Key Points

1. Regular exercise is essential for healthy ageing, and all older adults should be encouraged to be physically active.

2. Exercise has a role in prevention, treatment and management of cardiovascular disease, congestive heart failure, respiratory disease, osteoporosis, arthritis, mood and sleep disorders to name a few.

3. Exercise programs should be multi-component and include aerobic, strength, balance, and flexibility training.

4. Exercise programs are safe for older adults. The risk of inactivity poses a greater health risk than exercise. Even frail elderly people are able to safely participate in exercise programs and achieve benefits. Studies have shown that serious adverse effects are uncommon.

5. The evidence suggests that exercise interventions in older adults are cost effective.

6. Physical activity can increase longevity. Studies have shown this effect occurs in people who exercise throughout life, as well as those who commence exercise late in life.

7. Beneficial effects of exercise have been observed in the prevention and reduction in the rate of cognitive decline. People with cognitive impairment should be encouraged to exercise. There is a growing body of evidence for the benefits of exercise in people with dementia.

8. Exercise can reduce the risk of falls in older adults. Effective programs target people at risk for falling, are individually tailored, and include balance and strength training.

9. The evidence suggests that exercise can delay or prevent disability in older adults. Identification of older adults with preclinical disability is key, as is the development of intervention strategies to prevent functional decline.

10. Exercise programs can be successfully carried out at home or in group settings and should include some amount of instruction.

11. Older adults are more likely to adhere to an exercise program if they have social support and feel safe to exercise, have mutually agreed upon goals, and are confident in their ability to succeed.
12. Regular physician advice about exercise encourages participation in older adults.

13. Identification of barriers to participation is essential; physical, psychological, cultural and environmental barriers must be addressed.

14. There is a lack of consensus about the type of medical assessment and screening tests required before advising an older person to commence an exercise program. An activity plan that includes a strategy for risk management and prevention of injury should be developed.

15. Research to determine the most effective type, intensity, frequency and duration of exercise programs to optimize physical function in all older adults is needed. Exercise interventions must have standardized functional assessments and include the development of well-defined disability outcome measures.

This Position Statement represents the views of the Australian and New Zealand Society for Geriatric Medicine. This Statement was approved by the Federal Council of ANZSGM on 16th June 2013 Authors: Dr Michelle Dhanak and Assoc Prof R Penhall

Introduction

Hippocrates, 450 B.C.

“All parts of the body which have a function if used in moderation and exercised in labors in which each is accustomed, become thereby healthy, well developed and age more slowly; but if unused and left idle they become liable to disease, defective in growth and age quickly”.

The benefits of exercise have been recognized for thousands of years and are well supported by clinical evidence. Promoting physical activity in older people is key to the maintenance of health and function. Physical inactivity is a leading cause of preventable morbidity and mortality. Physical activity guidelines for older adults stress that older people should be as active as possible, and that some activity is better than none.

Australian and New Zealand physical activity guidelines for older adults are consistent with global recommendations of 30 minutes or more of moderate intensity activities at least five days per week, as well as two sessions per week of resistance and flexibility activities. (1,2,3,4,5,6,7) The recommended intensity level for older adults is now relative to fitness level instead of an absolute intensity in MET units, as recommended for adults <65 (4,8,).

Balance exercises are recommended for those with impaired mobility or at risk for falls (1,2,3,4,5,6,7).

Current guidelines recommend exercise of low intensity and duration initially in highly deconditioned individuals. All older adults should have an individually designed activity plan which describes recommended levels of physical activity, and how a person will achieve this. People with chronic conditions require a plan that integrates prevention and treatment (4, 9).
Definition

The terms exercise and physical activity are often used interchangeably, however they have different meanings. Physical activity is defined as any bodily movement produced by skeletal muscles that result in energy expenditure. Exercise, which is a subset of physical activity, is defined as a bodily movement that is planned, structured, and repetitive for the purpose of improving or maintaining physical fitness (10). While the focus of this statement is on exercise, the evidence supporting these guidelines includes studies of physical activity.

Scope of the problem

The costs of physical inactivity and disability are high and mobility impairment is one of the primary reasons for entry into aged residential care. Surveys in Australia identified women, older adults, the financially and educationally disadvantaged, and non-English speaking individuals as least likely to participate in physical activity (11). The 2011/12 New Zealand Health Survey found almost 30% of men and almost 40% of women over the age of 75 reported less than 30 minutes of daily physical activity (1). A recent randomized controlled trial in patients with New York Class II and III heart failure with low physical function suggests combined aerobic plus resistance exercise programs may be more effective in improving performance.

Benefits of exercise

Exercise can be an important intervention for the prevention and treatment of many chronic conditions such as cardiovascular disease, hypertension, diabetes, obesity, COPD, osteoporosis, depression and sleep disorder (17,18,19,20). A recent United States report highlights the increased risk for colon, breast and endometrial cancers associated with excess weight and physical inactivity (21).

Aerobic training has been shown to improve cardiovascular fitness, improve lipid profile, reduce blood pressure, and improve left ventricular hypertrophy. Both strength and aerobic training improve glucose metabolism, reduce abdominal mass, and have a positive effect on bone mineral density (19,22).
of activities required for daily living than aerobic exercise alone. (23). Observational and randomized controlled trials have shown that older adults (60-80 years) are able to substantially increase their VO2max with aerobic conditioning (22). It has been demonstrated that resistance training increases muscle mass, strength and improves neuromuscular performance (24,25,26,27,28).

The benefits of resistance training have been demonstrated in the oldest old. A randomized controlled trial of frail institutionalized 90 year-old men and women demonstrated increases in muscle mass of ~9% and increases in strength on average of 174% after 8 weeks of high-intensity resistance training (28).

Cost-effectiveness of exercise

Physical activity interventions in older adults appear to be cost-effective. The Lifestyle Interventions and Independence for Elders Study (LIFE), a multicenter randomized controlled trial currently underway, is investigating physical activity and prevention of disability. It includes a preliminary cost analysis which found reduction in the incidence of major mobility disability with physical activity at one year at an average cost/participant of $1134 for the physical activity program compared to $175 for the education program (29). Economic evaluations of the Otago Exercise Program, a home-based falls prevention program, determined that it costs about $1500 NZD (at 1998 prices) per person per fall prevented. The program was most effective in those over 80 years of age. When hospital cost savings due to falls prevented were taken into account, the cost was reduced to $576 NZD (at 1998 prices) per fall prevented (30).

A randomized controlled trial, which included a cost utility analysis, found resistance training more cost-effective than balance and tone classes. This economic benefit was sustained during the 12 month period following completion of the intervention, due in part to lower falls-related health care costs. This study was limited by small numbers of participants and a wide standard deviation in cost (31).

In Australia, Sherrington and colleagues have recently completed a randomized controlled trial evaluating the effectiveness of a home-based exercise program in reducing mobility-related disabilities and falls in recently hospitalized people over the age of 60. When published, this trial will include a cost analysis (32).

Physical activity, mortality and longevity

The Harvard alumni study demonstrated the causal effect of physical inactivity on mortality. In this observational study, sedentary middle-aged to older men who commenced moderately vigorous physical activity had a 23% lower risk of death during the 11 year follow-up period compared to those who remained inactive. Increased longevity was observed in all age groups, including 75-84 year olds (33). Flicker and colleagues found that inactivity in older Australians was associated with twice the all-cause mortality in women and with a 28% increase in men.
Additionally, mortality risk was lower in those who were overweight, defined as BMI’s between 25-30 (34).

Cardiovascular fitness is associated with reduced mortality rate; this protective effect is evident across age groups. Low levels of cardiovascular fitness are associated with increased relative risk for mortality for men and women (35). There is an inverse dose-response relationship between amount of physical activity and all-cause mortality. The frequency and duration required to achieve this result has yet to be defined, but energy expenditures of about 1000kcal/wk are associated with a 20-30% reduction in all-cause mortality (36). Results published in 2012 from the Whitehall II longitudinal cohort study provide additional support for promoting exercise in older adults. This study of middle aged men and women followed for almost 10 years found a 33% risk reduction in mortality with moderate physical activity, but no mortality risk reduction with mild or vigorous physical activity. They highlighted the importance of evaluating both type and intensity of exercise (37).

Simonsick et al assessed the risk of inactivity in non-disabled people over 65, and found a positive effect of increased physical activity on mortality. This supports the hypothesis that regular exercise reduces the risk for development of functional limitations and, by extension, disability (38).

Exercise to delay and prevent disability

Does exercise delay or prevent disability? Utilizing data from the Established Populations for Epidemiologic Studies of the Elderly study, a 10 year prospective trail to examine predictors of dying without disability in the last year of life, Leveille and colleagues found a nearly two-fold increase in the likelihood of dying without disability in the most active older adults compared to those who were sedentary (39).

The “Physical Activity Guidelines Advisory Committee Report, 2008” concluded that there is strong observational evidence that regular physical activity reduces the risk for moderate or severe functional impairment in middle-aged and older adults. There is modest evidence that regular physical activity improves or maintains function in older adults with existing functional impairments (40).

The evidence does not prove a causal effect of exercise in the prevention or delay of disability although there are a number of randomized controlled trials showing the benefits of exercise on aerobic capacity, strength and balance, suggesting the plausibility of a causal effect. A trial by Pennix et al provides some of the strongest evidence of this link. The Fitness Arthritis and Seniors Trial, a randomized controlled trial of community-dwelling adults with an average age of 69 with osteoarthritis of the knee, found that individuals who participated in aerobic and resistance exercise programs were less likely to develop incident disability at 18 months, compared to those participating in the educational program. Those with the highest compliance to the exercise programs were associated with the lowest risk for development of disability (41). The Lifestyle Interventions and
Independence for Elders (LIFE) Study compares a moderate intensity exercise program with an educational program in sedentary older adults at risk for major mobility disability, defined as the inability to walk 400 meters. When completed, this trial may provide evidence that physical activity can prevent mobility disability (42).

Keysor argues that clear definitions of physical activity and exercise are needed, that a framework for disablement outcomes which can be used in exercise interventions needs to be developed, and that a mechanism which explains the relationship between physical activity, exercise, and disablement should be developed (43).

The relationship of exercise to cognitive impairment and dementia

There are several hypotheses as to how exercise and aerobic fitness affect cognition. One is the cognitive reserve hypothesis, which proposes that exercise improves cerebral perfusion, thus leading to a larger cognitive reserve that can be beneficial in neurodegenerative disorders such as Alzheimer’s disease. Another is the vascular hypothesis, which suggests that aerobic fitness reduces the risk of cardiovascular disease, one determinant for dementia. Finally, the stress hypothesis suggests that exercise reduces stress, thereby reducing the risk for dementia (44).

There are a number of studies that provide evidence for the protective effect of physical activity on cognition. A prospective longitudinal cohort study by Laurin et al found moderate-to-high levels of physical activity were associated with lower risks for development of cognitive impairment, Alzheimer’s disease and other dementias in women (45). An observational study by Middleton and colleagues of people over the age of 70 found higher levels of physical activity were associated with lower incidence of cognitive impairment. This study did not examine intensity of activity, but did find a dose response relationship between physical activity and development of cognitive impairment (46). Recent randomized controlled trials suggest that resistance training may also provide cognitive benefits (47,48). A well designed randomized controlled trial by Lautenschlager et al that assessed the effects of physical activity on cognitive function in adults 50 years or older with self-reported memory complaints found small but significant improvement in objective measures of cognitive function which persisted during the 18 month follow up period in the intervention group (49). Just as importantly, a 10 year longitudinal study of elderly men aged 70-90 found that reduction in physical activity was associated with a higher rate of cognitive decline compared to those who maintained their level of physical activity (50).

A systematic review by van Uffelen found a beneficial effect on cognition with aerobic and strength training in one third of participants without cognitive impairment and in two thirds of those with cognitive impairment (51). A Cochrane review which examined the effect of cardiovascular fitness on cognition in healthy older adults found insufficient evidence that the observed improvements in cognitive domains...
were attributable to enhanced cardiovascular fitness from exercise (52). Both concluded that there appears to be a beneficial effect of exercise on cognition, but that the current evidence is limited by large variability in exercise protocols and measure of cognitive function, small study size and lack of high quality studies (51,52). In all of the studies reviewed, no negative effects on cognition were observed.

People with dementia can be included in exercise programs, as demonstrated in an Australian pilot randomized controlled trial evaluating the effectiveness of an exercise program in people with mild-to-moderate Alzheimer’s disease (53). A recent review of ten randomized controlled trials evaluating the effects of exercise on people with dementia supports the evidence for the benefits of exercise in this group. The authors suggest task specific interventions and those of longer duration may be more effective (54).

**Exercise in frail older people**

It is important to include this group in exercise programs and, in fact, they may achieve the greatest benefits. Fiatarone’s randomized controlled trial of high-intensity strength training in frail 90 year-old institutionalized people clearly demonstrated that the frail older person can participate and benefit from a strength training program (28). A further study by Fiatarone et al demonstrated functional improvements (defined as stair climbing ability) with 10 weeks of progressive resistance training in frail nursing home residents (55). The 1998 American College of Sports Medicine position statement suggests strength and balance training may need to precede aerobic activities in very frail individuals (56).

A recent randomized controlled trial evaluated 6 months of exercise interventions to prevent decline in highly deconditioned institutionalized elderly persons. While the control group experienced a significant decline, they found that the exercise intervention groups maintained their ADL functions at 6 months, although this benefit was lost at 12 months. Interestingly, they found worsening of neuropsychiatric symptoms in the control group but stabilization or improvement in the interventions groups. This finding should be explored in further research (57).

The evidence suggests that exercise programs are effective in frail elderly people, but diverse outcome measures, lack of a uniform definition of frailty, and significant variation in exercise protocols make it difficult to know who to target and which interventions will achieve maximum benefit. Additional research is required to determine which interventions impact specific functional domains (58, 59).

**Exercise to reduce falls risk**

30% of all adults over 65 living in the community fall each year (60). Current evidence indicates exercise interventions that contain two or more components of strength, aerobic, balance and flexibility exercises reduce both risk and rate of falling in community dwelling elderly people (60,61). Australian guidelines recommend balance training for people at risk for falling. The most effective interventions
are those that include progressively challenging balance activities, are of sufficient dose and frequency (at least two hours per week for at least six months) and do not include a walking component. Both home and group-based activities are effective (62). The successful Otago Exercise Program, a 12 month home-based program of strength and balance exercises to reduce falls, has shown adherence rates of 74% (63).

A 2010 Cochrane review of exercise interventions found inconsistent evidence that interventions in nursing care facilities reduce falls. However, a post-hoc subgroup analysis of these trials suggests that interventions that target multiple risk factors and are provided by a multidisciplinary team may be effective (64).

**Identifying preclinical disability**

Fried and colleagues (65) hypothesized that there is a identifiable transitional stage between non-disability and disability when impairments impact on general function, yet the individual remains able to complete the task and thus does not recognize the change as a disability. This “preclinical disability” is characterized by either a general reduction in activities requiring a particular physical ability or modification of the method to complete a task. Identification of individuals at risk to progress to disability is important, as it will allow for development of targeted preventative strategies. In a prospective observational study, Fried et al found a 3-4 fold increased risk for progression to disability in women who reported task modification at onset of the study, compared to women without task modification (66).

Observational research has shown that mobility disability leads to a 3-5 times risk for ADL dependency (67). Guralnik demonstrated that objective measures of lower extremity function were predictive of a subsequent onset of disability in a prospective cohort study of non-disabled men and women 71 years and older. Participants with the lowest scores on tests of standing balance, an 8 foot timed walk, and a timed sit-to-stand of five repetitions were 4-5 times more likely to have ADL or mobility disability at four years as compared to participants with the highest performance scores (68).

**Settings and adherence**

Older adults are more likely to adhere to an exercise program if they have social support to exercise, if the program meets their interest and needs, and they feel safe and confident in their ability to succeed.

Interventions that include goal setting with a written contract and provide regular performance feedback and positive reinforcement increase the likelihood that the activity will be maintained (69). Activities that are convenient, low cost, and of moderate intensity are associated with increased participation in community-dwelling older adults.

Both home and centre-based settings are effective in exercise interventions, but few studies have compared these two directly. In healthy middle-aged and older adults, it appears that participation
rates are higher in supervised home-based programs (70).

A recent randomized controlled trial demonstrated that video game balance programs are acceptable to older adults, can be performed at home and provide an alternative to standard group based balance activities (71).

Environmental factors such as good weather, well-maintained sidewalks, and provision of places to sit and rest influence participation in physical activities in older adults (69). Two recent qualitative studies examined factors influencing physical activity. A study in Christchurch New Zealand found that leisure-time physical activities in older adults varied according to socioeconomic neighborhood status, with lower activity levels associated with "high neighborhood deprivation", meaning neighborhoods with lower levels of services, income, employment, health, education and housing (72). An Australian study of older women reported ethno-specific differences in barriers to physical activity, highlighting the importance of considering cultural factors when developing programs and making physical activity recommendations (73). The New Zealand Ministry of Health guidelines on physical activity for older people address this and include culture-specific information (1).

Promoting exercise in older people

Health care providers play an important role in encouraging incidental activity and should give exercise advice at regular intervals. Studies have found a positive association between older people who received exercise advice and subsequent participation in moderate-to-high levels of physical activity (74,75). The Green prescription, introduced in New Zealand in 1998, has shown advice by general practitioners is effective in promoting physical activity, and that written advice can take as little as five minutes and is more effective than verbal advice alone (75). Morey et al proposed a paradigm shift from physician as gatekeeper to physical activity advocate (76).

All adults should have a physical activity plan. This plan must meet the person’s specific needs and includes realistic goal setting. It should describe how, when, and where each activity is done and should include a gradual approach to increase physical activity. Recommendations for the older adult must take into account chronic conditions and functional limitations. Older adults commonly have intercurrent illnesses that impact their ability to initiate and maintain an exercise program, highlighting the importance of tailoring an exercise program to the individual, with modifications during periods of ill health.

Medical assessment before commencing exercise

The issue regarding screening of older adults prior to starting an exercise program remains controversial. The ACSM has acknowledged that the risks associated with inactivity exceed the risks from participation in regular physical activity (5,9,56). For healthy asymptomatic adults of any age, cardiac screening is not required before
beginning a light intensity program (5,77). A strategy for risk management and prevention of injuries is recommended (69). The presence of common conditions like cardiovascular disease, diabetes, stroke and chronic pulmonary disease are not specific contraindications to exercise, and exercise may be therapeutic. Unstable cardiovascular disease or uncontrolled conditions are contraindications to exercise and require further investigation (5,56).

Reported adverse events with exercise interventions are rare, and most typically involve minor musculoskeletal injuries that have not required withdrawal from the studies, however the true prevalence is not known (17,25,28,56,). A recent study of adverse events over a 10 year period in people over 65 participating in high resistance training found only 448 adverse events in 105,793 training sessions. 72% of these were musculoskeletal, and only <0.02% were cardiovascular, with 10 episodes of angina, equivalent to one episode for every 10,529 hours of training (78). The risk of adverse cardiac events associated with exercise is a concern to clinicians when giving exercise advice to older adults as well as older adults themselves (69). The actual risk is not well defined, and much of the information comes from cardiac rehabilitation programs, with estimates of adverse cardiac events occurring between ~1/60000 to ~1/80000 per participant rehabilitative hours (76). Educating participants about risks and helping them to understand how to self-monitor their exercise intensity levels will help reduce their concerns (69).

Gill and colleagues (79) addressed the role of routine exercise stress testing before commencing an exercise program in adults over the age of 75. They argue the guidelines regarding exercise stress testing are not applicable to older adults who would like to use exercise to restore or enhance their physical function. They suggest pre-exercise stress testing is of unproven benefit and expensive and may deter them from participating in physical activity. They recommend a history and physical exam directed at identifying potential cardiac contraindications to exercise, which include MI within 6 months, angina, signs or symptoms of congestive heart failure, a resting systolic blood pressure of greater than 200 mm Hg or diastolic blood pressure of greater than 100 mm Hg. People with overt cardiovascular disease should undergo risk stratification and be managed appropriately.

Future Research

Research to determine the most effective type, intensity, frequency and duration of exercise programs to optimize physical function in all older adults is needed. Exercise interventions must include standardized functional assessments and the development of well-defined disability outcome measures. Training of physicians in exercise prescription is important and should be included in both general practice and geriatric medicine training.

Summary
Physical activity is essential for healthy ageing. It can help prevent disability and maintain function in older adults. Avoiding inactivity with regular exercise has significant personal and public health benefit and should be promoted to and for adults of all ages, including the oldest old.

References


66. Fried LP, Bandeen-Roche K, Chaves PH, Johnson BA. Preclinical mobility disability


