

# Physical activity for older adults

Evidence briefing

NATIONAL CENTRE FOR  
SPORT & EXERCISE MEDICINE  
WORKING FOR HEALTH & WELLBEING



Loughborough  
University



## Introduction

The number of adults in the population aged 65 and older is growing rapidly worldwide. This shift towards a population with an increasing number of older adults is a consequence of long-term downward trends in fertility accompanied by 25–30 year gains in average life expectancy. In the UK alone, the fastest growing age group in the entire population is those 85 years and over, ie, the ‘oldest old’. With continual growth over the last 25 years, this population group reached 1.3 million in 2007, meaning that today those aged 85 and over represents 2.1% of the total population of the UK <sup>(1)</sup>.

The changing demography associated with increasing longevity has brought about a growing awareness of the physical activity related needs of older adults. In recognition of this, and the growing body of evidence supporting the promotion of physical activity amongst older adults, the 2011 joint Chief Medical Officers’ report Start Active, Stay Active <sup>(2)</sup> for the first time provides guidelines for older adults.

In this evidence briefing we focus upon whole body physical activity involving the large muscle groups. In later life, physical activity occurs in many forms including active transportation, (such as walking to the shops), facility and group based activities, (such as dance and movement classes, swimming, tai chi) and activities of daily living (such as rising from a chair, climbing stairs, gardening and household activities). The predominant activity undertaken by older adults is likely to be regular walking <sup>(2)</sup>.

For the purpose of this evidence briefing, the population group representing those aged 65 and over will be referred to as older adults.



# Older adults evidence briefing

## Summary

The evidence reviewed in this document indicates:

- Physical activity can improve the physical and psychological health of older adults.
- Regular physical activity is associated with the maintenance of functional activities and independence in later life.
- Physical activity can assist in reversing the decline of physical function even in later, later life.
- Prolonged periods of sedentary behaviour may be adversely associated with chronic disease morbidity, irrespective of whether physical activity guidelines are reached.
- While participation in physical activity decreases throughout later life among both men and women, men still remain more active than women.
- A complex range of individual, social and environmental factors influence participation in physical activity by older adults.
- Older adults face a number of internal and environmental barriers to becoming and remaining active.
- For older adults, the health benefits of activity far outweigh the risks.
- Public health guidelines recommend older adults should be active daily and minimise the amount of time spent being sedentary.
- There is increasing evidence to demonstrate what is required from an intervention to successfully increase physical activity amongst older adults.
- Strength, balance and walking are key programme components for interventions in older adults.
- Evidence-based action is required at a range of levels to increase physical activity and reduce prolonged periods of sedentary behaviour amongst older adults.

### Key term – Physical activity

Physical activity is described as “any body movement produced by the skeletal muscles that results in a substantial increase over resting energy expenditure” <sup>(3)</sup>.



# Physical and psychological outcomes of physical activity

A growing body of evidence suggests physical activity plays an important part in preventing diseases and conditions which are the primary cause of loss of function and independence in later life. There is evidence that physical activity in later life is beneficially associated with a range of areas.

## Disease prevention and improvements in symptoms

The preventive effects arising from regular physical activity at recommended levels in later life are at least as strong as those found in middle age for all-cause mortality, cardiovascular disease and type 2 diabetes <sup>(2)</sup>. The evidence is strong that physically active older adults have higher levels of cardiorespiratory fitness and physical function, improved disease risk factor profiles and lower incidence of numerous chronic non-communicable diseases than those who are inactive <sup>(3)</sup>. Even in unfit older adults, low to moderate intensity activities, which are more achievable for those who associate injury and fatigue with strenuous activity, reduce the rate of age-associated decline in various physiological functions such as cardiorespiratory fitness <sup>(4)</sup>. Those who are overweight or obese can gain health benefits from meeting the guidelines for physical activity, even in the absence of reductions in body weight. Physical activity can help to reach a healthy weight; however, additional physical activity above the recommended levels and a reduction in calorie intake through dietary restriction may be required. Maintaining a healthy weight will help older adults retain physical function and mobility <sup>(2)</sup>.

Physical activity can also have a beneficial effect on symptoms caused by several diseases:

- A reduction in joint pain for people with rheumatoid arthritis and knee osteoarthritis <sup>(5-7)</sup>.
- Decreased symptoms of breathlessness for people with chronic obstructive pulmonary disease <sup>(4)</sup>.
- Strength training and combinations of endurance, balance and strength training are most effective at increasing bone turnover in those with low bone density. By increasing bone turnover and slowing age-related osteopenia (bone loss), the point which the disease progresses to clinically significant osteoporosis may be delayed <sup>(8)</sup>.

## Mental wellbeing and cognitive functioning

Physical activity is associated with improved mental health including perceptions of mental wellbeing, increased self-esteem and improved ability to cope with stress <sup>(1)</sup>. It has the potential to alleviate the symptoms of some clinically defined mental illnesses such as depression and anxiety which are common in older age. For example, physical activity may be as effective as medication in its treatment of mild, moderate and severe clinical depression <sup>(9, 10)</sup>. Physical activity also lowers the risk of dementia and improves day to day cognitive functioning <sup>(2, 11)</sup>. Physical activity has been shown to improve the quality and quantity of sleep among older adults which will further improve mental wellbeing <sup>(12-14)</sup>.

## The maintenance of mobility and independent living

Functional capacity declines with age: strength, endurance, balance, bone density and flexibility are all lost at about 10% per decade, and muscle power is lost even faster at around 30% per decade. Gradually, this loss in physical function will impact upon an older adult's health, wellbeing and ability to maintain an independent life <sup>(15)</sup>. Figure 1 helps demonstrate how the decline in strength with age can affect activities of daily living such as rising from a chair. Medium to high intensity resistance training can improve everyday physical function and mobility including factors such as walking speed and time to stand up from a chair, even in those at an advanced age <sup>(16, 17)</sup>.

Cardiorespiratory exercise can offset declines in endurance and reduce breathlessness and fatigue in older adults <sup>(18)</sup>. Rehabilitation exercise is effective at improving independence even in those in nursing or residential care <sup>(19)</sup>.

## Prevention of falls

Approximately 30% of older adults fall each year; this figure increases with age to over 40% in those 80 years and over <sup>(21)</sup>. Falls are a major source of injury for older adults, and the treatment and rehabilitation associated with falls entail substantial healthcare costs <sup>(10, 22)</sup>. It is predicted by 2036 over £6 billion a year could be spent (in the UK) on treating and caring for hip fractures <sup>(23)</sup>.

Evidence accumulated in recent years has identified balance impairment as one of the main risk factors for falls in older adults <sup>(2)</sup>. While regular

physical activity of a general nature can be used to maintain balance, to illicit improvements in unstable individuals, structured physical activity sessions which focus on improving postural stability are necessary.

### Key term – Physical inactivity

Physical inactivity is described as “doing no or very little physical activity at work, at home, for transport or during discretionary time ... not reaching physical activity guidelines deemed necessary to benefit public health” <sup>(20)</sup>.

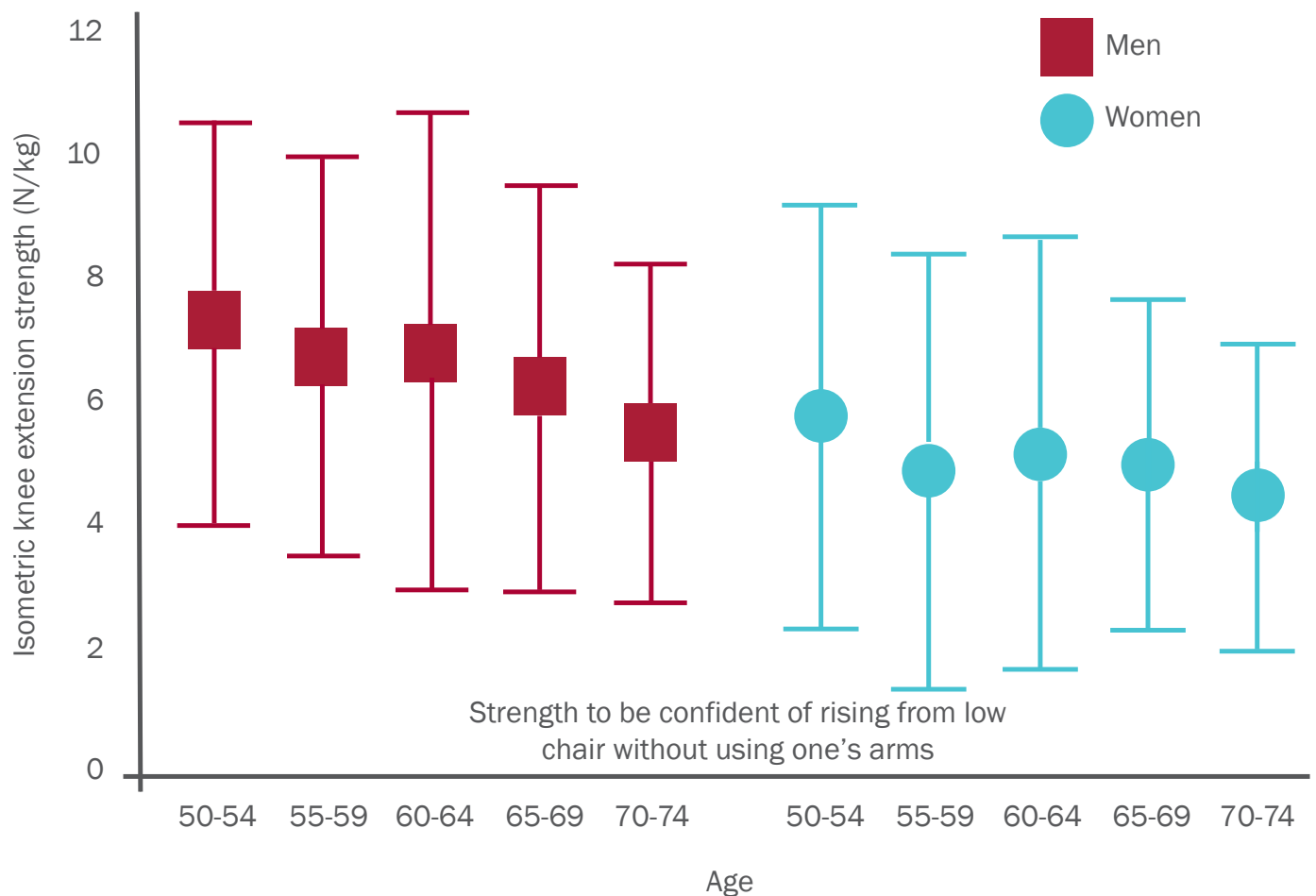


Figure 1. Knee extension strength in men and women aged 50-74 (mean±2 standard deviations) <sup>(15)</sup>

# Sedentary behaviour and health outcomes

Research examining sedentary behaviour is in its early stages and the consequences of long uninterrupted periods of sitting in terms of cardiovascular and metabolic health or overweight and obesity are not yet fully understood <sup>(25, 26)</sup>. Evidence to date does however indicate that sedentary time is a risk factor for poor health independently from physical activity <sup>(2)</sup>. Sedentary behaviour has been shown to have an impact on loss of muscle function, mobility and can contribute to low daily energy expenditure <sup>(27)</sup>. It also is known to lower levels of cognition <sup>(28)</sup>. Thus sedentary behaviour is an important area for consideration in older adults. For example, those living in residential settings or in rehabilitation wards may have prolonged periods of sedentary behaviour. These individuals should be encouraged to move on a regular basis <sup>(29)</sup>. Among the frailest of older adults, physical activity and movement that promote circulation will assist in reducing the complications of immobility and sedentary behaviours including:

- deep vein thrombosis (a blood clot in one of the deep veins – usually in the calf or thigh)
- gravitational oedema (swelling of the feet and lower legs caused by accumulation of fluid)
- contractures (thickening of the joint tissues leading to deformity)
- pressure sores
- severe constipation <sup>(30)</sup>.

## Key term – Sedentary behaviour

Sedentary behaviour refers to a group of behaviours that occur whilst sitting or lying down and that typically require very low energy expenditure <sup>(24)</sup>. The low energy requirements distinguish sedentary behaviours from other behaviours that also occur whilst seated, eg, chairbased exercise, but which require greater effort and energy expenditure. Sedentary behaviour is not defined simply as a lack of physical activity; it is a separate behaviour in its own right.

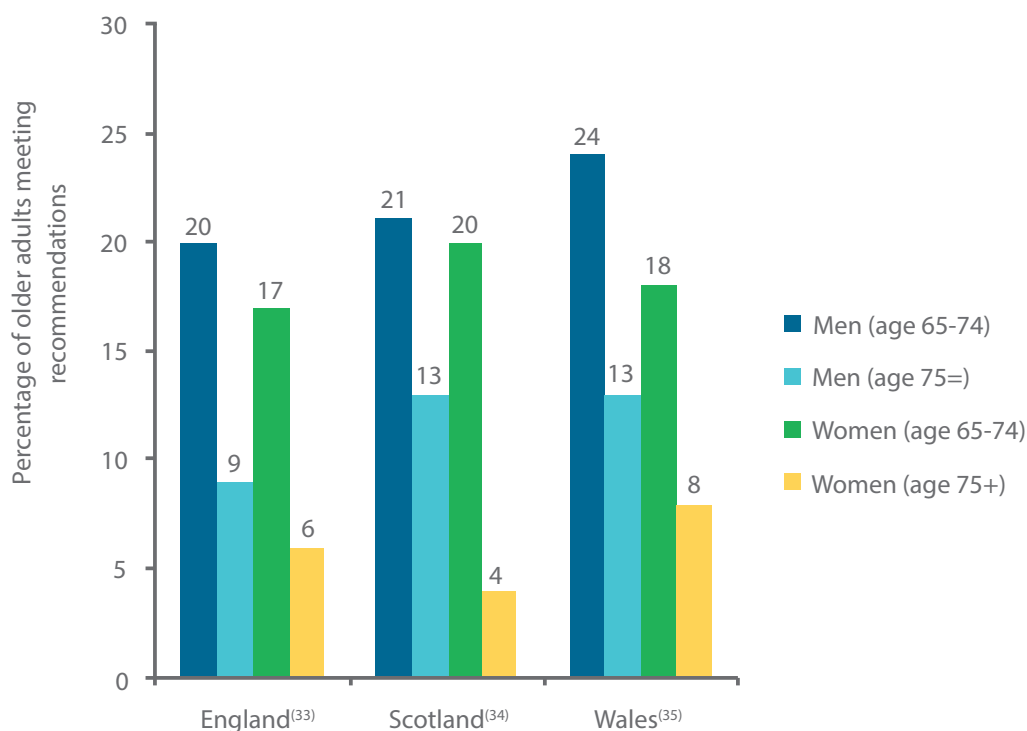


Figure 2. Proportions of physically active older adults



# Current levels of physical activity

In this section we describe current levels of physical activity among older adults using data from national representative studies. This data was produced prior to the release of physical activity guidelines for older adults in 2011 and is therefore based on the general adult recommendation from the CMO report At least five a week <sup>(9, 32)</sup>.

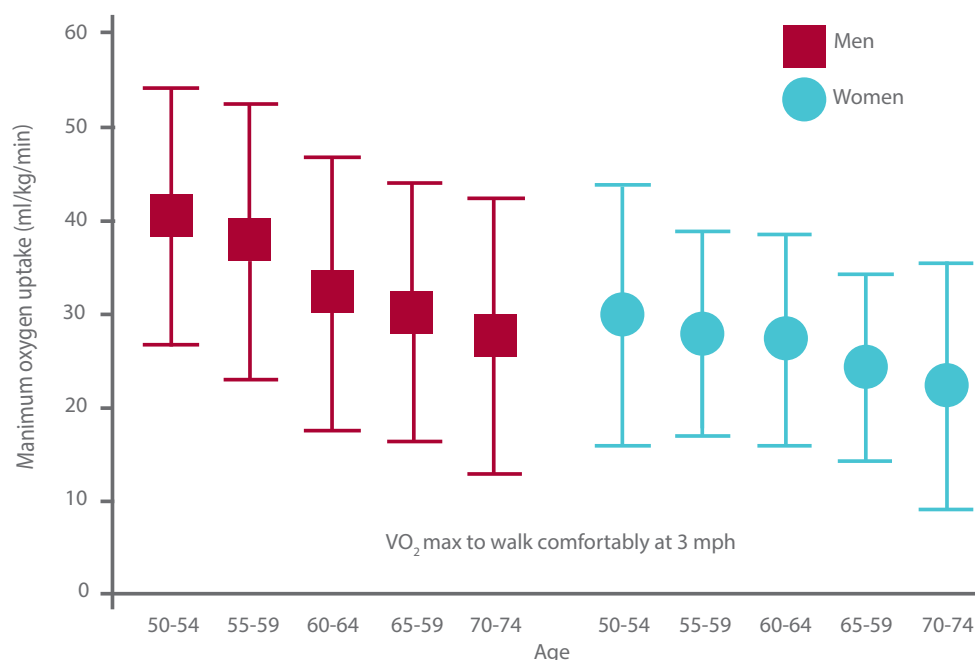
Figure 2 indicates the proportions of older adults in England, Scotland and Wales achieving at least 30 minutes of moderate intensity physical activity on 5 or more days a week.

- Data for Northern Ireland showed only 13% of older adults age 75+ achieved the recommended levels of physical activity. No data was found for older adults age 65–74 <sup>(36)</sup>.
- 78% of men and 86% of women living in care homes in Great Britain were classified as inactive. This is twice as many as those who live in private households <sup>(37)</sup>.
- 41% of adults in Great Britain over the age of 70 years take a 20 minute walk (for transport purposes) less than once a year <sup>(37)</sup>.

- In older adults age 65+ living in England, 14% of men and 25% of women were classified as ‘walking impaired’, ie, walking at speeds of less than 0.5 metres per second. Walking ability further declined with age as 36% of men and 56% of women aged 85+ noted walking difficulties <sup>(38)</sup>. Figure 3 further exhibits this decrease in walking ability with age.
- Data from the Scottish Health Survey (2008) showed by the age of 75 and over, men were walking (for 10 minutes or more) for only 0.7 hours per week and women only 0.2 hours per week <sup>(34)</sup>.

## Trends in physical activity

Between 1998 and 2008 there has been an increase for older men and women living in England in both the proportions meeting the recommendations and in overall levels of participation in physical activity. The increase occurred across all age groups among women, with the largest increases in the oldest groups, eg, among those aged 65-74, from 8% to 20%. This data illustrates that there is potential for an increase in levels of physical activity amongst older adults <sup>(39)</sup>.



**Figure 3. Aerobic capacity in men and women aged 50-74 (mean  $\pm$  2 standard deviations) <sup>(15)</sup>**

## Current levels of sedentary behaviour

- Sedentary behaviour increases with age and evidence from self-report measures and accelerometry indicates that sedentary time rises sharply from age 70 onwards <sup>(33)</sup>.
- Many older adults spend ten hours or more each day sitting or lying down, making them the most sedentary population group <sup>(40)</sup>.

## Factors affecting participation in physical activity

Physical activity is a complex, multi-dimensional behaviour influenced by a wide range of factors (often referred to as correlates) operating at individual, social and environmental levels. The following provides a summary of the influence of various factors on physical activity among older adults drawing from recent review of literature <sup>(41)</sup>.

### Key term – Correlates

Correlates are factors that influence behaviour. Correlates may be fixed or non-modifiable, eg, sex, ethnicity, age, which are useful for identifying population groups that should be targeted in intervention programmes. Alternatively, correlates may be modifiable, for example, social support or attitudes, wherein intervention strategies may be developed to change these factors potentially leading to changes in behaviour.

## Individual factors

### Biological factors

- Age: As age increases, the levels of physical activity participation decrease <sup>(33, 34, 36)</sup>.
- Gender: Regardless of the measure, men tend to be more active than women <sup>(33, 34, 36)</sup>.

### Demographic factors

- Ethnicity: The decline in physical activity participation with age is highest among those

from minority ethnic groups <sup>(31)</sup>.

- Marital status: People living alone are more likely to have lower physical activity levels than their married peers <sup>(42)</sup>.
- Socio-economic status: Those from a lower socioeconomic background have lower levels of physical activity participation <sup>(43)</sup>.
- Education: Lower levels of education attainment are associated with a greater decline in physical activity participation with age <sup>(44, 45)</sup>.

### Psychological factors

- Physical activity participation is positively associated with self-efficacy (belief in one's own ability to be active), confidence, risk perception as well as beliefs, attitudes and values <sup>(46, 47)</sup>.
- Physical activity participation is negatively associated with fear (including fear of falling and over exertion) and concern for personal safety <sup>(48, 49)</sup>.

## Social factors

- **Social support:** Physical activity participation is influenced (positively and negatively) by significant others and social support. This includes health professionals (including general practitioners), exercise and physical activity instructors, teachers and leaders, care givers, family, friends and their peers <sup>(50-52)</sup>.
- **Social cohesion:** Mutual trust, shared values and solidarity among neighbours are associated with increased levels of physical activity amongst older adults <sup>(53, 54)</sup>.

## Environmental factors

- **Crime:** Older adults are more likely than other age groups to be deterred from going out by fear of crime <sup>(55, 56)</sup>.
- **Traffic safety:** Crossing a road within the time allowed on traffic light controlled crossings requires an average walking speed that is higher than that achievable by most 70 year olds <sup>(57)</sup>. Pedestrians are most likely to be road traffic accident victims <sup>(58, 59)</sup>.
- **Transportation:** Older adults report being prevented from taking part in a range of activities because of shortage of transport <sup>(60)</sup>.



- **Settings and destinations:** Whilst a safe and pleasant environment is important, older adults report that they are also motivated to walk by having somewhere interesting to go <sup>(61, 62)</sup>. Older adults report a lack of suitable physical activity opportunities and settings <sup>(46)</sup>.



# UK Public health guidelines on physical activity for older adults

Current guidelines, released in July 2011 with endorsement from the CMOs from England, Scotland, Wales, and Northern Ireland, are the first ever UK wide guidelines to make recommendations for older adults<sup>(2)</sup>.

The current guidelines state:

- Older adults who participate in any amount of physical activity gain some health benefits, including maintenance of good physical and cognitive function. Some physical activity is better than none, and more physical activity provides greater health benefits.
- Older adults should aim to be active daily. Over a week, activity should add up to at least 150 minutes (2½ hours) of moderate intensity activity in bouts of 10 minutes or more – one way to approach this is to do 30 minutes on at least 5 days a week.
- For those who are already regularly active at moderate intensity, comparable benefits can be achieved through 75 minutes of vigorous intensity activity spread across the week or a combination of moderate and vigorous activity.
- Older adults should also undertake physical activity to improve muscle strength on at least two days a week.
- Older adults at risk of falls should incorporate physical activity to improve balance and co-ordination on at least two days a week.
- All older adults should minimise the amount of time spent being sedentary (sitting) for extended periods.

The CMO guidelines are relevant to all older people aged 65 and over, irrespective of gender, race or socio-economic status, but it is not appropriate to consider all older people as a homogeneous population. The 150 minutes a week message encourages the idea of accumulating physical activity in smaller bouts (ie, 10 minutes) which may be a more accessible message for older, older people. These guidelines also reflect the growing body of evidence indicating the additional health benefits of muscle strengthening and balance activities. In addition

to increasing physical activity, the guidelines also highlight the importance of reducing sedentary behaviour.

Three groups of older adults have been identified in the CMO report to accommodate differences in the older adult population, each with differing functional status and therefore different physical activity needs.

These include those:

- who are already active, either through daily walking, an active job and/or who are engaging in regular recreational or sporting activity
- whose function is declining due to low levels of activity, too much sedentary time, and who may have lost muscle strength, and/or are overweight but otherwise remain reasonably healthy
- described as frail or have very low physical or cognitive function perhaps as a result of chronic disease such as arthritis, dementia, or very old age itself.

For more information on the CMO physical activity guidelines download [Start Active Stay Active](#) from the Department of Health website.

# Interventions to increase physical activity

While there is emerging evidence on interventions to increase physical activity and decrease morbidity and all-cause mortality in older adults, more research is still necessary. When designing and implementing interventions, it is recommended agencies work with both the providers and older adults to offer tailored programmes which reflect the preferences of older adults <sup>(63, 64)</sup>. Common features found in successful physical activity interventions in older adults include:

- educational components where participants were given information and counselling by health professionals on physical activity and health and encouraged to engage in regular physical activity <sup>(65-67)</sup>
- a cyclical design which includes continuous reviews of participant progress towards goals throughout the intervention and provides on-going support and encouragement <sup>(68)</sup>
- use of a behaviour change model and intrinsic motivation <sup>(68)</sup>
- cognitive behavioural strategies (including selfmonitoring and goal setting) <sup>(65-67)</sup>
- assessment and negotiation of social and environmental barriers to physical activity <sup>(65-67)</sup>
- the use of support strategies (including telephone, home visits and peer support) <sup>(68)</sup>.

Additionally, in the short term (12 months), participation in group-based physical activity appears to be effective, although longer term adherence to physical activity programmes is superior in homebased programmes <sup>(69)</sup>.

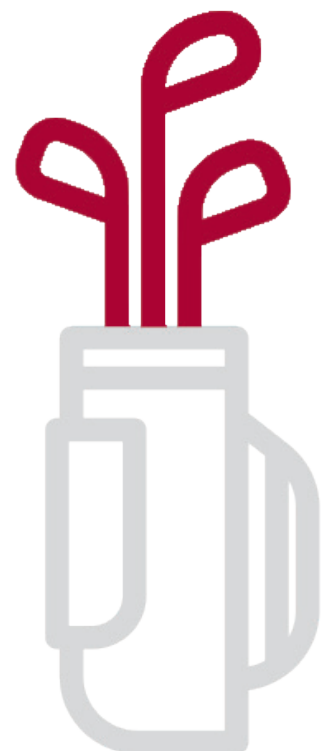
When planning interventions to improve balance and decreasing falls, research has found activities must be specifically designed with the purpose of improving balance rather than simply increasing physical activity levels <sup>(70)</sup>. There is no evidence that chair-based activities will help reduce falls among older adults <sup>(71)</sup>.

Exercises found to be most effective in reducing the incidence of falls are those:

- aimed at improving postural stability through

strength, balance, flexibility and coordination training <sup>(71, 72)</sup>

- including aspects of bone loading, postural and gait training and support endurance work <sup>(72)</sup>
- including tasks to improve visual, vestibular and sensory input <sup>(72)</sup>
- tailored specifically to the individuals and progressive <sup>(71)</sup>
- delivered by a specialist trained professionals in either a home or group-based setting <sup>(72)</sup>.





# Implications for practice

The evidence summarised in this document has important implications for commissioners, policy makers and practitioners. Potential action areas for each of these groups are outlined below. Strategies to increase physical activity in older adults should be implemented alongside those aimed at increasing general health.

## Actions for commissioners

- Ensure the evidence base demonstrates impact and cost effectiveness when commissioning and designing programmes for older adults.
- Commission multi-level interventions which include population wide, community-based and one-to-one interventions for older adults.
- Use the new CMO guidelines to underpin programme design.
- Ensure programmes are targeted to specific needs and abilities of older adults.
- Commission programmes that support sustained participation beyond 12 months.
- Build robust monitoring and evaluation into local programmes.

## Actions for policy makers

- Take action to promote physical activity to older adults of all abilities and needs through policy measures.
- Assess in advance the intended and unintended impact any policy proposals are likely to have on older adults' physical activity participation.
- Ensure older adults are engaged in all aspects of policy development.
- Work to promote social cohesion and environments which are safe and appropriately support physical activity in local communities.
- Provide educational opportunities and capacity building on physical activity for those different professional groups, eg, primary care, health and social care, residential settings, who work with older adults.

- Ensure equality of opportunities for both men and women.

## Actions for practitioners

- Review and improve knowledge and understanding of ageing and physical activity through appropriate education, training and resources.
- Ensure programmes are underpinned by the CMO guidelines for older adults.
- Develop a local coalition or alliance to ensure the co-ordination of community physical activity services and programmes.
- Ensure older adults are included in the planning and implementation of local programmes.
- Implement robust monitoring and evaluation of local programmes.
- Ensure local physical activity programmes are tailored, offer access and appropriate choice to older adults, including equal opportunities in gender specific activities.
- Collaborate with 'significant others', eg, instructors, care givers, family members, who are positioned to support older adults to become more physically active.
- Ensure those providing opportunities for older adults are appropriately trained to deliver experiences that are enjoyable, effective and safe.

# References

1. Falkingham J, Evandrou M, McGowan T, Bell D, Bowes A. Demographic issues, projections and trends: Older people with high support needs in the UK. Report for the. Joseph Rowntree Foundation: ESRC Centre for Population Change, University of Southampton and University of Stirling and Joseph Rowntree Foundation; 2010.
2. Department of Health. Start active, stay active. A report on physical activity for health from the four home countries' chief medical officers. The Department of Health; London. 2011.
3. Bouchard C, Shephard RJ. Physical activity, fitness, and health: The model and key concepts. In: Bouchard C, Shephard RJ, Stephens T, editors. Physical Activity, Fitness and Health: international proceedings and consensus statement. Champaign, Ill: Human Kinetics; 1994. p. 77-88.
4. Paterson DH, Jones GR, Rice C. Ageing and physical activity: Evidence to develop exercise recommendations for older adults. *Appl Physiol Nutr Metab*. 2007;32:S69-S108.
5. Ettinger WHJ, Burns R, Messier SP, Applegate W, Rejeski WJ, Morgan T, et al. A randomized trial comparing aerobic exercise and resistance exercise with a health education program in older adults with knee osteoarthritis. The fitness arthritis and seniors trial (FAST). *Journal of the American Medical Association*. 1997;277:25-31.
6. Miller ME, Rejeski WJ, Messier SP, Loeser RF. Modifiers of change in physical functioning in older adults with knee pain: The observational arthritis study in seniors (OASIS). *Arthritis and Rheumatism*. 2001;45:331-9.
7. Messier SP, Loeser RF, Miller GD, Morgan TM, Rejeski WJ, Seveck MA, et al. Exercise and dietary weight loss in overweight and obese older adults with knee osteoarthritis. *Arthritis and Rheumatism*. 2004;50(5):1501-10.
8. Howe TE, Shea B, Dawson LT, Downie F, Murray A, Ross C, et al. Exercise for preventing and treating osteoporosis in postmenopausal women. *Cochrane Database Syst Rev*. 2011(7).
9. Department of Health. At least five a week: Evidence on the impact of physical activity and its relation to health. A report from the chief medical officer. 2004.
10. Department of Health. On the state of public health. annual report of the chief medical officer. London: Department of Health; 2009.
11. Angevaren M, Aufdemkampe G, Verhaar HJJ, Aleman A, Vanhees L. Physical activity and enhanced fitness to improve cognitive function in older people without known cognitive impairment. *Cochrane Database Syst Rev*. 2008(3).
12. King AC, Oman RF, Brassington GS, Bliwise DL, Haskell WL. Moderate-intensity exercise and self-reported quality of sleep in older adults: A randomised controlled trial. *Journal of the American Medical Association*. 1997(277):32-7.
13. Reid KJ, Baron, K.G., Lu, B., Naylor E, Wolfe L, Zee PC. Aerobic exercise improves self-reported sleep and quality of life in older adults with insomnia. *Sleep Med*. 2010;11(9):934-40.
14. Richards KC, Lambert C, Beck CK, Bliwise DL, Evans WJ, Kalra GK, et al. Strength training, walking and social activity improve sleep in nursing home and assisted living residents: A randomized controlled trial. *J Am Geriatr Soc*. 2011;59(2):214-23.
15. Skelton DA, A., Walker A, Hoinville E. Physical activity in later life: Further analysis of the allied dunbar national fitness survey and the health education authority national survey of activity and health. London: Health Education Authority; 1999.
16. Skelton DA, Dinan-Young SM. Ageing and older people. In: Buckley J, editor. *Exercise Physiology in Special Populations*. Churchill Livingstone; 2008.
17. Lui CJ, Latham NK. Progressive resistance strength training for improving physical function in older adults. *Cochrane Database Syst Rev*. 2009(3).
18. Paterson DH, Jones GR, Rice CL. Ageing and physical activity: Evidence to develop exercise recommendations for older adults. *Appl Physiol Nutr Metab*. 2007(32):S69-S108.
19. Forster A, Lambley R, Hardy J, Young J, Smith J, Green J, et al. Rehabilitation for older people in long-term care. *Cochrane Database Syst Rev*. 2009(1).
20. Bull FC, Armstrong TP, Dixon T, Ham S, Neiman A, Pratt M. Chapter 10 physical inactivity. In: Ezzati M, Lopez AD, Rodgers A, Murray CJL, editors. *Comparative Quantification of Health Risks, Global and Regional Burden of Disease Attributable to Selected Major Risk Factors*. Volume 1 ed. Switzerland: World Health Organization; 2004. p. 729-881.
21. Falls in older people – department for work and pensions [Internet].: Department for Work and Pensions; cited 12 March 2012]. Available from: <http://www.dwp.gov.uk/publications/specialist-guides/medicalconditions/a-z-of-medical-conditions/falls/>.
22. Department of Health. Falls and fractures: Effective interventions in health and social care. London: Department of Health; 2009.
23. Report to the minister of state for care services: Breaking through: Building better falls and fracture services in England. National Osteoporosis Society; 2012.

24. Pate RR, O'Neill JR, Lobelo F. The evolving definition of "sedentary". *Exerc Sport Sci Rev.* 2008 10;36(4):173-8.
25. Grimm EKH, Mathiowetz NA, Swartz AM, Strath SJ. The exploration of sedentary behaviors in older adults. *Med Sci Sports Exerc.* 2011;43(5):539.
26. Lord S, Chastin SFM, McInnes L, Little L, Rochester L. Exploring patterns of daily physical and sedentary behaviour in community-dwelling older adults. *Age Ageing.* 2011;40(2):205-10.
27. Chastin SFM, Ferriolli E, Stephens N, Fearon KCH, Greig C. Relationship between sedentary behaviour, physical activity, muscle quality and body composition in healthy older adults. *Age Ageing.* 2012;41(1):111-4.
28. Vance DE, Wadley VG, Ball KK, Roenker DL, Rizzo M. The effects of physical activity and sedentary behavior on cognitive health in older adults. *Journal of Aging and Physical Activity.* 2005;13(3):294-313.
29. Tinetti ME. Prevention of falls and fall injuries in elderly persons: A research agenda. *Prev Med.* 1994(23):756-62.
30. Young A, Dinan S. Active in later life. In: McLatchie G, Harries M, Williams C, King J, editors. *ABC of sports medicine.* London: BMJ Books; 2000. p. 51-6.
31. Department of Health. *Health survey for England 2004. volume 1: The health of minority ethnic groups.* Leeds: The Information Centre; 2006.
32. Department of Health. *Health survey for England 2004.* London: The Stationery Office; 2005.
33. *Health survey for England 2008. Volume 1: Physical activity and fitness.* Leeds: The NHS Information Centre for health and social care; 2009.
34. *The Scottish health survey 2008. Volume 1: Main report.* Edinburgh: The Scottish Government; 2009.
35. *Welsh health survey 2009.* Cardiff: Welsh Assembly Government; 2010.
36. *Northern Ireland health and social wellbeing survey 2005/06. Top line Results Bulletin.* Belfast: Northern Ireland Statistics and Research Agency; 2007.
37. *National travel survey 2009.* Department of Transport; 2010.
38. *Health survey for England 2005: Health of older people.* Leeds: The Information Centre; 2007.
39. *Health survey for England – 2009: Trend tables* [Internet].: The Health and Social Care Information Centre; 2010; cited 05 March 2012]. Available from: <http://www.ic.nhs.uk/pubs/hse09trends>.
40. Grant MP, Granat MH, Thow MK, Maclaren WM. Analyzing free-living physical activity of older adults in different environments using body-worn activity monitors. *Journal of Aging and Physical Activity.* 2010;18(2):171-84.
41. Biddle SJ, Brehm W, Verheijden M, Hopman-Rock M. Population physical activity behaviour change: A review for the European college of sports science. *European Journal of Sports Science.* 2011.
42. Kelley K, Brach JS, Kriska AM, Bourdeau R, Richardson CR, Colbert LH, et al. Influence of marital status on physical activity levels among older adults. *Med Sci Sports Exerc.* 2006;38(3):541-6.
43. Lee RE, Mama SK, Banda JA, Bryant LG, McAlexander KP. Physical activity opportunities in low socioeconomic status neighbourhoods. *J Epidemiol Community Health.* 2009;63(12):1021.
44. Stuart CL, Marret J, Kelley GA, Nelson R. Predictors of physical activity in older adults in an independent living retirement community. *Am J Geriatr Cardiol.* 2002;11(3):160-2.
45. Chatzitheochari S, Arber S. Identifying the third agers: An analysis of British retirees' leisure pursuits. *Sociological Research Online.* 2011;16(4).
46. Health Education Authority. *Physical activity 'at our age': Qualitative research among people over the age of 50.* London: Health Education Authority; 1997.
47. Biddle S, Mutrie N. *The psychology of physical activity determinants, well-being and interventions.* 2nd ed. London: Routledge; 2008.
48. Yardley L. Fear of falling: Links between imbalance and anxiety. *Reviews in Clinical Gerontology.* 2003;12:195-201.
49. Scheffer AC, Marieke J, Schuurmans MJ, Van Dijk N, van der Hooft T, de Rooij SE. Fear of falling: Measurement strategy, prevalence, risk factors and consequences among older person. *Age Ageing.* 2008;37(1):19-24.
50. Horne M, Skelton D, Speed S, Todd C. The influence of primary health care professionals in encouraging exercise and physical activity uptake among white and south Asian older adults: Experiences of young older adults. *Patient Educ Couns.* 2010;78(1):97-103.
51. Horne M, Speed S, Skelton D, Todd C. What do community-dwelling Caucasian and South Asian 60-70 year olds think about exercise for fall prevention? *Age Ageing.* 2009;38(1):68-73.
52. Hawley H, Skelton DA, Campbell M, Todd C. Are the attitudes of exercise instructors who work with older adults influenced by training and personal characteristics. *J Aging Phys Act.* 2012;20(1):47-63.
53. Mendes de Leon CF, Cagney KA, Bienias JL, Barnes LL, Skarupski KA, Scherr PA, et al. Neighborhood social cohesion and disorder in relation to walking in community-dwelling older adults: A multilevel analysis. *J Aging Health.* 2009;21(1):155-71.
54. King D. Neighborhood and individual factors in activity in older adults: Results from the neighborhood and senior health study. *J Aging Phys Act.* 2008;16(2): 144-70.
55. Mirrlees-Black C, Budd T, Partridge S, Mayhew P. *The 1998 British Crime Survey.* London: Home Office; 1998.
56. Piro FN, Noess O, Claussen B. Physical activity among elderly people in a city population: The influence of neighbourhood level violence and self perceived safety. *Journal of epidemiology and community health.* 2006;60(7):626-32.



57. Hoxie RE, Rubenstein LZ. Are older pedestrians allowed enough time to cross intersections safely? *Journal of the American Geriatrics Society*. 1994;42:241-4.
58. Department for Transport. Transport statistics great britain: Factsheet 3: Pedestrian casualties in road accidents: GB: 1998. London: Department for Transport; 2001.
59. Center for Research and Prevention of Injuries. Fact sheet: Prevention of road traffic injuries among elderly. elderly safety-focus on accidental injuries. Athens University, Greece: Department of Hygiene & Epidemiology, School of Medicine.
60. Help the Aged. Pensioners' transport survey. London: Help the Aged; 1998.
61. Sugiyama T and Ward Thompson C. Associations between characteristics of neighbourhood open space and older people's walking. *Urban Forestry & Urban Greening*. 2008; 7(1), 41-51.
62. Li F, Fisher KJ, Brownson RC, Bosworth M. Multilevel modelling of built environment characteristics related to neighbourhood walking activity in older adults. *Journal of epidemiology and community health*. 2005;59(7):558-64.
63. National Institute for Health and Clinical Excellence. Occupational therapy interventions and physical activity interventions to promote the mental wellbeing of older people in primary care and residential care (mental wellbeing and older people). NICE public health guidance. 2008. Report No.: 16.
64. Wieckowski J, Simmons J. Translating evidence-based physical activity interventions for frail elders. *Home Health Care Services Quarterly*. 2006;25(1-2):75-94.
65. van de Bijl AK, Laurant MGM, Wensing M. Effectiveness of physical activity intervention for older adults. *Am J Prev Med*. 2002;22(2):120-33.
66. King AC, Rejeski WJ, Buchner DM. Physical activity interventions targeting older adults. A critical review and recommendations. *Am J Prev Med*. 1998;15(4):316-33.
67. Stewart AL, Gillis D, McLellan B, Grossman GP, L., Castrillo M, Santis J, et al. Tailoring an experimentally successful physical activity program for seniors (CHAMPS) for diverse community settings. *Annals of Behavioural Medicine*(23):S109.
68. Department of Health. Let's get moving – a new physical activity care pathway for the NHS: Commissioning guidance. London: Department of Health; 2009.
69. Ashworth NL, Chad KE, Harrison EL, Reeder BA, Marshall SC. Home versus center based physical activity programs in older adults. *Cochrane Database Syst Rev*. 2005.
70. Howe TE, Rochester L, Neil F, Skelton DA, Ballinger C. Exercise for improving balance in older people. *Cochrane Database Syst Rev*. 2011(11).
71. Sherrington C, Tiedemann AB, Fairhall N, Close JCT, Lord SR. Exercise to prevent falls in older adults: An updated meta-analysis and best practice recommendations. *N S W Public Health Bull*. 2011;22:3-4.
72. Department of Health. Falls and fractures: Exercise training to prevent falls. Department of Health; 2009.

**National Centre for Sport and Exercise  
Medicine East Midlands**

W: [www.ncsem-em.org.uk](http://www.ncsem-em.org.uk)

**School of Sport, Exercise and  
Health Sciences**

Loughborough University

W: [www.lboro.ac.uk/ssehs](http://www.lboro.ac.uk/ssehs)

This resource was written by the British Heart Foundation National Centre for Physical Activity and Health. It was last updated March 2012.