Ageing Well

Activity for healthy ageing, a review of interventions to improve health and wellbeing in older people

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Contents

List of Key Abbreviations

Physical Activity	PA
World Health Organization	WHO
High Intensity Interval Training	HIIT
Endurance Training	ET
Randomised Controlled Trial	RCT
Experimental Group	EG
Control Group	CG
Self-Perceptions of Ageing	SPA
Body Mass Index	BMI
6-Minute Walking Distance	6MWD
Timed Up-and-Go	TUG

Executive Summary

In the right setting, with the right support and the right opportunities, older people gain health, wellbeing, enjoyment and social engagement from physical activity. Social inclusion and physical activity are essential for ageing well. This report has reviewed 53 research papers (49 of them primary research) from the last five years that have studied the relationship between physical activity and its effectiveness in improving the health and wellbeing of older people. Not all of the positive outcomes can be measured as they are feelings of happiness, friendship, belonging and satisfaction with personal achievement; others can be measured in terms of cardiovascular fitness, body mass index (BMI), functional fitness and walking speed, balance and muscle strength. They are all important. It is essential to address the biopsychosocial aspects of our lives to promote ageing well for all. To be effective in supporting older people, the whole community must be engaged in supporting each other. Qualified instructors are essential, but employing the leadership and networking skills of older people themselves and offering a wide variety of group activities at central hubs and using outdoor, open-access facilities will provide more opportunities for engagement and support. Promoting social interaction as part of the offerings is essential, while promoting inclusivity and involving stakeholders in feedback, decisions and organisation is vital to success in promoting health, wellbeing and successful ageing through physical activity. Please see the recommendations at the end of the report for a summary of how the evidence can be applied.

1. Introduction

The World Health Organization (WHO) (World Health Organization, 2002) celebrates the public health achievement of increasing the older population (60 years and over). Nonetheless, it highlights the importance of active ageing policies to promote the quality of life for older people. From a societal perspective, active ageing is needed to enable working longevity, according to capacity and preference, and the prevention or delay of long-term illness, to reduce the impact of the person, their family and health services. They define active ageing as "the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age" (World Health Organization, 2002, p. 12). The Northern Ireland Executive (2020) identified the importance of providing sport and physical activity programmes for increasing participation opportunities for older people and those with disabilities, including the use of local authority swimming pools and other leisure activity hubs. While the "Healthy ageing: consensus statement" stops short of specifically identifying activity-related interventions, it does identify that "A person's changing needs should not be a barrier to maintaining or improving health and being able to continue to do the things that they value" (Public Health England with Centre for Ageing Better, 2019, p. 6).

In the WHO Global Strategy and Action Plan for Ageing and Health for 2016-20, the second of five objectives was to create and develop age-friendly communities to promote health, engagement and personal growth in older people (Rudnicka et al., 2020), and in the Decade of Health Ageing 2020-2030, the World Health Organization (2019) advised governments, agencies, private and public sectors, as well as professionals, academia and the society to make environments age-friendly, combat ageism, integrate care and provide good-quality long-term care where needed. As part of this, they have identified the need for older people to have a say and be heard so that they can engage in society; to build a legal and policy framework that promotes health and wellbeing for older people; to connect with stakeholders so that they can enable organisations to learning and align their actions with their aims; and to strengthen research into older people. The United Kingdom Government (Office for Health Improvement and Disparities, 2022) has recognised the importance of tackling ageism, promoting healthy ageing and encouraging physical activity and group activities. In order to allocate resources appropriately and effectively, it is important to identify which interventions are most effective in facilitating active aging. Thus, a narrative literature review, using a systematic search and data extraction strategy, has been carried out to identify the strengths and limitations of different active ageing interventions

2. Methods

2.1. Search Strategy and Inclusion Criteria

Three electronic database searches, using CINAHL Plus with Full Text, SPORTDiscus and PsychInfo, were carried out in August 2022. The terms used in the searches were deliberately broad to ensure that relevant papers were not excluded, resulting in initially high titles being returned for screening. Most age criteria were set from 65 years and over, but some of the papers selected included age groups from 55 and above.

Inclusion criteria: 60 years and over, related to healthy activity interventions / drives, healthy ageing
Exclusion criteria: children or adults below the age of 60; living in nursing homes or elder communities

2.2. Identification of Relevant Studies

Date searched: 05/08/2022
Database used: CINAHL Plus with Full Text
Search terms: Physical activity MH AND healthy aging MH OR healthy ageing NOT nursing homes or care homes or long term care or residential care or aged care facility
• Limiters used: o Date published January 2017 onwards o English language only o Aged 65 years and over o Academic journals only
• 657 results, but when abstracts screened, 566 did not meet inclusion criteria, leaving 91 papers for full text review
• Reasons for full-text exclusions: o 10 - health or individual intervention or multi-factorial studies rather than activity-related intervention o 1 – residential home setting o 38 – No intervention o 8 – not research o 1 – macroeconomic study that does not detail interventions o 5 – trial registration o 1 - Not older people o 7 reviews
20 results: (Bidaisee et al., 2020; Blain et al., 2017; Cholerton et al., 2020; Clare et al., 2019; Costello et al., 2019; Cunha et al., 2019; Dare et al., 2018; Fiorilli et al., 2022; Glover et al., 2020; Lera-Lopez et al., 2019; Lindsay-Smith et al., 2018; R. A. Merchant et al., 2021; Moore et al., 2019; Nau et al., 2021a; Pettigrew et al., 2019; Reddy et al., 2017; Santos et al., 2022; Shree Ganesh et al., 2021; Silveira Guimarães et al., 2020; Szychowska & Drygas, 2022)
Date searched: 06/08/2022
Database used: SPORTDiscus with Full Text
Search terms: Physical activity TX AND healthy aging or healthy ageing TX NOT nursing homes or care homes or long term care or residential care or aged care facility AND older adults or elderly or aged 65 or 65+
• Limiters used: o Date published January 2017 onwards o English language only o Academic journals only
• 412 results, but when abstracts screened, 299 did not meet inclusion criteria, leaving 113 papers for full text review

- Reasons for full-text exclusions:
    - 3 – intervention not physical activity
    - 19 – no intervention
    - 7 – not research
    - 15 – not looking at effects on health
    - 3 – Feasibility or pilot study or protocol registration
    - 15 – not looking at healthy ageing (disease / condition specific)
    - 7 - excluded as health or individual intervention or multi-factorial studies rather than activity-related intervention
    - 1 – review based on data more than 10 years old
    - 3 – residential home setting
    - 6– reviews (2 included for specific data where few primary studies available)
    - 5 - duplicates

27 results: (Alin et al., 2020; Beyer et al., 2019; Bouaziz et al., 2020; Brothers & Diehl, 2017; Cholerton et al., 2021; Ciaccioni et al., 2019; Clocksin et al., 2017; Da Rocha et al., 2018; de Camargo Smolarek et al., 2019; de Lacy-Vawdon et al., 2018; Esmail et al., 2020; Gambassi et al., 2017; Geraedts et al., 2021; Johnson et al., 2018; Matson et al., 2019; Mustafa et al., 2022; Outayanik et al., 2017; Ratz et al., 2022; Richardson et al., 2019; Roberts et al., 2017; Santos et al., 2020; Shahtahmassebi et al., 2019; Sipilä et al., 2021; Stolte et al., 2017; Thom et al., 2021; Ward et al., 2020; Yoshiko et al., 2018)

Date searched: 12/08/2022

Database used: PsychInfo

Search terms:
Physical activity (TX) AND healthy ageing or healthy aging NOT nursing homes or care homes or long term care or residential care or aged care facility

- Limiters used:
    - Date published January 2017 onwards
    - English language only
    - Aged 65 years and over
    - Academic journals only

- 160 results, but when abstracts screened, 134 did not meet inclusion criteria, leaving 28 papers for full text review

- Reasons for full-text exclusions:
    - 7 – No intervention
    - 1 – no physical intervention
    - 2 – not community based
    - 2- not looking at healthy ageing (disease / condition specific)
    - 2 – review where papers did not all have relevant participants or interventions
    - 2 - excluded as health or individual intervention or multi-factorial studies rather than activity-related intervention
    - 4 – duplicates
    - 2 - reviews

6 results: (Adcock et al., 2019; Batra et al., 2019; Borbón-Castro et al., 2020; Kinnafick et al., 2021; Ratz et al., 2020; Rehfeld et al., 2018)

3. Results

53 papers were included in this review. See Data Extraction Table (Table 1.) below for details.

3.1. Study Characteristics

Three literature reviews were included in this review because they added information on research and background information to the primary studies included (de Lacy-Vawdon et al., 2018; Santos et al., 2022; Szychowska & Drygas, 2022). One of these looked at the relationship between physical activity (PA) and successful ageing (Szychowska & Drygas, 2022), while another looked at facilitating factors in attendance and adherence to group-based PA classes (de Lacy-Vawdon et al., 2018). A third review focused on the needs of adults with intellectual disabilities (Santos et al., 2022) – the mean age was younger (44) but it was included because there are few studies that look specifically at the PA needs of this group of people when they are older. There was also one meta-analysis (Bouaziz et al., 2020) where data from studies on the effects of endurance or aerobic training versus resistance or strength training on peak oxygen uptake as a measure of respiratory fitness were combined, in order to inform the type of training that should be offered.. The remaining 49 explored the effects of different types of physical activity interventions on various aspects of health and wellbeing in older people. The youngest age for inclusion in the studies was 45 years, with the upper age in most cases below 90. There were 38 quantitative studies (Adcock et al., 2019; Alin et al., 2020; Batra et al., 2019; Beyer et al., 2019; Bidaisee et al., 2020; Blain et al., 2017; Borbón-Castro et al., 2020; Brothers & Diehl, 2017; Ciaccioni et al., 2019; Clocksin et al., 2017; Cunha et al., 2019; Da Rocha et al., 2018; de Camargo Smolarek et al., 2019; Esmail et al., 2020; Fiorilli et al., 2022; Gambassi et al., 2017; Geraedts et al., 2021; Johnson et al., 2018; Lera-Lopez et al., 2019; Matson et al., 2019; R. A. Merchant et al., 2021; Moore et al., 2019; Mustafa et al., 2022; Outayanik et al., 2017; Ratz et al., 2020; Ratz et al., 2022; Reddy et al., 2017; Rehfeld et al., 2018; Richardson et al., 2019; Roberts et al., 2017; Santos et al., 2020; Shahtahmassebi et al., 2019; Shree Ganesh et al., 2021; Silveira Guimarães et al., 2020; Sipilä et al., 2021; Stolte et al., 2017; Thom et al., 2021; Yoshiko et al., 2018), 9 qualitative studies (Cholerton et al., 2020; Cholerton et al., 2021; Clare et al., 2019; Costello et al., 2019; Dare et al., 2018; Glover et al., 2020; Nau et al., 2021a; Pettigrew et al., 2019; Ward et al., 2020) and two mixed methods studies (Kinnafick et al., 2021; Lindsay-Smith et al., 2018).

Of the 49 primary studies, five focused on the use of mostly home-based PA programmes (Adcock et al., 2019; Geraedts et al., 2021; Ratz et al., 2020; Ratz et al., 2022; Roberts et al., 2017). Of the remaining 44: 13 were on specific single types of PA: Tai Chi (Alin et al., 2020); walking (Blain et al., 2017); walking football (Cholerton et al., 2020; Cholerton et al., 2021; Reddy et al., 2017); judo (Ciaccioni et al., 2019); ocean swimming (Costello et al., 2019); dancing (Da Rocha et al., 2018; Rehfeld et al., 2018); eccentric pedal exercise (Johnson et al., 2018); walking netball (Kinnafick et al., 2021); karate (Mustafa et al., 2022); yoga (Silveira Guimarães et al., 2020); one looked at the facilities and activities carried out within parks (Moore et al., 2019); while the rest were on more generic or multiple types of PA offerings. Although most studies were interested in some kind of physical or social benefit, seven studies looked at the effects of PA on cognitive performance (Adcock et al., 2019; Alin et al., 2020; de Camargo Smolarek et al., 2019; Esmail et al., 2020; R. Merchant et al., 2021; Santos et al., 2020; Sipilä et al., 2021), though not always as the main outcome measure .

Table 1. Data Extraction Table

Article Short Reference	Study characteristics (Country of Origin / Aims / Study design /Sample size / Setting	Participant characteristics – Age / Gender / Ethnicity / Socio-Economic Status / Specific Needs / Other	Findings	Comments / Limitations / Conclusions
Adcock et al (2019). A pilot study of an in-home multicomponent exergame training for older adults: Feasibility, usability and pre-post evaluation	Switzerland. Pre-test, post-test pilot to explore effects of 40-minute exergame (Tai Chi, dance + step-based cognitive training) on strength, balance and cognition 3x week (24T)., 21 participants. Set in lab then home (approx. 4 weeks each)	Healthy 65-92-year-olds with access to smart TV	Adherence 91% Slight improvement in foot lift during walking and in short-term attentional span. Minimal physical or cognitive change overall.	6 drop-outs (29%) not included in non-adherence nos. 70% attendance was adherent. Very narrow suitability criteria – excludes the people interventions aim to involve, e.g., with diabetes and other long-term health issues. Technical and usability issues caused frustration.
Alin et al. (2020). Dementia and Tai Chi	Romania. Pre- and post-case studies exploring effects of Tai Chi 2-4 X per week on 5 participants. Used Mini-Mental State Examination (MMSE), Bristol Activities of Daily Living Scale, Cornell Scale for Depression in Dementia (CSDD), Quality of Live in Alzheimer's Disease and Neuropsychiatric Inventory Questionnaire.	5 68-73-year olds with mild-moderate dementia.	While carers perceived marginal improvement in function and quality of life for some individuals, there were no significant differences.	Tai Chi carried out with teacher present. Use of questionnaires limited exploration of experiential change in perception of carers. Home-based intervention.
Batra et al. (2019). Determining the long-term effectiveness of a group-based physical activity program	S. Florida, USA. Pre-test, post-test study to assess the effectiveness of a community-based stretching, balance, aerobics and strength-based EnhanceFitness (EF) exercise programme (N=1,295) in older adults in 222 settings, lasting at least 4 months. Self-assessed health status, number of fails and some functional measures of fitness were outcome measures.	60 years plus, able to follow instructions. 15% Male, 81% female; 46% white; 50% BAME; 58% single; 45% living alone; 9% frail/disabled.	Significant improvement in self-rated health status and reduction in falls in preceding 4 months. Significant improvement in the number of chair stands and arm curls completed in 30 seconds, and in the time taken to walk 8 feet from chair and return.	Statistically clear positive physical outcomes from a set programme made accessible to a diverse, large sample of older people who self-subscribed. All instructors had good communication and interpersonal skills, enthusiasm and motivation and were trained and qualified to deliver the programme.
Beyer et al. (2019). Are self-perceptions of ageing modifiable? Examination of an exercise	Germany. To test whether an intervention to enhance self-perceptions of ageing (SPAs)	65- 88 years. 35% men. 36% single. No acute impairments, but not exercising regularly and had lower	Both groups demonstrated significant improvements in their physical performance, Significant	Highlights the importance of positive perceptions of ageing in instructors and the benefit of

programme with vs. without a self-perceptions of ageing-intervention for older adults	would affect SPA (shown to benefit health) within a 12-week group exercise programme. 89 volunteer participants. Randomised, controlled, single-blinded trial. Experimental group (N=38) received additional cognitive behavioural therapy to replace negative thoughts on ageing with more realistic, neutral or positive ones, control group (N=46) group exercise only.	scores in Short Physical Performance Battery (138 started 45 excluded as too fit, and some dropouts).	improvement in SPA experimental group v. control.	challenging negative thoughts around ageing, Also shows that group exercises are beneficial for health ageing.
Bidaisee et al. (2020). Active aging: WINDREF's sports for health program among the elderly in Grenada, West Indies	Grenada, West Indies. Cross-sectional study to assess the impact of Sports for Health on participants over 65, using a self-report questionnaire, the RAND 36-item Health Survey. 23 participants,	22 females, 2 males, aged 65 to 73. Involves health and nutrition information as well as fitness sessions (expected 3 X a week for a year). Questionnaires complete before study and after one year.	Improved health and emotional status were both significantly linked to programme participation, but there were no significant differences in physical function, pain or energy levels.	Some of the participants had already attended the programme before the base survey was administered, so the findings might be weaker than they should have been.
Blain et al. (2017). Effect of a 6-month brisk walking program on walking endurance in sedentary and physically deconditioned women aged 60 or older: A randomized trial	France. Randomised controlled trial (RCT) over 6 months, N=121. Experimental group attended 2 supervised moderate-intensity walking sessions, and walked once on their own per week; the control group were given freedom to be physically active as they wished	Women, 60 years or over, with sedentary lifestyle with lower-than-normal 6-minute walking distance (6MWD). All participants wore heart monitors. The experimental group walking sessions began with a target of 40% maximal heart rate, working up to 60-80%.	6MWD increased more significantly in exercisers than controls (42% v 11%). Improvement was greatest in this with highest body mass index (BMI) and lowest walking endurance at baseline. 12 discontinued, leaving 51 exercisers and 47 controls.	This group walking programme was significantly more effective than advice to exercise, but the effect could be related to the group nature of the activity as well as the regulated heart rate increase.
Borbón-Castro et al. (2020). The effects of a multidimensional exercise program on health behavior and biopsychological factors in Mexican older adults	Mexico. Non-randomised controlled study over 12 weeks, N=45, 23 in experimental group physical activity sessions (aerobic, strength and mobility), 22 in group embroidery, weaving and handcraft activity groups.	35 female, 10 male participants, mean age 67, some with hypertension, Type II diabetes, obesity, but not those with limiting cardiac diseases or cognitive impairment.	Significant improvements were seen in the experimental group compared with the control group in terms of systolic blood pressure, while self-esteem and depressive symptoms were significantly improved in the experimental group but only for those who had pre-existing disease.	The lack of similarity between the two groups, including gender, is problematic. Clearly, exercise is beneficial, but the effects of belonging to a pre-existing and chosen group participating in other activities might be greater than being assigned to a group without choice.
Bouaziz et al. (2020). Effect of high-intensity interval training and	A meta-analysis of 15 RCTs, N=480 participants, comparing effects of	65 years or over. Studies that included dietary interventions	Both ET and HIIT were shown to significantly increase VO_{2peak} but in	Even though these are small numbers, they suggest that HIIT

continuous endurance training on peak oxygen uptake among seniors aged 65 or older: A meta-analysis of randomized controlled trials	High-intensity interval training (HIIT) and endurance training (ET – typical aerobic exercise) on VO_{2peak} (a measure of cardiorespiratory fitness – CRF). Training programmes lasted from 4 to 28 weeks and generally 3 x a week.	were excluded. 3 of the 15 studies only measured VO_{2peak} as a secondary outcome. 2 RCTs were female only, 1 was male only; 8 RCTs were healthy, independent adults; 7 RCTs enrolled people with health problems.	the three RCTs that compared ET and HIIT, the effects of HIIT were shown to be significantly larger than ET.	should be included in group activity classes and that further research should be carried out.
Brothers and Diehl (2017). Feasibility and Efficacy of the AgingPlus Program: Changing Views on Aging to Increase Physical Activity	Colarado, USA. Single-group pretest-posttest design (N=53) to assess efficacy of Aging*Plus* programme of education (4 weeks) to reduce negative views on aging (NVOA) and experiential components (self-designed physical activity goal) for(4 weeks to promote physical activity self-efficacy. Assessment completed 1-month post-completion of programme.	Volunteer participants, aged 50-82 years, 84% women), with half under 65 years; 56% were married; 94% white; only 18% were employed full-time; fewer than 20% had been active for longer than 6 months. 9 of original 62 participants either withdrew or had incomplete data.	Strongly significant improvements were shown in terms of positive gains of ageing and ageing stereotypes, as well as in expectations regarding ageing. They were also found in terms of general and motivational self-efficacy. There was also a large significant improvement in total weekly physical activity.	There was no control group to show whether the increased activity and more positive views on ageing, as well as motivation and self-efficacy, would have all resulted from a physical intervention only. However, the approach was clearly significantly effective over a number of important motivational and behavioural outcomes. Supported by the findings of the paper by Beyer et al. (2019)
Cholerton et al. (2020). Experiences Influencing Walking Football Initiation in 55- to 75-Year-Old Adults: A Qualitative Study	United Kingdom. Semi-structured interview study of (N=17) older adults who played walking football in organised clubs for at least 6 months.	Ages 55-75; 9 male, 8 female; 11 played for less than 2 years, 5 playing for 2 to 5 years, one for over 5 years; 15 players had participated in sport across the lifespan.	Participants valued the role of sport in health and generally saw themselves as sports lovers. The vast majority had previous positive experiences of sport. Most transitioned to walking football as a result of injury or health problems. Many found out about walking football through the media, and some through sports and football clubs. Walking football was seen by some as more achievable than other sports, however some women were initially reluctant because of its perceived masculinity, while others were a little hesitant that they may not be able to do it. Many participants, especially women, felt their fitness, levels of	This study is very small but important because it highlights some of the issues that organisations need to consider if they are to attract older people to take part in their offerings, including gender, ability level, group behaviour and attitude management, as well as improving access and raising awareness of what's on offer. It would be a useful activity to explore people's current experiences of sports offerings.

			physical activity and energy had increased as a result of walking football. Some spatial awareness / cognitive gains were identified, and many felt a greater sense of self-efficacy that generalised to other areas of their lives. A sense of belonging and social support was enhanced. Some women preferred the challenge of mixed-gender sessions, while others felt more comfortable playing women's walking football. Injuries were a negative experience, as were exclusion and non-cohesive team behaviours (such as men not passing the ball to women and running instead of walking). Some people found the day frequently inconvenient, and others found their early experiences quite daunting, in terms of social confidence and fear of injury/fatigue.	
Cholerton et al. (2021). Experiences and Strategies Influencing Older Adults to Continue Playing Walking Football	United Kingdom. Semi-structured interview study of (N=17) older adults who played walking football in organised clubs for at least 6 months.	Ages 55-75; 9 male, 8 female; 11 played for less than 2 years, 5 playing for 2 to 5 years, one for over 5 years; 15 players had participated in sport across the lifespan.	Many of the participants found walking football enjoyable in itself and found it a respite from daily life, with many seeing themselves as resilient and sport-loving. Others felt belonging to a team kept them attending. Acceptance of all abilities and team cohesion, whatever the result, was important to continuing, as was free sessions and sessions for different age groups. High quality coaching, teaching skills and ensuring fair play was seen as important, as well as their interpersonal skills and knowing	As with the study above, an active self-concept is important to walking football continuation, along with key factors in the playing environment, key to which is a good coach, exhibiting good interpersonal and technical skills. People with previous sports experience are more likely to have an active self-concept, so interventions aimed at those who have stopped exercising are more likely to be successful, while it might be useful to assess / modify people's self-efficacy in relation to physical activity.

			players individually. Not playing due to ill health or being away resulted in negative emotions, while attending elicited positive emotions. Prioritising, scheduling and planning to attend walking football ensured attendance – in other words, it was habitual.	
Ciaccioni et al. (2019). Effects of a Judo Training on Functional Fitness, Anthropometric, and Psychological Variables in Old Novice Practitioners	Italy. Evaluation of effects on physical and mental health of a 4-month judo training programme for older adult novices (N=30), by completing pre- and post-test anthropometric, fitness and psychological assessments in non-randomised study. Control group had no intervention (NI)	64-77 years old, with good mental and physical health, no invalidating diseases and a low risk of fails. 40 of 75 recruited were suitable, but of those, 10 did not have complete data. Judo group (JG) v control (NI)	Waist circumference was significantly reduced in the JG, while there were also significant improvements in chair sit-and-reach, back-scratch, chair stand and arm curl, while the NI group had diminished 30 second chair stand. Psychological effects showed slightly better outcomes in terms of body dissatisfaction for the NI, which was unexpected.	This does not tell us about the merits of judo compared with other interventions, but it does show that it can be effective for those who continue it. The psychological outcomes were unexpected but not particularly strong. This is a small study so it is hard to draw conclusions from.
Clare et al. (2019). Lessons Learned from the Active Aging for L.I.F.E. Intergenerational Programming: College-Age Student and Older Adult 65+ Focus Group Perspectives	Oklahoma, USA. Evaluation of participants' views on the Active Aging for L.I.F.E. (Longevity, Independence, Fitness and Engagement) speaker series delivered to combined audience (TN=30) of 18-25 years old college students (N=12) and 65+ years old adults (N=18) – follow-up focus groups (FGs), 6-months afterwards.	29 of 30 participants white.6 FGs of 4-6 people,	More interaction between two age-groups needed facilitation. Would have like more detailed, technical speakers. Learning environment not always helpful – too many PowerPoints, not enough discussion. Reach and diversity could have been improved.	Non-interactive, didactic sessions about health and wellbeing may not be the best way to foster learning about health and wellbeing, and intergenerational understanding.
Clocksin et al. (2017). The Efficacy of Handheld Resistive Exercise Device (HRED) Training on Wellness Outcome in Older Adults	California, USA. Pre-test, post-test evaluation of older adult (N=28) 10-week fitness programme (2 x per week) including handheld resistance exercise device (HRED). Evaluation tools: Static handgrip test; static balance using one-legged stance test (OLST); mobility using timed up and go (TUG); fall efficacy using Fall Efficacy Scale-	21 women, 7 men, 60 years plus, recruited from retirement community fitness centre and snowballing. Physically active, Independent living without long-term conditions or recent surgery.	Significant increase in handgrip strength, but while there was a significantly greater sense of self-efficacy for jogging a block and for performing a few push-ups, there was less confidence in walking. Most participants agreed they would like to continue with the HRED training.	No comparison group. Used trained, certified instructors. Full body resistance exercises using circuits with the addition of low weights if appropriate. Exercises increased in complexity through programme. Group exercise with qualified instructors seems to be effective, but there is no conclusive evidence that the HRED

	International (FES-I) survey; Self-Efficacy for Activities of Daily Living survey; group exercise survey on motivation and beliefs (not validated); blood pressure, height and weight.			is significantly better than other exercise.
Costello et al. (2019). 'A lot better than medicine' - Self-organised ocean swimming groups as facilitators for healthy ageing	Western Australia. Ethnographic study (observer participation and in-person interviews) with older members (N=17) of existing swimming groups at 3 Perth beaches exploring how they help to manage healthy ageing.	55-80+ years old. Most married and retired; many engaged in other fitness activities; some had specific health problems and adverse life events.	*Wild swimming environment* – intoxicating, magic, stunning, beautiful freedom, calming, healthier than chlorine, every day is different (pool boring), feel like a child, lots of fish, affinity with marine mammals, BUT fearful of sharks. *Health and wellbeing benefits* – low-impact, maintains healthy weight and blood pressure, maintains fitness, helps with immunity to colds, eases lymphoedema, respite from stress, anti-depressant, feelings of self-efficacy, aided by group, positive role of mentors and mentees. *Group membership* – look forward to coffee and chat afterwards, diverse conversation, stimulated by different people, intellectually, prevents social seclusion, sense of focus and purpose to life, helps with structure and routine, motivated by the group, look out for each other, celebrate together and share confidences. Belonging to a formal group important for biopsychosocial health.	Good insight into the benefits of a naturally occurring group – personal choice and motivation may explain why participants find it so rewarding. Environmental situation difficult to recreate in UK, but swimming is clearly important for health as is group activity.
Cunha et al. (2019). Resistance training performed with single-set is sufficient to reduce cardiovascular (CV) risk factors in untrained older women: The	Brazil. Says it is RCT, but the control group did not carry out any exercise intervention. Older women (N=48) randomly assigned to resistance training (RT) group	Women only. Had to be physically independent without heart disease, hypertension, diabetes or musculoskeletal disorders or on hormone therapy and exercising	While the only significant improvements for the RT group were in reduced triglycerides and low-density lipoprotein cholesterol, these are important	All participants personally supervised by physical education professionals. No comparison group of other types of exercise, e.g., aerobic.

randomized clinical trial. Active Aging Longitudinal Study	(12-week, 3 x per week) RT programme) or control group. Blood markers for fat and cholesterol, blood glucose and cardiovascular inflammation measured.	regularly. 8 did not meet criteria. Sessions lasted about 20 minutes and progressed in difficulty.	predictors of cardiovascular disease and do suggest that resistance training is beneficial for older people in terms of reducing cardiovascular risk.	Not clear if this effect would be maintained or improved over a longer period or how effective it would be for people with underlying diseases, which are common in older people. No men in study.
Da Rocha et al. (2018). Ballroom and circular dancing may improve the functional fitness of older senior women: a cross sectional study	Brazil. Cross-sectional study of healthy women (60 years plus) who had participated for 12 months, at least 3 x per week in 60 minutes of either ballroom (N=15) or circular dance classes (N=16) or had not regularly perform physical activity (N=10). Assessed body composition and functional fitness.	Women, 60 or over, who did not have dementia, psychiatric disorders, neurological disorders, intellectual disabilities, impairment from stroke, blindness, deafness or recent hospitalisation. Had an 85% attendance rate over the last year.	No differences found in body composition or BMI. Both sets of dancers had significantly better chair stand and 6-minute walk test performance, but there were no differences in arm curl, sit and reach, back scratch and agility tests.	Interesting comparison between naturally occurring groups showing some benefits to dancing in terms of fitness, but no baseline comparisons.
Dare et al. (2018). "The people make it fun, the activities we do just make sure we turn up on time." Factors influencing older adults' participation in community-based group programmes in Perth, Western Australia	Western Australia. Interview and focus group study (N=35, median age 71) to identify enablers and barriers to participation in community-based group activity and identify differences between regular participants and others.	60 years plus, recruited from pre-existing community programmes (e.g., fitness, dance, craft, older people's groups). Regular participants (weekly attendance), irregular participants (did not attend every week). 9 telephone interviews and 8 high street intercept interviews; 4 focus groups (N=18).	*Friendship and function* – activities had to have meaning / personal interest and provide a chance to socialise, helped them "get out of the house" and became part of their social support network, prevented social isolation; helped settle into new area; skilful facilitator, good at interpersonal skills important. *Availability and accessibility* – location, scheduling and structure all potential barriers to participation – local programmes that were convenient and close to home preferred – weekdays and mornings also were preferred, with reluctance to drive at night a major barrier to evening programmes. Short-term programmes did not allow for the development of relationships, but money and being locked into contracts were major issues – pay	Given the importance of social engagement and participation in preventing social isolation and promoting healthy ageing, physical activity interventions should make activities attractive to a heterogenous cohort of older people. Local organisations should canvas older adults to find out what their needs, preferences and barriers are.

			as you go was preferred. Poor public transport was also an issue. *Competing responsibilities and priorities* – family commitments – caring for extended family or partners - could be a barrier, as could irregular working hours. Bingo and other "traditional" activities for older people were not felt to be relevant to baby boomers, and senior citizens groups were finding it harder to recruit, threatening their survival but suggesting that more active groups might be more relevant.	
de Camargo Smolarek et al. (2019). Cognitive Performance Changes after a 12-Week Strength Training Program in Overweight Older Women	Brazil. Effects on cognitive performance of a strength training programme (12 weeks strength training circuits) on older overweight women. Control group were not overweight. N=21, CG, N=5; IG, N=16	All participants were women. Of the 16 IG, 8 were overweight and 8 were obese. All participants were asked to maintain normal eating habits. No diagnosis of Alzheimer's disease or other health condition.	Assessed BMI, functional capacity (push-up test and sit-to-stand test), cognitive function (Montreal Cognitive Assessment [MoCA]). No significant changes to BMI, but upper and lower body function and performance on the MoCA all significantly improved in the intervention group.	While this is a very small study that cannot be easily generalised, it does suggest that strength circuit training improves body function and cognitive performance for overweight women.
de Lacy-Vawdon et al. (2018). Facilitators of attendance and adherence to group-based physical activity for older adults: a literature synthesis	Victoria, Australia. Literature review of adherence and attendance facilitators for group-based activity in older adults. Systematic literature search yielded 8 quantitative and 13 qualitative studies.	Most students carried out in high-income economies, mostly studies of class-based activities but with some outdoor walking programmes. Most study samples included inactive but otherwise healthy adults, but one focused on people with mild cognitive impairment, while others looked at frail older people, people at risk of falls and those with English as a second language. Women were a higher proportion of participants than men, and the mean age of participants ranged from50-78	*Instructor characteristics* – encouraging, conscientious instructors who provided helpful guidance improved attendance and adherence. Good communication skills and trust and confidence in their skills, as well as qualities such as sincerity, patience, empathy, respect, charisma and expertise. *Type of physical activity (PA)* – activities such as cycling and walking had lower dropout rates than physiotherapist-led PA. Dropout was higher where the intensity of PA was too high or low	

		years. Ethnicity was predominantly white.	for the individual, while disease-specific classes had high dropout rates compared with general strength classes. Tailoring programme to ability of individual and individual attention important. The greater the number of classes that a programme offered, the greater the adherence at 6-month follow-up. Group-based sessions were preferred. Since men tend to prefer vigorous-intensity PA, while women prefer moderate-intensity PA, sometimes smaller, gender-specific groups can be helpful. *Physical activity outcomes* – realising fitness outcomes and improving self-efficacy improved PA adherence, while a lack of progress and not meeting expectations reduced adherence. Enjoying the class was important. *Barriers to attendance* – cost and up-front contracts, inconvenient time of day and location, lack of accessibility for disabled / frail people (ramps / handrails); inflexible scheduling; availability of transport (pick-up or shuttle bus helpful) *Social support* – social connectedness between participants was seen as vital for attendance and adherence, while opportunities to socialise were also highly valued. Shared customs and traditions, as well as language and religion were seen as important, and support from	

			families and health professionals could be helpful.	
Esmail et al. (2020). Effects of Dance/Movement Training vs. Aerobic Exercise Training on cognition, physical fitness and quality of life in older adults: A randomized controlled trial	Montreal, Canada. RCT of dance/movement training (DMT) versus aerobic exercise training (AET) effects on cognition, physical fitness and health-related quality of life (QOL) in healthy inactive older people. 3-arm design – DMT, AET, no intervention. N=41	Men and women, 60 and over who were inactive – non-smokers and alcohol within government guidelines. Significant illness in last 6 months or hormone therapy or cognitive impairment were exclusion criteria. Participants asked not to change other lifestyle behaviours. 62 recruited, 6 discontinued from AET, 11 discontinued from DMT, 4 discontinued from CG.	All groups, including control, showed improvement in executive and non-executive cognitive functioning. The AET group only, showed a significant increase in maximal aerobic power (MAP) and maximum oxygen consumption (VO_2), indicators of CV fitness.	Small study with limited generalisability.
Fiorilli et al. (2022). Long term physical activity improves quality of life perception, healthy nutrition, and daily life management in elderly: a randomized controlled trial	Italy. RCT of high impact PA (EG) (N=90) and low-impact PA (CG) (N=88) in older adults (50+) over 24 months (3x1hour sessions per week), looking at health, nutrition and physical activity outcomes. (N=178).	Exclusion criteria – medication contraindications to PA, an inability to walk for 6 minutes or regular participation in structure PA programmes. EG – male N=32, female N=58; CG – male N=28, female N=62). QOL assessed using Short-Form 36 (SF-36); nutritional status measured through Mini-Nutritional Assessment (MNA) and weekly level of PA through Physical Activity Scale for the Elderly (PASE) at baseline, 6, 12 and 24 months.	The high impact PA experimental group maintained a good physical quality of life over two years, and improved their nutritional behaviours, while the low impact PA CG worsened their nutritional status and physical quality of life.	Supervised by qualified trainers. Suggests aerobic and resistance training is more beneficial than stretch and balance exercise alone, and that it affects nutritional status, which is important for healthy ageing.
Gambassi et al. (2017). Effects of a new combined training approach on components of the functional autonomy of healthy elderly women.	Brazil. Effects of combined (aerobic and resistance) training programme (50 minutes, 3 x per week, for 8 weeks) on the ability of older women (N=17) to walk 10m more quickly, and to sit-stand, lying down-stand more quickly.	Exclusion criteria: being physically active, having musculoskeletal impairment or long-term illness.	Significant improvements were shown in all measures of functional autonomy.	While these results are not surprising, they do show that combined training is effective in the improvement and maintenance of physical autonomy, reducing the need for unpaid or paid caregiving or institutionalisation.
Geraedts et al. (2021). Effectiveness of an individually tailored home-based exercise programme for pre-frail older	Netherlands. Home-based exercise programme (N=40) with independent use of videos on a tablet and a necklace-worn sensor,	Over 70 and able to walk 10m independently, pre-frail and cognitively able to carry out tablet-assisted programme at home,	Only 21 participants out of 40 completed the programme. There was a significant improvement in the TUG test, but little else, and	The authors theorised that direct telephone supervision was needed throughout the programme. However, it seems likely that the

adults, driven by a tablet application and mobility monitoring: a pilot study.	while carrying out daily 10-40 minute resistance and aerobic PA. Weekly phone calls for first 3 months by qualified instructor, but could call if needed in second 3 months.	without limiting conditions, such as Parkinson's disease or severe vision loss.	that had gone by the six-month follow-up.	complexity of the use of technology, the lack of social support and not having expert instruction at each session might have reduced the effectiveness of PA for this study cohort.
Glover et al. (2020). Healthy ageing in a deprived northern UK city: A co-creation study.	Hull, United Kingdom. Co-creation project (5 x 2 hour meetings) to explore health and wellbeing in older age and promote inclusion to develop more innovative and effective services (N=10). Notes from meetings and questionnaires about the experience analysed qualitatively.	Ages 70-79, 7 women, 3 men, all white British, 4 married, 3 identified as having disability.	*Meaning of healthy ageing* – once family has grown up; sense of self continues throughout life; healthy ageing needs a positive attitude and to feel safe, secure and pain-free. It was key to address loneliness and social isolation. Social engagement led to better eating, drinking and movement, which helps with sleep. Loneliness is a barrier to engagement. *Barriers and facilitators to healthy behaviours* – people need to know what is available but don't always have internet access; older people may lack confidence and need to see other people doing things; poverty, costly and inconvenient transport and limited access to toilets are also barriers. *Recommendations* – 1. create a self-governing, community-led group, including older people. 2. Identify people who are at risk of being isolated through community networks; 3. create a comprehensive list of activities, services and opportunities available to older people and make it accessible for all; 4. Work with individuals (?volunteers) to make connections to older people who may be isolated / unaware of opportunities; 5. Work with	Many of these suggestions involve making people aware of current offerings and involving them. The social aspect of physical activity is again identified as a key factor in health and wellbeing. It also points to the importance of involving the local community in decisions about their PA preferences and offerings and of tying them to other local community issues, such as transport, toilets and information-sharing.

			volunteering network to act as bridge between older people and available resources; 6. Recruit older participants to help build a sustainable locality-based network.	
Johnson et al. (2018). Effect of an 8-Week Eccentric Training Program on Strength and Balance in Older Adults	Tennessee, USA. Evaluation study of changes in balance and strength in older adults (N=14), following an 8-week (2x per week lasting progressively from 3 – 10 minutes) eccentric exercise (recumbent seat with step-like pedals that work antagonistically – participant only resists oncoming pedal) programme (2 x 5-10 minute sessions per week)	8 women and 6 men with a mean age of 64 years. Exclusion criteria included a history of falling, hip surgery in the last year; medical clearance needed if surgical intervention of the hip, back or knee in previous 3 years	Static balance and strength measurements improved significantly.	This is a small study with little generaliseability, but suggests this machine, with training, might be a useful addition to a gym routine for older people.
Kinnafick et al. (2021). Is walking netball an effective, acceptable and feasible method to increase physical activity and improve health in middle- to older age women?: A RE-AIM evaluation.	England, United Kingdom. A programme of walking netball (WN) [45-60 minutes per week or fortnight, in indoor settings] was offered via the Women's Institute in England, reaching 1.4% of the WI population (N=3148). 87.7% of the WI groups who participated continued past the 20-week. programme. England Netball started as WN hosts, subsequently identifying, recruiting, mentoring and training WI members to become WI hosts. Resources were provided to support this initiative until COVID-19 intervened. Quasi-experimental study of WN members and those put on the waiting list. Quantitative data collected on gait function, functional movement, muscular strength and physical fitness;	Surveys were completed by 859 WI members, but by the 12-month follow-up, the number was 158 (19.1% response rate) Age groups of 45-60 and over 60 years. Most were married, but even in the younger age group, less than 30% were employed. Overwhelmingly white British.	Significant improvements were found in mental health and wellbeing, loneliness, physical function and pain. Physical activity significantly increased, as did gait speed, sit and stand ability, balance scores and TUG functional ability, as well as fitness (6M walking test), compared with the control group. Participants felt it reduced stress and promoted social support. Finding and funding an appropriate sports hall was a barrier, as was confidence to become a WI host, but the training itself, which was practice and theoretical, was well-evaluated. Again, the host was seen as being key, particularly in being welcoming, fun and inclusive, but over-competitive members and injury or fear of injury were	While this is one way of building PA into the structure of another organisation, it may need more financial and practical support in order to make it more accessible through the country. WN clearly had significant physical and mental benefits for participants.

	qualitative data collected by telephone interviews and face-to-face focus groups.		barriers to success. WN did provide a sense of self-efficacy.	
Lera-Lopez et al. (2019). How the relationship between physical activity and health changes with age.	Spain. Multivariate analysis of links between PA and self-perceived health (SPH) and whether the intensity of PA affects it. Used data from Spanish National Health Survey (NHS), linking it to questionnaires measuring PA (International Physical Activity Questionnaire - IPAQ short) and SPH or health-related quality of life (the European Quality of Live 5 dimension questionnaire – EQ-5D). N = 14, 456	Gender was representative of the Spanish population in terms of age, gender and urbanisation. Gender, BMI, disease and use of healthcare services were controlled for in the analysis.	The amount of PA undertaken is positively associated with SPH, but it is moderated by age. However, although the level of SPH decreases with age, the relationship between PA and SPH becomes stronger, suggesting PA becomes increasingly important for SPH as we age. Walking activity has a stronger positive relationship with SPH among people aged 50-69 than those aged 40-49. Walking and moderate PA is strongly associated with SPH in people over 49.	Encouraging walking groups, providing green infrastructure with good access and promoting walking in people over 50 is likely to promote better perceived health.
Lindsay-Smith et al. (2018). A mixed methods case study exploring the impact of membership of a multi-activity, multicentre community group on social wellbeing of older adults.	Victoria, Australia. Longitudinal mixed methods study, measuring loneliness and social support at baseline, 6 months and 12 months (N=28) and a qualitative focus group study (N=11) – FG1 (N=6) – PA in their life activities clubs (LAC); FG2 (N=5) – non-PA focus in LACs	*Survey* - Mean age was 67, 75% were female. 2/3 of participants were not married. Almost 90% described themselves as in excellent health. *Focus groups* – four of 6 in FG1 were women; all 5 in FG2 were women. Mean age 67. PA groups included walking, table tennis, dancing, exercise class, bowls, golf cycling. Non-PA groups included book groups, social groups, craft or cultural groups, mah jong, cards. A number of people took part in more than one activity.	Survey - Social support increased over time and loneliness decreased. *Focus Groups* – increase in social network and social connectedness; helpful during significant life events such as retirement, illness or death of a spouse, moving house. Having a coffee together after the meeting strengthened the social nature of the club. Friendships developed. Also, some leadership and responsibility made people feel their activity was meaningful and valued. Some felt they gained social support in terms of skills and emotional support from other members. They felt less lonely and had improved relationships at home and improved their social skills through opening up and becoming more	Membership of groups with different activities probably increases the chances that people have of finding others that they have something in common with, which then enables them to feel more supported and to develop friendships and feel less lonely. This is worth considering when planning group physical activities – the importance of promoting a supportive group network and building choice into offerings.

			accepting of others who are different.	
Matson et al. (2019). Changes in Self-Reported Health and Psychosocial Outcomes in Older Adults Enrolled in Sedentary Behavior Intervention Study.	Washington State, USA. RCT comparing self-reported health outcomes and psychosocial factors related to sedentary behaviour for EG (I-STAND intervention) and CG (self-study workbook on age-appropriate health topics) in older adults (60- 89) with BMI >/= 30kg/m^2 (N=53)	Participants 68% female, 87% white, mean age of 68, mean BMI of 36. 7 lost to follow-up.	No significant differences in mean changes across self-reported health outcomes or psychosocial effects on sedentary behaviour apart from self-efficacy and sedentary habit strength, both of which improved in the EG (they felt more competent in mobilising more, and felt that sitting was less habitual).	It is important to build non-sedentary habits into interventions that strengthen movement behaviours outside of classes.
R. A. Merchant et al. (2021). Community-based peer-led intervention for healthy ageing and evaluation of the 'HAPPY' Program	Singapore. Evaluation study of Healthy Ageing Program for You (HAPPY, a community-based exercise programme for older adults to promote healthy ageing including cognitive and physical function. Participants undertook functional status, physical activity, social network and physical performance assessments and then took part in classes (60 minutes, once or twice weekly) that included 40 minutes of cognicise – multicomponent exercise incorporating physical, cognitive and social activities. The exercise incorporated low to moderate intensity circuit and resistance training. Assessments made at baseline and 3-month follow-up.	Participants were screened to include only those who were pre-frail, frail or had cognitive impairment, but not those who had dementia, depression, weight loss, vision impairment or falls. The coaches were trained. Cognition was measured using the MoCA score.	There was a significant improvement in the MoCA scores, thus cognitive impairment was reduced. There was a significant improvement in social support scores and reduction of social isolation. There was also a significant improvement in perceived health. The prevalence of moderate to extreme depression or anxiety on Euroqol-5D reduced by 30%. There was a significant increase in the number of robust older adults and a reduction in mean FRAIL scores. The prevalence of 1 or more falls reduced significantly from 29% to 10%.	While parts of this intervention might not transfer culturally, the concept of incorporating games into physical activity to make it more enjoyable and perhaps mentally challenging might be adopted for at least some activities on offer.
Moore et al. (2019). An observational assessment of park-based physical activity in older adults in Nanchang, China	China. Audit of community parks in Nanchang, China, using Community Park Audit Tool (CPAT) and the System for Observing Play and Recreation (SOPARC) to assess park features, PA levels and primary activities IN=40.469 older	The smallest park was 3.5 hectares, with the largest being 32.6, but most were under 10 hectares. Only one had a playground, there were not basketball courts or baseball fields,	The quality of the parks was high, with no observed vandalism, animal waste, threatening persons or dangerous spots. All parks were aesthetically pleasing with trees, meadows and artistic features.	Making parks more accessible for older people by improving access to nature, providing benches, walking paths, clean toilets and better lighting and security might encourage more outdoor activity.

	adults across 8 parks). Parks were observed 4 times per week, including weekends, 4 times per observation day, over a period of 3 weeks.	one pool, 3 badminton courts and 5 lakes. 54% men, 46% women observed. More observations were made in lower temperatures and better air quality.	33% of older adults took part in organised activities. Overall, 49% of observed older adults were sedentary, 36% were moderately active and 16% were vigorously active. Women were less likely to be sedentary than men (37% v 58%), and more likely to do moderate PA (37% v 35%) and vigorous PA (26% v7%) than men. The most common activity was walking (23% overall) with dancing popular among women (26%) and both sexes using exercise equipment (8%) and performing tai chi (10%). Sedentary activities included mah-jong, card games and dice (16%) and sitting (14%).	
Mustafa et al. (2022). Five weeks of Yuishinkai karate training improves balance and neuromuscular function in older adults: a preliminary study.	Victoria, Canada. Evaluation of 5-week karate training programme for older adults (N=16) particularly related to dynamic balance. Baseline tests of dynamic balance on a balance board, functional capacity using the TUG test, grip and ankle strength, and reflexes.	8 male and 8 female participants, aged 59-90, with or without chronic conditions.	There was a significant reduction in dynamic balance reaction, but no change in the TUG test. Leg and arm strength significantly increased. There were no overall changes in reflex excitability.	Improvements in postural control are likely to lead to falls reduction. Martial arts are holistic, whole-body integrated exercise programmes for mind-body health and wellbeing. Not a large enough sample to be generalisable.
Nau et al. (2021a). Promoting adherence to organised physical activity among socially disadvantaged older people	Sydney, Australia. Semi-structured interviews and focus groups of stakeholders (community service providers (CSPs) [N=30] and older person participants [N=42]) to explore facilitators and barriers to participation in organised PA for socially disadvantaged groups of older people.	Of the older person participants, 38 were female and 4 male; 33 were single and 8 living with a partner; 21 spoke English at home, 21 spoke another language; 26 had a medical condition that limited physical activity. The mean age was 76.	Health problems, whether diagnosed as mainly physical or mental health symptoms, often prevented continuation of group PA. Providers emphasised the importance of a flexible approach to allow activities to be modified for participation by people of all abilities, including disability. There can be social barriers to attendance, but where the PA group provides social support, this can help. Cultural sensitivity by	Creating a warm, friendly, stigma-free environment for PA that is accessible to all levels of ability is more inclusive and more likely to promote adherence to PA. The social aspects of PA are important for health, wellbeing, satisfaction and adherence.

			becoming informed about a participant's language or culture was seen as important, particularly if they were a large part of the group. Having a non-judgemental instructor who made people feel welcome was very important; stigma or rejection at previous PA providers can be generalised and create a barrier to PA. A sense of belonging fostered by being asked to tea or coffee after a class was seen as important. Instructors keeping tabs on people to make sure they are included was seen as important. Some providers texted or called people if they missed a class, particularly for homeless or older people or those with mental health or social isolation problems. Participants tended to enjoy activity in a community space or in natural settings. Fun, laughter, friendly challenges, positive reinforcement (even certificates) were seen as making PA more enjoyable.	
Outayanik et al. (2017). Effects of a Physical Activity Intervention Program on Nutritional Status and Health-Related Physical Fitness in Thai Older Adults: Pilot Study	Thailand. Pilot study of the effects of the Nine Matrices Exercise Program (NME) – a combination of stretches, aerobics and bodyweight exercise - on the nutritional status and physical fitness of older people (N=15). NME performed 5 x per week. Baseline and after 8-weeks assessments of BMI, blood pressure and physical function were made.	11 females and 4 males, aged 61-75 took part.	There were significant improvements in body weight, BMI, cardiorespiratory fitness, limb and lower back strength, flexibility and balance. Blood pressure did not change significantly.	Combined stretching, aerobic and bodyweight exercise appears to be beneficial to BMI, cardiorespiratory fitness and body strength, but this is a small, non-generalisable study. It supports other data to show that mixed PA within group setting is effective in fitness for healthy ageing.

Pettigrew et al. (2019). Encouraging older people to engage in resistance training: a multi-stakeholder perspective	Western Australia. Qualitative interview and focus group study with resistance training (RT) instructors (18) health practitioners (8), policy makers (29) and seniors (24) to inform strategies for making resistance training programmes attractive to and appropriate for older people. Individual interviews (N=42) and focus groups (4 groups, N=37) were conducted with 79 Western Australians.	67% of RT instructors, 63% of centre managers, 75% of other RT practitioners, 80% of policy representatives and 79% of seniors were female.	RT was perceived as unknown, more difficult to do, and perhaps less convenient than walking, although others also preferred swimming, dancing and cycling. Because resistance training involved equipment it meant leaving the home and going somewhere else to access it. Resistance training was something that many older people were not familiar with and was seen as being for other population groups, associated more with body building than achieving and maintaining functionality. Instructors were more aware of the importance of explaining about how it promoted bone strength. Most older people needed individual attention to get them started on resistance training activities, wanting guidance that was tailored to their health history, exercise experience and health status and to ensure they had correct technique. Instructors identified the importance of small groups to allow for this, while seniors commented on the lack of progress without feedback. Social interaction is important, but individual attention is also important for RT. Gym work was often seen as repetitious and boring, while walking could provide variation in scenery and companion. Some people found the trainers did not understand their needs and were very young /	Some good points, but while it is clear that RT is important, earlier points about the social setting, accessibility, reduction of stigma, adjustment to individual levels of ability and making exercise fun are all important in the group PA provision.

			inexperienced. Large centres could be alienating and noisy, as well as a bit stuffy compared with the fresh air. Gyms were also seen as very costly. Caring responsibilities and health problems meant that older people wanted more flexible attendance – and pay as you go rather than annual memberships, although centre managers did not find this practical. Trainers and policy makers perceived the need for more education campaigns to persuade older people of RT's benefits for functional fitness. Seniors suggested the importance of integrating RT with other activities. Other strategies to increase participation in RT included opportunities for social interaction embedded in the sessions, e.g., teach and coffee at the end of sessions; regular outings or seminars.	
Ratz et al. (2020). Effects of two web-based interventions and mediating mechanisms on stage of change regarding physical activity in older adults	Germany. Older adults (N=351) undertaking a 10-week online PA programme, randomly allocated to 3 groups: IG1 – subjective PA monitoring via online diary (N=126); IG2 – as IG1 + activity tracker (N=108); CG – on waiting list (N=117). Older adults completed questionnaire on PA activity change. The programme advised moderate endurance training at least 150 minutes per week and strength training and balance twice a week. IG groups were supported by a weekly group meeting to support the	Ages 62-78. Needed to be able to live, walk and take part in assessments independently and not have cognitive impairment. Over half already exercised aerobically for at least 150 minutes per week.	Interestingly, PA did increase in both intervention groups, but IG1 showed a significant increase in endurance and strength PA, while IG2, with the activity tracker, was only significant for strength training.	The mean dropout rate was 31.2%, which is quite high, but it was significantly higher (around 40%) in the IG2 group, suggesting use of technology and time commitment both decreased adherence – 19 of the 79 dropouts from that group did not like the technology. Face-to-face meetings were included, which may have prevented even higher dropout rates. The participants had a high activity level already, so less active individuals might struggle with adherence to online fitness materials.

	programme and carry out the exercises together.			
Ratz et al. (2022). Distinct physical activity and sedentary behavior trajectories in older adults during participation in a physical activity intervention: a latent class growth analysis	Germany. (N=242). Randomised interventions – print-based – PA diary and exercise brochure (PG1)(N=113); web-based (same programme delivered online with smartphone app (WG2) (N=192); web-based plus activity tracker (WG2). PA mostly home-based, but: First phase, 10 weekly group sessions with 60 minutes PA and 30 minutes health education. Then 4 health education group sessions offered in following 6 months. Dropout rate 40%. Primary outcome was measure of moderate-vigorous PA (MVPA)	Cognitively healthy and independent older adults.	The PA was mainly stable over time, suggesting that older people tend to maintain their baseline level of activity with home-based activity interventions.	Again, this supports the idea that PA interventions need to be group-based, inclusive and supported by instructors who are knowledgeable and have good communication skills
Reddy et al. (2017). Walking football as sustainable exercise for older adults – A pilot investigation	Birmingham, United Kingdom. Mixed methods study (N=20) to investigate the effects of taking part in walking football (EG, N=11), compared with people on waiting list (CG, N=9). One-hour session of walking football a week for 12 weeks.	Aged 50-65 years. Experimental group (EG), had 1 female, 10 males; the control group (CG) had 2 females, 7 males. Included in analysis if they had taken part in 70% of sessions. They had all played football when younger and self-assessed as fit to play.	*Qualitative* data - Fear of being at the right level; ached afterwards because of increased walking; less boring than going to the gym; gives you an adrenaline high; makes you feel more confident; heled to meet people, develop friendships and get you out; self-perceived improvement to health and wellbeing. *Quantitative data* – 65/70 scored overall in Groningen Enjoyment Questionnaire (high); a mean of almost 2.4KM walked per player/game and the PA was "somewhat hard". Blood pressure was significantly improved.	The physical improvement measures showed only one change, a small but helpful improvement as blood pressure is an indicator of cardiovascular health. There was little evidence of cognitive improvement, but then this is a relatively young cohort. The qualitative data suggest that this activity contributed significantly to psychosocial health and wellbeing. Thus, a relatively simple activity to organise and take part in can have significant benefit.
Rehfeld et al. (2018). Dance training is superior to repetitive physical exercise in inducing brain plasticity in the elderly	Germany. Randomised trail (N=52) comparing brain scans, levels of brain-derived neurotrophic factor (BDNF) in the blood as an indicator of learning and memory, cognitive	32 participants (63-80 years) all without neurological conditions, metallic implants, claustrophobia, tinnitus, a BMI greater than or equal to 30, or a systolic blood	Dancers showed more grey matter associated with working memory, cognitive control and attention regulation, as well as proprioception (awareness of body	The participants were all very fit and healthy before the study started but their fitness and endurance still improved. Dancing promotes memory and balance,

	performance and physical fitness between two groups: dance group (EG) and PA group (CG). The PA group undertook strength and endurance exercise that did not vary. The dancing group learned a new dance very two weeks. Both interventions were 90 minutes, twice a week for 6 months.	pressure greater than or equal to 140mmHg, diabetes, intensive physical engagement, abnormal cognitive performance or depressive symptoms.	in space). Dancers showed an enlarged corpus callosum, which facilitates communication between the cerebral hemispheres, which degrades with age, leading to reduced cognitive performance. Both groups enhanced their physical fitness	which is also useful in falls prevention. Dancing may be an acceptable alternative to older people who find gym-based PA aversive.
Richardson et al. (2019). Effects of movement velocity and training frequency of resistance exercise on functional performance in older adults: a randomised controlled trial	Coventry, United Kingdom. A RCT (N=50) with multiple arms comparing once- or twice-weekly high-velocity, low-load (HVLL) exercise with low-velocity, high-load (LVHL) exercise and a no-exercise control group (CG), over 10 weeks.	25 females, 25 males, 60 years or older, without cognitive impairment, acute or terminal illness, heard disease, neuromuscular disease or uncontrolled hypertension, limb fractures in previous six months or resistance exercise in previous six months.	The weekly HVLL condition did not show significant advantage over CG, but there were significant improvements from baseline in chair stands and arm curls In the LVHL weekly group, there were significant improvements in in 8ft. Up-&-Go(s), chair stands 6-minute walk (distance). In the HVLL twice-weekly group, there were significant improvements in 8ft. Up-&-Go(s), chair stands, arm curls and 6-minute walk. In the LVHL twice-weekly group, as well as improvements over baseline there were significantly greater improvements than the control group in chair stands, arm curls and non-dominant grip strength, with just an improvement over baseline for the 6-minute walk. There was a significant improvement in Fat-free mass in LVHL weekly, compared with HVLL twice-weekly. Overall, resistance exercise was more effective than high velocity, low load exercise.	Older people need supervision to benefit from resistance exercise and prefer no more than once a week, so this study explored the minimum dose of resistance exercise needed to produce benefits. While all exercise is beneficial, it is clear that a weekly or preferably twice-weekly resistance exercise programme is beneficial for increased strength and aerobic fitness. Given the need for supervision and increased barriers to undertaking resistance exercise, it is important to review ways in which older adults can be supported to undertake resistance exercise. Swimming is an aerobic exercise with some resistance for shoulders, back and arms, without the strain on joints, so might be considered in addition to strength training.
Roberts et al. (2017). Long-Term maintenance of physical function in older adults following a DVD-delivered exercise intervention	Illinois, USA. Older adults (N=153) randomised to FTB group - 6-month DVD-delivered exercise (yoga and resistance bands) or	FTB (n=84), mean age 70 years, 61 female, 23 male; Control (n=69), mean age 71, 55 female, 14 male. Over 90% white. Had to be low-	There were positive improvements in balance, gait speed and lower extremity strength, which deteriorated over time but were	The changes are small but significant and show the advantage of using different approaches, particularly for those

	attentional Control group, which consisted of a health ageing advice DVD. Baseline measurements repeated at 8-months post-completion. Some telephone support for both groups.	active, aged 65 and older, pass a cognitive screening test and have participation approval from own doctor.	still superior to the control group, even 18-months post-intervention.	who cannot access centre-based exercise. However, they are unlikely to provide psychosocial advantage. The telephone support would be different to the usual use of DVDs, which may well not be as effective without this. Highlights the importance of doing exercise to gain self-efficacy and therefore make future exercise more likely.
Santos et al. (2022). Efficacy of healthy aging interventions for adults with intellectual and developmental disabilities: a systematic review.	Systematic review of 23 articles on healthy ageing interventions for people with intellectual disabilities. N=2,398, 18-86, mean age 44.	Aged 18-86, mean age 44.	Interventions that increased PA generally led to improved fitness and reduced BMI and waist circumference, except for a video intervention; health promotions interventions generally led to some perceived health behaviour change and in specific diabetes programmes to improved self-management of HbA1C (blood glucose levels) in people with diabetes. The social inclusion programmes were effective, including one that focused on transition to retirement, where interventions showed increased participation in inclusive community groups resulting in increased social satisfaction. Multicomponent programmes with PA and health education interventions were generally effective with improved physical performance and psychological status outcomes.	Most of the research was around pre-determined interventions and did not include participants in decisions about their type of activity or health lifestyle intervention. Social inclusion is key to psychosocial health improvements.
Santos et al. (2020). Improving cognitive and physical function through 12-weeks of resistance training in older adults: Randomized controlled trial	Brazil. RCT (N=50) – CG or RT (resistance training) group. RT group performed resistance training exercise for 50-60 minutes 3 x per week for 12 weeks.	Aged 60 or older, physically inactive, absence of clinical conditions; no cardiovascular, neurological or psychiatric illness; sufficient visual and hearing	At completion of the intervention, RT significantly mitigated the drop in some cognitive performance tests and showed an improvement in working memory and verbal	While there are some improvements with a short (12-week) resistance training intervention, the importance of trained supervision is clear. The

		capacity to undertake cognitive assessments; not taking hormone replacement therapy. All sessions supervised by experienced trainers.	fluency, but there were not differences in global cognitive function. There was some improvement in fast-pace gait performance and leg-extension strength, but no difference in 6m walking distance or timed up-and-go (TUG) test.	sessions were group sessions and this was not considered in the study.
Shahtahmassebi et al. (2019). Trunk exercise training improves muscle size, strength, and function in older adults: A randomized controlled trial.	Western Australia. RCT of older adults (N=61) in a 12-week exercise programme, with trunk strengthening / motor control exercises (EG) or without (CG) to test the hypothesis that the EG would have increased trunk muscle size and strength and have greater functional ability than a time-matched supervised walking and balance exercise group alone. For 6 weeks afterwards, participants were contacted to see if they continued with the walking programme (de-training, as it did not involve any muscle training for either group). Outcome measures of ultrasound images of trunk muscles, strength, functional ability and balance were administered at baseline, weeks 6, 12 and 18.	Participants were aged 60 years and over, with a mean age of 70. There were 38 women and 26 men in the original 64 (3 dropped out). The mean BMI was 27. About ¾ of the participants were on medication and almost all were either moderately active or very active.	Both groups improved in functional fitness throughout the programme. At 12 weeks, the EG had increased trunk muscle size compared with the CG, although most of this had gone, except for lateral abdominal musculature after the 6-week walking only programme (by week 18). The EG also had greater trunk strength, which persisted even after the de-training programme. The EG performed better in the chair-stand test from 6 weeks onwards, and at 12 weeks were also better in the other functional ability exercises. That improvement persisted in the 30-second chair stand test and the forward reach test compared with the walking-balance exercise group (CG). Thus,	This study supports the theory that all PA generally has a positive effect on fitness, but by adding resistance exercise to aerobic exercise, there is a greater beneficial effect on strength and functional fitness. While this study did not look at the social effects of group exercise, nonetheless, this was a group intervention with qualified, experienced trainers, which undoubtedly would have had an effect on the adherence of the participants, which was high – 61 out of 64 initial participants completed the programme, with the 3 who withdrew only pulling out due to unrelated health issues.
Shree Ganesh et al. (2021). Role of yoga therapy in improving digestive health and quality of sleep in an elderly population: A randomized controlled trial	India. Comparison study between EG who took part in 3 yoga sessions per week for 3 months and the CG on the waiting list. Self-reported sleep quality and constipation indices were used to measure outcomes.	Participants were aged between 60 and 75 years, were excluded if they had significant disease requiring physical or psychological intervention or used tobacco. There were 48 in each group, with 34 females in the EG and 26 females in the CG. 8 left the waiting group (CG), but none left the EG.	There was a significant decrease in the self-assessed constipation quality of life score in both groups, but it was significantly greater in the yoga group (EG). Both groups also experienced improved sleep, but the yoga group alone showed significant changes in subjective sleep quality, sleep disturbance scores and day time functioning.	Given the common problem of constipation and poor sleep quality in older people, this study shows that yoga can have beneficial effects on health. Again, the group nature of the intervention and its use of qualified instructors will have played a role in the success of the intervention.

Silveira Guimarães et al. (2020). Effectiveness of a Yoga program in improving self-esteem and self-image of the elderly	Brazil. Older people (50-70, N=36) were divided into a waiting-list group (CG) and a yoga training group (EG). The experimental group had 3 x 60-minute yoga classes per week over 3 months. Self-esteem was assessed using a questionnaire administered by a researcher.	The participants had not exercised in the previous 3 months or used medicines that increased self-esteem. Their mean age was 61, no gender information provided.	Scores on the post-intervention group self-esteem questionnaire were significantly higher than the baseline of the EG and the baseline of the CG.	Self-esteem is an important aspect of psychological wellbeing and can be reduced with age, so this study shows a positive effect of yoga on psychological wellbeing in older people. Again, this was a group exercise supervised by qualified trainers.
Sipilä et al. (2021). Effects of physical and cognitive training on gait speed and cognition in older adults: A randomized controlled trial	Finland. Investigated the effects of a 12-month physical and cognitive training (PTCT) on gait speed and executive functions, compared with physical training (PT). Participants were randomly allocated. 314 older participants were recruited, but 23 lost to follow-up, so N= 314. . The PT programme included aerobic, resistance and balance training; the PTCT also included a web-based computer cognitive training programme. Initial training was given on how to use this. The PT programme involved group supervised classes and home training	70-85-year-old men (126 - 40%) and women (188 - 60%) living in a Finnish city who were not physically active, but could walk 500 metres unaided and were cognitively able were included. They did not have any illness or disability that prevented their ability to take part.	Both groups increased their gait speed similarly during the interventions, and there was a significant increase in 6-minute walking distance. Cognitive improvements were seen in both groups, specifically around being able to name colour words that were printed in a different colour (Stroop test) more accurately and quickly, and in mental flexibility tests; in the Stroop test, the PTCT group improved significantly more than the PT group.	This study suggests that cognitive challenge added to multicomponent adds greater advantage to cognitive performance. The participants, although well enough to take part, were not excluded if they had illness or mild physical difficulties that many older people live with, but they were medically reviewed and alterations made to their exercise regime where needed. This makes this study relevant to normative older populations. Again, the social nature of this study and its use of qualified trainers highlights their importance in effective PA interventions.
Stolte et al. (2017). The Theory of Planned Behavior and physical activity change: Outcomes of the Aging Well and Healthily Intervention Program for Older Adults	The Netherlands. Sedentary adults, aged 50-70, in 21 local groups carried out a 6-week health education and exercise programme, *Aging well and healthily* (AWH). There were 6 2-hour sessions per week including health communication and low-intensity PA led by a professional PA instructor. Participants were advised on PA at home as well. Assessments were taken at	There were few limitations other than to be sedentary.	Physical activity at home increased significantly from baseline to the end of the 6-week programme, but then tailed off again. This study aimed to understand the effects of planned behaviour, perceived control and benefits from the behaviour to behaviour change, but relationships were not demonstrated.	Again, it seems clear that interventions where people join a group and received qualified instruction lead to greater adherence and therefore psychosocial benefit than home-based programmes without social events with trained instructors. 387 participants were recruited, but only 194 were followed up for the final interview.

	baseline, 6-weeks and a 4-6 month follow-up. N=194			
Szychowska and Drygas (2022). Physical activity as a determinant of successful aging: a narrative review article	A narrative review of studies (N=22) looking at the relationship between PA and aging and the potential pathways by which PA protects against physical and cognitive decline.	The studies reviewed are large population observational studies in the main, but with two meta-analyses and one case-control study.	Higher levels of PA lead to higher psychological and physical functioning and healthier ageing in older people, as well as to greater satisfaction with their own health and wellbeing, but activity needed to be moderate to vigorous in most studies. Older volunteers engaged in greater PA, and group-based social and PA programmes improved wellbeing and prevented loneliness. Older adults prefer to exercise with others and exercise combined with nutrition interventions improves cognitive function. Loneliness and social isolation in older people leads to lower quality of life and increased healthcare costs.	No clear search strategy. Findings suggest biopsychosocial benefits to group-based PA, which has a beneficial effect on individuals and society.
Thom et al. (2021). Promotion of healthy aging within a community center through behavior change: health and fitness findings from the AgeWell pilot randomized controlled trial	Wales, United Kingdom. Naturally existing group of older adults (N=70, 0ver 50 years) who attended a community Age Well centre (fitness, line dancing, Tai Chi, art, cooking and computer classes, and social gatherings). Half of EG had goal setting, where they set 5 individual behaviour change goals related to physical, cognitive, social activities, health and diet (GS group). Other half of EG were followed up with telephone mentoring. CG attended as normal. All participants had access to centre facilities and resources, choosing their own activities.	Started with 65 females, 10 males. 5 lost to follow-up. Mean age 68 years, range 51-84 years. 43% classified as obese, plus 37% classified as overweight. 56% hypertensive or on hypertension medication. 83% had high cholesterol or on medication to manage it.	Mean attendance was 34 sessions a year, but there was a wide range from 0 sessions attended to 131. Of sessions attended, 30% were PA, 21% were art and craft, 12% were cognitive activities (such as computer lessons). 7 participants attended the centre for 20 or more PA sessions, and they had better flexibility, strength and had attended a greater variety of sessions than the other group. Only 6 participants had attended more than 1 PA session/week over the year. After 12 months, both the GS combined group (EG) and the CG had significantly decreased weight and BMI, while the EG had a decrease in body fat. The	Participation in the community centre, irrespective of chosen activity, was beneficial to health for all participants. Help with goal setting had some additional effects on fitness and physical function. This demonstrates the effectiveness of a wide variety of classes, including PA, being offered in local community centres.

			percentage of those classified as obese had dropped from 43% at baseline to 30%. Diastolic blood pressure had improved more in the experimental group, and alcohol consumption had also reduced more. There was some improvement in sit to stands and balance in the goal-setting (EG) group.	
Ward et al. (2020). "Not everybody's an athlete, but they certainly can move": Facilitators of physical activity maintenance in older adults in a northern and rural setting	British Colombia, Canada. 9 qualitative interviews of older adults taking part in organised, community-based group exercise to find out facilitators for maintaining PA.	Aged 65-69, taking part in community-based exercise for over 6 months, 8 women, 1 man – representative of the cohort. Participants reported 56 minutes per day average moderate to vigorous PA – well above guidelines.	The social aspect of the group was important, with people identifying they had previously felt isolated and had difficulty making friends. The atmosphere and instructors were vital to their attendance – feeling cared about, feeling safe and finding the atmosphere enjoyable. Fear of loss of function increased desire to take part. People wanted to maintain independence and take part in activities, including active holidays, gardening and playing with grandchildren. Winter weather made access difficult – while this is Canada, most of this still applies in the UK. Having knowledge of indoor and outdoor facilities in the community was important, not just in the centre. Enjoyment in the activities was important to encourage them to schedule them as a priority.	Colder climes and more rural communities have greater barriers to group-based PA, so instructors and the community had to adapt to these. Welcoming, knowledgeable and supportive instructors were very important as was the range of potential activities and settings. Enjoyment rather than competition seems to be key to continued engagement, and awareness of the link between PA and ageing well is important. Providing information about accessible information about PA opportunities present in the community during different seasons is important. Community-based approaches seem to be more effective in engaging people.
Yoshiko et al. (2018). Effects of 10-week walking and walking with home-based resistance training on muscle quality, muscle size, and physical functional tests in healthy older individuals	Japan. Older adults (N=64) joined 10-week home-based individual walking programme (at least 2 x 30 minutes' walk at normal speed per week, with a goal of 10,000 steps every day) using a pedometer	31 in W-group (16 men and 15 women, mean age 72); 33 in WR-group, 12 men, 21 women, mean age 73). Both groups achieved their intended PA targets. No disease and not currently involved	Both groups achieved greater leg musculature, but WR-group had a significantly larger improvement than the W-group. Only the WR group lost significant amounts of subcutaneous fat. Both groups	Resistance training is more effective in promoting muscle mass, which may have a beneficial effect on preventing Type-II diabetes, but both groups showed an improvement in strength and

	(waking or W-group), some with additional home-based resistance training exercises (3 x 30 minutes per week), who received an initial training session and DVD (including chair stands, hip flexions, calf raises, lateral leg raises and sit-ups – Walking and resistance group, or WR-group)	in fitness training. However, they did have an unusually high natural level of exercise prior to the study.	achieved significant improvements in sit-ups and sit-to-stands, with the latter being further significantly improved in the WR-group. The WR-group were statistically better at the 5-m maximal walk at baseline, with no significant improvement, but the W-group did improve their performance on this walking speed test.	functional fitness. Consultations every 2 weeks would have contributed to the commitment and understanding of the participants.

3.2. Endurance Training or Aerobic Exercise *v* Resistance Training or Strength Exercise

Several studies looked at the benefits of and barriers to either endurance training (ET) / aerobic exercise / low impact exercise or strength exercise / resistance training (RT) / high impact exercise, either individually or in direct comparison (Blain et al., 2017; Bouaziz et al., 2020; Cunha et al., 2019; de Camargo Smolarek et al., 2019; Fiorilli et al., 2022; R. Merchant et al., 2021; Pettigrew et al., 2019; Richardson et al., 2019; Santos et al., 2020; Shahtahmassebi et al., 2019; Yoshiko et al., 2018). Other studies looked at the effects of combined training (Batra et al., 2019; Borbón-Castro et al., 2020; Gambassi et al., 2017; Outayanik et al., 2017).

3.2.1. Benefits of endurance training

A large study of older women (Blain et al., 2017) found that the participants who took part in two supervised moderate-intensity walking sessions a week and walked on their own once a week showed a significantly higher six-minute walking distance and lower BMI after six months than the control group, who were given freedom to be as physically active as they wished. Even though adding trunk exercise training to a 12-week exercise programme did produce greater trunk strength and functional ability that persisted six weeks after the programme, the endurance exercise only group still improved in functional fitness (Shahtahmassebi et al., 2019).

3.2.2. Benefits of resistance training

In a meta-analysis of 15 randomised controlled trials (Bouaziz et al., 2020), totalling 480 participants, comparing the effects of high intensity interval training (HIIT) with endurance training (ET) on peak oxygen uptake (a measure of cardiorespiratory fitness) showed that both ET and HIIT programmes significantly increased in training programmes lasting from four to 28 weeks, with a typically frequency of three times a week. Moreover, in the three studies that directly compared the two types of programme, the improvement was significantly greater in the HIIT group. In an older women's resistance training (RT) programme, three times a week for 12 weeks, Cunha et al. (2019) found that the only significant improvements were reduced triglyceride levels and low-density lipoprotein cholesterol. However, since these are important predictors of cardiovascular disease, it does suggest that resistance training has a protective effect in reducing the risk of cardiovascular disease. While RT programmes do not always lead to significant global improvements, specific improvements such as better fast-paced gait performance and leg-extension strength have been found (Santos et al., 2020). By recruiting older overweight women to a 12-week strength training circuits programme (frequency not specified), de Camargo Smolarek et al. (2019) found that their functional capacity and cognitive function improved, but there were no significant changes to BMI. One of the strongest studies (Fiorilli et al., 2022) carried out an RCT of high-impact, aerobic exercise versus low-impact stretching and balance PA in older adults over 24 months (with three one-hour sessions a week). The high-impact group maintained a good physical quality of life and improved nutritional behaviours over two years, while the low-impact group had a reduced physical quality of life and worsened their nutritional status. However, some low-impact exercise can incorporate aerobic exercise. In a 10-week intensive walking (individual, using a pedometer) programme (Yoshiko et al., 2018) adding home-based resistance training exercise improved leg musculature gain more than the walking group, although both were significant. The resistance group also improved in

sit-up and sit-to-stand performance even more than the walking group. Only the added resistance group lost significant amounts of subcutaneous fat.

3.2.3. Barriers to resistance training

While carrying out sufficient exercise of any kind to improve physical health and function is demanding, resistance training is generally associated with body building by older people, and it often seems to need individual instruction and supervision, whereas vigorous walking does not need specialist equipment or travelling to a centre (Pettigrew et al., 2019). In particular, they want guidance that is tailored to their health history, exercise experience and health status, and to ensure they have the correct technique, requiring small group sizes. (Pettigrew et al., 2019). Given the need for supervision and increased barriers to undertaking resistance exercise (Richardson et al., 2019), effective instructors and encouragement to learn simple RT (without specialist equipment) might be helpful, as well as including some RT as part of all PA programmes.

3.2.4. Effectiveness of combined programmes

PA generally has a positive effect on fitness, but by adding resistance exercise to aerobic exercise, there is a greater beneficial effect on strength and functional fitness (Shahtahmassebi et al., 2019). Batra et al. (2019) carried out a study of 1295 participants aged 60 years and over, taking part in community-based stretching, balance, aerobics and strength-based exercise programmes, in 222 group settings, where the programme lasted at least four months. They found a significant improvement in self-rated health status and a reduction in falls. Participants also showed a significant improvement in the number of chair stands and arm curls completed in 30 seconds, and in the time taken to walk eight feet from their chair and return. In a small-scale study (Batra et al., 2019) older Mexican adults, mostly female, had significantly improved systolic blood pressure after taking part in a 12-week combined exercise programme compared with those in arts and crafts clubs, but that is not an unexpected result and is not compared with a single-exercise intervention. Gambassi et al. (2017) also found (in a small study of 17 older women) that a 50-minute combined training programme (three times a week for eight weeks) resulted in a significant improvement in older women's ability to walk 10m more quickly and to go from lying down to standing more quickly and to perform more sit-stands in a given time. These are important skills for older people to maintain their independence and look after themselves, so this is a promising finding. However, the intervention is a long time-commitment and is reliant on a qualified instructor. In a similar small-sample study (15 older adults), Outayanik et al. (2017) found that a combination exercise programme (five times a week for eight weeks) led to significant improvement in body weight, BMI, cardiorespiratory fitness, limb and lower back strength, flexibility and balance, but not blood pressure. Again, however, this is a very significant time and attendance commitment, also requiring a qualified instructor.

3.2.5. Benefits of specific PA

While only one study focused on the effects of Tai Chi on older people with dementia, taught (2-4 times a week for six months) in a group setting (Alin et al., 2020), another was exploring the use of a home-based multi-component exergame for home use (three times a week for eight weeks), that included a Tai Chi component as well as dance and cognitive exercises (Adcock et al., 2019) in healthy older adults. Some of the taught Tai Chi participants were shown to improve individually in

terms of function and quality of life, but not all, while the exergame participants showed only minimal physical or cognitive gain. The taught group (Alin et al., 2020) had the benefit of trained supervision and a longer time period (six months rather than four), but it was a small (5 participants) study of people with existing illness who would normally go through variations in their ability anyway. The exergame group had less supervision, a shorter intervention and other elements to the intervention, but it was still a relatively small group to show significant results (21 participants), and the inclusion of other elements makes it difficult to know which findings relate to which aspects of the game. However, given that Tai Chi combines balance and some strength exercise that might aid fall prevention (although no more effectively than other standing and dynamic balance exercise) (Nyman, 2021), and that quiet repetition can be calming, some people might find it a desirable choice. Yoga is another form of standing and dynamic balance exercise that is thought to promote physical and psychological wellbeing (Shree Ganesh et al., 2021; Silveira Guimarães et al., 2020). In a study of older people who took part in three yoga group sessions a week for three months, the participants reported a decrease in self-assessed constipation quality of life compared with the control group, as well as significantly improved sleep scores, including subjective sleep quality, sleep disturbance and daytime functioning (Shree Ganesh et al., 2021), while Silveira Guimarães et al. (2020) found that self-esteem was significantly improved in previously inactive people who took part in a yoga training group three times a week. Since self-esteem is an important aspect of psychological wellbeing and can be reduced with age, this study shows a positive effect of yoga on psychological wellbeing in older people. This finding is supported by a review of the effects of literature on health-related quality of life and mental wellbeing (Tulloch et al., 2018) that found yoga was beneficial for both, but was unable to establish it as being better than other types of PA for this. Again, however, yoga might appeal to some people over some other types of PA.

Martial arts such as judo and karate have been explored in relation to healthy ageing, but there are few studies related to novice learning in that age group. Ciaccioni et al. (2019) found that, of those participants healthy and fit enough to take part (40 out of 75), a four-month beginner programme significantly improved chair sit-and-reach, back-scratch, chair stand and arm curl tests (in other words, functional abilities and upper limb strength), but did not help with body dissatisfaction. As only 30 participants completed the programme, it may be that this is not a PA suitable for all tastes and abilities, but it could appeal to those for whom less combative sports are unappealing. A small (16 older adults) study (Mustafa et al., 2022) of a five-week karate training programme found that it improved postural control but little else, in what is a very short time-period. However, although this is not a generalisable study, it does suggest another option, in addition to tai chi, yoga and other balance-related PA, for interventions that have the potential reduce falls risk in older adults. Similarly, an eight-week, twice-weekly programme training people in the use of an eccentric recumbent pedal machine has been shown, in a small study of only 14 older adults, to enhance both static balance and strength (Johnson et al., 2018). So, if machine-based circuits are offered as part of a PA programme for older adults, this might be a useful machine for inclusion. However, some older people are not keen on strength training (Pettigrew et al., 2019), while many older people enjoy dance, and two small studies found that dance improves both fitness and endurance as well as balance (Da Rocha et al., 2018; Rehfeld et al., 2018).

Exercise in nature is highly valued (Nau et al., 2021a), and while swimming in the sea is not particularly accessible in the northern United Kingdom, a qualitative study on the benefits of belonging to ocean swimming groups in Australia does have some useful insights into what older people want from their PA groups (Costello et al., 2019). Outdoors exercise produces a sense of

freedom and calm, but is less boring than repetitive indoor exercise. Swimming is a low-impact exercise that helps to maintain a healthy weight and blood pressure, as well as fitness and immunity, so even though our outdoors access is limited, developing older swimming clubs and communities could be a useful way to promote an enjoyable and healthy PA, while at the same time promoting social engagement for older people Walking is a common (Moore et al., 2019), often pleasurable (Nau et al., 2021b), low-intensity exercise that helps to reduce non-sedentary behaviour outside of exercise classes (Matson et al., 2019), but there is evidence that higher intensity walking is associated with higher self-perceived health in older people (Lera-Lopez et al., 2019). Indeed, gait speed is often used as an outcome measure of fitness (Outayanik et al., 2017; Sipilä et al., 2021). One study measured the effects of a supervised moderate intensity walking programme on walking endurance in sedentary women over 60 years of age, all of whom had a lower-than-normal six-minute walking distance (6MWD). After a six-month programme of two supervised moderate-intensity walking groups per week, plus an unsupervised walk once a week, the walkers showed significantly increased 6MWD, with the greatest improvement in those with the highest BMI and lowest walking endurance at baseline measurement (Blain et al., 2017).

Walking football, on the other hand, is generally an organised and supervised activity, intended to be a low-impact version of football that provides mental stimulation and social interaction as well as other physical benefits (Cholerton et al., 2020; Cholerton et al., 2021; Reddy et al., 2017). An interesting study reported in two papers by Cholerton et al. (2020); (2021) highlighted some of the potential strengths and limitations of this type of PA for older adults, including happiness and improved physical and cognitive health. It seems to have been a favoured option for those who had suffered injury or health problems that prevented them from playing soccer, and was seen as more achievable. However, some women found its perceived masculinity off-putting and where some male participants did not pass the ball to women or ran instead of walking, this resulted in others, particularly women, feeling excluded and fearful of injury or excessive fatigue (Cholerton et al., 2020). A programme to introduce walking netball to Women's Institute (WI) members, via a training programme for member volunteers who then supervised the activity within their local WI group, was unfortunately halted by the COVID-19 pandemic (Kinnafick et al., 2021). Nonetheless, for those who took part (just once a week or fortnight for 20 weeks), it did improve levels of PA, gait speed, sit-to-stand ability, balance scores and timed up-and-go (TUG) functional ability. Participants also felt it reduced stress and promoted social support. However, finding and funding an appropriate sports hall was a barrier, as was the confidence to become a WI walking netball host.

3.3. Psychological effects of exercise – cognition, self-esteem, affect

Strength training has been shown to improve cognitive function (using the Montreal Cognitive Assessment [MoCA] (de Camargo Smolarek et al., 2019). An evaluation (R. Merchant et al., 2021) of the Healthy Ageing Program for You (HAPPY), a community-based programme to promote healthy ageing, that includes multicomponent exercise (low-to-moderate-intensity circuit and resistance training) , incorporating physical, cognitive and social activities, showed a reduction in cognitive impairment (MoCA score), and the prevalence of moderation to extreme depression or anxiety was reduced by 30%. While a resistance training exercise programme (three times a week for 12 weeks) did not show any improvement in MoCA scores, there was significant improvement in some cognitive function tests that suggested it did help with cognitive function (Santos et al., 2020). While directly comparing dance movement classes with aerobic exercise training has shown that they both

offer similar improvement in cognitive functioning (Esmail et al., 2020), dance training that involves learning new dances has been show to improve memory and balance more effectively than generic strength and endurance exercise classes (Rehfeld et al., 2018). This suggests that gym-based PA or movement classes, while important as part of a programme of activity, might not be sufficient, on their own, to promote the best overall health outcomes. One qualitative study emphasised the importance of having a positive attitude in order age healthily, suggesting that this might be fostered by the right kind of community PA approach as well as offering (Glover et al., 2020)

A study that looked specifically at enhancing perceptions of ageing, using cognitive behavioural therapy (CBT) to replace negative thoughts on ageing with more realistic, neutral or positive ones, found that while a 12-week group exercise programme was effective in improving physical performance, only the participants who had experienced the CBT improved their self-perceptions of ageing (Beyer et al., 2019). This could have important implications for instructors on how they communicate with older people, setting goals and valuing effort and achievement. However, a review (Szychowska & Drygas, 2022) and several studies have noted improved psychological health and wellbeing for older people taking part in exercise programmes without specific psychological interventions. For example, in a study of 23 adults aged 65-73 who took part in three fitness sessions a week for a year, there was significant improvement in health and emotional status on a self-report health questionnaire (Bidaisee et al., 2020), while even a four-week programme of education and PA showed significantly more positive views and expectations of ageing as well as motivational self-efficacy (their belief that they could and would exercise more) (Brothers & Diehl, 2017), a finding shared by in a study that aimed to decrease sedentary behaviour in older adults (Matson et al., 2019). A greater sense of self-efficacy, that generalised to other areas of their lives, was also found among the ocean swimmers (Costello et al., 2019) and the walking footballers (Cholerton et al., 2020), with the activity itself being fun and a respite from their daily lives (Cholerton et al., 2021).

The walking netballers also reported significant improvements in mental health and wellbeing, despite already belonging to a social group (the WI) (Kinnafick et al., 2021). Walking itself is strongly associated with health-related quality of life, particularly in people aged 50 years or over (Lera-Lopez et al., 2019). Taking part in three yoga classes a week for three months significantly improve the self-esteem of the participants, aged 50-70 (Silveira Guimarães et al., 2020). In a review of PA for people with intellectual disabilities, increased PA generally led to improved psychological status outcomes (Santos et al., 2022). Enjoying the activity was also important from a motivational perspective (Thom et al., 2021).

3.4. Group-based activity versus home-based activity

From the small number of homebased activity interventions included in this study, most of them had a significant amount of external support and, where there was reliance on information technology or specialist equipment there was often some resistance or difficulty with this and adherence tended to be lower than in the face-to-face interventions (Geraedts et al., 2021). In the studies that reported feedback, many advantages were identified with group activity, even though there were several barriers identified that made regular attendance more difficult.

3.4.1. Social networks, friendships and social support to reduce isolation

Teams games such as walking football engendered a sense of belonging and enhanced social support, provided there was acceptance of all abilities and team cohesion (Cholerton et al., 2020). The ocean swimmers felt aided by the group, who looked out for each other, and enjoyed the intellectual stimulation of diverse conversation, the joint celebrations and shared confidences. They felt the regular swim and coffee meetings gave them a sense of purpose and prevented social isolation (Costello et al., 2019). Older people want activities that have meaning for them and give them a chance to socialise and help get them "out of the house" (Dare et al., 2018, p. 876), particularly important for people who had moved house in later life, again preventing social isolation. This highlights the importance of the social aspect of PA interventions for older people, echoed by the people in (de Lacy-Vawdon et al.)'s 2018 study of facilitators of attendance in PA activities. While group PA was seen as key to addressing loneliness and social isolation, loneliness was also seen as a barrier to participation (Glover et al., 2020)– presumably related to issues such as motivation, transport, confidence and being made aware of services. Social engagement was thought to encourage better eating, drinking and movement, which in turn led to better sleep. It was suggested that people who are at risk of being isolated need to be identified through community networks and that a self-governing, community-led group including older people should be created to act as a bridge between older people and resources. (Glover et al., 2020). A study of a multi-activity community centre showed that social support increased over time and loneliness decrease, so it is important to focus on social activities and after-group drinks as well as PA (Lindsay-Smith et al., 2018). Not only does group PA reduce isolation, but it also the social aspect of the group increases the motivation to keep taking part (Ward et al., 2020)

3.4.2. Adherence

Some group-based interventions produced significantly better outcomes than, say, advice to walk, but this may well have been because of the group nature of the activity (Blain et al., 2017). For instance, belonging to a team kept the walking footballers attending (Cholerton et al., 2021) and the ocean swimmers were motivated by the group, looking forward to the coffee and chat after their swim (Costello et al., 2019). Drop-out rates were higher where the intensity of PA was too high or low, so it is important to tailor the effort to each individual – not achieving goals leads to lower self-efficacy and lower adherence; interestingly, men in general tend to prefer vigorous intensity PA, while women generally prefer low-to-moderate intensity PA (de Lacy-Vawdon et al., 2018). It might be helpful, therefore, to offer at least some women-only sessions. Also, disease-specific and physiotherapy-led classes had a higher drop-out rate than general strength classes, while walking and cycling classes had the highest adherence rates, with group sessions being preferred (de Lacy-Vawdon et al., 2018).

3.4.3. Inclusivity of marginalised groups

Shared customs and language were seen as being important in making PA groups welcoming (de Lacy-Vawdon et al., 2018). Some older people felt that they improved their social skills through opening up and becoming more accepting of others who were different (Lindsay-Smith et al., 2018). Fear of not being at the right level can deter people from taking part in PA (Reddy et al., 2017).

Social inclusion programmes for people with intellectual disabilities are effective, where a transition to retirement programme showed increased participation in inclusive community groups leading to increased social satisfaction (Reddy et al., 2017). Older adults prefer to exercise with others and, since loneliness and social isolation in older people leads to lower quality of life and increased healthcare costs, a primary aim of activity for health ageing should be to promote desirable group activities (Szychowska & Drygas, 2022).

3.5. Optimum centre-based offerings and approaches

3.5.1. Suite of offerings

Longer-term classes were preferred by older people as long as they were not locked into membership contracts, as they preferred to pay as they went – this is important as they may still be working irregular hours or caring for extended family or partners. Older people feel that many offerings such as bingo are not suitable for their generation, so traditional senior citizen groups are no longer attractive.(Dare et al., 2018). Above all, classes should be enjoyable (de Lacy-Vawdon et al., 2018). Almost all the studies have shown that there is no one-size-fits-all best activity for individuals, and that some people get bored with one activity, so offering a number of different types of activity, perhaps aimed at specific groups of people, such as women or people who feel differently able to other groups, or perhaps are concerned about stigma. Offering some non-PA classes might be helpful in bringing people into the centre (Thom et al., 2021) and making them aware of PA groups that they could join Where there are multiple offerings, people will often take part in several (Lindsay-Smith et al., 2018), which could help to increase the number of times people undertake PA in a week, an important factor in increasing fitness and seeing measurable health benefits. It also increases the chances that they will meet someone with whom they have something in common, which is another way of combatting social isolation.

3.5.2. Information hub for community activities and accessible outdoor PA settings

People don't always know what is available, especially if they don't have internet access, so it is important that community hubs offer information on all activities and accessible outdoor PA settings for people so that they know where they can find that information (Glover et al., 2020)

3.5.3. Promotion of autonomy

A couple of the qualitative studies highlighted the importance of older people having a say in their activities (Costello et al., 2019; Glover et al., 2020). Being given some leadership and responsibility within community activity hubs made older people feel their activity was meaningful and valued (Lindsay-Smith et al., 2018).

3.5.4. Transport needs and accessibility

Older people wanted local activities that they could access easily during the daytime (when it wasn't dark for driving and walking) and with supportive transport systems (Dare et al., 2018). Making parks more accessible for older people by improving access to nature, providing benches, walking paths, clean toilets and better lighting and security might encourage more outdoor activity (Moore et al., 2019). People tended to enjoy activity in a community space or natural setting (Nau et al., 2021a)

3.6. Instructor skills and qualities

3.6.1. Inclusivity / management of competition / technical knowledge and skills - patience to teach them

The qualities of the instructor in terms of inclusivity and knowing how to teach and having specific skills and knowledge in what they were teaching was important (Dare et al., 2018). Encouraging and conscientious instructors who provided helpful guidance improved attendance and adherence. Good communication skills and trust and confidence in their skills, as well as qualities such as sincerity, patience, empathy, respect, charisma and expertise were identified as important (de Lacy-Vawdon et al., 2018). Creating a warm, friendly, stigma-free environment for PA, that is accessible to all levels of ability, is more inclusive and more likely to promote adherence to PA. (Deneau et al., 2020). It was seen as important for instructors to become informed about a participant's language or culture, even if they could not speak it, in order to show cultural sensitivity; and instructors keeping tabs on people to make sure they are included was also important (Nau et al., 2021a). Novice learners, particularly in strength-based / gym-based routines, needed expert, one-to-one guidance, tailored to their needs, so small groups and skilled instructors are needed for this (Pettigrew et al., 2019)

Instructors were expected to have the necessary training and qualifications to support PA interventions in most of these research studies (Batra et al., 2019; Cunha et al., 2019; Fiorilli et al., 2022; Ratz et al., 2022)

3.6.2. Good communication skills, knowing individuals and setting individualised goals

Even in the quantitative studies, where the focus was on the activity and measurable outcomes, it was sometimes noted that instructors had good communication and interpersonal skills, and were enthusiastic and motivating (Batra et al., 2019). Having a positive attitude towards ageing and challenging participants' negative attitudes is important in motivating them (Beyer et al., 2019), and education on positive attitudes towards ageing can improve self-efficacy and motivation (Brothers & Diehl, 2017). Previous positive experiences of sport are important to encourage future engagement (Cholerton et al., 2020), so it is better to adapt a programme to enable someone to enjoy it rather than aiming for the best physical outcome if the person is not enjoying that.

4. Recommendations

- Set up an information hub at the centre and online and via any other media available – liaise with local stakeholder groups. Use these to publicise timetables, recruit stakeholders to advise and give feedback, promote the use of outdoor areas for PA.
- Set up a continuous feedback system and stakeholder involvement group to explore what works and what does not work for older people. Recruit people from marginalised groups, e.g., people with physical / intellectual disabilities / mental health needs / with different cultural / language needs to advise on specific reasonable adjustments that can be made / promote different cultural celebrations. If feasible, setting up a volunteer system to help with transport and buddy systems, or act as ambassadors for the centres, might be helpful

- While it is important to provide facilities for individuals to carry out PA, the social aspect of PA is a primary goal, so classes and group activities should be the focus
- Where possible, include a variety of skills within a class, to ensure that endurance, strength, flexibility and balance are all addressed. Change routines regularly to ensure that people do not get bored.
- Offer total novice classes to attract people who are not confident to take up a PA – this is particularly important in teaching people how to stretch and use gym machines and equipment and help them to develop a workout that suits them. This should be a series of classes rather than a one-off, preferably with a dedicated trainer who knows people individually
- Employ qualified instructors and ensure they are supported to develop their communication skills / attitudes towards ageing and disability. Getting to know people by name is important. It is also important that they challenge stereotypes and negative ideas about ageing and promoting a positive attitude towards ageing in older people and others around them
- Many activities that are attractive to older people offer health benefits, such as dancing, yoga and Tai Chi
- Aqua-based classes and swimming are useful for offering aerobic and resistance exercise with less joint strain
- Team games such as walking football and walking netball are attractive to some people, provided they are managed to avoid over-competitive play and promote inclusivity of all players
- Use outdoor locations near to centres where possible for activities such as walking and running – supervised walking to increase from low- to moderate-intensity provides extra health benefits, while those who walk more slowly can be accompanied further back.
- Liaise with local government over PA potential in outdoor locations, with a view to improving facilities such as paths, lighting, toilets and security, and provide information about such locations, to encourage autonomous outdoor PA. Also liaise over public transport to support access to PA centres and locations for older people
- Plan classes that adapt easily to different levels of ability and ensure that there is someone available in the class who can help those who are struggling – this may mean an assistant instructor is needed, particularly in large classes
- Offer the same classes at different times of day (but particularly during daylight hours) over the week so that older people can access them and not miss a week if they have other appointments or commitments
- Offer a rolling programme of different activities across the week, including some that are not PA-based to make centres known to and used by a wider number of older people.
- Provide facilities and encouragement to groups to have hot drinks together after classes to facilitate social interaction

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