

## Evidence Regarding the Benefits of Physical Exercise

**J**UST OVER A QUARTER OF A century ago, thought leaders in the aging research arena recognized that the promotion of increased physical activity was a relatively unexplored but potentially powerful avenue to promoting healthy aging.<sup>1,2</sup> Since that mandate to examine the role of exercise in preventive gerontology was issued, and during the past decade in particular, a growing body of evidence has accumulated that has given legs to the hypothesis that the promotion of physical activity may be the most effective prescription that physicians can dispense for the purposes of promoting successful aging. Today it is recognized that virtually all of the diseases and conditions that lead to physical disability in older adults have as part of their etiology a component of personal lifestyle choices (eg, physical inactivity) in addition to biological aging and environmental exposure. Improving our understanding of the relative contributions of these factors to aging-related loss of independence and the subsequent development and implementation of prevention and treatment approaches is the essence of the present research mission for scientists working in the areas of geriatric medicine and gerontology.

*See also pages 170, 179, 186, and 194*

It is also now well established that higher quantities of physical activity have beneficial effects on numerous age-related conditions such as osteoarthritis, falls and hip fracture, cardiovascular disease, respiratory diseases, cancer, diabetes mellitus, osteoporosis, low fitness and obesity, and decreased functional capacity, all conditions that greatly increase the risk of reduced independence in late life.<sup>3</sup> Regular physical activity has also been associated with greater longev-

ity as well as reduced risk of physical disability and dependence, the most important health outcome, even more than death, for most older people. In this issue of the *Archives*, 4 new articles move the scientific enterprise in this area further along the path toward the goal of understanding the full range of important aging-related outcomes for which exercise has a clinically relevant impact. Two of these studies<sup>4,5</sup> evaluated the relationship between physical exercise and decline in cognitive function, a major contributor to loss of independence and related institutionalization in elderly individuals. Optimism in this area, especially cognition, is sorely needed owing to the failure of promising interventions aimed at preventing cognitive decline and dementia in the recent past.<sup>6,7</sup>

In the study by Etgen et al,<sup>4</sup> physical activity was independently associated with reduced risk for cognitive function decline in a group of self-selected volunteers residing in a single community in the Bavarian region of Germany. Cognitive function was assessed using a brief measure of global cognitive function, and the results essentially confirm similar epidemiologic findings by other investigators while leaving open the question of whether these results should be generalized beyond the study population. These results essentially add to the existing data supporting the need for well-designed clinical trials testing the impact of physical activity on clinically meaningful cognitive outcomes. In another article, Liu-Ambrose et al<sup>5</sup> describe the use of a broader battery of neuropsychological tests to evaluate the impact of a 1-year weekly or twice-weekly resistance training program on cognitive decline in 155 Canadian women aged 65 to 75 years. The authors show that resistance training reduced the risk for decline in measures of executive function. Individuals who had high ad-

herence to the resistance training program in this study had better Stroop test scores, a measure of selective attention and conflict resolution. Interestingly, although lower brain volume is typically associated with poorer cognitive function, the intervention that had a positive impact on executive function showed that the total brain volume as measured by magnetic resonance imaging was actually lower after 12 months of exercise in the resistance training group. The intervention did not, however, have an impact on other domains of cognition, such as working memory, nor did the sample size, duration, and study population help in determining the impact of the intervention on dementia incidence.

In the other 2 articles, the authors examined a composite measure of healthy aging<sup>8</sup> and a measure of cost-effectiveness,<sup>9</sup> both increasingly important outcomes related to debates on best practices for maintaining the health and independence of aging populations in developed countries. In the article by Sun et al,<sup>8</sup> data from the Nurses' Health Study demonstrate that modest levels of physical exercise during middle age increased the probability of successful aging beyond 70 years, defined by low burden of comorbidity, no mental health disease, and preserved physical and cognitive function. The study by Kemmler et al<sup>9</sup> again shows the health benefits of physical exercise on risk factors for disability in older adults but does not establish definitive evidence for the cost-effectiveness of these interventions in this population. In summary, the findings of all 4 of these articles fit into the larger and optimistic view of gerontologists regarding the power of higher levels of physical activity to aid in the prevention of late-life disability owing to either cognitive impairment or physical impairment, separately or together.

The impact of unsuccessful aging is readily apparent to both clinicians and nonclinicians. Physical inactivity is one of the strongest predictors of such unsuccessful aging for older adults and is perhaps the root cause of many unnecessary and premature admissions to long-term care. Clinical trials targeting the diseases and conditions that populate the pathway to disability for older people have demonstrated the efficacy of physical activity to prevent or delay complications. However, while scientific value of these studies cannot be disputed, whether the results can or should be translated into recommendations for preventing disability progression in the broader community of older adults typically seeking care in the outpatient setting is the burning question that remains. This is because most of these studies and other published studies have enrolled younger and generally healthier older people.

A few major issues remain from the original mandate to explore the efficacy of exercise in the 1980s. Of these, the primary issue is the lack of randomized controlled trials (RCTs) of adequate scope examining the feasibility, safety, and impact of exercise over a long duration (>2 years) in persons who are at highest risk for loss of independence on relevant geriatric outcomes, such as onset of major disability. To address this important clinical and public health question, the Lifestyle Interventions and Independence for Elders (LIFE) study, a phase 3 multicenter RCT of physical activity to prevent major mobility disability, will start recruiting early next year. A total of 1600 older sedentary persons who are at risk for major mobility disability will be ran-

domized to a physical activity or to a health education program and followed for up to approximately 4 years to assess the effects on major mobility disability, defined as inability to walk 400 m, cognition, injurious falls, and other health outcomes. The LIFE study expands on the promising results of a pilot study<sup>10</sup> that found the rate of onset of mobility disability was lower among a group of older adults who engaged in a structured exercise program for a year compared with a group of seniors who took part in a health education program for a year. The LIFE study will provide definitive evidence regarding whether physical activity is effective and practical for preventing major mobility disability. These results will have crucial implications for public health prevention in a rapidly aging society and will fill an important gap in knowledge for practicing evidence-based geriatric medicine. The study will also yield valuable information concerning the efficacy and effectiveness of physical activity across a broad spectrum of important health outcomes. The study will have an impact on both clinical practice and public health policy and will, therefore, benefit individuals and society.

Along with the expected results of the LIFE study, the 4 new studies in this issue of the *Archives*, and the evidence from clinical studies over the past 25 years, we have never had greater reason to be hopeful regarding the potential for exercise to become a proven and generalizable strategy for promoting successful aging in the expanding population of older adults.

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