Guest Editorial

The Critical Link Between Health-Related Quality of Life and Age-Related Changes in Physical Activity and Nutrition

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TANTALIZING research in nutrition and exercise in the last few years has promised the possibility of extending life span, delaying the effects of aging, preventing chronic disease, and augmenting the body’s immune function. Yet the current state of knowledge seems to raise more questions than solutions. The more we know, it seems, the less we understand. In Special Issue II of The Journals of Gerontology: Biological Sciences and Medical Sciences (October 2001), an in-depth review addresses age-related changes in nutrition and physical activity and their effect on quality of life. This special issue adds to our unraveling of the complexities of nutrition and exercise.

Most elderly persons would have to be described as sedentary. Only 7.5% of persons 65 years and older participate in aerobic activity. Even fewer participate in resistive exercise training (1). Both dynamic, static, and isokinetic muscle strength decreases with age (2). Age-related sarcopenia is recognized as a major cause of disability and morbidity in elderly persons (3). A substantial 65% of older men and women report that they cannot lift 10 lb using their arms (4). This decline in strength has been hypothesized to be a reason for some of the functional decline that occurs with aging (3,6,7). Physical deconditioning and undernutrition compound difficulties in medical care of older adults (8,9).

One of the effects of increasing life expectancy is accumulation of nonfatal, chronic disease. This “burden of illness” often leads to disability and poorer perceived health status. This paradox has shifted the focus to quality, rather than quantity, of life. If “adding life to years rather than years to life” should be our new focus, how do we measure this quality of life?

A common surrogate for quality of life uses functional status. Individuals with severe functional limitations have been assumed to have a poorer life satisfaction. For example, increasing disability on the Katz’s Activities of Daily Living Scale has been assumed to correlate with decreased quality of life. However, human beings are marvelously adaptive. Persons with severe physiological limitations frequently express high life satisfaction scores measured by standard instruments. On the other hand, the loss of ability to pursue usual lifestyle activities in a formerly active adult can profoundly affect the perception of quality of life. In a superb review, Rejeski and Mihalko (10) argue for a shift in the definition of health-related quality of life. At an individual level, a psychological, rather than a functional, construct must be adopted to assess health perception. Very few studies have examined changes in physical activity or diet in understanding individual outcomes from interventional studies.

Total energy expenditure (TEE) declines with aging, chiefly due to changes in resting energy expenditure (REE). REE decreases 10% to 20% with age, primarily due to a decrease in muscle mass (11,12). REE is higher in active older adults compared to sedentary older adults (13), but a decline in muscle mass occurs in both sedentary and active aging adults (14–16). Westerterp and Meijer (17) examined age-related physiological changes in energy expenditure on body composition. A decrease in physical activity largely explains the decline in TEE with age. Surprisingly, there is little correlation between physical activity and fat mass in older persons. Higher physical activity is not associated with a lower body fat mass in subjects older than 60 years. Five studies reviewed by Westerterp and Meijer found an absence of an exercise effect for body weight, TEE, or fat mass in elderly persons contrasted with younger persons (18).

Consistent studies in younger adults show that muscle strength and mass increases with high-intensity resistive training (70%–90% of one repetition maximum; 19–21). In older men, upper arm strength was increased by 23% to 48% (22,23) and lower extremity strength by 107% to 226% (24). Similar increases, in the range of 28% to 115%, have been reported in older women (25). Aniansson and Gustafsson demonstrated a 9% to 22% increase in lower extremity strength at 12 weeks in healthy men aged 69 to 74 years (26). The benefit of strength training has been demonstrated to exist in even frail, institutionalized, elderly men and women. After 8 weeks of training in volunteers aged 90 years, muscle strength increased by 174% and mid-thigh muscle size by 9% (27). The improvement in muscle strength in older adults may improve health outcomes (28–32).

How much exercise is enough? Exercise strategies should be designed to increase muscle power (33). DiPietro focuses on the exercise prescription (34), which may vary greatly with the disease-specific prevention goals. Total energy expenditure may be more important than duration or intensity.
of exercise. Interestingly, no dose effect has been observed comparing vigorous activity with moderate walking in reducing coronary events. Unfortunately, older patients who would benefit from help with glycemic control by exercise often are unable to exercise due to diabetic complications such as cardiovascular or peripheral vascular disease.

If exercise is to have an effect on health-related quality of life, participants must be assisted in changing their lifestyle. The focus must be on lifestyle change, since brief periods of exercise may not be beneficial. The benefit of exercise dissipates within a few weeks of ceasing exercise in both young and old adults. Thirty-two percent of the gain in muscle strength in institutionalized residents was lost within 4 weeks of ceasing training. Physiological control of glucose metabolism may improve with exercise (35,36), but the effect is very short-lived. Ten days without exercise reverses the benefit (37). Similarly, epidemiological studies show that physically active women have higher bone mineral content than less active women (38,39), but bone mineral loss returns to baseline if exercise is stopped (40).

How do we prescribe exercise in a way that results in lifestyle changes? The central question is how to sustain benefit in large groups of sedentary persons when the exercise must be continued indefinitely for most of their lives. Components of effective exercise programs are reviewed by King (41). She divides the components into personal characteristics, program characteristics, and environmental factors. Interventions must be structured to improve the exercise prescription by understanding these factors. The setting and supervision of the exercise prescription seems important. When older adults are randomized to a home exercise program with or without supervision, new cardiovascular diagnoses were made in 2.5% of the supervised group, 2% of the nonsupervised group, and 13% of the control group after 2 years (42). Improvements in muscle strength with exercise extended into the sixth decade (43) and in institutionalized adults (44).

Our knowledge of nutritional requirements in older adults is limited. Dietary prescriptions previously relied on the Recommended Daily Allowances (RDA) of the National Academy of Sciences (45), but the accuracy was limited by grouping all adults aged 51 years and older. A revision to Dietary Reference Intakes may improve this limitation by dividing older adults into two age groups (51–70 years and 70+ years; 46). Amaranos et al. (47) address the limitations of instruments in measuring the effect of nutrition on health-related quality of life. Differences occur between cross-sectional and longitudinal studies. For example, the intake of cholesterol over time may reflect cultural change rather than aging change. Energy and macronutrient intakes decrease with age in both longitudinal and cross-sectional studies, contributing to a decrease in micronutrient intakes. In the face of this decline, it is difficult to judge the adequacy of intakes with aging.

On average, persons over the age of 70 years consume one third fewer calories compared to younger persons (48). Of community-dwelling elderly persons, 16% to 18% consume fewer than 1000 Kcal daily (49). Undernutrition seems to be related to functional decline (50). The decline in energy intake that accompanies aging has been the subject of intensive investigation (51). Morley (52) reviews the decline in food intakes from a physiological perspective. The relationship between hedonic qualities of food, gastrointestinal and central satiation drives, and hormonal relationships may explain this observed difference. The importance of understanding this relationship lies in the hope that pharmacological (53) or dietary interventions (54) may reverse this anorexia of aging.

The relationship between exercise and nutrition is clouded by findings that seem contrary to common sense. When 34 healthy elderly persons who completed a daily 19-mile walk of 4 days were compared to 175 younger healthy blood donors using two different nutritional risk instruments, undernutrition was diagnosed in 6% to 21% of elderly persons (55). Improved muscle strength in 90-year-old, institutionalized persons has been demonstrated in the face of evidence of malnutrition in some subjects. Forty percent of these subjects were between 72% and 88% of ideal body weight and did not meet RDA for micronutrients (60). Such data suggest that malnutrition either conveys no functional limitation or that the parameters used to diagnose malnutrition are inadequate.

The results of nutritional supplementation have been disappointing (56). Fiatarone randomized 100 long-term care residents, whose mean age was 87 years, to high-intensity exercise training (57). The groups were further randomized to receive 240 ml of nutritional supplementation or no supplementation. While muscle strength increased by 113% in the training group, the addition of a nutritional supplement did not improve outcome. A previous study in 11 long-term care residents involving the addition of 560 Kcal of a nutritional supplement did not increase muscle strength, but computed tomography of the thigh showed more gain in muscle mass in the supplemented group (58). The nutritional intervention may have been too small or the observation period too short to detect a difference in outcome.

What do we know? The reviews in Special Issue II highlight our current knowledge. Data clearly indicate that high-intensity resistance exercise can improve both muscle strength and muscle mass, even in very old persons. This gain in muscle strength may improve walking distance, stair climbing, and balance, thus reducing falls. However, adding nutritional supplements to the exercise regimen does not appear to improve strength, but may increase muscle mass slightly more than in nonsupplemented controls. The sarcopenia that accompanies aging is most likely due to disuse, rather than to abnormalities in nutrition.

Nutritional intake declines with aging. This seems to be primarily due to a decrease in muscle mass and resting energy expenditure. However, multiple physiological changes associated with aging suggest that this decline in energy intake also may be due to anorexia of aging. Little is known about measuring the effect of exercise and diet prescriptions on health-related quality of life.

Special Issue II of The Journals of Gerontology greatly advances our understanding of the age-related changes in physical activity, nutrition, and aging, and their effect on health-related quality of life. Our understanding of these links is critical to providing prescriptive care of the aging population. Both the current state of knowledge and the
gaps indicating areas for future research are addressed. Un-tying this Gordian knot will be facilitated by these reviews.

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