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Research

Physical exercise improves strength, balance, mobility, and endurance in people with cognitive impairment and dementia: a systematic review

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KEY WORDS

Dementia
Exercise
Mild cognitive impairment
Physical fitness
Quality of life

ABSTRACT

Question: Does physical exercise training improve physical function and quality of life in people with cognitive impairment and dementia? Which training protocols improve physical function and quality of life? How do cognitive impairment and other patient characteristics influence the outcomes of exercise training? **Design**: Systematic review with meta-analysis of randomised trials. **Participants**: People with mild cognitive impairment or dementia as the primary diagnosis. **Intervention**: Physical exercise. **Outcome measures**: Strength, flexibility, gait, balance, mobility, walking endurance, dual-task ability, activities of daily living, quality of life, and falls. **Results**: Forty-three clinical trials (n = 3988) were included. According to the Grades of Recommendation, Assessment, Development and Evaluation (GRADE) system, the meta-analyses revealed strong evidence in support of using supervised exercise training to improve the results of 30-second sit-to-stand test (MD 2.1 repetitions, 95% CI 0.3 to 3.9), step length (MD 5 cm, 95% CI 2 to 8), Berg Balance Scale (MD 3.6 points, 95% CI 0.3 to 7.0), functional reach (3.9 cm, 95% CI 2.2 to 5.5), Timed Up and Go test (–1 second, 95% CI –2 to 0), walking speed (0.13 m/s, 95% CI 0.03 to 0.24), and 6-minute walk test (50 m, 95% CI 18 to 81) in individuals with mild cognitive impairment or dementia. Weak evidence supported the use of exercise in improving flexibility and Barthel Index performance. Weak evidence suggested that non-specific exercise did not improve dual-tasking ability or activity level. Strong evidence indicated that exercise did not improve quality of life in this population. The effect of exercise on falls remained inconclusive. Poorer physical function was a determinant of better response to exercise training, but cognitive performance did not have an impact. **Conclusion**: People with various levels of cognitive impairment can benefit from supervised multi-modal exercise for about 60 minutes a day, 2 to 3 days a week to improve physical function. **[Lam FMH , Huang MZ, Liao LR, Chung RCK, Kwok TCY, Pang MYC (2018) Physical exercise improves strength, balance, mobility, and endurance in people with cognitive impairment and dementia: a systematic review. *Journal of Physiotherapy* XX: XX–XX]**

Introduction

Dementia is an increasingly important public health concern.[1] It is estimated that by 2050 the number of people with dementia will reach 131.5 million worldwide.[1] Apart from deficits in cognition and behaviour,[2] deficits in balance, gait, and movement coordination are also found in people with mild dementia and mild cognitive impairment.[3,4] People with dementia are less likely to participate in regular physical exercise when compared with their counterparts with normal cognition.[5] Physical inactivity may give rise to further decline in physical functioning.[6] These factors may partially explain the higher risk of falls and hip fractures in people with dementia compared with their peers without dementia.[7,8]

Exercise training improves cognitive[9] and physical[10–12] functions in healthy older adults and is feasible for people with cognitive impairment.[13,14] Previous reviews have attempted to examine the effects of exercise on physical function in individuals with dementia, but the heterogeneous participant groups and different outcome measures that were used made conducting and interpreting meta-analyses difficult.[13–21] Meta-analyses were conducted in seven reviews to quantify the amount of improvement gained after exercise training.[14–16,20,22–24] However, non-randomised trials were included in some reviews, which compromised the quality of evidence.[16,23] Other reviews focused on one type of exercise training, one patient subgroup,[14,24] or few domains of physical function.[15,20,22,23] None of the existing systematic reviews conducted sensitivity analysis to specifically examine the effect of subject characteristics (eg, cognitive impairment level) on training efficacy – probably due to the small number of trials included in the reviews. Thus, the existing reviews have not provided a comprehensive understanding of the effect of physical exercise on physical function in people with cognitive impairment. Moreover, a good number of new exercise trials on people with mild cognitive impairment or dementia have been

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published in the last few years, and it is thus timely to conduct a systematic review on this topic to address the knowledge gaps identified above.

Therefore, the research questions for this systematic review were:

1. Does physical exercise training improve physical function and quality of life in people with cognitive impairment and dementia?
2. Which training protocols improve physical function and quality of life?
3. How do cognitive impairment and other patient characteristics influence the outcomes of exercise training?

Method

Identification and selection of trials

MEDLINE, CINAHL, PubMed, PsycINFO, and The Cochrane Library Databases of Systematic Reviews were searched electronically with search terms related to *cognitive impairment*, *dementia*, *exercise*, *rehabilitation*, and *randomised trial*. An example of the search strategy for one database is provided in Appendix 1 on the eAddenda. Two independent researchers screened the search results for publications about the effect of physical exercise in people with mild cognitive impairment or dementia. Potentially eligible trials were selected for further assessment of eligibility. Relevant reviews and the reference lists of all selected articles were then examined to look for potentially eligible articles. Finally, a forward search was performed on all articles selected in the above process using the Science Citation Index. The last search was performed in May 2016. The inclusion criteria for trials to be included in the review are presented in Box 1. However, trials were excluded if they were published only in conference proceedings or books. Disagreements about eligibility were resolved by the principal researcher.

Assessment of characteristics of trials

Quality

The PEDro score, obtained by searching the PEDro website (www.pedro.org.au), was used to assess the methodological quality of each selected trial. For trials that were not originally listed on the PEDro website, the PEDro team was contacted via email to request them to examine these trials and provide the PEDro scores. Hence, the PEDro scores of all trials included in this review were based on the information obtained from the PEDro website, where studies are rated in duplicate by trained raters.

Participants

To describe the participants in each trial, the following information was extracted from the published report: sample size, mean age, gender ratio, location of participants (community, institution), diagnosis, and cognitive impairment test scores (eg, Mini Mental State Examination).

Intervention

The details extracted from each included study about the exercise intervention were: frequency, intensity, duration and type of physical exercise.

Outcome measures

Outcome data were extracted from each included study if they pertained to any domain of physical function or quality of life.

Corresponding authors were contacted via email in case information needed for the meta-analysis could not be acquired from the original articles. When there were discrepancies between the two researchers responsible for data extraction, the information extracted was confirmed by the principal investigator.

Data analysis

Meta-analysis was performed for a given outcome only if at least three similar trials used the same outcome measure. Meta-analyses were conducted using RevMan software.[a] Random-effect models were used in all meta-analyses, given the large variation in study design across trials (eg, participants' characteristics, exercise protocols).[25] The existence of publication bias was examined using Egger's regression asymmetry test using Comprehensive Meta-analysis software.[b] A p-value of <0.1 (two-tailed test)

Box 1. Inclusion criteria.

Design
- Randomised trial
- English language

Participants
- People with a primary diagnosis of mild cognitive impairment or dementia

Intervention
- Physical exercise

Outcome measures
- Measures of physical function
- Measures of quality of life

Comparisons
- Exercise versus no intervention/placebo
- Exercise plus other intervention versus other intervention only

Box 2. Criteria used to downgrade ratings in the Grades of Recommendation, Assessment, Development and Evaluation (GRADE) system. See the Methods section for further details.

Risk of bias
- for outcomes where meta-analysis was possible, fewer than half of the trials included in the primary analysis had a PEDro score of ≥ 6
- for outcomes where meta-analysis was not possible, fewer than half of the trials included for outcome evaluation had a PEDro score of ≥ 6

Inconsistency
- for outcomes where meta-analysis was possible, $I^2 \geq 50\%$ in the primary meta-analysis and the meta-analysis that involved only trials with high methodological quality
- for outcomes where meta-analysis was not possible, mixed results were reported

Indirectness
- the participants, intervention, comparator intervention, outcome measure or study design did not match between the included studies and the eligibility criteria for this review

Imprecision
- insufficient studies for meta-analysis
- the number of subjects included in the primary meta-analysis was less than that required by a conventional sample size calculation for a single trial
- the 95% CI spanned zero

Publication bias
- $p < 0.1$ on the two-tailed Egger's regression asymmetry test

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