Published in final edited form as:

Arch Intern Med. 2007 April 23; 167(8): 750–751. doi:10.1001/archinte.167.8.750.

Obesity, Disability, and Mortality:

A Puzzling Link

Luigi Ferrucci, MD, PhD and Dawn Alley, PhD

Thou seest I have more flesh than another man, and therefore more frailty.

—Falstaff, in William Shakespeare's *Henry IV* (Part 1),
Act III

The idea that obesity and frailty are connected is not new. More than 400 years ago, Shakespeare masterfully expressed this concept with Falstaff's words. However, as new scientific evidence for a direct causal pathway between obesity and frailty accumulates, we need to begin a dialogue on the consequences for the aging population of the marked escalation in obesity witnessed over the past 25 years.

Demographic changes and increased life expectancy have led to prevalence rates of chronic diseases and disabilities that are higher than ever before. Because obesity is a strong risk factor for several common chronic medical conditions that frequently underlie disability in older persons, future rates of disability could rise even higher.

Two articles in this month's *ARCHIVES* contribute to our understanding of the impact of obesity on morbidity and disability. Using data from Duke Health System and University employees participating in a health risk assessment program, Østbye et al¹ describe a positive linear relationship between body mass index (BMI) (calculated as weight in kilograms divided by height in meters squared) and the number of workers' compensation claims, lost work days, and indemnity and claims costs. Although these findings are based on data largely from younger and middle-aged workers, they confirm previous work demonstrating a strong, positive association between obesity, disability, and health care costs in older workers.²

Using the rich data set of the Established Populations for Epidemiologic Studies of the Elderly (EPESE), Al Snih et al³ investigate the complex relationship of BMI with incident disability and mortality. They found that participants with a BMI of 24 had the lowest risk of disability, with a progressive increase in risk of disability below and above this threshold. The lowest mortality, in contrast, was observed in participants with a BMI between 25 and 35, who are typically considered overweight and even obese. Putting these observations together reveals that overweight and obese older adults live longer but spend a greater proportion of their life with some disability (2.3 years for men and 4.6 years for women) than their normal-weight counterparts. Interestingly, for both men and women, disability-free life expectancy was greatest among the overweight (those with a BMI of 25-30).

From these findings, we would expect the increasing prevalence of overweight and obesity in the older population to lead to increasing rates of disability, with substantial negative effects on health care costs. However, at the individual level, considering the trade-off between total

Correspondence: Dr Ferrucci, Longitudinal Studies Section, Clinical Research Branch, National Institute on Aging, 3001 S Hanover St, Baltimore, MD 21225 (ferruccilu@grc.nia.nih.gov).

Financial Disclosure: None reported.

and disability-free life expectancy, it would seem that becoming slightly overweight as we grow older may not be so bad.

Several important questions about the relationship between obesity and disability remain unanswered. First, how does obesity lead to disability? Although obesity is a strong risk factor for many chronic conditions, such as osteoarthritis, diabetes mellitus, heart disease, and stroke, accounting for the presence of these diseases does not explain the relationship between obesity and disability.⁴ Perhaps adipose tissue exerts a direct negative impact on functional status in old age, independent of disease. With age, muscle mass decreases and fat mass increases, with the largest increases in the proportion of visceral and abdominal fat. Adipose tissue operates as both an endocrine organ and active metabolic tissue, which produce adipokines that up-regulate systemic inflammation and cause insulin resistance.⁵⁻⁶ There is solid evidence that inflammation is an independent risk factor for disability.⁷⁻⁸ Inflammatory factors, including tumor necrosis factor α , IL-6, leptin, and adiponectin, may contribute to functional decline through increasing the risk of sarcopenia, bone loss, and anemia,⁹⁻¹¹ thereby creating a vicious cycle leading to sarcopenic obesity.

Second, the differential effect of obesity on disability and mortality in older persons is reminiscent of a major paradox of aging: women live longer but bear more morbidity and disability than men.^{5, 12-13} It is possible that differences in body composition and hormonal milieu, partially captured by BMI, may account for these puzzling findings.

The studies by Østbye et al¹ and Al Snih et al³ add valuable information to our understanding of the impact of obesity on the health status of older individuals, but several methodological issues remain. First, because body composition changes with age, BMI may be a poor indicator of adiposity in older persons. Recent analyses¹⁴⁻¹⁵ suggest that in older persons, waist circumference may be a better predictor of mortality than BMI. However, it is not known whether the relationship between waist circumference and mortality differs in different age groups. Indeed, if the association between waist circumference and mortality is consistent across age, and excessive fatness continues to have detrimental effects on health in older individuals, this detrimental effect may not be accurately captured by differences in BMI. Second, and even more important, most of the available information on the relationship between BMI and mortality derives from studies in which BMI was assessed at one point in time. Using a single measurement obscures the dynamic complexity of weight changes over the life span, especially in old age when weight change may reflect disease status rather than dietary or activity practices. Studies are needed to evaluate the role of weight history, including periods of weight gain and duration of obesity, and how the impact of weight history varies by age, birth cohort, and socioeconomic status.¹⁶ Obese people who die at or before age 65 years may have been obese as a young adult and thus have experienced a long duration of obesity, whereas those who become obese in later life may have a relatively short duration of obesity in old age. A related question is whether a mechanism of differential selection is responsible for the weak association between obesity and mortality at older ages. Only about half of the EPESE cohort (those born around 1920 or earlier) survived to age 65 years.¹ Because the effect of obesity on mortality tends to decline with age, those available to participate in a study of older persons constitute *healthy survivors*, those for whom obesity is less likely to be linked to poor health and reduced longevity. For instance, if those who survive to old age with obesity are less sedentary, they may have compensated for increased weight in ways that protect against mortality. Finally, as Al Snih et al³ note, it is possible that the lack of an association between obesity and mortality in old age may not be due to measurement error or selection effects but rather reflects a true protective effect of obesity in old age. Given obesity's negative effects on disability, it is useful to think about how obesity might protect against mortality even while placing individuals at risk for excess disability. One possibility is that those with greater fat stores may be better able to tolerate periods of low caloric intake associated with acute illness

and to minimize the effects of wasting associated with chronic illness.¹⁸ Although obesity is clearly associated with higher rates of many chronic diseases, it seems to be paradoxically protective of mortality among those diagnosed with heart failure and coronary artery disease.¹⁹ It is similarly possible that obesity increases the risk of disability but protects against mortality among those with disabling conditions.¹⁸

A related and hotly debated issue concerns whether and how to treat obesity in older patients. Weight loss in elderly individuals can reduce morbidity from arthritis and diabetes mellitus, reduce cardiovascular risk factors, and improve functioning.²⁰ But, elderly participants in weight loss programs risk losing muscle mass as well as fat, and the optimum weight for mortality risk is higher in older adults. This poses a dilemma for physicians, nurse practitioners, and dietitians treating obese elderly patients. Recent clinical trials suggest that interventions using exercise as a way to lose weight and increase function may be associated with the most positive outcomes in elderly patients,²¹⁻²² but more work is needed in this area.

In summary, there is a great deal about the relationship between obesity and disability that we still do not understand. How does obesity result in disability independent of disease? Are there ways to intervene in this process by making obesity less disabling, and are there ways to intervene without weight loss, which may be risky in older persons? Why is obesity closely related to disability in old age but less related to mortality? Does obesity exert a protective effect in elderly patients? Given the costs, the difficulties, and the burden associated with treating obesity, there is an overwhelming need for research that addresses these questions.

References

1. Østbye T, Dement JM, Krause KM. Obesity and workers' compensation: results from the Duke Health and Safety Surveillance System. *Arch Intern Med* 2007;167:766–773. [PubMed: 17452538]
2. Sturm R, Ringel JS, Andreyeva T. Increasing obesity rates and disability trends. *Health Aff (Millwood)* 2004;23:199–205. [PubMed: 15046144]
3. Al Snih S, Ottenbacher KJ, Markides KS, Kuo YF, Eschbach K, Goodwin JS. The effect of obesity on disability vs mortality in older Americans. *Arch Intern Med* 2007;167:774–780. [PubMed: 17452539]
4. Ferraro KF, Su YP, Gretebeck RJ, Black DR, Badylak SF. Body mass index and disability in adulthood: a 20-year panel study. *Am J Public Health* 2002;92:834–840. [PubMed: 11988456]
5. Lyon CJ, Law RE, Hsueh WA. Minireview: adiposity, inflammation, and atherogenesis. *Endocrinology* 2003;144:2195–2200. [PubMed: 12746274]
6. Maggio M, Guralnik JM, Longo DL, Ferrucci L. Interleukin-6 in aging and chronic disease: a magnificent pathway. *J Gerontol A Biol Sci Med Sci* 2006;61:575–584. [PubMed: 16799139]
7. Ferrucci L, Harris TB, Guralnik JM, et al. Serum IL-6 level and the development of disability in older persons. *J Am Geriatr Soc* 1999;47:639–646. [PubMed: 10366160]
8. Ferrucci L, Penninx BW, Volpato S, et al. Change in muscle strength explains accelerated decline of physical function in older women with high interleukin-6 serum levels. *J Am Geriatr Soc* 2002;50:1947–1954. [PubMed: 12473005]
9. Andrews NC. Anemia of inflammation: the cytokine-hepcidin link. *J Clin Invest* 2004;113:1251–1253. [PubMed: 15124013]
10. Scheidt-Nave C, Bismar H, Leidig-Bruckner G, et al. Serum interleukin 6 is a major predictor of bone loss in women specific to the first decade past menopause. *J Clin Endocrinol Metab* 2001;86:2032–2042. [PubMed: 11344203]
11. Schrager MA, Metter EJ, Simonsick E, et al. Sarcopenic obesity and inflammation in the InCHIANTI study. *J Appl Physiol*. 10.1152/jappphysiol.00627.2006 published online November 9, 2006
12. Hays NP, Bathalon GP, Roubenoff R, McCrory MA, Roberts SB. Eating behavior and weight change in healthy postmenopausal women: results of a 4-year longitudinal study. *J Gerontol A Biol Sci Med Sci* 2006;61:608–615. [PubMed: 16799144]

13. Lee JS, Kritchevsky SB, Tykavsky F, et al. Weight change, weight change intention, and the incidence of mobility limitation in well-functioning community-dwelling older adults. *J Gerontol A Biol Sci Med Sci* 2005;60:1007–1012. [PubMed: 16127104]
14. Price GM, Uauy R, Breeze E, Bulpitt CJ, Fletcher AE. Weight, shape, and mortality risk in older persons: elevated waist-hip ratio, not high body mass index, is associated with a greater risk of death. *Am J Clin Nutr* 2006;84:449–460. [PubMed: 16895897]
15. Visscher TL, Seidell JC, Molarius A, van der Kuip D, Hofman A, Witteman JC. A comparison of body mass index, waist-hip ratio and waist circumference as predictors of all-cause mortality among the elderly: the Rotterdam study. *Int J Obes Relat Metab Disord* 2001;25:1730–1735. [PubMed: 11753597]
16. Koster A, Bosma H, Penninx BW, et al. Association of inflammatory markers with socioeconomic status. *J Gerontol A Biol Sci Med Sci* 2006;61:284–290. [PubMed: 16567379]
17. Bell, FC.; Miller, ML. Social Security Administration, Office of Chief Actuary. Life tables for the United States Social Security Area 1900-2100. [January 30, 2007]. Web site http://www.ssa.gov/OACT/NOTES/pdf_studies/study120.pdf SSA publication 11-11536: 1-194. Published August 2005
18. Grabowski DC, Campbell CM, Ellis JE. Obesity and mortality in elderly nursing home residents. *J Gerontol A Biol Sci Med Sci* 2005;60:1184–1189. [PubMed: 16183961]
19. Curtis JP, Selter JG, Wang Y, et al. The obesity paradox: body mass index and outcomes in patients with heart failure. *Arch Intern Med* 2005;165:55–61. [PubMed: 15642875]
20. Elia M. Obesity in the elderly. *Obes Res* 2001;9(suppl 4):244S–248S. [PubMed: 11707549]
21. Messier SP, Loeser RF, Miller GD, et al. Exercise and dietary weight loss in overweight and obese older adults with knee osteoarthritis: the Arthritis, Diet, and Activity Promotion Trial. *Arthritis Rheum* 2004;50:1501–1510. [PubMed: 15146420]
22. Villareal DT, Banks M, Sinacore DR, Siener C, Klein S. Effect of weight loss and exercise on frailty in obese older adults. *Arch Intern Med* 2006;166:860–866. [PubMed: 16636211]