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Abstract

Background Physical exercise interventions have benefits for older individuals and improve the health and well-being of individuals living with a dementia, specifically those living in nursing homes. **Purpose** Report evidence from randomized controlled trials and cluster randomized control trials that evaluated the effects of physical exercise interventions on individuals living with a dementia in nursing homes. **Data sources** Web of Science, Scopus, Science Direct, Academic Search Complete, Proquest Central, British Medical Journal Database, PubMed, Cochrane Library, PEDro, Informit, Informa, and Nursing Consult were searched for relevant clinical trials and snowballing of recommended studies. **Study selection** One reviewer screened articles on inclusion criteria and identified relevant studies. **Data extraction** Data extraction was performed by 1 reviewer and checked by second and third reviewers. Two authors assessed the methodological quality and risk of bias of the relevant studies. **Data synthesis** Twelve study populations consisting of individuals living with a dementia in nursing homes were included (n = 901). Different types of physical exercises were undertaken: multimodal (n = 6), walking (n = 5), music and movement (n = 2), and hand exercises (n = 1). The parameters of the interventions varied across the studies. Most of the studies reported significant positive effects of physical exercise on cognition, agitation, mood, mobility, and functional ability for individuals living with dementia in nursing homes. **Limitations** The main limitations were the heterogeneity of design, small samples, and short interventions. **Conclusions** There is emerging evidence that physical exercise significantly benefits individuals living with a dementia in nursing homes. Higher quality research is required adopting more rigorous methods, including longer interventions and larger samples to determine optimum parameters of the physical exercise interventions evaluated.

Disciplines

Medicine and Health Sciences | Social and Behavioral Sciences

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Effects of Physical Exercise on Health and Well-Being of Individuals Living With a Dementia in Nursing Homes: A Systematic Review

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Abstract

Background. Physical exercise interventions have benefits for older individuals and improve the health and well being of individuals living with a dementia, specifically those living in nursing homes.

Purpose. Report evidence from randomized controlled trials and cluster randomized control trials that evaluated the effects of physical exercise interventions on individuals living with a dementia in nursing homes.

Data sources. Web of Science, Scopus, Science Direct, Academic Search Complete, Proquest Central, British Medical Journal Database, PubMed, Cochrane Library, PEDro, Informit, Informa and Nursing Consult were searched for relevant clinical trials and snowballing of recommended studies.

Study selection. One reviewer screened articles on inclusion criteria and identified relevant studies.

Data extraction. Data extraction was performed by one reviewer and checked by second and third reviewers. Two authors assessed the methodological quality and risk of bias of the relevant studies.

Data synthesis. Twelve study populations consisting of individuals living with a dementia in nursing homes were included (n=901). Different types of physical exercises were undertaken: multimodal (n=6), walking (n=5), music and movement (n=2) and hand exercises (n=1). The parameters of the interventions varied across the studies. Most of the studies reported significant positive effects of physical exercise on cognition, agitation, mood, mobility and functional ability for individuals living with dementia in nursing homes.

Limitations. The main limitations were the heterogeneity of design, small samples and short interventions.

Conclusions. There is emerging evidence that physical exercise significantly benefits individuals living with a dementia in nursing homes. Higher quality research is required adopting more rigorous methods, including longer interventions and larger samples to determine optimum parameters of the physical exercise interventions evaluated.

Keywords: exercise; physical activity; dementia; Alzheimer's; nursing home

Introduction

As global fertility rates decline and life expectancy rises, the ageing population increases. In later life, the incidence of chronic conditions increases and an associated rise in the prevalence of age related morbidities, such as dementia. Worldwide, there are 35.6 million individuals living with a dementia and 7.7 million new cases are diagnosed each year⁽¹⁾. The most common form of dementia is Alzheimer's Disease (60-70% of cases) and other forms of dementia include vascular, Lewy bodies, frontotemporal, Parkinson's', multi infarct and mixed⁽¹⁾.

Most individuals living with dementia have regular contact with healthcare services. The overall aim of healthcare services for individuals living with dementia is to optimize their health and well being and that of their family carers, including treatment of the associated behavioral, psychological and physical symptoms of dementia⁽¹⁾. Dementia care services implement a range of strategies, such as psychosocial activities, behavior strategies, sensory stimulation, medication and physical exercise, to achieve their goals of improving the health and well being of individuals living with a dementia⁽²⁾. We know that physical exercise is beneficial for healthy older individuals by improving mobility, physical function, cognition and mood and preventing falls^(3,4). A Cochrane review reported that physical exercise significantly effects individuals with a dementia living in various settings but further research was needed to explain the specific effects and what type of physical exercise is most beneficial⁽⁵⁾.

Thirty percent of individuals with a dementia live in nursing homes due to the disabling effects and increased dependency associated with dementia⁽⁶⁾. A nursing home is an accommodation service in which an individual is provided with a high level of nursing and/or personal care, including care staf who provide these nursing and personal care needs as well as meals, cleaning and furnishings and equipment for the provision of that care ⁽⁷⁾. Demands for nursing homes will increase as the prevalence of dementia continues to rise⁽⁸⁾. In nursing homes, care services and interventions are provided by a range of practitioners, including nurses, Occupational Therapists, Diversional Therapists and Physical Therapists. The main focus of the Physical Therapist is to direct the implementation of physical exercise strategies which improves and maintains range of movement, strength, balance, mobility and functional ability in individuals and contribute to improved quality of life for individuals living with a dementia in nursing homes. Physical exercise is defined as physical activity that is

planned, structured, repetitive and has a final or intermediate objective of improving or maintaining physical fitness⁽³⁾. It is important to know what type of physical exercise best suits this population to ensure the work of physical therapists is evidence based and engages individuals living with a dementia physically and mentally⁽⁹⁾. The purpose of this systematic review was to evaluate evidence from randomized controlled trials (RCTs) and cluster RCTs measuring the effects of physical exercise on the health and well being of individuals living with a dementia in nursing homes. The influence of the studies on future research and clinical practice was also considered.

Methods

This systematic review was informed by the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) Statement⁽¹⁰⁾.

Data searches and study selection

A comprehensive literature search was undertaken using a range of databases to retrieve relevant studies for the review: Web of Science, Scopus, ScienceDirect, Academic Search Complete, Proquest Central, British Medical Journal Database, PubMed, Cochrane Library, PEDro, Informit, Informa and Nursing Consult. The search terms used were: for population: "Dementia", "Alzheimer's"; for intervention: "Exercise", "Physical activity", "Physical intervention", "Physiotherapy", "Physical therapy", "Walking"; for setting: "Nursing home", "Residential accommodation", "Aged care facility", "Long term care", "Care home", "Rest home"; for outcome: "Physical function", "Healthcare outcome measure", "Behaviors", "Agitation". In addition, snowballing was used to locate additional references.

The titles and abstracts of all studies found in the database searches and from snowballing were screened and duplicates and irrelevant studies excluded. From the remaining studies, the full text was read to identify relevant information and checked against the inclusion criteria. Studies were eligible if they: (1) involved participants diagnosed with a dementia; (2) used a physical exercise intervention; (3) set in a nursing home; (4) were a RCT or cluster RCT; (5) published in English. The references of review papers identified were also checked for additional relevant studies that could have been missed in the database searches.

Methodological quality assessment

The quality of the studies was critically appraised using the Joanna Briggs Institute Critical Appraisal Tool: Meta Analysis of Statistics Assessment and Review Instrument (MAStARI) critical appraisal tool for randomized control/pseudo randomized control trials⁽¹¹⁾. Ten items were considered, they evaluated the randomization process, blinding, intention to treat analysis, homogeneity of groups, outcome measures and statistical analysis (Table 1). Each item was either answered 'yes' or 'no'. When there was insufficient information to answer the question or it was unclear 'no' was recorded. After completing the evaluation of a paper, it was given a score out of 10 and the score increased with higher methodological quality. Two reviewers score all selected studies and differences between reviewers are discussed and an agreement reached on the final score allocated to the study and if agreement cannot be met a third reviewer scores the studies. A cutoff value of the mean score minus one Standard Deviation is used to ensure only high quality studies are included in the review.

Data extraction and analysis

Data extraction was completed by one reviewer using a standardized extraction form. This was checked by second and third reviewers and any obscurities discussed to avoid potential errors or misinterpretation of results. A meta-analysis was not possible due to the large variability between the studies: physical exercise intervention, parameters applied, outcome measures, who conducted the intervention and type of dementia among the participants (not specified in majority of the studies).

Results

A PRISMA Consort Statement summarized the outcomes of the literature search (Figure 1). Screening the titles and abstracts found 1,722 (94%) irrelevant and duplicated studies. Full texts of the remaining 102 studies were read and the inclusion criteria applied: 15 eligible studies of which three were excluded due to low methodological quality. Twelve studies were included in the systematic review: 11 RCTs⁽¹²⁻²⁴⁾ and one cluster RCTs⁽²⁵⁾, of which one RCT had generated three separate publications. Williams C (2015 pers. comm., 16 July) and Roach K (2015 pers. comm., 22 July) verified through email communications that each publication was drawn from the same sample^(14, 22, 23).

Methodological quality

The methodological quality of the studies was assessed using the MASTARI critical appraisal tool for randomized/pseudo randomized control trials (from the Joanna Briggs Institute Critical Appraisal Tools) (Table 1)⁽¹¹⁾. Both reviewers were able to agree on the scores for all studies without the need to consult the third reviewer. Fifty seven percent of the studies received a score of seven or above which suggests the results were less likely to be bias^(12, 15, 17, 18, 20, 22, 25). Eight was the highest score obtained: achieved by four studies^(12, 15, 17, 18). Three studies obtained a score of less than five (cutoff value) so were excluded from the systematic review due to their high risk of bias⁽²⁶⁻²⁸⁾. Most studies obtained points for the method used to conduct the outcome measures and use of appropriate statistical analysis. As is the case with a lot of clinical trials, it was not possible to blind participants to the intervention allocation that they would participate in, therefore no studies received a score for this quality. Common shortcomings in methodological quality were lack of allocator blinding and detail about attrition and intention to treat analysis.

Participant characteristics and sample size

The selected studies were undertaken across different continents: Europe (n=8), North America (n=1), South America (n=1), Canada (n=1) and Asia (n=1). The important characteristics and significant results of the studies were summarized (Table 2). The total number of participants in the studies was 901 (mean age 82.6 (3.5) years). All participants lived in nursing homes and were recognized as living with a dementia.

The severity of dementia varied across the studies from mild to severe. Some studies only included individuals with a specific level of severity, others included individuals with a range of severity levels; the most common selection was individuals across the spectrum of mild to severe dementia (n=4). When determining the severity, tools such as the Clinical Dementia Rating and the Global Deterioration Scale should be used as they assess multiple aspects of dementia: cognition, emotion, memory and functional ability⁽²⁹⁾; both scale were used in one study each^(20, 21). Often, cognitive screening tools such as the Mini Mental State Examination (MMSE) are used to determine severity of dementia, and in this review it was the most commonly used approach to assessing severity of dementia (n=10). This tool is limited because it only assesses one element of dementia and is influenced by the educational level of an individual⁽²⁹⁾. Due to the variation of tools used and

the different aspects of dementia assessed, it was not possible to compare the effects of physical exercise on the severity of dementia across the studies.

Information about the functional ability of participants was limited in all studies. Only one included a sub analysis of participants that had low mobility (determined by the inability to walk more than 91.4 meters in the six minute walk test at baseline); they found that the changes were the same as in the whole group analysis though any improvements made were more pronounced in the low mobility group^(14, 22, 23). One study did not mention the functional ability of the participants⁽¹⁸⁾ and all other studies only provided information on the required functional ability as part of the inclusion criteria. The level of functional ability and how it was measured varied widely across the studies. Some studies only stated tasks that participants were able to complete: sit and engage in simple activities^(16, 20), have no hand disabilities⁽²⁵⁾, be able to walk with or without assistance (type and level of assistance varied between studies)^(12, 13, 15, 19, 24), or be dependent in an activity of daily living (ADL) and have the ability to walk with or without assistance^(14, 22, 23). Other studies used more rigorous methods of functional assessment, such as the Barthel Index (BI)⁽²¹⁾, the Performance Orientated Mobility Assessment⁽²¹⁾ and the German scale of medical care⁽¹⁷⁾. The heterogeneity of functional ability among participants and how this was assessed across the studies meant it was not possible to determine which level of function benefited the most from a physical exercise intervention.

Control group type

All studies used a control group. Five control groups received some form of interaction: four had individual social visits/conversations^(12-14, 16, 22, 23) and one participated in group reading sessions⁽²⁵⁾. All groups received the control activity for the same duration and frequency as the intervention group. Six control groups received no extra input but continued to participate in the usual care and activities provided at the nursing homes^(15, 17, 19-21, 24). One control group had no motor intervention (the meaning of 'no motor intervention' was not clarified by the authors)⁽¹⁸⁾.

Intervention characteristics

Three of the studies had two intervention groups^(14, 18, 22-24). The proportion of individual and group settings were similar: eight group interventions^(15-18, 20, 24, 25), six individual interventions^(12-14, 18, 21-23) and it was unclear

in one study⁽¹⁹⁾. The intervention characteristics varied across the studies (Table 2), though some similarities were found in terms of the type of physical exercise completed: (i) Multimodal (n=6); (ii) walking (n=5); (iii) music and movement (n=2); and (iv) hand exercises (n=1). One study had a second intervention group that did not involve physical exercise, instead it was a conversation only group⁽²⁴⁾. The multimodal groups included interventions that combined different types of physical exercises targeting strength, balance, flexibility, aerobic capacity, cognition, functional ability and/or coordination^(14, 15, 17-19, 22, 23). The most common combination was physical exercises in sitting and standing for strength, balance and flexibility combined with walking^(14, 15, 22, 23). All the walking groups were supervised and occurred inside, four were individual sessions^(12-14, 21-23) and one was completed in pairs⁽²⁴⁾. The music and movement groups focused more on the music and involved generalized movement of the arms and legs^(16, 20). The hand exercises group only completed hand exercises, although not common, was included as this systematic review which considered all types of physical exercise⁽²⁵⁾. This was similar to the open inclusion criteria adopted in the Cochrane systematic review completed in 2013⁽⁵⁾. Older individuals living with a dementia in nursing homes are often frail and not able to participate in physical activities such as walking or standing exercises⁽³⁰⁾. It is important that different types of physical exercise interventions, such as hand exercises are considered to accommodate varied abilities, and why the hand exercises study was included in this systematic review.

The duration of the intervention varied greatly among the studies from four weeks to 52 weeks (mean duration 17.4 (11.5) weeks). There was also variability in the frequency (mean 4.5 (1.4) sessions per a week) and length (mean 49.3 (30.2) minutes) of the interventions. In most studies, the intensity was not stated (n=10) and of the two studies that did, it was moderate^(15, 21). The most common parameters were 5 sessions per week (n=6), 30 minutes per session (n=8) at moderate intensity (n=2). These parameters were similar to the recommendation by the American College of Sports Medicine for 'apparently healthy adults' which advised 5 or more sessions of moderate intensity physical exercise or 3 or more sessions of high intensity physical exercise for 30 to 60 minutes per week⁽³⁾.

Compliance of the physical exercise intervention was only detailed in five studies; one only had a mean compliance rate of 33%⁽¹⁵⁾, whilst the others ranged from 91 to 100%^(12, 13, 19, 21). Four other studies stated that

compliance was monitored but no numerical data was provided^(14, 18, 20, 22, 23, 25). Three studies did not discuss compliance^(16, 17, 24). Even though compliance was only detailed in less than half of the studies, majority of those that did showed a high compliance from individuals living with a dementia in nursing homes.

Outcome measures

A range of outcome measures were used (n=38) to evaluate different aspects of health and well being, such as cognitive function (n=10), mood and depression (n=8), functional ability (n=5), mobility (n=4) and unmet needs* (n=4). Other areas included balance, agitation, communication, activity levels and nutrition. Generally, outcome measures were collected at baseline and endpoint with three studies also completing data collection halfway through the intervention and four with a follow up at six or 24 weeks post intervention.

Psychological health and well being outcomes

Cognition

Seven studies used outcome measures that evaluated cognition^(12, 16-19, 21, 25), the MMSE was the most commonly used^(16, 18, 21, 25) and produced significant results in two studies^(16, 21). In one study the music and movement group's MMSE score improved significantly from 12.9 (5) to 15.5 (4.4) and at the end of the study the score was 2.7 greater than the control group. This represented a medium effect size of 0.5; the multimodal intervention group was clinically relevant⁽¹⁶⁾. The music and movement group also significantly improved in median category fluency score (one of the subscales of the Amsterdam Dementia Screening Test 6) from 10 to 14, compared to the control group which only increased by 0.5⁽¹⁶⁾. In the other study the interaction between groups could not be properly interpreted, however they did find the MMSE score of the control group decreased significantly from 12 (2) to 6 (2) over time, while the walking group only decreased by one point⁽²¹⁾.

Other cognition outcome measures used which showed significant changes include: The Nurses' Observation Scale for Geriatric Patients (NOSGER) which found significant improvements in the multimodal group (total score and memory subscale) over time while the control group remained unchanged⁽¹⁷⁾; the French Rapid

* Healthcare practitioners and researchers working in the field of dementia care describe 'unmet needs' as those displayed as behaviors by individuals which cannot be easily explained, for example constant calling out, performing repetitive mannerisms and making strange noises.

Evaluation of Cognitive Function test that found the multimodal group significantly improved over time from 26.8 (6.4) to 30.4 (7.7) which was significantly greater than the control group's post intervention score of 23.2 (8.4). These findings also demonstrated a significant correlation with the walking parameters (speed, stride length and double limb support time) assessed as part of this study⁽¹⁹⁾; and the Brief Cognitive Screening Battery (BCSB) that showed even though there was a global decline in cognition in the two multimodal groups and the control group, the multimodal group that was led by a multidisciplinary team declined at a significantly slower rate in the Clock Drawing Test and Verbal Fluency Test (components of the BCSB) compared to the control group⁽¹⁸⁾. Other cognitive outcome measures used were the Rivermead Behavioral Memory Test, Eight Words Test, Digit Span, Category and Letter Fluency Tests which were used in two studies but no significant changes were observed^(12, 25).

Mood and Depression

Mood and depression categories have been combined as one for the purpose of this systematic review as all studies that stated they assessed the benefits of physical exercise on mood and/or depression looked at both similarly. Mood and depression was evaluated in four studies using a variety of outcome measures^(15, 17, 22, 23, 25). One study used the Alzheimer's Mood Scale (AMS), Dementia Mood Assessment Scale (DMAS), Cornell Scale for Depression in Dementia (CSDD) and the Observed Affect Scale^(22, 23). The study compared the effect of a multimodal physical exercise intervention with walking and a control group on the mood of participants and also completed a sub analysis of those with depression (determined by a score of seven or higher on the CSDD). The multimodal group showed the most improvement, followed by the walking group and then the control group. However, this was only significant for some of the outcome measures when differences between the group's baseline MMSE, physical ability, treatment intensity, depression and affect or mood score were controlled. There were differences in the DMAS posttest adjusted scores for each group, though preplanned contrasts indicated that only the difference between the comprehensive exercise groups score (19.7) and the control group (33.1) was significant. The control group had an adjusted posttest AMS negative subscale score of 64.2 which was significantly poorer than the multimodal group score of 46.9 and the walking group score of 53, the difference between the two physical exercise intervention groups was not significant⁽²³⁾. This was also reflected in the sub analysis of depressed individuals living with a dementia which demonstrated a significant difference in the posttest adjusted score of the negative subscale of the AMS of the control group

(72.3) when compared to the multimodal group (55.2) and the walking group (52), again the difference between the two physical exercise intervention groups was not significant⁽²²⁾.

Other studies showed mixed results in mood and depression using different outcome measures: In one study the mood subscale of the NOSGER significantly improved over time in the multimodal group by one point (moderate effect size) but remained the same in the control group, however no relative advantage of the change between the groups was found⁽¹⁷⁾; another study used a combination of the Symptoms Check List and the GDS, in the pre protocol analysis a significant reduction in the combined feelings of anxiety and depression in the hand exercise group was found ($t(22)=2.7, p=0.01$) whereas there was no change in the control group ($t(23)=-1.7, p=0.1$)⁽²⁵⁾; and one study that compared a multimodal physical exercise intervention to a control group found no significant changes with the Montgomery and Asberg Depression Rating Scale⁽¹⁵⁾.

Agitation

One study evaluated the effect on agitation using the Cohen Mansfield Agitation Inventory (CMAI) and found a significant improvement over time in the music and movement group which was also significantly different to the control group at the halfway and endpoint of the study; halfway difference of 0.6 (0.2) and endpoint difference of 1.1 (0.4)⁽²⁰⁾.

Unmet needs

Four studies used outcome measures that evaluated unmet needs^(15-17, 24). One study demonstrated a change in the 'need for help' unmet needs subscale of the Dutch version of the Stockton Geriatric Rating Scale in the control group; a significant improvement from 23 to 17.5 at the intervention halfway point, then a significant reverse trend at the endpoint as the score increase back to 21. The music and movement group improved, as with the between group difference, it was not significant⁽¹⁶⁾. The study which used the NOSGER did not show any significant changes but was able to show clinical relevance of the multimodal group which had a moderate effect size for the sub scales social behavior ($d=0.54$) and challenging behavior ($d=0.32$)⁽¹⁷⁾. The other studies which used the Neuropsychiatric Inventory⁽¹⁵⁾ and the London Psychogeriatric Rating Scale (LPRS)⁽²⁴⁾ did not show any significant changes in relation to unmet needs.

Communication

Communication was considered in one study using the Functional Assessment of Communication Skills for Adults. This study compared a walking and conversation group to a conversation only group and a control group; no statistically significant changes were found⁽²⁴⁾.

Physical health and well being outcomes

Mobility

Five studies evaluated mobility^(14, 15, 19, 21, 24). One study used the six meter walk test and showed significantly improved efficiency in walking in the multimodal group over time and when compared to the control group, as demonstrated through increased walking speed⁽¹⁵⁾; 0.08m/s after six months which was sustained after 12 months compared to only 0.04m/s after six months and 0.03m/s after 12 months for the control group⁽¹⁵⁾. The six minute walk test showed mixed results in the two studies that adopted it. One study had two intervention groups, multimodal and walking and a control group which all showed improvement though the changes were not significant⁽¹⁴⁾. The other assessed the effect of walking against a control group and found the walking group distance significantly improved from 245 (31) meters (m) to 294 (49) m, while the control group significantly reduced from 238 (47) m to 168 (34) m; a significant difference of 134 m⁽²¹⁾. Another study which considered the effect of walking and conversation used the two minute walk test but no significant changes were found⁽²⁴⁾. The Locometer was used in another study and again provided results in favor of the multimodal group which improved in all the parameters assessed (speed, stride length and double limb support) while the control group decreased⁽¹⁹⁾. The double limb support time changes were significant within and between both groups; 0.2 (0.04) seconds (sec) to 0.1 (0.03) sec in the multimodal group compared to a change of 0.13 (0.04) sec to 0.14 (0.04) sec for the control group⁽¹⁹⁾. These changes demonstrated a significant improvement in the efficiency of mobility and balance of the individuals in the multimodal group.

Balance

Balance was evaluated in two studies^(15, 18), both used the Get Up and Go Test, though they were assessed in different ways; one used a score system⁽¹⁵⁾ and the other used time⁽¹⁸⁾, neither produced significant results and neither did the One Leg Balance Test⁽¹⁵⁾. The Berg Balance Scale was the only measure that showed significant changes over time in the two multimodal groups (multidisciplinary approach and physical therapy only) and

control group; the multidisciplinary group showed the most significant improved score from 39.5 (1.9) to 41.7 (2.4), the physical therapy only group also improved from 37.4 (2) to 37.7 (2.8), while the control group decreased from 35.2 (3) to 27.4 (3)⁽¹⁸⁾. There was no significant difference in the between group analysis⁽¹⁸⁾.

Functional ability

Five studies used outcome measures that considered ability to complete ADLs and amount of care time required^(14, 15, 17, 21, 24). The most commonly used measure was the BI^(17, 21). Both studies showed that the BI improved in the intervention groups (multimodal and walking) though it was only significant in the walking study, where there was an improvement in the score from 34 (4) to 42 (4) which was significantly better than the control group which decreased from 35 (6) to 32 (6)⁽²¹⁾. Another study showed significant improvement in ability to transfer from one surface to another in the multimodal group using the Acute Care Index Function measure while the walking group and control group both declined⁽¹⁴⁾. In another study that compared a multimodal group to a control group, the Katz Index of ADLs score significantly reduced for both groups which demonstrated deterioration in functional ability. However, the rate of decline was significantly slower in the multimodal group (declined from 3.2 (1.3) to 2.6 (1.5)) compared to the control group (changed from 3.1 (1.3) to 2.2 (1.5))⁽¹⁵⁾. There were no significant findings in the study that used the LPRS to assess physical disability⁽²⁴⁾ or the study that assessed care time required using the Resource Utilization in Dementia- Formal Care tool⁽¹⁷⁾.

Activity level

Two studies evaluated the effect of physical exercise intervention on individual's activity level, including daily activity patterns of rest activity patterns and sleep disturbance, using an Actiwatch ; there were no significant findings in either study^(13, 25).

Nutrition

One study considered nutrition using the Mini Nutritional Assessment (MNA) and no change was found in either group⁽¹⁵⁾.

Discussion

The results of this systematic review showed there was emerging evidence that physical exercise has a positive effect on health and well being of individuals living with a dementia in nursing homes. Nine of the 12 studies reviewed showed either significant improvement in the intervention group and/or deterioration in the control group in at least one health and well being outcome measure. Cognition, mood and depression, agitation, unmet needs, mobility, balance and functional ability all showed significant improvements. Mood and depression and agitation showed the most consistent improvement as 75% or more of the studies that used these types of outcome measures had a positive effect in at least one outcome measure; three studies showed improvement in mood and depression^(17, 22, 23, 25) and the one study that assessed agitation showed an improvement⁽²⁰⁾. The results from these studies appear trustworthy and have a low risk of bias as they were high quality studies; the majority scored a 7 or higher in the methodological assessment. It could be hypothesized that both these categories of outcome measures showed the most consistent improvement as the physical exercise interventions engaged the participants and encouraged interaction with others which may have given them a feeling of belonging and purpose whilst distracting them from negative feelings. This could have also been the case in the study which demonstrated clinical relevance in some of the sub categories of the NOSGER (social behavior and challenging behavior) which was used to assess unmet needs⁽¹⁷⁾. However, the other three studies that considered unmet needs did not find significant changes. In one study treatment was only provided twice a week which may not have been enough to significantly affect this outcome and a more targeted approach to unmet needs may be necessary⁽¹⁵⁾. The results of the other studies were limited by a small sample size^(16, 24) and low methodological quality (lack of blinding and detail about the intervention and attrition)⁽¹⁶⁾.

Cognition was another area that showed improvement with physical exercise and there are several hypotheses for this, including improved blood circulation in the brain and stimulation of synaptic and/or neuronal function^(19, 21). Of the five studies that found significant changes in cognition, three used a multimodal physical exercise intervention⁽¹⁷⁻¹⁹⁾ and one was a music and movement group⁽¹⁶⁾. Whereas the two that showed no significant changes in cognition involved either walking⁽¹²⁾ or hand exercises⁽²⁵⁾. This may suggest that physical exercise interventions that involve multiple tasks and are aerobic are the most effective in producing cognitive changes for individuals living with a dementia in nursing homes. A previous study in older healthy individuals

showed aerobic activity improved cognition but anaerobic activity did not⁽³¹⁾. Even though walking is considered an aerobic activity the study that found no significant changes may not have been intense or long enough to effect cognition, as participants walked at a self-selected speed and were encouraged to rest as required over a six week period⁽¹²⁾. This was different to the other walking study that found significant changes which lasted 24 weeks and had participants walk at a moderate intensity⁽²¹⁾. The study that did not show any changes in cognition also had a large proportion of individuals with cardiovascular disease (89%) which leads to reduced cardiac output and may reduce cerebral perfusion, limiting the effects of aerobic exercise⁽¹²⁾. The results from the studies that assessed cognition should be considered with caution as even though four were high quality studies^(12, 17, 18, 25), three were of lower quality^(16, 19, 21) so there is a risk that bias was introduced which along with the common limitations of a small sample size and short duration could have influenced the results. Caution should also be taken when interpreting results from cognition outcome measures as most requires a minimum level of comprehension and schooling. They are also influenced by depression which is highly prevalent in older individuals living with a dementia⁽¹⁸⁾. Both these factors can alter the results obtained from outcome measures such as the MMSE (most commonly used cognition outcome measure in this systematic review) and the Clock Drawing Test.

Along with the psychological benefits some studies were able to demonstrate physical benefits for individuals living with a dementia in nursing homes. Seven studies used various outcome measures that assessed the effect of a physical exercise intervention on mobility, balance and/or functional ability^(14, 15, 17-19, 21, 24), six found changes in favor of the intervention group which were significant in all but one study⁽¹⁷⁾. This study used the BI to assess functional ability which may have not been sensitive enough for the study population that included individuals with mild to severe dementia. The BI has very coarse categories when rating independence which are less reliable when assessing individuals with a cognitive impairment⁽³²⁾. All studies that assessed mobility, balance and/or functional ability used a multimodal and/or walking intervention. It could be hypothesized that these type of physical exercise were beneficial as they targeted and included elements of the outcome measures, such as walking, strength, flexibility and range of movement. All of the studies lasted at least 15 weeks which provided sufficient time for changes in physical function to occur. The literature suggested participation in physical exercise for a minimum of 12 weeks is required for physiological adaptations to occur in frail, older individuals⁽³³⁾. However, not all studies showed significant changes in physical outcome

measures. Two studies showed there were no positive influence on activity levels with the use of an Actiwatch^(12, 13). Both studies were by the same authors and considered the effect of a walking intervention (same parameters) on individuals living with a mild to moderately severe dementia, one focused on nighttime restlessness⁽¹³⁾ and the other cognition⁽¹²⁾. Both papers were checked by three reviewers to ensure they were not from the same study. A third study that considered the effect of walking and conversation on functional ability, using the LPRS, did not find significant changes either⁽²⁴⁾. As all studies had similar parameters and findings it could be hypothesized that walking or the parameters set were not effective in targeting the outcomes measures used (the duration was only six weeks in two studies and the intensity was not stated but appeared low in all studies) or were not specific enough to produce changes for individuals living with a dementia. A previous study did find a multimodal intervention only had a positive effect on sleep disturbances of individuals living with a severe dementia in nursing homes⁽³⁴⁾. Another study did not find any benefit of a multimodal physical exercise intervention on nutrition as assessed by the MNA⁽¹⁵⁾. This may have been because the MNA was not sensitive enough for this study population, or a more targeted approach to nutrition was required. In terms of methodological quality there was a mixture of high and low quality studies (50% each) that assessed physical outcome measures so the overall results should be considered with caution.

A high proportion of studies used a multimodal intervention, including different types of physical exercises, functional tasks and cognitive tasks. These studies showed the most benefit as all five studies had a significant improvement in at least one health and well being outcome in the intervention group(s) compared to the control group^(14, 15, 17-19, 22, 23). Strength and balance were the most common components in all the studies that included a multimodal group. In one studies that had a multimodal group, walking only group and control group, the multimodal group showed the most improvement; mobility and functional ability outcome measures were significantly better than the other two groups involved, while improvements in the mood and depression outcome measures were only significant when compared to the control group only^(14, 22, 23). The studies that investigated walking interventions did have some significant findings, though they did not appear to be as beneficial as a multimodal approach. Five studies considered the effect of walking on individuals with a dementia^(12-14, 21-24) but only two of these found significant improvement in health and well being^(21, 22). The other two studies either had inconclusive results or found that there was no benefit. This may have been because the walking activity was not intense or long enough to produce any significant changes. The studies

that used music and movement found significant improvements^(16, 20), as did the study that used hand exercises⁽²⁵⁾. These studies and those in the multimodal group used activities that were not part of the usual day to day routine, while walking was an automatic task completed daily by the participants. This could explain why these types of physical exercise showed more significant improvements than walking alone. They also involved more social interaction and touch which could have enhanced the results⁽²³⁾ and involved activities that targeted the various elements that are required to improve the outcome measures. Examples include strengthening and balance exercise to help improve mobility and aerobic exercises to stimulate cerebral blood circulation and function in cognition.

Physical exercise interventions that are different to an individual's usual routine and targets more than one aspect could be the most beneficial for individuals living with a dementia in nursing homes. Physical Therapists would be the most appropriate to complete such interventions due to their knowledge and understanding of physical exercise. Three of the studies conducted physical exercise interventions that were completed or supervised by a Physical Therapist or Physical Therapy student and all showed significant improvements in psychological and physical health and well being outcome measures^(14, 18, 21-23). This demonstrates the importance of and need to increase the role of Physical Therapists in dementia care in the nursing home setting, as currently their skills and knowledge are an untapped resource in this area. It would also be important to consider the economic benefits of providing physical exercise programs by Physical Therapists in nursing homes.

The most common limitation found in the review was a small sample size; highlighted as a limitation in 50% of the studies. This is most likely due to reduced feasibility, ethical concerns with consent and high attrition rate in this population group. In some studies the duration of the intervention period was too short which limited the possible effect of the intervention. There were four studies that went for six weeks or less: two found no benefit of physical exercise for individuals living with a dementia in nursing homes^(12, 13). Another issue identified was the lack of detail, specifically of the method and the intervention used. This reduced the reliability and validity of some studies, introducing bias and reducing the ability to replicate all or elements of the studies. Further, high quality research, for longer periods and with larger sample sizes is required to help support the current evidence. There is also a need to determine the optimum parameters of physical exercise

interventions, such as type, frequency, length and intensity. This evidence will help practitioners plan and implement the most effective physical exercise program for individuals living with a dementia in nursing home.

This systematic review considered all relevant studies identified from a search across several databases and from snowballing. It differed from the Cochrane review⁽⁵⁾ completed in 2013 as this systematic review focused on studies set in nursing homes only and, unlike the Cochrane review, did not limit the type of outcomes considered and including more than simply the effects of physical exercise on cognition, ADLs, challenging behavior, depression and mortality. Due to these differences this systematic review considered three studies not included in the Cochrane systematic review. It provided further evidence and supported the findings of the Cochrane systematic review, on the beneficial effects of physical exercise interventions for individuals living with a dementia in nursing homes. Other limitations were that studies could have been missed due to an inability to access other databases and non-English publications. This review only considered RCTs and cluster RCTs, other types of studies that were excluded could have provided further relevant evidence on this topic. Due to the high variability between the studies in terms of the type of physical exercise, parameters used and outcome measures assessed it was not possible to complete a meta analysis. It was also not possible to evaluate which levels of functional ability and severity of dementia benefited the most from physical exercise due to the wide variation in tools/methods used to assess these aspects and the lack of detail in many of the studies.

Conclusion

The findings of this systematic review suggested that physical exercise positively effects health and well being of individuals living with a dementia in nursing homes, particularly when a multimodal approach that involves a combination of activities was utilized. Interventions that combined strength, balance, flexibility and endurance (most often in the form of walking) were the most common combination to produce significant improvements in the health and well being of individuals living with a dementia in nursing homes. Not only over time but also when compared to other interventions, such as walking and seated social activities. A number of studies demonstrated significant improvements in areas such as cognition, agitation, mood, mobility and functional ability. The duration, length and frequency set in the studies reviewed varied greatly and even though the optimum parameters of physical exercise interventions have not yet been determined,

this systematic review has shown that physical exercise for at least 30 minutes twice a week can produce significant improvements. No conclusions in regards to the intensity of the physical exercise interventions or severity of dementia could be drawn from this systematic review as this information varied in the few studies that did documented it.

This is an emerging area of research that has gained momentum over recent years and as the population ages the demand on healthcare will increase so it is important that effective dementia care is in place. To ensure this can happen, further high quality research for longer periods and with larger sample sizes are warranted to build on current evidence. This will help to determine the optimum parameters of physical exercise interventions for individuals living with a dementia in nursing homes and address other key issues, such as falls, sleep, social interaction and self esteem. This will help to guide practitioners who work in nursing homes and utilize the skills of health professionals such of Physical Therapists, so that a rehabilitation approach to dementia care can be adopted, optimizing the quality of life of individuals living with a dementia in nursing homes.

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Table 1
Methodological Quality Assessment

Article	Methodological Questions*										Total [†] (/10)
	1	2	3	4	5	6	7	8	9	10	
Christofolletti et al, 2008 ¹⁸	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	8
Eggermont et al, 2009 ¹²	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Luttenberger et al, 2012 ¹⁷	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Rolland et al, 2007 ¹⁵	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	8
Eggermont et al, 2009 ²⁵	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7
Sung et al, 2006 ²⁰	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	7
Williams and Tappen, 2008 ^{22,‡}	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	7
Cott et al, 2002 ²⁴	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes	6
Venturelli et al, 2011 ²¹	Yes	No	No	No	Yes	Yes	Yes	Yes	No	Yes	6
Williams and Tappen, 2007 ^{23,‡}	No	No	Yes	No	Yes	Yes	No	Yes	Yes	Yes	6
Eggermont et al, 2010 ¹³	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	5
Kemoun et al, 2010 ¹⁹	Yes	No	No	No	No	Yes	Yes	Yes	No	Yes	5
Roach et al, 2011 ^{14,‡}	No	No	No	No	Yes	Yes	Yes	Yes	No	Yes	5
van De Winckel et al, 2004 ¹⁶	Yes	No	No	No	No	Yes	No	Yes	Yes	Yes	5
Stevens and Killeen, 2006 ^{26,§}	Yes	No	No	No	No	Yes	No	Yes	Yes	No	4
Francese et al, 1997 ^{28,§}	No	No	No	No	No	No	No	Yes	No	Yes	2
Venturelli et al, 2012 ^{27,§}	No	No	No	No	No	No	No	Yes	No	Yes	2
Mean Total Score	6										

Method: Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument critical appraisal tool for randomized/pseudo-randomized control trials.

*Methodological questions:

- (1) Was the assignment to treatment groups truly random?
- (2) Were participants blinded to treatment allocation?
- (3) Was allocation to treatment groups concealed from the allocator?
- (4) Were the outcomes of people who withdrew described and included in the analysis?
- (5) Were those assessing outcomes blind to the treatment allocation?
- (6) Were the control and treatment groups comparable at entry?
- (7) Were groups treated identically other than for the named intervention?
- (8) Were outcomes measured in the same way for all groups?
- (9) Were outcomes measured in a reliable way?
- (10) Was appropriate statistical analysis used?

[†]Higher score = higher methodological quality.

[‡]Different publication from the same study.

[§]Studies excluded because of methodological score below cut-off point (mean score minus 1 standard deviation).

Table 2

Physical Exercise for Individuals With Dementia in Nursing Homes—Current Research Summary Table

N (% Completing Study) and Drop outs (%)	Study Design	Intervention Group (IG)	Control Group (CG)	Intervention Conducted By	Length and Frequency of Session and Duration of Study	Outcome Measures	Significant Findings
1. Christofoletti et al (2008) Brazil ¹⁸ 54 (76% completed) 13 dropped out (24%)	RCT	Group 1 Interdisciplinary program inc PT, OT, and physical edu.- group session PT- strength, balance, and cognition OT- motor coordination and cognition Physical edu.- strength, balance, motor coordination, agility, flexibility, and aerobic endurance Group 2 PT only- same PT as group 1 Individual session	Group 3 No motor intervention	Group 1: PT, OT and Physical Education Professional. Group 2: PT.	Group 1: 120 min ×5 wk Group 2: 60 min ×3 wk Both: 24 wk	Ax at baseline and endpoint MMSE BCSB Berg Balance Scale Timed Get-Up-and-Go Test	Multidisciplinary and PT intervention can improve the balance of individuals with a dementia in NH Multidisciplinary intervention may also slow the deterioration rate of cognition <i>P</i> value < .05, (SD) Significant findings Mean Berg Balance Scale; G1 39.5 (1.9) to 41.7 (2.4); G2 37.4 (2) to 37.7 (2.8) Mean BCSB; clock drawing test; G1 3.5 (1) to 4.1 (1.1); G3 3.4 (0.6) to 2.9 (0.6); verbal fluency test; G1 7.8 (1.3) to 7.9 (1.5); G3 9.2 (0.9) to 6.4 (1.1)
2. Cott (2002) USA ²⁴ 86 (86% completed) 12 dropped out (14%) 3 NH sites	RCT	Completed in pairs with 1 research assistant Walk-and-talk group (WTG) Completed inside Supervised walking in pairs Encouraged to walk and talk as much as possible Allowed to rest as often as required Conversation guided by the Resident Interest Information Sheet and Pleasant Events Schedule completed by participant's family Talk-only group (WG) Conversation guided by the Resident Interest Information Sheet and Pleasant Events Schedule completed by participant's family	No intervention	Research assistants (health professionals) trained by the primary investigators	30 min ×5 wk 16 wk	Ax at baseline and endpoint FACS 2min walk test LPRS	Walking and talking and talking only do not benefit communication, mobility, and functional ability for individuals living with a dementia in NH No significant findings
3. Eggermont et al 2009 The Netherlands ¹² 97 (93% completed) 7 dropped out (7%) 23 NH sites	RCT	Inside Walking Walked at self-selected speed Rests allowed PRN Individual session	Social visits 1-to-1	Psychology student	30 min ×5 wk 6 wk	Ax at baseline, endpoint and 6 wk follow-up DS Letter and Category Fluency RBMT 8 WT	Exs doesn't benefit cognition for individuals living with a dementia with cardiovascular disease in NH No significant findings

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Table 2 (continued)

N (% Completing Study) and Drop outs (%)	Study Design	Intervention Group (IG)	Control Group (CG)	Intervention Conducted By	Length and Frequency of Session and Duration of Study	Outcome Measures	Significant Findings
4. Eggermont et al (2009) The Netherlands ²⁵ 66 (92% completed) 5 dropped out (8%)	Cluster RCT	Hand movement program Exs based on movements especially designed for this population Morning activity Group session	Read aloud group program Stories from books recommended for this population read aloud by group leader Followed by conversation based on preselected topics from meeting with residents	Recreational Therapist and Psychology students	30 min ×5 wk 6 wk	Ax at baseline (T1), endpoint (T2) and 6 wk follow-up (T3) RBMT 8WT DS Category Fluency MMSE GDS SCL Anxiety Actiwatch	Increased attendance to hand motor activity program improved mood <i>P</i> value .05, (SD) Significant findings Mean GDS; IG 7.9 (6.1) to 5.9 (4.6) to 6.1 (4.9) Mean SCL Anxiety; IG 16.0 (5.1) to 13.3 (3.3) to 12.8 (38.5) IG vs CG time × group interaction; mood domain 5.5 IG vs CG contrast T1-T2; mood domain 3.2
5. Eggermont et al (2010) The Netherlands ¹³ 79 (91% completed) 7 dropped out (9%) 19 NH sites	RCT	Walking with a student Self-selected speed Rest PRN Time of day variable Individual session	Social visits from a student Time of day variable	A student (type of student not stated)	30 min ×5 wk 6 wk	Ax at baseline, endpoint and 6-wk follow-up Actiwatch	No beneficial effect of walking on night-time restlessness or other actigraphy parameters No significant findings
6. Kemoun et al (2010) France ¹⁹ 38 (89% completed) 7 dropped out (11%)	RCT	×1 wk- walking and motor route exs ×1 wk- stamina exs ×1 wk- combined stamina, equilibrium and walking Each session- warm up for 10 min, followed by 40 min of one of the above activities, then 10 min relaxation Unclear if individual or group session	Usual activities provided at NH	Not stated	60 min ×3 wk 15 wk	Ax at baseline and endpoint ERFC Bessou Locometer and SATEL software	Walking program had positive influence on spatiotemporal variables concerning walking and cognitive capabilities Significant correlation between changes in ERFC and walking variables <i>P</i> value < .01, (SD) Significant findings Mean ERFC; IG 26.8 (6.4) to 30.4 (7.7); CG 28.3 (7.1) to 23.2 (8.4) Mean Walking speed; IG 0.7 (0.1) to 1.0 (0.2); CG 0.9 (0.2) to 0.8 (0.2) Mean Stride length; IG 0.9 (0.2) to 1.0 (0.2); CG 1.0 (0.20) to 0.9 (0.2) Mean Double limb support; IG 0.2 (0.04) to 0.1 (0.03); CG 0.13 (0.04) to 0.14 (0.04)
7. Luttenberger et al (2012) Germany ¹⁷ 141 (84% completed) 22 dropped out (16%)	RCT	Multicomponent group therapy 10 min "spiritual" intro, 30 min motor activity, 10 min break, 30 min individualized cognitive tasks, 40 min ADLs Groups of 10	Usual activities provided at NH	2 therapists and 1 aide (type of therapists and aide not stated)	120 min ×6 wk 24 wk	Ax at baseline and endpoint BI NOSGER RUD-FOCA	MAKS significantly and clinically more effective than usual care for dementia, especially social unmet needs and ADL completion <i>P</i> value < .05, (95% CI) Significant findings NOSGER mean difference after 24 wks; IG sum 5.3 (2.2–8.3); IG subscale mood 1.0 (0.3–1.7); IG subscale memory 1.5 (0.6–2.3) NOSGER clinical relevance; moderate effect size in sub scales social behavior (<i>d</i> = 0.54) and challenging behavior (<i>d</i> = 0.32)

8. Rolland et al (2007) France ¹⁵ 134 (82% completed) RCT 24 dropped out (18%) 5 NH sites	Collective exs program, individualized Inc walking (aerobic), strength, balance, and flexibility training Stretching warm-up Then walked as fast to reach moderate breathlessness Interspersed with strength, flexibility and balance training at predetermined stations along the trail Held in the afternoon Music accompanied sessions Groups of 2–7	Routine medical care No exs or specific behavior Mx training	OT	60 min ×2 wk (Except during OTs absence) 52 wk (44 wk of activity)	Ax at baseline, 26 wks and endpoint Katz Index of ADLs 6m walk speed Get-up-and-go test Abnormal 1-leg balance test NPI MADRS MNA	Moderate exs significantly slows (by ~ ¹ / ₃) progressive deterioration in ability to perform ADLs in individuals with AD in NH <i>P</i> value < .05, (SD) Significant findings Mean Katz Index of ADLs; IG 3.2 (1.3) to 2.7 (1.4) to 2.6 (1.5); CG 3.1 (1.3) to 2.6 (1.5) to 2.2 (1.5) Mean walking speed; IG 0.33 (0.14) to 0.41 (0.17) to 0.41 (0.16); CG 0.33 (0.14) to 0.37 (0.17) to 0.36 (0.19)
9. Sung et al (2006) Taiwan ²⁰ 40 (90% completed) RCT 4 dropped out (10%)	Music with movement intervention Familiar music that had pleasant, moderate rhythm, and tempo Exs not specified, only stated it involved movements of the body and limbs Conducted in the afternoon Group session	Usual care provided at NH	Nurse researcher and 2 research assistants	30 min ×2 wk 4 wk	Ax at baseline, 2 wks and endpoint Modified CMAI	Group music with movement can be beneficial in managing agitated behaviors in individuals with a dementia <i>P</i> value 0 (SD) Significant findings CMAI; IG 5.1 (2.5) to 3.9 (2) to 3.4 (1.3)
10. van De Winckel et al (2004) The Netherlands ¹⁶ 25 (96% completed) RCT 1 dropped out (4%)	Music-based seated dance sessions Music choice based on the age of residents Exs focused on upper and lower body strengthening, balance, trunk movements, and flexibility training Group session	Usual care provided at NH	Therapist (type of therapist not stated)	30 min daily 12 wk	Ax at baseline, after 6 wks of intervention and endpoint MMSE ADS 6 abbreviated BOP	Music-based exs could improve cognition for individuals with a dementia <i>P</i> value 0.05, (SD) Significant findings Mean MMSE; IG 12.9 (5) to 14.4 (4.4) to 15.5 (4.4); CG 10.8 (5) to 11.5 (5.2) to 11 (4.3) Median ADS 6; category fluency- IG 10 to 13 to 14, CG 6.5 to 7 to 7 Median BOP; need for help- CG 23 to 17.5 to 21
11. Venturelli et al (2011) Italy ²¹ 25 (84% completed) RCT 4 dropped out (16%)	Started with 1–2 min informal chatting Walked up and down hallway (60 m long) Aim to maintain constant walking speed Moderate intensity Completed between 3 and 5 PM Offered cookies after session Individual session	Usual activities provided by NH	Caregiver trained by PT	minimum 30 min ×4 wk 24 wk	Ax at baseline and endpoint 6MWT BI MMSE	Walking program in NH with family can stabilize, for a short time, progressive, cognitive dysfunctions and improve ADLs in advanced AD <i>P</i> value < .05, (SD) Significant findings Mean 6MWT; IG 245 (31) to 294 (49); CG 238 (47) to 168 (34) Mean BI; IG 34 (4) to 42 (4) Mean MMSE; CG 12 (2) to 6 (2)

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Table 2 (continued)

N (% Completing Study) and Drop outs (%)	Study Design	Intervention Group (IG)	Control Group (CG)	Intervention Conducted By	Length and Frequency of Session and Duration of Study	Outcome Measures	Significant Findings
12a. Williams et al (2007) USA, ²³ 116 (76% completed) 26 dropped out (24%) 8 NH sites b. Sub-set 45 (80% completed) 9 dropped out (20%) c. Sub-set 105 (78% completed) 23 dropped out (22%)	RCT	Individual session Comprehensive exs group (EG) Designed around familiar functional activities Strength, flexibility, balance and endurance exs and walking Reps progressed from 3 up to 9 Amount of support decreased and resistance increased as progressed Supervised walking group (WG) Walk at own pace Rest and assistance PRN Pace, distance and duration increased incrementally 1x assist walked along side using a gait belt PRN	Social conversation Individual Casual conversation In own room or nearby quiet room Talk about topics that interested them Reminiscence, life review and cognitive exs avoided	PT and Nursing students trained by the investigators	EG 15–30 min of exs and 10–20 min of walking WG 15–30 min CG 15–30 min All × 5 wk 16 wk	Ax at baseline and endpoint OAS AMS DMAS b. Sub-set CSDD DMAS AMS OAS c. Subset ACIF 6MWT	Comprehensive exs can have better outcomes in affect and mood compared with conversation only Outcome of walking on mood not clear as scores fell between the other 2 groups Comprehensive exs can reduce depression in individuals with severe AD in NH Comprehensive exs reduces mob limitations in individuals in NH that have mod-severe cognitive impairment Walking not sufficient to improve mob limitations when individuals are dependent in T/Fs <i>P</i> value < .05 (SD) Significant findings Post-test mean OAS 10 min negative; EG 2.6; WG 4.1; CG 4.8 Post-test mean OAS 2 wk positive; EG 11.1; WG 9.7; CG 9.1 Post-test mean AMS negative subscale; EG 46.9; WG 53; CG 64.2 Post-test mean DMAS; EG 19.7; WG 26.5; CG 33.1 b. Sub-set (Only significant when baseline differences controlled) Mean OAS 2 wk positive; EG 10.8; WG 9; CG 8.7; <i>F</i> = 3.2 Mean AMS negative subscale; EG 55.2, WG 52; CG 72.3; <i>F</i> = 3.3 c. Sub-set Mean ACIF T/F; EG 0.8 (0.2) to 0.9 (0.2) (low mob at baseline 0.7 (0.2) to 0.8 (0.2)); CG 0.8 (0.2) to 0.8 (0.3) (low mob at baseline 0.7 (0.2) to 0.7 (0.3)); WG 0.9 (0.2) to 0.8 (0.2) (low mob at baseline 0.8 (0.2) to 0.8 (0.2))

ABRS, Agitated Behavior Rating Scale; ACIF, Acute Care Index of Function; AD, Alzheimer disease; ADS 6, Amsterdam Dementia Screening Test 6; Ax, assessed; BI, Barthel Index; BCSB, Brief Cognitive Screening Battery; BOP scale, Stockton Geriatric Rating Scale; CADS, Changes in Advanced Dementia Scale; CMAI, Cohen-Mansfield Agitation Inventory; CSDD, Cornell Scale for Depression in Dementia; DMAS, Dementia Mood Assessment Scale; DS, Digit Span; exs, exercise; ERFC, French Rapid Evaluation of Cognitive Function; FACS, Functional Assessment of Communication Skills for Adults; GDS, Geriatric Depression Scale; MADRS, Montgomery and Asberg Depression Rating Scale; min, minute(s); NH, nursing home(s); NPI, Neuropsychiatric Inventory; OAS, Observed Affect Scale; OM, outcome measure; OME, Object Memory Evaluation; OT, occupational therapist; PGCMS, Philadelphia Geriatric Center Morale Scale; PRN, as required; PT, physical therapist; RBMT, Rivermead Behavioral Memory Test; REPDS, Revised Elderly Persons Disabilities Scale; RUD-FOCA, Resource Utilization in Dementia- Formal Care; Rx, treatment; SCL, Symptoms Check List; SD, standard deviation; STS, sit to stand; T/F, transfer; TSI, Test for Severe Impairment; wk, week(s); 6MWT, 6-Minute Walk Test; 8WT, 8 Words Test; -ive, negative; +ive, positive.

Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram of studies through the systematic review.