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Feature Article

Effects of Tai Chi on cognitive function in community-dwelling older adults: A review

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ABSTRACT

As the population of the United States ages, activities to maintain or improve cognitive function will become increasingly important to preserve functional ability, independence and health-related quality of life. This article is a review of recent research on Tai Chi and cognitive function in community-dwelling older adults. Of the 12 studies reviewed, 10 reported improvement in measures of executive function, language, learning, and/or memory. Several design features make comparisons across studies challenging. As a moderate-intensity, low-impact form of exercise, Tai Chi is appropriate for older adults and seems to offer positive cognitive benefits. Recommendations for future research are provided.

Introduction

The population of the United States is aging, and by the year 2030 the number of Americans older than 65 will almost double.[1] Although older adults exhibit wide variability in the aging process, age-related changes in cognitive function are common, including declines in executive function, information processing speed, and attention.[2] Changes in cognitive function can be viewed on a continuum, with age-related cognitive changes on one end of the continuum, mild cognitive impairment as a mid-stage, and dementia as the most severe end-point on the continuum of cognitive decline. Age-related cognitive changes cause minimal to no interference in instrumental activities of daily living (IADL) and independence,[3] while mild cognitive impairment causes minor but noticeable changes and abnormal findings in one or more cognitive domains.[4] The final stage of the cognitive decline continuum is dementia, characterized by a broad range of severe cognitive deficits, behavioral changes and functional decline, leading to dependence.[5] Cognitive impairment places older adults at risk for progression to dementia,[6] and strategies are needed to maintain or enhance cognitive function, and prevent cognitive decline. One promising intervention to enhance cognitive function in older adults is through exercise.

Exercise and cognitive function

The health benefits of exercise in older adults are well-documented.[7,8] Exercise is important for physical and cognitive function, and is a strategy to maintain or increase independence in the growing population of older adults in the United States. In spite of this, adults aged 65 and older are the least active group of Americans,[9,10] and can benefit from regular physical exercise. Exercise is classified by the energy cost to the individual using *metabolic equivalents of task* (METs).[11] For example, low-intensity activities such as cooking or dusting have a MET value <3, moderate-intensity activities such as brisk walking or water aerobics are 3–6 METs, and high-intensity activities such as jogging are greater than 6 METs.[11]

Aerobic exercise in older adults has been shown to improve task-related cognitive function, brain connectivity (measured by functional magnetic resonance imaging), and regional brain volume.[12] The biological mechanisms of action of exercise impacting cognitive function are thought to include changes at the molecular, vascular, synaptic and neural levels.[13] Mechanisms include neurogenesis and synaptogenesis and involve substances such as lactate, enzymes, proteins, cytokines and glucose uptake. For example, at the vascular level, exercise promotes angiogenesis, while learning motor skills promotes synaptic connectivity. Neuronal growth and maintenance is impacted by substances such as hormones, growth actors, and neurotransmitters. Neural functions such as neuroplasticity, neurotransmitter release, and cell growth and differentiation are influenced by several factors

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including brain-derived neurotrophic factor, insulin-like growth factor-1, neurotransmitters and intracellular pathways.[12,13] Although precise causal mechanisms for each of the neurocognitive changes have not been determined, growing evidence supports a positive association between aerobic exercise and cognitive function and suggests that physical exercise maintains or improves cognitive function. However, the type of exercise, the exercise dose, and methods to target specific cognitive functions are still under investigation.[12,13]

An additional area of cognitive aging research is the concept of cognitive enrichment as an intervention to maintain or improve cognitive function in older adults.[14] Cognitive enrichment activities include deliberate practice of mentally stimulating, novel, and challenging cognitive skills focusing on areas such as attention, memory, and other executive-control functions. One potential strategy to combat cognitive decline is through exercise of both the mind and the body.[15,16] One type of mind–body exercise is Tai Chi, a centuries-old form of martial arts combining memorized, sequenced physical postures and movement with imagery, visualization, relaxation, and meditation. Tai Chi is practiced using slow, balanced movements, and has low impact on joints, making it an appropriate activity for older adults.[16–18]

Tai Chi as exercise

As a form of physical exercise, Tai Chi has a MET value of 3–6 and is a moderate-intensity activity,[19,20] comparable to brisk walking.[21,22] Tai Chi can also be considered a conditioning activity with cardiovascular benefits.[16,20–22] In addition to being a form of physical exercise, Tai Chi also exercises the mind through memorization of sequences of postures, concentration, and meditation.[17] Through the combined physical and mind exercise components, possible pathways affecting cognitive function include the benefits of aerobic exercise, cognitive enrichment, and secondary effects of improved mood, sleep promotion, and stress reduction.[23–28]

As the population of the United States and the world ages, promotion of a form of exercise that benefits both the body and the mind may help maintain or improve cognitive function, reduce the rate of cognitive decline, preserve IADL, and ultimately improve quality of life. This paper reviews current research on the effect of Tai Chi on cognitive function in community-dwelling older adults, makes recommendations for future research, and provides suggestions for promoting Tai Chi as a beneficial exercise supporting cognitive function.

Methods

An electronic search was conducted in CINAHL, PubMed, and Web of Science using controlled vocabulary functions and keywords "Tai Chi" and "cognition." The search was restricted to adults aged 55 years or older, articles written in the English language, and articles published between June 2003–June 2013, yielding a total of 46 articles. One additional article was found via a hand search of references from published articles. Abstracts and full-text articles were reviewed for measures of executive function, attention, memory, learning, and verbal fluency. Studies reporting psychological measures such as sleep, energy, depression, stress, or quality of life, but not cognitive measures listed above were excluded. The purpose of this review was to explore the effect of Tai Chi on cognitive function in community-dwelling older adults; therefore, studies which included adults with significant dementia diagnoses (Mini-Mental State Exam [MMSE] score < 24[29] or Clinical Dementia Rating [CDR] scale score > 1[30]) were excluded. Data from studies meeting the inclusion criteria were extracted including: country of study, study design, Tai Chi style and exercise dose, comparison group, cognitive domains measured, and findings.

Results

Study designs and populations

A total of 12 articles were included in this review examining the effects of Tai Chi on cognitive function in community-dwelling older adults (Fig. 1). Study designs included randomized controlled trials (RCT) ($n = 6$),[17,31–35] quasi-experimental ($n = 3$),[36–38] and cross-sectional ($n = 3$)[39–41] studies (Table 1). The cross-sectional studies compared Tai Chi to other forms of exercise such as walking, stretching/toning, and/or no exercise.

The studies reviewed were conducted in Asia, North America, and South America and included community-dwelling adults ranging in age from 55 to 90, with a majority of female participants (average = 71%). Nine of the 12 studies listed exclusion criteria of participants with unstable conditions, substance abuse, diagnoses for which physical activity would be contraindicated, or active

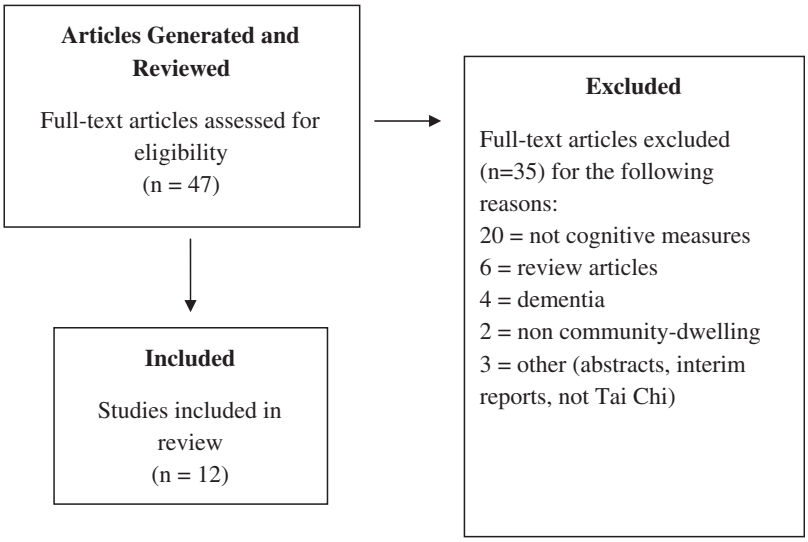

Fig. 1. Study selection flow diagram showing reasons for exclusion.