of sensory challenges on mobility components. In-depth kinematic analysis is required to understand whether young and older adults adopt altered movement strategies to adapt to these challenges.

To the authors' knowledge, this is the first study that has systematically examined the global effects of sensory challenges on mobility. A larger prospective study is warranted to substantiate clinical applications of this study.

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REFERENCES

1. Simonsick EM, Newman AB, Nevitt MC et al. Measuring higher level physical function in well-functioning older adults: Expanding familiar approaches in the Health ABC study. J Gerontol A Biol Sci Med Sci 2001;56A:M644–M649.
2. Guralnik JM, Ferrucci L. Assessing the building blocks of function: Utilizing measures of functional limitation. Am J Prev Med 2003;25(Suppl 2):112–121.
3. Podsiadlo D, Richardson S. The Timed 'Up and Go': A test of basic functional mobility for frail elderly persons. J Am Soc Geriatr Dent 1991;39:142–148.
4. Shumway-Cook A, Brauer S, Woollacott M. Predicting the probability for falls in community-dwelling older adults using the Timed Up and Go test. Phys Ther 2000;80:896–903.
5. Vaillant J, Martigne P, Vuillerme N et al. Prediction of falls with performance on Timed 'Up-and-Go' and one-leg-balance tests and additional cognitive tasks. Ann Readapt Med Phys 2006;49:1–7.
6. Wall J, Bell C, Campbell S et al. The Timed Get-up-and-go test revisited: Measurement of the component tasks. J Rehabil Res Dev 2000;37:109–113.
7. Shumway-Cook A, Horak FB. Assessing the influence of sensory interaction of balance. Suggestion from the field. Phys Ther 1986;66:1548–1550.
8. Deshpande N. Sensory interactions during goal directed locomotion. PhD Thesis. Waterloo, ON, Canada: University of Waterloo, 2005.

RELATIVE STRENGTH PREDICTS FUNCTION EVEN IN THE OBESE

To the Editor: The relationship between strength and function has interested many authors.[1–3] In 1991, Buchner and deLateur[1] reported an inverse curvilinear relationship between relative strength of the quadriceps and the physical dimension scale of the Sickness Impact Profile (SIP).[4] Relative strength was measured using an isokinetic dynamometer and expressed as peak torque in newton-meters/body mass index (BMI, body weight in kg divided by height squared in m) at a contraction velocity of 60° per second. The SIP is a self-report instrument that asks individuals to rate as true or not true certain statements regarding activities of daily living, such as "I stand for only short periods of time," or "I have trouble getting shoes, socks, or stockings on." A score of 0 indicates no difficulties; the score increases as the number of complaints increases. The relationship between relative strength and the SIP is illustrated in a graph (Figure 1) in which SIP scores are represented on the ordinate, with the best score (0) being at the top. Relative strength of the quadriceps is represented on the abscissa.

This graph suggested an apparent threshold of relative strength below which patients report themselves as having difficulties in physical function; the older the patient, the greater the number of complaints. As relative strength decreases, the number of complaints increases.

Two short case reports suggest that this relationship remains true, even in patients with extremely low strength-to-weight ratios. In fact, both individuals had even more complaints than the extrapolated curve predicted (dotted line on Figure 1).

Ms. A. is a 79-year-old severely obese female (93 kg, 1.45 m; BMI 44), who was admitted to the hospital for progressive lower limb weakness and falls preceded by a sensation that her knees would buckle when she walked. She denied any pain but reported that she had adopted an increasingly sedentary lifestyle for the previous 8 months. She ambulated with a rolling walker. Her lower limb weakness had become debilitating to the point that she was unable to get out of bed, thus warranting her admission.

Mr. S. is a 58-year-old obese male (122.6 kg, 1.78 m; BMI 39) who was admitted with a recurrent acute gout flare with a chief complaint of a constant diffuse bilateral knee pain. He had lost 100 pounds in the previous few months. He ambulated with a rolling walker for short household distances and used manual wheelchair outside the house.

When plotting both individuals' data on the existing graph, each fell well to the left of the curve generated for people in their age group (Figure 1).

Buchner and deLateur[1] suggested that there may be (at least) two reasons for the prior apparent lack of association between strength and function. The first may be that the association was expected to lie in a relationship between absolute strength and function. The second may be that the relationship was expected to be a purely linear relationship. This continues to confound studies. In fact, the relationship is curvilinear, with a threshold of relative, not absolute, strength, below which subjects report having impairments of mobility and other physical activities. This possible relationship between strength and impairment continues to be investigated. One study[5] recently found that women with

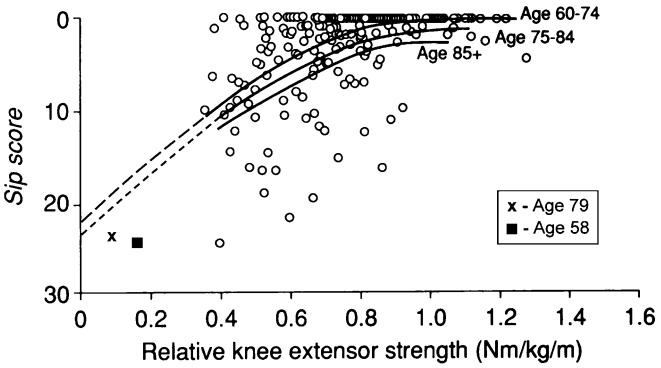

Figure 1. Relationship between Sickness Impact Profile (SIP) scores and knee strength expressed as peak torque in newton meters/body mass index, measured at a contraction velocity of 60° per second. Circles represent original data; squares represent new data.

BMIs greater than 30 and normal muscle mass had a high prevalence of functional limitations, but using linear regression modeling, it found that there was no predictive relationship between strength and function. Not seeking a linear relationship, another study[6] found that low relative muscle mass is an indicator of functional impairment and disability. Others[7] have also reported that leg extensor power is a significant predictor of independence in older adults.

Although this brief report discusses only two patients, it is likely that this curvilinear relationship will be true for most individuals with low levels of relative strength associated with obesity. As the population ages and the number of obese people continues to rise, the number of individuals reporting numerous difficulties with activities of daily living and instrumental activities of daily living is also rising, resulting in rising healthcare costs.[8] Research is needed to see whether moving people to the right on this curve (indicating greater relative strength), by weight reduction, strength increase, or both, will result in perceived ability to function.

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REFERENCES

1. Buchner DM, deLateur BJ. The importance of skeletal muscle strength to physical function in older adults. Ann Behav Med 1991;13:91–98.
2. Teixeira-Salmela LF, Olney SJ, Nadeau S et al. Muscle strengthening and physical conditioning to reduce impairment and disability in chronic stroke survivors. Arch Phys Med Rehabil 1999;80:1211–1218.
3. Purser JL, Pieper CF, Poole C et al. Trajectories of leg strength and gait speed among sedentary older adults: Longitudinal pattern of dose–response. J Gerontol A Biol Sci Med Sci 2003;58A:M1125–M1134.
4. Bergner M, Bobbitt R, Carter WB et al. The Sickness Impact Profile: Development and final revision of a health status measure. Med Care 1981;19: 787–805.
5. Zoico E, DiFrancesco V, Guralnik JM et al. Physical disability and muscular strength in relation to obesity and different body composition indexes in a sample of healthy elderly women. Int J Obes Relat Metab Disord 2004;28: 234–241.
6. Janssen I, Heymsfield SB, Ross R. Low relative muscle mass (sarcopenia) in older persons is associated with functional impairment and disability. J Am Geriatr Soc 2002;50:889–896.
7. Petrella JK, Miller LS, Cress ME. Leg extensor power, cognition, and functional performance in independent and marginally dependent older adults. Age Ageing 2004;33:342–348.
8. Sands LP, Wang Y, McCabe GP et al. Rates of acute care admissions for frail older people living with met versus unmet activity of daily living needs. J Am Geriatr Soc 2006;54:339–344.

RESPONSE TO COMMENTARY BY DR. OLIVER AND COLLEAGUES ON HIP PROTECTORS

To the Editor: We appreciate the commentary on our economic analysis "A Cost-Benefit Analysis of External Hip Protectors in the Nursing Home Setting" by Dr. Oliver and colleagues published December 2005.[1,2] They compare the estimate that we used for the relative risk of sustaining a hip fracture with hip protectors of 0.43 with an estimate of 0.53 from a recent meta-analysis of institutionalized subjects, indicating less benefit from hip protectors (unpublished data). In our sensitivity analysis, we determined that the hip protector intervention would still be cost saving to Medicare, with a relative risk 0.53, and indeed even if the relative risk was as high as 0.65.

Adherence is the driving force in hip protector effectiveness. Unfortunately, adherence in studies is reported in several different ways. In our model, we defined adherence as the percentage time that hip protectors are used when an individual is at risk for a hip fracture, and we believe that the estimate of adherence that we used is realistic.[3] Even though O'Halloran's recently reported adherence (20% at 2 years) is below the level necessary to achieve cost-savings in our model, several other studies have reported adherence rates above the threshold that we found necessary to obtain cost savings in the nursing home.[4,5]

An approach that targets highest-risk individuals and maximizes adherence will benefit the most-vulnerable patients and lead to economic gains. Maximizing adherence