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Original Study

Efficacy of Physical Exercise in Preventing Falls in Older Adults With Cognitive Impairment: A Systematic Review and Meta-Analysis

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A B S T R A C T

Objective: Numerous studies have reported the prevention of falls through exercise among cognitively healthy older people. This study aimed to determine whether the current evidence supports that physical exercise is also efficacious in preventing falls in older adults with cognitive impairment.
Methods: Two independent reviewers searched MEDLINE; EMBASE; PsycINFO; the Cumulative Index to Nursing & Allied Health Literature; the Cochrane Central Register of Controlled Trials; the Cochrane Bone, Joint, and Muscle Trauma Group Specialized Register; ClinicalTrials.gov; and the UK Clinical Research Network Study Portfolio up to July 2013 without language restriction. We included randomized controlled trials that examined the efficacy of physical exercise in older adults with cognitive impairment. The methodological qualities of the included trials were appraised according to the criteria developed for the Cochrane review of fall prevention trials. The primary outcome measure was the rate ratio of falls. A meta-analysis was performed to estimate the pooled rate ratio and summarize the results of the trials on fall prevention through physical exercise.
Results: Seven randomized controlled trials involving 781 participants were included, 4 of which examined solely older people with cognitive impairment. Subgroup data on persons with cognitive impairment were obtained from the other 3 trials that targeted older populations in general. The meta-analysis showed that physical exercise had a significant effect in preventing falls in older adults with cognitive impairment, with a pooled estimate of rate ratio of 0.68 (95% confidence interval 0.51–0.91).
Conclusions: The present analysis suggests that physical exercise has a positive effect on preventing falls in older adults with cognitive impairment. Further studies will be required to determine the modality and frequency of exercise that are optimal for the prevention of falls in this population.

The global population is aging at an unprecedented pace. In 2012, 23% of the population in the more developed regions and 9% in the less developed regions were aged 60 years or older.[1] It is estimated that by 2050 the proportion of older citizens will increase to 32% and 19% in developed and developing countries, respectively.[1] Because the prevalence of dementia rises rapidly after the age of 60 years,[2] a dramatic change in population demographics will inevitably increase the number of people affected by this disorder, and make dementia a pressing health care issue.

One of the major issues in dementia care is the prevention of falls, for which evidence shows that persons with cognitive impairment are at an elevated risk. The annual incidence of falls among older adults with cognitive impairment is about twice that in the elderly who are cognitively healthy.[3,4] Even after taking other known risk factors into account, cognitive impairment remains an independent risk factor for falls.[4] Studies also have shown that people with cognitive impairment who fall suffer from poorer outcomes than those who are cognitively healthy. For example, people with dementia have a greater likelihood of needing hospital admission for orthopedic crises than people without dementia,[5] and have a significantly greater mortality rate after sustaining fractures.[6,7]

The authors declare no conflicts of interest.

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The prevention of falls in persons with cognitive impairment is challenging. A number of psychological (eg, behavioral symptoms,[4] cognitive impairment,[8] poor attention and orientation,[9] anxiety,[9] and depressive symptoms[10]), physiological (eg, increased postural sway,[9] symptomatic orthostatic hypotension,[10] impaired simple reaction time,[11] and leaning balance[11]), and medical risk factors (eg, Lewy body disorder,[10] antipsychotic use,[4] and antidepressant use[9]) pertinent to older people with cognitive impairment have been identified. The prevention of falls in persons with cognitive impairment is particularly relevant in long-term care settings, because approximately half of all nursing home residents have dementia.[12] It is thus essential to understand which interventions are most efficacious in persons with cognitive impairment before effective fall-prevention programs can be devised for long-term care facilities.

Fall prevention has been studied extensively in the general older population, and strategies including group and home-based exercise programs, home safety interventions, and multifactorial assessment and intervention programs have been found to reduce the rate of falls and the risk of falling.[13] However, the efficacy of these interventions, including the more established types, such as physical exercise, among cognitively impaired individuals remains unclear, because most previous studies on fall prevention either excluded subjects with cognitive impairment or did not conduct subgroup analyses related to cognitive impairment status.[14] It is thus not surprising that although several systematic reviews have been conducted to examine the effect of physical exercise on the prevention of falls in the elderly,[13,15–17] only 1[15] included randomized controlled trials (RCTs) conducted specifically on cognitively impaired older people. This particular review,[15] for which the search was performed in 2004, found that the evidence on the effect of physical exercise in preventing falls among cognitively impaired populations was inconclusive because only 3 RCTs with conflicting results on the number of falls were available. Subsequently, a meta-analysis that investigated the impact of dementia on the efficacy of fall-prevention programs also found no conclusive evidence to suggest an association between the two.[18] However, of the 43 studies included in this meta-analysis, which comprised studies published up to 2005, only 1 examined people with dementia exclusively and another performed a subgroup analysis to compare the efficacy of the preventive programs in participants with or without dementia.[18] This partly explains why, based on the studies of older adults with known cognitive impairment published up to 2006, the Panel on the Prevention of Falls in Older Persons of the American Geriatrics Society and British Geriatrics Society concluded that there was insufficient evidence to recommend or oppose single or multifactorial interventions for fall prevention in people with dementia.[19]

We thus conducted an updated systematic review and meta-analysis to summarize the current evidence on the efficacy of physical exercise, one of the more established fall-prevention interventions,[13,16,17] in persons with cognitive impairment.

Methods

Study Selection

The studies included in this review were RCTs that compared the efficacy of physical exercise with routine medical care or other controlled activities in preventing falls in older people with cognitive impairment. Physical exercise referred to planned, structured, and repetitive movement to improve or maintain one or more components of physical health.[18] Cognitive impairment needed to be suggested by either a standardized cognitive assessment or a diagnosis of dementia established according to accepted criteria. For trials that did not specifically report information on cognitively impaired or demented older people, original subgroup data were requested from the authors. To better understand the efficacy of physical exercise in the prevention of falls, we excluded trials in which exercise was only part of a multifactorial program.

Literature Search

We searched MEDLINE (from 1946); EMBASE (from 1980); PsycINFO (from 1967); the Cumulative Index to Nursing & Allied Health Literature (from 1982); the Cochrane Central Register of Controlled Trials (the latest issue); the Cochrane Bone, Joint, and Muscle Trauma Group Specialized Register; ClinicalTrials.gov; and the UK Clinical Research Network Study Portfolio up to July 2013 using the grouped terms (dementia or alzheimer* or lewy body or lewy bodies or cognitive disorders or mild cognitive impairment or memory disorder or memory disorders) and (exercise or physical activit* or physical training or motor activit* or gait training or balance training or bicycling or swim* or gym* or walk* or danc* or yoga or “tai chi” or “Tai Ji”). No language restriction was applied. We also screened reference lists of relevant reviews.[13,15–17] Two reviewers were responsible for searching the databases. Any disagreement was resolved by consensus, discussion, and third-party adjudication (JWFY). We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) in reporting this systematic review.

Data Extraction and Quality Evaluation

One author (WCC) extracted the data independently and the other (JWFY) checked the accuracy of the extracted data. The following variables were extracted from each study: study design, participant characteristics, treatment and control protocols, and outcome parameters. The primary outcome measure was the rate ratio of falls (ie, the ratio of the total number of falls per unit of person time in any 2 groups in each trial). When the rate ratio was not reported, it was calculated from the ratio of the total number of falls divided by the total length of time during which falls were monitored (person-years) in the 2 comparison groups. A secondary outcome measure was the number of participants who sustained fractures.

The methodological qualities of the trials included were appraised according to the 7 domains in Cochrane’s tool for assessing risks of bias: random sequence generation, allocation concealment, blinding of the participants, blinding of the assessors, incomplete outcome data, selective reporting, and other sources of bias. In the domain of other sources of bias, we assessed bias in the recall of falls due to unreliable methods of ascertainment,[20] using the criteria developed for the Cochrane review of fall-prevention trials.[13] The risk of bias in each domain was rated as low, high, or uncertain.

Data Synthesis and Analysis

The generic inverse variance method in the Review Manager software (RevMan 5.1, The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark) was used to group the results of the trials and compile the forest plot. The rate ratio (RaR) was calculated for the rate of falls between 2 groups with a 95% confidence interval (CI). Heterogeneity between the trials was assessed using χ^2 and I^2 statistics. We used a fixed effects model in the absence of statistical heterogeneity (heterogeneity test, $P \geq .10$) and a random-effects model when heterogeneity was present (heterogeneity test, $P < .10$). A sensitivity analysis was carried out by excluding 1 study at a time to explore whether the results were influenced by 1 large study or by a study with an extreme result. The possibility of publication bias would have been assessed using funnel if 10 or more trials had been included in the meta-analysis.[21]