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Addressing Obesity to Promote Healthy Aging

Meredith Roderka, BS[a], **Sadhana Puri, BS**[a], **John A. Batsis, MD**[a,b,c,d,e]

[a]Section of Weight & Wellness, Department of Medicine, Dartmouth-Hitchcock, Lebanon, NH

[b]Geisel School of Medicine at Dartmouth Hanover, NH

[c]The Dartmouth Institute for Health Policy & Clinical Practice, Lebanon, NH

[d]Dartmouth Centers for Health and Aging, Dartmouth College, Hanover, NH

[e]Section of General Internal Medicine, Dartmouth-Hitchcock Medical Center, Lebanon, NH

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Introduction

The population worldwide is aging and is not immune to the changing prevalence of obesity. Older adults with obesity are at risk for adverse events, including functional decline, institutionalization and mortality. Other consequences of obesity and changes in body composition with aging, are an increased risk of falls, fractures, reduced quality of life, and cognitive decline. This article will describe the epidemiology of obesity, its geriatric-specific consequences and the benefits and risks of intentional weight-loss.

Epidemiology of Obesity in Older Adults

It is projected that, over 83.7 million people in the US will be >65 years in the year 2050.[1] This demographic shift is largely due to an increase in baby boomers and improved medical care, all which have led to an increase in life expectancy.[1] The most recent National Health and Nutrition Examination Survey data highlights an obesity prevalence of ~41% in adults aged 60+,[2] that leads to consequences resulting in impaired physical function[3] decreased quality of life (QoL), institutionalization[4] and death.[5]

Rates of obesity in older adults have also increased worldwide,[6] with rates tripling over the past 40 years.[7] Drivers of this epidemic include changes in the global food system, an

CORRESPONDING AUTHOR: John A. Batsis, MD, FACP, AGSF, FTOS, FGSA, Section of General Internal Medicine, Dartmouth-Hitchcock Medical Center, 1 Medical Center Drive, Lebanon, NH 03756, john.batsis@gmail.com.

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increased intake of energy-dense foods and sedentary work, expanding urbanization, changes in transportation modalities, and the interactions of biological and environmental factors. There are important disparities observed in obesity rates in older adults including race/ethnicity[8] rural/urban[2] and socioeconomic status.[9] In 2007–2010, Hispanic men aged 75+ had a higher prevalence of obesity (27.9%) when compared with non-Hispanic white men (26.4%),[10] with different rates observed in women (49.4% in non-Hispanic black, 30.2% in Hispanic, and 27.5% in non-Hispanic white).[10] In the US, obesity prevalence was higher in rural than in urban residents.[9] Socioeconomic status (SES) influences the development of obesity in both developed and low-income countries.[11] Few studies demonstrate associations between SES and obesity in older adults. Individuals aged≥50 years with financial hardship in the EPIC-Norfolk study were at higher risk for obesity irrespective of education, social class or home ownership.[12]

Changes in Body Composition

Aging is associated with body composition changes, including loss of skeletal muscle mass and redistribution of fat to the abdominal area and visceral organs. With age, there is a gradual increase in body fat; specifically visceral adipose tissue,[13] a trend continuing until extreme old age when fat mass may decrease.[14] Abdominal fat redistribution significantly contributes to insulin sensitivity and metabolic syndrome[15] and is a correlate of cardiometabolic disease.[16] Visceral fat promotes intramuscular fat infiltration that leads to pro-inflammatory cytokine production ultimately contributing to reduced muscle and physical function.[17]

As muscle mass declines with age,[18] the amount of available insulin-responsive tissue drops which may also lead to insulin resistance. Starting at age 30, there is approximately a 20–40% decrease in muscle mass by age 70 that may lead to sarcopenia,[19] the age-related loss of muscle mass and strength.[20] The Health, Aging and Body Composition Study noted a loss of muscle mass was associated with a decline in strength in older adults,[21] but the decline in strength was more rapid than the loss of mass, suggesting a decline in muscle quality.[22] Changes in skeletal muscle mass and function is critically important as it affects older adults' mobility and function.

While body mass index (BMI) is a simple and inexpensive method for assessing obesity, it lacks sensitivity and may underestimate adiposity in older adults.[18] This is, in part, due to its inability to discriminate between subcutaneous and visceral fat, and failing to account for muscle and bone mass. In contrast, waist circumference easily approximates increased intra-abdominal fat[23] with its sensitivity exceeding that of BMI, and is strongly associated with an increased morbidity risk.[24] Despite such limitations, BMI is valuable at the population-level by allowing health professionals to make comparisons across time, regions, and subgroups.

Consequences of Obesity

Consequences of obesity include cardiometabolic dysfunction, arthritis, pulmonary, urinary incontinence, cataracts, and cancer.[25] Specific to older adults include an increased risk of falls, cognitive decline, quality of life, and disability, which are reviewed below.[18]

Falls

Obesity negatively impacts balance and increases postural sway,[26] predisposing to falling and negatively impacting activities of daily living.[27] Among middle-aged and older adults, obesity is associated with a higher prevalence of falls and stumbling during ambulation.[28] The prevalence of falls differs in men and women, with middle-aged women at a particularly higher risk,[29] which may be due to an increased rate of trip-related falls.[30] This has implications in sarcopenic obesity; in older men with obesity, for instance, the loss of muscle mass is associated with an increased risk of falls,[31] with rates higher in this population.[32] Participants with obesity that fall have a higher prevalence of pain and inactivity than fallers of a healthy weight.[28]

Fractures

The association between hip fractures and obesity is less understood with conflicting associations.[33] A prospective population-based study of sarcopenic obese men found a high risk of fracture.[31] Weight-loss leads to loss of bone density. Intentional weight-loss was strongly associated with an increased risk of hip fracture. The pathophysiology associated with such fractures and whether obesity impacts bone quality is unclear and requires further investigation.[33]

Quality of Life

The presence of obesity in older adults negatively impacts quality of life (QoL), in part due to the loss of physical function that accompanies obesity.[34] Older obese adults were found to have a lower health-related QoL in the Medical Expenditure Panel Survey.[18] A study examining the relationship between BMI and QoL among adults aged ≥60 years old[35] found that overweight older females were more likely to have a lower scores andoverweight older males were less likely to have low visual analogue scale compared with normal BMI. Gaining an understanding of the differences in QoL in older obese adults could be helpful in tailoring specific interventions.

Cognitive Impairment

Several studies have explored the relationship between obesity and cognitive impairment.[36–38] Overweight and obesity demonstrated lower neuropsychological test scores than individuals with a normal BMI. Bischof[39] explored whether obesity in midlife or later life placed older adults at greater risk for cognitive decline and found that midlife obesity increased the risk for cognitive decline in late-life. Others demonstrated that conventional care plus nutritional counseling (vs. conventional care) in obese patients >60 years led to significant weight loss and improved global cognition, memory, semantic fluency, and Wisconsin categories.[37] Even a diet, exercise, and diet-exercise intervention in frail older obese adults age≥65 led to improved modified mini-mental status scores, trail making, and word fluency tests compared to controls at 1 year.[38] In contrast, the intensive lifestyle arm in Look-AHEAD[40] found no significant difference in the prevalence of cognitive impairment compared to controls.[36] There is promise that improved diet-exercise may positively impact cognition; further efficacy studies are needed.

Disability

Disability can be one of the most devastating consequences in older obese adults that leads to higher utilization,[41] institutionalization,[42] and death.[43] A number of factors promote the development of disablement process, both from a mechanical and inflammatory standpoint. Body fat redistribution promotes intramuscular fat infiltration leading to a vicious cycle of pro-inflammatory cytokine production and contributing to reduced muscle function.[17] (Figure 3). Inflammatory-based lipotoxicity reduces the potential of muscular regeneration leading to muscle fibrosis,[44] promotes insulin resistance, and negatively impacts muscle strength.[17] Such tissue damage inhibits the regeneration of muscle mass in those with sarcopenic obesity that negatively impacts physical function. For example, greater muscle fat infiltration was associated with an increased risk of mobility limitation.[45] A meta-analysis found that a BMI ≥30 kg/m^2 with low muscle strength in older adults, and not low muscle mass, was associated with functional decline.[45] Persons with sarcopenic obesity have difficulty ascending and descending the stairs.[46] Applying newer sarcopenia definitions, the presence of sarcopenic obesity resulted in an increased risk of frailty, activity of daily living disability and instrumental activity of daily living disability.[47] Data from the Osteoarthritis Initiative also showed that a combination of low knee extensor strength and high BMI was associated with reduced gait speed, a lower degree of physical function, and decreased self-reported health status.[48] Considerable evidence exists to suggest that sarcopenia and obesity is strongly associated with reduced physical function in older adults.

Nursing Home Admission

Older obese adults are at a higher risk for nursing home admission. A review suggested that obesity early in life is a risk factor for future admission,[42] even for middle-aged persons.[49] Separately, there was a greater rate of nursing home admission in whites with obesity compared to a normal BMI but no relationship in blacks.[50] Between 1992–2002, the proportion of newly admitted residents with obesity to nursing homes rose from 15% to 25%.[51] The distribution of residents with obesity was also unequal across different facilities, ranging from 0–40%, highlighting the inability of nursing homes to accommodate such residents.[51] The increased number of obese patients admitted to nursing homes can also impact the institution's ability to accommodate such patients. Patient size was a barrier to admission,[52] but also led to increased time to accomplish care needs.[53] Nursing home administrators reported inadequate staffing for the care of morbidly obese residents in 31% of nursing homes and also reported concerns about having the proper equipment for individuals with obesity in 68% of nursing homes.[52]

Obesity Paradox

A major challenge for clinical providers has been whether to recommend weight-loss interventions in older adults. This controversy, coined "the obesity paradox," stems, in part, from the inverse correlation between higher adiposity and mortality observed from several epidemiological studies; data has been strongest amongst older adults.

Previous studies demonstrated that obesity is associated with increased survival in those with established cardiovascular disease (CVD).[54] There has also been support for the paradox in

the context of type 2 diabetes, suggesting lower mortality in patients with type 2 diabetes and obesity than in normal or lower weight patients.[55] The paradox has been described in chronic obstructive pulmonary disease and in nursing home residents.[56] There are strong critics who believe the term ‘paradox’ is misleading as it was derived from biased observational studies.[57] A number of arguments dispel this paradox. Previous studies do not differentiate between unintentional weight loss associated with chronic illness and intentional weight loss.[57,58] The potential for bias increases with older age as the presence of chronic diseases accumulate, possibly explaining why this paradox is so prominent in older individuals.[58] Possible confounders are not accounted for (smoking, cardiorespiratory fitness or socioeconomic variables).[57] Last, mortality studies have stratified by smoking status which is associated with a lower BMI.[58]

A key study refuting the obesity paradox analyzed the association between BMI and lifetime risk of cardiovascular disease. The study design accounted for measurement, selection, and survival bias and variable follow-up times by stratifying the risk for non-CVD death by age, sex, and BMI strata to observe the relationship between BMI and risk of mortality from CVD in an isolated fashion. Overweight and obesity were associated with a significantly increased risk for CVD, and obesity was associated with a shorter lifespan and a greater proportion of life lived with CVD. Incident CVD among middle-aged men and women with morbid obesity was accelerated by 7.5 and 7.1 years compared with middle-aged men and women with normal BMI. Men and women with normal BMI lived an average of 5.6 and 2.0 years, respectively, longer than those with morbid obesity. Future studies can learn from and build upon the methods of this study.

Benefits of Weight Loss in Older Adults

Guidelines support the role of intentional weight loss in older adults in improving physical function.[3] Clinicians need to individualize health promotion efforts and be aware of specific adverse events in this at-risk population. We briefly describe the risks/benefits of diet-exercise inducted weight-loss in older adults as there is a limited evidence base for pharmacotherapy and bariatric surgery. Other benefits are outlined in a recent review.[59]

A review of weight-loss interventions in older adults[60] found a greater degree of weight loss in groups with a dietary component than in those with exercise alone. Exercise alone led to improved physical function and increased fat-free mass without significant weight loss. A combined diet/exercise approach led to the greatest improvement in physical performance and QoL, mitigating the reduction in muscle and bone mass observed in diet-only arms. More recently, a review assessed the impact of treating obesity in older persons[61] and found that lifestyle interventions resulted in similar weight-loss efficacy in older and younger people. Positive effects were observed on outcomes such as physical function and cardiovascular health. Weight-loss led to improved QoL of older adults in a 6-month study.[62] Weight loss plus the addition of any form of exercise (aerobic or resistance) has produced an improvement in QoL scores beyond those observed in the weight loss only conditions.[63] These findings suggest the importance in counseling patients in achieving their weight loss goals in order to help them improve their overall QoL.

Recent trials demonstrate the synergy of diet and exercise on improving physical function in older obese adults more than either separately.[64] Peak oxygen consumption increased more in the calorie restriction with aerobic/resistance training and diet-aerobic groups than in the diet-resistance group alone. Strength was higher in the diet-aerobic/resistance and resistance groups alone than in the aerobic group. Lean mass and hip bone mineral density decreased less in the diet-aerobic/resistance and resistance groups than in the aerobic group. Participants in LOOKAhead had improved gait speed over 4m and 400m walk tests and higher short performance physical battery scores over controls.[65]

A meta-analysis showed that caloric restriction plus aerobic and resistance exercise helped preserve fat-free mass in older adults, supporting the role of these strategies in the treatment of sarcopenic obesity.[66] A randomized trial of a dietary intervention in older obese adults and hypertension resulted in a mean 3.5kg reduction in weight and a decreased need for anti-hypertensive medications by 30%.[67] Another study found that weight-loss via both diet and exercise effectively reduced pain and improved function and QoL in older adults with knee osteoarthritis in comparison to diet or exercise alone.[68] Hence, the optimal approach to improve physical function in older adults with obesity is a multi-component, caloric restriction combined with aerobic and resistance program.

Protein supplementation has been proposed to reduce the potential weight-loss induced muscle loss. Consumption throughout the day can reduce the likelihood of weight loss-induced sarcopenia by stimulating muscle protein synthesis. The PROT-Age group recommends 1.0–1.1 g/kg protein per day in divided doses, acknowledging that a ‘one size fits all protein recommendation’ fails to account for the complex physiological changes of ageing.[69] Of three studies evaluating the effects of high vs. low protein diets in older adults with obesity[70], only one study[70] demonstrated a significant benefit of a high protein diet vs, normal protein diet on the short performance physical battery. While weight-loss was achieved at a comparable level in both groups, there were discrepancies in the age and sex of participants.[70] Future studies are critically needed.

Risks of Weight-Loss

There are inherent risks that healthcare providers should be mindful when counseling patients. Recognizing sarcopenia in the context of obesity is important[71] as reduction in caloric intake may lead to reduced adipose tissue, but also loss of muscle mass. Caloric restriction alone as a means of weight loss can increase the risk of sarcopenia, bone loss, and musculoskeletal injury in older adults.[59,48]

We advise caloric restriction should be coupled with resistance-based exercises. In one systematic review, unopposed calorie restriction without resistance training led to the loss of muscle mass and handgrip strength of up to 4.6% and 1.7kg, respectively.[72] Diet-only interventions without exercise in older frail adults led to a marked loss of lean mass compared with diet-exercise, where the loss of lean mass was partially mitigated.[64] A review evaluating the effects of energy restriction on adults with a BMI≥25kg/m^2 showed that 81% of caloric restriction groups and 39% of caloric restriction with exercise led to ≥15% loss in fat-free mass, while exercise alone only led to modest loss in fat-free mass. Look-AHEAD

participants showed significant reductions in total skeletal muscle mass in the intensive lifestyle group compared to controls.[73] In a 4-month trial, overweight and older adults in the caloric restriction group experienced a significant decrease in fat-free mass in contrast to the caloric restriction and exercise group. Recommendations for weight loss in older obese adults that allow for fat-free mass preservation include 150 min of aerobic exercise/week, 2–3 days of weight bearing exercises/week, protein supplementation 1.0–1.2 g/kg/day, and 1000 IU vitamin D or high-dose supplementation (if necessary).[59]

Calorie restriction alone has also demonstrated reduced bone-mineral density. Soltani[74] reviewed 32 randomized trials in adults ≥18 years and found that weight-loss significantly led to reductions in hip and lumbar spine bone density. Hip bone density decline with weight-loss was more pronounced in participants with obesity.[74] A one-year study of older adults with obesity were randomized to caloric restriction, exercise, calorie restriction and exercise, or controls.[75] Participants in the caloric restriction group exhibited more bone density loss at total hip (−2.6%) compared with the caloric restriction-exercise and exercise groups (−1.1%, + 1.5%).[75] In Look-AHEAD, intensive lifestyle participants were at a 39% higher risk of fragility fractures.[73] The POUNDS LOST trial assessed diet-only effects of weight-loss in older adults with obesity on bone density,[76] demonstrating both weight loss and significant bone density loss at the spine, hip, and femoral neck.[76] Only women demonstrated a significant association between loss of bone density and loss of muscle mass.[76] Recommendations for weight-loss in older adults with obesity parallel those to mitigate muscle loss as outlined above but, in those indicated, consideration for osteoporosis therapy.[59]

Other risks pertain to musculoskeletal injuries and hypoglycemia. The 12-month incidence of injuries related to exercises in older adults was roughly 13.8%.[77] Even in the LIFE study, the risk ratio between the exercise and the education group was no different.[78] Providers also must be mindful of alterations in metabolic variables, particularly hypoglycemia in participants on insulin as insulin sensitivity improves and reduces its need.

Importance of Treating Obesity to Promote Health Aging

Healthcare professionals can aid older patients with obesity in losing weight. The goal should be on improving physical function and QoL. The quality of care can be enhanced in its diagnosis and measurement. While BMI can be helpful, there may be improvements in accuracy by including waist circumference. Healthcare professionals can counsel patients by promoting multi-disciplinary lifestyle interventions. Concurrent dietary, behavioral, and exercise (aerobic/resistance) approaches should be prescribed and recommended as they lead to marked improvements in physical function, metabolic improvements, and can minimizes sarcopenia and osteoporosis. Caloric restriction without a concurrent resistance program may be detrimental; we advise against such an approach. Furthermore, there is a critical need to enhance delivery systems in the primary care setting by[79] changing policy structure and reimbursement mechanisms to permit non-physicians to deliver intensive behavioral therapy.[18] Monitoring of complications as a result of weight-loss induced metabolic improvements should be considered. We strongly advocate the need for additional community-based, pragmatic and effectiveness interventions to de-medicalize obesity in this

population. Clinic-community partnerships are a potential way to help implement an easy, cost-effective method to improve weight management programs.[80] Promising preliminary data[81] shows that implementing a community-based weight management program are feasible and acceptable. Treating obesity in older adults can mitigate the significant public health crisis, reduce healthcare utilization and risk of long-term adverse events.

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KEY POINTS

- This article reviews epidemiology of obesity including increase in prevalence; race/ethnicity, and socioeconomic disparities.
- Consequences of obesity in older adults; falls, cognitive decline; fractures, quality of life, disability and nursing home admissions.
- There are specific benefits to intentional weight-loss on physical function and comorbidity but also key risks to muscle and bone loss that need to be understood
- Health care professionals should encourage older adults with obesity to try to implement healthy lifestyle behaviors that includes exercise and diet routine.

SYNOPSIS

The population worldwide is aging. The prevalence of obesity in this population is also increasing. There are a range of consequences that effect these at-risk patients including increased risk of falls, fractures, reduced quality of life, and cognitive decline. This article will describe the epidemiology of obesity, the risks and benefits of weight loss, and the importance of treating obesity to help promote healthy aging.

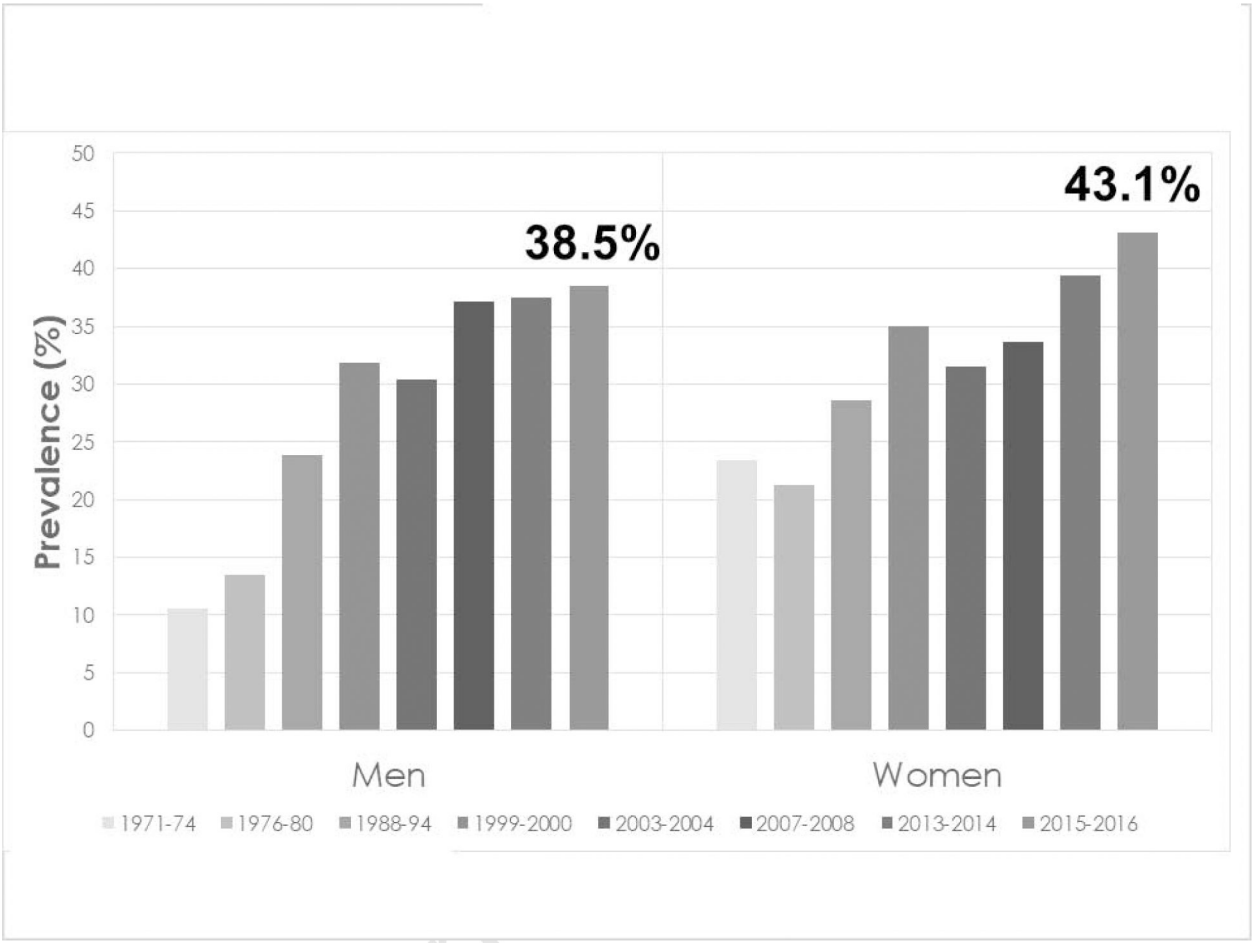

Figure 1: Population with Obesity in the United States

Data from the National Health and Nutrition Examination Survey demonstrating the changing demographics of older adults.

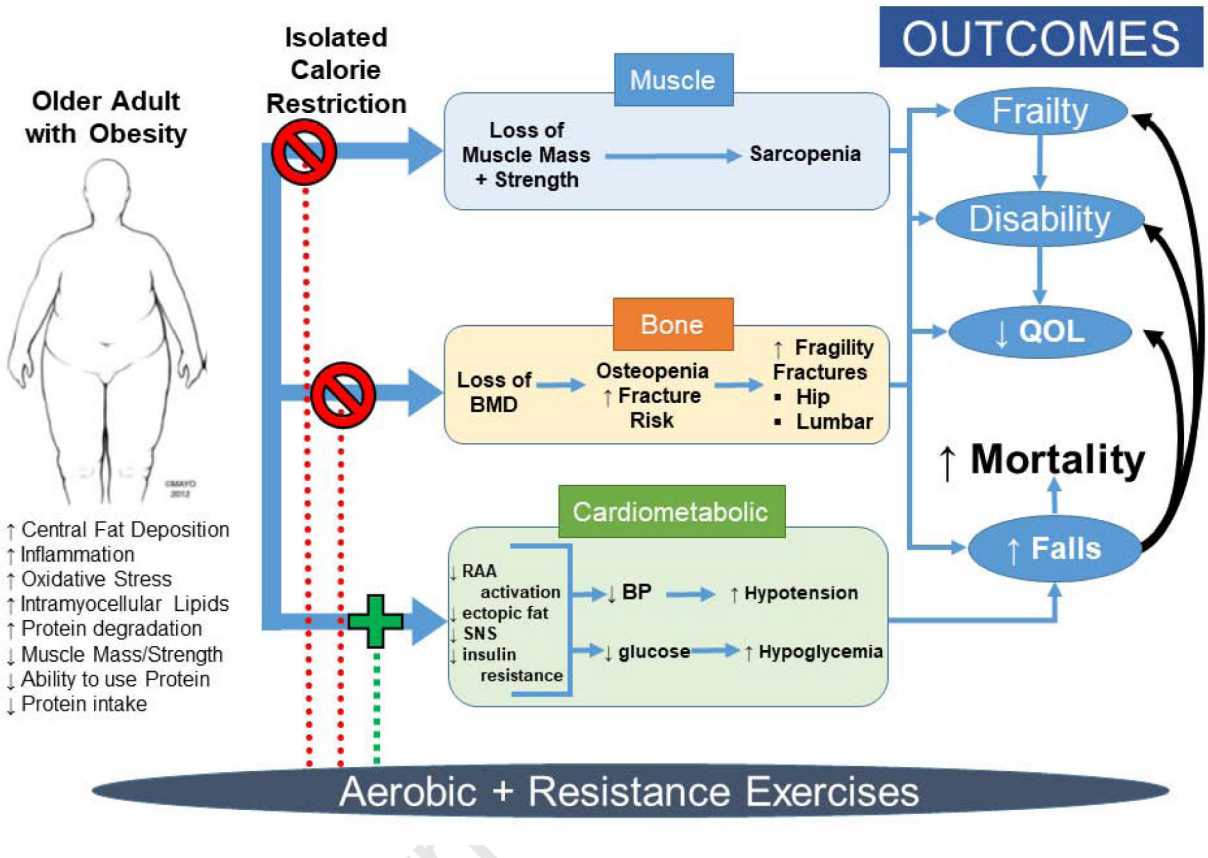

Figure 2: Risks of Intentional Weight-Loss in Older Adults

From DiMilia PR, Mittman AC, Batsis JA. Benefit-to-risk balance of weight loss interventions in older adults with obesity. Curr Diab Rep. 2019;19(11):114; with permission. This figure represents the major risks associated with isolated calorie restricted, diet-induced weight loss on muscle, bone, and the cardiometabolic system and their impact on key outcomes of frailty, disability, quality of life, falls, and mortality. The interrelationships between these elements are presented through the arrows. Elements of the underlying pathophysiologic processes in aging in the older adult with obesity are presented. Aerobic and resistance exercises coupled with diet-induced weight loss mitigate the loss of muscle mass and strength, and bone mineral density (indicated by red line and prohibition symbol). This combination also stimulates enhancement of elements of the cardiometabolic system leading to improvements in glucose homeostasis and blood pressure, requiring providers to be cognizant of relative hypotension and hypoglycemia (indicated by green line and plus symbol). BMD, bone mineral density; BP, blood pressure; RAA, renin, angiotensin, aldosterone; QOL, quality of life; Rx, prescription medications; SNS, sympathetic nervous system.

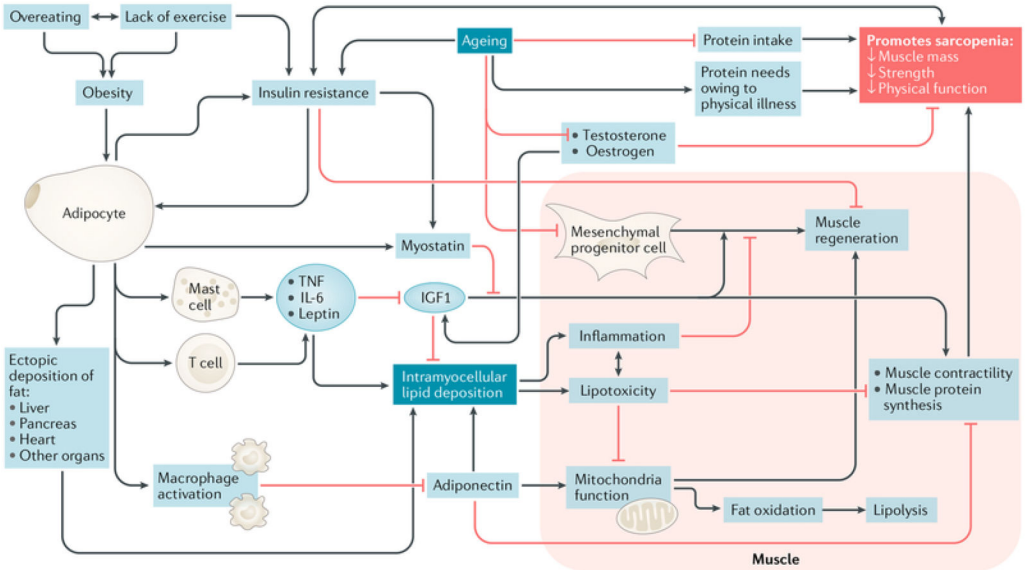

Figure 3: A proposed model of mechanisms leading to sarcopenic obesity

From Batsis JA, Villareal DT. Sarcopenic obesity in older adults: aetiology, epidemiology and treatment strategies. Nat Rev Endocrinol. 2018;14(9):513–37; with permission.

The proposed interplay between adipose and muscle tissue, which is believed to contribute to the development of sarcopenic obesity, is shown. The black lines are stimulatory, while red lines with flat ends indicate inhibition. IGF1, insulin-like growth factor 1; TNF, tumor necrosis factor.