Published in final edited form as:
Curr Diab Rep. ; 19(11): 114. doi:10.1007/s11892-019-1249-8.

Benefit-to-Risk Balance of Weight Loss Interventions in Older Adults with Obesity

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Abstract

Purpose of review—Obesity in the older adult is a burgeoning health epidemic that leads to increased morbidity, disability and institutionalization. This review presents a brief overview of geriatric-specific consequences of obesity by highlighting the risks and benefits of intentional weight loss.

Recent Findings—Intentional weight loss reduces the extent of adiposity-related illnesses yet the approach in older adults is fraught with challenges. Interventions combining caloric restriction and physical exercise (aerobic and resistance), maximize fat loss and minimize loss of muscle and bone. Interventions are also effective at improving physical function, reducing medication burden, and improving symptomatic osteoarthritis in this population. Approaches can mitigate the risks of isolated caloric restriction on muscle and bone in a safe and effective manner.

Summary—Effective weight loss strategies should be considered in older adults. While there are potential risks, practical clinical approaches can minimize the potential harms while maximizing their benefits.

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Conflict of Interest
Peter R. DiMilia and Alexander Mittman declare that they have no conflict of interest.
John A. Batsis received honoraria from the Royal College of Physicians of Ireland, Endocrine Society, and Dinse, Knapp, McAndrew LLC, legal firm. In addition, Dr. Batsis has a patent issued on Instrumented Resistance Exercise Device.

Compliance with Ethical Standards
Human and Animal Rights and Informed Consent
This article does not contain any procedures with human or animal subjects performed by any of the authors.

Keywords

obesity; older adults; benefits; risks

INTRODUCTION

Healthcare advances have resulted in upturns in life expectancy leading to a higher proportion of older adults living into their eighth decade of life (1, 2). More than 47 million people in the United States are currently aged ≥65 (~15% of the population) (3), with estimates predicting a doubling of this demographic within the next 40 years (4). Integral to healthy aging have been reductions in the rates and magnitudes of early mortality from chronic diseases (5). The healthcare system has begun emphasizing prevention and management of chronic conditions among older adults, as apparent with recent Centers for Medicare and Medicaid Services (CMS) initiatives such as the Annual Wellness Visit (6), Intensive Behavioral Therapy for obesity (7), and chronic care management (8).

One condition proving particularly vexing for primary care providers, especially among older adults, is obesity. The epidemic extends into older adulthood where 41% are classified as having obesity (9), with rates steadily increasing over the past four decades (9–11). This review provides a brief overview of body composition changes with aging followed by a specific emphasis on the inherent benefits and risks associated with intentional weight loss in older adults. We highlight evidence-based strategies and posit clinical recommendations for attenuating the potential deleterious, multifaceted impact of treating this epidemic.

Body Composition with Aging

Adults experience natural changes in body composition resulting from a cascade of biological and sociological factors as part of the aging process. In the fourth decade, lean mass begins declining and, consequently, body mass is gained as fat in higher proportions (12), stemming in part from declines in serum testosterone (13), leptin resistance (14), and reduced responsiveness to thyroid hormone (15). Reduced mitochondrial volume and oxidative capacity also contribute to declines in resting metabolic rates (16, 17) that incrementally increase body fat. Older adults are also at risk of developing anabolic resistance due to reduced amino acid availability, muscle perfusion and uptake, and digestive capacity (18). There is a natural tendency for weight redistribution centrally (19), a concurrent loss of height (20), and increased kyphosis (21) due to age-related changes in bone metabolism and architecture (22). These changes make body mass index (BMI), a marker of excess adiposity (23, 24), a less accurate surrogate for obesity in older adults. (25)

In older adults, obesity is associated with worsening physical function (26), impaired quality of life (27), nursing home placement (28, 29) and reduced life expectancy (30). It is also associated with cardiometabolic disorders (31), obstructive sleep apnea (32), osteoarthritis (33), cancer (34), and cognitive dysfunction (35). Yet, its treatment is complex as weight loss may paradoxically exacerbate incident frailty or disability and could be an indication of various underlying medical disorders (36, 37). An increasingly recognized subset of older adults with obesity have co-existent sarcopenia placing them at a synergistically higher risk of functional decline and adverse events (38–41). Sarcopenic obesity is a multifactorial disorder characterized in older adults by low skeletal muscle mass, strength or function in addition to excess adiposity (42, 43), whose prevalence increases with age (44). While the definition of this co-defined entity is debated (43, 45), its pathophysiology and treatment strategies are complex and are reviewed elsewhere (46).

Unintentional vs. Intentional Weight Loss

Discriminating between unintentional and intentional weight loss is crucial in understanding the safety of weight loss in older adults. Unintentional weight loss is a harbinger of serious illness in older adults (47) and directly correlates with decreased quality of life (48). Significant unintentional weight loss (>5% in six months (49)) can be identified using screening questionnaires (50) to alert providers of underlying cardiopulmonary disorders or malignancies (49). Major depression, cognitive decline, and food insecurity are other important considerations in an older adult (51).

The ‘obesity paradox’ is a term coined from a 2002 study that found improved outcomes in overweight or obese individuals with coronary artery disease after percutaneous coronary interventions (52). This paradox has, in part, been explained by reverse causality where cohorts whose study participants with normal weight had worse health (53), undiagnosed cachexia (54), or illness-related weight loss (55, 56). Flegal and Ioannidis clearly describe the problem in attributing elements of different observational studies whose foci and outcomes differ, which, lead to inappropriate population-level recommendations (57). Previous epidemiological studies have demonstrated negative relationships between weight loss and mortality, but fail to differentiate between intentional and unintentional weight loss (58–61). Studies also fail to account for smoking, cardiorespiratory fitness or other socioeconomic variables (55, 57). Age-related factors that alter the relationship between weight loss and mortality and are described elsewhere (62). Using large data sets to evaluate such relationships requires considerable data manipulation particularly if persons with serious illnesses or those at-risk of early mortality are included (55). Statistical errors are introduced leading to biased and false positive associations. Hence, clinical trials provide a unique opportunity to resolve such discrepancies by minimizing the impact of confounders on important outcomes.

The recent Cardiovascular Disease Lifetime Risk Pooling Project collected individual-level data across ten prospective cohorts free of cardiovascular disease, with 3.2 million person-years of follow-up (63). Long-term follow-up of the 190,672 in-person examinations noted that, compared to normal weight, incident cardiovascular disease for overweight persons demonstrated a hazard ratio (HR) of 1.21 (95% confidence interval 1.14, 1.28) and 1.32 (1.24, 1.40) in men and women, respectively, and 1.67 (1.55, 1.79) and 1.85 (1.72, 1.99) for obesity. The strongest relationship was for morbid obesity (men: HR 3.14 (2.48, 3.97); women: HR 2.53 (2.20, 2.91)). These trends were also observed in adults aged 60–79 at baseline (men: overweight 1.22 (1.14, 1.30); obesity 1.43 (1.32, 1.55); morbid obesity 1.81 (1.31, 2.50); women: overweight 1.18 (1.12, 1.24); obesity: 1.57 (1.48, 1.66); morbid obesity 2.22 (1.98, 2.49)). These data provided evidence to challenge the paradox in older adults suggesting that safe and effective weight loss can be recommended by providers as long the specific risks are understood and strategies are employed to mitigate them.

Benefits of Weight Loss in Older Adults

Older adults with obesity can significantly reduce their risk for long-term chronic medical conditions by engaging in weight loss efforts. However, continued skepticism about the effectiveness of weight loss in an older adult population exists due to limited life expectancy (64), difficulties in engaging in behavioral change (65) and other mobility disabilities (66, 67) that may prevent them from participating in interventions. Two recent reviews support the importance of weight loss treatments in older adults. Batsis et al. (39) evaluated 5,741 citations of which six unique studies with a duration ranging from 6–18 months (mean participant age 66.7–77.1 years) demonstrated weight loss of 0.5–10.7 kg (0.1–9.3%). Combined dietary and exercise (aerobic/resistance) programs led to greater improvements in physical performance measures and quality of life than either alone. Separately, Haywood and Sumithran (68) evaluated publications related to lifestyle, surgical and pharmacologic therapy for obesity in adults aged ≥60 years. Their findings confirmed the benefits of hypocaloric, diet-induced weight loss combined with exercise. There was insufficient data to guide clinical decisions regarding pharmacotherapy in older adults.

More recently, Villareal et al. evaluated 160 older adults with obesity, demonstrating improvements in the combined caloric restriction, aerobic and resistance groups in physical performance testing, peak oxygen consumption and body weight over aerobic-only or resistance-only and control groups (69). While multicomponent weight loss efforts are effective, there may also be long-term reductions in all-cause mortality of approximately 15% (70) with sustained improvements in function (71). In an earlier Villareal et al. trial with obese older adults, those randomized to the combined diet-exercise program demonstrated clinically significant weight loss (−8.6±3.8 kg) and improved physical function by 21% as measured by the physical performance test, even when compared to the diet or exercise-only groups (12% and 15% respectively; p=0.04) (72). Participants in the Look AHEAD diet-exercise group (mean age 58.6±0.13 years) had improved physical function through peak metabolic-equivalent capacity over four years of follow-up compared to their control group (71). Rejeski et al. also found benefits of using a combined diet-exercise approach to weight loss on physical function in older adults (73). Compared to diet-only, older adults engaging in either aerobic or resistance exercise with dieting exhibited improvements in both knee extensor strength (aerobic: 4.6 N/m, p=0.13; resistance: 6.6 N/m, p=0.027) and in 400-m walk time (16.9 s; p<0.001). The profound benefits of combined diet-exercise weight loss efforts among obese older adults also improves osteoarthritis symptoms. In a randomized trial of 399 obese older adults with knee osteoarthritis, those allocated to a combined diet-exercise program experienced improved 6-minute walk (41.5 m; p<0.001), walking speed (−0.04 m/s; p=0.02), and short-form-36 physical function score of (−2.26, p=0.03) (74). The INFINITE study, a 20-week randomized trial of 180 older adults with obesity demonstrated VO_2 max increases of 7.7%, 13.8%, and 16% in those with exercise alone, exercise with moderate-, and high-caloric restriction, respectively (75). In contrast, the CROSSROADS trial failed to demonstrate differential improvement of physical function or quality of life with energy restriction or weight maintenance diets compared to an exercise-only control group (76). These studies likely suggest a positive effect of weight loss on obese older adult's physical function with obesity and should be considered a key outcome measure for this population.

Risks of Intentional Weight Loss in Older Adults

While intentional weight loss in older adults portends considerable benefits on physical function (69, 72–76), chronic disease (77, 78), mortality (70), and quality of life (79, 80), there are inherent risks to be aware of. Caloric restriction during weight loss induces a catabolic state that not only affects fat, but also causes undesirable catabolism of other tissues, including skeletal muscle and bone (81). Because weight loss is also associated with significant loss of fat-free mass, sarcopenia, bone loss and musculoskeletal injury are some of the negative consequences, as described below and in part, in Figure 1.

Adverse Effects on Muscle—Loss of muscle mass and strength are associated with adverse health outcomes, including reductions in physical function and quality of life (82), frailty (83), and all-cause mortality (39, 84). While sarcopenia is a commonly accepted consequence of aging (12), it may also occur following an acute illness or injury (85) or immobilization (86). Without engaging in concurrent activities to minimize sarcopenia, weight loss initiatives can effectively accelerate its development. A meta-analysis identified the impact of diet-induced weight loss in overweight or obese adults on muscle strength (87) with seven weight loss intervention studies ranging from 8–24 weeks (age range 28–70 years). Overall, knee extensor strength by isokinetic dynamometry (n=108) was lower following diet-induced weight loss (−9.0 N/m [−13.8, −4.1]; $p<0.001$), representing a 7.5% decrease from baseline. Handgrip strength (n=231) demonstrated non-significant declines (−1.7 kg [−3.6, 0.1]; $p=0.07$). While the results were based on varying methods and a wide age range, this study highlighted the effect of diet induced weight loss on muscle strength. A review of 52 studies (age >50 years) established that caloric restriction led to loss of substantial proportion of fat-free mass (88). Even in adults aged 45–65, caloric restriction leads to approximately 4% reduction in lower-extremity lean mass (89). The Look AHEAD trial (mean age 58 years) also showed significant reductions in total skeletal muscle mass in the intensive lifestyle group (90). These trials demonstrate that mechanistically, caloric restriction alone during weight loss interventions can lead to the loss of lean mass.

In a trial that compared the effects of four interventions (control, diet-only, exercise-only, diet-exercise) among older individuals with obesity, the diet-only group had significant reductions in lean mass at 6-months (−3.5±2.7 kg) and one year (−3.2±2.0 kg) (72). Declines in lean mass were mitigated by a combined aerobic, resistance, and stretching program at six (−1.7±1.6 kg) and 12 months (−1.8±1.7 kg). A 2017 study also demonstrated that a combined diet/exercise group had more extensive weight loss, with less fat-free mass loss (1.8±1.5 kg vs. 3.5±2.1 kg), lower extremity lean mass loss (0.9±0.8 kg vs. 2.0±0.9 kg) and upper extremity lean mass loss (0.1±0.2 kg vs. 0.2±0.2 kg), as compared to the diet-only group ($p<0.05$) (69). Despite loss of lean mass, the diet-exercise group increased upper and lower extremity strength in response to exercise (17–43%), whereas the diet group maintained strength.

Weiss et al. (89) randomly allocated 52 overweight adults (45–65years) to three groups: caloric restriction-only with maintained physical activity; b) endurance exercise-only group with maintained calorie consumption; and c) combined caloric restriction-exercise group. At 12 months, all three groups experienced roughly 7% reduction in body weight and roughly 15% reduction in fat mass (89, 91). The caloric restriction group experienced a statistically significant 2.1% reduction in whole-body muscle mass, which remained unchanged in the two exercise groups. A distinct study conducted by the same investigators yielded similar results, with only the caloric restriction group demonstrating significantly decreased thigh muscle volume and knee flexion strength (92).

The one-year CROSSROADS trial (76) randomized older adults to three groups: exercise; weight maintenance; and a 500 kCal restriction diet. After one year, no differences were observed in visceral adipose tissue between groups; however, the exercise group demonstrated a 0.3 kg increase in lean mass while the caloric restriction group experienced a 0.4 kg decrease, though not statistically significant. In a pilot trial of 30 older, frail adults, the diet only group lost more fat-free mass (3.5±2.1 kg vs. 1.8±1.5 kg, $p=0.02$), lower extremity lean mass (2.0±0.9 kg vs. 0.9±0.8 kg, $p=0.001$), and upper extremity lean mass (0.2±0.2 kg vs. 0.1±0.2 kg, $p=0.03$) than the diet-exercise group over six months (93). In a separate four-month trial (mean age 67.2±4.2 years), whole-body fat-free mass decreased significantly ($p<0.05$) in the weight loss alone group (−4.3±1.2%) but not in the group coupled with exercise (−1.1±1.0%) (94).

Conflicting findings of the impact of weight loss on muscle strength exist. A six-month weight loss intervention on muscle strength and quality in older obese adults with knee osteoarthritis noted that the weight loss group exhibited decreases in lean mass ($p<0.001$) and increases in concentric muscle quality ($p<0.05$), while concentric extension strength increased non-significantly, suggesting that reductions of lean mass may be overshadowed by maintenance in muscle strength and quality (95). Rejeski et al. demonstrated that the addition of aerobic training or resistance training to caloric restriction led to greater weight loss and improved mobility among community-based older adults with overweight/obesity (73). Finally, a five-month trial comparing the effects of caloric restriction (CR) and CR plus resistance training among 126 older (65–79 years) individuals with overweight/obesity found no between-group differences in change in knee extensor strength (96).

In summary, isolated caloric restriction could lead to loss of muscle mass and muscle strength. Loss of muscle mass and strength are strongly associated with increased risk of functional decline (97), institutionalization (98) and mortality (39, 99). Thus, efforts should guide the need to mitigate the impact of weight loss induced sarcopenia.

Adverse Effects on Bone—Weight loss from isolated caloric restriction also has negative effects on bone mineral density (BMD), that can exacerbate age-related osteopenia by increasing the risk of fragility fractures (100). A study of 1,342 older men (mean age 73±5.5 years) found that intentional weight loss was associated with an adjusted rate of change in total hip BMD of −1.4% per year (101). Similarly, intentional weight loss-induced bone loss exhibited subsequent hip fracture risk was 1.8 [1.43, 2.24] times more likely in women who lost weight compared to those with stable or increased weight, highlighting the increased risk for osteoporotic fractures in older adults losing weight (102). In fact, significant weight loss (≥10%) in older women presents a clinically significant increased risk of fractures among older women (50–64 years: relative risk RR 2.54 [1.10, 5.86]; 65–74 years: 2.04 [1.37, 3.04] (14, 103). Consequences of fractures are especially important among older adults and vary from chronic pain and loss of independence to institutionalization and early mortality (104–106). One year following hip fracture, 47% experience chronic pain (106), and 29% do not reach pre-fracture mobility (106, 107). Within the first year following hip fracture, older adults have nearly a three-fold risk of death (HR 2.78 [2.12, 3.64]) (107).

A meta-analysis of 38 studies among individuals aged 18 years and older with overweight/ obesity, found significant reductions by 0.010 to 0.015 g/cm^2 in hip BMD after dietary weight loss interventions for 6 to 24 months (108). Overall a reduction in hip BMD was observed (−0.012 g/cm^2; p=0.04). Loss of BMD at the lumbar spine was found in low to very low energy diets (−0.031 g/cm^2, p=0.05; <5.0 megajoules/day), but not in moderate energy-restricted diets (≥5.0 megajoules/day). Further, both premenopausal and postmenopausal women exhibited overall loss of total body BMD, but it was only significant in postmenopausal women (p=0.006).

Soltani analyzed the effect of 32 diet, exercise, or combined diet-exercise weight loss trials on BMD in adults 18 years and older (109). The authors observed reductions in total body, hip, and lumbar spine BMD among participants in diet-only weight loss interventions, although significance was observed only at the hip and spine (total: −0.003 g/cm^2, p=0.14; hip: −0.017 g/cm^2, p<0.001; spine: −0.020 g/cm^2, p<0.001). BMD at the hip and spine increased for participants in exercise-only weight loss programs (hip: 0.005 g/cm^2, p=0.005; spine: 0.008 g/cm^2, p=0.027), and increased at total body in the combined diet-exercise group (total: 0.004 g/cm^2, p=0.009). Exercise-only programs (−0.561 kg, p=0.006) did not result in as much overall weight loss as compared to diet-only programs (−6.883 kg, p<0.001); combined diet-exercise programs offered the greatest prospect of preserving BMD while still achieving meaningful weight loss (−5.670 kg, p<0.001). In a subanalysis of older adults (≥65 years), only reduction in hip BMD was statistically significant (mean difference −0.011 (−0.014, −0.007); p<0.001).

Bariatric surgery is an effective means in achieving profound weight loss even in older adults (110) and is a model to evaluate the effect of weight loss on BMD. A recent meta-analysis of 10 studies (mean age 33 to 58 years) evaluated BMD after surgery compared to non-surgical groups in adults (111). While there was no overall differential reduction in BMD at the lumbar spine (−0.01 g/cm^2 [−0.07, 0.05]; p=0.66), a reduction in BMD at the femoral neck was observed in the bariatric surgery group (−0.05 g/cm^2 [−0.07, −0.02]; p=0.001). While there are limited studies evaluating the risk of bariatric surgery in older adults on BMD (112), the above reviews provide important overviews of the mechanistic risks inherent to bone loss as a result of bariatric surgery, independent of age. Importantly, the included study results are limited by the heterogeneity of the widely varying methodologies. Below, we highlight salient findings from a number of trials exploring the effect of intentional weight loss on BMD.

A prospective cohort of 6,785 older women demonstrated that unintentional and unstructured intentional weight loss led to osteopenia and increased risk of hip fracture (113). The rate of bone loss in the weight loss group was nearly double that of the weight gain group, and 35% higher than in the weight-maintenance group ($p<0.001$). The POUNDS LOST trial highlighted the sex-specific effects of diet-only weight loss interventions on BMD among 424 overweight and obese middle-aged and older adults (114). While both sexes across all four diet-only groups demonstrated both weight loss and significant loss in BMD at the spine, hip, and femoral neck at the end of the two-year trial, only women (n=242) exhibited a significant, direct correlation between loss of lean mass and loss of BMD at these sites. Men (n=182) exhibited an indirect, paradoxical relationship whereby lean mass decreased and BMD increased. Consequently, middle-aged women may be at a greater risk of bone loss during weight loss interventions than men (mean age 52 years), but sex-specific effects of weight loss interventions on BMD have not been demonstrably explored in older adults (≥ 65 years) (115).

In a one-year study by Shah et al., 107 obese older adults were randomized to three intervention groups and a control arm (116). Participants in the diet-only weight loss arm exhibited more loss of BMD at total hip (−2.6%) compared to the diet-exercise and exercise groups (−1.1% and +1.5%; $p<0.001$). The investigators noted the changes in lean mass predicted changes in BMD at the total hip ($p<0.05$). In a smaller randomized trial of 48 overweight and obese adults (mean age 57±3years; mean BMI 27±2 kg/m^2), participants in the exercise-only and diet-only groups showed similar, clinically significant weight loss (10.7±6.3% vs 8.4±6.3%, respectively; $p=0.21$). The diet-only group was found to have clinically and statistically significant decreases in BMD at the intertrochanter, total hip, and lumbar spine compared to the exercise-only and control groups, for which BMD remained constant or increased over the one-year trial at all sites (117).

The Look AHEAD trial randomly allocated 5,145 adults with overweight/obesity (mean age 59 years; mean BMI 36kg/m^2) with type 2 diabetes to either an intensive lifestyle intervention comprising of diet and exercise (ILI) or a diabetes support and education (DSE) (71). Over a median follow-up of 9.6 years, average weight loss was 6.0% and 3.5% in the ILI and DSE groups. Incident total or hip fracture rates did not differ between the groups, but ILI group had a 39% higher risk of fragility fracture.

Musculoskeletal Injuries—Musculoskeletal injuries are commonly observed during any exercise programs and the risks of such should be clearly communicated to patients. In a review of adverse events reported by older adults engaging in resistance strength exercises, 68 relevant clinical trials reported on adverse events (118), the most common one being musculoskeletal. The 12-month incidence of exercise-related injuries was studied in 167 older adults (mean age 69 years) (119). Investigators found that 13.8% reported an exercise-related injury over this period. Even in the LIFE trial (120), the risk ratio was non-significant between the physical activity and the health education group (0.91 [0.56, 1.47]). In the major weight loss trials, the main adverse events were also musculoskeletal (69, 72, 73, 75, 76, 96).

Balancing the Benefits and Risks of Weight Loss with Clinician Monitoring

Focusing on weight loss and improvement in physical function in any multicomponent program through caloric restriction and combination aerobic and resistance exercises are key health promotion objectives for older adults. Our recommendations and guidelines parallel those from the evidence-based LIFE study (120), and are briefly summarized in Table 1.

Muscle strength is emerging as a better predictor than muscle mass for incident disability, physical function (43), and early mortality (99). The ability to assess strength in clinical practice is a key component and can be conducted easily by clinic support staff to permit monitoring during weight loss efforts. We advise assessing two performance-based measures of upper and lower extremity strength at program onset and quarterly thereafter: handgrip strength and 30-second sit-to-stand. Muscle mass can be assessed using bioelectrical impedance or dual-energy x-ray absorptiometry (DXA). The former can be assessed in place of a regular scale; however, it is contraindicated in older adults with automated implantable defibrillators, fever >39^{o}C, or abnormal hydration status. DXA provides additional diagnostic accuracy, is more affordable, and has much less radiation than computer tomography or magnetic resonance imaging. While many DXA scanners have embedded software to permit body composition assessment, reimbursement is possible only if performed for another Medicare-covered indication (121). Promising markers including D3-creatine may permit ascertainment of muscle mass (122). Further, the International Classification of Diseases Code for sarcopenia may potentially circumvent such issues in the future (122). To our knowledge, there are no systematic data to suggest a frequency or timing of muscle mass or strength testing, nor are there thresholds at which practitioners should halt weight loss efforts due to loss of muscle mass.

DXA scans can be considered in the initial evaluation of older adults engaging in a weight loss program. CMS covers BMD testing in post-menopausal females aged 65 years and older every 24 months; in males, the indications are limited to prednisone usage, hyperparathyroidism, or x-ray evidence of osteoporosis, osteopenia, vertebral fractures. In concert with other variables, DXA permits calculation of the FRAX score (123) which assists in risk-stratification. Clinicians can then promote supplementation with sufficient dosing of calcium or vitamin D or prescribe treatment if fracture risk is elevated (i.e., FRAX >3% for hip, >20% any fragility fracture) (124) at the onset of weight loss treatments.

As older adults have a disproportionate number of chronic medical conditions necessitating medications and other therapeutics, including hypertension, diabetes, and dyslipidemia, periodic medication monitoring during weight loss efforts may be indicated. Specifically, primary care providers should monitor antihypertensive and antidiabetic medications (specifically insulin) and encourage patients to communicate closely if downward trends in blood pressure or sugars are observed. Further, complications with antihypertensive medications could lead to greater reductions in blood pressure, impairing cerebral auto-regulatory mechanisms leading to hypotension, falls, and fractures.(125) For instance, in the TONE study, older adults (mean age 66.5 years) randomized to caloric-reduction required a reduction in their use of antihypertensive medications (126). Patients with diabetes on glucose-lowering agents (including insulin derivatives) are at risk for hypoglycemic episodes. In the Look AHEAD trial, participants with type 2 diabetes on insulin or other antidiabetic medications in the diet-exercise intervention (mean age 59 years) were 8.02 [3.58, 17.95] times more likely to experience a severe hypoglycemic event compared to participants controlling diabetes with diet only (127); age was not significant in the multivariable analysis. The diet-exercise intervention group was more likely to report severe hypoglycemia than controls in the first year (RR 3.7; p=0.023), but was not different in ensuing years (p=0.41). While older adults with diabetes generally accounted for only 17% of participants, in other geriatric weight loss studies, the rate of hypoglycemia is also low (73, 75, 76, 96, 128).

Providers should adhere to core geriatric principles, including ‘start low, go slow’ for engaging in an exercise program. While the American College of Sports Medicine does not routinely recommend cardiovascular stress testing for older adults (129), symptomatic patients should be stratified accordingly by providers in advance of medical clearance. In those with pre-existing musculoskeletal impairments, we suggest referral to a physical therapist and/or an exercise physiologist at the local institution.

Research Gaps and Future Directions—The adverse implications of unintentional weight loss among older adults are well-established in terms of both poor health- and utilization-related outcomes (49), and the phenomenon appropriately alerts providers to the increased risk of serious underlying medical conditions. However, the long-term effects of intentional weight loss among older adults are not as definitive, especially in terms of cognition, quality of life, early institutionalization, and utilization. The lack of consensus regarding optimal body size and composition for older adults in various health circumstances begets a degree of clinical uncertainty regarding recommendations for intentional weight loss. Similarly, the specific nature, duration and intensity of exercise programs (both aerobic and resistance) for mitigating adverse outcomes from intentional weight loss in older adults need consensus. Whether altering specific components of dietary composition could mitigate risks of muscle and bone changes is currently being investigated.

Future trials with larger sample sizes that include outcomes relevant to older adults within community-based and low-resource (e.g., rural) settings are needed. Such outcomes could focus not only on the efficacy of multicomponent weight-loss interventions on cognition, urinary incontinence and falls, but also whether there are risks on these elements. Further, interventions evaluating structured, intentional weight loss in older adults have largely been underpowered to detect small yet clinically significant changes in bone or muscle health. Long-term interventional studies powered on changes in muscle mass, strength and bone loss are critically needed to better understand weight loss induced risks. Accurate proximal measures of bone and muscle health are also not well-established and would be valuable in clinical settings. Other treatment modalities, including pharmacotherapy and bariatric surgery are not currently standard of care; however, as they are increasingly offered to older adults, studies should be designed to understand their safety and efficacy in this population.

CONCLUSION

Weight loss achieved with a comprehensive therapeutic intervention that combines caloric restriction, and aerobic and resistance exercise, can improve physical function and overall health in older adults. In older adults, the negative impact of weight loss achieved with caloric restriction only on muscle and bone physiology and subsequent physical function could be mitigated to some extent by the addition of resistance exercise. Future studies should not only focus on the impact of weight loss on important geriatric outcomes, but should evaluate the risk of pragmatic interventions and natural experiments in usual clinical care that are often unstructured as compared to research-based studies. Future initiatives should develop guidelines for clinicians and researchers alike to maximize the health of older adults seeking weight loss efforts.

Acknowledgments

Funding:

Dr. Batsis receives funding from the National Institute on Aging of the National Institutes of Health under Award Number K23AG051681 and from the Friends of the Norris Cotton Cancer Center at Dartmouth and National Cancer Institute Cancer Center Support Grant 5P30 CA023108–37 Developmental Funds. Dr. Batsis also receives funding from the Patient Centered Oriented Research Institute. Support was also provided by the Department of Medicine and the Dartmouth Health Promotion and Disease Prevention Research Center supported by Cooperative Agreement Number U48DP005018 from the Centers for Disease Control and Prevention. The Dartmouth Clinical and Translational Science Institute, under award number UL1TR001086 from the National Center for Advancing Translational Sciences (NCATS) of the National Institutes of Health (NIH), and by the National Institute for Drug Abuse P30DA029926.

ABBREVIATIONS

BMD	bone mineral density
BMI	body mass index
CMS	Center for Medicare and Medicaid
HR	hazard ratio

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•• Of major importance

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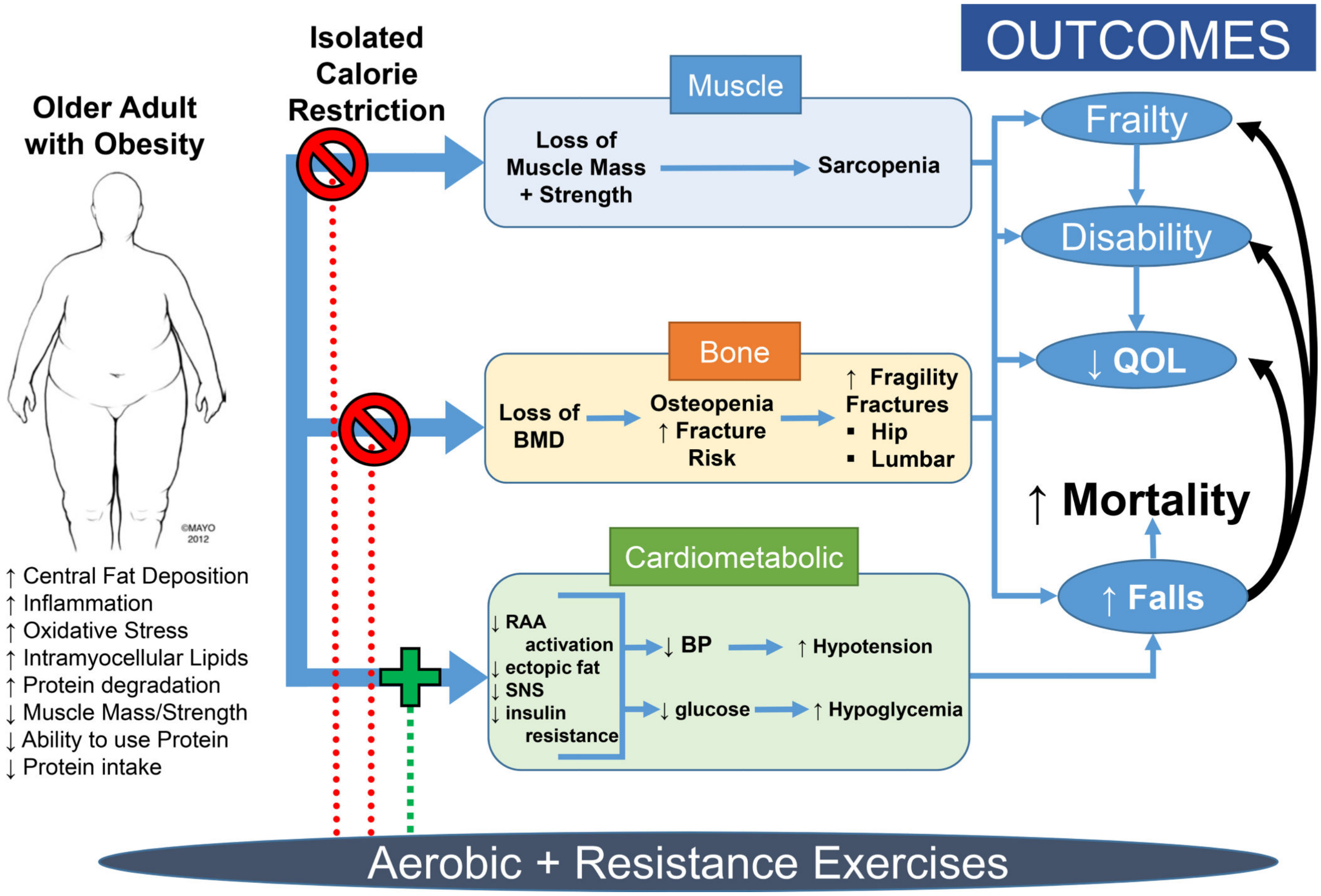

Figure 1: Risks of Diet-Induced Weight Loss in Older Adults with Obesity.

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 inter-relationships 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, in part, reproduced from: Coutinho et al. J Am Coll Cardiol. 2013;61:553–60, with permission from Elsevier) (130).

TABLE #1:

Management Approach to Weight-Loss Induced Complications in Older Adults

System Affected	Monitoring Tools	Treatment Options
Muscle	Body Composition	150 minutes of aerobic exercise activity
	■ DXA	Resistance Exercise - 2–3 days of weight bearing exercises
	■ BIA	Protein Supplementation 1.0–1.2g/kg/day
	Performance Measures	1000 IU Vitamin D or high-dose supplementation (if necessary)
	■ Grip Strength	
	■ Sit-to-Stand	
	Vitamin D levels	
Bone	Calcium Supplementation	800–1200mg of Calcium – preferably from diet
	Vitamin D levels	1000 IU Vitamin D or high-dose supplementation (if necessary)
	Bone Mineral Density	Resistance Exercise - 2–3 days of weight bearing exercises
	■ DXA	Osteoporosis therapies
Cardiovascular	Blood pressure	Medication adjustments
Blood Glucose	Fasting or POC glucose	Medication adjustments
Musculoskeletal	Clinical, symptoms-based	Guided, incremental exercises, physical therapy referral

Abbreviations: BIA – body impedance analysis; DXA – dual-energy x-ray absorptiometry;