Body weight increases approximately up to the 5th or 6th decade of life and then progressively declines as part of the aging process. However, the prevalence of obesity is increasing in the elderly population, and, indeed, late-life obesity constitutes a threat to public health status in developed societies.
2. Indexes of centralized fat distribution, primarily waist circumference, appear to have greater prognostic value than BMI for characterizing obesity and associated health risks in the elderly. BMI alone reflects more accurately the associated risk of underweight in this age-group.
3. Weight gain, and particularly visceral fat redistribution associated with aging, seems to further contribute to increased risk for metabolic comorbidities, functional decline, disability, and earlier mortality.
4. Intentional weight loss may have beneficial effects in the elderly. Even small but sustained weight loss (not exceeding 10% of initial body weight) can prove beneficial in older obese adults, while weight cycling appears to hold additional risks. Diabetes risk and glycemic control do improve with weight reduction in this age-group, whether this is achieved by lifestyle intervention, pharmacotherapy, or surgery.
5. Weight loss interventions should be cautious and individualized in older patients to limit lean body mass loss and avoid nutritional deficiencies. Risk-benefit analysis is crucial in decisions of weight management in the elderly, and expected benefits must be assessed against potential detrimental effects of weight loss. Establishing the long-term benefits and/or risks of such interventions after the age of 65 years requires further study.

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