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Evidence Check

Community-based health promotion for older adults

An **Evidence Check** rapid review brokered by the Sax Institute for the NSW Office of Preventive Health. April 2019.

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This report was prepared by:

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Contents

Executive summary

Background

Older adults who are physically active maintain better health and cognitive function than adults who are not. Evidence-based strategies to increase health and wellbeing among older people are needed as the proportion of older people living in Australia is expected to double by 2050. The Office of Preventive Health is seeking to develop a new community-based program for delivery throughout the state. The program should be designed to incorporate both physical activity and components that also address other health risk factors such as diet, mental health and social isolation.

Review question

This review aimed to address the following question:

Question 1: What community-based programs, that combine physical activity, with other activities addressing key health risk factors, have shown to be effective in improving the health behaviours and outcomes for people aged over 60 years?

Summary of methods

A comprehensive systematic search of seven electronic databases (Medline, CINAHL, PsycINFO, PEDro, DoPHER, TRoPHI and Cochrane) to identify peer-reviewed literature on community-based programs that combine physical activity, with other activities, targeting people aged over 60 years published between January, 2009 and February, 2019 was conducted. The review team independently reviewed the final search results in duplicate against the following primary selection criteria (detailed inclusion and exclusion criteria are presented in Box 1 and Box 2, respectively):

- Published from 1 January, 2009;
- Participants aged 60+ years, in good general health, living in Australia or comparable countries;
- The programs or interventions were community-based and combine physical exercise with at least one other activity;
- The study reported outcomes relevant to the review question.

The review team extracted data, including study characteristics, methodological quality, intervention content and outcomes from included studies. An additional search of grey literature for other programs that had not been disseminated in the peer-reviewed literature was conducted. These included searching government website and reports, research organisations, and clinical trial registries.

Evidence grading

The NHMRC evidence grading recommendation statement was used to assess the overall quality of the body of evidence. Of the 26 included studies, 11 were randomised controlled trials (level II evidence); however, all of these were assessed as having a medium (n=7) or high (n=4) risk of bias. All remaining studies (level of evidence: III-1 = 6, III-2 = 1, III-3 = 3, IV = 5) were assessed to have a high risk of bias. Therefore, the overall evidence base was considered to be satisfactory (C) to poor (D). As the studies used different study designs and reported different outcome measures, the consistency of the evidence and the clinical impact were assessed to be satisfactory (C) to poor (D). However, the generalisability and

applicability were both considered to be good (B). The overall grade of recommendation was rated as C: "Body of evidence provides some support for recommendation(s) but care should be taken in its application".

Key findings

Question 1: What community-based programs, that combine physical activity, with other activities addressing key health risk factors, have shown to be effective in improving the health behaviours and outcomes for people aged over 60 years?

The evidence check identified 26 papers reporting on 23 different community-based programs for older adults (60+ years) that met the criteria for inclusion in this rapid review.

Programs were developed in the United States, Canada, Brazil, several European countries, Japan, South Korea, Mexico and Australia. Studies were categorised into three categories:

1. Physical activity + Education on lifestyle factors (including nutrition) (n=12)
2. Physical activity + Cognitive training (n=9)
3. Physical activity + Other interventions (could not be categorised in above) (n=2)

Note, no programs combined physical activity + education + cognitive training.

Common elements of successful community-based programs were identified according to program length, content (multicomponent, most with a lifestyle component and several with a psychological component), design and activities (group-based, with or without a one-to-one contact) and logistics (Table ES1).

Table ES1: Characteristics of the programs delivered in the included studies

Target population	Program duration	Time	Logistics[1]	Design and activities
Older adults with generally good health, relatively mobile (e.g. can travel to group exercise, can move around independently); some studies targeted older adults who already exercised regularly	Often between 8–12 weeks, multiple sessions per week (often every 2–3 days)	Between 45–90 minutes per session	Mostly in group / in-class setting (some programs had complemented individual tailored home-based exercise); delivered by trained health professionals (physiotherapists) OR exercise trainers / instructors OR certified coaches OR postgraduate students; OR volunteer lay leaders	Varying between programs evaluated, but often included a variety of activities; physical activities included aerobics, flexibility, balance, strength; cognitive activities included counting, naming, mathematical operations; education included topic presentation, group discussions, demonstration, goal settings, etc.; Some programs applied progressive intensity schedule; Order of activities was also considered (physical exhaustion vs. yoga to relax before cognitive training); some programs contained coaching or counselling (and were often found to be effective in either promoting adherence or attributable to positive changes)

[1] Some programs delivered by health professionals could be delivered in the community setting by trained support staff when programs are relatively simple to conduct

The majority of the studies concluded that there are positive differences in favour of combined interventions in some primary and secondary outcomes between the intervention and control groups, at least in the short term. Specifically,

- Physical performance
    - There is some evidence of improved physical performance of older people participating in the combined intervention (vs. no intervention or not physical activity); however, this was limited and was of weak and low quality evidence.
    - It is possible that the short duration of the intervention (mostly between 2–4 months) and the volume and intensity of training (light exercise, 45–60 minutes, 2–3 times per week) were insufficient to provide a significant result for older adults who already engaged in regular and systematic physical activity.
- Cognitive performance
    - Physical activity does not seem to improve cognitive performance within a short period of time, but it appears that the greatest effects may be for interventions that last longer than four months, those that target executive functioning, and those that are multi-factorial.
    - Physical activity training may convey greater relative short-term benefits of cognitive function among older adults (70–85 years).
    - Social aspects of group activities, even without physical activity and/or cognitive training, has a positive impact on older adults. For instance, Legault 2011 found cognitive benefits for older adults in the controlled arm (healthy aging education only) possibly attributable to increased social engagement (1).

However, the evidence of protective health benefits and/or long-term impact is limited. Most studies stated that protective health benefits and/or long-term impact was not found or needed further investigation. Additionally, a longer program duration might be needed in order to observe changes in physical and cognitive performance.

Gaps in the evidence

Identified programs were conducted in researcher-led programs and thus there is limited evidence that these programs are effective outside of a research environment. Most studies had small sample sizes and there was limited evidence of the long-term program effectiveness. Only one study investigated the cost-effectiveness of the community-based program. Additionally, there was little evidence of scaling up the programs to the general community.

Discussion of key findings

Question 1: What community-based programs, that combine physical activity, with other activities addressing key health risk factors, have shown to be effective in improving the health behaviours and outcomes for people aged over 60 years?

Overall, there was some evidence that "exercise in combination with other modalities" has positive impacts on various measures of physical and cognitive performance during the trial period. Physical activity training may convey greater relative short-term benefits of cognitive function among older adults (70–85 years). Pre- vs. post- analyses (studies) appeared to establish some positive effects of physical activity plus education on physical fitness; however, the study designs are weak with a high risk of bias. As such, this finding should be interpreted with caution. Approximately 40% of the included studies did not find a positive effect of the intervention. Possible reasons for this may be the short duration of the trial and/or the volume of activity

engaged in. This is especially relevant for trials that recruited older adults who were already engaged in regular and systematic physical activity. Most studies stated that protective health benefits and/or long-term impact need further investigation, as well as longer program duration to detect changes in physical and cognitive performance.

Applicability

When considering to establish an effective and sustainable community-based program, that combines physical activity and other interventions, for older adults in New South Wales, the following characteristics should be considered: frequency and dosage, adherence, delivery, reach, cultural applicability and resources required.

Figure 2 summarises components to consider when planning a health promotion and physical activity for older people.

Background

Physical and cognitive function decrease gradually as we age; however, the negative effects can be slowed through daily healthy lifestyle, including having enough sleep, eating well, reducing sitting time, regular physical and mental activities and social engagement. Physical decline in older adults can be slowed down through regular and systematic practice of physical activity, especially with multicomponent training, i.e. a combination of strength, endurance, flexibility, motor coordination, and balance exercises (2, 3). Despite the health benefits of physical activity in reducing morbidity and mortality and cost savings through reduced medical care costs (4), the prevalence of leisure time physical activity among older adults in Australia and in comparable countries is still lower than that of younger adults and falls far below recommended guidelines (5, 6). Australian guidelines for adults aged over 65, updated in 2008, recommend at least 30 minutes of physical activity per day (7).

A more positive and productive viewpoint of old age considers successful aging as a combination of active social engagement, low probability of disease and disability, and high physical and cognitive functioning, leading to a healthier and happier life (8). Both physical activity and good diet are vital elements of programs to improve health outcomes of older adults in the community (4). Social activities and engagement are also an important aspect as it has been shown to improve depression and give meaning to the lives of older people when conducted in a group setting (9).

Community-based physical activities have been shown to improve physical and cognitive function, overall health status and quality of life, while reducing risk of falling, symptoms of various illnesses and subsequently, health and social care costs (10, 11). However adherence to physical activity guidelines, particularly strength and aerobic training remains low in older people and there is an imperative to provide effective interventions to prevent current age-related declines in physical activity and subsequent health care costs (6).

The NSW Health Active Ageing portfolio, managed by the Office of Preventive Health, is seeking to develop a new community-based program for delivery throughout the state. The program should be designed to incorporate both physical activity and components that also address other health risk factors such as diet, mental health and social isolation. The program should also increase alignment with the NSW Healthy Eating Active Living Strategy.

Methods

Scope of the review

This evidence check summarised available information to address this research question:

Question 1. What community-based programs, that combine physical activity, with other activities addressing key health risk factors, have shown to be effective in improving the health behaviours and outcomes for people aged over 60 years?

A rapid review approach was used to identify and evaluate the evidence of community-based physical activity program in older adults. In order to fully inform the search strategy and data extraction for the evidence check, the question of interest was translated into a PICO (Population, Intervention, Comparator and Outcome) format (Box 1).

Box 1: Details of the PICO

PICO	
POPULATION OF INTEREST	People aged over 60 years Living in Australia or comparable countries Of good general health
INTERVENTION	Community based programs delivered at least in part in group setting, by community members (lay workers, peers, community health workers and students) Combined physical activity education and training, health behaviour modification including cognitive training and/or nutrition
COMPARATOR	Community based program that contain physical activities alone OR No program at all (business as usual)
OUTCOMES	Physical health: Level of physical activities (self-reported and measured) Balance and strength Psycho-social health and well-being (self-reported and measured) Behaviours related to key health risk factors: Knowledge and understand of healthy behaviours Intention to change behaviours Changes in behaviours (related to key health risk factors) Presence of key health risk factors Long term sustainability Of outcomes for participants Of program in terms of delivery and fidelity Program reach and acceptability

Peer review literature

Relevant studies were identified in an electronic search of the Medical Literature Analysis and Retrieval System Online (Medline), the Cumulative Index to Nursing and Allied Health Literature (CINAHL), the literature database in the field of psychology (PsycINFO), the Physiotherapy Evidence Database (PEDro), two databases from EPPI-Centre – the Database of Promoting Health Effectiveness Reviews (DoPHER) and the Trial Register of Promoting Health Interventions (TRoPHI) – and the Cochrane Library. The complete list of search terms is presented in Appendix A. The database search was undertaken in February 2019, covering publications for the period 1 January 2009 to 26 February 2019 (Table A1 of Appendix A).

For each paper identified, the title and abstract were scanned by two reviewers to determine the relevance. In the case of disagreements between the two reviewers, a third independent reviewer assessed and a final decision was made. The exclusion criteria are described in Box 2.

Box 2: Details of the exclusion criteria

EXCLUSION CRITERIA	
	• studies not published in English • studies published prior to 2009 • studies of non-comparable countries or population groups • people aged under 60 years[1] • people not in good general health (e.g. health conditions such as dementia, severe arthritis) • programs that are designed for treatment or rehabilitation of specific conditions or post-surgery (e.g. falls prevention, frailty) • programs that are run in a clinical setting • programs that require specialised training for delivery (eg. allied health, expertise in particular sports) • programs that require access to specialised equipment, including pools, bicycles, weight machines • programs that do not include a physical activity component • studies that do not report on the evaluation of the physical activity intervention • programs that involve physical activity only

[1] As programs targeted different age groups, relevant studies with participants aged 55 years and over were included.

The full text of included papers from the initial scan were examined by two reviewers to further remove irrelevant studies. In the case of disagreements between the reviewers, a third independent reviewer assessed and a final decision was made following discussions. Citation lists of the included papers were also examined for references to other relevant studies that might have been missed in the electronic database search. The additional relevant papers were then obtained from the respective journals or via standard web search engines (e.g. Google).

Evidence grading

The NHMRC evidence grading recommendation statement was used to assess the overall quality of the body of evidence (12). Firstly, studies were categorised as Level I, II, III-1, III-2, III-3 or IV according to the evidence hierarchy. Risk of bias for each study was assessed according to assessment of randomisation, sample size and adequate blinding. Only measurement of outcome was considered in the blinding as it is not possible to blind participants to an exercise intervention. Results were extracted and presented in the summary table (Table B1 of Appendix B). Following this assessment, a consensus meeting was held and all authors evaluated the body of evidence according to the NHMRC matrix considering the evidence base, consistency, clinical impact, generalisability and applicability. Differences were discussed until consensus was reached. An overall grade of recommendation was agreed on.

Individual studies were critically assessed by two independent reviewers. Each study was reviewed to determine: the PICO, study type (trial vs. prospective cohort study), number of participants, country/region/jurisdiction, intervention design and details (frequency and duration, setting, delivery mode, personnel required, costs, etc.), primary and secondary outcomes (including effect size, direction and interpretation), sustainability planning, and policy implications.

Included studies

A flowchart of the literature search and selection process and its results is included in Appendix C.

The literature search, of the seven databases and grey literature, resulted in 4,344 titles (after removal of duplicates). The majority were published journal articles. A total of 4,234 papers were removed from the list following screening of the titles and/or abstracts. A total of 113 full-text articles were assessed for eligibility. The review process resulted in 26 studies included in the data synthesis for this report.

A total of 16 studies of physical activity with nutritional supplements and 372 studies of physical activity interventions only were excluded from this report. Appendix D includes study characteristics and examples of these studies.

Grey literature

A desktop search was conducted of health agencies and government bodies for any grey literature that met the inclusion criteria. Several programs from Australia and USA were identified. These were mainly physical activity interventions only.

Content relevant to "community-based exercise programs for older adults or seniors" was extracted from reports or guidelines by government bodies and health agencies and presented in the Findings section of this report. This information serves as examples of how other countries and jurisdictions implement and evaluate such programs as part of their effort to promote health and wellbeing of older people living in the community.

Findings

We identified 4,344 studies from the comprehensive search, of which 26 met the inclusion criteria for the review and were included in this report.

Question 1: What community-based programs, that combine physical activity, with other activities addressing key health risk factors, have shown to be effective in improving the health behaviours and outcomes for people aged over 60 years?

Overall

The Evidence Check identified 26 papers reporting on 23 different programs. Comprehensive details of the studies are presented in Table B1 of Appendix B. Studies were categorised into three categories:

1. Physical activity + Education on lifestyle factors (including nutrition) (n=12)
2. Physical activity + Cognitive training (n=9)
3. Physical activity + Other interventions (could not be categorised in above) (n=2)

Note, no programs combined physical activity + education + cognitive training.

These programs were delivered in nine different countries (Table 1). The majority of the programs were conducted in the USA.

Table 1: Included studies categorised by intervention category and country

Country	Physical activity + Education	Physical activity + Cognitive task/training	Physical activity + Other
Australia	2 (1 program)	1	
Brazil		1	
Canada		1	
Japan	1		1 (music)
Germany		1	
Mexico		1	
Poland	1		
South Korea	2		1 (body mind soul)
USA	8 (6 programs)	5	

USA: United States of America

Program settings:

Common elements of successful community-based programs were identified according to program length, content (multicomponent, most with a lifestyle component and several with a psychological component), design and activities (group-based, with or without a one-to-one contact) and logistics (Table 2).

Table 2: Characteristics of the programs delivered in the included studies

Target population	Program duration	Time	Logistics[1]	Design and activities
Older adults with general good health, relatively mobile (e.g. can travel to group exercise, can move around independently); some studies targeted older adults who already exercised regularly	Often between 8–12 weeks, multiple sessions per week (often every 2–3 days)	Between 45–90 minutes per session	Mostly in group / in-class setting (some programs had complemented individual tailored home-based exercise); delivered by trained health professionals (physiotherapists) OR exercise trainers / instructors OR certified coaches OR postgraduate students; OR volunteer lay leaders	Varying between programs evaluated, but often included a variety of activities; physical activities included aerobics, flexibility, balance, strength; cognitive activities included counting, naming, mathematical operations; education included topic presentation, group discussions, demonstration, goal settings, etc.; Some programs applied progressive intensity schedule; Order of activities was also considered (physical exhaustion vs. yoga to relax before cognitive training); some programs contain coaching or counselling (and often found them effective in either adherence or attributable to positive changes)

[1] Some programs delivered by health professionals could be delivered in the community setting by trained support staff when programs are relatively simple to conduct

While outcomes of interest were broadly similar (i.e. physical performance, cognitive performance, or health behavioural change), the specific type of outcome measurement varied widely across studies (Table B1 of Appedix B). It is therefore not possible to "pool" the effect sizes in a meaningful way. For example,

- Measurement of physical fitness and performance ranged from timed up and go (TUG), gait speed (partial, 25-feet), time to complete a walk (6-metre obstacle course, 400-metre), short physical performance battery, number of steps per day (self-report, or by pedometers) to self-reported physical activity surveys (Yale instruments, international physical activity questionnaire, physical activity scale for the elderly, etc.) and strength and reach measures (arm grip, chair stand, chair sit and reach, stair climbing, etc.).
- Cognitive performance was often measured by standardised instruments, including Cambridge cognitive assessment (original and revised versions), mini-mental state examination, Rey auditory verbal learning test, controlled oral word association test, memory functioning questionnaire, Montreal cognitive assessment.
- Health behaviour changes as well as wellbeing and/or quality of life were measured by a very wide range of indicators – often driven by specific research objectives. They included self-efficacy and psychological wellbeing questionnaires, self-rated health, healthy and preventative behaviours (including diet), readiness to change, residence, depression. Findings on effect size and direction were mixed.
- Measurement of body composition (e.g. height, weight, percentage body fat, skeletal muscle mass, waist circumference) and biomarkers (e.g. blood pressure, glucose level, cholesterol level) were possibly the most consistent across studies. However, only a few studies included those as primary or secondary outcomes. Additionally, they often did not show much change over the short trial period of a few weeks or months.

The majority of the studies concluded that there are positive differences in favour of combined interventions in some primary and secondary outcomes between the intervention and control groups, at least in the short term. Specifically,

- Physical performance
  - There is some evidence of improved physical performance of older people participating in the combined intervention (vs. no intervention or not physical activity); however, this was limited and was of weak and low quality evidence.
  - It is possible that the short duration of the intervention (mostly between 2–4 months) and the volume and intensity of training (light exercise, 45–60 minutes, 2–3 times per week) were insufficient to provide a significant result for older adults who already engaged in regular and systematic physical activity.
- Cognitive performance
  - Physical activity does not seem to improve cognitive performance within a short period of time, but it appears that the greatest effects may be for interventions that last longer than four months, those that target executive functioning, and those that are multi-factorial.
  - Physical activity training may convey greater relative short-term benefits of cognitive function among older adults (70–85 years).
  - Social aspect of group activities, even without physical activity and/or cognitive training, has a positive impact on older adults. For instance, Legault 2011 found cognitive benefits for older adults in the controlled arm (healthy aging education only) possibly attributable to increased social engagement (1).

However, the evidence of protective health benefits and/or long-term impact is limited. Most studies stated that protective health benefits and/or long-term impact was not found or needed further investigation. Additionally, a longer program duration might be needed in order to observe changes in physical and cognitive performance.

Of the 26 studies, 11 were randomised controlled trials (level II evidence); however, all of these were assessed as having a medium (n=7) or high (n=4) risk of bias. All remaining studies (level of evidence: III-1 = 6, III-2 = 1, III-3 = 3, IV = 5) were assessed to have a high risk of bias. Therefore, the overall evidence base was considered to be satisfactory (C) to poor (D). As the studies used different study designs and reported different outcome measures, the consistency of the evidence and the clinical impact were assessed to be satisfactory (C) to poor (D). However, the generalisability and applicability were both considered to be good (B). The overall level of the evidence was NHMRC evidence grade C: "Body of evidence provides some support for recommendation(s) but care should be taken in its application".

Detailed analysis of the three different categories of programs is presented below.

Physical activity + Education on lifestyle factors, including nutrition

Fourteen studies (of the 26 included studies) evaluated programs that combined physical activity and education on lifestyle factors. There were two distinctive types of educational programs presented in the included studies. The two main types of programs were:

1. Physical activity combined with general health education, including exercise, nutrition, social skill and self-efficacy technique (n=5) (Table 3), and
2. Physical activity combined with nutritional education (n=9) (Table 4).

Half of the studies aimed to evaluate the impact of adding a physical component to an existing (general health or nutrition) educational program; the remaing studies aimed to understand whether adding an educational (and counselling) component enhanced the adherence and efficacy of a physical activity

program.

These studies highlighted that lifestyle modification, to maintain adequate levels of physical activity and a well-balanced diet, was necessary to minimise adverse age-induced physiological changes, thereby improving the overall quality of life of older people. They suggested that effective lifestyle modification programs for promoting physical activity in older adults included social support, strategies to increase self-efficacy, activity choices, assurances of safety, and positive reinforcement.

Some of those principles were reflected in the programs identified in the Evidence Check. They were not discussed explicitly in most studies, with a few exceptions, including:

- The theory of successful aging, developed by Rowe and Kahn 1997 (13), underpins the integrated health management program (IHMP) program (14). Successful aging was operationally defined as having relatively high levels of physical, psychological, and social functioning. Successfully aging seniors were those who maintained a better body composition, increased physical fitness level, a normal range of biomarkers (physical function), decreased depressive symptoms (psychological function), and increased perceived social support (social function).
- The "10 keys" to healthy aging, developed by Newman et al 2010 (15), was implemented and evaluated in studies by Robare 2011 (16) and Zgibor 2017 (17). They included: (i) low systolic blood pressure, (ii) stop smoking, (iii) participate in cancer screening (prostate, breast, cervical), (iv) get immunised regularly, (v) regulate blood glucose, (vi) lower LDL cholesterol, (vii) be physically active, (viii) maintain healthy bones, joints and muscles, (ix) maintain social contacts, and (x) combat depression.
- Behavioural theory, specifically behaviour modification and social learning theory (Bandura, Adams, & Beyer, 1977 (18); Botelho & Skinner, 1995 (19)) was used to inform the behavioural counselling used in the study by Robare 2011 (16).

Table 3: Physical activity and general health education (n=5)

Study ID	Population	Intervention	Comparator	Effect
Teri 2011 (US) (20)	Older adults, living independently in the community, ambulatory, English speaking, and not participating in regular exercise	2x2 factorial setting: **Group exercise + home-based physical activity:** (balance and flexibility, strengthening, and aerobic) Group class: 60-mins per session, 14 sessions per year (first 9 weekly, followed by 3 monthly, then 2 quarterly) Home-based activities: 2 additional non-consecutive days between classes, 3–5 days per week of aerobics and balance/ coordination exercise AND/OR **Health promotion program:** (healthy and mood-enhancing behaviours)	Routine medical care (no exercise and/or health promotion)	↑ SF-36 (over 18 months) No change in geriatric depression scale ↑ some physical performance + willingness to exercise ↑ quality of life, well-being, decreased worrying
Ahn 2015 (Korea) (14)	60+ years, women only, living in the community, not exercising regularly, no serious illness and cognitive	***Integrated health management program (IHMP):*** **Physical activity:** (elastic band and towel exercises: 10 min of warm-up, including light walking, 30 min of exercise, and 10 min of cool-down)	N/A (pre- and post- analyses)	↑ self-reported physical fitness No change in physical activity

	impairment; did not participate in a health program in the last month prior to the study	AND **Health education:** theories about exercise, nutrition, chronic disease management, stress management, depression, AND **Social activities:** recreation, communication skill, relationship maintenance, volunteering, learning how to care for disabled elderly The program runs for 3 hours per week, for 12 weeks		
Oh 2017 (Korea) (21)	70+ years; regular attendance at senior centres; no difficulties in walking a quarter of a mile and climbing 10 steps; no difficulties in basic ADL, can participate in exercise without exacerbating existing health condition or illness	**Resistance training:** (5 min warm-up, 50 min progressive elastic band resistance training focused on upper (biceps curls, triceps extensions, lateral and front raises) and lower body (ankle raises, squats, leg presses and leg abductions), and 5 min cool-down); 60 mins per session, twice per week; for 18 weeks; supervised 8 weeks (by expert trainers), then 10 weeks at home. AND **Health education and counselling:** (encouraging initiation and maintenance of self-management behaviours). Education was delivered by a nurse for 18 weeks; counselling every 6 weeks.	**Control:** normal routine daily activities + stretching (static and dynamic) once per week for 1 hour, under supervision	↑ SPPB ↑ isokinetic leg extension/ flexion strength and ↑ leg muscle quality Supervised training (first 8 weeks) did not show improvement; maintenance period (10 following weeks) showed improvement
Zgibor 2017 (US) (17)	50+ years, no surgery or cardiac event in the past 6 months, no use of oxygen therapy	***The "10 keys" to Heathy Aging:*** **Health promotion behaviour change**: focus on risk factors such as blood pressure control, smoking cessation, immunizations, cancer screening, regulating blood glucose and cholesterol, physical activity, maintaining healthy bones, joints, and muscles, promoting social contact, and combating depression AND **Physical activity**: joint check, warm-up, active range-of-motion, strengthening, joint check, cool-down and relaxation. Each session was 60 mins, mostly exercise and 10–20 mins of health information and health behaviour change strategies from the "10 Keys"™; delivered by volunteer community health workers	**Physical activity** of the same format, plus 3–5 min of health education about chronic disease risk factors. For 10 weeks.	No difference in achievement of the "10 keys" goals OR physical performance or arthritis outcomes

		For 10 weeks, plus four monthly booster / maintenance sessions.		
Cwirlej 2018 (Poland) (22)	65–75 years, no cognitive impairment, no depression, ability to walk independently and without orthopedic aids, did not participate in exercise more than once a week; allowed to exercise (by their doctor), and low income	**Multifactorial exercise and health education (MEE) program:** **Physical exercise:** endurance, balance, resistance, functional exercise and stretching, using inexpensive and readily available tools (elastic bands, sensory discs, fitness sticks). Duration 60 mins (10 mins warm up, 15–20 mins aerobics low-moderate intensity, mix of balance, resistance, functional exercise, and stretching, 5–10 mins relaxation in the end); twice per week; for 16 weeks. AND **Health education:** information about physical activity and nutrition (7 sessions), and oral care (1 session) 45 mins per session; once every two weeks; for 16 weeks.	Health education only	↑ tandem tests ↑ mobility ↑ senior fitness

ADL, activities of dailty living; mins, minutes; SF-36, 36-Item Short Form Health Survey; SPPB, short physical performance battery
Single arrow (↑) refers to a positive change of small magnitude; double arrow (↑↑) refers to a positive change of larger magnitude; triple arrow (↑↑↑) refers to a positive change of an even larger magnitude.

Table 4: Physical activity and nutritional education (n=9)

Study ID	Population	Intervention	Comparator	Effect
Wunderlich 2009 (US) (23)	Older adults, healthy enough to exercise (and allowed to exercise by their doctors)	**Physical activity:** (group exercise: balancing, stretching and overall muscle relaxation, toning and strengthening; increase intensity over time; walking at home 20–30 mins were encouraged) Duration 30–45 mins per session, 3 times per week, for 4 years. AND **Nutrition education:** (group session, interactive teaching, demonstration by nutritionists, focusing on hypertension, salt intake, meal preparation). Education sessions occurred quarterly, for 4 years.	Not applicable (longitudinal study of a cohort enrolled in meal and exercise programs)	↑ physical health
Robare 2011 (US) (16)	65+ years, living in the community	***Brief Education and Counselling Intervention (BECI), based on "10 Keys" to Healthy Aging*** *(educational material on "10 keys")* AND **Physical activity:** group-based walking and instructional weight training covering stretching, chair exercises, and recreational activities and sports. Duration 60 mins per session, twice a	**Brief Education and Counselling Intervention:** (education only) **"**10 Keys" to encourage adherence to age-appropriate screening procedures and vaccinations and to work towards the reduction of specific	No difference between BECI and BECI plus (with exercise) with respect to physical performance ↑↑ adherence to the program (in both arms), hypothesised as attributable to the counselling

		week, for 12 weeks; plus exercise on their own at least one other day per week. AND **Nutrition program:** focus on dietary pattern, sodium intake and blood pressure; Group session delivered by registered dietitian, over 10 weeks. AND **Counselling:** by professional every 6 months.	health risk factors AND **Counselling** by professional every 6 months	component
Kimuara 2013 (Japan) (24)	65+ years, able to provide consent and travel independently to the closest participating community centre	**TAKE10 program:** (eat regularly from 10 food groups and take at least 10 mins of physical activities at least 2–3 times per day) includes: **Nutrition education:** a general lecture (by researcher) plus 5 education sessions information about 10 food groups and a check sheet to keep track of intakes / diet. AND **Exercise:** group sessions and home-based (walking, stretching, muscle strengthening, and balance training in the home environment at the individual's own pace; did not require equipment). Each TAKE10 session: 1.5 hours each, once every 2 weeks; 30 mins of nutrition education and 60 mins of exercise.	**Control** (by sites)	No changes in physical activity ↑ social roles ↑ dietary pattern
Burke 2013 (Australia) (25)	60–70 years, low socioeconomics, living in community, classified as insufficiently active, generally healthy and not on a special diet	*Home-based **physical exercise and nutrition program for senior (PANS),** containing 3 components:* A booklet providing **physical activity and nutrition recommendations** for older adults and goal setting. AND An **exercise chart, calendar, bi-monthly newsletters, resistance band, pedometer** AND **Telephone and email contact**.	**Control:** only baseline and post-program questionnaires	↑ physical activity
Pasalich 2013 (Australia) (26)				No long-term effect for physical activity measure or anthropometric measures ↑ some dietary behaviour
Turk 2016 (US) (27)	50+ years, living in the community, not on medically supervised diet or assistive device or had illness that	***Wise choices – Nutrition and exercise for older adults:*** **Education:** (45 mins, varying weekly, covering nutritional topics on how to be more active).	N/A (pre- and post-analyses)	↑ physical activities (walking, daily steps) ↑ physiologic outcomes (weight)

	prevented exercising safely (indicated by physical symptoms or doctor instructions)	AND **Physical activity:** (10–15 mins walking). Each wise choice session was 50–60 mins, once per week, for 12 weeks.		No change in perceived quality of life, body mass index or blood pressure
Smith 2015 (US) (28)	55+ years, living in the community; no physical or cognitive exclusionary criteria but participants needed to be able to complete the questionnaires	***Texercise**, consisting of:* **Physical activity:** (30–45 mins per session, covers endurance, strength, balance and flexibility). AND **Education about nutrition and exercise:** (information, interactive discussions, and goal setting activities). Each Texercise session was 90 mins, twice a week, for 10 weeks (plus 2 weeks recruitment)	N/A: pre- and post-analyses	↑ nutrition ↑↑ physical performance
Akanni 2017 (US) (4)				↑↑↑ cost effective
Towne 2018 (US) (29)			Control group (14 comparison sites) = older adults living in the community not exposed to the Texercise program	↑ physical performance

mins, minutes

Single arrow (↑) refers to a positive change of small magnitude; double arrow (↑↑) refers to a positive change of larger magnitude; triple arrow (↑↑↑) refers to a positive change of an even larger magnitude.

Cognitive training with exercise

Ten studies (of the 26 included studies) evaluated programs that have both physical activity and cognitive training components. The two main types of interventions were:

1. Physical activity with concurrent dual-task (i.e. participants engage in physical activity and perform a challenging cognitive task concurrently) (n=4) (Table 5), and
2. Physical activity with consecutive cognitive training (i.e. participants engage in physical activity and perform cognitive training sequentially or at different times) (n=6) (Table 6).

It is often hypothesised that these types of programs that combine physical activity and cognitive training present a greater benefit in physical performance variables compared to the physical activity only. The design (including frequency, types of exercise and dosage) of both physical activity and/or cognitive training program was often based on previous evidence of efficacy.

Table 5: Physical activity with concurrent dual-task (n=4)

Study ID	Population	Intervention	Comparator	Effect
Plummer-D'Amato 2012 (US) (30)	65–83 years, living in the community	***Dual* task:** **Physical activity:** 45-min group circuit, once weekly, 4 weeks. Additional 45-min twice weekly exercise for the study duration. AND **Cognitive activities:** simultaneously with gait and balance exercise	**Exercise only** (45-min group circuit, once weekly, 4 weeks) Additional 45-min twice weekly exercise for the study duration	Group-format dual-task did not improve walking time or dual-task cost on an obstacle negotiation task

Salazar-Gonzalez 2015 (Mexico) (31)	65+ years, sedentary individuals (convenient sample)	***Dual task:*** **Physical activity:** 45–60 mins physical and cognitive exercise, 3 weekly sessions during 12 weeks) AND **Cognitive activities:** counting backward or naming animals aloud	**Observation only** (with information about prevention)	↑ physical performance
Gill 2016 (Canada) (32)	55–90 years, current and active members of exercise programs, demonstrated preserved iADL ≤27 (MoCA). Exclude dementia, severe ortho and/or CVD	***Dual task:*** **Physical activity:** 50+ minutes aerobic and 45-minute beginner-level square-stepping AND **Cognitive activities:** answer cognitively challenging question while doing square-stepping	**Exercise only** (50+ minutes aerobic and 45-minute beginner-level square-stepping)	↑ global cognitive function (for those without cognitive impairment)
Medeiros 2018 (Brazil) (33)	60+ years, living in the community, exercise regularly for at least a year, can walk alone, do not have Parkinson's disease, dementia or cerebrovascular accident	***Dual task:*** **Multicomponent physical activities:** flexibility, handgrip strength, lower limb strength, balance, functional mobility AND **Cognitive training:** motor task with progressive complexity during physical activity 50-min sessions, 3 times per week, for 12 weeks	**Individual physical exercises** (50-min sessions, 3 times per week, for 12 weeks)	Addition of a dual task to the multicomponent training was not able to improve physical performances of older adults

iADL, instrumental activities of daily living; mins, minutes; MoCA, Montreal cognitive assessment; CVD, cardiovascular disease
Single arrow (↑) refers to a positive change of small magnitude; double arrow (↑↑) refers to a positive change of larger magnitude; triple arrow (↑↑↑) refers to a positive change of an even larger magnitude.

Table 6: Physical activity with consecutive cognitive training (n=6)

Study ID	Population	Intervention	Comparator	Effect
Legault 2011 (US) (1)	70–85 years, living in the community, at risk of cognitive decline	***Physical and/or cognitive training*** *(2x2 factorial design):* **Physical activity**: centre-based 40-min walking stimulus + 20-min flexible training, twice weekly, for 4 months; plus tailored home-based walking 1–2 times per week in the first month AND **Cognitive training:** in centre, computer-based, 4	Health education on healthy aging (in group)	No change observed for composite scores of cognitive, executive, and episodic memory function for all arms ↑ sub-population of older age (maybe)

		consecutive 10–12min sessions per day, twice weekly, for 2 months; then once per week for another 2 months		
Shah 2014 (Australia) (34)	60-85 years, MMSE>24, no dementia, CVD, epilepsy, severe arthritis	**Physical activity**: 48 sessions of 60-min walking per day, 3 days per week, 32 sessions of 40-min resistance training, 2 days per week) AND **Cognitive stimulation**: 40 sessions of 60-min per day, 5 days per week 16-week program	Physical activity Cognitive stimulation Control	↑ verbal memory ↑↑ levels of glucose metabolism
Barnes 2013 (US) (35)	65+ years, subjective memory complaints, English language fluency, not concurrently engaging in aerobic exercise or intensive computer training, not travelling more than 1 week during trial period; exclude dementia, other neurological disorders, heart or lung diseases, limited life expectancy	***MAX trial*** *(2 x 2 factorial design):* **Home-based mental activity (game)**: games designed to enhance the speed and accuracy of visual and auditory processing; difficulty level automatically adjusted based on individual performance; 60 mins/day, 3 days/week for 12 weeks AND **Class-based physical activity (aerobic):** 10 mins warm-up, 30 mins aerobic exercise (traditional dance-based aerobics format), 5 mins cool-down, 10 mins strength training, and 5 mins stretching/relaxation. 60 mins/day, 3 days/week for 12 weeks	**Mental activity control group (education)**: watch educational lectures on art, history and science on DVD, then answered 6 paper-based multiple choice questions or short answers about the watched topics. 60 minutes/day, 3 days/week for 12 weeks AND **Class-based physical activity (stretch):** 10 mins warm-up, 30 mins stretching and toning, 10 mins strength training, and 10 mins relaxation 60 mins/day, 3 days/week for 12 weeks	↑ cognitive function for all No difference between control and intervention groups
Pa 2014 (US) (36)	65+ years, low activity level, reported sleep and cognitive problems			↑↑↑ stretching + education ↑ stretching + cognitive training / aerobic + education aerobic + cognitive training
McDougall 2015 (US) (37)	50+ years, living in retirement communities	**Memory training**: delivered by registered psychologist) AND **30-min yoga**: before each memory training session, delivered by certified yoga instructor 1.5 hours per session, 8 sessions (classroom-based)	Not available	↑ memory performance (post-test) ↑ activities of daily living (post-test)
Streber 2017 (Germany) (38)	60+ years	***Multimodal and multicomponent:*** **Physical activity:** including walking, sports, games, dance	Gymnastic OR Cognitive training	↑ short term impact on physical performance but no long-term impact

		AND **Cognitive + social activities** AND **Education**: physical activity coaching 90-min session, weekly, for 12 weeks	Weekly, for 12 weeks	No impact on other outcomes

mins, minutes; MMSE, mini mental state examination; CVD, cardiovascular disease

Single arrow (↑) refers to a positive change of small magnitude; double arrow (↑↑) refers to a positive change of larger magnitude; triple arrow (↑↑↑) refers to a positive change of an even larger magnitude.

Physical activity + other interventions

Two studies of physical activity with other interventions were identified (Table 7). These studies were:

- Physical activity combined with music (n=1), and
- Physical activity combined with a body, mind and soul program (n=1).

The theories underlying the interventions are:

- Self-efficacy theory: enactive mastery experience, vicarious experience, verbal persuasion, physiological arousal;
- Music can effectively improve mental and immune functions in older people, and subjective exercise intensity and execution (Sakai 2017).

Evidence of overall efficacy for physical activity and other interventions was weak. The effect found was improved adherence to the program and self-efficacy in Sakai 2017.

Table 7: Physical activity with other interventions

Study ID	Population	Intervention	Comparator	Effect
Lee 2012 (Korea) (39)	Elderly living in the community	**Body mind soul program:** Educational program + yoga practice – Body: exercise, nutrition, leisure, and sexuality. – Mind: stress, emotions, thoughts, and will. – Spirit: meaning, relations, forgiveness, and happiness. Once per week, for 12 weeks; instructional methods = didactic presentations, group discussion questions, in-class activities, and case examples.	Control group, unclear description of comparator	No data about individual participants presented, only rating by evaluators
Sakai 2017 (Japan) (40)	60+ years, living in the community, relatively independent	Exercise with **added music** + posters with exercise procedures, movements, written explanations and CDs for exercise at home. Once a week, for 3 weeks	Exercise (with only verbal instructions) + posters with exercise procedures, movements, written explanations and CDs for exercise at home. Once a week, for 3 weeks.	↑ adherence ↑ self-efficacy

CD, compact discs

Single arrow (↑) refers to a positive change of small magnitude; double arrow (↑↑) refers to a positive change of larger magnitude; triple arrow (↑↑↑) refers to a positive change of an even larger magnitude.

Grey Literature

A grey literature search of government and state health sites (such as Council on the Ageing (COTA) in Australia and internationally found existing health promotion campaigns for older adults, however most of the programs focus on improving health and wellbeing through physical activity only. The USA Centers for Disease Control and Prevention describe seventeen programs in a reference guide for planning interventions, some of which were also described in the academic literature (41). Relevant programs include the *Get fit for active living*, *Texercise*, and *Eat better and move more*. Box 3 describes the components of the *Eat better and move more program*. This program is an education only program that encourages walking and improvements in dietary intake. In a ten site study, participants had significantly improved step counts post intervention (increase from 3,110 steps pre- up to 4,183 steps post-intervention) (13).

Box 3: Components of the Eat better and move more program

Week	Eat better talk	Move more talk
1	Health orientation and enrolment	No session
2	No session	Orientation to step counters
3	5-a-day, fruits and vegetables – importance of eating fruits and vegetables	Set a new step goal – solve any problems incurred in wearing step counters
4	5-a-day with variety and colour – increasing variety in choosing fruits and vegetables	Stretching and movement – introduce safe ways to stretch and to improve balance and flexibility while adding steps
5	3-a-day for calcium – importance of calcium for bone health	Stepping up your pace – how to monitor how your body is working, add steps to walking regimen
6	3-a-day for strong bones – recognise the 3-a-day for stronger bones campaign	Stepping for strong bones – identify the benefits of physical activity for bone health
7	Fibre fitness – health benefits of fibre	Walking in all weather – how to keep up activities in different weather conditions
8	More options for fibre – review benefits of fibre	Keeping regular – value of activity for intestinal health
9	Sensible portion sizes – recognise healthy food portions	Walking tall – activities to do in addition to walking (e.g. proper posture)
10	Conquering portion distortion – review and practice sensible portion sizes	Stepping to healthy weight – the role of physical activity in weight control
11	Food guide pyramid – the health benefits of using the food guide pyramid to guide food choices.	Activity at home and away – identify physical activities to do in addition to walking
12	Celebrate success – closing comments, distribute and collect questionnaires	

In Australia, the *'60 and better' program* has been implemented in different areas of Queensland and Victoria (e.g. https://cotaqld.org.au/2015/02/60-and-better-program-queensland-contacts/). This program has been designed to promote healthy ageing through a combination of physical, social and intellectual activities (e.g. exercise, health talks, craft, theatre, card games and computer/ technology) that enable participants to meet

people and develop new interests. However, there were no structural details provided about these programs or reports about outcomes measured. Another relevant program for this age group is the *Seniors toolbox program*, which provides tools to individuals and groups to co-design projects with seniors to meet their needs (https://www.seniorsonline.vic.gov.au/get-involved/for-organisations/online-toolbox).

The Healthy Eating Activity and Lifestyle (HEAL™) is an eight week group lifestyle modification program targeting physical activity and healthy eating developed in Sydney and funded nationally through the Australian government (https://www.essa.org.au/Public/HEAL_Program/The_HEAL_Program.aspx) (42). While targeted at people with diabetes, obesity or other risk factors, the program contains similar elements to lifestyle programs for older people and could provide a model for implementation. Participants who completed the program had significant improvements on measures of physical activity, dietary intake and BMI (42). The program is delivered by allied health professionals.

Another model for successful implementation is the The *Engage project* in Shepparton, which comprises a range of social and active activities co-designed with participants and is specifically targeted at including hard to reach and vulnerable groups including refugees (https://www.seniorsonline.vic.gov.au/get-involved/for-organisations/online-toolbox/ongoing-partnerships/engage). There were no outcomes that were relevant to the research question reported from these programs.

Internationally, *'Sixty and better'* is a not-for-profit organisation in the United States (www.sixtyandbetter.org). The program is delivered across the United States and offers older people healthy meals, opportunities to take part in social activities and contribute to their communities in meaningful ways. While, again, there is no clear description of or structure for the service delivery, the annual reports suggest that the program has significantly increased the participants' activity engagement, healthy eating habits, social interactions, and ability to contribute to their communities (43).

Gaps in the evidence

Most programs were conducted in researcher-led projects and it is difficult to determine if these programs are effective outside of a research environment; with the exception of the *Texercise program* (4, 28, 29). *Texercise* has been evaluated extensively and has been implemented widely across different community settings in the United States. Resources and information on how to host the program is freely available from https://hhs.texas.gov/services/health/food-fitness/texercise.

The sample sizes in the included studies were small and evidence about the long-term program effectiveness is limited. For example, little information was provided about the implications for participants following cessation of the programs. Consequently most studies highlight long-term implications on health protective behaviours as a main limitation.

While some studies included in this review reported detail about the average program attendance, adherence to programs was poorly reported. Similarly, only some studies reported on the use of theory (such as behaviour theory) to inform the development of the programs. There is also limited information about specific behaviour change techniques applied in the programs. Program fidelity was not assessed in the included studies. Little is also known about the economic impact or outcomes of the included programs. Only one program (Texercise) investigated and reported the cost-effectiveness of the program (4).

Lastly, it is difficult to assess the transferability of the programs included in this review as limited information regarding the training of personnel who delivered the different program components was reported in the studies. Information was also lacking about the specific components that formed the intervention provided. It may be possible to contact study authors to request additional information regarding specific programs.

Discussion

The evidence check has summarised physical activity plus additional lifestyle interventions (n=26) and found the following components, illustrated in Figure 1, are most commonly used in these types of programs:

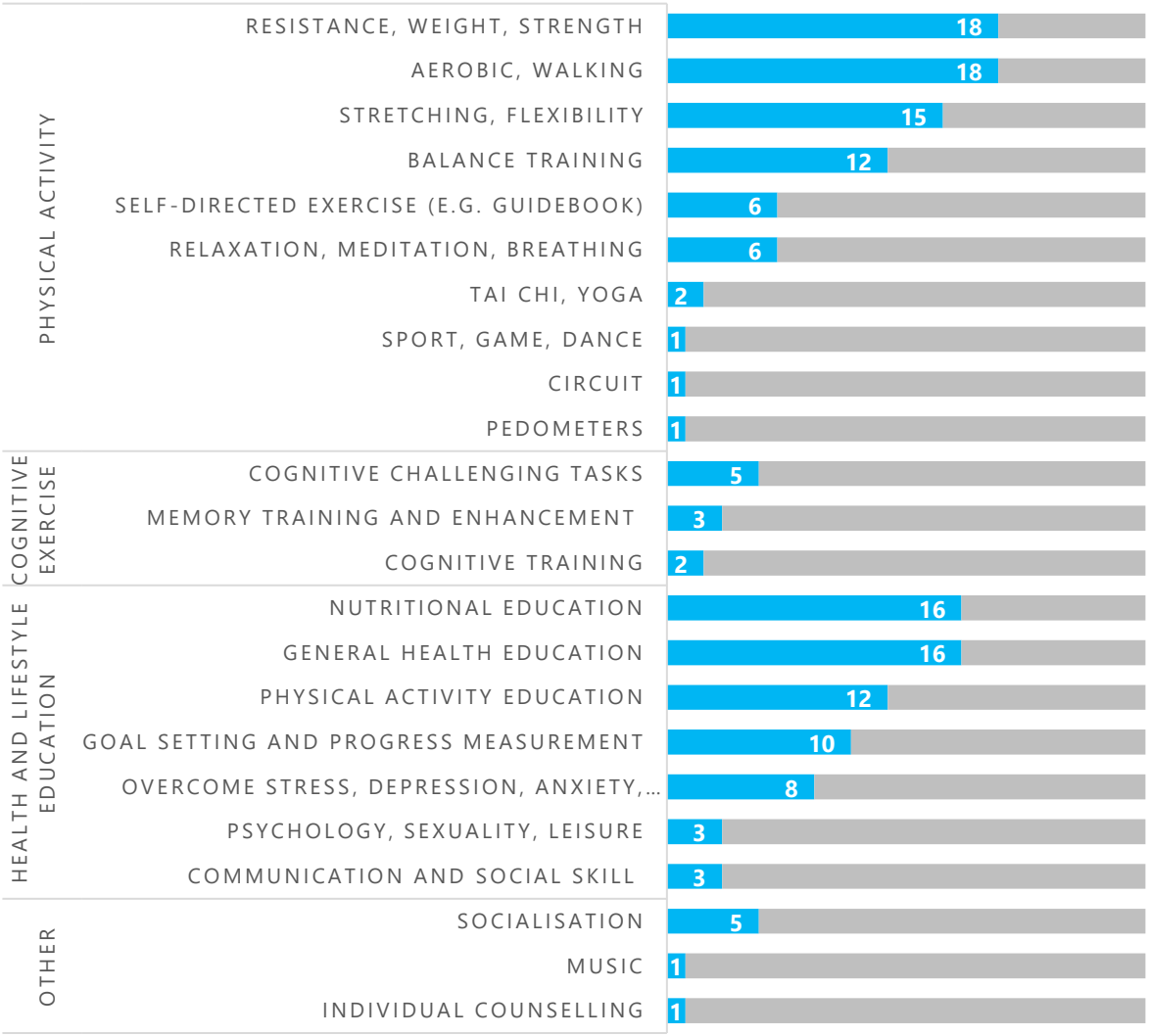

Figure 1: Most commonly used components in included studies of physical activity plus lifestyle interventions

The evidence on efficacy is mixed, reasons include: heterogeneity of program design (duration, frequency, dosage), program delivery, study type (pre/post vs. trial with intervention/control arms), and outcome measurement. The population effect, as a result of studies recruiting heterogeneous populations (those who were already exercising; those who were not exercising, different age groups), makes comparisons between studies difficult.

Overall, there was some evidence that "exercise in combination with other modalities" has positive impacts on various measures of physical and cognitive performance during the trial period. Physical activity training may convey greater relative short-term benefits of cognitive function among older adults (70–85 years). Pre- vs. post- analyses (studies) appeared to establish some positive effects of physical activity plus education on

physical fitness; however, the study designs are weak with a high risk of bias. As such, this finding should be interpreted with caution. Approximately 40% of the included studies did not find a positive effect of the intervention. Possible reasons for this may be the short duration of the trial and/or the volume of activity engaged in. This is especially relevant for trials that recruited older adults who were already engaged in regular and systematic physical activity. Most studies stated that protective health benefits and/or long-term impact need further investigation, as well as longer program duration to detect changes in physical and cognitive performance.

The body of evidence was rated as C: *"provides some support for recommendations but care should be taken in its application".*

The *Texercise program* was delivered in a standard community setting, and is a good example of the combination of program elements that could be considered in a health promotion and physical activity program for older people. The *Texercise program* elements are described in Box 4.

Box 4: Summary of the Texercise programs (as described in the literature)

Texercise program (*evaluated in Smith 2015, Akanni 2017, Towne 2018*) (4, 28, 29)

A health promotion and wellness program, using volunteer lay leader, to encourage middle-aged and older adults to adopt healthy lifestyle habits such as physical activity and good nutrition

Objectives: (*age target: 55+ years*)

- improve participants' knowledge about the value of physical activity and nutrition (i.e. improving healthy behavioural skills)
- increase participants' confidence in their ability to make healthier choices related to physical activity and nutrition
- improve participants' mobility and increase the ease of sitting

Design:

- A 10-week program of interactive classes, twice a week, approximately 90 minutes per session
- Each session: (i) 30–45 minutes of guided exercise to build endurance, strength, balance and flexibility; plus (ii) educational components, interactive discussions, and activities about physical activity and nutrition topics (including setting nutrition and physical activity goals).

Logistics:

- Facilitators: volunteers recruited from the community, no prior license required; each received training in a one-day six hour-long session
- Program is delivered in community setting (e.g. senior centre, community facility)

Efficacy evidence: (Smith 2015, Towne 2018) (28, 29)

- Improvements in confidence and physical performance, based on pre/post (Smith 2015) (28)
- Improvements in physical performance, based on quasi-experiment analyses (Towne 2018) (29)
- No reported information about other outcome measures (nutrition, self-reported health, etc.)

Value for money: (Akanni 2017) (4)

- Direct cost: 10-week program total cost = US$50,474, or average cost per participant = US$229, including:
  - Incentive cost (to encourage participation: pedometers, handbooks, pledge sheets, resistance bands, t-shirts and certificates, approximate US$6.91 per participant)
  - Promotion and material (approximate US$0.43 per participant)
  - Facilitators: Estimated cost per facilitator = US$1,684.80 (their opportunity cost of time to deliver the program + training cost)
- Cost-effectiveness ratios: ranged from $1,374 to $1,452 per quality-adjusted life year (QALY) gained.

Applicability

This evidence check has identified the following factors that should be considered when applying a program to the local context: frequency and dosage, adherence, delivery, reach, cultural applicability and resources required. Evidence points (EP) for each area is presented below. These are drawn from the reported outcomes in the include studies. Practice recommendations (PR) are also included which provide a synthesis of the interpretation of the results and practical applicability.

Frequency and dosage

EP Low intensity physical and mental activities may be more effective than moderate- to high-intensity activities in older adults with cognitive and sleep difficulties (36)

EP Long sessions (higher expectation) of physical activities may not achieve the desired effects as it may reduce motivation to participate (36)

EP Low intensity physical activity (combined with short-time frame) might not be effective for relatively heathy older adults already engaged in some physical activity regularly (16)

PR Targeting multiple health behaviours at once may be a risky intervention strategy because it has the potential to overwhelm participants. A more realistic strategy may be to keep contents broadly similar and change focus every three months or so to cover different aspects of health behaviours.

Adherence

EP Adherence to effective long-term preventive interventions is essential in ensuring success/ sustainability, but was not measured for most of the included studies.

EP Adherence was better for cognitive training than physical activity (1).

PR Incentives to motivate session attendance may be useful. A possible strategy may be to provide morning or afternoon tea (with healthy options or food and beverage options consistent with the program contents and which demonstrates and provides an example of healthy nutritional content.

EP From a logisticcal perspective, combining physical activity and cognitive training session might help improve adherence as it reduces travel time (1).

EP Adding a structured behavioural module (e.g. counselling) to physical activity may help address the barriers to physical activities encountered by sedentary older adults and maximise adherence (16).

EP While it is theorised that the social aspect of group activities, even in the absence of physical activity and/or cognitive training, has a positive impact on older adults and should improve adherence, no studies formally tested this by administration of a social interaction scale.

PR Participant satisfaction with the program is a key factor that should be considered in the design of the program. A possible strategy to help maximise participant satisfaction is to co-design the program with the local community and people who will participate in the intervention.

Delivery

EP /PR Most programs were delivered by researchers and health care professionals – driven by the research context. Many of these programs could be adapted for delivery by other leaders.

EP Texercise is a program that is close to the delivery of a real-life community-based program: delivered by volunteer lay leader (who received training before the program delivery) (44).

EP The majority of programs were delivered in face-to-face settings, with some programs delivering some sessions via telephone.

EP The duration of individual sessions ranged from 1 to 3 hours.

PR Sustainability of the program may be improved if the program is designed to complement existing community-based efforts and available resources.

Reach

PR Only a sub-group of the eligible population would be expected to attend group physical activity programs. Factors such as timing, transport, and personal preference makes the reach of these programs limited.

EP The '60 and better' program in the Unites States reported 2 in 5 older adults could not drive themselves to the program.

PR Community transport may need to be provided in order to improve reach.

Cultural applicability

EP The programs from Asian countries (Korea and Japan) in this evidence check have a strong focus on yoga, meditation, and a body-mind-soul approach, which may be driven by cultural aspects and familiarity with particular types of activities.

PR Considering incorporating a mix of different approaches is warranted to ensure inclusiveness of the program. This may have an added benefit of making the programs more interesting to other participants.

Resources

EP Programs can be delivered by professional staff, volunteers or a combination of both.

EP Volunteer delivery may be less expensive than delivery by professional staff; however, training of volunteers and program fidelity checks would be required.

PR Resource would include train-the-trainer manuals and materials. This model is not necessarily less expensive than paid trained staff reviewing the program.

EP Most programs with education components provided participants with some form of printed material, generally a workbook. Some programs also provided participants with calendars or other material so they could self-monitor their own progress.

EP Pedometers were provided to participants in some programs.

PR Pedometers are generally inexpensive and evidence suggests that they improve physical activity generally.

PR Delivering a program at a local level would require co-ordination and co-funding with local government.

When considering to establish an effective and sustainable community-based program, that combines physical activity and other interventions, for older adults in New South Wales, the following characteristics should be considered: frequency and dosage, adherence, delivery, reach, cultural applicability and resources

required. Figure 2 summarises components to consider when planning a health promotion and physical activity for older people.

Figure 2: Summarised evidence on suggested components to include for a multi-factorial community based program for older people

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Appendix A

Table A1: Search strategy – Medline (via EBSCOhost) 1 January 2009 to 26 February 2019

ID#	Search Terms	Search Options	Results
S7	S3 AND S6	Search modes - Boolean/Phrase	2,889
S6	S4 OR S5	Search modes - Boolean/Phrase	433,108
S5	TI (aged or elderly or senior or older people or geriatric or old* or old* people or elder*) OR TI aged: 65+ years OR TI (aged, 80 and over) OR TI aged: 60+ years	Limiters - Date of Publication: 20090101-20191231; English Language; Human. Search modes - Boolean/Phrase	95,085
S4	AB (aged or elderly or senior or older people or geriatric or old* or old* people or elder*) OR AB aged: 65+ years OR AB (aged, 80 and over) OR AB aged: 60+ years	Limiters - Date of Publication: 20090101-20191231; English Language; Human. Search modes - Boolean/Phrase	413,682
S3	S1 OR S2	Search modes - Boolean/Phrase	7,410
S2	(TI (public OR community) AND TI (information OR education OR campaign OR intervention OR strategy OR program* OR policy) AND TI (exercise OR physical activity OR fitness OR aerobic training OR strength training OR cardiovascular training OR workout OR group training OR circuit training OR gardening OR walk* OR danc*)) NOT TI ((stroke OR cancer OR diabetes OR fracture OR COPD OR dementia OR Alzheimer* OR protocol OR child* OR infant OR adolescen* OR youth OR spinal cord injury OR brain injury OR india OR africa OR china OR middle east OR latino OR latina OR brazil OR jordan OR malaysia OR thai* OR chronic obstructive OR mental illness OR alcohol OR rehabilitation OR HIV OR asthma OR parkinson's OR multiple sclerosis OR qualitative OR fibromyalgia))	Limiters - Date of Publication: 20090101-20191231; English Language; Human. Search modes - Boolean/Phrase	318
S1	(AB (public OR community) AND AB (information OR education OR campaign OR intervention OR strategy OR program* OR policy) AND AB (exercise OR physical activity OR fitness OR aerobic training OR strength training OR cardiovascular training OR workout OR group training OR circuit training OR gardening OR walk* OR danc*)) NOT TI ((stroke OR cancer OR diabetes OR fracture OR COPD OR dementia OR Alzheimer* OR protocol OR child* OR infant OR adolescen* OR youth OR spinal cord injury OR brain injury OR india OR africa OR china OR middle east OR latino OR latina OR brazil OR jordan OR malaysia OR thai* OR chronic obstructive OR mental illness OR alcohol OR rehabilitation OR HIV OR asthma OR parkinson's OR multiple sclerosis OR qualitative OR fibromyalgia))	Limiters - Date of Publication: 20090101-20191231; English Language; Human. Search modes - Boolean/Phrase	7,357

Appendix B

Table B1: Study characteristics of the included studies

Author, Year Country (Evidence level)	Participants in initial analysis, n	Setting, delivery mode (eg. online) and personnel required	Participant recruitment/ referral	Time points to measure outcomes	Outcomes reported
Teri, 2011 United States (II)	273	Setting not clearly described. Small group sessions. Master's-level trainers experienced in delivering exercise groups with older adults led groups.	Community mail-out, local independent-living retirement centres and cohort of persons without cognitive impairment involved in a Group Health Cooperative (another study).	Baseline, at 3, 12 and 18 months.	Physical function and general health perception using SF-36 Geriatric Depression Scale (GDS) Physical performance: • 6-min walk test • grip strength Self-rated health and health behaviours • Physical Activity Scale for the Elderly • Physician-based Assessment and Counselling for Exercise • Self-reported Exercise Minutes Affective function • Psychological General Well-Being Index • Perceived Quality of Life Scale • Penn State Worry Questionnaire • Chronic Disease Self-Efficacy scale
Ahn, 2015 Korea (IV)	26	Setting not clearly described. The exercise program was designed by a physical education professor. Program was delivered by researcher and the public health nurse.	Recruited by public health nurses from the public health centre in Kimje City, South Korea.	Baseline and immediately post intervention.	Body composition and physical fitness: • Height, weight, body mass index, percentage body fat, skeletal muscle mass. Physical performance:

					• Arm grip strength, chair stand, chair sit-and-reach, straight walking test Biomarkers: • Blood pressure, fasting blood glucose levels, blood cholesterol levels Depression: • Korean Geriatric Depression Scale (GDS) 15 items Social support: Multidimensional Scale of Perceived Social Support, 12 items
Oh, 2017 Korea (II)	38	Setting not clearly described. Health education was provided by trained nurses. Exercise supervision was provided by expert trainers.	Recruitment through advertisement at senior centre and verbal invitation.	Baseline, after 8 weeks of intervention and post intervention (at 18 weeks).	Body composition: • Leg lean mass • Total body fat mass • Body mass index Physical function • SPPB (static balance, gait speed and time for repeated chair rise) • Sit and reach, stair climbing, Muscle strength (isokinetic leg strength) and muscle quality
Zgibor, 2016 Canada (III-1)	416	Program was delivered in senior centres, residential facilities, churches, community centres, YMCAs, fitness centres/clubs, and libraries. Community health workers delivered the program.	Existing program sites identified through networking at community events and referrals from community partners.	Baseline, immediately, 6 months and 1 year post intervention	Arthritis-specific outcomes: • Osteoarthritis Index scales (WOMAC) covering function, pain, stiffness Physical performance: • SPPB General physical fitness: height, weight, blood pressure. Questionnaires preventive behaviours. Self-efficacy: • Stanford Patient Education Research Center Self-efficacy scale • Preventive Services Use Self-efficacy Scale

Cwirlej, 2018 Poland (II)	44	Setting not described. Physiotherapists delivered the program.	Radio announcement. Required medical clearance from practitioner to participate in physical activity.	Baseline and within a week from completion of program (at 16 weeks)	Physical performance: • TUG • Functional Reach Test • Tandem Stance Test; Tandem Walk Test; Tandem Pivot Test • Senior Fitness Test: chair stand, arm curl, 2-min step, chair sit and reach, back scratch, 8-foot up and go Static balance: • Cosmogamma stabilometric platform
Wunderlich, 2009 United States (III-3)	139	Setting not clearly described. Participants were required to be 'healthy enough to attend the centre'. Certified exercise trainers delivered exercise component of program. Nutrition education materials were developed / approved by a registered dietitian.	Participants already enrolled in a government Sponsored meal and exercise programs. Clearance from Physicians required.	2 or 3 times per year for 4 years	Physical health and clinical markers: • BMI • Blood pressure • Pulse • Blood glucose, • Percent body fat • Serum cholesterol
Robare, 2011 United States (II)	389	Small group exercise sessions. Encouragement to exercise on own and resources to reinforce this was provided. Use of health counsellors as advisors – one on one meet with participant every 6 months, and monthly phone calls.	Mail-out sent to community members identified through voter registration.	Baseline, at 12 and 24 months.	Achievement of "10 Keys" to Healthy Aging. Physical activity performance: • Modified Activity Questionnaire • Heart rate • Total time to complete 400m walk • Gait speed • Lower extremity battery score
Kimura, 2013 Japan (III-1)	92	Intervention delivered at community centres (in Sumida Ward, Tokyo), with >90 m2 of floor space and air-conditioning. Participants required to travel independently to the closest participating centre. Program was delivered by researcher and staff at community centres.	Notifications printed in the Sumida Ward Bulletin, delivered to all homes.	Baseline collected in October and post intervention in January.	Dietary • Changes in eating habit (frequency of intake of the 10 food groups) Physical activity: • Changes in frequency of walking and distance Health and health practice Outcomes: • Self-rated health

					• TMIG Index of Competence 13 items, covering iADL, intellectual activity and social roles
Burke, 2013 Australia (II)	375	Setting not described. The main resource for program was a booklet specifically designed for seniors and provided physical activity and nutrition recommendations. Frequent phone (between 6-10 calls) or email (between 2-5) contact (based on participant preference). Other resources provided were calendar, exercise chart, newsletter, pedometer, and resistance bands.	Residents of Perth metropolitan suburbs with low or medium socioeconomic status randomly selected from the Australian Federal Electoral Roll. Approach method not described.	Baseline and at the completion of the program (6 months).	Physical activity: • IPAQ short-form to measure self-reported walking, moderate-intensity physical activity, vigorous-intensity physical activity and sitting time Dietary intake behaviours: • Modified FFB
Pasalich, 2013 Australia (II)	349	Setting not described. The main resource for program was a booklet specifically designed for seniors and provided physical activity and nutrition recommendations. Frequent phone (between 6-10 calls) or email (between 2-5) contact (based on participant preference). Other resources provided were calendar, exercise chart, newsletter, pedometer, and resistance bands.	Residents of Perth metropolitan suburbs with low or medium socioeconomic status randomly selected from the Australian Federal Electoral Roll. Approach method not described.	6 months post follow up	Follow-up data collection (6-months after the trial) • Physical activity: IPAQ, plus a strength exercise question • Dietary behaviour: FFB • Anthropometric measurements (self-reported height, weight, waist and hip circumferences • Additional question "Are you currently using any of the following PANS materials"
Turk, 2016 Unites States (IV)	118	Intervention was delivered in community-based sites including city-run senior community centres, a senior high-rise apartment building, and a family support centre. Sessions were led by doctoral students who followed the manualized protocol and were trained in the intervention delivery.	Research team attend each site a week before baseline data collection and intervention implementation	Baseline and at completion of program (12 weeks)	Eating behaviours: • 17-item nutrition questionnaire to assess food intake (developed by the National Resource Center on Nutrition, Physical Activity and Aging) Physical activity: • Pedometers (to measure daily steps) • Tips and Tasks sheet for self-reported number of daily steps walked; • 9-item physical activity questionnaire developed by the National Resource

					Center on Nutrition, Physical Activity and Aging Physiologic outcomes: • Body weight, BMI, blood pressure, and functional mobility
Smith, 2015 Unites States (IV)	220	Program was delivered in senior centres, multi-purpose community facilities, faith-based organizations and at senior housing. Program was led by trained facilitators (volunteers) who have undergone 6h of standardized training.	Community presentations, flyers and word of mouth	Baseline and 12 weeks	Physical performance: • TUG • Self-reported physical activities (RAPA 1 and 2) Nutrition habits: self-reported consumption of • Fast food • Fruit / vegetable • Soft drinks General health status: self-reported 1 question Confidence: self-reported 1 question Social support: self-reported 6 items Health-related quality of life: self-reported 4 items
Akanni, 2017 Unites States (IV)	132 (220)	Program was delivered in senior centres, multi-purpose community facilities, faith-based organizations and at senior housing. Program was led by trained facilitators (volunteers) who have undergone 6h of standardized training.	Community presentations, flyers and word of mouth	Baseline and 12 weeks	The average cost per participant was ~$229 and the average total program cost was $50,474 (USD), using a total participant number n=220 (Smith, 2015). Texercise requires an investment of $1374 to $1452 for each QALY gain; a rate lower than comparison to other health promotion interventions and the common cost-effectiveness threshold ($50,000 USD).
Towne, 2018 Unites States (III-3)	162	Program was delivered in local senior or community centres.	Community presentations, flyers and word of mouth	Baseline and immediately after intervention (or 3 months	Physical performance: • Accelerometers • Self-reported physical activities (IPAQ, MVPA)

				from entry into study) and 6 months from entry to study.	
Plummer, 2012 Unites States (II)	17	Intervention was delivered from local senior community centre. Exercise delivered in group format where participants divided into smaller groups and rotated around three activity stations per session. Each dual task station was led by 1-2 instructors.	Participants were recruited from a local senior centre.	Baseline and at 12 months and 4 weeks	Physical performance • Time to complete a 6-meter obstacle course under single task and dual task conditions. • 25-ft gait speed • Time up and go • Activity-specific balance confidence scale
Salazar-Gonzalez, 2015 Mexico (III-1)	286	Program delivered at local senior centres selected based on space to carry out the exercise sessions, and Accessibility.	Participants were selected from senior citizen centres managed by the Mexican National System for Integral Family Development.	Baseline and at 6 and 12 weeks.	Physical performance: • Spatial gait speed • Step width • Stride length Cognitive performance: • Counting backward • Naming animals
Gill, 2016 Canada (II)	37	Setting not described. Group classes led by certified seniors' fitness instructors.	Participants were recruited from pre-existing exercise classes at the Canadian Centre for Activity and Aging.	Baseline and at 12, 26 and 52 weeks. Program duration was 26 weeks.	Changes in Global Cognitive Function (measured using MoCA and MMSE)
Medeiros, 2018 Brazil (III-1)	71	Setting not described. Intervention delivered in classes supervised by physiotherapists and physical education professionals.	Not described.	Baseline and at completion (at 12 weeks).	Physical performance: • Flexibility (Wells bench) • Muscle strength (Jamar adjustable hand dynamometer) • Lower limb strength (30-second chair stand test, 5 times sit to stand text) • Functional mobility (TUG)

					• Aerobic capacity (6-min walk test along 30-meter corridor)
Legault, 2011 Unites States (II)	73	Sessions were centre-based monitored by skilled trainers and conducted via computer with small groups (<6 people). Physical activity sessions were home and centre based.	Mail-out and presentations. Clearance from physician was required.	Baseline and at completion (at 4 months).	• Cognitive function: o Executive function: 6 different measures o Episodic memory: 4 different measures • Physical function: time for 400-meter walk • Anxiety and depression: GDS (global depression scale) • Cognitive deficit: modified mini mental state examination (mMMSE) • ApoE genotype
Shah, 2014 Australia (III-2)	172	Instructions / training provided by an instructor in monthly intervention-specific group meetings. All physical activities performed under the training provided by exercise physiologists. Instruction booklets with explanation of respective physical / cognitive exercises.	Existing research database, the Survey Research Centre, or local media advertisements, public talks and word of mouth. Clearance from physician was required.	Baseline and at 8 and 16 weeks.	• Cognition (CamCOG-R, MMSE, RAVLT, COWAT, MFQ) • Anxiety and depression (HADS) • Quality of life (SF-36) • Physical fitness assessment (IPAQ) • Cerebral glucose metabolism
Barnes, 2013 United States (II)	126	All participants attended study-specific group exercise classes at a local YMCA. All classes were taught by a single, certified exercise instructor with experience conducting classes in the elderly with a maximum of 12 participants per class at any given time. Home-based mental activity performed independently on a computer and class based physical activity	Direct mail-out to the neighborhoods adjacent to the intervention site, advertisements, fliers, physician and friend referrals, and recruitment databases	Baseline and at completion (12 weeks).	Cognitive function: a composite score from a comprehensive Neuropsychological test battery, including • Rey Auditory Verbal Learning Test • Verbal fluency (letter and category), • Processing speed (Digit Symbol Substitution Test • Executive function/ mental flexibility (Trail-Making Test, Parts A & B) • Executive function/ inhibition (Eriksen Flanker Test congruent and incongruent reaction times)

					• Visuospatial function (Useful Field of View processing speed, divided attention and selective attention) Physical performance: Senior Fitness Test • Chair stand • Arm curl • 2-minute step test • Sit-and-reach • Back scratch • 8-foot up-and-go
Pa, 2014 Unites States (II)	72	All participants attended study-specific group exercise classes at a local YMCA. All classes were taught by a single, certified exercise instructor with experience conducting classes in the elderly with a maximum of 12 participants per class at any given time. Home-based mental activity performed independently on a computer and class based physical activity	Direct mail-out to the neighborhoods adjacent to the intervention site, advertisements, fliers, physician and friend referrals, and recruitment databases	Baseline and at completion (12 weeks).	Sleep quality (measured by Sleep Disorders Questionnaire)
McDougall, 2015 United States (IV)	82	Classroom sessions held at the study sites (retirement facilities). A female septuagenarian role model taught the memory training classes. No detail was provided about the other facilitators.	Individuals living in retirement facilities. Approach method not otherwise described.	Baseline and 2 months	• Memory performance: RBMT • Memory self-efficacy: memory self-efficacy questionnaire • Memory complains: sub-questions of the MIA • Instrumental Activity Daily Living: DAFS-E • Anxiety: STTAI • Depression: CES-D

Streber, 2017 Germany (III-1)	87	Carried out by prevention providers who worked in sports club, protestant education institute, local sports department and two were from assisted living facilities. Required exercise instructor qualification.	General population and the assisted living facilities. Approach method not otherwise described.	Baseline and at 3 and 12 months.	• Physical performance: o Mean steps per day (collected using waist-mounted pedometers) • Cognitive function (by DemTect) • Social activity (by Social Activity Log questionnaire)
Lee, 2012 Korea (III-3)	70	Two community welfare centres (1) in a metropolitan area (2) in a suburban/rural area. Gerontological social workers working at these centres served as group facilitators, instructors, and coordinators.	Older adults attending included community centres. Approach method not otherwise described.	Baseline and at completion (at 12 weeks).	Self-rated overall health status: 5 items Illness and disease: 9 items Physical activity: 3 items Mind dimension: • Positive Affect Negative Affect Scale • Center for Epidemiological Studies Depression Scale • Self-Efficacy Scale Spiritual dimension: 11 items Mindfulness: 9 items
Sakai, 2017 Japan (III-1)	48	Classroom type exercise groups delivered in community centres. During exercises, instructors stood in front demonstrating the exercises. Instructors were volunteers with knowledge of and skilled in instruction for group exercise. A municipal public servant was also involved.	Participants who attended group exercise classes held as part of a long-term care prevention project (other research study).	Baseline (at completion of 3 month exercise classes)	Exercise continuance: stamp for each session attended, and self-reported exercise sessions at home Quality of life: • Life satisfaction index • GDS 5-items Exercise self-efficacy: ESE five items scale

SF-36, short form 36 items; GDS, geriatric depression scale; YMCA, young men's christian association; WOMAC, Western Ontario and McMaster universities (WOMAC) osteoarthritis index; SPPB, short physical performance battery; TUG, timed up and go measure; BMI, body mass index; TMIG, Tokyo metropolitan institute of gerontology Index; iADL, instrumental activities of daily living; IPAQ, international physical activity questionnaire; FFB, fat and fibre barometer; PANS, physical activity and nutrition for seniors; RAPA, rapid assessment of physical activity; QALY, quality adjusted life years; MVPA, moderate to vigorous physical activity; MoCA, Montreal cognitive assessment; MMSE, mini mental status examination; mMMSE, modified mini mental status examination; ApoE, apolipoprotein E; CamCOG-R, Cambridge cognitive assessment-revised; RAVLT, Rey auditory verbal learning test; COWAT, controlled oral word association test; MFQ, memory functioning questionnaire; HADS, hospital anxiety and depression scale; RBMT, Rivermead behavioural memory test; MIA, 108-item metamemory in adulthood; DAFS-E, direct assessment of functional status - extended; STTAI, Spielberger state trait anxiety inventory; CES-D, center for epidemiologic studies depression scale; ESE, exercise self-efficacy

Appendix C

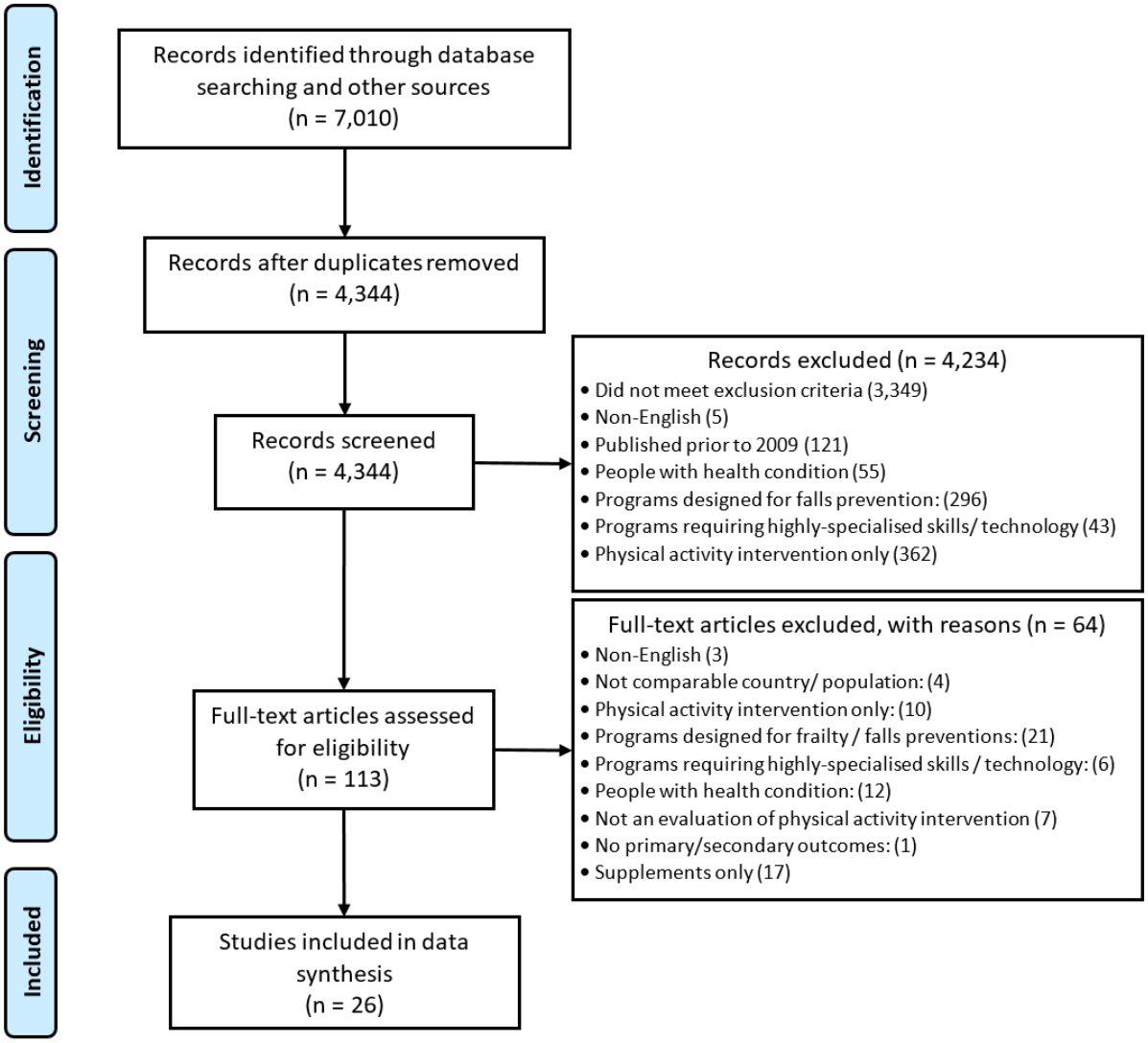

Figure C1: Flow chart of the study selection

Appendix D

Supplements studies

Table D1: Study characteristics of the studies evaluating physical activity plus nutritional supplements

Study ID (Author, year, country)	Study type (NHMRC evidence grade)	Population (n)	Intervention/ comparator	Frequency of the intervention and duration	Details of the intervention / theories supporting the intervention	Effect (primary outcome)
Von Berrens 2018 (USA and Sweden) (45)	RCT (II)	Community dwelling >=70 (n=149)	(1) Receive a nutritional supplement + PA (2) or a placebo + PA	PA program 2–3 times/ week 6 months	PA - Warm up, 30 minutes walking, 20 mins strength using ankle weights, balance and flexibility exercises, cool down. Nutritional supplement: 150kcl- 20g whey protein, 800IU vitamin D and vitamins and minerals every day Theory interventions in the VIVE2 not only had effects on the participants' physical function but also on their quality of life, both in the physical and the mental domains, and on depressive symptoms	PA had positive effects on mental status. No additional effects from nutritional supplementation were detected
Petrie 2017 (USA) (46)	Randomised controlled double-blind placebo-controlled (II)	≥55 hypertensive and sedentary individuals (n=26)	(1) PA centre-based + placebo supplement (2) PA + Beetroot juice supplement - BEET IT sport shot with 560mg nitrate	6 weeks of exercise	PA - three 50 minute sessions per week of moderately intense walking for 6 weeks. Stretching before and after. On treadmill. Beetroot juice supplement: Daily supplement given 1 hour before exercise (if on PA day). Theory whether there are synergistic effects of beetroot juice supplement	Significantly increased somatomotor community consistency in beetroot juice supplement group. Beetroot juice supplement vs. placebo: mean (sd) 2.27 (0.145) vs -2.89 (0.156); p=.007

					and PA on neuroplasticity in the aging brain	
Patil 2016 (Finland) (47)	Double-blind, RCT vitamin D and open exercise intervention trial (II)	Older (70-80) women, fallen once in the previous year, not using Vitamine D supplements or exercising vigorously (n=409)	(1) Placebo (2) Vitamin D supplement only (3) PA only (4) PA plus Vitamin D supplement	1 daily pill for 24 months. Supervised exercise twice a week for 12 months then 1 time per week, Unsupervised prescribed exercise on other days for 12 months reducing to 3 times per week	Compare against placebo. Theory exercise not only improved physical functioning in older Finnish women but also reduced their injurious falls by more than 50%, while vitamin D supplementation had no effect	No significant differences were found in QoL or mental wellbeing between groups receiving either vitamin D, exercise or both treatments
Mori 2018 (Japan) (48)	RCT (II)	Community-dwelling older women, aged 65–80 years (n=81)	(1) Ingestion of a whey protein supplement after the resistance exercise program (2) whey protein supplement only (3) resistance exercise only	24 weeks twice per week	Benefit of protein supplementation after resistance exercise in enhancing muscle mass among older individuals.	Whey protein supplementation, provided after moderate-intensity whole-body movement resistance exercise, resulted in increases in lower and upper limb muscle strength among older women
Berton 2015 (Italy) (49)	Parallel-group, open-label RCT (II)	Women over 65 years of age (n=65)	Beta-hydroxy-beta-methylbutyrate (HMB)	8 weeks - twice weekly fitness	HMB supplementation could improve physical performance and muscle function in active older women	No significant difference
Seino 2018 (Japan) (50)	RCT (II)	Non-disabled adults who were aged 65 to 80 years and did not exercise regularly (n=82)	PA and low-dose dairy protein plus micronutrient supplementation (ExPM) PA alone (Ex)	Twice weekly for 12 weeks	Low-dose dairy protein plus micronutrient supplementation augments the effects of regular exercise on muscle mass and physical performance compared with regular exercise alone among older adults	Significantly increases muscle mass during PA but not physical performance
Hildreth 2013 (USA) (51)	RCT (II)	Untrained community dwelling men 60 years (n=143)	Testosterone supplementation with and without	12 months	2 placebo packets in the placebo group, 1 Testosterone gel and 1 placebo packet in the lower-range Testosterone group, and 2	Effects of Testosterone supplementation with and without progressive resistance training on

			progressive resistance training		Testosterone gel packets in the higher-range Testosterone group. PA resistance intervention included 4 upper-body (bench press, incline press, overhead pull-down, and seated row), and 3 lower body (knee extension, knee flexion, and seated leg press) exercises.	change from baseline in the body composition
Aoki 2018 (Japan) (52)	RCT (II)	Community-dwelling > 60 years (n=130)	(1) Vitamin D onlu (2) PA only (3) PA and vitamin D	24-week	3 daily sets each of single-leg standing, vitamin D supplementation was 1000 IU/day	Lower limb muscle mass increased signicantly in all three groups, with no signicant differences between the groups in the degree of change
Sakurai 2013 (Japan) (40)	RCT crossover trial (II)	Community-dwelling older adults (n=61)	(1) Exercise, diet, and hot bath (2) Exercise and diet (3) Hot bath (4) Control group	Twice a week for 3 months	Exercise and diet classes: twice a week for 3 months, and those in groups 1 and 3 took hot baths. Theory an intervention with exercise and dietary modification combined with hot bathing for the improvement of physical function	Exercise, diet, and hot bathing improved
Tabue-Teguo 2018 (French) (53)	RCT (II)	Community-dwellers aged >=70 (n=1,680)	(1) multidomain intervention (2) polyunsaturated fatty acids (3) multidomain intervention plus polyunsaturated fatty acids (4) Placebo	For Omega-3 Polyunsaturated Fatty Acids supplementation, participants took two capsules of either placebo or polyunsaturated fatty acids daily	Multidomain intervention and Omega-3 Polyunsaturated Fatty Acids supplementation can modify the cognitive function on elderly according to frail status.	No effect
Kukuljan 2011 (Australia) (54)	Factorial design RCT (II)	50-79 year old men (n=172)	1) Exercise + fortified milk; 2) Exercise only 3) Fortified milk only	3 days per week	Exercise consisted of progressive resistance training activities Men assigned to fortified milk consumed 400 ml/d of 1% fat milk	Community-based multi-component exercise program successfully improved lumbar

			4) Controls		containing 1000 mg/d calcium and 800 IU/d vitamin D3. Theory calcium-vitamin D3 fortified milk could enhance the effects of exercise on bone strength, structure, and mineral density	spine and femur neck bone mineral density and strength. Providing additional calcium-vitamin D3 did not enhance the osteogenic response. Daily consumption of 400ml of low-fat calcium-vitamin D3 fortified milk did not enhance the effects of exercise on bone in this group
ten Haaf 2018 (Netherlands) (55)	Cross sectional (IV)	Community-dwelling elderly people (n=140)	Data comes from two studies: Four Days Marches study: measurement of protein intake, physical activity, muscle strength, physical functioning and quality of life ProMuscle in Practice study: measurement	*Not applicable*	Theory higher protein intake and a spread protein distribution are associated with improved strength and physical function, while adding physical activity to the equation will enlarge these effects.	Total protein intake was not associated with outcome measures
van Dongen 2017 (Netherlands) (56)	Pilot pre-post-test (IV)	>65 years and community dwelling (n=23)	Adapted prototype intervention: Resistance exercise intervention, guided by physiotherapists. Nutrition intervention: with dietitians.	Pilot duration: 12 weeks Exercise: twice a week (one day's rest in between) for one hour,	Resistance training: warmingup (5 min easy biking on a home trainer, 60 rpm), six strength exercises (leg press, leg extension, lat pulldown, vertical row, chest press, and pec dec), and cooling-down (5 min easy biking on a home trainer, 60 rpm) The nutrition programme included two consultations with a dietician (at the beginning and halfway through), and an additional consultation if needed. Dieticians	Significant improvements in muscle strength and functioning, but no change in lean body mass

					formulated a personally tailored nutrition intervention with proteinrich dairy products for breakfast and lunch (the second bread-meal), aiming to achieve an intake of 25 g of protein. Participants received the recommended protein products, such as cheese, dairy drinks, and Greek yoghurt, for free during the study.	

RCT, randomised controlled trial; PA, physical activity; QoL, quality of life

Table D2: Study characteristics of the systematic reviews evaluating physical activity plus nutritional supplements

Study ID (Author, year)	Study type (NHMRC evidence grade)	Population (n)	Review and study objectives	Frequency of the intervention and duration	Details of the interventions included in the review	Effect (primary outcome)
ten Haaf (2018) (57)	Systematic review; included 36 studies	50+ years non frail and community dwelling (n=1,682)	Assessed the effect of protein supplementation on lean body mass, muscle strength, and physical performance in exclusively non frail community-dwelling older adults. Assessed the superior effects of protein supplementation during concomitant resistance exercise	Multiple times per week; minimal duration of 4 weeks	11 studies assessed lean body mass, upper body strength, lower body strength, gait speed, and/or chair rise ability. 18 studies assessed the additional effect of protein intake compared with controls on these variables while performing resistance exercise training.	No significant effects of protein supplementation on changes in lean body mass. No superior effects of protein supplementation were found during concomitant resistance exercise training on muscle characteristics.

			training on muscle characteristics.			
Denison (2015) (58)	Systematic review; included 17 studies	65+ years in which combined nutrition and exercise interventions were used to increase muscle strength and/or mass, and achieve improvements in physical performance (population: n=17 to 217)	Majority of studies were resistance studies, investigating the effects of combined exercise and nutrition intervention on muscle mass and muscle function	Ranged from 8 weeks to 18 months	50% were Intervention and control and 50% were factorial being exercise, nutrition, exercise and nutrition and control	Muscle strength improved with exercise training in all 7 studies using protein. There was no interaction between protein and essential amino acid supplementation with exercise training on muscle strength in 6 of the 7 of the studies. Physical performance was questionable for multinutrional use
Beudart (2017) (59)	Systematic review, included 37 randomised controlled trials	60+ years	Primary purpose was to investigating the effects of combined exercise and nutrition intervention on muscle mass and muscle function on old people	Multiple sessions of exercise per week, from 30+ minutes per session	22 studies used a two-group comparison methodology: one group receiving exercise + nutrition and the other group receiving exercise only (with placebo or no intervention). 11 studies used a four-group comparison model with one control group with no intervention, one group with exercise only, one group with nutrition only and one group with combined exercise and nutrition interventions. 3 studies randomized their population into 3 groups: a control group with no intervention, a group with exercise only,	Muscle mass increased with exercise but an additional effect of nutrition was only found in 8 RCTs (23.5%). Muscle strength increased in 82.8% of the studies (29/35 RCTs) following exercise intervention, and dietary supplementation showed additional benefits in only a small number of studies (8/35 RCTS, 22.8%). The majority of studies showed an increase of physical performance following exercise intervention (26/28 RCTs, 92.8%) but interaction with nutrition

					and a group with exercise combined with nutrition. 1 study used a five-group comparison: two groups with exercise and nutrition interventions, but used a different nutritional supplement in each of these two groups.	supplementation was only found in 14.3% of these studies (4/28 RCTs).

RCT, randomised controlled trial

Physical activity

As the aim is to establish a program that incorporates physical activity as well as components that can address other factors related to health or health risk (such as diet, mental health and social isolation), 372 studies were excluded from this report as they evaluated the effects of an physical activity intervention only. Main modes of intervention delivery in these studies were walking, resistance or balance training, yoga, tai chi, or general physical / exercise or home based activity programs.

Physical activity (as a mode to improve wellbeing – or aspects of wellbeing) in the excluded studies was evaluated in number of different ways. Some of the excluded studies compared an exercise type only intervention to another (eg. 60), while others evaluated the effects of exercise compared to other approaches to improving health outcomes such as health education (eg.61). A few studies also evaluated other psychosocial outcomes of engaging in exercise, such as 'social participation' (eg. 62). Systematic reviews (eg. 63) that evaluated the overall effects of specific exercise programs (such as yoga) on physical and/ or mental function (of older people) were also excluded.

It should be noted that a few of the excluded studies included an economic evaluation of the intervention (eg. 64, 65-70). While economic benefits were reported from participating in a range of different exercise only programs for a range of participants (such as older adults with Rheumatoid Arthritis), it is difficult to determine if similar economic benefits can be reached from interventions that include a combination approaches (for example programs that also address other health factors such as diet, mental health and social isolation).