

Epidemiology of sarcopenia

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Epidemiological studies have assessed the relationship between sarcopenia and 4 other conditions: (1) osteoporosis, (2) falls, (3) mortality, and (4) sarcopenic obesity. The aim of this presentation is to review how findings from such studies can be used to identify individuals at risk for the adverse outcomes of sarcopenia and associated conditions.

Osteoporosis. The prevalence of sarcopenia, osteopenia, and osteoporosis all increase with age; based on a UK study using dual energy X-ray absorptiometry measurements, 1 of every 3 women over 70 years has sarcopenia, while 1 of 2 has osteopenia, and 1 of 10 has osteoporosis.¹ Early study results showed an association between quadriceps muscle strength and bone mineral density (BMD) of the hip (femoral neck).² Further, Health ABC study results demonstrated that lower lean body mass and higher fat mass independently contributed to low BMD levels, but the association depended on the bone site and bone index used.³ Where differences did occur, they were primarily by gender not race. Thus, maintaining or increasing lean mass in older people may help to preserve BMD in old age, regardless of race or gender.

Falls. Low levels of muscle mass and poor muscle strength are associated with risk for falling. In elderly men, low relative appendicular skeletal muscle mass index was associated with impaired balance and with increased risk of falls.⁴ A regression analysis identified weak hand grip strength as an independent predictor of future falling in older adults.⁵ And in a study of older people who underwent surgical repair of minimal trauma hip fractures, low muscle strength (hand grip, knee extension, and hip abduction) was a risk factor for recurrent and injurious falls.⁶

Mortality. Poor muscle strength, but not low muscle mass, is associated with mortality risk. From the InChianti study of community-dwelling older adults (≥ 65 years; $n = 934$), neither calf skeletal muscle mass nor fat mass could predict mortality.⁷ In older adults (ages 70-79 years), muscle quality (strength) was a much better predictor of mortality than was muscle quantity (mass); mortality risk was evaluated according to muscle strength (measured by isometric handgrip strength and isokinetic knee extension strength) and muscle mass (measured as muscle mass by CT and DEXA methods).⁸ In yet another study of older disabled adults (women 65-101 years; $n = 919$), handgrip strength was a powerful predictor of both cause-specific and total mortality.⁹ An inverse association between muscular strength and death from all causes and cancer was already observed in young men, even after adjusting for cardiorespiratory fitness and other potential confounders.¹⁰

Sarcopenic obesity. Sarcopenic obesity is a condition characterized by both sarcopenia and obesity.¹¹ This condition appears to be caused by a combination of factors—including excess energy intake, physical inactivity, low-grade inflammation, insulin resistance and changes in hormonal milieu. It was originally believed that the culprit of age-related muscle weakness was a reduction in muscle mass, but it is now clear that changes in muscle composition and quality are predominant. Data analysis of 4 different cohort studies showed that older persons with low strength were about 2 times more likely to be obese than those with greater muscle strength.¹¹

Conclusion. The ultimate goal of epidemiological studies is to determine what muscle characteristics and what assessment techniques can optimally identify older people who are at increased risk for adverse outcomes.

Take-home messages

- Muscle mass, muscle strength and fat mass seem to be associated with bone mineral density, with some differences due to bone site and gender.
- Low levels of muscle mass and poor muscle strength are associated with risk for falling.
- Poor muscle strength, but not low muscle mass, increases mortality risk based on several large, aging cohort studies.
- Sarcopenic obesity may emerge as an important geriatric syndrome in the near future.

References

1. Walsh MC, Hunter GR, Livingstone MB. Sarcopenia in premenopausal and postmenopausal women with osteopenia, osteoporosis and normal bone mineral density. *Osteoporos Int*. Jan 2006;17(1):61-67.
2. Blain H, Vuillemin A, Teissier A, Hanesse B, Guillemin F, Jeandel C. Influence of muscle strength and body weight and composition on regional bone mineral density in healthy women aged 60 years and over. *Gerontology*. Jul-Aug 2001;47(4):207-212.
3. Taaffe DR, Cauley JA, Danielson M, et al. Race and sex effects on the association between muscle strength, soft tissue, and bone mineral density in healthy elders: the Health, Aging, and Body Composition Study. *J Bone Miner Res*. Jul 2001;16(7):1343-1352.
4. Szulc P, Beck TJ, Marchand F, Delmas PD. Low skeletal muscle mass is associated with poor structural parameters of bone and impaired balance in elderly men – the MINOS study. *J Bone Miner Res*. May 2005;20(5):721-729.
5. Pluijm SM, Smit JH, Tromp EA, et al. A risk profile for identifying community-dwelling elderly with a high risk of recurrent falling: results of a 3-year prospective study. *Osteoporos Int*. 2006;17(3):417-425.
6. Lloyd BD, Williamson DA, Singh NA, et al. Recurrent and injurious falls in the year following hip fracture: a prospective study of incidence and risk factors from the sarcopenia and hip fracture study. *J Gerontol A Biol Sci Med Sci*. May 2009;64(5):599-609.
7. Cesari M, Pahor M, Lauretani F, et al. Skeletal muscle and mortality results from the InCHIANTI Study. *J Gerontol A Biol Sci Med Sci*. Mar 2009;64(3):377-384.
8. Newman AB, Kupelian V, Visser M, et al. Strength, but not muscle mass, is associated with mortality in the health, aging and body composition study cohort. *J Gerontol A Biol Sci Med Sci*. Jan 2006;61(1):72-77.
9. Rantanen T, Volpato S, Ferrucci L, Heikkinen E, Fried LP, Guralnik JM. Handgrip strength and cause-specific and total mortality in older disabled women: exploring the mechanism. *J Am Geriatr Soc*. May 2003;51(5):636-641.
10. Ruiz JR, Sui X, Lobelo F, et al. Association between muscular strength and mortality in men: prospective cohort study. *BMJ*. 2008;337:a439.
11. Stenholm S, Harris TB, Rantanen T, Visser M, Kritchevsky SB, Ferrucci L. Sarcopenic obesity: definition, cause and consequences. *Curr Opin Clin Nutr Metab Care*. Nov 2008;11(6):693-700.