Review of effects of physical activity on strength, balance, mobility and ADL performance in elderly subjects with dementia

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CRD summary
The review concluded that multicomponent interventions improved physical functioning (gait speed, functional mobility, and balance) and activities of daily living in elderly participants with dementia. Multicomponent interventions were more effective than progressive resistance training for physical functioning but gave similar improvements in lower-limb strength. In view of evidence limitations and general heterogeneity, the reliability of the authors’ conclusions is unclear.

Authors’ objectives
To evaluate the effect of physical activity on strength, balance, mobility and activities of daily living in the elderly with dementia and secondarily to formulate guidelines for the most effective training programme.

Searching
PubMed, EMBASE, Web of Science, PsycINFO, CINAHL and Biological Abstracts were searched to March 2010 for publications in English, Dutch, French and German; search terms were reported. Bibliographies of retrieved articles were handsearched.

Study selection
Studies of the effects of physical activity in preventing incorporation of early-onset dementia (any aetiology) in participants with an average age of more than 70 years were eligible for inclusion. Studies were eligible if they solely investigated the effects of physical activity on outcomes of mobility, endurance, lower-extremity strength, balance and activities of daily living.

All of the included studies considered physical activity interventions that included progressive resistance training, endurance training or a combination of strength, endurance and balance training. Intervention duration ranged from three weeks to 80 weeks. Session frequency ranged from two times per week to four per day. Sessions lasted 30 to 75 minutes. Training intensity was light, moderate or high. Most of the randomised controlled trials (RCTs) compared interventions with usual care; three studies used non-physical activities, conversation only or a home safety review. The outcomes measured included: gait speed, activities of daily living, lower extremity strength, balance (various measures such as one leg balance), muscle strength, muscle endurance, leg extension, hip abductor, stair climb, sit-to-stand test, timed up and go, chair rise, two or six minute walk tests, two minute step test, knee extensor (right or left), Southampton mobility assessment and Yale physical activity survey. Mean age ranged from 72.9 to 89.6 years. Where measured, mini-mental state examination (MMSE) score ranged from 7.0 to 20.1 (out of a maximum possible score of 30).

Two independent reviewers performed the initial selection and one reviewer performed the final selection.

Assessment of study quality
Methodological quality was assessed by one reviewer using the Downs and Black checklist for reporting (score up to 11 points), external validity (score up to 3), internal validity/bias (score up to 7), internal validity/confounding (score up to 6) up to a maximum score of 27. Studies were also assessed for the evidence level.

Data extraction
Cohen’s d effect sizes (ES) were calculated for each outcome. If effect sizes could not be calculated then the level of significance (p) was provided. It is not clear how many reviewers performed the extraction.

Methods of synthesis
Overall effect size was calculated as the mean of individual effect sizes, with 95% confidence intervals (CI), and
weighted for sample size. An effect size of $d=0.2$ was considered to be small, $d=0.5$ was considered to be medium and $d=0.8$ was considered to be large. Spearman's rank correlation coefficient was used to test for correlation between various variables.

**Results of the review**

Sixteen studies were identified (642 participants, range eight to 134) and these comprised 10 RCTs (492 participants, range 16 to 134) and six non-RCTs, all case series (150 participants, range eight to 50). RCTs had an average Downs and Black score of 15.2 (range 11 to 23). Non-RCTs had an average 40.7% of the total methodological score. Six studies performed a per protocol analysis. Four studies performed an intention-to-treat analysis. Seven studies did not provide the relevant data. Rates of enrolment were reported for 10 studies (range 35% to 100%, seven studies had a rate of ≥85%). Where reported (eight studies), drop-out rates ranged from 8% to 27%. Reasons for drop-out were hospitalisation, death, being moved and refusal to exercise. Average participation rate was 81.4%. There was a significant correlation between participation rate and global cognitive function (MMSE score, $r=0.73$, $p=0.06$).

**Gait speed (six studies)**: Physical exercise did not significantly increase normal gait speed (six studies), but significantly increased fast gait speed (effect size $d=0.14$, 95% CI 0.10 to 0.19; two studies). Three studies that used multicomponent interventions (combined strength, endurance and flexibility training) over three weeks to 12 months significantly increased normal gait speed (effect sizes of $d=0.32$, $d=0.50$ and $p=0.02$). Three studies of progressive resistance training did not significantly increase normal gait speed. Fast gait speed was significantly higher after progressive resistance training in one study (effect size $d=0.19$).

**Endurance (five studies)**: Physical activity significantly increased endurance (effect size $d=1.08$, 95% CI 0.31 to 3.79; five studies). All five studies found a significant increase in endurance. The effect was larger with multicomponent interventions (four studies) and was related to the length of the intervention, which ranged from 12 weeks to one to four years (effect sizes from three studies ranged from $d=0.58$ to $d=3.79$). The lowest effect size was with a solely walking intervention (effect size $d=0.31$).

**Functional mobility (eight studies)**: Physical exercise did not significantly increase functional mobility (six studies). Six studies had multicomponent interventions (duration 12 weeks to 12 months) and four showed a significant effect (effect sizes $d=0.89$, $d=2.37$, $p=0.02$ and $p=0.001$). Two relatively high-quality studies had no significant effect (one had a short duration of 12 weeks). Two studies of progressive resistance training for six weeks had no significant effect.

**Lower-extremity strength (seven studies)**: Physical activity did not significantly increase lower-extremity strength (seven studies). Four of five studies with multicomponent interventions with durations of eight weeks to 12 months had a significant effect (effect sizes ranged from $d=0.34$ to $d=3.14$). Two studies of progressive resistance training for six and 12 weeks significantly improved lower-extremity strength (effect sizes $d=0.14$ and $d=1.95$). For both types of intervention, the longer the duration the greater the effect.

**Balance (seven studies)**: Physical exercise did not significantly improve balance (five studies). Five of six studies with multicomponent interventions had a significant effect (effect sizes ranged from $d=0.25$ to $d=3.59$). Duration ranged from eight weeks to 12 months and longer durations had greater effects. One study of progressive resistance training for 12 weeks had no significant effect.

**Basic activities of daily living (four studies)**: Physical activity significantly increased activities of daily living (medium effect size $d=0.68$, 95% CI 0.11 to 5.06; four studies). All four studies had multicomponent interventions. Duration ranged from 12 weeks to 12 months. Three of the four studies had a significant effect (range $d=0.22$ to $d=5.78$). Effect size related to intervention duration. One study with a three-week duration had no significant effect. Higher quality studies appeared to have lower effect sizes.

Improvements were seen among participants with mild, moderate and severe dementia.

**Authors' conclusions**

Multicomponent interventions can improve physical functioning (gait speed, functional mobility and balance) and basic activities of daily living in elderly subjects regardless of the stage of dementia. Multicomponent interventions led to larger improvements than progressive resistance training alone for gait speed, functional mobility and balance. Similar
improvements were found in lower-limb strength for both multicomponent interventions and progressive resistance training. The small number of high-quality studies and heterogeneity of participants and interventions precluded firm conclusions.

**CRD commentary**
The review addressed a well-defined question in terms of participants, interventions, study design and relevant outcomes. Relevant databases were searched for studies published in four languages. It seemed that unpublished studies were not considered, and so some relevant studies may have been missed. Publication bias was not assessed. Study quality was assessed using suitable criteria. Some effort was made to reduce error and bias in study selection, but not for other aspects of the review process. Relevant study details were reported.

The authors based their conclusions on the results of individual studies rather than their meta-analyses. It was not clear whether the statistical method used for the meta-analysis was appropriate. Statistical heterogeneity was not assessed and no effort was made to assess the relative intensity of the interventions. Most of the studies included in the review were small and of medium quality.

Potential limitations in the review process together with the small sample sizes, limitations in study quality and heterogeneity among interventions and participants highlighted by the authors made the reliability of the conclusions unclear.

**Implications of the review for practice and research**

**Practice:** The authors suggested that exercise should be offered in all stages of dementia and use multicomponent interventions with sessions of 45 to 60 minutes at least three times a week for 12 weeks or more.

**Research:** The authors identified a need for high-quality studies to determine which interventions influenced activities of daily living (and physical functioning), dose-response of interventions with respect to optimal duration, frequency and intensity, the most important component/s of interventions and mediating factors (such as cognitive level). Studies should provide details of diagnosis, cognition, participation, drop-out and enrolment rates of patients. Suitable valid and reliable measurements should be made for the targeted population and be sensitive to change.

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