

# Guidelines on Physical Activity for Older People (aged 65 years and over)

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# Foreword

The Government is committed to ensuring that New Zealanders live longer, healthier and more independent lives. At the same time, the health and disability sector faces significant challenges such as the need to respond to an ageing population; new technology; new medicines; and more people living longer with multiple, long-term conditions. To assist the Government in seeing its commitment through, the Ministry of Health aims to help older New Zealanders to prevent illness and maintain independence, rather than focusing only on treating ill health (Ministry of Health 2012a).

Looking after the health and wellbeing of older New Zealanders is important on three levels. First, on an individual level, it ensures older people lead longer and healthier lives. Second, on a social level, healthy older people are able to make positive contributions to their whānau, communities and wider society for longer. Third, on a population level, a healthy older population will reduce the burden on New Zealand's health, disability and welfare systems.

Physical activity, along with good nutrition, is a key contributor to healthy living. There is a growing body of evidence to suggest that a small, sustained increase in physical activity, along with a reduction in sedentary behaviour, can help in preventing and managing certain chronic diseases and conditions.

The *Guidelines on Physical Activity for Older People (aged 65 years and over)* provide health practitioners with evidence-based advice on the type, intensity and frequency of physical activity recommended to reduce the risk of developing certain health conditions and to assist in maintaining or improving quality of life for those who already have various health conditions. Health practitioners may use this information to educate and encourage older people and their whānau on the benefits of leading a physically active lifestyle.

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## **Executive summary**

The *Guidelines on Physical Activity for Older People (aged 65 years and over)* provide information for health practitioners on:

- > how physically active older people in New Zealand are
- > physical activity recommendations for older people in New Zealand
- > evidence for why it is important for older people to be physically active.

The recommendations apply to all older people in New Zealand regardless of ethnicity, gender or income. Table 2 gives examples of different types of activities; some may appeal particularly to certain communities or cultural groups within New Zealand.

Accumulating physical activity through activities of daily living (ADLs) is important. ADLs are a valuable way of improving flexibility, coordination, balance and muscle strength, maintaining independence and, importantly, reducing sedentary behaviour.

#### Recommendations

The following recommendations apply to **all older people in New Zealand**, but should be adjusted for each older person according to their individual needs and abilities.

- > Be as physically active as possible and limit sedentary behaviour.
  - View movement as an opportunity, not an inconvenience, as every bit helps. Older people should be encouraged to increase their physical activity levels (especially their ADLs) and reduce their sedentary behaviour. Incremental increases in physical activity and decreases in sedentary behaviour can both reduce mortality and morbidity risk.
- > Consult an appropriate health practitioner before starting or increasing physical activity.
  - This recommendation applies particularly to insufficiently active and physically inactive older people, or those who have a health condition (or co-morbidities), to ensure they will be able to do it safely.
- > Start off slowly and build up to the recommended daily physical activity levels.
  - As fitness tends to decrease with age, older people tend to have lower exercise capacity than younger people. Older people are advised to slowly build up to the recommended amount of physical activity to prevent injury.
- > Aim to do aerobic activity on five days per week for at least 30 minutes if the activity is of moderate intensity; or for 15 minutes if it is of vigorous intensity; or a mixture of moderate- and vigorous-intensity aerobic activity.
  - No amount of physical activity can prevent ageing, but people can gain significant health benefits from doing **at least** 30 minutes of moderate-intensity aerobic activity on five days per week, in sessions of at least 10 minutes at a time.
- > Aim to do three sessions of flexibility and balance activities, and two sessions of muscle-strengthening activities per week.
  - Flexibility and balance are essential for older people to do everyday activities such as climbing stairs, getting on and off the bus, and hanging out the washing. Strong muscles and bones are needed for everyday activities such as carrying shopping.

The following recommendations apply to **older people in New Zealand who are frail** in place of the recommendations given above. Older people who are frail should:

- > be as physically active as possible and limit sedentary behaviour
- > consult an appropriate health practitioner before starting or increasing physical activity
- > start off slowly and build up to the recommended physical activity levels
- > aim for a mixture of low impact aerobic, resistance, balance and flexibility activities
  - Physical activity is beneficial for older people who are frail to maintain strength and improve muscular functions which are important for everyday activities
- > discuss with their doctor about whether vitamin D tablets would benefit the older person.
  - Low levels of vitamin D can lead to muscle weakness and poor balance which can cause falls. Taking vitamin D tablets has been shown to significantly reduce falls in older people in residential care.

#### **Key findings**

Sedentary behaviour increases with age, while physical activity and the ability to perform activities of daily living decline, for both men and women. Between the ages of 65 and 74 years, the percentage of those who are regularly physically active was 55 percent of men and 47 percent of women from all ethnic groups. After the age of 75 years, these figures dropped to 38 percent for men and 28 percent for women; conversely nearly 40 percent of women and 30 percent of men in this age group were regularly physically inactive (Ministry of Health 2012b).

People in residential care are more likely to be sedentary than people who live in the community (Ministry of Health 2006).

Sedentary behaviour or a lack of physical activity in older people can contribute to obesity. Research from the United Kingdom indicates that obesity can reduce average life expectancy by three years and morbid obesity by 8 to 10 years.

Māori appear to be the most physically active ethnic group across all age ranges including those over 65 years, but they have a lower overall health status than non-Māori. Health practitioners need to encourage Māori to continue their physically active lifestyles into older age, and combine this advice with education on other lifestyle factors (such as good nutrition) to improve their health status (Ministry of Health 2012b).

The Asian population, including those over 65 years, appear to be both the least physically active and most sedentary of any ethnic group, followed by Pacific peoples. It is important that health practitioners focus on increasing physical activity levels within these populations through effective education and culturally appropriate programmes (Ministry of Health 2012b).

Physical activity has many benefits for health including by:

- > increasing muscle strength, flexibility, balance and coordination
- > helping to prevent and manage premature mortality from any cause, falls, stroke, heart disease, obesity, type 2 diabetes, osteoarthritis, certain cancers, obesity and depression
- > enhancing sleep, wellbeing and quality of life
- > increasing levels of social interaction.

# Physical activity recommendations for older people

Physical activity recommendations for older people are based on evidence from studies evaluated in the literature review, as well as international recommendations from the World Health Organization, Australia, Canada, the United Kingdom and the United States of America.

#### **Recommendations for all older people**

It is recommended that all older people:

- > limit sedentary behaviour and be as physically active as possible
- > consult an appropriate health practitioner before starting or increasing physical activity
- > start off slowly and build up to the recommended physical activity levels
- > aim to do aerobic activity on five days per week for at least 30 minutes per day if the activity is of moderate intensity, 15 minutes per day if it is of vigorous intensity, or doing a mixture of moderate and vigorous intensity, in sessions of at least 10 minutes at a time
- > aim to do three sessions of flexibility and balance activities, and two sessions of muscle-strengthening activities per week.

#### **Recommendations for additional health benefits**

For **additional** health benefits, older people should consider working towards:

- > 60 minutes of moderate-intensity aerobic activity on five days per week
- > 30 minutes of vigorous-intensity aerobic activity on five days per week
- > an equivalent amount of combined moderate- and vigorous-intensity activity per week.

#### Recommendations for older people who are frail

It is recommended that older people who are frail:

- > limit sedentary behaviour and be as physically active as possible
- consult an appropriate health practitioner before starting or increasing physical activity
- > start off slowly and build up to the recommended physical activity levels
- > consult an appropriate health practitioner before starting or increasing physical activity
- > aim for a mixture of low-impact aerobic, resistance, balance and flexibility activities
- > discuss with their doctor about whether vitamin D tablets would benefit them.

The following are examples of activities recommended to enhance general health, and to prevent and/or manage certain health conditions. A higher number of ticks in a column indicates more evidence is available at Australian National Health and Medical Research Council (NHMRC) levels I and II supporting the benefit of physical activity.

Health condition or attribute	Activity type	Prevention	Management	Enhancing general health
Premature mortality from any cause	A, R, B, F	$\checkmark \checkmark \checkmark$	_	-
Breast cancer	А	$\checkmark \checkmark \checkmark$	$\checkmark\checkmark$	$\checkmark$
Colon cancer	А	$\checkmark \checkmark \checkmark$	$\checkmark\checkmark$	$\checkmark$
Depression	A, R	$\checkmark$	$\checkmark \checkmark \checkmark$	$\checkmark$
Frailty	A, R, B, F	$\checkmark$	$\checkmark\checkmark$	$\checkmark$
Heart disease	A, R	$\checkmark \checkmark \checkmark$	$\checkmark\checkmark$	$\checkmark$
Injury from falls	R, B	$\checkmark\checkmark\checkmark$	-	$\checkmark$
Kidney dysfunction	А	$\checkmark\checkmark$	$\checkmark\checkmark$	$\checkmark$
Neurological diseases eg, Parkinson's	Α, Β	$\checkmark$	$\checkmark\checkmark$	$\checkmark$
Obesity	A, R	$\checkmark\checkmark$	$\checkmark\checkmark\checkmark$	$\checkmark$
Osteoarthritis	A, R, F	$\checkmark\checkmark$	$\checkmark\checkmark\checkmark$	$\checkmark$
Osteoporosis	A, R	$\checkmark\checkmark$	$\checkmark\checkmark$	$\checkmark$
Physical disability	A, R, B, F	$\checkmark\checkmark$	$\checkmark\checkmark$	$\checkmark$
Prostate cancer	А	$\checkmark$	$\checkmark$	$\checkmark$
Rectal cancer	А	$\checkmark$	$\checkmark$	$\checkmark$
Sarcopaenia	A, R, B	$\checkmark\checkmark$	-	$\checkmark$
Sleep disorders	A, R, B, F	$\checkmark$	$\checkmark$	$\checkmark$
Stroke	A, R, B, F	$\checkmark \checkmark \checkmark$	$\checkmark\checkmark\checkmark$	$\checkmark$
Type 2 diabetes	A, R	$\checkmark\checkmark$	$\checkmark\checkmark\checkmark$	$\checkmark$
Vascular disease	A, R	$\checkmark$	$\checkmark \checkmark \checkmark$	$\checkmark$
Cognitive decline	A, R, B, F	$\checkmark \checkmark \checkmark$	-	-
Cognitive functioning	A, R, B, F	-	-	$\checkmark \checkmark \checkmark$
General health	A, R, B, F	_	_	$\checkmark \checkmark \checkmark$
Physical fitness	A, R, B, F	-	-	$\checkmark \checkmark \checkmark$
Physical functioning	A, R, B, F	_	_	$\checkmark \checkmark \checkmark$
Wellbeing/quality of life	A, R, B, F	-	-	$\checkmark \checkmark \checkmark$

#### Table 1: Types of activities

<sup>#</sup>A = Aerobic, R = Resistance, B = Balance, and F = Flexibility

Some activities (such as cycling) will span several activity types depending on the intensity rate. Some aerobic activities may be vigorous-intensity if they significantly increase the person's heart rate and breathing.

Moderate-intensity aerobic activities	Resistance activities	Flexibility activities	Balance activities
Cycling	Carrying shopping	Ankle stretches	Bowls
Fast dancing	Chair raises	Bowls	Chair raises
Golf	Cycling	Gardening	Cycling < 14 km/h
Hill walking	Golf	Golf	Golf
Housework	Hill walking	Housework	Modified tai chi
Kapa haka	Knee lifts	Kapa haka	Otago Exercise Programme
Kaumātua line dancing	Modified tai chi	Kilikiti	Petanque (French bowls)
Playing with grandchildren	Stair climbing	Modified tai chi	Pilates
Stair climbing	Swimming	Otago Exercise Programme	Poi toa
Strenuous gardening	Waka ama	Petanque	Social dancing
Swimming	Water aerobics	Pilates	Standing on one leg
Walking	Weight training	Stretching	Waka ama
Waka ama		Washing the car	Yoga
Water aerobics/aqua jogging		Yoga	

#### Table 2: Examples of suitable activities for older people

# Introduction

Health is the second-biggest area of public spending in New Zealand, costing the Crown \$13.2 billion per year, or 19 percent of its total annual expenditure (Ministry of Health 2011a). Therefore, it is essential that New Zealand promotes preventative health care for its population to ensure a sustainable health care system for all in the future.

The New Zealand Government is committed to improving the health and independence of all New Zealanders including older people, and to managing the burden of noncommunicable diseases by providing policy advice on the benefits of physical activity for health (Ministry of Health 2011a).

Physical inactivity is the fourth-leading cause of global mortality from non-communicable diseases (6 percent of deaths annually) behind high blood pressure, smoking and high glucose levels (WHO 2010). The Ministry of Health (the Ministry) has identified a lack of clear guidance on physical activity for older people in New Zealand.

In 2010 the Ministry commissioned a literature review on recent evidence (2004 to 2010) of the risks and benefits of physical activity for older people. This literature review provides the evidence base for the *Guidelines on Physical Activity for Older People (aged 65 years and over)* (the Guidelines).

The aim of the Guidelines is to provide health practitioners, physical activity professionals and community fitness providers with advice and recommendations that align with the current national and international evidence for increasing physical activity levels and reducing sedentary behaviour in older people. The recommendations are consistent with other international recommendations on physical activity for older people, including those from the World Health Organization (WHO), Australia, Canada, the United Kingdom and the United States of America (USA).

These Guidelines are accompanied by an online factsheet that is designed for the general public and easy to understand.

The Guidelines outline:

- > physical activity
  - the benefits, risks, types and dimensions of physical activity for older people
- > physical inactivity and sedentary behaviour
  - the risks of physical inactivity and sedentary behaviour, older people who do not meet recommended activity levels, Green Prescriptions and older people who are frail
- > New Zealand population profile
  - physical activity among older New Zealanders, safety, and factors that enable and act as barriers to physical activity
- > physical activity for preventing and managing chronic health conditions, and for enhancing general health.

# Review of the literature: substantive evidence to support the Guidelines

The Ministry of Health commissioned and funded a literature review which was conducted by the New Zealand Guidelines Group (NZGG) and University of Western Sydney (UWS). The literature review analysed evidence-based research from 2004 to 2010 for preventing and managing health conditions, enhancing wellbeing and life in older people.

Within the literature review, articles meeting evidence levels I and II of the Australian National Health and Medical Research Council (NHMRC) standard were evaluated. The level of evidence reflects the best study types for the specific type of question. The most appropriate study design to answer each type of clinical question (intervention, diagnostic accuracy, aetiology or prognosis) is level II evidence. Level I studies are systematic reviews of the appropriate level II studies in each case (NHMRC 2009). Where there were gaps in the evidence, lower levels of evidence were sought to supplement the information. Expert researchers evaluated and critiqued the articles, which included systematic reviews, randomised controlled trials and prospective cohort studies, for the quality of methods used in drawing conclusions (NZGG and UWS 2011).

In the literature review, participants' activity levels were categorised into three groups.

- > The **physically inactive** group reported doing less than 30 minutes of physical activity per week.
- > The **partially active** group reported doing 'some' physical activity per week but less than 30 minutes of moderate- to vigorous-intensity activity on most days of the week.
- > The **physically active** group reported doing a minimum of 30 minutes of moderate- to vigorous-intensity physical activity on most days of the week (NZGG and UWS 2011).

The literature review also assessed international physical activity recommendations, policies and principles for older people, published in English, from countries similar to New Zealand. These countries included Australia, the United Kingdom, USA, Canada and some Scandinavian countries (Sweden, Norway and Finland).

In addition to the main literature review, the Ministry of Health commissioned a separate review on the impact of sedentary behaviour on older people's health. Its aims were to look at the evidence on older people's sedentary behaviour and any potential impacts on health (2010 to 2011), and to explore the rationale for including sedentary behaviour in the Guidelines (Ministry of Health 2011b).

# **Profile of the New Zealand population**

New Zealand's population, like other populations around the world, is ageing due to lower mortality rates and lower fertility rates. It is estimated that by 2061, older people will make up one-quarter of the New Zealand demographic (approximately 1.5 million), up from 14 percent (600,000) in 2012 (Statistics NZ 2012). With this ageing population comes the challenge of how to meet the increasing demands on the health and disability system.

Life expectancy in New Zealand over the last 30 years has significantly increased; male New Zealanders can now expect to live on average until the age of 78 years, and females to the age of 82 years (Statistics NZ 2009). In addition, females have a longer healthy life expectancy (the number of years that a person can expect to live in full health) than males (Ministry of Health 2011a). In 2006 the healthy life expectancy at birth for males was 67.4 years; for females it was 69.2 years (Statistics NZ 2009).

It is important to ensure that the longer life expectancy is not accompanied by an increase in the time spent living with ill health (Ministry of Health 2011a).

#### Physical activity behaviour among older New Zealanders

In the 2011/12 New Zealand Health Survey (NZHS), people were asked about their physical activity over the past seven days. The results of the NZHS indicate that older people are the age group least likely to be meeting the physical activity guidelines for adults. That is, they are least likely to be sufficiently active to achieve maximum health benefits (Ministry of Health 2012b).

The percentage of men aged over 25 years who were physically active remained relatively consistent until the age of 74 years, when it dropped. Significantly, the percentage of women who regularly participated in physical activity dropped off after the age of 65 years and fell even further after the age of 75 years (see Figure 1).



#### Figure 1: Regular physical activity for adults (2011/12)

Up to the age of 65 years, the percentage of physically inactive men and women from all ethnic groups was relatively stable (approximately 7 to 13 percent for each individual age category) but it increased after the age of 65 years. This proportion increased significantly more after the age of 75 years, when nearly 30 percent of men and nearly 40 percent of women reported doing less than 30 minutes of physical activity per week (see Figure 2) (Ministry of Health 2012b). This high level of physical inactivity in this age group is a significant problem for the future as the number of people aged over 85 years is expected to increase from 76,000 in 2012 to about 310,000 in 2061 which will put more pressure on the New Zealand health care system (Statistics NZ 2012).



#### Figure 2: Proportion of physically inactive men and women (2011/12)

Source: Ministry of Health 2012b

In 2008 SPARC (now Sport New Zealand) conducted the Active New Zealand (Active NZ) Survey. This survey found that only 34 percent of people aged 65 years and over met the recommended physical activity levels of 30 minutes of moderate-intensity physical activity on five or more days per week (SPARC 2008).

Using the data from the Active NZ Survey, SPARC defined the types of activities that physically active individuals aged 65 years and over undertook (see Figure 3). The top three activities are walking (73.3 percent), gardening (65.7 percent) and swimming (15.3 percent) which are all either free or low-cost activities that require minimal specialist equipment. Walking is a good physical activity for health practitioners to recommend to older people as it is free, can be done at various intensities, can accumulate and can contribute significantly towards meeting the recommendation of doing at least 30 minutes of moderate-intensity physical activity on five days per week. Walking should be recommended in conjunction with flexibility, balance and resistance activities for optimal health benefits.



Figure 3: Activities of physically active older New Zealanders (2008)

Note: Total activities do not add up to 100 percent as some individuals may participate in more than one activity. Source: SPARC 2008

The Life and Living in Advanced Age: a Cohort Study in New Zealand: Puawaitanga o Ngā Tapuwae Kia Ora Tonu (LILAC study) is a 10-year follow-up study. It aims to improve understanding of ageing in both Māori (aged between 78 and 90 years) and non-Māori (aged 85 years), so that older people are able to share their wisdom with future generations (Wham et al 2011).

Wham et al (2011) acknowledge the importance of physical activity for improving muscle strength, balance, mobility, energy expenditure and energy intake so that older people continue to be able to perform activities of daily living (ADLs). ADLs are essential for healthy ageing and staying mobile, maintaining independence and protecting against and managing certain health conditions.

The LILAC study used a Physical Activity Scale for the Elderly (PASE), which used 10 items to identify physical activity related to leisure, household work and occupational tasks over one week. Māori had a significantly higher median score for physical activity than non-Māori, in particular for the leisure time and household physical activity (Wham et al 2011).

Older people interviewed were also asked what physical, mental, social, spiritual and family aspects of life are important to their current wellbeing. A significant preliminary finding is that being able to be physically active is one of the highest-ranking factors for quality of life in both Māori and non-Māori (Wham et al 2011).

# **Physical activity**

Physical activity is defined as any bodily movement produced by the skeletal muscles that use energy above resting level. It may be in the form of general movement or more planned structured or repetitive movement such as exercise (WHO 2010). Regular physical activity is essential for healthy ageing (Nelson et al 2007). It may take any of the following forms.

- Incidental activities or activities of daily living are carried out as part of usual daily living. ADLs are important as they accumulate to help achieve the weekly guideline recommendations, and importantly reduce the time an older person spends being sedentary. They help older people to stay mobile; can help protect against and manage certain health conditions; and can help to maintain independence. ADLs include walking the dog, washing the car, gardening, other household chores and kaumātua activities.
- > Occupational activities are physical activities carried out as part of work. They can help prevent health conditions and enhance general health, and may count towards meeting the weekly physical activity recommendations.
- Recreational activities are important for maintaining social and physical independence. Recreational activities include walking, golf, lawn bowls and dancing.
- Active transport is physical activity used as a mode of transport from one destination to another. It includes walking to the shops and cycling.
- Structured activities are organised by a club or individual, such as group exercise activities, tai chi, kaumātua line dancing, aqua aerobics and competitive sports. Structured activities can motivate older people to get out and be physically and socially active.
- > Supervised activities may occur as part of a rehabilitation programme by a trained health practitioner, such as a physiotherapist, following injury or surgery, or as a training programme to manage long-term conditions. Supervised training programmes such as the Otago Exercise Programme can help older people have fewer falls.

The recommendations in the Guidelines are relevant to all older people, but it is important to note that chronological age alone may be too simplistic when describing the status of health, physical function and disease of older people due to the significant diversity within this population (BHFNC 2012).

Over time, the intensity required to perform a particular activity (for example, walking at 7 km/h) may change as a person's functional capacity tends to decrease with age. As such, older people tend to have lower exercise capacity than younger people (WHO 2010). It is recognised that although the overall exercise capacity of an older person is lower,



the relative intensity is the same (because it is calculated as a percentage of a person's maximum individual capacity).

Because of the individual capacity of older people, the recommendation of at least 30 minutes of moderate-intensity aerobic activity on five days per week, as set out in the Guidelines, should be adjusted for each individual according to their needs and abilities (BHFNC 2012). An older person can choose when and how to achieve their recommended weekly physical activity, which gives them the flexibility to take any of a variety of individual approaches to meet the recommendations.

### **Benefits of physical activity**

It is never too late for an older person to start participating in regular physical activity, and the benefits of doing so are wide ranging. Incremental increases in physical activity or decreases in sedentary behaviour are both independently associated with reductions in mortality and morbidity risk (WHO 2010). Whatever their age, older people in New Zealand, including those with health conditions, are likely to improve their health and wellbeing, and perform daily tasks more easily with regular physical activity.

Significant health benefits can be obtained by doing at least 30 minutes of moderateintensity aerobic physical activity (for example brisk walking) on five days per week. Importantly, it is also recognised that any level of physical activity and reduction in sedentary behaviour is beneficial. Further, a growing body of evidence suggests that additional health benefits can be achieved by including some vigorous-intensity activity. Older people who already meet the recommendations should aim to double the time or increase the intensity of activity to achieve those additional health benefits.

Physical activity is beneficial when it is done alone, but it may be even more beneficial when done in groups. Physical activity is excellent for increasing social interaction which is particularly important for older people. Increasing the amount of physical activity and social interaction has numerous positive effects. For example, it has the potential to reduce the risk of premature mortality from any cause, as well as the risk of stroke, cardiovascular disease, osteoporosis, arthritis, Alzheimer's, certain cancers and depression. Social interaction can also benefit an older person psychologically, leading them to be more active which will be of further benefit to their health (Yale Medical Group 2012).

According to the Ministry of Health, there is evidence that mental wellbeing can be improved by undertaking 60 minutes of physical activity per day, and that a lower level of good-quality physical activity can still have positive effects on mental health (Ministry of Health 2012c). It is recommended that older people choose activities that they are likely to enjoy with family or friends, as then they are more likely to continue participating in them (Ministry of Health 2012c).

### Risks of physical activity for older people

Generally, the benefits that older people gain from being physically active outweigh the risk of being injured or exacerbating an existing condition, although risks do appear to increase with intensity. Physical activity may aggravate some pre-existing conditions and injuries (Mazzeo and Tanaka 2001). For instance, older people who have existing coronary artery disease may be at an increased risk of a cardiac event (Chien et al 2008).

Older people are at an increased risk of injury when they are physically active outside the home; for example, when out walking or cycling. The increased risk may be attributed to some effects of ageing including:

> reduced eyesight or hearing

- > slower physical and decision-making ability
- > side effects of medication (NZTA 2012).

The risks of physical activity need to be managed where possible. Before an older person starts to participate in or increase their level of physical activity, they are advised to ask an appropriate health practitioner for advice based on their health condition and previous physical activity levels.

### The types of physical activity

There are four main types of physical activity: aerobic, resistance, balance and flexibility. Each has its own effect on the overall quality of life of older people, as well as on their morbidity and mortality.

The definitions used in the Guidelines are as follows.

Aerobic endurance activities	Aerobic endurance (or cardiovascular) activities require continuous and rhythmic movement of the body's major muscles for a sustained period (WHO 2010). Aerobic endurance activities (such as walking) are needed for a healthy heart and lungs, for weight control, to cross the road safely, and for the energy to play with grandchildren.
Resistance activities	Resistance activities (such as climbing stairs) involve creating resistance to help increase muscle strength and mass, as well as power and endurance (WHO 2010). Strong muscles and bones are needed to lift and carry groceries.
Flexibility activities	Flexibility activities (such as stretching) improve the range of movement possible at a joint by gently stretching the muscles, tendons and ligaments. Flexibility is specific to each joint and depends on a number of key variables such as the tightness of tendons and ligaments (WHO 2010). Flexibility is required on a daily basis to tie shoelaces, wash hair and hang up washing.
Balance activities	Balance activities (such as tai chi) improve a person's ability to prevent falls caused by self-motion, the environment or other objects (WHO 2010). Balance is required to climb stairs or get on and off a bus.

### **Dimensions of physical activity**

Each type of physical activity is influenced by three dimensions: duration, frequency and intensity. Collectively, these dimensions are known as the volume of activity (WHO 2010).

Metabolic equivalents (METs) are a measurement of energy expenditure. One MET is the energy required to perform vital core functions for one minute at rest, such as breathing and pumping blood round the body (Brown et al 2010; WHO 2012). The Borg Rating of Perceived Exertion (RPE or the Borg scale) is a subjective self-rating energy scale based on the physical sensations a person experiences during physical activity. The Borg scale ranges from 6 to 20, where 6 is no energy expenditure and 20 is maximal energy expenditure (Borg 1998). Intensity levels can be classified into three categories, as follows.

Intensity level	МЕТ	Borg scale equivalent
Light-intensity activity	1.5-2.9 METs	9–11 RPE
Moderate-intensity activity	3-6 METs	12–14 RPE
Vigorous-intensity activity	7–10 METs	15–20 RPE

(SPARC 2005)

Each physical activity dimension can significantly influence the quality of life, wellbeing, cognitive function and physical function of an older person. Older people are advised to regularly participate in different types and volumes of activity.

The dimensions of physical activity for achieving positive health outcomes will vary between health conditions. The suitability of activities will depend on factors such as previous physical activity levels, ability and the particular health condition.

# Physical inactivity and sedentary behaviour

An older person who is physically inactive does less than 30 minutes of physical activity per week (NZGG and UWS 2011).

Sedentary behaviour is the participation in activities that require little or no energy expenditure (less than 1.5 MET) above resting level (Pate et al 2008). Sedentary activities include sitting down, lying down, watching television and using a computer. Sedentary activities differ from seated activities that expend a lot of energy, such as rowing and cycling.

Both physical inactivity and sedentary behaviour are independent risk factors for poor health. A reduction in sedentary behaviour is important for good health outcomes as physical activity alone may not be sufficient to offset the negative effects of other time spent being sedentary. Previous health recommendations have concentrated on increasing physical activity, but research now recognises the importance of reducing sedentary behaviour and breaking up sitting time as well. Even small breaks in sedentary behaviour may have positive benefits on health (Healy et al 2008).

# Risks of physical inactivity and sedentary behaviour

Evidence on the risks of physical inactivity among older people shows that premature mortality and other health-related conditions increase with a less active or more sedentary lifestyle (NZGG and UWS 2011). Incremental increases in physical activity and decreases in sedentary behaviour are both independently associated with reductions in mortality and morbidity risk (WHO 2010).

To reduce the risk of injury, older adults who are physically inactive or sedentary or who have one or more health conditions should seek advice from an appropriate health practitioner before starting or increasing their level of activity.

Falls in New Zealand account for 75 percent of injury-related hospital admissions in older people. Many falls can be attributed to internal factors such as poor balance, weak muscles, low blood pressure, poor vision and co-morbidities to which physical inactivity and sedentary behaviour contribute (ACC 2009).

Older physically inactive people, particularly those aged over 85 years, are at an increased risk of falls. Falls can result in a decline in physical activity, further reducing quality of life, independence and autonomy. Even falls that do not cause physical injuries can result in a loss of confidence, which may in turn lead to a loss of mobility and independence.

Sedentary behaviour or physical inactivity in older people can contribute to obesity. In the United Kingdom, a review of 57 international prospective studies found that body mass index (BMI) is a strong predictor of premature mortality among adults. In particular, it found that obesity (BMI 30–35 kg/m<sup>2</sup>) reduced average life expectancy by three years and morbid obesity (BMI 40–50 kg/m<sup>2</sup>) can reduce life expectancy by 8 to 10 years, which is similar to the effect of a lifetime of smoking (NOO 2012).

Leisure-time sedentary behaviour can increase the risk of cardiovascular disease even in those who meet the physical activity guidelines (Katzmarzyk et al 2009). Higher levels of sedentary behaviour are associated with metabolic syndrome risk factors such as increased blood pressure, increased triglycerides and reduced high-density lipoprotein (HDL) cholesterol in adults, independent of physical activity levels (Wijndaele et al 2009).

# Older people who do not meet recommended activity levels

A partially active older person does more than 30 minutes of physical activity per week but is not sufficiently active to meet the physical activity guidelines of at least 30 minutes of moderate-intensity activity on five days per week (NZGG and UWS 2011).

Some older people may not be able to achieve the minimum recommended amount of physical activity because of frailty, disability or health conditions. If an older person cannot increase activity to the levels required to meet these Guidelines, they are advised to be as active as their abilities and health conditions allow, and to do as many ADLs as possible. A lack of physical activity can increase a person's frailty or worsen their health conditions (WHO 2010).

When an older person increases their level of physical activity, they should do so gradually, as people who start or suddenly increase their physically activity levels may experience dizziness, chest pain or difficulty breathing. If they experience any of these sensations, they should stop activity immediately and seek further advice from their health practitioner.

### **Green Prescriptions**

Health practitioners should aim to improve an older person's belief in their ability to change, by using support programmes that discuss the benefits of physical activity with the person (NOO 2012). A New Zealand example of a good support-based programme is the Green Prescriptions programme, which gives an older person access to support for physical activity through telephone calls, face-to-face meetings and group support. Green Prescriptions can help prevent and manage chronic diseases and long-term conditions such as weight problems, cardiovascular disease and diabetes (Ministry of Health 2012d).

Elley et al (2003) found that Green Prescriptions can increase physical activity, and improve a person's quality of life over 12 months, with no evidence of any adverse effects. Green Prescriptions appear to be cost-effective relative to other 'exercise on prescription' interventions reported in the literature (Elley et al 2003, 2004).

Patel et al (2011) found that Green Prescriptions were prescribed by general practitioners (GPs) for primary preventive and secondary management effects on health conditions. GPs thought the benefits of Green Prescriptions were that they take 'the non-medication approach to a healthier lifestyle' and 'they support benefits of physical activity'.

Green Prescriptions may also be used to promote physical activity in healthy older people who have the potential to develop long-term health conditions due to physical inactivity and sedentary behaviour (Patel et al 2011). The Green Prescriptions reviews did not focus on older people specifically.

#### Older people who are frail and in residential care

Frailty in older people can be linked to a combination of significant factors such as advancing age, health conditions, and physical inactivity over a lifetime. Many older people who are frail will have a combination of co-morbidities such as arthritis, diabetes, cardiovascular disease and dementia. Older people who are frail may lack the strength required for everyday living, may have a fear of falling and often live in residential care (BHFNC 2012).

Physical activity is extremely important for older people who are frail, and for those in residential care. For older people who are frail, the primary benefits of physical activity are that they are able to maintain strength and improve muscular functions, which are important for everyday activities and to prevent disability (Broman et al 2006).

In New Zealand, frailty was found to be greater in those with:

- > lower income and lower self-rated standards of living
- > housing issues (such as problems with safety, maintenance and heating)
- > fewer assets causing mobility problems (such as lack of availability and safety of transport)
- > health problems or co-morbidities
- > difficulty shopping and visiting friends (Barrett et al 2006).

Activities recommended for older people who are frail may need to be adapted to meet an individual person's needs. As aerobic activities can be difficult for this group, a good option is low-intensity resistance activities combining some aerobic activity, such as Chairobics and repeated sit-to-stand exercises.

Older people in residential care are more likely to be sedentary and are at a greater risk of falling than older people who live in the community. However, based on the available data, older people in residential care appear no more likely to be overweight or obese than older people living in the community (Ministry of Health 2006).

Older people living in residential care should be encouraged to discuss vitamin D supplementation with their doctor. According to the Accident Compensation Corporation (ACC), low vitamin D levels are common in older people, especially those in residential settings (Ceglia 2008). Low levels of vitamin D can lead to muscle weakness and poor balance (Pfeifer et al 2002), both of which contribute to falls in older people. Taking vitamin D tablets has been shown to significantly reduce falls in older people in residential care (Robertson and Campbell 2008). Through ACC's 'stay on your feet and stay active' programme, vitamin D tablets are available to an older person living in residential care free of charge, as long as their doctor determines that supplements are suitable for them (ACC 2008).

#### **Otago Exercise Programme**

Falls are frequently cited as a reason contributing to the need for an older person to be admitted to residential care (NZGG and UWS 2011). However, there is evidence that lower muscle strength, flexibility and balance gained through physical activity can help prevent falls (ACC 2009), especially multi-component physical activity such as the Otago Exercise Programme (OEP) and modified tai chi (Chang et al 2004; Arnold et al 2008; Sherrington et al 2008; Gillespie et al 2009).

The OEP is an evidence-based falls prevention programme that can reduce the number of falls and fall injuries by up to 35 percent, especially in the age group over 80 years (Robertson and Campbell 2008). The OEP uses muscle strengthening and balance exercises delivered at home by trained health practitioners such as physiotherapists. The exercises are completed on three days per week, increasing in intensity over time; participants also go for a walk at least twice per week. A health practitioner visits the patient five times during the programme at one-month intervals, and follows up every six months after the programme has finished (Robertson and Campbell 2008). Specific features of the OEP may vary due to funding constraints as the OEP was no longer centrally funded at the time of this publication.

### Modified tai chi

Modified tai chi focuses on improving lower limb strength and balance. It offers an excellent way for an older person to reduce their chance of falling. By participating in modified tai chi, people aged over 70 years can reduce their rate of falls by 48 percent (Robertson and Campbell 2008). Modified tai chi is a good programme to move on to after completing the OEP as it can be done easily at home under supervision.

### Enablers of and barriers to physical activity

Physical activity programmes for older people can be popular, well-attended, enjoyable and an effective way of increasing physical activity. However, they need to be carefully designed to meet the needs of the participants (NICE 2006).

Older people rate social interaction and proximity to others as important (Sheldon et al 2001; Gavin et al 2006). Physical activity can benefit an older person's social wellbeing, such that they are likely to feel more socially integrated, less lonely and less depressed.

Some key factors can either enable older New Zealanders of all ethnicities to undertake physical activity or act as barriers against their participation. These factors include education, cost, environment, time, physical/medical limitations (eg, injury or lack of physical functioning), lack of motivation or interest, psychological factors including the fear of falling, and a lack of cultural appropriateness (NZGG and UWS 2011).

Hutton et al (2009) reported that older adults who have access to suitable public transport, community-based programmes and local facilities for physical activity were more likely to be active as they had fewer barriers to physical activity. In addition, guidance from a health professional was a vital enabler for physical activity for older people.

Fear of falling is a significant barrier to participation in physical activity for some older people (Wijlhuizen et al 2007); however, physical activity does not appear to increase the actual risk of falling (Foster et al 2005; de Morton et al 2007; Heesch et al 2008; Liu-Ambrose et al 2008; Kerse et al 2009).

Social barriers to participating in physical activity were significant among older people in New Zealand. Māori, Pacific and Asian populations, in particular, cited cultural norms and expectations, familial constraints, socioeconomic considerations and domestic needs as barriers to participation (NZGG and UWS 2011).

The social environment plays an important part in determining whether an older person will enjoy physical activity. If people in the wider social environment support physical activity, an older person is more likely to be physically active. There are numerous aspects

of the social environment that may influence an older person's decision to participate in physical activity including:

- > the attitude of whānau, friends, peers and health care providers
- > opportunities to socialise and have fun with others
- > appropriate community venues such as marae, churches and walking clubs
- > safety considerations (ACAL 2012).

Kaumātua (Māori elders) are recognised and respected for their knowledge and life experiences, but the role brings challenges, such as time constraints, and the need to fulfil responsibilities. Physical activity can improve the health and wellbeing of older Māori, enabling them to fulfil their kaumātua role. They can also use it as a vehicle to teach tikanga and mātauranga Māori.

The design of intergenerational programmes, for example, activities that grandparents and grandchildren can participate in together, can encourage both generations to be physically active and reduce the barriers to participation in physical activity.

Physical safety has been cited as a concern for some older people and can act as a barrier to participation in physical activity. Therefore, when prescribing physical activity, it is important to consider the safety of participants.

### Safety

Older people are advised to take appropriate precautions to manage their own safety when undertaking physical activity. Precautions may involve using personal protective equipment such as helmets, hats and sunscreen; choosing safe environments such as well-lit streets, open parks and indoor facilities; and making sensible choices about when and where to be active and who to be active with, such as choosing to stay out of the midday sun, and to walk with friends or in a group (USDHHS 2008).

To maintain the flexibility needed for regular physical activity and to prevent injury, an older person should warm up and cool down appropriately for the activity they are doing. ACC Sport Smart is a free online tool that an older person or whānau member can use to find information for warming up and cooling down, including stretching exercises. Note that this online tool is for adults generally so older people must take care to only do what is within their capability.

Walking and cycling have many benefits for the health and wellbeing of older people, and can also help them to maintain independence in everyday living. Older people who want to walk or cycle safely can get advice from the New Zealand Transport Agency (NZTA)

# Culture

To meet the needs and expectations of specific cultural groups in New Zealand, such as Māori, Pacific and Asian cultural groups, physical activity programmes for older people should specifically target those groups according to their capacity to exercise, their level of independence and their preference for particular types of physical activity. A key element to a successful programme that establishes sustainable physical activity among different cultural groups is engaging relevant communities, particularly older people, in its development, implementation and evaluation phases.

Both the NZHS and Active NZ Survey identified that across all age categories, the Asian population is both the least physically active and the most sedentary of any ethnic group (SPARC 2008; Ministry of Health 2012b), followed by Pacific peoples. Therefore, it is important that health practitioners focus on increasing physical activity levels within these population groups through effective education, and culturally appropriate, physically appropriate and cost-effective programmes.

It also appears from the Active NZ Survey that Māori are the most physically active ethnic group across all ages (SPARC 2008). Therefore, we need to provide the mechanism and motivation for Māori to continue their physically active lifestyles into older age, combined with other lifestyle behaviours that contribute to optimal health, such as good nutrition.



#### Māori

The Guidelines aim to align with the Māori Health Strategy – He Korowai Oranga and Whānau Ora to support older Māori to achieve their optimal health and wellbeing. He Korowai Oranga aims to ensure Māori have the same level of health as non-Māori, while safeguarding Māori cultural concepts, values and practices. To improve Māori health, effective interventions will need to focus on achieving whānau ora, recognising that the collective wellbeing and individual wellbeing of Māori are equally important.

Kaumātua continue to hold valued and varied roles within whānau, hapū and iwi. As holders of whakapapa, knowledge, tikanga and life experience (such as whakawhanaungatanga), kaumātua often provide leadership and nurturing to younger generations.

Tikanga are the Māori customs and traditions handed down by their tupuna (ancestors). Many Māori are increasingly seeing the value of using tikanga to guide Māori to be more physically active (Mead 2003; Waiti 2007). Therefore, underpinning approaches need to incorporate values such as whakapapa in order to recognise the wider scope of hauora (wellbeing).

Importantly, 54 percent of all Māori meet the adult physical activity recommendation of 30 minutes of moderate-intensity physical activity or more on five days per week. Māori also had a higher participation rate in organised competition compared with the total population (SPARC 2008). This positive behaviour provides an opportunity to build on the strength of physical activity initiatives to address other health factors such as good nutrition.

The literature review concluded that physical activity programmes underpinned by tikanga and Treaty of Waitangi principles enable physical activity for Māori. Specifically, professionals who trained on the marae, demonstrated an understanding of tikanga, conducted activities on the marae and included traditional Māori activities such as poi toa were more likely to be successful in terms of uptake and retention than those that did not (NZGG and UWS 2011). With these results in mind, it is important that culturally appropriate activities are available for Māori, led by Māori, and that consideration is given to developing and continuing these activities.

Wham et al (2011) measured each older participant's current level of leisure, occupational and household physical activity. The median physical activity scores were significantly higher for Māori aged between 78 and 90 years than for non-Māori aged 85 years, especially for leisure-time activity and household-related activity. Māori elders were generally extremely positive about their lives and highly engaged with their communities. In particular, Māori elders who engaged with whānau and hapū more frequently on the marae had a better quality of life. Opportunities for kaumātua to engage in physical activity within a marae setting are likely to result in improvements in physical health and, importantly, in spiritual and mental health as well.

Table 3 gives some New Zealand examples of physical activity programmes specifically targeting older Māori. Further research is needed to determine the effectiveness of these intervention programmes. Note that this is not an exhaustive list of programmes and that the programmes may be locally targeted.

Programme	Summary
Te Hauora Runanga o Wairarapa	Te Hauora Runanga o Wairarapa healthy lifestyles (Fitness and Mobility) programme has a guiding philosophy of strengthening whānau to strengthen communities. The programme aims to promote healthy living to koroua (older men) and kuia (older women) through weekly fitness and mobility sessions in conjunction with education about positive life changes, nutrition and screening services.
Te Tihi o Ruahine Whakapai Hauora	Nutrition and physical activities – Whakapai Hauora promotes regular physical activity within a marae setting, to improve the health and wellbeing of kaumātua. Whakapai Hauora provides activities such as line dancing and low-impact exercise classes that enable regular physical activity and to increase lifelong participation in regular physical activity.
Te Taiwhenua o Heretaunga – Kāinga Tautoko	Kāinga Tautoko is a community-based health programme aimed at kaumātua within the community. The programme helps kaumātua to develop and maintain a healthy and independent lifestyle by facilitating access to activities that promote wellness and independence. One component of the programme is physical activity that is targeted at individual needs and capabilities.
Te Taiwhenua o Heretaunga – Kaumatua Ora	The Kaumatua Ora programme delivers free monthly health checks at local community marae, in addition to opportunities for smoking cessation and health screening, regular physical activity, and education on nutrition.

#### Table 3: Examples of physical activity programmes targeting older Māori

#### **Pacific peoples**

The seven largest Pacific ethnic groups in New Zealand are Samoan, Cook Island Maori, Tongan, Niuean, Fijian, Tokelauan and Tuvaluan (Statistics NZ 2007). These seven groups, known collectively as Pacific peoples, share some similar characteristics, but each also has its own cultural beliefs, values, traditions, language, social structure and history.

In general, Pacific peoples have a poorer health status and higher rates of chronic disease such as cardiovascular disease (coronary heart disease and stroke), obesity, diabetes and respiratory diseases (chronic bronchitis, emphysema and asthma) than other New Zealanders (Ministry of Health 2004).

For many Pacific peoples, the church is a social institution through which they can maintain their language, cultural beliefs and practices. Given that large populations of Pacific peoples belong to a church, the churches have increasingly been identified as places that can influence health and physical activity levels (Ministry of Health 2008).

Table 4 gives some New Zealand examples of physical activity programmes specifically targeting older Pacific peoples. Further research is needed to determine the effectiveness of these intervention programmes. Note that this is not an exhaustive list of programmes and that the programmes may be locally targeted.

Programme	Summary
Enua Ola	Enua Ola is a physical activity and lifestyle programme for older Pacific peoples in West Auckland. Weekly group sessions for physical activity and monthly sessions for nutrition education are delivered in 30 different church and community halls.
Vaku Tautua	Vaku Tautua runs day programmes in the community for Pacific peoples aged 65 years and over. The programme themes are health and wellbeing, independent living and health promotion. Activities include physical activity classes, healthy eating demonstrations, arts and crafts, outings, socialisation and information sharing with other older Pacific peoples.
Treasuring Older Adults (TOA) Pacific Services	TOA is a service for older Pacific peoples and their families which includes day care/time out programmes, health and disability information, physical activity programmes and movements to Pacific music.
South Waikato Pacific Community Services (SWPICS)	SWPICS runs a programme in which Pacific peoples can socialise and increase their physical activity levels to Pacific music.

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#### **Asian peoples**

In 2006 the broad 'Asian' ethnic group was the fourth-largest ethnic group in New Zealand. According to the New Zealand Health Survey only 4.5 percent of the Asian population in New Zealand are aged 65 years or over, with the majority (74 percent) aged between 15 and 64 years. The number of Asians over 65 years of age is set to increase to 9 percent of the Asian population in New Zealand by 2021 (Scragg 2010).

Older Asians are the least physically active and most sedentary of any ethnic group. They are less likely to access health practitioners than non-Asians, so are less likely to receive information about healthy lifestyle choices such as physical activity and nutrition (Scragg 2010). Due to the combination of physical inactivity and ageing, demand for access to health services in the future may potentially be greater among older Asians compared with the total New Zealand population.

Diversity within Asian communities often brings challenges in designing culturally appropriate services and programmes. Every Asian ethnic group has distinctive physical lifestyle characteristics and eating habits. As with other ethnic groups, older Asians are more likely to gain physical and mental health benefits when they are socially connected to others. More awareness-raising programmes that educate older people about the mental and physical benefits of leading a physically active lifestyle should be introduced.

According to The Asian Network Incorporated (TANI), older Asians perceive that there is a limited number of physical activity programmes specifically designed for them and there may need to be more support for older Asians to be physically active. It is suggested that culturally appropriate health promotion efforts are required to increase awareness of good lifestyle choices and reverse sedentary lifestyles. One possible approach is to encourage culturally familiar physical activity options such as traditional dance, games and physical activity programmes that run at temples, mosques, churches or cultural centres.

Table 5 gives some New Zealand examples of physical activity programmes specifically targeting older Asians. Further research is needed to determine the effectiveness of these intervention programmes. Note that this is not an exhaustive list of programmes and that the programmes may be locally targeted.

Programme	Summary
Shanti Niwas Charitable Trust	Shanti Niwas offers day programmes for older Asians that include physical activity, socialisation, festival celebrations, traditional Asian games (indoor bowls, memory etc), healthy lifestyle workshops, outings and picnics. The aim is to reduce loneliness, social isolation and depression; enhance quality of life through involvement in physical fitness and nutrition programmes; and promote health and safety awareness and lifestyle.
Bhartiya Samaj	Bhartiya Samaj offers day programmes for older Asians that include fellowship and friendship, exercise (yoga classes), outings and picnics, health checks, celebration of festivals, mutual support and community lunches.
Care and Craft	The Care and Craft programme offers crafts and games, companionship, communication group and bowls. It is aimed at older people who are lonely, disabled, restricted in their mobility, would like to get out, enjoy support and want companionship.
Chinese Positive Ageing Charitable Trust (CPACT)	CPACT offers a range of community day activity programmes for older people that include social contact, physical and recreational activities, socialisation, cultural programmes and vocational experience. All these activities include tai chi, crafts, health talks, chess, outings, sing-alongs and games.

#### Table 5: Examples of physical activity programmes targeting older Asians

### **Preventing health conditions**

Physical activity helps to reduce the risk of premature mortality, injury from falls, stroke, heart disease and certain cancers including breast and colon cancer. In addition, there is some evidence suggesting that participation in regular physical activity can help reduce the risk of neurological disorders/cognitive decline, rectal cancer, prostate cancer, sarcopaenia, kidney dysfunction, osteoporosis, type 2 diabetes, depression, disability, functional limitation and hospitalisation, but further evidence is required to confirm this link. For examples of suitable activities for helping to reduce the risk of various health conditions in older people, see Table 2.

This chapter briefly summarises findings from the literature review on the role of physical activity in reducing the risk of relevant health conditions in older people. All references come from the literature review unless stated otherwise.

Each section in this chapter summarises effective interventions for preventing a specific health condition. To reduce the risk of experiencing that particular health condition, older people could consider including one or more of those interventions as part of meeting the recommendations.

The effective interventions identified in the studies may have included participants under the age of 65 years, but all groups of participants had a median age of 65 years or over. The results from the effective interventions were usually compared with results linked to no physical activity.

As with the earlier recommendations, older people with certain health conditions should increase their activity levels gradually, building up to the recommended levels or to a level that they are capable of doing. Older people should see an appropriate health practitioner before changing their activity levels or if they have existing health conditions. If an older person experiences pain during physical activity, they should stop immediately and see a doctor.

#### Benefits of physical activity for preventing premature mortality from any cause

Premature mortality in New Zealand is classified as death occurring before 75 years that could potentially have been avoided through individual or population-based interventions (Ministry of Health 2012e).

Three systematic reviews and 10 prospective cohort studies were evaluated in relation to the benefits of physical activity for preventing premature mortality from any cause.

The three systematic reviews found that physical activity is a modifiable risk factor for premature mortality from any cause in both men and women (Nocon et al 2008; Löllgen et al 2009; Warburton et al 2010). A systematic review of prospective cohort studies in over 1.5 million people found mortality from any cause fell through increased physical activity in most studies (Warburton et al 2010).

Eight prospective cohort studies and three systematic reviews found that older people who regularly participate in physical activity have a lower risk of premature mortality from any cause than individuals that are physically inactive. Across these 11 studies, increasing levels of physical activity was correlated with decreasing levels of mortality (Knoops et al 2004; Garg et al 2006; Lan et al 2006; Manini et al 2006; Schooling et al 2006; Whang et al 2006; Leitzman et al 2007; Byberg et al 2009; Löllgen et al 2009; Nocon et al 2008; Warburton et al 2010).

A prospective cohort study compared the physical activity levels of 253,000 individuals aged 50 to 71 years with the American physical activity recommendation of 30 minutes of moderate-intensity activity on five days per week. It found that participants who met this recommendation had a significantly lower premature mortality rate than those who did not (Leitzmann et al 2007). In addition, among those participants who did 30 minutes of moderate-intensity activity on most days of the week, if they then added 20 minutes of vigorous-intensity activity on three days per week they could reduce their risk of premature mortality by a further 50 percent (Leitzmann et al 2007).

Effective interventions found to reduce the risk of premature mortality from any cause include:

- > 30 minutes or more of moderate- to vigorous-intensity exercise on most days of the week. Health benefits appear to be greater with higher volumes and/or intensities of activity
- > limiting sedentary behaviour and being as physically active as possible.

Based on three systematic reviews and 10 prospective cohort studies.

# Benefits of physical activity for preventing injury from falls

Falls in older people are common. They are the leading cause of injury for those aged over 65 years in New Zealand, accounting for 75 percent of injury-related hospital admissions (ACC 2009). The rate of falls for older adults in New Zealand ranges from 513 falls per 100,000 people aged 65 to 69 years, to 5689 falls per 100,000 people aged over 85 years (NZGG and UWS 2011).

Nine systematic reviews and five randomised control trials were evaluated in relation to the benefits of physical activity for preventing injury from falls in older people.

Seven systematic reviews concluded that physical activity intervention programmes provide benefits for reducing falls in older people (Chang et al 2004; McClure et al 2005; Arnold et al 2008; Sherrington et al 2008; Gillespie et al 2009; Baker et al 2010; Cameron et al 2010).

A systematic review of 41 studies established that <u>supervised</u> physical activity programmes in nursing homes and hospitals reduced the number of falls by 50 percent compared with unsupervised groups (Cameron et al 2010).

In general, programmes that included more than one type of physical activity (aerobic, resistance, balance and flexibility), such as the Otago Exercise Programme, were more likely to reduce the rate of falls in older people compared with single-component programmes (Chang et al 2004; Baker et al 2007; Arnold et al 2008; Sherrington et al 2008; Gillespie et al 2009; Cameron et al 2010). Group-based tai chi, individual home-based physical activity and supervised multiple-component group physical activities were found to be effective for preventing falls (Gillespie et al 2009).

### Effective interventions found to reduce the risk of injury from falls include:

- > mobility and balance interventions, consisting of one to three 60-minute sessions of modified tai chi per week for around 16 weeks
- > one to three sessions of 30 to 90 minutes of mixed aerobic and resistance activity per week for at least four weeks and up to one year.

Based on one systematic review and three randomised controlled trials on mobility and balance, and eight systematic reviews on mixed or various physical activity programmes.

#### Benefits of physical activity for preventing stroke

Three systematic reviews and one prospective cohort study were evaluated in relation to the benefits of physical activity for preventing stroke.

One systematic review concluded that older people who are physically inactive have a much higher risk of ischaemic, haemorrhagic and total stroke than those who are physically active (Warburton et al 2010). Another systematic review of 23 studies found the risk of all types of stroke was 27 percent lower in highly active individuals compared with those who were physically inactive (Lee et al 2003).

The third systematic review concluded that the risk of stroke was 36 percent lower for participants with physically active occupations and 15 percent lower for individuals who participated in physical activity for leisure compared with those who were physically inactive (Wendel-Vos et al 2004).

In a cohort study, Myint et al (2009) investigated lifestyle behaviour and stroke risk. They found that physical inactivity, alongside other lifestyle factors such as poor nutrition, smoking and excessive alcohol consumption, can increase the risk of stroke.

#### Effective interventions found to reduce the risk of stroke<sup>\*</sup> include:

- > 30 to 60 minutes of moderate- to vigorous-intensity aerobic endurance sessions on five days per week
- > three 60-minute sessions of moderate- to vigorous-intensity interventions involving mixed or various types of physical activity
- > brisk walking for 30 minutes on most days of the week.

Based on three systematic reviews and one prospective cohort study.

#### Benefits of physical activity for preventing heart disease

Four systematic reviews, five randomised controlled trials and two prospective cohort studies were evaluated in relation to the benefits of physical activity for preventing heart disease. All four systematic reviews consistently showed evidence that physical activity is a key factor in preventing heart disease (Kelley et al 2001; Taylor et al 2004; Thomas et al 2007; Warburton et al 2010).

Two systematic reviews (Kelley et al 2001; Taylor et al 2004) and one randomised controlled trial (Huang et al 2006) found a reduction in systolic blood pressure from physical activity when at rest. Positive improvements in diastolic blood pressure at rest were also seen in a randomised controlled trial (Huang et al 2006).

A systematic review of 66 studies found higher levels of physical activity could lower the risk for cardiovascular disease and hypertension in community-dwelling older people (aged between 65 and 85 years) compared with lower levels of physical activity (Warburton et al 2010).

Older people who participated in regular physical activity had beneficial changes in blood triglycerides according to one systematic review (Thomas et al 2007). Similar benefits were also found in two randomised controlled trials (Villareal et al 2006a, 2006b).

Warburton et al (2006) addressed primary and secondary prevention of cardiovascular disease across all ages in a large narrative review. The narrative review indicated that there is strong and compelling evidence that physical activity helps to prevent cardiovascular disease and many other chronic diseases.

#### Effective interventions found to reduce the risk of heart disease include:

- > two sessions, each lasting 12 to 60 minutes, of moderate- to vigorous-intensity aerobic endurance interventions per week
- > three to four sessions of mixed or various types of physical activity interventions per week, lasting about 53 minutes at a medium- to high-intensity heart rate
- > one to five sessions, each lasting 15 to 60 minutes, of moderate- to vigorous-intensity aerobic endurance activity per week over four to 52 weeks, along with three 50-minute resistance sessions per week
- > 30- to 60-minute sessions of moderate- to vigorous-intensity aerobic endurance activity on five days per week
- > one hour of brisk walking per week, as higher volume and/or intensities of activity appear to provide greater health benefits.

Based on four systematic reviews, five randomised controlled trials and two prospective cohort studies.

#### Benefits of physical activity for preventing cancer

Higher levels of physical activity and lower levels of sedentary behaviour may be a significant factor in the prevention of colon cancer, postmenopausal breast cancer and endometrial cancer (WCRF and AICR 2007).

The World Cancer Research Fund (WCRF) and American Institute for Cancer Research (AICR) report that several large studies in the USA have found links between physical inactivity and overall cancer risk. Physical activity may protect against certain cancers (particularly postmenopausal breast and colon) due to its positive influence on hormone levels, energy balance and the ability for the body to consume more food and good nutrients without putting on unhealthy weight. There is no minimum or maximum threshold for physical activity as even small increases can help to protect against the risk of cancer; however, greater risk reduction was observed with increasing levels of physical activity (WCRF and AICR 2007).

Two systematic reviews and five prospective cohort studies were evaluated in the literature review in relation to the benefits of physical activity for preventing certain cancers (including postmenopausal breast and colon) in older people.

Two systematic reviews and two prospective cohort studies found that the risk of postmenopausal breast cancer was lower in older women who undertook regular moderate or vigorous physical activity compared with older women who were physically inactive (Bardia et al 2006; Dallal et al 2007; Monninkhof et al 2007; Warburton et al 2010).

One systematic review reported the mean risk of postmenopausal breast cancer was 27 percent lower in older women who were physically active compared with those who were physically inactive (Warburton et al 2010). A dose-response relationship was evident in the other systematic review; for every additional hour spent exercising, a 6 percent decrease in the risk of postmenopausal breast cancer was observed (Monninkhof et al 2007).

A prospective cohort study followed 151,000 older people over six years (Chao et al 2004). It found that the risk of colon cancer decreased in proportion to the amount of time spent being physically active per week. Older people who report the least physical activity relative to more active older people in the population are often shown to have a higher risk of colon cancer (Chao et al 2004; Warburton et al 2010). Chao et al (2004) concluded that the risk of colon cancer decreased significantly when both MET hours and total hours of physical activity were increased.

### Effective interventions found to reduce the risk of cancer (particularly postmenopausal breast cancer and colon cancer) include:

- > 30 minutes of moderate- to vigorous-intensity aerobic endurance sessions on five days per week
- > mixed or various types of physical activity interventions (although the detail of the nature of those interventions has not been reported).
- > The World Cancer Research Fund and American Institute for Cancer Research recommend:
- > being moderately physically active, equivalent to brisk walking, for at least 30 minutes every day
- > aiming for 60 minutes or more of moderate-intensity, or 30 minutes or more of vigorous-intensity, physical activity every day as fitness improves
- > limiting sedentary habits such as watching television.

Based on two systematic reviews and five prospective cohort studies.

# **Managing health conditions**

Physical activity is beneficial for managing stroke, peripheral vascular disease, heart disease, arthritis, weight (and for reducing obesity), type 2 diabetes, and depression. There is also some evidence indicating that physical activity may help in the management of some cancers, pulmonary diseases, neurological diseases (such as Parkinson's, dementia and Alzheimer's), disability and sleep disorders, but further evidence is required to confirm this link. For examples of suitable activities for managing various health conditions, see Table 2.

This chapter briefly summarises findings from the literature review on the role of physical activity in managing relevant health conditions in older people. All references come from the literature review unless stated otherwise.

Each section in this chapter summarises effective interventions for managing a specific health condition. To manage that particular health condition, older people could consider including one or more of the interventions as part of meeting the recommendations.

The effective interventions identified in the studies may have included participants under the age of 65 years, but all groups of participants had a median age of 65 years or over. The results of the effective interventions were usually compared with results linked to no physical activity.

As with the earlier recommendations, older people with certain health conditions should increase their activity levels gradually, building up to the recommended levels or to a level that they are capable of doing. Older people should see an appropriate health practitioner before changing their activity levels or if they have existing health conditions. If an older person experiences pain during physical activity, they should stop immediately and see a doctor.



#### Benefits of physical activity for managing stroke

Three systematic reviews and two randomised controlled trials were evaluated in relation to the benefits of physical activity for managing stroke.

A systematic review of 2000 participants found that gait-speed and walking distance were improved by gait-oriented training programmes, and that specific aerobic endurance programmes can benefit unassisted walking and stair climbing ability in older people who have had a stroke (van de Port et al 2007; Saunders et al 2009). A further systematic review found that resistance activity programmes can reduce the impact of musculoskeletal impairment in older people who have had a stroke (Morris et al 2004).

Two randomised controlled trials found evidence that overall fitness, mobility, leg strength and bone density can be improved by a variety of physical activity interventions in older people who have had a stroke (Marigold et al 2005; Pang et al 2005).

#### Effective interventions found to manage stroke include:

- > three to five sessions, each lasting 30 to 60 minutes, of aerobic endurance activity over eight weeks (the level of intensity is not specified)
- > two to five sessions of resistance activities per week, over 4 to 12 weeks (the level of intensity is not specified)
- > three to five mobility and balance interventions per week (studies vary widely in the session duration, and some are at low intensity while others do not specify an intensity)
- > three 60-minute sessions of moderate- to vigorous-intensity mixed or various types of physical activity interventions over 19 weeks.

Based on one systematic review on aerobic endurance programmes, one systematic review on resistance activities, and one systematic review and one randomised controlled trial on mobility and balance interventions.

# Benefits of physical activity for managing peripheral vascular disease

One randomised controlled trial and three systematic reviews were evaluated in the literature review in relation to the benefits of physical activity for managing peripheral vascular disease.

Two systematic reviews of 1600 older people in 28 randomised controlled trials found that being physically active wherever possible helps to manage peripheral vascular disease in older people (Ashworth et al 2005; Watson et al 2008). Improvements to walking time, distance covered without pain, and blood flow were all seen in the studied walking programmes (Watson et al 2008).

A systematic review of physical activity programmes found that programmes involving walking, leg exercises and treadmill exercises supervised by a physiotherapist were often successful for managing intermittent claudication (pain in the legs when walking) in older people (Watson et al 2008). A systematic review analysed whether supervised treadmill programmes offered any benefit over unsupervised walking programmes for the management of intermittent claudication. Both programmes were considered to be of benefit, but the supervised treadmill showed more marked reductions in intermittent claudication in older people (Bendermacher et al 2006).

In a randomised controlled trial, McDermott et al (2009) found that both treadmill and resistance-based programmes benefited walking performance and quality of life. In addition, treadmill programmes increased blood flow, and resistance-based programmes improved stair climbing ability.

### Effective interventions found to manage peripheral vascular disease include:

- > 90 to 120 minutes of moderate- to vigorous-intensity walking for three to five sessions per week, over 12 to 24 weeks
- > three sessions, each lasting 15 to 40 minutes, of resistance activities per week over 24 weeks, building from 50 percent to 80 percent intensity of the older person's maximum personal resistance rate
- > 30 to 60 minutes of mixed or various types of physical activity interventions, consisting of walking and leg exercises, two or three times per week.

Based on two systematic reviews and one randomised controlled trial on aerobic endurance programmes, and one randomised controlled trial on resistance activities.

# Benefits of physical activity for managing heart disease

Four systematic reviews and three randomised controlled trials were presented in relation to the benefits of physical activity for managing heart disease. Many of the studies looked at centre- or home-based aerobic and resistance activities.

In a systematic review of 48 randomised controlled trials, a 25 percent reduction in cardiac mortality was observed in older people on cardiac rehabilitation programmes compared with older people receiving standard medical care only (Taylor et al 2004). Risk factors such as total cholesterol and triglyceride levels in people with existing heart failure can be managed by cardiac rehabilitation programmes that include physical activity as a key component (Taylor et al 2004).

Two systematic reviews of 29 randomised controlled trials found that home- and centrebased programmes were equally beneficial, but that older people were more likely to adhere to the home-based programmes (Chien et al 2008; Davies 2010).

A systematic review of 19 randomised controlled trials found that aerobic endurance activity programmes helped to reduce short- and long-term hospital admission and improve quality of life for older people with heart failure (Davies 2010).

Two randomised controlled trials both found positive benefits for older people with existing heart disease (Hung et al 2004; Wisløff et al 2007). The first trial compared a single component aerobic training group with a combined aerobic and resistance activity group. Both groups showed an improvement in aerobic capacity, quality of life, distance walked over six minutes, lower body strength and emotional quality of life; the combined group also showed increased upper body strength and improved social quality of life (Hung et al 2004). The second trial evaluated an aerobic endurance training programme and found that higher-intensity aerobic activity had positive effects on left ventricle remodelling, aerobic capacity and quality of life in the people sampled with heart disease (Wisløff et al 2007).

#### Effective interventions found to manage heart disease include:

- > 15 to 120 minutes of moderate- to vigorous-intensity sessions of aerobic endurance activity, two to seven days per week, over eight weeks
- > 20 to 60 minutes of moderate- to vigorous-intensity sessions involving mixed or various types of physical activity, three to five days per week, over 2 to 24 weeks.

Based on three randomised controlled trials on aerobic endurance programmes, and three systematic reviews and two randomised controlled trials on mixed or various physical activity programmes.

#### Benefits of physical activity for managing arthritis

Arthritic pain tends to be cyclical in its severity. Aggravation on days of severe pain should be limited and treated with anti-inflammatory medication prescribed by an appropriate health professional. Small repetitive movements and high-impact exercise should be avoided as they can aggravate the arthritic joint.

Four systematic reviews and five randomised controlled trials were evaluated in relation to benefits of physical activity for managing arthritis. Programmes were mixed in their activity types (flexibility, resistance and aerobic endurance).

Two of the systematic reviews found that physical activity can reduce pain in arthritic populations (Brosseau et al 2003; Fransen and McConnell 2008) and increase gait stability (Brosseau et al 2003). In a systematic review of 3600 participants in 32 trials, Fransen and McConnell (2008) strongly linked increased physical activity with reduced knee pain and improved physical function for older people with osteoarthritis of the knee.

Two systematic reviews and two randomised controlled trials found that physical activity programmes tailored to older people with arthritis are likely to improve aerobic capacity, physical performance and physical functioning (Brosseau et al 2003; Messier et al 2004; Suetta et al 2004; Fransen et al 2007). One randomised controlled trial replicated these results in overweight older people with arthritis when combined with weight loss (Messier et al 2004).

Both high- and low-intensity cycling was beneficial for decreasing pain and improving gait stability, functional status and aerobic capacity (Brosseau et al 2003). Land- and water-based physical activities showed positive short-term outcomes for older people with arthritis, but it was suggested that older people may prefer water-based activities and are more likely to persevere with them (Bartels et al 2007; Fransen et al 2007; Fransen and McConnell 2008).

### Effective interventions found to manage arthritis (particularly osteoarthritis) include:

- > two to three sessions, each lasting 30 to 60 minutes, of aerobic endurance activity per week (such as cycling at low or high intensity and aquatic physical activity at moderate intensity), over 6 to 52 weeks
- > two or three resistance activity sessions per week with multiple sets of several exercises
- > two 60-minute sessions of tai chi or hydrotherapy mobility and balance exercises per week
- > two or more mixed or various types of physical activity interventions per week, lasting 30 to 90 minutes each session.

Based on two systematic reviews on aerobic endurance programmes, one systematic review and one randomised controlled trial on resistance activities, one randomised controlled trial on mobility and balance programmes, and two systematic reviews and two randomised controlled trials on mixed or various programmes.

#### Benefits of physical activity for managing weight and reducing obesity

One systematic review and five randomised controlled trials were evaluated in relation to the benefits of physical activity for managing weight and reducing obesity.

A systematic review of 27 studies discovered that older people with obesity can benefit from regular moderate- and vigorous-intensity physical activity; however, resistance activities may be better than aerobic endurance activities as a fat reduction method (Kay et al 2006).

Two randomised controlled trials by Villareal et al (2006a, 2006b) focused on a lifestyle intervention consisting of six months of weight loss behaviour therapy in conjunction with a physical activity programme run three times per week. Results showed that participants' body weight, fat mass, waist circumference, plasma glucose, triglycerides and blood pressure lowered significantly compared with the control group. The participants in the trials also improved their physical performance, aerobic capacity, strength, walking speed and physical health scores.

Television viewing and sitting for long periods were associated with an increased risk of obesity and type 2 diabetes. The more time spent sitting, the higher the risk of obesity and type 2 diabetes, independent of physical activity (Hu et al 2003).

Physical activity interventions that focus on diet and physical activity together, rather than separately, are more likely to be effective for managing weight in older people. Older people looking to manage weight and reduce obesity can refer to the Ministry of Health's food and nutrition guidelines for healthy older people for information on diet.

Physical activity for older people with obesity should be realistic and achievable. Activities that easily fit into people's daily lives and are enjoyable, such as walking, cycling or dance, are more likely to be continued than those that are not compatible or enjoyable (NOO 2010). Older people who were obese and have lost weight may need to be active for 60 to 90 minutes a day to avoid regaining weight (NOO 2010).

### Effective interventions found to manage weight and reduce obesity include:

- > three 60-minute sessions of high-intensity resistance activity per week, over six months (high intensity was more effective than low intensity during this study)
- > 30 to 90 minutes of interventions involving moderate-intensity mixed or various types of physical activity, two to four times per week, over 8 to 60 weeks.

Based on one randomised controlled trial on resistance activities, and one systematic review and three randomised controlled trials on mixed or various physical activity programmes.

#### Benefits of physical activity for managing type 2 diabetes (including metabolic syndrome)

Two systematic reviews and four randomised controlled trials were evaluated in relation to the benefits of physical activity for managing type 2 diabetes.

One systematic review and meta-analysis of 14 randomised controlled trials concluded that physical activity is beneficial for stabilising blood glucose levels, reducing the level of visceral adiposity and triglycerides, and reducing insulin resistance (Thomas et al 2007). The second systematic review also found that moderate- to high-intensity physical activity is beneficial for people with type 2 diabetes (Kay et al 2006).

One randomised controlled trial compared a group of older people with type 2 diabetes on a combined aerobic endurance and resistance activity programme with a sedentary control group. The results established that the active group were able to decrease their insulin resistance and functional limitations significantly more than the sedentary group (Davidson et al 2009).

#### An effective intervention found to manage type 2 diabetes is:

> moderate-intensity sessions of mixed or various types of physical activities over 8 to 52 weeks (studies vary widely in the duration and frequency).

Based on one systematic review and two randomised controlled trials on mixed or various activity programmes.

# Benefits of physical activity for managing depression

Three systematic reviews and five randomised controlled trials were evaluated in relation to the benefits of physical activity for managing depression.

Research from the three systematic reviews found a clear link between participation in physical activity and a reduction in depressive symptoms for older people, especially when participants complied strictly with an intervention programme (Frazer et al 2005; Sjösten and Kivelä 2006; Blake et al 2009).

Four of the five randomised controlled trials concluded that aerobic endurance and resistance activity, or combined physical activity interventions, are successful for reducing depression in older people (Motl et al 2005; Singh et al 2005; Blake et al 2009; Kerse et al 2010). Further evidence from one randomised controlled trial found that higher-intensity progressive resistance activity is more beneficial than lower-intensity progressive resistance activity for treating depression (Singh et al 2005).

#### Effective interventions found to manage depressive symptoms include:

- > 10 to 45 minutes of moderate-intensity aerobic endurance sessions (walking) three times per week for six months
- > 60 minutes of high- or low-intensity resistance activity sessions, three times per week over eight weeks (high-intensity resistance activity was more effective than low-intensity)
- > three 20- to 60-minute sessions of mixed or various types of physical activity per week, for at least six weeks.

Based on one randomised controlled trial on aerobic endurance training, one randomised controlled trial on resistance activities, and one systematic review and three randomised controlled trials on mixed or various physical activity programmes.

# Enhancing quality of life and independence

Physical activity is important for enhancing the quality of life and independence of older people as it helps them perform normal daily activities and maintain social independence. If physical activity is not maintained into older age, physiological changes can result in older people functioning below the level required to live independently (Young 1992). For examples of suitable activities for enhancing quality of life and independence, see Table 2.

This chapter briefly summarises findings from the literature review on the role of physical activity in enhancing the quality of life and independence in older people. All references come from the literature review unless stated otherwise.

Each section in this chapter summarises effective interventions for enhancing a particular aspect of quality of life and independence. To enhance that particular aspect, older people could consider including one or more of the interventions as a part of meeting the recommendations.

The effective interventions identified in the studies may have included participants under the age of 65 years, but all groups of participants had a median age of 65 years or over. The effective interventions were usually compared to no physical activity.

As with the earlier recommendations, older people with certain health conditions

should increase their activity levels gradually, building up to the recommended levels or to a level that they are capable of doing. Older people should see an appropriate health practitioner before changing their activity levels or if they have existing health conditions. If an older person experiences pain during physical activity, they should stop immediately and see a doctor.



#### Benefits of physical activity for enhancing wellbeing and quality of life

Enhancing physical functioning, cognitive functioning and physical fitness can contribute towards enhancing wellbeing, quality of sleep and overall quality of life for healthy older people and those with certain diseases or conditions.

Eight systematic reviews, eleven randomised controlled trials and a prospective cohort study were evaluated in relation to the benefits of physical activity for enhancing wellbeing and quality of life. Nineteen of the 20 studies concluded that physical activity is beneficial for enhancing quality of life and wellbeing (Montgomery and Dennis 2002; Hung et al 2004; Mador 2004; Taylor et al 2004, 2010; Windsor et al 2004; Kerse et al 2005; Netz et al 2005; Güell et al 2006; Baker et al 2007; Heesch et al 2007; Luctkar-Flude et al 2007; Dubbert et al 2008; Holland and Hill 2008; Courtney et al 2009; McDermott et al 2009; Morey et al 2009; Davies 2010; Windle et al 2010).

One systematic review concluded physical activity can aid sleep quality in older people (Montgomery and Dennis 2002). A randomised controlled trial concluded that physical activity could enhance vitality as well as decrease hospitalisations (Kerse et al 2005).

### Effective interventions found to enhance wellbeing and quality of life include:

- > three sessions, each lasting 15 to 47 minutes, of moderate-intensity aerobic endurance activities per week
- > three sessions, each lasting 15 to 60 minutes, of medium- to high-intensity resistance per week
- > two to seven sessions, each lasting 15 to 120 minutes, of moderate- to vigorousintensity mixed or various physical activity per week.

### An effective intervention found to enhance wellbeing and quality of life in older people who are frail is:

> one to three mixed physical activity sessions of 45 to 60 minutes per week (although the intensity and timeline are not specified).

Based on one systematic review and three randomised controlled trials on aerobic endurance programmes, two randomised controlled trials on resistance activities, and five systematic reviews and five randomised controlled trials on mixed or various physical activity programmes.

# Benefits of physical activity for enhancing physical functioning and mobility

Physical functioning is the ability of an older person to engage in activities of daily living and is closely related to physical fitness. Ongoing participation in physical activity is important for older people to gain long-term physical functioning benefits (Howe et al 2007; Liu and Latham 2009).

Seven systematic reviews and 10 randomised controlled trials were evaluated in relation to the benefits of physical activity for enhancing physical functioning.

Fourteen of the 17 articles concluded that physical activity is beneficial for physical functioning aspects including mobility, physical ability, strength, flexibility and balance in older people (Seynnes et al 2004; Kalapotharakos et al 2005; Pahor et al 2006; Greenspan et al 2007; Howe et al 2007; Kerse et al 2008; Orr et al 2008; Paw et al 2008; Peri et al 2008; Forster et al 2009, 2010; Liu and Latham 2009; Mänty et al 2009; Pettersen et al 2009).

Evidence from three systematic reviews of older people found mixed activity programmes with gait, balance, coordination, resistance and other physical activity components have positive outcomes for balance and physical functioning (Howe et al 2007; Orr et al 2008; Forster et al 2010).

### Effective interventions found to enhance physical functioning and balance include:

- > 30- to 60-minute sessions of moderate-intensity aerobic endurance activity three times per week, over 4 to 26 weeks
- > two to three resistance activity sessions per week, consisting of multiple sets of resistance exercises, done at a wide range of intensities, over 2 to 78 weeks
- > two to five sessions of mobility and balance activity, lasting from 8 to 120 minutes (but typically around 60 minutes), over 3 to 52 weeks
- > two to five sessions of mixed or various physical activity, done at a range of intensities, typically lasting 30 to 90 minutes, over 4 to 112 weeks.

### Effective interventions found to enhance physical functioning and balance in older people who are frail include:

- > high-intensity free weight training, three times per week supervised by a physiotherapist (high-intensity training was more effective than lower-intensity training)
- > three 90-minute sessions of high-intensity aerobic endurance and resistance activity per week, to effectively increase physical function and mobility.

Based on three systematic reviews and two randomised controlled trials on aerobic endurance programmes, three systematic reviews and six randomised controlled trials on resistance activities, one systematic review and two randomised controlled trials on mobility and balance, four systematic reviews and 10 randomised controlled trials on mixed or various physical activity programmes.

#### Benefits of physical activity for enhancing physical fitness including aerobic capacity, strength and balance

Physical fitness is the ability to carry out activities with appropriate stamina, and with enough energy left to enjoy leisure-time pursuits (Mosby 2009). Physical fitness is more specific than physical functioning as it relates to types of activities carried out over and above daily tasks. Physical fitness includes a number of components including cardiorespiratory endurance (aerobic), skeletal muscle endurance, skeletal muscle strength, skeletal muscle power, flexibility, balance, speed of movement, reaction time and body composition (CDC 2012).

Six systematic reviews and 18 randomised controlled trials were evaluated in relation to the benefits of physical activity for enhancing physical fitness.

A meta-analysis of physical activity interventions found that moderate- to vigorousintensity aerobic endurance activity can improve body composition and aerobic capacity, and resistance activities can reduce body fat and increase strength in older people (Shekelle et al 2003). In a randomised controlled trial, Haykowsky et al (2005) also established that muscle strength and aerobic capacity could be enhanced by resistance activity or mixed activity programmes.

A systematic review of 49 studies found that 30 to 45 minutes of exercise, three times per week, can improve physical fitness (Forster et al 2009). Eight randomised controlled trials all found that moderate-intensity resistance activity is beneficial for physical fitness, especially strength, but that higher-intensity resistance activity was even more beneficial (Fatouros et al 2005; Kalapotharakos et al 2005; Ginis et al 2006; Sullivan et al 2007; Wieser and Haber 2007; Rydwik et al 2008, 2010; Verdijk et al 2009).

A moderate- to vigorous-intensity cycling programme improved overall physical fitness in older people, especially when related to cardiac stroke volume and heart rate in a randomised controlled trial by Gass et al (2004). In an additional randomised controlled trial by Broman et al (2006), older people improved their maximum aerobic power, maximum ventilation and submaximal work capacity when assigned to an exercise group that did high-intensity running in deep water, compared with a standard control exercise group.

A strong dose-response relationship between training intensity with free weights and strength plus functional gains was found during a randomised controlled trial of 22 older people who were frail and in residential care. This study also established that supervised resistance activities with free weights were safe for frail older people in rest homes (Seynnes et al 2004).

All 24 papers that were evaluated reported positive benefits related to one or more types of physical fitness (aerobic capacity, strength or balance) in the older people studied (Binder et al 2002; Shekelle et al 2003; Gass et al 2004; Latham et al 2004; Seynnes et al 2004; Suetta et al 2004; Takeshima et al 2004; Fatouros et al 2005; Galvão and Taaffe 2005; Haykowsky et al 2005; Kalapotharakos et al 2005; Symons et al 2005; Broman et al 2006; Ginis et al 2006; Kay and Fiatarone Singh 2006; Pogliaghi et al 2006; Sullivan et al 2007; Wieser and Haber 2007; Angevaren et al 2008; Rydwik et al 2008, 2010; Liu and Latham 2009; Verdijk et al 2009; Forster et al 2010).

#### Effective interventions found to enhance aerobic capacity include:

- > two to three sessions, each lasting 30 to 60 minutes, of moderate- to vigorousintensity aerobic endurance sessions per week, over 8 to 12 weeks
- > two to three sessions of multiple-set, medium-intensity resistance activity per week, over 12 weeks
- > three sessions, each lasting 50 to 90 minutes, of moderate- to high-intensity mixed physical activity per week, over 8 to 19 weeks.

Based on three systematic reviews and five randomised controlled trials on aerobic endurance programmes, two randomised controlled trials on resistance activities, and five randomised controlled trials on mixed or various physical activity programmes.

#### Effective interventions found to enhance strength include:

- > three 30-minute sessions of moderate- to vigorous-intensity aerobic endurance activity, over eight weeks
- > two to three sessions of multiple-set, mixed-intensity resistance activity per week, over 2 to 102 weeks
- > three to five programmes, each lasting 50 to 90 minutes, involving mixed or various physical activity at moderate to vigorous intensity, over 8 to 52 weeks.

Based on one randomised controlled trial on aerobic endurance, three systematic reviews and eleven randomised controlled trials on resistance activities, and eight randomised controlled trials on mixed or various physical activity programmes.

#### Effective interventions found to enhance balance include:

- > three 60-minute sessions of aerobic endurance activity per week, over 4 to 52 weeks
- > three sessions, each lasting 35 to 90 minutes, of multiple exercise resistance activity at varied intensities per week (timeline was not specified)
- > one to five 60-minute mobility and balance sessions per week over 4 to 52 weeks (intensity was not specified)
- > three sessions, each lasting 30 to 60 minutes, of mixed or various physical activity over 4 to 52 weeks (intensity was not specified).

Based on one systematic review on aerobic endurance programmes, two systematic reviews on resistance activities, one systematic review and three randomised controlled trials on balance and mobility programmes, and two systematic reviews and one randomised controlled trial on mixed or various physical activity programmes.

### An effective intervention found to enhance strength in older people who are frail is:

> two 60-minute aerobic endurance, resistance and balance sessions per week, over 12 weeks.

# Benefits of physical activity for enhancing cognitive functioning

Cognitive functioning refers to the retention and recollection of information by a person's brain; it can include memory recall, speech, reading and the ability to learn and understand new information. Ageing and disease may have an adverse effect on cognitive functioning over time.

Two systematic reviews, six randomised controlled trials and one prospective cohort study were evaluated in the literature review in relation to the benefits of physical activity for enhancing cognitive function.

The two systematic reviews, based on 171 studies, found a positive correlation between moderate physical activity and cognitive benefits (Angevaren et al 2008; Kruger et al 2009).

Angevaren et al (2008) established that aerobic activity could improve cognitive capacity such as motor function and auditory attention in older people. This systematic review also found that there were other significant benefits to cognitive enhancement such as improved information processing speed and visual attention (Angevaren et al 2008). Kruger et al (2009) found that the level of physical activity given to trial participants was often lower than recommended levels and that the benefits could be greater than shown in the studies if recommended levels were followed.

Programmes to identify the best physical activities to improve cognitive functioning were compared in three randomised controlled trials. Benefits from tai chi, agility and weight shifting were seen in several groups due to improvements in postural reflex and step reaction time (Marigold et al 2005; Voukelatos et al 2007; Taylor-Piliae et al 2010). In addition, it is accepted that a good mind-body connection can significantly prevent older people from falling (Marigold et al 2005).

One randomised controlled trial concluded that 'physical activity is an inexpensive treatment with preventative and restorative properties for cognitive and brain function' (Kramer and Erickson 2007).

#### Effective interventions found to enhance cognitive functioning include:

- > one to five sessions, each lasting 30 to 90 minutes, of moderate- to vigorous-intensity aerobic endurance activity per week, over 12 to 48 weeks
- > two 60-minute sets of six to eight resistance exercise repetitions per week, over 52 weeks
- > four to five 60-minute moderate-intensity mobility and balance exercises per week, over 52 weeks.

Based on two systematic reviews and two randomised controlled trials on aerobic endurance programmes, one randomised controlled trial on resistance activities, and one randomised controlled trial on mobility and balance interventions.

# Glossary

Activities of daily living (ADLs) are activities such as housework, washing the car and gardening that are carried out as part of everyday life.

**Aerobic** (or cardiovascular endurance) activities require continuous and rhythmic movement of the major muscles for a sustained period (10 minutes or more).

**Balance** activities are static and dynamic exercises designed to improve an individual's ability to withstand instability caused by movement, the environment or other objects.

**Borg Rating of Perceived Exertion (RPE or the Borg scale)** is a subjective self-rating energy scale based on the physical sensations a person experiences during physical activity.

**Chairobics** is a sit-down exercise class that uses low-impact aerobic routines to meet the needs of people with limited movement.

**Duration** is the length of time over which an activity or exercise is performed. Duration is generally expressed in minutes.

**Effective interventions** where randomised controlled trials have identified outcomes that differ from control groups to a statistically significant level; or systematic reviews that have identified statistically significant differences and/or those authors have drawn conclusions about from the systematic reviews.

**Exercise** is a subcategory of physical activity that is planned, structured and repetitively performed to improve or maintain physical fitness, physical performance or overall health.

**Flexibility** is the range of motion possible at a joint. Flexibility is specific to each joint and depends on a number of variables such as the tightness of specific ligaments.

**Frail older person** is an older person with limited physical function or with deterioration of the musculoskeletal, cardiovascular, metabolic and/or immunological systems.

**Frequency** is the number of times or sessions per week that physical activity is performed.

Hapū is a sub-tribe.

**Intensity** is the effort required by an individual to perform physical activity and is individually determined. Intensity can be measured using metabolic equivalents (METs) or the Borg scale.

**Light-intensity** activities (1.5 to 2.9 METs or 6 to 11 on the Borg scale) are daily activities that take little effort but contribute to total daily energy expenditure.

**Moderate-intensity** activities (3 to 6 METs or 12 to 14 on the Borg scale) cause a slight but noticeable increase in breathing and heart rate. Individuals can chat during moderate-intensity activity. Moderate intensity aerobic training is at 50–70 percent of an individual's maximum heart rate.

**Vigorous-intensity** activity (7 to 10 METs or 15 to 20 on the Borg scale) is performed at more than 70 percent of an individual's maximum heart rate. Vigorous-intensity activities significantly raise breathing and heart rate and individuals are not able to chat during the activity.

Iwi is a tribe.

Kapa haka is a traditional Māori performance often in the form of a cultural dance.

Kaumātua are Māori elders who can influence community decision-making.

Kilikiti is a modified version of cricket played by Pacific peoples.

Koroua is an elderly Māori man.

Kuia is an elderly Māori woman.

**Major muscles** are divided into five main groups: arms, legs, chest, abdominals and back.

**Mātauranga Māori** means the understanding of Māori knowledge passed down from ancestors including Māori world view, language and cultural practices.

**Metabolic equivalents (METs)** are a measurement of energy expenditure. One MET is the energy required to perform vital core functions for one minute at rest, such as breathing and pumping blood round the body.

**Mixed activity interventions** are structured programmes involving multiple types of activity (aerobic endurance, resistance, mobility and balance).

**Mobility and balance interventions** are structured programmes involving multiple intermittent movements aimed at maintaining control of the body to avoid falling, improving gait function, and building coordination, flexibility, muscular strength and endurance.

**Modified tai chi** is a style of tai chi developed for older people that focuses on preventing falls by improving lower limb strength and balance.

Morbid obesity is commonly defined as a body mass index of 40 to 50 kg/m<sup>2</sup>.

**Partially or insufficiently active** in this document refers to an older person who is not sufficiently active to meet the physical activity guidelines.

Petanque is the traditional game of French bowls.

*Physical activity* is movement produced by the skeletal muscles that uses energy above resting level.

**Physically inactive** in this document refers to an older person who reports less than 30 minutes of activity per week.

**Poi toa** is a traditional Māori activity used in action songs and dances. Traditionally, skills developed while practising poi toa were transferable to weaponry use and fighting.

**Obesity** is commonly defined as a body mass index of  $30-35 \text{ kg/m}^2$ .

**Older person** in this document refers to someone aged 65 years and over. This definition is consistent with the definition used to report on statistics from New Zealand and overseas. It is also consistent with the current age of entitlement for superannuation in New Zealand.

**Regularly physically active** describes a person who does at least 30 minutes of moderate- to vigorous-intensity physical activity on five or more days of the week.

**Resistance** or strength activities involve creating resistance to help increase skeletal muscle strength, power, endurance and muscle mass. Resistance in this document is expressed in terms of low, medium or high intensity:

**Low intensity** is performed at 20 percent of a person's maximum personal resistance rate.

**Medium intensity** is performed at 50 percent of a person's maximum personal resistance rate.

**High intensity** is performed at 80 percent of a person's maximum personal resistance rate.

**Sedentary behaviour** involves participating in activities that require little or no energy expenditure above resting level (ie, 1 MET). Examples of sedentary activities include sitting, watching TV or other screen-based entertainment, and reading.

**Tikanga** are customs, values and traditions that have been handed down through generations.

**Waka ama** is the activity of paddling a traditional outrigger canoe. It is an integral part of the culture of Māori and Pacific peoples.

Weight-shifting involves full or partial transfer of body weight from one foot to another.

Whakapapa is the Māori genealogy.

Whakawhanaungatanga is the recitation of genealogies or stories about the world.

Whānau is the extended family group.

## References

ACC. 2008. ACC4940 Stay on Your Feet and Stay Active: Vitamin D information booklet for older adults in residential care facilities. Wellington: Accident Compensation Corporation.

ACC. 2009. Information for health professionals. URL: www.acc.co.nz/preventing-injuries/at-home/older-people/information-for-health-professionals/index.htm (accessed 1 March 2012).

ACAL. 2012. Factors affecting participation: The social environment. Alberta Centre for Active Living. URL: www.centre4activeliving.ca/physical-activity-for-all/ecological/social.html (accessed 1 May 2012).

Angevaren M, Aufdemkampe G, Veerhaar H, et al. 2008. Physical activity and enhanced fitness to improve cognitive function in older people without known cognitive impairment. *Cochrane Database of Systematic Reviews* (3), art no. CD005381.

Arnold C, Sran M, Harrison E. 2008. Exercise for fall risk reduction in community-dwelling older adults: a systematic review. *Physiotherapy Canada* 60(4): 358–72.

Ashworth N, Chad K, Reeder B, et al. 2005. Home versus center based physical activity programs in older adults. *Cochrane Database of Systematic Review* (1), art no. CD004017.

Baker L, Atlantis E, Singh M. 2010. Effects of aerobic exercise on mild cognitive impairment. *Archives of Neurology* 67(1): 71–9.

Baker M, Atlantis E, Singh M. 2007. Multi-modal exercise programs for older adults. *Age and Ageing* 36: 375–81.

Bardia A, Hartmann L, Vachon C. 2006. Recreational physical activity and risk of postmenopausal breast cancer based on hormone receptor status. *Archives of Internal Medicine* 166(22): 2478–83.

Barrett P, Twitchin S, Kletchko S, et al. 2006. The living environments of community-dwelling older people who become frail: another look at the living standards of older New Zealanders. *Social Policy Journal of New Zealand* 28: 133–57.

Bartels E, Lund H, Hagen K, et al. 2007. Aquatic exercise for the treatment of knee and hip osteoarthritis. *Cochrane Database of Systematic Reviews* (4), art no. CD005523.

Bendermacher B, Willingendael E, Teijink J, et al. 2006. Supervised exercise therapy versus nonsupervised exercise therapy for intermittent claudication. *Cochrane Database of Systematic Reviews* (2), art no. CD005263.

BHFNC. 2012. Interpreting physical activity guidelines for older adults. British Heart Foundation National Centre for Physical Activity and Health. URL: www.bhfactive.org.uk/homepage-resources-and-publications-item/334/index.html (accessed 15 October 2012).

Binder E, Schechtman K, Ehsani A, et al. 2002. Effects of exercise training on frailty in communitydwelling older adults: results of a randomized controlled trial. *Journal of the American Gereatrics Society* 50(12): 1921–8.

Blake H, Mo P, Malik S, et al. 2009. How effective are physical activity interventions for alleviating depressive symptoms in older people? A systematic review. *Clinical Rehabilitation* 23(10): 873.

Borg G. 1998. Borg's Perceived Exertion and Pain Scales. Champaign, Illinois: Human Kinetics.

Broman G, Quintana M, Lindberg T, et al. 2006. High intensity deep water training can improve aerobic power in elderly women. *European Journal of Applied Physiology* 98(2): 117–23.

Brosseau L, MacLeay L, Robinson V, et al. 2003. Intensity of exercise for the treatment of osteoarthritis. *Cochrane Database of Systematic Review* (2), art no. CD004259.

Brown D, Heath G, Martin S, et al. 2010. *Promoting Physical Activity*. 2nd edition. Atlanta: Centers for Disease Control and Prevention.

Byberg L, Melhus H, Gedeborg R, et al. 2009. Total mortality after changes in leisure time physical activity in 50 year old men: 35 year follow-up of population based cohort. *British Medical Journal* 338(b688).

Cameron I, Murray G, Gillespie L, et al. 2010. Interventions for preventing falls in older people in nursing care facilities and hospitals. *Cochrane Database of Systematic Reviews* 20(1), art no. CD00546.

CDC. 2012. Glossary of terms. Centers for Disease Control and Prevention. URL: www.cdc.gov/physicalactivity/everyone/glossary/index.html (accessed 1 September 2012).

Ceglia L. 2008. Vitamin D and skeletal muscle tissue and function. *Molecular Aspects of Medicine* 29(6): 407–14.

Chang J, Morton J, Rubenstein L, et al. 2004. Interventions for the prevention of falls in older adults: a systematic review and meta-analysis of randomised clinical trials. *British Medical Journal* 680: 328.

Chao A, Connell C, Jacobs E, et al. 2004. Amount, type, and timing of recreational physical activity in relation to colon and rectal cancer in older adults: the Cancer Prevention Study II Nutrition Cohort. *Cancer Epidemiology Biomarkers and Prevention* 13(12): 2187.

Chien C, Lee C, Wu Y, et al. 2008. Home-based exercise increases exercise capacity but not quality of life in people with chronic heart failure: a systematic review. *Australian Journal of Physiotherapy* 54(2): 87–93.

Courtney M, Edwards H, Chang A, et al. 2009. Fewer emergency readmissions and better quality of life for older adults at risk of hospital readmission: a randomized controlled trial to determine the effectiveness of a 24-week exercise and telephone follow-up program. *Journal of the American Geriatrics Society* 57(3): 395–402.

Dallal C, Sullivan-Halley J, Ross R, et al. 2007. Long term recreational physical activity and risk of invasive and in situ breast cancer: the California teachers study. *Archives of Internal Medicine* 167(4): 408–15.

Davidson L, Hudson R, Kilpatrick K, et al. 2009. Effects of exercise modality on insulin resistance and functional limitation in older adults: a randomized controlled trial. *Archives of Internal Medicine* 169(2): 122–31.

Davies E. 2010. Exercise based rehabilitation for heart failure. *Cochrane Database of Systematic Reviews* (4), art no. CD003331.

de Morton N, Keating J, Jeffs K. 2007. The effects of exercise on outcomes for older acute medical inpatients compared with control or alternative treatments: a systematic review of randomized controlled trials. *Clinical Rehabilitation* 21(1): 3–16.

Dubbert P, Morey M, Kirchner K, et al. 2008. Counselling for home-based walking and strength exercise in older primary care patients. *Archives of Internal Medicine* 168(9): 979–86.

Elley R, Kerse N, Arroll B, et al. 2003. Effectiveness of counselling patients on physical activity in general practice: cluster randomised controlled trial. *British Medical Journal* 326: 793.

Elley R, Kerse N, Arroll B, et al. 2004. Cost-effectiveness of physical activity counselling in general practice. *New Zealand Medical Journal* 117(1207).

Fatouros I, Tournis S, Leontsini D, et al. 2005. Leptin and adiponectin responses in overweight inactive elderly following resistance training and detraining are intensity related. *Journal of Clinical Endocinology and Metabolism* 90(11): 5970–7.

Forster A, Lambley R, Hardy J, et al. 2009. Rehabilitation for older people in long term care. *Cochrane Database of Systematic Reviews* (1), art no. CD004294.

Forster A, Lambley R, Young J. 2010. Is physical rehabilitation for older people in long term care effective? Findings from a systematic review. *Age and Ageing* 39(2): 169–75.

Foster C, Hillsdon M, Thorogood M. 2005. Interventions for promoting physical activity. *Cochrane Database of Systematic Reviews* (1), art no. CD003180.

Fransen M, Nairn L, Winstanley J, et al. 2007. Physical activity for osteoarthritis management: a randomized controlled clinical trial evaluating hydrotherapy or tai chi classes. *Arthritis Care and Research* 57(3): 407–14.

Fransen M, McConnell S. 2008. Exercise for osteoarthritis of the knee. *Cochrane Database of Systematic Reviews* (4), art no. CD004376.

Frazer C, Christensen H, Griffiths K. 2005. Effectiveness of treatments for depression in older people. *Medical Journal of Australia* 182(12): 627–32.

Galvão D, Taaffe D. 2005. Resistance exercise dosage in older adults: Single- versus multiset effects on physical performance and body composition. *Journal of the American Geriatrics Society* 53(12): 2090–7.

Garg P, Tian L, Criqui M, et al. 2006. Physical activity during daily life and mortality in patients with peripheral arterial disease. *American Heart Association Journal* 114(3): 242–8.

Gass G, Gass E, Wicks J, et al. 2004. Rate and amplitude of adaptation to two intensities of exercise in men aged 65–75 years. *Medicine and Science in Sports and Exercise* 36(10): 1811.

Gavin J, McBrearty M, Sēguin D. 2006. The psychology of exercise. *Idea Fitness Journal*. URL: www.ideafit.com/fitness-library/psychology-exercise-1 (accessed 1 March 2012).

Gillespie L, Robertson M, Gillespie W, et al. 2009. Interventions for preventing falls in older people living in the community. *Cochrane Database of Systematic Reviews* (2), art no. CD007146.

Ginis K, Latimer A, Brawley L, et al. 2006. Weight training to activities of daily living: helping older adults make a connection. *Medicine and Science in Sports and Exercise* 38(1): 116.

Greenspan A, Wolf S, Kelley M, et al. 2007. Tai chi and perceived health status in older adults who are transitionally frail: a randomized controlled trial. *Physical Therapy* 87(5): 525–35.

Güell R, Resqueti V, Sangenis M, et al. 2006. Impact of pulmonary rehabilitation on psychosocial morbidity in patients with severe COPD. *Chest* 129(4): 899–904.

Haykowsky M, McGavock J, Vonder Muhll I, et al. 2005. Effect of exercise training on peak aerobic power, left ventricular morphology, and muscle strength in healthy older women. *The Journals of Gerontology. Series A: Biological Sciences and Medical Sciences* 60(3): 307.

Heesch K, Miller Y, Brown. W. 2007. Relationship between physical activity and stiff or painful joints in mid-aged women and older women: a three-year prospective study. *Arthritis Research and Therapy* 9(2): R34.

Heesch K, Byles J, Brown W. 2008. Prospective association between physical activity and falls in community-dwelling older women. *Journal of Epidemiology and Community Health* 62: 421–6.

Healy GN, Dunstan DW, Salmon J et al 2008. Breaks in sedentary time: beneficial associations with metabolic risk. *Diabetes Care*, *31*(*4*), *661-666*.

Holland A, Hill C. 2008. Physical training for interstitial lung disease. *Cochrane Database of Systematic Reviews* 4, art no. CD006322.

Howe T, Rochester L, Neil F, et al. 2007. Exercise for improving balance in older people. *Cochrane Database of Systematic Reviews* (4), art no. CD004963.

Hu F, Li T, Colditz G, et al. 2003. Television watching and other sedentary behaviors in relation to risk of obesity and type 2 diabetes mellitus in women. *Journal American Medical Association* 289(14).

Huang G, Thompson C, Osness W. 2006. Influence of a 10-week controlled exercise program on resting blood pressure in sedentary older adults. *Journal of Applied Research in Clinical and Experimental Therapeutics* 6(3): 188–95.

Hung C, Daub B, Black B, et al. 2004. Exercise training improves overall physical fitness and quality of life in older woman with coronary artery disease. *Chest* 126(4): 1026–31.

Hutton L, Frame R, Maggo H, et al. 2009. The perceptions of physical activity in an elderly population at risk of falling: a focus group study. *New Zealand Physiotherapy Journal* 37(2): 85–92.

Kalapotharakos V, Michalopoulos M, Tokmakidis S, et al. 2005. Effects of a heavy and a moderate resistance training on functional performance in older adults. *Journal of Strength & Conditioning Research* 19(3): 652.

Katzmarzyk PT, Church TS, Cora L, et al. 2009. Sitting time and mortality from all causes, cardiovascular disease, and cancer. *Medicine and Science in Sports & Exercise* 0195/9131.

Kay S, Fiatarone Singh M. 2006. The influence of physical activity on abdominal fat: a systematic review of the literature. *Obesity Reviews* 7(2): 183–200.

Kelley G, Kelley K, Tran Z. 2001. Aerobic exercise and resting blood pressure: a meta-analytic review of randomized controlled trials. *Preventative Cardiology* 4(2): 73–80.

Kerse N, Elley C, Robinson E, et al, 2005. Is physical activity counseling effective for older people? A cluster randomized controlled trial in primary care. *Journal of the American Gereatrics Society* 53(11): 1951–6.

Kerse N, Peri K, Robinson E, et al. 2008. Does a functional activity programme improve function, quality of life, and falls for residents in long term care? Cluster randomised controlled trial. *British Medical Journal (Clinical Research Ed)* 337 (Oct09\_3): 1445.

Kerse N, Shaw L, Walker D. 2009. *Staying Upright in Rest Home Care Trial*. Wellington: Accident Compensation Corporation.

Kerse N, Hayman K, Moyes S, et al. 2010. Home-based activity program for older people with depressive symptoms: DeLLITE: a randomized controlled trial. *Annals of Family Medicine* 8(3): 214–23.

Knoops K, de Groot L, Kromhout D, et al. 2004. Mediterranean diet, lifestyle factors, and 10-year mortality in elderly European men and women: the HALE project. *Journal of the American Medical Association* 292(12): 1433–9.

Kramer A, Erickson K. 2007. Capitalizing on cortical plasticity: Influence of physical activity on cognition and brain function. *Trends in Cognitive Sciences* 11(8): 342–8.

Kruger J, Buchner D, Prohaska T. 2009. The prescribed amount of physical activity in randomized controlled trials in older adults. *The Gerontologist* 49(1): 100–7.

Lan T, Chang H, Tai Y. 2006. Relationship between components of leisure physical activity and mortality in Taiwanese older adults. *Preventative Medicine* 43(1): 36–41.

Latham N, Bennett D, Stretton C, et al. 2004. Systematic review of progressive resistance strength training in older adults. *Journals of Gerontology* 59A(1): 48–61.

Lee C, Folsom A, Blair S. 2003. Physical activity and stroke risk: a meta-analysis. *Stroke* 34(10): 2475–81.

Leitzman M, Park Y, Blair A, et al. 2007. Physical activity recommendations and decreased risk of mortality. *Archives of Internal Medicine* 167(22): 2453–60.

Liu C, Latham N. 2009. Progressive resistance strength training for improving physical function in older adults. *Cochrane Database of Systematic Reviews* (3), art no. CD002759.

Liu-Ambrose T, Donaldson M, Ahamed Y, et al. 2008. Otago home-based strength and balance retraining improves executive functioning in older fallers: a randomized controlled trial. *Journal of the American Geriatrics Society* 56(10): 1821–30.

Löllgen H, Böckenhoff A, Knapp G. 2009. Physical activity and all cause mortality: an updated meta-analysis with different intensity categories. *International Journal of Sports Medicine* 30(3): 213–24.

Luctkar-Flude M, Groll D, Tranmer J, et al. 2007. Fatigue and physical activity in older adults with cancer: a systematic review of the literature. *Cancer Nursing* 30(5): E35.

Mador M. 2004. Endurance and strength training in patients with COPD. Chest 125(6): 2036-45.

Manini T, Everhart J, Patel K, et al. 2006. Daily activity energy expenditure and mortality among older adults. *Journal of the American Medical Association* 296(2): 171–9.

Mänty M, Heinonen A, Leinonen R, et al. 2009. Long term effect of physical activity counseling on mobility limitation among older people: a randomized controlled study. *The Journals of Gerontology: Series A* 64A(1), 83–9.

Marigold D, Eng J, Dawson A, et al. 2005. Exercise leads to faster postural reflexes, improved balance and mobility, and fewer falls in older persons with chronic stroke. *Journal of the American Geriatrics Society* 53(3): 416–23.

Mazzeo R, Tanaka H. 2001. Exercise prescription for the elderly: current recommendations. *Sports Medicine* 31(11): 809–18.

McClure R, Turner C, Peel N, et al. 2005. Population-based interventions for the prevention of fallrelated injuries in older people. *Cochrane Database of Systematic Reviews* (1), art no. CD004441.

McDermott M, Ades P, Guralnik J. 2009. Treadmill exercises and resistance training in patients with peripheral arterial disease with and without intermittent claudication: a randomized controlled trial. *Journal of the American Medical Association* 301(2): 165–74.

Mead H. 2003. Tikanga Māori: Living by Māori values. Wellington: Huia Publishers.

Messier S, Loeser R, Miller G, et al. 2004. Exercise and dietary weight loss in overweight and obese older adults with knee osteoarthritis: the arthritis, diet, and activity promotion trial. *Arthritis and Rheumatism* 50(5): 1501–10.

Ministry of Health. 2004. *Tupu Ola Maui: Pacific Health Chart Book 2004*. Wellington: Ministry of Health.

Ministry of Health. 2006. Older People's Health Chart Book. Wellington: Ministry of Health.

Ministry of Health. 2008. *Improving Quality of Care for Pacific Peoples: A paper for the Pacific Health and Disability Action Plan Review*. Wellington: Ministry of Health.

Ministry of Health. 2011a. Annual Report for the year ended 30 June 2011: Including the Director-General of Health's Annual Report on the state of public health. Wellington: Ministry of Health.

Ministry of Health. 2011b. *Sedentary Behaviour in Older Adults: A review of the literature 2010–2011*. Unpublished internal report, Ministry of Health.

Ministry of Health. 2012a. Statement of Intent 2012/13 to 2014/15. Wellington: Ministry of Health.

Ministry of Health. 2012b. The Health of New Zealand Adults 2011/12. Wellington: Ministry of Health.

Ministry of Health. 2012c. *Staying Active Will Help You Through It*. URL: www.depression.org.nz/ ContentFiles/Media/PDF/Getting\_active.pdf (accessed 1 March 2012).

Ministry of Health. 2012d. Green Prescriptions. URL: www.health.govt.nz/yourhealth-topics/physical-activity/green-prescriptions (accessed 1 March 2012).

Ministry of Health. 2012e. Avoidable mortality. URL: www.health.govt.nz/nz-health-statistics/ health-statistics-and-data-sets/maori-health-data-and-stats/tatau-kahukura-maori-healthchart-book/nga-punaha-hauora-tutohu-health-system-indicators/avoidable-mortality-andhospitalisation-0-74 (accessed 30 November 2012).

Monninkhof E, Elias S, Vlems F, et al. 2007. Physical activity and breast cancer: a systematic review. *Epidemiology* 18(1): 137.

Montgomery P, Dennis J. 2002. Physical exercise for sleep problems in adults aged 60. *Cochrane Database of Systematic Reviews* (4), art no. CD003404.

Morey M, Snyder D, Sloane R, et al. 2009. Effects of home-based diet and exercise on functional outcomes among older, overweight long term cancer survivors. *Journal of the American Medical Association* 301(18): 1883–91.

Morris S, Dodd K, Morris M. 2004. Outcomes of progressive resistance strength training following stroke: a systematic review. *Clinical Rehabilitation* 18(1): 27.

Mosby. 2009. Mosby's Medical Dictionary. 8th edition.

URL: http://medical-dictionary.thefreedictionary.com/physical+fitness+1 (accessed 1 March 2012).

Motl R, Konopack J, McAuley E, et al. 2005. Depressive symptoms among older adults: long term reduction after a physical activity intervention. *Journal of Behavioral Medicine* 28(4): 385–94.

Myint P, Luben R, Wareham N, et al. 2009. Combined effect of health behaviours and risk of first ever stroke in 20,040 men and women over 11 years' follow-up in Norfolk cohort of European Prospective Investigation of Cancer (EPIC Norfolk): prospective population study. *British Medical Journal* 338(2): 349.

Nelson M, Rajeski W, Blair S, et al. 2007. Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *American Heart Association Journal* 116: 1094–5.

Netz Y, Wu M, Becker B, et al. 2005. Physical activity and psychological wellbeing in advanced age: a meta-analysis of intervention studies. *Psychology and Aging* 20(2): 272–84.

NHMRC. 2009. *National Health and Medical Research Council Resources for Guideline Developers*. National Health and Medical Research Council. URL: https://www.nhmrc.gov.au/\_files\_nhmrc/file/guidelines/developers/nhmrc\_levels\_grades\_evidence\_120423.pdf (accessed 1 March 2012).

NICE. 2006. Promotion of physical activity among adults: evidence into practice briefing. National Institute for Health and Clinical Excellence. URL: www.nice.org.uk/niceMedia/pdf/physical\_ activity\_eip\_v3.pdf (accessed 1 May 2012).Nocon M, Hiemann T, Müller-Riemenschneider F, et al. 2008. Association of physical activity with all-cause and cardiovascular mortality. *European Journal of Cardiovascular Prevention and Rehabilitation* 15(3): 239.

NOO. 2010. Treating adult obesity through lifestyle change interventions: a briefing paper for commissioners. National Obesity Observatory. URL: www.noo.org.uk/uploads/doc/vid\_5189\_Adult\_ weight\_management\_Final\_220210.pdf (accessed 1 May 2012).

NOO. 2012. Obesity and health. URL: www.noo.org.uk/NOO\_about\_obesity/obesity\_and\_health (accessed 1 May 2012).

NZGG and UWS. 2011. A Literature Review of Evidence on Physical Activity and a Review of Existing Physical Activity Guidelines for Older People. Unpublished, New Zealand Guideline Group and University of Western Sydney.

NZTA. 2012. Senior road users. New Zealand Transport Agency. URL: www.nzta.govt.nz/traffic/senior-road-users (accessed 1 September 2012).

Orr R, Raymond J, Singh M. 2008. Efficacy of progressive resistance training on balance performance in older adults: a systematic review of randomized controlled trials. *Sports Medicine* 38(4): 317–43.

Pahor M, Blake S, Espeland M, et al. 2006. Effects of physical activity intervention on measures of physical performance: results of the Lifestyle Interventions and Independence for Elders Pilot (LIFE-P) study. *The Journals of Gerontology. Series A, Bilogical Sciences and Medical Sciences* 61(11): 1157–65.

Pang M, Eng J, Dawson A, et al. 2005. A community-based fitness and mobility exercise program for older adults with chronic stroke: a randomized, controlled trial. *Journal of the American Geriatrics Society* 53(10): 1667–74.

Pate R, O'Neill J, Lobelo F. 2008. The evolving definition of sedentary. *Exercise and Sport Sciences Review* 173–8.

Patel A, Schofield G, Kolt G, et al. 2011. General practitioners' views and experiences of counselling for physical activity through the New Zealand Green Prescriptions program. *Biomed Central Family Practice* 12: 119.

Paw C, van Uffelen J, Riphagen I, et al. 2008. The functional effects of physical exercise training in frail older people: a systematic review. *Sports Medicine* 38(9): 781–93.

Peri K, Kerse N, Robinson E, et al. 2008. A randomised controlled trial in residential care facilities: the Promoting Independent Living Study (PILS). *Age and Ageing* 37(1): 57–63.

Pettersen S, Mizner R, Stevens J, et al. 2009. Improved function from progressive strengthening interventions after total knee arthroplasty: a randomized clinical trial with an imbedded prospective cohort. *Arthritis Care and Research* 61(2): 174–83.

Pfeifer M, Begerow B, Minne H. 2002. Vitamin D and muscle function. *Osteoporosis International* 13(3): 187–94.

Pogliaghi S, Terziotti P, Cevese A, et al. 2006. Adaptations to endurance training in the healthy elderly: arm cranking versus leg cycling. *European Journal of Applied Physiology* 97(6): 723–31.

Robertson C, Campbell J. 2008. *Optimisation of ACC's Fall Prevention Programmes for Older People: Final report*. Dunedin: University of Otago.

Rydwik E, Lammes E, Frandin K, et al. 2008. Effects of a physical and nutritional intervention program for frail elderly people over age 75: a randomized controlled pilot treatment trial. *Aging Clinical and Experimental Research* 20(2): 159–70.

Rydwik E, Gustafsson T, Frandin K, et al. 2010. Effects of physical training on aerobic capacity in frail elderly people (75+ years). Influence of lung capacity, cardiovascular disease and medical drug treatment: a randomized controlled pilot trial. *Aging Clinical and Experimental Research* 22(1): 85–94.

Saunders D, Greig C, Young A. 2009. Physical fitness training for stroke patients. *Cochrane Database of Systematic Reviews* (4), art no. CD003316.

Schooling C, Lam T, Li Z, et al. 2006. Obesity, physical activity and mortality in a prospective Chinese elderly cohort. *Archives of Internal Medicine* 166(14): 1498–504.

Scragg R. 2010. *Asian Health in Aotearoa 2006–07: Trends since 2002–03*. Auckland: Northern DHB Support Agency.

Seynnes O, Fiatarone Singh M, Hue O, et al. 2004. Physiological and functional responses to low-moderate versus high-intensity progressive resistance training in frail elders. *The Journals of Gerontology. Series A: Biological Sciences and Medical Sciences* 59(5): 503–9.

Shekelle P, Maglione M, Mojica W, et al. 2003. Exercise programs for older adults: a systematic review and meta-analysis. URL: www.rand.org/pubs/reprints/RP1257.html (accessed 1 March 2012).

Sheldon K, Elliot A, Kim Y, et al. 2001. What is satisfying about satisfying events? Testing 10 candidate psychological needs. *Journal of Personality and Social Psychology* 80(2): 325–39.

Sherrington C, Whitney J, Lord S, et al. 2008. Effective exercise for the prevention of falls: a systematic review and meta-anaylsis. *Journal of the American Geriatrics Society* 56(12): 2234–43.

Singh N, Stavrinos T, Scarbek Y, et al. 2005. A randomized controlled trial of high versus low intensity weight training versus general practitioner care for clinical depression in older adults. *Journals of Gerontology Series A: Biomedical and Medical Sciences* 60(6): 768.

Sjösten N, Kivelä S. 2006. The effects of physical exercise on depressive symptoms among the aged: a systematic review. *International Journal of Geriatric Psychiatry* 21(5): 410–8.

SPARC. 2005. *Movement = Health*. Wellington: Sport and Recreation New Zealand.

SPARC. 2008. Sport, Recreation and Physical Activity Participation among New Zealand Adults: Key results of the 2007/08 Active NZ Survey. Wellington: Sport and Recreation New Zealand.

Statistics NZ. 2007. QuickStats about Pacific peoples. URL: www.stats.govt.nz/ Census/2006CensusHomePage/QuickStats/quickstats-about-a-subject/pacific-peoples.aspx (accessed 1 September 2012).

Statistics NZ. 2009. Longer Life, Better Health? Trends in health expectancy in New Zealand, 1996–2006. Wellington: Statistics New Zealand.

Statistics NZ. 2012. *Demographic Projections from Statistics New Zealand: Aims, methods, and results.* Wellington: Statistics New Zealand.

Suetta C, Aagaard P, Rosted A, et al. 2004. Training-induced changes in muscle CSA, muscle strength, EMG, and rate of force development in elderly subjects after long term unilateral disuse. *Journal of Applied Physiology* 97(5): 1954–61.

Sullivan D, Robertson P, Smith E, et al. 2007. Effects of muscle strength training and megestrol acetate on strength, muscle mass, and function in frail older people. *Journal of the American Geriatrics Society* 55(1): 20–8.

Symons T, Vandervoort A, Rice C, et al. 2005. Effects of maximal isometric and isokinetic resistance training on strength and functional mobility in older adults. *The Journals of Gerontology. Series A: Biological Sciences and Medical Sciences* 60(6): 777.

Takeshima N, Rogers M, Islam M, et al. 2004. Effect of concurrent aerobic and resistance circuit exercise training on fitness in older adults. *European Journal of Applied Physiology* 93(1): 173–82.

Taylor R, Brown A, Ebrahim S, et al. 2004. Exercise-based rehabilitation for patients with coronary heart disease: systematic review and meta-analysis of randomized controlled trials. *American Journal of Medicine* 116(10): 682–92.

Taylor R, Dalal H, Jolly K, et al. 2010. Home-based versus centre-based cardiac rehabilitation. *Cochrane Database of Systematic Reviews* (1), art no. CD007130.

Taylor-Piliae R, Newell K, Cherin R, et al. 2010. Effects of tai chi and Western exercise on physical and cognitive functioning in healthy community-dwelling older adults. *Journal of Aging and Physical Activity* 18(3): 261–79.

Thomas D, Elliott E, Naughton G. 2007. Exercise for type 2 diabetes mellitus. *Cochrane Database of Systematic Reviews* (3), art no. CD002968.

USDHHS. 2008. *Physical Activity Guidelines for Americans*. Washington: United States Department of Health and Human Sciences.

van de Port I, Wood-Dauphinee S, Lindeman E, et al. 2007. Effects of exercise training programs on walking competency after stroke: a systematic review. *American Journal of Physical Medicine and Rehabilitation* 86(11): 935–51.

Verdijk L, Jonkers R, Gleeson B, et al. 2009. Protein supplementation before and after exercise does not further augment skeletal muscle hypertrophy after resistance training in elderly men. *American Journal of Clinical Nutrition* 89(2): 608–16.

Villareal D, Banks M, Sinacore D, et al. 2006a. Effect of weight loss and exercise on frailty in obese older adults. *Archives of Internal Medicine* 166: 860–6.

Villareal D, Wood-Dauphinee S, Lindeman E, et al. 2006b. Effect of lifestyle intervention on metabolic coronary heart disease risk factors in obese older adults. *American Journal of Clinical Nutrition* 84(6): 1317–23.

Voukelatos A, Cumming R, Lord S, et al. 2007. A randomized controlled trial of tai chi for the prevention of falls: the central Sydney tai chi trial. *Journal of the American Geriatrics Society* 55(8): 1185–91.

Waiti J. 2007. Tikanga-based motivation for physical activity. Masters thesis, University of Otago, Dunedin.

Warburton D, Charlesworth S, Ivey A, et al. 2010. A systematic review of the evidence for Canada's physical activity guidelines for adults. *International Journal of Behavioral Nutrition and Physical Activity* 7(1): 39.

Warburton D, Nicol C, Bredin S. 2006. Health benefits of physical activity: the evidence. *Canadian Medical Association Journal* 174(6): 801–9.

Watson L, Ellis B, Leng G. 2008. Exercise for intermittent claudication. *Cochrane Database of Systematic Reviews* (4), art no. CD000990.

WCRF and AICR. 2007. *Food, Nutrition, Physical Activity and the Prevention of Cancer: A global perspective.* Washington DC: World Cancer Research Fund and American Institute for Cancer Research.

Wendel-Vos G, Schuit A, Feskens E. 2004. Physical activity and stroke: a meta-analysis of observational data. *International Journal of Epidemiology* 33(4): 787–98.

Wham C, Dyall L, Kerse N, et al. 2011. Nutrition risk: Cultural aspects of assessment. *Asia Pacific Journal of Clinical Nutrition* 20(4): 632–8.

Whang W, Manson J, Hu F, et al. 2006. Physical exertion, exercise and sudden cardiac death in women. *Journal of the American Medical Association* 295(2): 1399–403.

WHO. 2010. *Global Recommendations on Physical Activity for Health*. Geneva: World Health Organization.

WHO. 2012. Resources: Global Activity Physical Activity Questionnaire (GPAQ) anaylsis guide. URL: www.who.int/chp/steps/resources/GPAQ\_Analysis\_Guide.pdf (accessed 1 March 2012).

Wieser M, Haber P. 2007. The effects of systematic resistance training in the elderly. *International Journal of Sports Medicine* 28: 59–65.

Wijlhuizen G, de Jong R, Hopman-Rock M. 2007. Older persons afraid of falling reduce physical activity to prevent outdoor falls. *Preventative Medicine* 44(3): 260–4.

Wijndaele K, Duvigneaud N, Matton L, et al. 2009. European Journal of Clinical Nutrition 63: 421–9.

Windle G, Hughes D, Linck P, et al. 2010. Is exercise effective in promoting mental wellbeing in older age? A systematic review. *Aging and Mental Health* 14(6): 652–69.

Windsor P, Nicol K, Potter J. 2004. A randomized controlled trial of aerobic exercise for treatmentrelated fatigue in men receiving radical external beam radiotherapy for localized prostate carcinoma. *Cancer* 101(3): 550–7.

Wisløff U, Stoylen A, Loennechen JP, et al. 2007. Superior cardiovascular effect of aerobic interval training versus moderate continuous training in heart failure patients: a randomized study. *Circulation* 115(24): 3086–94.

Yale Medical Group. 2012. Older adults and the benefits of social interaction. URL: www.yalemedicalgroup.org/stw/Page.asp?PageID=STW037188 (accessed 1 September 2012).

Young A. 1992. Strength and power. In: *The Oxford Textbook of Geriatric Medicine*. Oxford: Oxford University Press.