Physical activity programs for persons with dementia (Review)

Forbes D, Forbes S, Morgan DG, Markle-Reid M, Wood J, Culum I

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[Intervention Review]

Physical activity programs for persons with dementia

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ABSTRACT

Background

There is some evidence that physical activity delays the onset of dementia in healthy older adults and slows down cognitive decline to prevent the onset of cognitive disability. Studies using animal models suggest that physical activity has the potential to attenuate the pathophysiology of dementia. 'Physical activity' refers to 'usual care plus physical activity'.

Objectives

Primary: do physical activity programs maintain or improve cognition, function, behaviour, depression, and mortality compared to usual care in older persons with dementia?

Secondary: do physical activity programs have an indirect positive impact on family caregivers' health, quality of life, and mortality compared to family caregivers of older persons with dementia who received usual care alone? Do physical activity programs reduce the use of health care services (e.g., visits to the emergency department) compared to usual care in older persons with dementia and their family caregiver?

Search strategy

The trials were identified from searches of the Specialized Register of the Cochrane Dementia and Cognitive Improvement Group, *The Cochrane Library*, MEDLINE, EMBASE, PsycINFO, CINAHL and LILACS on 9 September 2007 using the search terms: exercise OR "physical activity" OR cycling OR swim* OR gym* OR walk* OR danc* OR yoga OR "tai chi".

Selection criteria

All relevant, randomized controlled trials in which physical activity programs were compared with usual care for the effect on managing or improving cognition, function, behaviour, depression, and mortality in people with dementia of any type and degree of severity. Secondary outcomes related to the family caregiver(s) included quality of life, mortality, and use of health care services were intended to be examined.

Data collection and analysis

Two reviewers independently assessed the retrieved articles for relevance and methodological quality, and extracted data from the selected trials. These were pooled were appropriate.

Main results

Four trials met the inclusion criteria. However, only two trials were included in the analyses because the required data from the other two trials were not made available. Only one meta-analysis was conducted. The results from this review suggest that there is insufficient evidence of the effectiveness of physical activity programs in managing or improving cognition, function, behaviour, depression, and mortality in people with dementia. Few trials have examined these important outcomes. In addition, family caregiver outcomes and use of health care services were not reported in any of the included trials.

Authors' conclusions

There is insufficient evidence to be able to say whether or not physical activity programs are beneficial for people with dementia.

PLAIN LANGUAGE SUMMARY

There is insufficient evidence to determine the effectiveness of physical activity programs in managing or improving cognition, function, behaviour, depression, and mortality in people with dementia

Few trials examined these important outcomes. In addition, family caregiver outcomes and use of health care services were not reported in any of the included studies. There is some evidence that physical activity delays the onset of dementia in healthy older adults and slows down cognitive decline to prevent the onset of cognitive disability. Studies using animal models suggest that physical activity has the potential to attenuate the pathophysiology of dementia. Four trials met the inclusion criteria. However, only two trials were included in the analyses because the required data from the other two trials were not made available. Further well-designed research is required.

BACKGROUND

Worldwide, it is estimated that there are 24.3 million people with dementia, with 4.6 million new cases every year (Ferri 2005). Physical activity programs have been shown to have multiple positive effects on older adults, including improved cognition (Angevaren 2008; Barnes 2007; Weuve 2004; Yaffe 2001), functional ability (Larowski 1999), and mental health (Penninx 2002; Taylor 2004). Several longitudinal cohort studies in healthy older adults have demonstrated that physical activity is associated with delayed risk of developing dementia from three to six years later (Abbott 2004; Karp 2006; Larson 2006; Laurin 2001) and reduced cognitive decline in older adults with mild cognitive impairment (Lytle 2004; Scherder 2005). Indeed, most of these studies have demonstrated that high levels of physical activity in older adults with no dementia is associated with a 30 to 50% reduction in the risk of cognitive decline and dementia (Barnes 2007). A recent Cochrane review (Angevaren 2008) that included 11 randomized controlled trials (RCTs) of aerobic physical activity programs for healthy older adults reported improvement in at least one aspect of cognitive function with the largest effects on cognitive speed, delayed memory functions, auditory and visual attention. However, the cognitive functions which improved differed across studies and the majority of comparisons were not significantly different. Another meta-analysis that included 36 studies (22 had a control group) examined the effects of physical activity on psychological well being in healthy older adults and reported an overall small effect size for psychological well-being (Netz 2005). Thus, there is some evidence that physical activity delays the onset of dementia in older adults and slows down cognitive decline to prevent the onset of significant cognitive disability (Barnes 2007). However, it is less clear if physical activity manages or improves other symptoms among persons with a diagnosis of dementia.

Studies using animal models have showed that physical activity attenuates some of the cognitive symptoms and pathophysiology of dementia (Cotman 2007). Work in this area has identified several key responses including up-regulation of growth factors, increased neurogenesis, and improved learning and memory in response to physical activity (Cotman 2007). A meta-analysis on the effects of physical activity training in older persons with cognitive impairment and dementia (Heyn 2004) included 30 RCTs and revealed that exercise training increased fitness, physical function,

cognition and positive behaviour in these individuals. However, not all included trials targeted persons with dementia. In addition, this review (Heyn 2004) was completed several years ago, thus it is important to update the review. A recent RCT that specifically targeted persons with Alzheimer's disease revealed that an activity program consisting of walking, strength, balance, and flexibility training one hour twice a week for one year led to a significantly slower decline in their ability to perform activities of daily living when compared to routine care but no effect was observed in behavioural disturbances or depression (Rolland 2007). Other studies have examined the effect of a combination of endurance (aerobic) activities, strength, balance and flexibility training with other strategies such as behavioural management (e.g., Teri 2003) or environmental activities (e.g., Alessi 1999) while others focused on a single activity (e.g., walking program, MacRae 1996). To examine the effectiveness of physical activity programs, this systematic review included trials that have examined only physical activity programs offered to older persons diagnosed with dementia.

Persons diagnosed with dementia often have unique needs as they tend to be older and present with acquired impairment in short- and long-term memory, associated with impairment in abstract thinking, judgment, and other disturbances of higher cortical function, or personality changes (APA 1995; McKhann 1984). This definition of dementia is the most widely used in practice (Robillard 2007). Greater numbers of persons with dementia are living in their communities (Cranswick 2005) with up to 90% of their care provided by family and friends (Keating 1999). In 2007, 9.8 million American caregivers of persons with dementia provided 8.4 billion hours of care, a contribution valued at $89 billion (Alzheimer's Association 2008). Caregivers of a family member with dementia are more likely than non-caregivers to experience fair to poor health, to have high levels of stress hormones, reduced immune function, slow wound healing, newly diagnosed hypertension and coronary heart disease (Alzheimer's Association 2008). There are potentially immense benefits to persons with dementia, their family caregivers, and the health care system of managing or improving the symptoms of dementia. A systematic review that incorporates meta-analysis, when appropriate, is needed to determine the effects of physical activity programs on cognition, function, behaviour, depression, and mortality in older persons with dementia, family caregiver quality of life and mortality, and use of health care services. In this review, 'physical activity' refers to 'usual care plus physical activity'.

OBJECTIVES

Primary:

- Do physical activity programs mange or improve cognition, function (e.g., activities of daily living [ADLs]), behaviour, depression, and mortality compared to usual care in older persons with dementia?

Secondary:

- Do physical activity programs have an indirect positive impact on family caregiver's health, quality of life, and mortality compared to family caregivers of older persons with dementia who received usual care alone?

- Do physical activity programs reduce the use of health care services (e.g., visits to the emergency department) compared to usual care in older persons with dementia and their family caregiver?

METHODS

Criteria for considering studies for this review

Types of studies

Randomized controlled trials (RCTs) in which older adults diagnosed with dementia were allocated to either a physical activity program or usual care (control group). Trials with inadequate allocation concealment were excluded from the review. Although parallel group trials were preferred, crossover trials were eligible but only data from the first treatment phase (prior to the crossover) were considered. Non-blinded trials were included as it was unrealistic to expect blinding of the participants and those who conducted the physical activity programs. The outcome assessors were expected to be blinded to treatment allocation.

Types of participants

The participants were older persons (65 years and older) who resided in the community or in a long-term care facility and who were diagnosed as having dementia using accepted criteria such as the Diagnostic and Statistical Manual of Mental Disorders (DSM-III-R, DSM-IV; APA 1995), the National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association (McKhann 1984) or ICD-10 (WHO 1992). The types of dementia and levels of severity were described. Unfortunately, subgroup analyses to determine the effects of type and severity of dementia on the outcomes of interest were not possible due to the small number of included trials and participants.

Types of interventions

Interventions included aerobic exercise training or physical activity programs offered over any length of time with the aim to improve cognition, function, behaviour, depression, and mortality in older persons with dementia and/or family caregiver health, quality of life, or to decrease caregiver mortality, and/or use of health care services. Trials were included where the only difference between groups was the physical activity intervention. The types, frequencies, intensities, duration, and settings of the physical activity programs were described. Again, subgroup analyses were not conducted to determine these effects on the outcomes of interest due to the small number of included trials and participants. The comparison groups received usual care.

Types of outcome measures

Primary outcomes

The primary outcomes were related to the person with dementia: cognition, function (i.e., activities of daily living [ADLs]), behaviour, depression, and mortality.

Secondary outcomes

Secondary outcomes related to the family caregiver(s) included health, quality of life and mortality. System costs related to use of health services were intended to be examined. However, none of the included trials examined use of health care services. Measures from dichotomous and continuous scales were accepted and follow-up measures over time were included. The outcomes in the included trials were all measured using continuous scales.

Search methods for identification of studies

See Cochrane Dementia and Cognitive Improvement Group methods used in reviews.

The Specialized Register of the Cochrane Dementia and Cognitive Improvement Group (CDCIG) was searched on 9 September 2007 for all years up to December 2005. This register contains records from the major healthcare databases The Cochrane Library, MEDLINE, EMBASE, PsycINFO, CINAHL and LILACS, and many ongoing trial databases and other grey literature sources. The following search terms were used: exercise OR "physical activity" OR cycling OR swim* OR gym* OR walk* OR danc* OR yoga OR "tai chi".

The Cochrane Library, MEDLINE, EMBASE, PsycINFO, CINAHL and LILACS were searched separately on 9 September 2007 for records added to these databases after December 2005 to September 2007. The search terms used to identify relevant controlled trials on dementia for the Group's Specialized Register can be found in the Group's module on The Cochrane Library. These search terms were combined with the following search terms and adapted for each database, where appropriate: exercise OR "physical activity" OR cycling OR swim* OR gym* OR walk* OR danc* OR yoga OR "tai chi".

The first authors of important identified RCTs that were potentially suitable for inclusion were contacted to request additional information on related new, unpublished, or in press studies.

On 9 September 2007, the Register consisted of records from the following databases:

Health Care databases:

- CENTRAL: (The Cochrane Library 2006, Issue 1);
- MEDLINE (1966 to 2006/07, week 5);
- EMBASE (1980 to 2006/07);
- PsycINFO (1887 to 2006/08, week 1);
- CINAHL (1982 to 2006/06);
- SIGLE (Grey Literature in Europe) (1980 to 2005/03);
- LILACS: Latin American and Caribbean Health Science Literature (http://bases.bireme.br/cgi-bin/wxislind.exe/iah/online/?IsisScript=iah/iah.xis&base=LILACS&Lang=i&form=F) (last searched 29 August 2006);

Conference Proceedings:

- ISTP (http://portal.isiknowledge.com/portal.cgi) (Index to Scientific and Technical Proceedings) (to 29 August 2006);
- INSIDE (BL database of Conference Proceedings and Journals) (to June 2000);

Theses:

- Index to Theses (formerly ASLIB) (http://www.theses.com/) (UK and Ireland theses) (1716 to 11 August 2006);
- Australian Digital Theses Program (http://adt.caul.edu.au/): (last update 24 March 2006);
- Canadian Theses and Dissertations (http://www.collectionscanada.ca/thesescanada/index-e.html): 1989 to 28 August 2006);
- DATAD - Database of African Theses and Dissertations (http://www.aau.org/datad/backgrd.htm);
- Dissertation Abstract Online (USA) (http://wwwlib.umi.com/dissertations/gateway) (1861 to 28 August 2006);

Ongoing trials:

UK

- National Research Register (http://www.update-software.com/projects/nrr/) (last searched issue 3/2006);
- ReFeR (http://www.refer.nhs.uk/ViewWebPage.asp?Page=Home) (last searched 30 August 2006);
- Current Controlled trials: Meta Register of Controlled trials (mRCT) (http://www.controlled-trials.com/) (last searched 30 August 2006)
- ISRCTN Register - trials registered with a unique identifier
- Action medical research
- Kings College London
- Laxdale Ltd
- Medical Research Council (UK)
- NHS Trusts Clinical Trials Register
- National Health Service Research and Development Health Technology Assessment Programme (HTA)
- National Health Service Research and Development Programme 'Time-Limited' National Programmes
- National Health Service Research and Development Regional Programmes
- The Wellcome Trust
- Stroke Trials Registry (http://www.strokecenter.org/trials/index.aspx) (last searched 31 August 2006);

Netherlands

- Nederlands Trial Register (http://www.trialregister.nl/trialreg/index.asp) (last searched 31 August 2006);

USA/International

- ClinicalTrials.gov (http://www.ClinicalTrials.gov) (last searched 31 August 2006) (contains all records from http://clinicalstudies.info.nih.gov/);
- IPFMA Clinical trials Register: www.ifpma.org/clinicaltrials.html. The Ongoing Trials database within this Register searches http://www.controlled-trials.com/isrctn, http://www.ClinicalTrials.gov and http://www.centerwatch.com/. The ISRCTN register and Clinicaltrials.gov are searched separately. Centerwatch is very difficult to search for our purposes and no update searches have been done since 2003.
- The IFPMA Trial Results databases searches a wide variety of sources among which are:
- http://www.astrazenecaclinicaltrials.com (seroquel, statins)
- http://www.centerwatch.com
- http://www.clinicalstudyresults.org
- http://clinicaltrials.gov
- http://www.controlled-trials.com
- http://ctr.gsk.co.uk
- http://www.lillytrials.com (zyprexa)
- http://www.roche-trials.com (anti-abeta antibody)
- http://www.organon.com
- http://www.novartisclinicaltrials.com (rivastigmine)
- http://www.bayerhealthcare.com
- http://trials.boehringer-ingelheim.com
- http://www.cmrinteract.com
- http://www.esteve.es
- http://www.clinicaltrials.jp
- This part of the IPFMA database is searched and was last updated on 4 September 2006;
- Lundbeck Clinical Trial Registry (http://www.lundbecktrials.com) (last searched 15 August 2006);
- Forest Clinical trial Registry (http://www.forestclinicaltrials.com/) (last searched 15 August 2006).

The search strategies used to identify relevant records in MEDLINE, EMBASE, PsycINFO, CINAHL and LILACS can be found in the Group's module on *The Cochrane Library*. Reference lists of retrieved articles were examined for additional trials.

Data collection and analysis

Selection of trials

Titles and abstracts of citations obtained from the search were examined by one or two authors and obviously irrelevant articles discarded. At this stage the authors were overly inclusive: any article that suggested a relevant RCT was retrieved for further assessment. Two authors independently assessed retrieved articles for inclusion in the review according to the criteria above. Disagreements were resolved by discussion, or if necessary referred to a third author.

Assessment of methodological quality

Methodological quality criteria were developed with input from all of the authors based on The Cochrane Handbook for Systematic Reviews of Interventions, version 5.0.0 (Higgins 2008). Two authors independently assessed and rated the trials according to the following criteria that reflected the adequacy of the randomization process. If the description of the randomization process was unclear or missing, the original author of the trial was contacted in an attempt to retrieve the required information.

A. Adequate

- centralised allocation by a central office unaware of participant characteristics
- pre-numbered or coded identical containers which were administered serially to participants
- on-site computer system combined with allocations kept in a locked unreadable computer file that could be accessed only after the characteristics of an enrolled participant were entered
- sequentially numbered, sealed, opaque envelopes
- other approaches that ensured adequate concealment.

B. Unclear

- "list" or "tables" to allocate assignments
- "envelopes" or "sealed envelopes"
- simply stated that the trial was randomized with no further details

C. Inadequate

- case record numbers, dates of birth, alternation, date of referral, and other similar approaches that were transparent before allocation
- any other system in which allocation could be known in advance such as open list of random numbers.

D. Allocation concealment not used

Because empirical research has shown that lack of adequate allocation concealment is associated with bias (Moher 1998), only those trials rated as "Adequate" or "Unclear" were included in the review.

Other elements of trail quality, although not rated, were assessed by two authors independently and reported:

- blinding of participants, those providing the physical activity, and outcome assessors to the nature of the allocated group,
- level of participant drop-out at the follow-up stage of the trial study, and
- equal treatment of both intervention and control participants in all respects other than the delivery of the physical activity.

Since at least two empirical studies have failed to demonstrate a relationship between blinding of outcome assessment and trial results, perhaps due to inadequacies in the reporting of studies (Reitman 1988) and since attrition after allocation has not been found to be consistently related to bias (Schulz 1995), the results of these criteria were reported but not used as criteria for exclusion of trials from the review.

Data extraction and analysis

Data were extracted from published reports or requested from the original first author when necessary. Summary statistics were required for each trial and each outcome. For continuous data, the effect measure was the weighted mean difference (WMD) when the pooled trials used the same rating scale or test to assess an outcome. The standardized difference in means (SMD), which is the absolute mean difference divided by the standard deviation (SD), was used when the pooled trials used different rating scales or tests. Accordingly, the mean change from baseline to final measurements, the SD of the mean change, and the number of participants for each group at each assessment were extracted. Where the SD of change from baseline to final measurement was not reported, the final mean, SD, and the number of participants for each group were extracted. No dichotomous data of interest to this review were reported in the included trials.

The amount of missing data related to participants' drop-out was described in the Risk of Bias Tables. The potential impact of the missing data on the results depended on the extent of missing data, the pooled estimate of the treatment effect and the variability of the outcomes. Variation in the degree of missing data was also considered a potential source of heterogeneity. However, sensitivity analysis was not conducted due to the small number of included trials and participants.

Only trials that demonstrated clinical homogeneity (e.g., trials that tested similar aerobic activity programs and examined similar outcome measures) were considered potentially appropriate for meta-analysis. A test for statistical heterogeneity (a consequence of clinical and/or methodological diversity among trials) was then performed using I^2. This is a useful statistic for quantifying inconsistency (I^2 = [(Q - df)/Q] x 100%, where Q is the chi-squared statistic and df is its degrees of freedom; Higgins 2003; Higgins 2002). This described the percentage of variability in effect estimates that was due to heterogeneity rather than sampling error (chance). A value greater than 50% was considered substantial heterogeneity. If the value was less than 50%, the overall estimate from a fixed effects model was presented. If, however, there was evidence of heterogeneity of the population and/or treatment effect between trials then only homogeneous results were pooled, or a random-effects model was used. In this case the confidence intervals were broader than those of a fixed-effects model.

Because of the small number of trials and participants included in the review, the following subgroup analyses could not be undertaken:

Disease type:
- Alzheimer's disease
- vascular dementia
- mixed Alzheimer's disease and vascular dementia
- unclassified or other dementia

Severity of dementia at baseline:
- mild (MMSE > 17 to 26 or similar scale) (Hogan 2007)
- moderate (MMSE 10 to 17 or similar scale (Hogan 2007)
- severe (MMSE < 10 or similar scale) (Feldman 2005)

Type of aerobic physical activity, example:
- walking program
- dancing

Frequency of physical activity program:
- < 3 times per week
- > 3 times per week

Duration of physical activity program:
- < 12 weeks
- > 12 weeks

Intensity of physical activity program
- low-intensity
- moderate-intensity
- high-intensity

Setting of physical activity program
- institution
- home

RESULTS

Description of studies

See: Characteristics of included studies; Characteristics of excluded studies.

Please see Table Characteristics of included studies.

0ne-hundred and eighty-seven abstracts and titles were screened for relevance. Seventeen articles were retrieved and independently rated by two reviewers for relevance and validity. Six articles met the relevance criteria and only four met the methodological quality criteria (Francese 1997; Holliman 2001; Rolland 2007; Stevens 2006). Two trials (Gillogly 1991; Van de Winckel 2004) did not meet the methodological quality criteria because of inadequate concealment during the randomization process. The included articles were published between 1997 and 2007. Two trials were conducted in the United States, one in northern Virginia (Francese 1997) and the location of the other was not reported (Holliman 2001). Another trial was conducted in Toulouse, France (Rolland 2007) and another in northern New South Wales, Australia (Stevens 2006). Participants were residents of a Medicare nursing facility (Francese 1997), geriatric psychiatry facility (Holliman 2001), and nursing homes (Rolland 2007; Stevens 2006).

Consent was obtained in all trials from the residents and/or from their legal guardian or family member. The total number of residents who agreed to participate in the included trials was 280 and of these, 208 completed the protocol.

Residents were considered to have dementia if they scored 23 or lower (Holliman 2001; Stevens 2006) or 25 or lower (Rolland 2007) on the Mini Mental State Examination (MMSE). In the trial conducted by Stevens 2006, residents were also assessed for dementia by a local Aged Care Assessment Team and residents who scored between 0 and 9 (severe dementia) on the MMSE were not included. In the trial by Rolland 2007, only residents who were diagnosed with Alzheimer's disease by a geriatrician and who met the National Institute of Neurological and Communicative Diseases and Stroke/Alzheimer Disease and Related Disorders Association criteria for probable or possible Alzheimer's disease were eligible for inclusion. Subjects were excluded if there was evidence of Parkinson's disease or vascular dementia. In the trial conducted by Francese 1997, a diagnosis of Alzheimer type dementia (late stage) was required. The type of dementia was not reported in the remaining trials (Holliman 2001; Stevens 2006). In two of the trials (Holliman 2001; Rolland 2007) the MMSE was used to determine the severity of dementia at baseline. The mean MMSE scores of the participants in these trials were: 8.8 (SD 6.6) (Rolland 2007) and 4.6 (SD 4.9) (Holliman 2001).

In addition to being diagnosed with dementia, in order to be eligible for two of the trials, participants had to have been living in the nursing home for three weeks (Holliman 2001) or two months (Rolland 2007). Two trials required different levels of physical abilities from the participants. One trial (Rolland 2007) required that the residents be able to transfer from a chair and walk 6 meters without human assistance, while another (Francese 1997) required that the residents needed one-two person assistance to transfer. Additional inclusion criteria included that the participants were: not scheduled for discharge until following the trial (Holliman 2001), physically able to participate (Francese 1997; Stevens 2006), not participating in another research trial (Holliman 2001), able to respond to most verbal requests (Stevens 2006), and to understand English (Francese 1997).

Three of the trials administered the physical activity program three times a week for 20 minutes (Francese 1997) or 30 minutes (Holliman 2001; Stevens 2006). Rolland 2007 offered a one hour session, twice a week. The period of time the program was offered varied greatly from two weeks (Holliman 2001), seven weeks (Francese 1997), 12 weeks (Stevens 2006), to 12 months (Rolland 2007). In three trials, the physical activities were performed while seated in order to accommodate people in wheelchairs (Francese 1997; Holliman 2001; Stevens 2006). Rolland 2007 required that participants be able to transfer from a chair and walk at least 6 m without human assistance since walking was required for the first half hour of the session. The remainder of the program included strength, flexibility and balance training. Francese 1997 offered a physical activity regime that consisted of activities such as catching, throwing, and kicking balls, leg weight exercises and parachute reaches. Holliman 2001 designed the physical activity program to target the training of gross and fine motor skills and movement and to also be meaningful and appropriate for the residents. This program included several interactive physical activities such as passing a bean bag or playing volleyball in order to promote socialization. The program used by Stevens 2006 was based on joint and large muscle group movement with the intention to create gentle aerobic exertion. Francese 1997, Stevens 2006 and Rolland 2007 based their physical activity programs on previous interventions for frail or impaired residents and the programs were accompanied by music.

Three trials measured the behaviours of the residents (Holliman 2001; Rolland 2007; Stevens 2006). A subscale of the Psychogeriatric Dependency Rating Scale (PGDRS) was used to measure difficult behaviours such as wandering, active aggression and restlessness related to dementia (Holliman 2001). Rolland 2007 measured ADL using the Katz Index of ADLs and evaluated behavioural disturbances as a secondary outcome measure using the Neuropsychiatric Inventory (NPI). The Revised Elderly Disability Scale (REPDS) used by Stevens 2006 assessed self-help skills, behaviour and six other categories reflecting functional ability. Stevens 2006

measured the progression of dementia with the Clock Drawing Test and Francese 1997 used the Changes in Advanced Dementia Scale (CADS). Depression was evaluated using the Montgomery-Åsberg Depression Rating Scale (MADRS) (Rolland 2007). A description of the scales used to assess outcomes of interest in this review can be found in the Additional Table: Description of Rating Scales Used in Included Studies (Table 1).

Table 1. Description of Rating Scales Used in the Included Studies

Scale	Abbreviation	Description	Reference
Mini Mental State Examination, used in Stevens 2006 and Holliman 2001 trials studies	MMSE	The MMSE was developed as a short test suitable for the elderly with dementia. It concentrates on the cognitive aspects of mental function, the five sections cover orientation, immediate recall, attention and calculation, delayed recall and language. A maximum score of 30 indicates no impairment. Concurrent validity was determined by correlating MMSE scores with the Wechsler Adult Intellegence Scale, Verbal and Performance scores. For Mini-Mental Status vs Verbal IQ, Pearson r = 0.776 (P < 0.001) and for Mini-Mental Status vs Performance IQ, Pearson r = 0.660 (P < 0.001). Test re-test reliability was determined by a single examiner 24 h apart (r = 0.887), by two different examiners 24 h apart (r = 0.827), and at 28 day re-test (r= 0.988).	Folstein 1975
Neuropsychiatric Inventory, used in Rolland 2007 trial	NPI	The NPI includes 10 behavioral domains with 7-8 subquestions and measures severity (3-point scale) and frequency (4-point scale). Categories include delusions, hallucinations, dysphoria, anxiety, agitation/aggression, euphoria, disinhibition, irritability/lability, apathy, and aberrant motor activity. A global score can be generated by summing the total scores (frequency multiplied by severity) of the individual subscales. Higher scores indicate more behavioural disturbance. Concurrent validity was determined by comparing the scores on the relevant subscales of the NPI with the appropriate	Cummings 1994

Table 1. Description of Rating Scales Used in the Included Studies (*Continued*)

		scales of 2 instruments, BEHAVE-AD and the HDRS (coefficients not reported). To establish content validity a delphi panel was developed and asked to rate the scale items. Inter-rater reliability was found to be very high (correlation not reported) and test-retest reliability was found to be 0.79 for frequency (P = 0.0001) and 0.86 for sensitivity (P = 0.0001).	
Revised Elderly Persons' Disability Scale, used in Stevens 2006 trial	REPDS	The REPDS includes 53 items using a 4-point scale. Categories include communication, physical problems, self-help skill, confusion, behaviour, sociability, psychiatric, nurse dependence, and total score. Higher score indicates higher level of impairment. Unable to retrieve original article, validity and reliability not mentioned.	Stevens 2006
Clock-drawing test, used in Stevens 2006 trial	n/a	The Clock-drawing test has three items each with a 6-point scale. Items include free-drawn, pre-drawn, and examiner drawing tasks. Higher score indicates higher level of impairment. Inter-rater reliability was found to be high (range r = 0.94-0.97). Concurrent validity determined by correlaring clock-drawing scores to Mini-Mental State Examination scores (r = 0.77, P < 0.001).	Shulman 1993
Katz Index of Activities of Daily Living, used in Rolland 2007trial	Katz Index of ADLs	The Katz includes six items with a 3-point scale. Items include competence in: feeding, continence, transferring, going to toilet, dressing, and bathing. Higher scores indicate higher dependence. Concurrent validity claimed by comparison to paediatric texts, no statistical results reported. Reliability not discussed.	Katz 1963
Changes in Advanced Dementia Scale, used in Francese 1997 trial	CADS	The CADS includes 9 items (room finding, direction following, recognition, bathing, dressing, mobility, toileting, eating, and conversation). Higher scores indicate greater function (not directly stated, assumed	McCracken 1993

Table 1. Description of Rating Scales Used in the Included Studies (*Continued*)

		from text). Questionable inter-rater reliability (range r = 0.31-0.87)High criterion validity shown by correlating the CADS scores to the Global Deterioration Scale scores (Pearson r = 0.92, P < 0.001).	
Psychogeriatric Dependency Rating Scale, used in Holliman 2001 trial	PGDRS	The PGDRS includes 3 categories: orientation, behaviour, physical. Orientation consists of 10 yes/no questions, behaviour consists of 16 items (3-point scale), and physical consists of 7 sub-categories (see Wilkinson 1980 for a copy of the rating sheet). Higher scores indicate more dysfunction. Face validity assesed by comparison to nursing time commanded by patients (mean r = 0.72, P < 0.001). Inter-rater validity was determined by Kappa weight (Pearson r scores of .86, .71, and .87 for orientation, behaviour, and physical respectively). See Wilkinson 1980 for comprehensive evaluation of the scale.	Wilkinson 1980
Montgomery-Asberg Depression Rating Scale, used in Rolland 2007 trial	MADRS	The MADRS includes 10 items and uses a 7-point scale, scored following the interview. No questions asked regarding somatic symptoms. Higher scores indicate increasing depressive symptoms. Concurrent validity determined by correlating scores to the Cornell Scale for Depression in Dementia (range r = 0.74-0.93, P < 0.0001). Inter-rater reliability was not discussed.	Müller-Thomsen 2005

Risk of bias in included studies

Two authors (Francese 1997; Holliman 2001) were contacted to determine the method of randomization and allocation concealment, as the description in the published articles was unclear. One trial (Holliman 2001) randomly assigned eligible residents a number. In order to assign each resident to either the control or treatment group, copies of these numbers were made and put into an envelope and the numbers were then drawn from the envelope (correspondence from Holliman 2001 on 5 June 2007 and 5 July 2007). In another trial (Francese 1997), allocation to either group was concealed by assigning each resident a number using a random numbers table (correspondence from Francese 1997 on 20 June 2007 and 5 July 2007). Two trials (Rolland 2007; Stevens 2006) used a lottery draw method to allocate residents into either the control or experimental groups.

Two of the included trials had small samples sizes; 12 (Francese 1997) and 14 (Holliman 2001) participants at baseline and 11 (Francese 1997) and 12 (Holliman 2001) at completion. The other two trials recruited 120 (Stevens 2006) and 134 (Rolland 2007) participants at baseline and 75 (Stevens 2006) and 110 (Rolland 2007) participants completed the trials, although Rolland 2007 included all the participants in the intention-to-treat analysis. The total number of participants who were assessed at baseline was 280

and 208 (74%) participants completed the trials.

Stevens 2006 reported having two control groups (one group received a social visit and the other usual care) and one experimental group. All other trials had only two groups: a control (usual care and in one trial a sing-along video Francese 1997) and treatment (physical activity program) group.

Attrition rates (dropouts from the trials) varied from 8.3% to 44.2% in the included trials. All authors indicated from which group (treatment or control) the dropout rates occurred except for one (Stevens 2006). No report referred to attempting to retrieve dropouts. Reasons for non-adherence were provided: death, acute illness, increased disability, disinterest, behaviour disorders, moved to another institution and refusal to continue to participate. Two authors (Rolland 2007; Stevens 2006) provided information regarding the attendance and adherence of participants to the intervention program. Stevens 2006 analysed data from residents with 75% attendance or greater. Rolland 2007 indicated that the mean adherence to the exercise program was 33.2 (SD 25.5) sessions out of the 88 sessions offered to the treatment group, although 100% were included in the intention-to-treat analysis.

In these included trials, it was not possible for the participants or for those providing the intervention to be blinded to the assigned group. Two trials reported that those who assessed the outcomes were blind to group allocation (Holliman 2001; Rolland 2007). A Risk of Bias Graph captures the review authors' judgments about each risk of bias item presented as percentages across all included trials see Figure 1 and a Risk of Bias Summary captures the review authors' judgments about each risk of bias item for each included trial see Figure 2.

Figure 1. Risk of bias graph: review authors' judgments about each risk of bias item presented as percentages across all included trials.

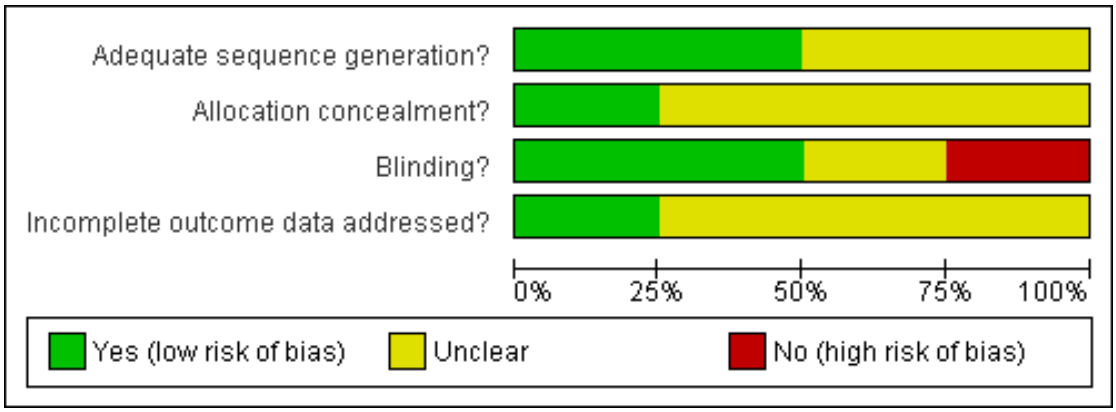
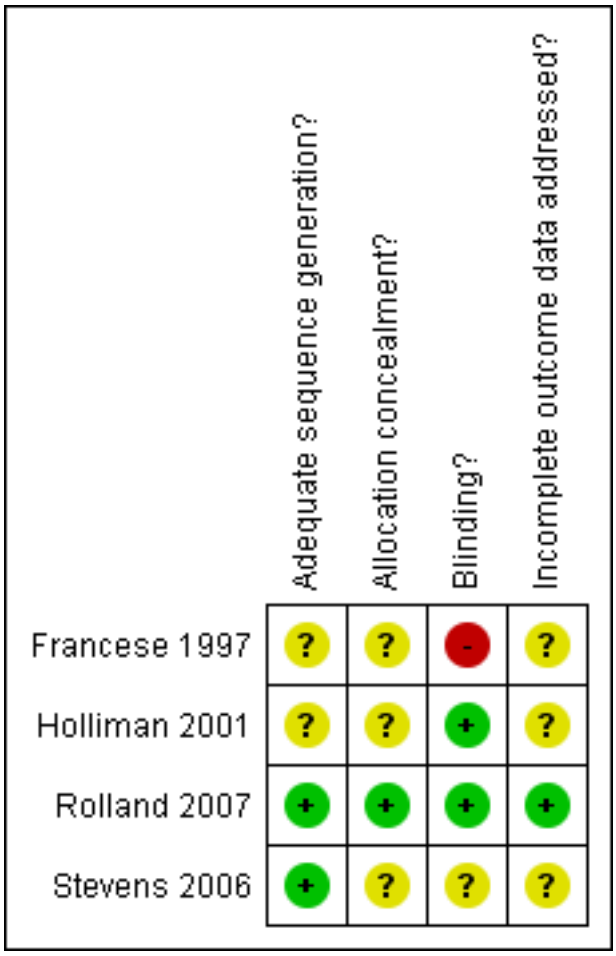


Figure 2. Risk of bias summary: review authors' judgments about each risk of bias item for each included trial.



Effects of interventions

Two trials (Holliman 2001, Stevens 2006) could not be included in the analyses as data needed to conduct the meta-analyses were not reported and when requested from the authors were not forthcoming. Specifically, Holliman 2001 only reported the mean pre-test, intervention, and post-test scores of the behavioural subscale of the PGDRS with no standard deviations, standard errors, confidence intervals, interquartile ranges, or P values. When requested to provide the missing data, the response on 10 November 2007 was that the data were unavailable . Similarly, Stevens 2006 reported the pre-post mean differences and P values for the REPDS scores using Wilcoxon Signed Rank Test analyses. Additional data were requested from the original author on 22 August 2007 and 17 September 2007, but to date, no response was received. The reported P values in Stevens 2006 trial reflected the rank ordering of responses. Calculating standard deviations from these P values would not provide a meaningful comparison with the other trials that reported continuous data results. Thus, the data from these two trials were not included in the analyses. This is unfortunate as the Stevens 2006 trial revealed significant differences between the physical activity group and control group for Self-Help Skills (P = 0.006; function).

The only meta-analysis that could be completed was related to the outcome of function. Francese 1997 and Rolland 2007 examined changes in function, measured by the Katz Index of ADL and the CADS scales, from baseline to completion of the physical activities programs (seven weeks and six months respectively). Because the changes in SD scores were not reported, final measures of means,

SDs and number of participants in each group were included in the meta-analysis. Although the I^2 test for heterogeneity was 0%, a random effects model was used in the meta-analysis as the participants varied in cognitive ability (from mild-severe in Rolland 2007 and severe in Francese 1997) and from being able to transfer and walk 6 m (Rolland 2007) to needing one to two person assistance to transfer (Francese 1997). In addition, the physical activity programs differed from walking for the first half hour of the session followed by strength, flexibility and balance training (Rolland 2007) to seated activities such as catching, throwing, and kicking balls, leg weight exercises and parachute reaches (Francese 1997). Non-significant results were revealed (SMD -0.08, 95% CI -0.68, 0.52; Figure 3). Rolland 2007 did report the change in SD scores for the 12 month data, thus mean change scores and SD change scores from baseline to 12 month measurements were used in this analysis. Similar non-significant follow-up results were revealed when the activity program was extended to one year (Rolland 2007; WMD 0.30, CI -0.13, 0.73; Figure 4), however, the effect size had increased over time from 0.08 to 0.30.

Figure 3. Forest plot of comparison: 1 Physical Activity vs Usual Care, outcome: 1.1 Comparison of Function at 7 weeks-6 months (CADS and ADL scores).

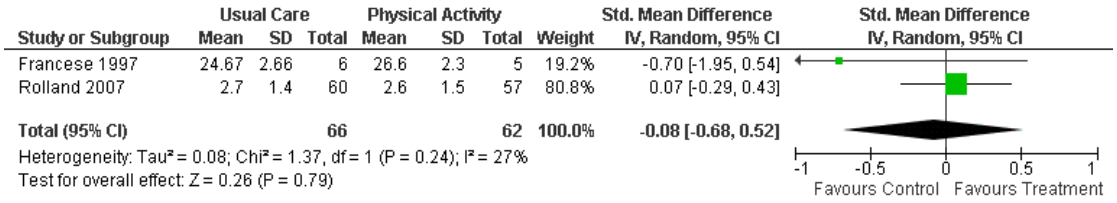
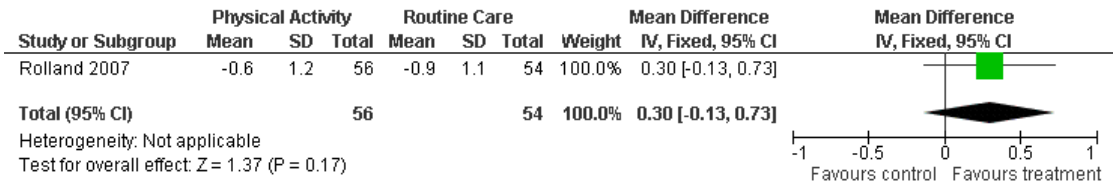


Figure 4. Forest plot of comparison: 2 Physical Activity vs Usual Care , outcome: 2.1 Comparison of Function from baseline to 12 months (ADL scores).



Using NPI and MADRS scores, Rolland 2007 examined changes in behavioural disturbances and depression respectively from baseline to six months and from baseline to 12 months of physical activity. However, the change in SD scores were not reported. Thus, final mean scores, final SD scores, and number of participants in each group were included in the analyses. Using the NPI data to determine changes in behavioural disturbances, both at six and 12 months, the results were non-significant (WMD -0.1, 95% CI -3.96, 1.96 Figure 5; WMD -0.60, 95% CI -4.22, 3.02 Figure 6 respectively). Similarly, non-significant results were found for depression at both six months and 12 months (WMD -1.80, 95% CI -4.14, 0.54 Figure 7; WMD -1.40, 95% CI -4.24, 1.44 Figure 8 respectively).

Figure 5. Forest plot of comparison: 3 Physical Activity vs Usual Care, outcome: 3.1 Comparison of Behavioral Disturbances at 6-months (NPI scores).

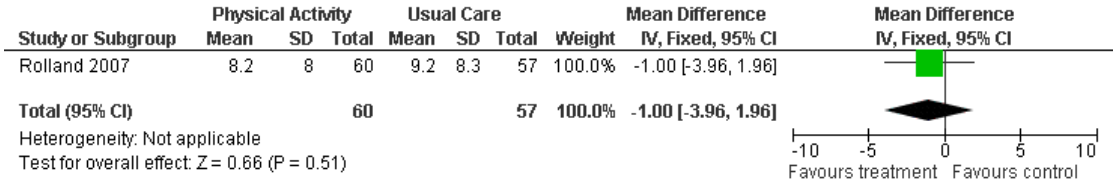


Figure 6. Forest plot of comparison: 4 Physical Activity vs Usual Care, outcome: 4.1 Comparison of Behavioral Disturbances at 12 months (NPI scores).

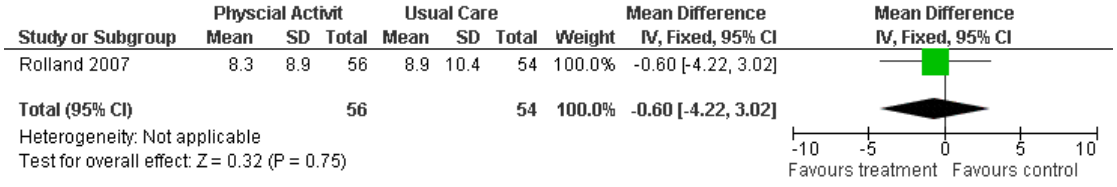


Figure 7. Forest plot of comparison: 5 Physical Activity vs Usual Care, outcome: 5.1 Comparison of Depression at 6 months (MADRS scores).

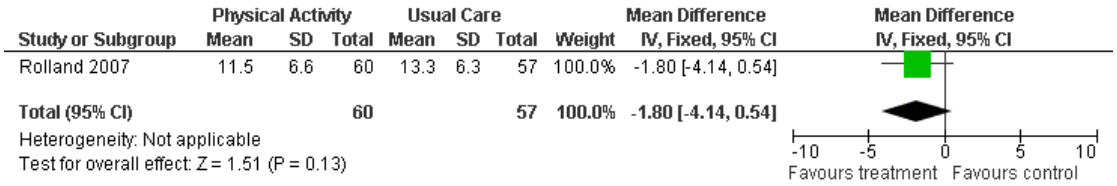
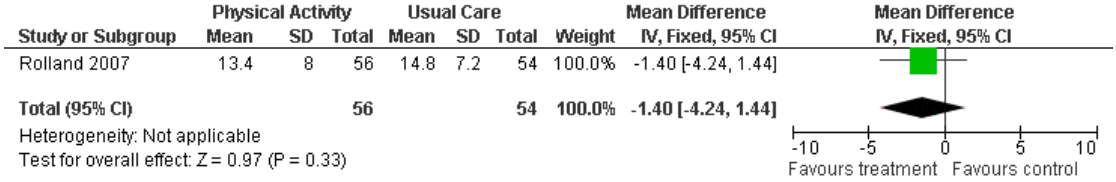


Figure 8. Forest plot of comparison: 6 Physical Activity vs Usual Care, outcome: 6.1 Comparison of Depression at 12 months (MADRS scores).



DISCUSSION

This review of the effectiveness of physical activity programs on cognition, function, behaviour, depression, and mortality in older persons with dementia revealed insufficient evidence of benefit. Trials were not included in the review if the participants were not diagnosed with dementia, the intervention was not compared to usual care or the research design was not a randomized controlled trial that incorporated concealed allocation procedures. The lack of evidence for effectiveness may be due to methodological shortcomings in the published trials. For example, none of the trials used a computer generated randomization technique to assign participants to the intervention or control groups. Because allocation bias is a concern, future research should use a RCT design in which participants are truly randomized. It was difficult to determine the process of randomization and concealment during assignment to groups for many of the trials included. Clinical researchers need to make a practice of providing the information (e.g., process of randomization and concealment) and data (e.g., means and SDs for change from baseline to final measurement scores) required for systematic reviews in published articles or be willing to share this information with reviewers when contacted.

The non-significant results of the meta-analysis may be related to the small sample size (n = 11) of one trial (Francese 1997), although the other trial (Rolland 2007) had an adequate sample size (n = 134). Small sample sizes contribute to insufficient power to detect a difference, if one is present. The non-significant results may also be related to the type of physical activity (e.g., muscle strengthening), frequency (three times per week), duration (20 minutes), and period of time (seven weeks) the program was offered in the one trial (Francese 1997). For adults in general, the evidence is more conclusive that aerobic-type exercise has a clear benefit over resistance training, and moderate-intensity exercise of at least one hour a day, three to five times or more a week may be more effective in improving cognition (Kramer 2007; Middleton 2007). However, these recommendations may not be appropriate for persons with dementia. Thus, further research is needed to determine the type of exercise, frequency, duration, and length of time the activity should be offered for persons with dementia. The poor adherence to the activity programs may also have contributed to the non-significant results. For example, in the Rolland 2007 trial, 35 of the 67 participants attended less than one third of the activity sessions. This trial reported that physical activity adherence was significantly related to less deterioration in ADL scores. Thus, further research should focus on exploring the barriers and facilitators to improving adherence. Perhaps attempting to match the physical activity programs with the needs, capabilities, and preferences of persons with dementia, and ensuring adequate funding to provide regular, appropriate programs, over extended periods, by qualified instructors would increase adherence (Forbes 2007).

The participants within the trials were not homogeneous in terms of their diagnosis and severity of dementia and level of mobility. Rolland 2007 and Francese 1997 included only participants with a diagnosis of Alzheimer's disease while the other two trials (Holliman 2001; Stevens 2006) required only a diagnosis of dementia. Dementia cannot be viewed as a single disease entity as there is preliminary evidence that physical activity might affect the risk of these conditions differently (Rockwood 2007). Several observational studies have found that the preventive effects of physical activity may be weaker for vascular dementia than for Alzheimer's disease or dementia in general (Rockwood 2007). The levels of severity of cognitive impairment also varied from mild to severe even within trials (e.g., Rolland 2007) and between trials. Differences were also apparent in the levels of mobility of participants, for example Rolland 2007 required that participants be able to transfer from a chair and walk at least 6 m without human assistance, and participants in the Francese 1997 trial were all non-ambulatory. These diversities have implications for the type of intervention and approach used in physical activity programs. Investigators need to be sensitive to the importance of controlling for these differences in pathology and severity of dementia and level of mobility when designing trials that examine the effectiveness of physical activity.

It was only possible to combine data in a single meta-analysis. This analysis compared changes in function between the experimental and control groups. Single trials examined changes in behavioural disturbances and depression following the physical activity programs. Although cognition was measured using the MMSE at baseline in three of the trials studies (Holliman 2001; Rolland 2007; Stevens 2006), cognition was not included as a measure of outcome. In addition, no included trials examined the other outcomes of interest, namely the impact on family caregivers' health and quality of life and use of health care services. Clearly, further RCTs are needed to explore these important outcomes in relation to the person with dementia and their family caregivers. Only the Rolland 2007 trial examined potential adverse effects of physical activity programs for persons with dementia (i.e., falls, fractures, and death). No differences between the physical activity plus usual care group and usual care group were reported. Further research is required to determine if this population is similar to older adults in general who are less likely to fall and less likely to injure themselves from falls if they are physically active (Kannus 2005; Sherrington 2004) or is the risk of falling higher in persons with dementia during physical activity?

Due to the small number of trials included in the review, sub-group analysis to determine a dose-response between the type, frequency, and intensity of physical activity and the degree of protection from cognitive decline and other outcomes could not be examined. Similarly, determining the influence of age, co-morbidities, and setting (institution versus home) on the outcomes of interest was not possible. Clearly further research is required in this population.

giver's health, quality of life, and mortality.

Implications for research

As there is rationale for physical activity in managing or improving important manifestations of dementia, further and better-designed research is required.

Trials should incorporate:

1) a randomized controlled parallel-group design with statistically appropriate analyses,

2) a computer generated randomization technique,

3) a more homogeneous sample in terms of diagnosis, severity of disease and mobility,

4) a sample size with sufficient power to detect an effect (positive or negative) of clinically significant magnitude,

5) a well designed physical activity intervention that is appropriate for people with dementia, and

6) blinded and objective outcome ratings.

Further research is necessary to identify the optimal physical activity modalities particularly in terms of frequency, intensity, and duration for persons with different types and severity of dementia. Outcomes that contribute to the quality of life of those with dementia and their family caregivers should be examined as well as potential adverse effects of physical activity. Economic analyses comparing the different interventions are also needed.

AUTHORS' CONCLUSIONS

Implications for practice

There is insufficient evidence of the effectiveness of physical activity programs on cognition, function, depression behaviour, and mortality in older persons with dementia and on their family care-

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* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Francese 1997

Methods	Randomly assigned to experimental physical activity group or control group, 7 week trial duration
Participants	Country: USA 12 Medicare nursing facility residents. Age and sex of participants not reported.
Interventions	Incorporated use of music, canes, bean bags, parachute leg weights, and beach, squoosh and velcro balls Frequency = 3 times per week Duration = 20 minutes Time period = 7 weeks
Outcomes	Function
Notes	

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Unclear	Unclear
Allocation concealment?	Unclear	Used a random numbers table
Blinding? All outcomes	No	Outcome assessors not blinded to group allocation
Incomplete outcome data addressed? All outcomes	Unclear	Attrition rate was 8.3% and rate of compliance not reported

Holliman 2001

Methods	Randomly assigned to experimental physical activity group or control group, 2 week trial duration
Participants	Country: USA 14 geriatric psychiatric facility residents (12 women and 2 men). MMSE (mean=4.57, SD=4.88). Ages of participants were: 65-69, n=1; 70-74, n=3; 75-79, n=3; 80-84, n=4; 85-89, n=3. All were pronounced to be a danger to themselves or other.
Interventions	Activity targeted gross and fine motor skills and movement in a way that was meaningful and appropriate for participants. Frequency = 3 times per week

Holliman 2001 (*Continued*)

	Duration = 30 minutes Time period = 2 weeks
Outcomes	Function Behaviour
Notes	In the published article the following statement is made "the sample was not fully randomly assigned due to patient availability, informed consent matters, and institutional procedures" p. 67. E-mail messages clarified the process of randomization (see text).

Risk of bias

Item	**Authors' judgement**	**Description**
Adequate sequence generation?	Unclear	Numbers used but unaware of where they originated
Allocation concealment?	Unclear	Used envelopes
Blinding? All outcomes	Yes	Outcome assessors were blinded to group allocation
Incomplete outcome data addressed? All outcomes	Unclear	Attrition rate was 14.29% and "all participants were active almost all the time".

Rolland 2007

Methods	Randomly assigned to experimental physical activity group (two to seven participants per group) or control group, 12 month trial duration, 2 week enrolment, single blind
Participants	Country: France 134 nursing home residents (101 women and 33 men), mean age 83, MMSE (mean=8.8, SD=6.6) with mild to severe AD, ADL (mean=3.1, SD=1.3).
Interventions	Activity consisted of aerobic (walking), strength (lower extremity), flexibility and balance training. Frequency = 2 times per week Duration = one hour Time period = 1 year
Outcomes	Function Mood Behaviour
Notes	

Risk of bias

Rolland 2007 (*Continued*)

Item	Authors' judgement	Description
Adequate sequence generation?	Yes	Used lottery draw
Allocation concealment?	Yes	Published in Forbes 2007
Blinding? All outcomes	Yes	Geriatrician outcome assessor was blinded to group allocation. Data analysts also blinded.
Incomplete outcome data addressed? All outcomes	Yes	Attrition rate was 18%, however 100% were included in intention to treat analysis (Forbes 2007).

Stevens 2006

Methods	Randomly assigned to experimental physical activity group, social visit control group and no intervention control group, 12 week trial duration
Participants	Country: Australia 120 eligible residents 75 nursing home residents completed trial study (56 women and 19 men), mean age 80.5
Interventions	Activity was based on joint and large muscle group movement with the intention of creating gentle aerobic exertion Frequency = 3 times per week Duration = 30 minutes Time period = 3 months
Outcomes	Function Cognition Behaviour
Notes	

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Yes	Lottery method
Allocation concealment?	Unclear	Simply stated that subjects were randomly allocated by a lottery method
Blinding? All outcomes	Unclear	Inclear if outcome assessors blinded to group allocation

Stevens 2006 (*Continued*)

Incomplete outcome data addressed? All outcomes	Unclear	Attrition rate was 37.5%; rate of compliance not reported

Characteristics of excluded studies *[ordered by study ID]*

Anon 1986	Participants not diagnosed with dementia (residents of senior citizens housing)
Batman 1999	Unknown study design (may not be RCT), unknown age of participants, not able to contact author
Bentley 2003	Unable to contact author. Email from Anthony Davis (Anthony.Davis@oxleas.nhs.uk)on April 12, 2007 that copy of article not available, trial may not have been completed
Gillogly 1991	Inadequate allocation concealment
Littbrand 2006	Participants not diagnosed with dementia (older, dependent people)
Netz 1994	Participants not diagnosed with dementia (cognitive deterioration and/or depression)
Powell 1974	Participants not diagnosed with dementia (geriatric mental patients)
Rodgers 2002	Participants not diagnosed with dementia (elderly veterans)
Scherder 2005	Participants not diagnosed with dementia (mild cognitive impairment)
Tappen 2000	Outcome measured was mobility, an outcome that was not of interest
Van de Winckel 2004	Inadequate allocation concealment
van Uffelen 2005	Participants not diagnosed with dementia (mild cognitive impairment)
Viscogliosi 2000	Participants not diagnosed with dementia (mild cognitive impairment)

DATA AND ANALYSES

Comparison 1. Physical Activity vs Usual Care

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Comparison of Function at 7 weeks-6 months (CADS and ADL scores)	2	128	Std. Mean Difference (IV, Random, 95% CI)	-0.08 [-0.68, 0.52]

Comparison 2. Physical Activity vs Usual Care

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Comparison of Function from baseline to 12 months (ADL scores)	1	110	Mean Difference (IV, Fixed, 95% CI)	0.30 [-0.13, 0.73]

Comparison 3. Physical Activity vs Usual Care

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Comparison of Behavioral Disturbances at 6-months (NPI scores)	1	117	Mean Difference (IV, Fixed, 95% CI)	-1.0 [-3.96, 1.96]

Comparison 4. Physical Activity vs Usual Care

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Comparison of Behavioral Disturbances at 12 months (NPI scores)	1	110	Mean Difference (IV, Fixed, 95% CI)	-0.60 [-4.22, 3.02]

Comparison 5. Physical Activity vs Usual Care

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Comparison of Depression at 6 months (MADRS scores)	1	117	Mean Difference (IV, Fixed, 95% CI)	-1.80 [-4.14, 0.54]

Comparison 6. Physical Activity vs Usual Care

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Comparison of Depression at 12 months (MADRS scores)	1	110	Mean Difference (IV, Fixed, 95% CI)	-1.40 [-4.24, 1.44]

Analysis 1.1. Comparison 1 Physical Activity vs Usual Care, Outcome 1 Comparison of Function at 7 weeks-6 months (CADS and ADL scores).

Review: Physical activity programs for persons with dementia

Comparison: 1 Physical Activity vs Usual Care

Outcome: 1 Comparison of Function at 7 weeks-6 months (CADS and ADL scores)

Study or subgroup	Usual Care N	Mean(SD)	Physical Activity N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
Francese 1997	6	24.67 (2.66)	5	26.6 (2.3)		19.2 %	-0.70 [-1.95, 0.54]
Rolland 2007	60	2.7 (1.4)	57	2.6 (1.5)		80.8 %	0.07 [-0.29, 0.43]
Total (95% CI)	**66**		**62**			**100.0 %**	**-0.08 [-0.68, 0.52]**

Heterogeneity: Tau² = 0.08; Chi² = 1.37, df = 1 (P = 0.24); I² =27%

Test for overall effect: Z = 0.26 (P = 0.79)

Analysis 2.1. Comparison 2 Physical Activity vs Usual Care, Outcome 1 Comparison of Function from baseline to 12 months (ADL scores).

Review: Physical activity programs for persons with dementia

Comparison: 2 Physical Activity vs Usual Care

Outcome: 1 Comparison of Function from baseline to 12 months (ADL scores)

Study or subgroup	Physical Activity N	Mean(SD)	Routine Care N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Rolland 2007	56	-0.6 (1.2)	54	-0.9 (1.1)		100.0 %	0.30 [-0.13, 0.73]
Total (95% CI)	**56**		**54**			**100.0 %**	**0.30 [-0.13, 0.73]**

Heterogeneity: not applicable

Test for overall effect: Z = 1.37 (P = 0.17)

Analysis 3.1. Comparison 3 Physical Activity vs Usual Care, Outcome 1 Comparison of Behavioral Disturbances at 6-months (NPI scores).

Review: Physical activity programs for persons with dementia

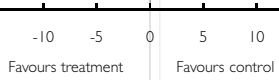
Comparison: 3 Physical Activity vs Usual Care

Outcome: 1 Comparison of Behavioral Disturbances at 6-months (NPI scores)

Study or subgroup	Physical Activity N	Mean(SD)	Usual Care N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Rolland 2007	60	8.2 (8)	57	9.2 (8.3)		100.0 %	-1.00 [-3.96, 1.96]
Total (95% CI)	**60**		**57**			**100.0 %**	**-1.00 [-3.96, 1.96]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.66 (P = 0.51)

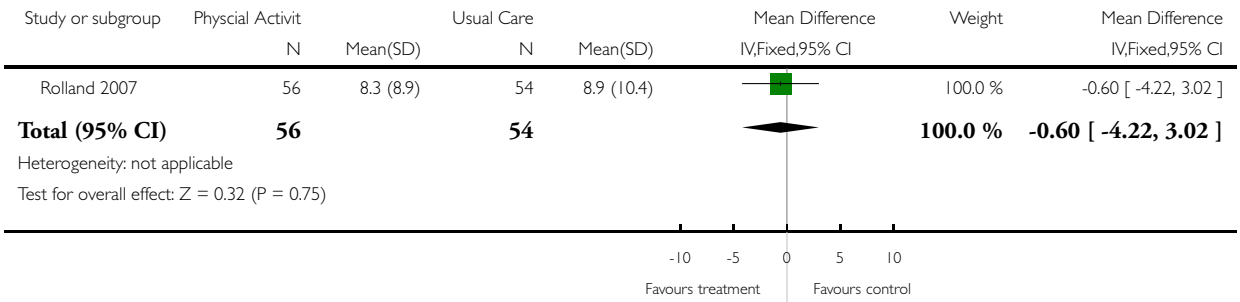


Analysis 4.1. Comparison 4 Physical Activity vs Usual Care, Outcome 1 Comparison of Behavioral Disturbances at 12 months (NPI scores).

Review: Physical activity programs for persons with dementia

Comparison: 4 Physical Activity vs Usual Care

Outcome: 1 Comparison of Behavioral Disturbances at 12 months (NPI scores)

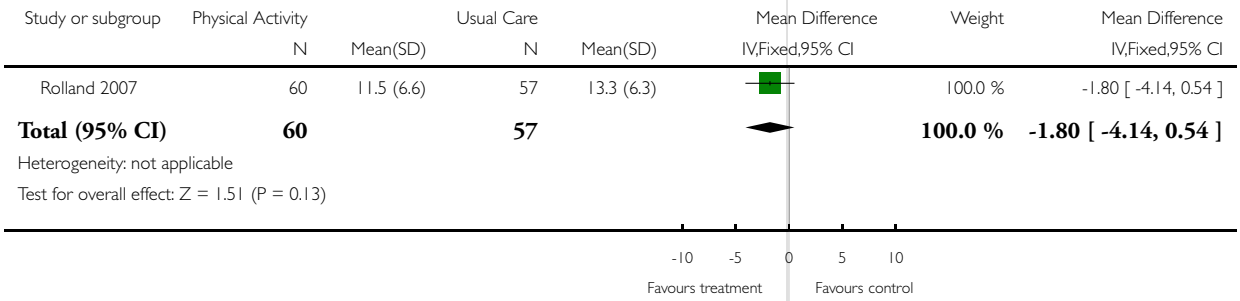


Analysis 5.1. Comparison 5 Physical Activity vs Usual Care, Outcome 1 Comparison of Depression at 6 months (MADRS scores).

Review: Physical activity programs for persons with dementia

Comparison: 5 Physical Activity vs Usual Care

Outcome: 1 Comparison of Depression at 6 months (MADRS scores)

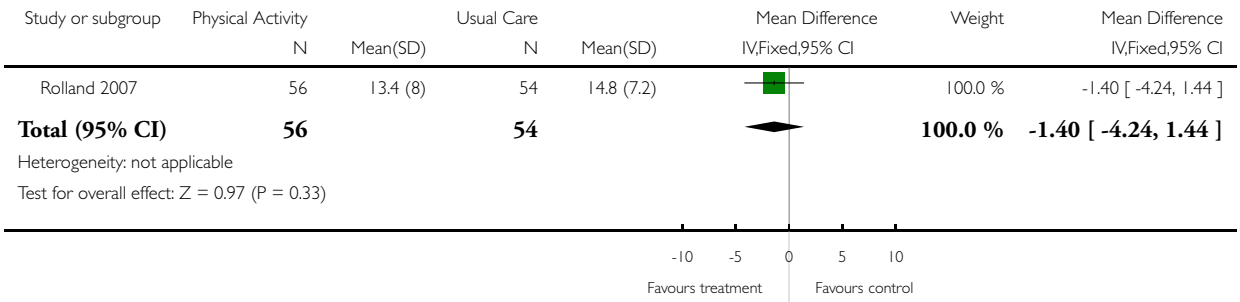


Analysis 6.1. Comparison 6 Physical Activity vs Usual Care, Outcome 1 Comparison of Depression at 12 months (MADRS scores).

Review: Physical activity programs for persons with dementia

Comparison: 6 Physical Activity vs Usual Care

Outcome: 1 Comparison of Depression at 12 months (MADRS scores)



WHAT'S NEW

Last assessed as up-to-date: 23 January 2008.

28 May 2008	Amended	In additional Table 1: Description of Rating Scales Used in the Included Studies, the abbreviation for Psychogeriatric Dependency Rating Scale has been changed to PGDRS from PGSRS

HISTORY

Protocol first published: Issue 2, 2007

Review first published: Issue 3, 2008

14 December 2007	New citation required and conclusions have changed	Substantive amendment

CONTRIBUTIONS OF AUTHORS

DF: all correspondence

DF, SF, DM, MMR, JW, IC: extraction of data, interpretation of data analysis

DF, SF, DM, MMR, JW, IC: drafting review versions

DF, JW, IC: entry of data into RevMan

DF: obtaining hard copy

Consumer editor: Ted Sayer

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DECLARATIONS OF INTEREST

None known

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INDEX TERMS

Medical Subject Headings (MeSH)

*Motor Activity; Cognition; Dementia [psychology; *rehabilitation]; Depression [rehabilitation]; Exercise; Exercise Therapy; Randomized Controlled Trials as Topic; Tai Ji; Yoga

MeSH check words

Aged; Humans