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Physical activity and cognitive health

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Abstract

Background: The industrialized nations are experiencing a demographic revolution caused by the continuing increase in longevity and the rapid rise in the percentage of the population older than 65 years. Interventions that promote healthy aging will continue to gain significance as efforts to delay disability and loss of function intensify.

Methods: Because physical activity has been implicated in promoting healthy aging, here we review a large body of research that examines physical activity and cognitive health. Specifically, we focus on the associations of physical activity with cognitive function and dementia, including prevention, delay, or slowing down of disease progression. Thus, we have prepared a descriptive review of the literature including various types of publications, prospective cohort, case-control, clinical trial, and meta-analysis articles published since 1999 in peer-reviewed journals.

Results: On the basis of currently available data, we conclude that the relative risk of cognitive decline with aging might diminish in individuals who are physically active; however, this has not been definitively demonstrated thus far.

Conclusions: Further research is needed to determine conclusively the effects of physical activity on cognitive function and dementia and to elucidate the basis for this linkage.

Keywords: Cognitive function; Cognitive health; Cognitive decline; Dementia; Alzheimer's disease; Physical activity(ies); Exercise; Fitness

1. Introduction

In the United States, we are experiencing nothing short of a demographic revolution. Two segments of the population are growing exponentially, those age 85 years and older or the "oldest-old" and those born between 1946 and 1964, the baby boomers [1,2]. It is estimated that between 2000 and 2030 those age 65 years and older will double, and that by 2050 there will be five times the number of those age 85 years and older compared with the year 2000 [3]. In addition, not only are people living longer, disability rates are declining as well [4]. Given the demographic shift that we in the U.S. and other industrialized countries are experiencing, the challenge of the future will be to continue to support and augment this trend toward lower disability rates, thereby enabling individuals the optimal opportunities to age successfully. Without vigorous commitment to these goals, which are certainly within our grasp provided there are sufficient resources dedicated to accomplishing them, our healthcare and economic systems will be overwhelmed.

When considering a prescription for healthy, successful aging, the vital role of physical activity is immediately apparent, and this role is increasingly supported by data from a variety of epidemiologic, health outcomes, and experimental studies. Physical activity not only lowers the risk of mortality [5] but is associated with decreased morbidity from many chronic diseases like cardiovascular disease, stroke, coronary heart disease, cancer [6,7], depression [8],

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and diabetes [9–11]. Research has shown a positive association between physical activity and both cognitive function [12,13] and physical function [14].

In this article we review a large body of research that examines physical activity and cognitive health. Although cognitive health can be defined in many different ways, for the purposes of this article we use a broad definition that includes improvement, maintenance, or minimal decline of cognitive function and absence, delay of onset, or slowing the progression of dementia. Specifically, we focus on the associations of physical activity with (or effects of physical activity on) cognitive function and dementia. Our definition of physical activity is also broad and includes exercise as well as usual daily activities, such as household chores and walking, and physical leisure activities, such as playing golf or tennis. To be as comprehensive as possible, we have not performed a meta-analysis, which would considerably limit the type and number of studies that we could include for review and analysis here. Instead, we have prepared a descriptive review of the literature including various types of publications, prospective cohort, case-control, clinical trial, and meta-analysis articles published recently (1999 or later) in peer-reviewed journals (Tables 1 and 2 for a brief tabulation and summary of the studies examined here). Through this systematic descriptive review, we examine the current state of knowledge about any putative beneficial effects of physical activity on both cognitive function and dementia. Key questions that we have used to structure our examination of the current literature are the following:

1. Does engagement in physical activity result in improvement or maintenance of cognitive function?
2. Does engagement in physical activity result in a lower risk for dementia?

2. Cognitive function

There is a growing body of research, predominantly prospective cohort studies, that has examined the connections between cognitive function and physical activity (Table 1). Results have overwhelmingly shown an association between the two.

2.1. Evidence from prospective cohort studies

Two studies of women only show strong associations between physical activity and cognitive function [13,15]. Both include walking, have large sample sizes, controlled for typical potential confounding factors, and have long follow-up periods.

With data from the Nurses' Health Study, Weuve et al [13] included 18,766 women ages 70 to 81 years to ascertain whether greater participation in leisure-time physical activities, as measured by energy expenditure (mean of biennial reports during 8 to 15 years), resulted in better cognitive function, as measured by a global cognitive function score created by combining scores from six different tests. Analyses controlled for potential confounders (ie, age, education). Results indicated that cognitive scores were higher for women who expended more energy ($P < .001$ for trend). Furthermore, easy walking at a pace of about 21 to 30 minutes per mile for at least 1 and ½ hours per week resulted in scores that were at least 0.06 units higher than those of subjects walking less than 38 minutes per week ($P = .007$ for trend), indicating that exercise might not need to be vigorous to have an effect. Although 0.06 might not appear to be much of a difference, it approximates the difference in cognitive functioning of women differing by about 1½ years in age [13].

In another study of women only, Yaffe et al [15] followed 5925 women age 65 years and older for 6 to 8 years to determine whether walking and kilocalories (or energy) used during physical activity (assessed at baseline) were associated with less cognitive decline, as measured by the modified Mini-Mental State Examination (3MS). The women, part of the Study of Osteoporotic Fractures, were all cognitively unimpaired at baseline. After adjusting for potential confounders such as age, education, and functional limitations, at follow-up, women in the highest quartile of blocks walked per week (median, 175; range, 113 to 672), compared with those in the lowest quartile (median, 7; range, 0 to 22), were 34% (odds ratio, 0.66; 95% confidence interval, 0.54–0.82) less likely to experience cognitive decline, defined as a score on the 3MS ≥3 points lower than at baseline. One block was estimated to be about 160 meters, so women in the highest quartile walked approximately 17.4 miles per week. Those in the highest quartile for kilocalories expended, compared with those in the lowest quartile, were 26% (odds ratio, 0.74; 95% confidence interval, 0.60–0.90) less likely to have cognitive decline at follow-up [15].

Several studies have examined the relationship between physical activity and cognitive function for men only. Both studies have small sample sizes, which might explain the weaker links between physical activity and cognitive function that their results indicate.

In one such prospective cohort study, 295 men, part of the Finland, Italy, and the Netherlands Elderly (FINE) Study, age 70 years and older, were assessed at baseline and 10 years later for both physical activity, such as walking, bicycling, gardening, and chores, and cognitive function, by using the Mini-Mental State Examination (MMSE). A cutoff point of more than 18 on the MMSE, which the authors note as "not severely cognitively impaired," was used as part of inclusion criteria along with an absence of stroke, diabetes, cancer, and heart attack. Physical activity data were not available from Finnish subjects at the 10-year follow-up, leaving 243 subjects for those analyses. After adjusting for potential confounders such as age and education, no measures of duration or intensity of physical activity at baseline were associated with differences in baseline cognitive functioning. However, results indicated linear