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Effectiveness of exercise programmes in improving physical function and reducing behavioural symptoms of community living older adults with dementia living in Asia, and impact on their informal carers: A systematic review and meta-analysis

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Background: There is a growing evidence on the benefits of exercise for older people living with dementia in developed countries. However, cultural, health-care systems and environmental differences may impact on the uptake of exercise and outcomes in different regions of the world.
Objective: This study synthesised the available evidence examining the effectiveness of exercise interventions on improving physical function and reducing behavioural symptoms in community-dwelling older people living with dementia in Asia, and the impact on their informal carers.
Methods: Six databases were searched to November 2021. Randomised controlled trials (RCTs) or quasi-experimental studies evaluating exercise interventions for community-dwelling older people with dementia

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living in Asia were included. The Cochrane risk-of-bias tool for randomised trials and Downs and Black checklist had been used to assess methodological quality of the studies. Meta-analyses using a fixed effects model assessed the effects of exercise interventions where sufficient data were available. Mean difference (MD) with 95% confidence interval (CI) was used to pool results.

Results: Nine studies (five RCTs) were included (Hong Kong-4, China-1, South Korea-2, Taiwan-1, Indonesia-1). Exercise improved dynamic balance [Functional Reach (2 studies, $n = 111$ people with dementia), MD = 2.61, 95% CI (1.55, 3.67)], but not for the Berg Balance Scale (MD = 1.10, 95% CI [−2.88, 5.07]), Timed Up and Go (MD = −3.47, 95% CI [−7.27, 0.33]) and 5 times sit to stand tests (MD = −1.86, 95% CI [−5.27, 1.54]). Single studies where data could not be pooled showed no effect of exercise on behavioural symptoms or impact on informal carers.

Conclusion: Exercise appeared to have a beneficial effect on improving balance performance among older people with dementia living in Asia, however, this evidence is limited and inconsistent, and should be interpreted with caution. Further high-quality large RCTs are necessary for advancing the evidence base of exercise interventions for this population.

Keywords: Asia; caregivers; dementia; exercise; physical functional performance.

Introduction

Dementia is a worldwide public health concern that primarily affects older people. It was the fifth leading cause of death globally in 2016, contributing 28.8 million Disability Adjusted Life Years lost.[1] The number of people living with dementia worldwide is expected to increase from 55.2 million in 2020 to 152 million by 2050.[2] More than two-thirds of people living with dementia live in Asia, and countries in Asia are rapidly ageing.[3] These factors have seen many of these countries facing challenges, particularly in providing health-care services that are only starting to focus on ageing populations, and more specifically on management of dementia care.[4]

As well as the cognitive decline in people living with dementia, dementia can lead to impairments of gait,[5] disability and dependency,[6] at least 50% increase in risk of falls,[7] and also increased burden and psychological stress for their family and carers,[8,9] and increased costs for health-care and social-care systems.[10,11] All of these factors highlight the importance of programmes that can address these issues for people with dementia and their carers.

Previous systematic reviews and meta-analyses have reported significant positive effects of exercise on physical function of older adults with dementia (e.g., balance, mobility and endurance), behavioural symptoms and impact on informal carers.[12–17] Sixty percent of the world's population live in Asia,[18] however, these reviews have included predominantly studies from non-Asian countries. Moderate differences in the contexts of culture, environment, knowledge/preferences of consumers and health-care systems between non-Asian and Asian countries may limit these interventions being directly implemented with similar effects in Asian countries. For example, cross-cultural issues influencing translation of research have been reported in reviews of other health conditions,[19] including falls.[20] Therefore, it is likely that research evidence from non-Asian countries may need to be explored in the Asian context to be directly applicable and be able to be effective in translation into Asian countries.

There were several additional limitations associated with these previous reviews, including grouping of studies regardless of the differences in settings (long term/residential care, hospital and community settings), and severity of cognitive impairment (with or without presence of dementia). The difference in settings may influence what interventions can be undertaken and resources available to support the interventions within a particular setting. Grouping of people with mild cognitive impairment (MCI) with those who had a diagnosed dementia may create substantial heterogeneity in the sample, particularly as MCI does not necessarily lead to dementia.[21] In light of these limitations and the growing need for evidence to guide dementia care planning in the ageing community of Asia, it is important to evaluate exercise effects focussing on people with dementia who are living in the community, and in an Asian country so that the evidence will be more readily applicable to this population.

The aims of this review were to synthesise the available evidence on the effectiveness of exercise interventions on physical function, and behavioural symptoms of community-dwelling older people with dementia living in Asia, and the impact of these programmes on their informal carers.

Method

Design

This study was a systematic review and meta-analysis.

Inclusion criteria

The inclusion criteria were that the study (1) was conducted in a country within Asia; (2) recruited community-dwelling people aged 60 years or above (because many parts of Asia have a "young old" population, therefore the commonly used age cut-point for older people is defined as people aged $\geq$ 60 years); (3) involved participants with a medical diagnosis of any type of dementia; (4) used an exercise or physical activity programme as an intervention for which the effect from the intervention could be clearly demonstrated; (5) had a control group that received usual care, no routine intervention, placebo; or comparison group(s) that received other interventions; (6) reported outcomes of physical function (the ability to perform activities of daily living, and measures of balance, mobility, endurance and strength), behavioural symptoms (the behavioural and psychological symptoms experienced by people with dementia including hallucination, aggression, agitation and inhibition), and/or impact on informal carers (feelings of burden experienced by informal carers of people with dementia related to their physical functioning, emotional, financial and social well-being) and (7) design was a randomised controlled trial (RCT), pilot RCT or quasi-experimental study.

Exclusion criteria

Studies were excluded if they (1) published in languages other than English; (2) had a study sample mean age < 60 years, or more than 50% of the sample aged < 60 years; (3) were letters, commentaries, systematic reviews, case studies, qualitative papers, poster abstracts or dissertations.

Procedure

The following electronic databases were searched from inception to November 2021 to identify studies meeting the inclusion criteria: CINAHL, Ovid Medline, PubMed, Ovid Embase, PsycINFO and Scopus. Grey literature was not included due to the variability of scientific rigour and lack of guidelines in performing grey literature searches systematically.[22–24] Medical Subject Heading (MeSH) terms where appropriate were used in the search. An example of the search strategy used for the Ovid database is presented in Appendix A. In addition, the reference lists of all selected articles and excluded review articles were checked for relevant articles.

Three stages were conducted in selecting papers: stage one included initially screening the titles by the first author (YMS) based on the eligibility criteria to identify relevant papers. Stage two involved (YMS) fully screening the abstracts. This was followed by stage three which involved (YMS) screening the full articles then discussing with other authors (KDH and EB) on final papers to identify whether they met the inclusion criteria and to achieve consensus. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were adhered to, to ensure the results were reported systematically.[25] After the selection of studies, data were extracted by (YMS) using a data extraction form for the characteristics of study design, purpose, intervention, participants, sample size, programme dropout rate, dementia severity, outcome measures, findings/effect of the intervention, intervention duration and follow-up (FU) assessment time points.

The Cochrane risk-of-bias tool for randomised trials[26] was used to assess methodological quality of the RCT articles and Downs and Black checklist[27] was used to assess the quasi-experimental studies. Two researchers assessed each paper independently. Care was taken to ensure the author (s) did not review the quality of any co-authored paper. For the Cochrane risk-of-bias tool, the key domains assessed by the tool included (1) sequence generation; (2) allocation concealment; (3) blinding of participants, personnel and outcome assessors; (4) incomplete outcome data; (5) selective

outcome reporting and (6) other sources of bias.[24] Articles were identified (across domains) as "low risk of bias" if they had low risk of bias for all key domains; "unclear risk of bias" if they had unclear risk of bias for one or more key domains; or "high risk of bias" if they had high risk of bias for one or more key domains.[24] The Downs and Black checklist provides an overall numeric score out of 27 points based on five themed sections: study quality (overall quality), external validity (ability to generalize findings), study bias (in interventions and outcome measures), confounding and selection bias (in sampling) and power (sample size).[27]

Data analysis

Physical function and behavioural symptoms of people with dementia, and impact on informal carers of older people with dementia were assessed by various measures in the included studies. Inverse variance using the DerSimonian and Laird's method[28] and fixed effect meta-analyses[29] was performed for outcomes where data were available to be pooled for meta-analyses. The consistency in results between studies in the meta-analyses was assessed using I^2 where a value of 0% indicated no heterogeneity and larger values showed increasing heterogeneity.[30] The mean difference (MD) and 95% confidence intervals (CI) were used to pool continuous outcome measures that used the same units of measurement at the end of the intervention regardless of the type of exercise or physical activity intervention. Where quasi-experimental studies were present and there were sufficient studies, a sensitivity analysis was planned to assess if studies of lower scientific quality affected the meta-analyses results. Sub-group analysis was also planned if there were sufficient studies to perform sub-group analysis.[29]

The corresponding authors of included studies were contacted for further information where data in the published articles were insufficient for meta-analysis. Where standard deviations (SD) were unavailable from the study or from author contact, it was calculated with the formula of SD = Standard Error (SE) $\times \sqrt{n}$. Review Manager (RevMan) version 5.4.1[31] was used to pool data where two or more studies reported the same outcome for the meta-analyses. Statistical significance was set at $p < 0.05$ for all analyses.

Results

Four thousand, two hundred and fifty-two papers were generated by the search strategy from the six databases. Following removal of duplicate articles, screening of title, abstract and full text (see Fig. 1, study flowchart), nine articles were included in the review. The included studies had 511 people with dementia and 82 carers; with 482 (94.3%) people with dementia and 73 (89%) carers completing post-programme testing. Five studies were RCTs,[32–36] one was a pilot study that used a clustered randomised design[37] and three quasi-experimental studies[38–40] were included. Four studies were conducted in Hong Kong,[32,33,35,37] two from South Korea,[34,39] one from China,[36] Taiwan[40] and Indonesia,[38] respectively.

Sample sizes across the studies ranged from 26 to 90 participants with dementia [mean (SD) of 56.8 (±21.3) participants)] (Table 1). Participants with dementia had an average age of 78.0 (±6.1) (one study did not report the mean/SD for age),[38] and 60% were female. Two studies also included carers as participants, with a mean (SD) sample size of carers being 41 (±21.2).[33,37] Ninety percent of the carer samples were female, and the average age of carers in one study was 51.3 (±19.0),[37] while the Law and Kwok study reported that 28.5% of their sample of carers were aged over 50 years (did not report mean age data).[33]

Four of the five authors replied to our email contacts and provided missing information required for meta-analyses. One author did not provide the SD of an outcome measure and therefore this was calculated by a review author. Liu *et al.*[37] clarified that their data analyses had accounted for the clustering effect due to the study design.

Types of exercise used in the studies

There were three types of exercise used in the included studies including multimodal exercise programmes (5 studies),[32–35,39] aerobic exercise (3 studies)[36,38,40] and tai chi (1 study).[37]

Multimodal exercise programmes

Five trials tested multimodal exercise programmes that comprised more than one exercise type.[32–35,39] The intervention duration varied between 5 and 52 weeks with a re-assessment at the end of the intervention. One study had an additional FU

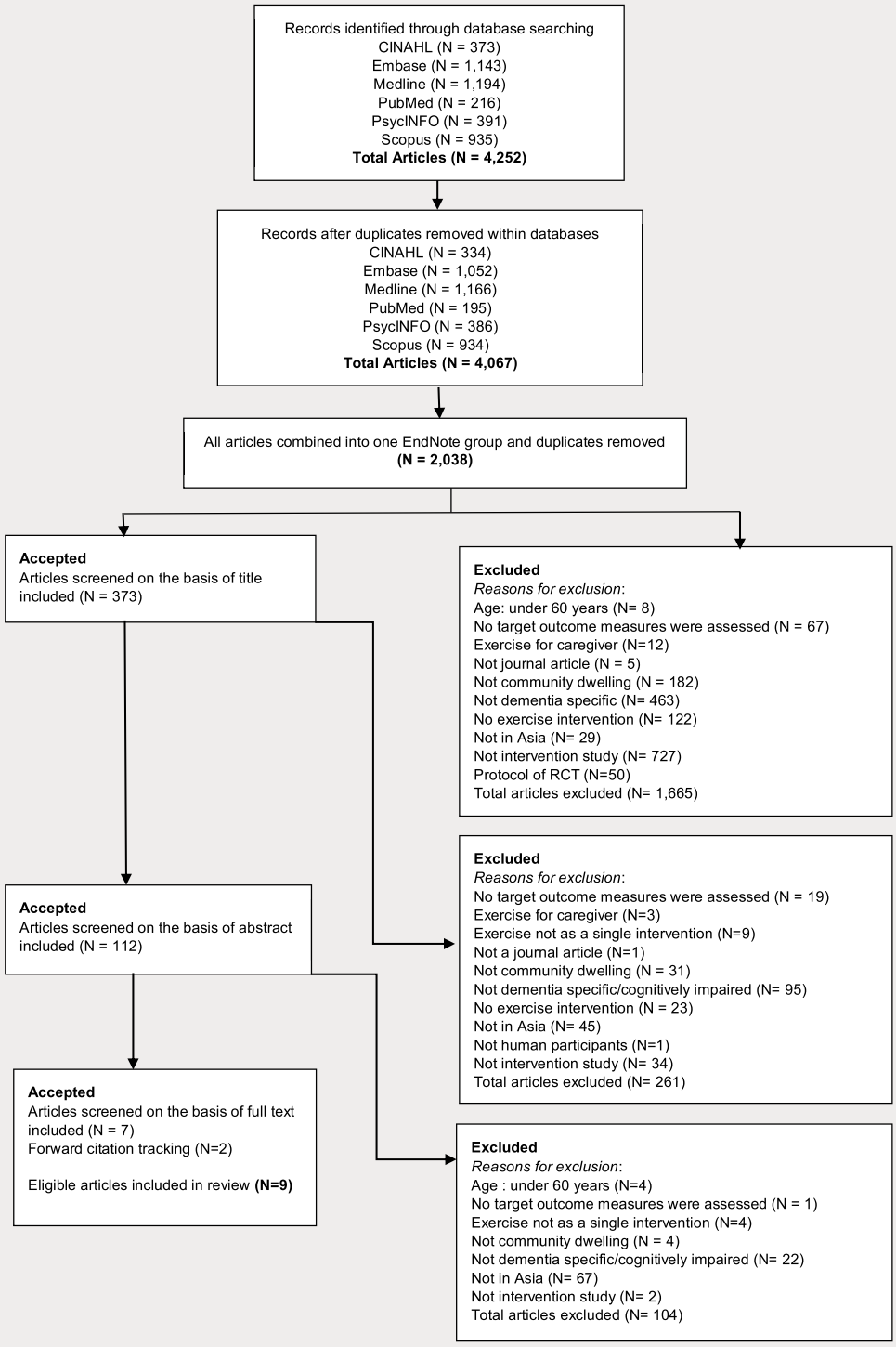

Fig. 1. Study selection flow chart.

assessment 12 weeks after the programme ended.[32] The multimodal exercise interventions comprised of limb mobilisation exercise,[32,33] limb strengthening exercise,[32] balance exercise,[32] walking,[32,33] aerobic exercise,[33,35] shoulder pulley exercise,[33] flexibility exercise[35] and the Otago exercise programme.[34,39] Three studies provided programmes which included a discrete exercise component being reported, but also included an additional element of non-exercise intervention such as self-management support;[33] whole-body vibration (WBV) training;[32] handicraft and music activities[39] and a cognition programme.[34,39] However, for these studies, the

Table 1. Summary of included articles.

Reference	Study design	Study purpose	Intervention	Sample size; % female; age (years) (SD); dropout	MMSE score (SD) or rating of dementia	Outcome measure	Findings	FU
Liu *et al.*, 2018 Hong Kong	A pilot cluster RCT	To evaluate feasibility and preliminary effects of a simplified 10-step Tai-chi programme	IG: 16 week 10-step simplified Tai-chi training programme, 1 h, 2 × /week in the community centre and 30 min, 3 × /week at home. CG: recreational activities organised by the centres, 1 h 2 × /week	26 dyads of PLWD and carers (13 dyads/group); female PLWD IG: 61% (8/13), CG: 69% (9/13), female carers IG: 100% (11/11), CG: 77% (10/13); age PLWD IG: 79.8 (±8.16), CG: 80.5 (±6.94) years; age carers IG: 46.2 (±17.62), CG: 55.6 (±19.67); dropouts, IG: 5 participants CG: 2 participants	5-min Montreal Cognitive Assessment score IG: 15.8 (±5.37), CG: 11.8 (±3.07)	Feasibility assessment included recruitment, attrition, adherence and engagement. Outcome measures were motor performance, including mobility: TUG; functional leg muscle strength: Timed-Chair-Stand; dynamic bilateral stance: FR; and dynamic standing balance: Step Test	Recruitment rate-58% (26/45 assessed dyads), high attendance rate-81% (25.8/32 sessions). No adverse incidents reported. High attrition rate of 38%, and mean home practice time decreased between weeks 8 and 16. Small but insignificant improvement was observed for most motor performance outcomes for IG compared to CG	IL = 16 weeks; FU = NA
Lam ***et al.***, 2018 Hong Kong	RCT	To evaluate effects of adding WBV to a routine activity programme among community-dwelling individuals with mild–moderate dementia	IG: routine day activity programme combined with WBV training (WBV at 30 Hz, 2 mm peak-to-peak amplitude) ranged between 4 and 6 min/training session, 2 × /week; CG: the routine programme only without WBV. Routine programme: 30–60 m active limb mobilization exercises, leg strengthening exercises, walking and balance exercises. Also included social and cognitive activities	54 PLWD (27/group); female IG: 70.3% (19/27), CG: 77.7% (21/27); age IG: 79.7 (±5.5), CG: 79.9 (±6.7) years; dropouts, IG: 1 participant, CG: 2 participants	CMMSE score IG: 13.6 (±4.7), CG: 15.6 (±4.5)	Primary outcome was functional mobility (TUG). Secondary outcomes were: BBS, Tinetti balance assessment, 5 times sit to stand time, QoL in Alzheimer's disease questionnaire, and Activities-specific Balance Confidence scale. Also recorded attendance rate and adverse events	Significant improvement in TUG, BBS and Tinetti balance assessment for both groups, however, no significant group by time interactions. High attendance rate for training (86.0%), low adverse event incidence-7.4% (2/27) in the IG reporting mild knee pain	IL = 9 weeks; FU = 12 weeks
Law and Kwok, 2019 Hong Kong	RCT	To explore feasibility of a multicomponent intervention programme and to evaluate its effects on behavioural and psychological symptoms of dementia (BPSD) and psychological health of carers	Participants in both groups underwent an individual physiotherapy session (personalised home exercises with 5–10 repetitions of each set of knee exercises within 15–20 min and care education) 7 × /week and 8 weeks of a 1-h-structured group exercise session weekly at a day care centre. The IG received a multicomponent programme, combining knee OA-specific therapeutic exercise for participants with dementia and self-management support for the carers, the CG attended the routine group exercise programme only	56 dyads of PLWD and their carers (28 dyads in each group); female PLWD IG: 82.1% (23/28), CG: 78.6% (2/28); female carers IG: 92.9% (26/528), CG: 89.3% (25/28); age PLWD IG: 82.4 (±5.8), CG: 82.7 (±5.3) years; dropouts IG: 1 dyad, CG: 1 dyad	CMMSE score IG: 19 (16–22); CG: 20 (15–23)	Attendance rate and non-attendance reasons were recorded for feasibility. Carer self-efficacy and distress: the Chinese versions of RSCSE and neuropsychiatric symptoms: the NPI-Q	Attendance rate was high (94.4%). Compared with the CG, IG carers significantly improved in three domains of RSCSE scores ($P \leq 0.005$) and carers' distress ($P = 0.004$) post-intervention. No effects were observed for BPSD severity in PLWD. No adverse events or falls were reported	IL = 8 weeks; FU = NA
Yang ***et al.***, 2015 China	RCT	To evaluate effect of moderate intensity aerobic exercise on older people with mild Alzheimer's disease	IG: cycling training, moderate intensity, 70% maximum heart rate for 40 min (5 min warm-up, 30 min target intensity exercise, 5 min reorganisation movement) 3 × /week. training time of initial stage was 25–30 min, and exercise load was 0.5 kg. CG: health education	50 PLWD (25 participants in each group); female: 66% (33/50); age 71.9 (±6.9) years	MMSE score, IG: 21.33 (±2.24), CG: 20.00 (±3.50)	MMSE, QoL Alzheimer's disease, plasma Apo-a1 level, the Alzheimer's Disease Assessment Scale-cognition score and NPI-Q	Significant improvement by the IG compared to CG for MMSE, QoL Alzheimer's Disease score and the plasma Apo-a1 level ($P < 0.05$), the Alzheimer's Disease Assessment Scale-cognition score and NPI-Q score was significantly decreased ($P < 0.05$) baseline to post-intervention in IG compared to CG	IL = 12 weeks; FU = NA

Table 1. (*Continued*)

Reference	Study design	Study purpose	Intervention	Sample size; % female; age (years) (SD); dropout	MMSE score (SD) or rating of dementia	Outcome measure	Findings	FU
Miu ***et al.***, 2008 Hong Kong	RCT	To explore effect of exercise in older people with dementia	IG: aerobic exercise training with treadmill, bicycle, arm ergometry and flexibility exercises for 45–60 min and 10-min flexibility training, 2 × /week. CG: conventional medical treatment	85 PLWD (IG = 36 and CG = 49); female IG: 42% (15/36), CG: 63% (31/49); age IG: 75 (±7), CG: 78 (±6) years; dropouts IG: none, CG: 3	MMSE score, IG: 19.52 (±4.59), CG: 19.69 (±4.0)	Physical performance: 6-min walking distance, FR, BBS and SF12 QoL questionnaire. Cognitive function: MMSE and ADAS-Cognitive Subscale. Depressive symptoms: Cornell Scale for Depression in Dementia and Carer stress: Zarit Burden Interview	Greater significant improvements in physical performance in IG than CG for the 6-min walking distance (12-month mean treatment difference 29.75, $p = 0.014$) and FR (12-month mean treatment difference 2.63, $p = 0.009$). No statistically significant differences between groups in cognitive function, and no effect on depression	IL = 52 weeks; FU = *NA*
Lee and Don Kim, 2018 South Korea	RCT	To evaluate effects of a physical activity programme in older adults with mild dementia	IG: cognition programme for 30 min and physical activity programme for 30 min 3 × /week for 8 weeks (Otago exercise programme with 1–6 kg ankle weight); CG: cognition programme only	60 older persons with mild dementia (30/group); female IG: 60% (18/30), CG: 53.3% (16/30); age IG: 76.27 (±3.86), CG: 75 (±4.98) years	CDR = 1	Cognitive function: LOTCA-G; and ADLs: FIM	Cognitive function and ADLs significantly improved in both groups, however, effects in IG were significantly greater than CG (i.e., statistically significant between group difference)	IL = 8 weeks; FU = NA
Shih ***et al.***, 2019 Taiwan	Quasi-experimental study	To evaluate effects of walking on sundown syndrome in older adults with Alzheimer's disease	3 groups (2 IG and 1 CG); IG: morning or afternoon walking programme with carer supervision for 30 min 4 × /week; CG: usual daily activities	60 PLWD (20/group); female IG (morning): 73.3% (11/15), IG (afternoon): 40% (6/15), CG: 62.5% (10/16); age IG (morning): 75.1 (±8.3), IG (afternoon): 79.9 (±8.3), CG: 78.1 (±7.3); dropouts IG (morning): 5, IG (afternoon): 5, CG: 4	CDR score all groups, 1 = 54.3% (25/46), 2 = 37% (17/46), 3 = 8.7% (4/46)	Neuropsychiatric symptoms (sundown syndrome): The Chinese version of C-CMAI	Neuropsychiatric symptoms significantly decreased on two (morning and afternoon) IG compared to CG. No statistically significant differences between morning and afternoon IG	IL = 24 weeks; FU = NA
Kim ***et al.***, 2017 South Korea	Quasi-experimental study	To explore effects of an occupation-centred activity programme in community-dwelling older people with dementia	IG: occupation-centred activity programme (physical activities, cognitive activities, daily life activities, instrumental daily life activities, handicraft, traditional Korean music activities and other music activities) for 60 min 5 × /week and dementia medications; CG: only taking medications for dementia symptoms	30 PLWD (15/group); female IG: 13.3% (2/15), CG: 26.7% (4/15); age IG: 82 (±4.6); CG: 80.9 (±3.4)	MMSE-K score, IG: 15.5 (±2.9), CG: 15.6 (±2.4)	Cognitive function: MMSE-K and GDS. Fall-related factors: FES-K, Chair stand test, 244 cm Up and Go Test, one leg standing test. QoL: KQOL-AD	Cognitive function improved significantly in both IG and CG, fall-related factors and the quality of life significantly improved only in the IG	IL = 5 weeks; FU = NA
Juniarti ***et al.***, 2021 Indonesia	Quasi-experimental study	To investigate the effect of exercise and learning therapy on the cognitive functions and daily physical activities of people living with dementia	IG: physical exercise (low-impact aerobic exercise) and reading therapy for 60 min 3 × /week; CG: daily activities programme	90 PLWD (45/group); female IG: 77.8 (35/45), CG: 66.7 (30/45); age IG, 60–70 years: 71% (32/45), > 70 years: 28.9% (13/45); CG, 60–70 years: 62.2% (28/45), > 70 years: 37.8% (17/45)	MMSE score, IG: 22.5 (±2.7), CG: 20.93 (±3.4)	Cognitive function: MMSE; and physical activity level: PASE	Cognitive function and physical activity level significantly improved in IG but not in the CG. There were statistically significant differences between groups in cognitive function and physical activity level	IL = 4 weeks; FU = NA

Notes: RCT, Randomised Controlled Trial; PLWD, People Living with Dementia; IL, intervention length; FU, follow up; IG, intervention group; CG, control group; MMSE, Mini Mental State Examination; CMMSE, Cantonese Mini Mental State Examination; SD, Standard Deviation; TUG, Timed Up and Go; LOTCA-G, Loewenstein Occupational Therapy Cognitive Assessment for Geriatric Population; FIM, Functional Independence Measure; NPI-Q, neuropsychiatric inventory questionnaire; BBS: Berg Balance Scale; QoL, Quality of Life; FR, Functional Reach; RSCSE, Revised Scale for Caregiving Self-Efficacy; ADAS, Alzheimer Disease Assessment Scale-Cognitive subscale; ADLs, Activity of Daily Livings; C-CMAI, Cohen-Mansfield Agitation Inventory-Chinese version; MMSE-K, Mini Mental State Examination-Korea; GDS, Global Deterioration Scale; FES-K, Korean Falls Efficacy Scale for the Elderly; KQOL-AD, Korean version of the Quality of Life-Alzheimer's Disease Scale; PASE, Physical Activity Scale for the Elderly.

exercise intervention effect was clearly able to be identified compared to the control group.

Three studies reported dropout rates between 3.5%[35] to 5.5%[32] for people with dementia, and 5%[33] for carers. Reasons for participants with dementia withdrawing were hospitalisation,[32,33] declined to continue[35] and death.[35] Two studies reported exercise adherence rates of 86%[32] and 94.4%.[33] Reasons for non-participation included knee pain onset, holiday, did not like the vibration training, regular medical FU[32,33] and medical conditions.[33] No adverse events were reported.

Aerobic exercise

Three studies investigated the effectiveness of aerobic exercise including cycling training,[36] walking[40] and low-impact aerobic exercise.[38] The intervention duration varied between 4 and 24 weeks with re-assessment at the end of the intervention. One study reported a dropout rate of 23.3%, and reasons for participants with dementia withdrawing were hospitalisation, carer changed and refused to participate.[40] No adverse events were reported.

Tai chi

Liu *et al.*[37] investigated the effectiveness of Tai-chi exercise. The programme was delivered by a Tai-chi master at a community centre over a 16-week period with re-assessment at the end of the intervention. Carers were actively engaged to provide supervision and support in undertaking the Tai-chi programme at home. The dropout rates were 38% in the Tai-chi group. Reasons for participants with dementia withdrawing were hospitalisation, declined to continue and carer health issue. Adherence rate was 81% for Tai-chi practice sessions, recruitment rate was 58% and positive engagement in the exercise programme was reported. No adverse events were reported.

Quality of studies

The risk of bias assessment for each study is reported in Tables 2 and 3. Based on the assessment criteria in Cochrane risk-of-bias tool, four RCT studies did not provide sufficient information and were scored as having an unclear risk of bias.[32,34–36] Two studies were assessed as having a

Table 2. The Cochrane risk-of-bias tool for randomised trials.

Study	Selection bias Sequence generation	Selection bias Allocation concealment	Performance bias Blinding of participants, personnel and outcome assessors	Attrition bias Incomplete outcome data	Reporting bias Selective outcome reporting	Other bias Free of other bias
Liu ***et al.***	○	x	○	x	x	●
Lam ***et al.***	○	x	○	○	x	x
Law and Kwok	x	x	●	○	x	x
Yang ***et al.***	x	x	x	x	x	x
Miu ***et al.***	x	x	x	x	x	x
Lee and Don Kim	x	x	x	x	x	x

Notes: Bias was scored as low risk (○), unclear (x) or high risk (●). Selective outcome reporting domain was scored with unclear for the studies if the study protocol is not available.

Table 3. Down and Black quality checklist for quasi-experimental studies.

Study	Reporting (10)	External validity (3)	Internal validity bias (7)	Internal validity confounding selection bias (7)	Sufficiently powered?	Subtotal score (27)	Quality interpretation
Shih ***et al.***	9	2	5	4	Yes	20	Good
Kim ***et al.***	4	1	3	1	No	9	Poor
Juniarti ***et al.***	7	0	5	3	Yes	15	Fair

Notes: Values in parentheses indicate total score available. Adapted Downs and Black (1998) quality appraisal checklist: 27 total points possible ratings for poor ($\leq$ 14), fair (14–19), good (20–25), excellent (26–28).

high risk of bias[33,37] due to lack of blinding and selection bias attributable to small sample size and recruitment strategy used, respectively. For the quasi-experimental studies, one study was assessed as having good quality[40] with a total score of 20, another was assessed as having poor quality[39] (total score 9) and the third study was assessed as having fair quality[38] (total score 15).

Effectiveness of exercise programmes

Various outcome measures were used across the nine studies in this review. Assessment tools used in more than one study were the Timed Up and Go (TUG) test (3 studies),[32,37,39] Functional Reach (FR) (2 studies),[35,37] Berg Balance Scale (BBS) (2 studies),[32,35] 5 times sit to stand (2 studies)[32,37] and the Neuropsychiatric Inventory-Questionnaire (NPI-Q) (2 studies).[33,36] Because of the small number of studies which could be included in each meta-analysis, sensitivity analysis, sub-group analysis and publication bias detection (either using funnel plot asymmetrical testing or Egger's regression method) were not able to be performed.[29,41,42]

Physical function

Balance. Balance outcomes were reported in three studies, using the FR test,[35,37] the Step Test,[37] the BBS[32,35] and the Tinetti Performance Oriented Mobility Assessment (POMA) balance score.[32] Pooled results from Liu *et al.*[37] and Miu *et al.*[35] indicated a benefit of their exercise interventions on FR performance compared to controls (MD [95% CI] = 2.61 [1.55 to 3.67], heterogeneity: $I^2 = 0\%$, $p = 0.95$) (Fig. 2). In contrast, pooled results from Lam *et al.*[32] and Miu *et al.*[35] indicated no benefit of their exercise interventions on BBS performance compared to controls (MD [95% CI] = 1.10 [−2.88 to 5.07], heterogeneity: $I^2 = 0\%$, $p = 0.45$) (Fig. 3).

There were two single studies where the balance outcomes could not be pooled. Liu *et al.*[37] reported a benefit of their exercise intervention on Step Test performance [Effect size (Cohen's d) = 0.24] compared to controls (p-value was not reported). In contrast, Lam *et al.*[32] reported no benefit of their exercise intervention on the Tinetti POMA balance score [Effect size = 0.006, 95% CI (−0.1, 1.3), $p = 0.705$] compared to controls.

Functional mobility. Functional mobility was reported by three studies using the TUG test[32,37,39] and the Tinetti POMA gait score.[32] Pooled results from Lam *et al.*[32] and Liu *et al.*[37] indicated no benefit of their exercise interventions on TUG test performance compared to controls (MD [95%CI] = −3.47 [−7.27 to 0.33], heterogeneity: $I^2 = 0\%$, $p = 0.57$) (Fig. 4). Kim *et al.*[39] were not included in the meta-analysis as they used a different distance of walking for their TUG test, but did report a benefit of exercise on TUG ($p < 0.05$)

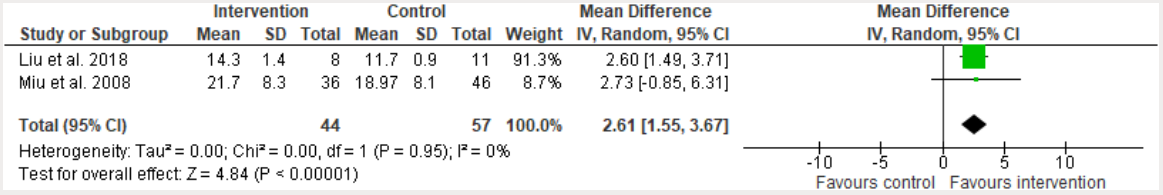

Fig. 2. Forest plot of comparison: intervention versus control for FR. FR = Functional Reach, SD = standard deviation, CI = confidence interval, IV = inverse variance.

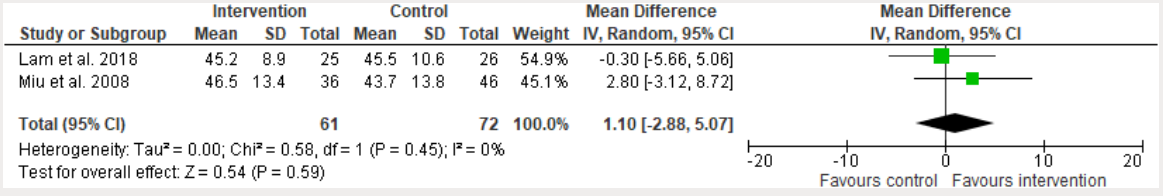

Fig. 3. Forest plot of comparison: intervention versus control for BBS. BBS = Berg Balance Scale, SD = standard deviation, CI = confidence interval, IV = inverse variance.

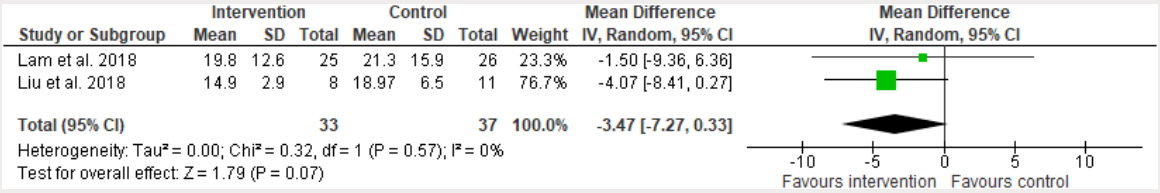

Fig. 4. Forest plot of comparison: intervention versus control for TUG Test. TUG = Timed Up and Go, SD = standard deviation, CI = confidence interval, IV = inverse variance.

(actual effect size and *p*-value were not reported). Data from Lam *et al.*[32] also could not be pooled, however, they reported no benefit of their exercise intervention on the Tinetti POMA gait score [Effect size = 0.034, 95% CI (−0.6, 0.4), $p = 0.178$].

Endurance. Miu *et al.*[35] separated the effects of exercise into diagnostic groups (Alzheimer's disease group, and a mixed dementia group [Alzheimer's disease + vascular dementia, or vascular dementia]) and reported a benefit of their exercise intervention in the Alzheimer's disease group and the mixed dementia group at 3 ($p < 0.001$) and 6 months ($p = 0.009$) measured by the 6-min walk test compared to controls (effect size was not reported).

Lower limb strength. Three studies reported lower limb strength outcomes using the 5 times sit to stand test,[32,37] and 30 s sit to stand test.[39] Pooled results from Lam *et al.*[32] and Liu *et al.*[37] indicated no benefit of their exercise interventions on lower limb strength on the 5 times sit to stand test compared to controls (MD [95%CI] = −1.86 [−5.27 to 1.54], heterogeneity: $I^2 = 0\%$, $p = 0.99$) (Fig. 5). Data from Kim *et al.*[39] could not be pooled, however, they reported improved 30 s sit to stand test performance ($p < 0.05$) (actual effect size and *p*-value were not reported).

Functional independence. Lee and Don Kim[34] reported no benefit of their exercise intervention on functional independence as measured by the Functional Independent Measure (FIM) ($p > 0.05$) (effect size was not reported).

Balance confidence. Lam *et al.*[32] reported no benefit of their exercise intervention on balance confidence using the Activities-specific Balance Confidence scale [Effect size = 0.005, 95% CI (−6.1, 7.0), $P = 0.757$].

Behavioural symptoms

Three studies reported behavioural symptom outcomes.[33,35,36] A meta-analysis was not able to be performed even though two studies[33,36] reported the NPI score. Law and Kwok[33] reported individual scores for each domain of the NPI-Q, while Yang *et al.*[36] reported the total score of the scale. Law and Kwok[33] reported a benefit of exercise on behavioural symptoms as measured by the NPI-Q score for carer stress ($p = 0.004$) (effect size was not reported). Yang *et al.*[36] reported a significant difference within the exercise intervention group as measured by the NPI-Q ($p = 0.004$) (effect size was not reported), however, they did not report differences between the intervention and control groups. Miu *et al.*[35] reported no benefit of their exercise intervention on behavioural symptoms as measured by the Cornell depression scale compared to controls (*p*-value and effect size were not reported).

Impact on informal carers

Two studies reported impact on informal carer outcomes, although the results were not be able to be pooled as these scales measured different

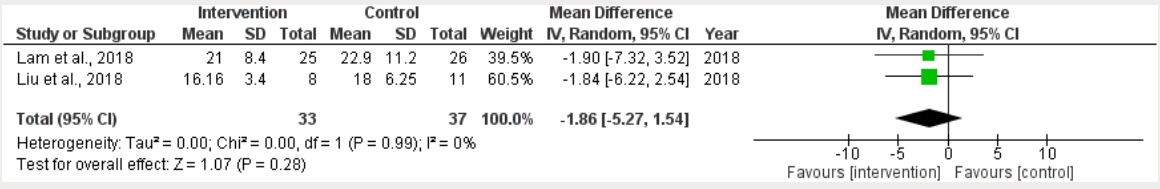

Fig. 5. Forest plot of comparison: intervention versus control for 5 times sit to stand test, SD = standard deviation, CI = confidence interval, IV = inverse variance.

constructs of impact on carers.[33,35] Miu *et al.*[35] reported no effect of their exercise intervention on the impact on informal carers using the Zarit burden scale (p-value and effect size were not reported), while Law and Kwok[33] reported a benefit of their exercise intervention measured by the Revised Score for Caregiving Self-Efficacy [($p = 0.0001, 0.001, 0.005$) for three domains of the Revised Score for Caregiving Self-Efficacy] (effect sizes were not reported).

Discussion

Despite the growing and promising evidence that exercise programmes can improve physical function and reduce behavioural symptom outcomes of older adults with dementia and the impact on their informal carers, this systematic review identified that little of this research occurred in Asia (where 60% of the world population live)[18] and where the ageing trajectory is increasing rapidly.[3] Overall, only four meta-analyses were able to be performed, spread over three of the nine studies included in this review. The results need to be interpreted with caution due to the small number of studies, small sample sizes and low or unknown risk of bias in the majority of overall methodological quality ratings. A meta-analysis of two studies shows that exercise interventions may improve balance performance when measured by a single task measurement (i.e., FR). However, this benefit was not demonstrated in other meta-analyses when balance was measured using a multi-task measurement scale (i.e., BBS), or for functional mobility or lower limb strength. Single studies where results could not be pooled reported that their exercise interventions had no effect on endurance, functional independence and balance confidence. Single studies however did report significant benefits for lower limb strength (30 s sit to stand) and balance (Step Test). Mixed effects were reported on behavioural symptoms and impact on informal carers between the single studies reporting these outcomes.

Compared to other recent systematic reviews not limited to Asia, where a substantially greater number of research studies have been undertaken and reported the benefits of exercise to improve physical function, behavioural symptoms, and to reduce impact on informal carers,[14,15,17] these benefits were not consistently identified in our review. This is similar to findings of other systematic reviews where research evidence in Asia relative to the rest of the world are emerging, for example the effectiveness of fall prevention programmes on community-dwelling older people in Asia.[20]

The studies included in this paper varied substantially in terms of the nature of the exercise programmes, dosage (session length (minutes), frequency, duration of the exercise programme) and participants characteristics (age, gender, dementia severity). This, and the limited ability to pool study results due to varied outcomes evaluated between studies, limits conclusions able to be made related to these factors that may influence outcomes. Five out of nine studies[28–31,35] used multimodal exercise as the intervention (which combine more than one exercise type) or included an additional element of a non-exercise intervention (where the exercise intervention effect was clearly able to be identified compared to the control group). Multimodal exercises usually included a balance training component, which may help to reduce falls risk. However, a systematic review of exercise programmes to reduce falls risk in cognitively intact older people,[43] which highlighted the importance of balance training to reduce falls risk, also concluded that programmes needed to include three hours of exercise/week to be likely to reduce falls risk. Only one of the multimodal programmes in this review met this exercise dosage.[33] Several studies focussed on participants with mild severity dementia.[34,36,38] Exercise interventions that commence early after dementia diagnosis, or when people have mild dementia severity may be more likely to have effective outcomes than those targeting people with more advanced dementia, although further research is needed to confirm this.[13]

Overall, the studies indicated that community-based exercise programmes appear to be safe and feasible for older people with dementia living in Asia. Most studies in this review utilised exercise programmes limited to short, time limited or episodic bursts (between 4 and 52 weeks (Median (IQR [25, 75]) = 9 [6.5, 20]), whereas guidelines and recommendations highlight the need for exercise as an approach to care utilised for people with dementia needs to become a lifestyle change and a sustained behaviour.[14,44] This review identified only one study[32] that reported a 12-week FU while the other eight studies did not conduct a FU assessment. It is unknown if participants continued to participate in exercises beyond the intervention period to sustain any benefits that were gained.

Exercise load and intensities were reported for some studies included in this review. However, in other studies, aspects of intensity and load that may have an effect on the findings, were reported inconsistently. Based on the American College of Sports Medicine (ACSM)[45] exercise prescription guidelines, increasing exercise intensity may lead to the positive response of health and fitness benefits, and exercise below a minimum intensity or threshold will likely not challenge the body sufficiently to result in physiologic adaptive changes (the overload principle).

This review focussed on Asia because of the cultural and health system factors in the Asian context that may influence outcomes relative to studies conducted in non-Asian countries.[19,20] Factors that could possibly influence effective translation of exercise interventions in Asian countries may include: (1) family role including filial piety; (2) health system and service including people's expectations of health practitioners; (3) lifestyle factors; (4) different understanding of intervention approach and prevention[19,46] and (5) barriers and facilitators to exercise participation among older Asians such as cultural and family values.[46] It is also important to note that there is considerable diversity between Asian countries e.g., country income status. Most studies in this review were from the more economically developed Asian countries. More research and assistance to conduct research in developing countries would provide a more comprehensive evidence base for exercise interventions for people with dementia in Asia and enhance the translation of effective research between Asian countries.

There were several limitations of this review. We did not search the grey literature and have only included studies published in English. It is possible that if other studies exist, they may modify the results. The small number of studies, small sample size of individual studies likely resulting in some outcomes being underpowered, unclear risk of bias and only a few studies that were able to be pooled for meta-analysis may have over-estimated the result of meta-analysis and potentially limited the evidence of this review. Another limitation is the absence of FU assessments in most of the studies beyond the formal intervention period to evaluate sustained, longer term exercise participation.

Future research for large RCTs of community-based exercise interventions for people with dementia in Asia is needed to establish whether exercise is beneficial for improving physical function, reducing behavioural symptoms and carer impact for this population. There is also a need for greater standardisation of measures across studies to increase pooling of data in future research to establish effects. In addition, future studies should include longer term FU to evaluate sustained exercise participation beyond the formal exercise programme duration.

Conclusion

Our review is a starting point to building the evidence base of exercise for older people with dementia living in Asian countries. Although one meta-analysis ($n = 2$ studies) identified improved balance performance among older people with dementia living in Asia, overall findings were inconsistent and limited by the small number of studies, small sample sizes and risk of bias in the methodological quality. There is a need to strengthen the research evidence investigating effectiveness of exercise interventions for people living with dementia across Asia, including consideration of local context factors that may influence uptake, sustained participation and outcomes.

Conflict of Interest

The authors have no conflicts of interest relevant to this paper.

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Author Contributions

Conception and design of study were done by Y. M. Sari, K. D. Hill and E. Burton. Acquisition of data was done by Y. M. Sari. Analysis and/or interpretation of data were done by Y. M. Sari, K. D. Hill, D.-C.A. Lee, E. Burton. This manuscript was drafted by Y. M. Sari, K. D. Hill, D.-C.A. Lee, E. Burton and was revised critically for important intellectual content by Y. M. Sari, K. D. Hill, D.-C. A. Lee, E. Burton. Finally, approval to publish this manuscript was given by Y. M. Sari, K. D. Hill, D.-C. A. Lee and E. Burton.

Appendix A. Search Keywords (According to Medline Terminology)

1	**Dement**ia/[**MeSH**]
2	Dement ∗ ti.ab
3	Alzheimer disease/[MeSH]
4	Alzheimer ∗ ti.ab
5	Cognitive ∗ impair ∗ ti.ab
6	Cognition disorders/[MeSH]
7	1 or 2 or 3 or 4 or 5 or 6
8	Exercise/[MeSH]
9	Exercise ∗ ti.ab
10	Exercise therapy/[MeSH]
11	Exercise training ti.ab
12	Exercise movement techniques/[MeSH]
13	Physical activit ∗ ti.ab
14	Physical exerc ∗ ti.ab
15	Physical therapy ti.ab
16	Physical therapy modalities/[MeSH]
17	Physiotherapy ti.ab
18	8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17
19	Physical function ti.ab
20	Functional status ti.ab
21	Physical fitness/[MeSH]
22	Physical fitness ti.ab
23	Balance ∗ ti.ab
24	Postural balance/[MeSH]
25	Mobility ∗ ti.ab
26	Mobility limitation/[MeSH]
27	Strength ∗ ti.ab
28	Muscle strength/[MeSH]
29	Endurance ti.ab
30	Physical endurance/[MeSH]
31	Behaviour ti.ab
32	Health behaviour/[MeSH]
33	Neuropsychiatric symptom ∗ ti.ab
34	Mental disorders/[MeSH]
35	Mental disorder ∗ ti.ab
36	Caregiver ∗ burden ti.ab
37	Carer ∗ burden
38	Caregiv ∗ ti.ab
39	Caregivers/[MeSH]
40	19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39
41	Communit ∗ ti.ab
42	Home ti.ab
43	41 or 42
44	7 and 18 and 40 and 43

References

1. Nichols E, Szoeke CEI, Vollset SE, et al.. Global, regional, and national burden of Alzheimer's disease and other dementias, 1990–2016: A systematic analysis for the Global Burden of Disease Study 2016. Lancet Neurol 2019;18(1):88–106. doi: 10.1016/S1474-4422(18)30403-4.
2. World Health Organization. Global status report on the public health response to dementia. 2022. Available at https://www.who.int/publications/i/item/9789240033245.
3. World Bank. Live Long and Prosper: Aging in East Asia and Pacific. Washington, DC, 2016.
4. Alzheimer's Disease International. Dementia in the Asia Pasific Region. 2018. Available at https://www.alz.co.uk/adi/pdf/Dementia-Asia-Pacific-2014.pdf.
5. Bridenbaugh SA, Kressig RW. Quantitative gait disturbances in older adults with cognitive impairments. Curr Pharm Des 2014;20(19):3165–72. doi: 10.2174/13816128113196660688.
6. Cipriani G, Danti S, Picchi L, Nuti A, Di Fiorino M. Daily functioning and dementia. Dement Neuropsychol 2020;14(2):93–102. doi: 10.1590/1980-57642020dn14-020001.
7. Allan LM, Ballard CG, Rowan EN, Kenny RA. Incidence and prediction of falls in dementia: A prospective study in older people. PLoS One 2009;4(5):e5521. doi: 10.1371/journal.pone.0005521.
8. Walter E, Pinquart M. How effective are dementia caregiver interventions? An updated comprehensive meta-analysis. Gerontologist 2020;60(8):E609–19. doi: 10.1093/geront/gnz118.
9. Cheng S-T. Dementia caregiver burden: A research update and critical analysis. Curr Psychiatry Rep 2017;19(9):1–8. doi: 10.1007/s11920-017-0818-2.
10. Alzheimer's Disease International. World Alzheimer report 2019. Attitudes to dementia. 2020. Available at https://www.alz.co.uk/research/WorldAlzheimerReport2019.pdf.
11. World Health Organization. Global action plan on the public health response to dementia 2017–2025. 2019. Available at https://www.who.int/mental_health/neurology/dementia/action_plan_2017_2025/en/.
12. Burton E, Cavalheri V, Adams R, et al.. Effectiveness of exercise programs to reduce falls in older people with dementia living in the community: A systematic review and meta-analysis. Clin Interv Aging 2015;10:421–34. doi: 10.2147/CIA.S71691.
13. Forbes D, Forbes S, Blake C, Thiessen E, Forbes S. Exercise programs for people with dementia (Review). Cochrane Database Syst Rev 2015;(4):CD006489. doi: 10.1002/14651858.CD006489.pub4.
14. Lam F, Huang M-Z, Liao L-R, Chung RC, Kwok TC, Pang MY. Physical exercise improves strength, balance, mobility, and endurance in people with cognitive impairment and dementia: A

systematic review. J Physiother 2018;64(1):4–15. doi: 10.1016/j.jphys.2017.12.001.
15. Law C, Lam FM, Chung RC, Pang MY. Physical exercise attenuates cognitive decline and reduces behavioural problems in people with mild cognitive impairment and dementia: A systematic review. J Physiother 2020;66(1):9–18. doi: 10.1016/j.jphys.2019.11.014.
16. Lewis M, Peiris CL, Shields N. Long-term home and community-based exercise programs improve function in community-dwelling older people with cognitive impairment: A systematic review. J Physiother 2017;63(1):23–29. doi: 10.1016/j.jphys.2016.11.005.
17. Orgeta V, Miranda-Castillo C. Does physical activity reduce burden in carers of people with dementia? A literature review. Int J Geriatr Psychiatry 2014;29(8):771–83. doi: 10.1002/gps.4060.
18. Population Reference Bureau. World population data sheet 2018. 2020. Available at https://www.prb.org/2018-world-population-data-sheet-with-focus-on-changing-age-structures/.
19. Chongsuvivatwong V, Phua KH, Yap MT et al.. Health and health-care systems in southeast Asia: Diversity and transitions. Lancet 2011;377(9763):429–37. doi: 10.1016/S0140-6736(10)61507-3.
20. Hill K, Suttanon P, Lin S et al.. What works in falls prevention in Asia: A systematic review and meta-analysis of randomized controlled trials. BMC Geriatr 2018;18(1):1–21.
21. Pandya SY, Clem MA, Silva LM, Woon FL. Does mild cognitive impairment always lead to dementia? A review. J Neurol Sci 2016;369:57–62. doi: 10.1016/j.jns.2016.07.055.
22. Paez A. Gray literature: An important resource in systematic reviews. J Evid Based Med 2017;10(3):233–40. doi: 10.1111/jebm.12266.
23. Mahood Q, Eerd DV, Irvin E. Searching for grey literature for systematic reviews: Challenges and benefits. Res Synth Methods 2014;5(3):221–34. doi: 10.1002/jrsm.1106.
24. Bellefontaine SP, Lee CM. Between black and white: Examining grey literature in meta-analyses of psychological research. J Child Fam Stud 2013;23(8):1378–88. doi: 10.1007/s10826-013-9795-1.
25. Liberati A, Altman DG, Tetzlaff J et al.. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. Ann Intern Med 2009;151(4):W65. doi: 10.7326/0003-4819-151-4-200908180-00136.
26. Higgins JPT, Altman DG, Gøtzsche PC et al.. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. BMJ (Clin Res ed.) 2011;343:d5928. doi: 10.1136/bmj.d5928.
27. Downs SH, Black N. The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. J Epidemiol Community Health 1998;52(6):377–84. doi: 10.1136/jech.52.6.377.
28. DerSimonian R, Laird N. Meta-analysis in clinical trials. Control Clin Trials 1986;7(3):177–88. doi: 10.1016/0197-2456(86)90046-2.
29. Deeks JJ, Higgins JPT, Altman DG. Analysing data and undertaking meta-analyses. In: Higgins JPT, Thomas J, Chandler J *et al.*., eds., Cochrane Handbook for Systematic Reviews of Interventions, Chap. 10. Cochrane, 2022. www.training.cochrane.org/handbook.
30. Higgins JPT, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. Br Med J 2003;327(7414):557–60. doi: 10.1136/bmj.327.7414.557.
31. Review Manager (RevMan). Version 5.3. The Cochrane Collaboration, 2014.
32. Lam FM, Liao LR, Kwok TCY, Pang MYC. Effects of adding whole-body vibration to routine day activity program on physical functioning in elderly with mild or moderate dementia: A randomized controlled trial. Int J Geriatr Psychiatry 2018;33(1):21–30. doi: 10.1002/gps.4662.
33. Law W, Kwok TCY. Impacts of a multicomponent intervention programme on neuropsychiatric symptoms in people with dementia and psychological health of caregivers: A feasibility pilot study. Int J Geriatr Psychiatry 2019;34(12):1765–75. doi: 10.1002/gps.5191.
34. Lee HJ, Don Kim K. Effect of physical activity on cognition and daily living activities of the elderly with mild dementia. J Phys Ther Sci 2018;30(3):428–33. doi: 10.1589/jpts.30.428.
35. Miu DKY, Szeto P, Mak Y. A randomised controlled trial on the effect of exercise on physical, cognitive and affective function in dementia subjects. Asian J Gerontol Geriatr 2008;3(1):8–16.
36. Yang S-Y, Shan C-L, Qing H et al.. The effects of aerobic exercise on cognitive function of Alzheimer's disease patients. CNS Neurol Disord Drug Targets 2015;14(10):1292–7. doi: 10.2174/1871527315666151111123319.
37. Liu JYW, Kwan RYC, Lai CK, Hill KD. A simplified 10-step Tai-chi programme to enable people with dementia to improve their motor performance: A feasibility study. Clin Rehabil 2018;32(12):1609–23. doi: 10.1177/0269215518786530.
38. Juniarti N, Al'Adawiyah MZI, Sari CWM, Haroen H. The effect of exercise and learning therapy on cognitive functions and physical activity of older

people with dementia in Indonesia. J Aging Res 2021;2021:1–9. doi: 10.1155/2021/6647029.
39. Kim K-U, Kim S-H, Oh H-W. The effects of occupation-centered activity program on fall-related factors and quality of life in patients with dementia. J Phys Ther Sci 2017;29(7):1188–91. doi: 10.1589/jpts.29.1188.
40. Shih YH, Pai MC, Lin HS, Sung PS, Wang JJ. Effects of walking on sundown syndrome in community-dwelling people with Alzheimer's disease. Int J Older People Nurs 2020;15(2):e12292. doi: 10.1111/opn.12292.
41. Borenstein M, Higgins JPT. Meta-analysis and subgroups. Prev Sci 2013;14(2):134–43. doi: 10.1007/s11121-013-0377-7.
42. Doleman B, Freeman SC, Lund JN, Williams JP, Sutton AJ. Funnel plots may show asymmetry in the absence of publication bias with continuous outcomes dependent on baseline risk: Presentation of a new publication bias test. Res Synth Methods 2020;11(4):522–34. doi: 10.1002/jrsm.1414.
43. Hopewell S, Adedire O, Copsey BJ et al.. Multifactorial and multiple component interventions for preventing falls in older people living in the community. Cochrane Database Syst Rev 2016;2016 (6):CD012221. doi: 10.1002/14651858.CD012221.
44. Guideline Adaptation Committee. Clinical Practice Guidelines and Principles of Care for People with Dementia, 2016.
45. American College of Sports Medicine. ACSM's Guidelines for Exercise Testing and Prescription. 9th ed. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins, 2014.
46. Karuncharernpanit S, Hendricks J, Toye C. Perceptions of exercise for older people living with dementia in Bangkok, Thailand: An exploratory qualitative study. Int J Older People Nurs 2016;11 (3):166–75. doi: 10.1111/opn.12091.