The Effects of Non-Aerobic Exercise on Cognitive Function in Older Adults

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INTRODUCTION

Cognitive decline among older adults is a major health care concern. Over 24 million people currently live with dementia worldwide, causing it to be the leading cause of disability in people over 60, with annual costs of 100 billion dollars in the U.S.A. Despite a lack of evidence supporting the use of pharmacological treatments for preventing or slowing the progression of Alzheimer's disease (AD) (the most common form of dementia), there are three drugs that are commonly prescribed for mild to moderate AD.

There is currently no known cure for dementia. However, since there is a strong association between the increase in physical inactivity and the emergence of modern chronic diseases, physical activity has been widely promoted as a strategy for healthy aging. Physical activity provides clear benefits for cognition among older adults and lowers the risk of cognitive impairment and dementia. It reduces brain tissue loss, increases brain volume, and protects and enhances CNS integrity. It also promotes brain vascularization, neurogenesis, functional changes in neuronal structure, and neuronal resistance to injury. Finally, it enhances several neurotransmitter systems in the brain, including dopamine, serotonin, and acetylcholine.

It is also believed that exercise activates molecular and cellular cascades that support and maintain brain plasticity. For example, exercise-induced increases of brain-derived neurotrophic factor (BDNF) and insulin-like growth factor-1 (IGF-1) are believed to play important roles in mediating the effects of exercise on brain health and performance, while exercise-induced reductions in serum homocysteine may play a role in reducing cognitive impairment.

Most studies to date have focused on aerobic-based exercise interventions, but it has been suggested that non-aerobic exercise may also benefit cognition. While non-aerobic exercise may not provide an easy fix to enhance brain health and cognition across the life span, there is evidence to suggest that it may be an effective means available to improve mental and physical health, without the side effects of many pharmacological treatments. If found to have a positive effect on cognition, non-aerobic exercise based interventions may provide clinicians with a variety of alternative treatment options. Thus, a systemic review investigating the effects of non-aerobic exercise on cognitive function in older adults is warranted.

OBJECTIVES

Primary: to determine whether non-aerobic exercise training is beneficial for cognitive function in older adults.

Secondary: to determine whether different types and/or parameters (i.e. frequency, intensity, & duration) of non-aerobic exercise training have different effects on cognitive function.

METHODS

Literature Search:

Articles were searched in MEDLINE, EMBASE, and CINAHL electronic databases as of July 2012. The literature search was limited to older adults and the English language. A hand search was also performed and some authors were contacted to obtain data not reported.

Study Selection:

Inclusion Criteria	Exclusion Criteria
1) Older Adults (mean age > 65 y.o.)	1) An aerobic component was incorporated into the non-aerobic intervention
2) A non-aerobic exercise group or a multimodal intervention of which at least one component included non-aerobic exercise to a no exercise or sham exercise (i.e. breathing exercises or stretching) control group	2) The MMSE is the only outcome measure used to assess cognitive function
3) An outcome measure of cognitive function is examined	3) Cognitive function was assessed using subjective tests only
4) RCT Design	4) A behavioral outcome measure of cognitive function was lacking
5) English Language	5) Study examined CVA population

A three phase approach was used to screen articles in order to determine their relevance for this review. Articles were screened first by title and abstract and then by full text review.

Quality Assessment of Studies:

Methodological quality and risk of bias for the RCTs were assessed using the PEDro rating scale. The inclusion of each article in this review was not affected by their PEDro score.

Data Extraction & Synthesis:

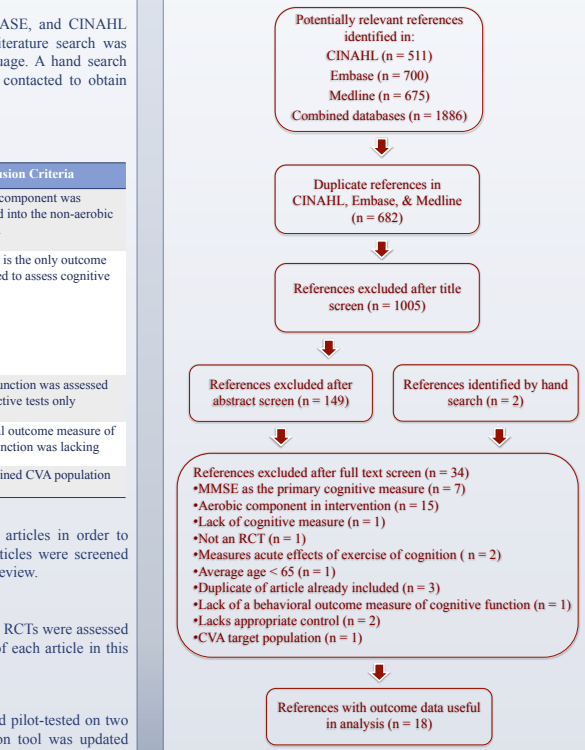
A draft data extraction tool was developed and pilot-tested on two studies. Following pilot testing, the extraction tool was updated and used to extract data from all articles including the setting, participants, intervention type, intervention length, time of assessment, outcome measures, and a summary of results.

Data Analysis:

It was found that interventions, populations, and outcome measures of cognitive function amongst studies were highly heterogeneous and, therefore, data obtained was not combined for meta-analysis. Instead, study results were broadly categorized first by population characteristics (normal cognition vs. impaired cognition), and then by intervention (resistance vs. multi-modal vs. Tai Chi vs. yoga vs. PT intervention vs. dance movement therapy vs. music-based exercise). Vote counting was then performed to identify the number of studies supporting or refuting the benefits of non-aerobic exercise on cognitive function in older adults.

RESULTS

Literature Search Flow Chart



Summary of the Effects of Non-aerobic Exercise on Cognitive Function in Older Adults

	Older Adults with Normal Cognition		Older Adults with Impaired Cognition	
Non-aerobic Exercise Intervention	Positive Effect	No Effect	Positive Effect	No Effect
Resistance Training	3	3	1	-
Multi-modal Non-aerobic Exercises	2	1	-	-
Tai Chi	2	1	1	-
Yoga	-	1	-	-
Physical Therapy	-	-	-	1
Music-based Exercises	-	-	1	-
Dance Movement Therapy	-	-	1	-

DISCUSSION

Although it is unclear why there is so much variability, there are a number of methodological and intervention-specific differences that may be partially responsible for the mixed results. For example, sample sizes ranged from 15 subjects to 329 subjects and intervention duration ranged from 8 to 52 weeks. Exercise sessions ranged from 1 day/week to 7 days/week and lasted anywhere from 30 to 90 minutes. Some interventions were individual based, while others were group based.

It has also been suggested that a ceiling affect may exist for older adults with normal cognitive function. Since they are functionally at a higher cognitive level to begin with, they may be less likely to show improvements on objective measures of cognitive function, whereas older adults with impaired cognition may posses higher potential for change.

The potential intrinsic mechanisms responsible for the positive changes in cognitive function also remain unclear. Although BDNF, IGF-1, and homocysteine have been identified in animal models as key factors in mediating the effects of exercise on brain health and performance, the extent to which these mechanisms account for benefits of exercise on executive function in humans is a topic that deserves future consideration.

Despite mixed results, there were some trends in the exercise prescription parameters that were observed in the resistance training (RT), multi-modal, and Tai Chi intervention groups. For example, in studies investigating RT it was found that longer durations of exercise were associated with positive results, and in studies investigating multi-modal interventions and Tai Chi it was found that longer intervention durations were associated with positive results.

CONCLUSION

Novel findings from this review suggest that non-aerobic exercise interventions may have a positive effect on cognitive function in older adults. Future research is needed to examine specific cognitive domains, to determine optimal exercise prescription parameters, and to integrate animal and human models investigating the effects of exercise on brain structure and function.

CLINICAL RECOMMENDATIONS

Non-aerobic exercise may be an effective alternative treatment to improve cognitive function in older adults

- RT exercise duration should be a minimum of 60 minutes
- Multi-modal intervention lengths should be a minimum of 24 weeks
- Tai Chi intervention lengths should be a minimum of 20 weeks

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