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Review

Body Weight, Anorexia, and Undernutrition in Older People

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A B S T R A C T

Ideal body weight for maximum life expectancy increases with advancing age. Older people, however, tend to weigh less than younger adults, and old age is also associated with a tendency to lose weight. Weight loss in older people is associated with adverse outcomes, particularly if unintentional, and initial body weight is low. When older people lose weight, more of the tissue lost is lean tissue (mainly skeletal muscle) than in younger people. When excessive, the loss of lean muscle tissue results in sarcopenia, which is associated with poor health outcomes. Unintentional weight loss in older people may be a result of protein-energy malnutrition, cachexia, the physiological anorexia of aging, or a combination of these. The physiological anorexia of aging is a decrease in appetite and energy intake that occurs even in healthy people and is possibly caused by changes in the digestive tract, gastrointestinal hormone concentrations and activity, neurotransmitters, and cytokines. A greater understanding of this decrease in appetite and energy intake during aging, and the responsible mechanisms, may aid the search for ways to treat undernutrition and weight loss in older people.

In Western countries, there have been substantial increases over recent decades in the number of older people who are overweight or obese, according to standard body mass index (BMI) criteria.[1] For example, between 1995 and 2007 to 2008, the percentage of Australians who were obese (BMI of $\geq$30 kg/m^2) steadily increased from 13% to 31% for 65- to 74-year-olds, and from 6% to 23% for those older than 75 years.[2] There is increasing evidence, however, that the adverse effects associated with being overweight or obese by BMI criteria are not as great in older as in younger adults. This is particularly so for life expectancy; in people older than 65 years, a higher BMI is associated with neutral rather than detrimental effects on length of life.[1] Consistent with this, body weights associated with maximum life expectancy are higher for older than younger adults. For example, in a 12-year longitudinal study of 324,000 people in the American Cancer Society Cohort, people younger than 75 had a progressive reduction in subsequent life expectancy as baseline BMI increased above 21.9 kg/m^2. These adverse effects of increasing body weight weakened, however, with increasing age above 45 years and were absent altogether in those older than 75 years.[3] Among 4736 people aged 60 or older followed for an average of 4.5 years in the Systolic Hypertension in the Elderly Program (SHEP), those whose baseline BMI was in the lowest quintile (<23.6 kg/m^2) had the highest subsequent mortality, and those within the highest BMI quintile ($\geq$31 kg/m^2) had the lowest mortality.[4] The optimum BMI for survival in people older than 70 years is probably in the range of 25 to 30 kg/m^2, and close to the upper end of that range. There is also evidence that above (so-called) "normal" BMIs (18.5–24.9 kg/m^2) may be more beneficial in women than men.[5]

Of note, in older people, the body weight associated with maximum life expectancy is probably higher than that associated with optimum function and lack of disability. Among 12,725 people aged 65 or older in the Established Populations for Epidemiologic Studies of the Elderly, life expectancy was greatest with a BMI between 25 and 27 kg/m^2, but disability-free life expectancy was greatest at a BMI of 24 kg/m^2.[6]

Whereas high BMI values are associated with fewer adverse effects on life expectancy and possibly function in older than young adults, the opposite is probably true for low body weights. There is good evidence that BMI values below approximately 21 to 22 kg/m^2 are associated with significant adverse events and increased mortality in older people;[4,6,7] BMIs below 18.5 kg/m^2 are a particular concern.[6] Thus, with increasing age, the U-shaped curve describing the association between BMI and mortality moves to the right, and the curve becomes flatter at higher BMIs.[8]

Weight Loss in Older People

Although optimum body weight for survival is probably higher for older than younger adults, they tend to weigh less. This is documented in population-based, cross-sectional, and longitudinal studies[9,10] and is due to a combination of lower peak body weight and weight loss in old age. For example, in the 1997 to 1998 US National

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Health Interview Survey, more people aged 75 years or older were "underweight" (BMI <18.5 kg/m^2; 5.0% vs 1.2%) than those aged 45 to 64 years, and substantially fewer were "overweight" (BMI >25 kg/m^2; 47.2% vs 63.5%).[9] The lower average body weight of older than younger adults is not just because overweight people die earlier, leaving the healthier, more lean ones behind. On average, older people are more likely to lose than gain weight.[11,12] For example, 247 community-dwelling American men older than 65 lost on average 0.5% of their body weight per year over 2 years, and 13.1% had involuntary weight loss of 4.0% per annum or more.[11] The reasons for such weight loss are multiple and vary between individuals. Unintentional weight loss and associated adverse outcomes in older people may be attributable to protein-energy malnutrition, cachexia, the physiological anorexia of aging, or some combination of these factors.

Weight Loss Is Associated With Poor Health Outcomes in Older People

Numerous studies have shown that weight loss in older people not resulting from malignancy is associated with poor outcomes, certainly if unintentional, but possibly even when intentional. The prospective Cardiovascular Health Study,[12] for example, studied 4714 home-dwelling subjects older than 65 years without known cancer. In the 3 years after study entry, 17% of the subjects lost 5% or more of their initial body weight, compared with 13% who gained 5% or more. The weight-loss group had significant increases in total (2.09-fold increase; 95% confidence interval [CI] 1.67–2.62) and risk-adjusted mortality (1.67-fold increase; 95% CI 1.29–2.15) over the following 4 years compared with the stable weight group, with no increased mortality in the weight-gain group. Increased mortality among those who lost weight occurred irrespective of starting weight and whether or not the weight loss was intentional. In the SHEP study,[4] which studied 4736 people aged 60 or older, those subjects who had a weight loss of 1.6 kg per year or more experienced a 4.9 times greater death rate (95% CI 3.5–6.8) than those without significant weight change. Weight gain was also associated with increased mortality, but less so than weight loss (2.4- vs 4.9-fold increase). Of particular note, the adverse association between mortality and weight loss was present even in the subjects who were heaviest at baseline (BMI ≥31 kg/m^2). Subjects with a low baseline weight (BMI <23.6 kg/m^2) who lost more than 1.6 kg per year had a mortality rate of 22.6%, almost 20 times greater than the mortality rate of those with a baseline BMI of 23.6 to 28 kg/m^2 whose weight remained stable.

Thus, the combination of initially low body weight and weight loss is especially bad news for older people. This interaction is a particular concern as the tendency for older people to lose weight is variable, with lean individuals probably most at risk.[13]

Lean Tissue Loss and Sarcopenia in Older People

There are many reasons why weight loss in older people is associated with adverse effects. In some cases, weight loss is attributable to an illness, such as a malignancy, which is mainly responsible for the poor outcome. The loss of body weight after the age of 50 to 60 is disproportionately due to losses of lean body tissue, with average decreases of up to 3 kg of lean body mass, mainly skeletal muscle, per decade after the age of 50.[14] When skeletal muscle mass falls too far, sarcopenia results. This has been defined in various ways, often by comparison of skeletal muscle mass with values in young adults (eg, more than 2 standard deviations below the young adult mean as measured by dual-energy X-ray absorptiometry),[15] and sometimes also by the coexistence of functional impairments, such as reduced grip strength[16] and decreased gait speed.[17] The prevalence of sarcopenia increases dramatically as the "young-old" age and is up to 4 times higher in those older than 85 years than in those 70 to 75 years.[18] Sarcopenia is an independent predictor of poor gait, falls, fractures, and other disability. In the National Health and Nutrition Examination Survey III (NHANES III), older people with marked sarcopenia were 3.3 times (women) to 4.7 times (men) more likely to have physical disability than those with low-risk skeletal muscle mass.[19]

For these reasons, a high level of awareness needs to be maintained to detect unintentional weight loss, low body weight, and undernutrition in older people.

Weight Loss Programs in Older People

Weight loss is often recommended for overweight and obese older adults in the same manner as for younger adults, and for similar increases in body weight and BMI. At any given time, a substantial proportion of older people wish to lose weight and are trying to reduce their energy (food) intake to do so. There is evidence from studies in species as varied as yeast, spiders, mice, and possibly primates that long-term restriction of energy intake by 30% to 60% compared with ad libitum intake prolongs life.[20] It might seem, therefore, that reducing food intake to lose weight would be good for most older people. This is not necessarily the case, however. In fact, the opposite may be true. The effects of long-term voluntary energy restriction have not been tested in humans, and the benefits observed in other species may not apply to ours.[21] Moreover, marked energy restriction in older adults is likely to lead to a substantial loss of beneficial lean body tissue as well as fat mass and increases the risk of vitamin, mineral, and other dietary deficiencies. Thus, caution should be exercised in recommending weight loss to older people, unless there are definite health problems resulting from the excess weight.

Cachexia in Older People

Cachexia can also contribute to weight loss and harmful undernutrition in older people. Cachexia is a complex metabolic syndrome associated with underlying illness and characterized by loss of muscle with or without loss of fat mass. A prominent feature of cachexia is weight loss, but inflammation is also a key component, with an increase in levels of inflammatory cytokines such as tumor necrosis factor (TNF), interleukin (IL)-1, and IL-6. Anorexia, insulin resistance, and increased muscle protein breakdown are also frequently associated with cachexia. Conditions that often afflict older people that are associated frequently with cachexia include cancer, cardiac failure, chronic obstructive pulmonary disease, and chronic renal failure.

Although there is often considerable overlap between them, cachexia and malnutrition are not the same. Although all patients with cachexia are malnourished, not all malnourished patients are cachectic.[22] Cachexia is distinct from age-related loss of muscle mass, primary depression, hyperthyroidism, malabsorption, and starvation and does not respond readily to increased feeding.[23] Recently, the European Society of Clinical Nutrition and Metabolism subclassified cachexia on the basis of severity, into pre-cachexia—defined as (1) an underlying chronic disease, (2) a systemic inflammatory response, (3) anorexia, and (4) unintentional weight loss over the previous 6 months of less than 5% of usual body weight—and cachexia, defined as (1) to (4) but with weight loss of more than 5%.[22]

Protein-Energy Malnutrition in Older People

Weight loss in older people predisposes to the development of protein-energy malnutrition. This is surprisingly common in developed countries, with up to 15% of community-dwelling and home-