14. Elderly

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Summary

Although factors such as heredity and illness affect how we age, it is absolutely clear that regular physical activity and exercise, as a significant lifestyle factor, can both prevent and reduce various age-related physical and mental changes. Elderly men and women can improve their aerobic fitness and endurance as well as balance, strength and flexibility up to a very advanced age. Aerobic exercise can affect risk factors for cardiovascular disease. Strength training leads to an increased muscle mass and muscle strength and improved functional capacity. Physical activity and training also affects bone mass as well as balance, coordination and flexibility, which together reduce the risk of falling accidents and fractures. Physical activity and training also appear to be able to have a positive effect on various psychological factors and quality of life among the elderly. Altogether, available data indicate that physical activity and exercise, as a significant lifestyle factor, are an effective way of maintaining a high level of activity and high degree of independence among elderly men and women. However, the elderly are a very heterogeneous group and individualised exercise programmes are most often preferable to general recommendations.

In terms of *aerobic exercise*, mainly low to moderate intensity activity is recommended to affect risk factors of cardiovascular disease, while moderate to high intensity activity can be needed to be able to achieve improvements in cardiovascular function. Training should be done at least 2–3 times a week, at least 20 minutes at a time depending on intensity. In terms of *strength training*, exercises should be done 1–2 times a week and include the body's major muscle groups in both the upper and lower extremities. Suitable activities with regard to both aerobic exercise and strength training include brisk walks, dancing, callisthenics, swimming, skiing, jogging, cycling and weight training.

Background

In the past 10 years, our knowledge has increased markedly with regard to the effects of physical activity and exercise among men and women over the age of 70 and the significance this has to ageing (1–3). Worldwide, the elderly comprise a larger part of the population and the most rapidly growing proportion are those over the age of 85. For many of these people, physical activity and exercise comprise an important part of preventing illness, improving physical and mental capacity and thereby retaining a high degree of personal independence and quality of life. The health benefits of physical activity are largely the same for the elderly as for other age groups. People who remain active have more years without disability and there are many indications that chronic diseases in association with ageing are partially due to physical inactivity rather than ageing itself. The functional level of the elderly is affected by heredity, illness and lifestyle, and the variation in the level of function between different people also increases with increasing age. However, research has been able to show that it is also possible to enhance health and prevent functional impairment through physical activity and exercise among people with a low functional level and a complex clinical picture.

Effects of ageing and physical activity

Cardiovascular function and aerobic exercise

Maximal oxygen uptake (VO_2 max) decreases by between 5 and 10 per cent per decade after the age of 30 (1, 4). This is caused by a decreased maximal heart rate, reduced heart-minute volume, decreased arteriovenous oxygen difference and reduced stroke volume. In the elderly, the heart muscle also reacts differently to maximum physical exertion than in younger people, including with regard to the ejection fraction (in other words, the stroke volume in relation to the total diastolic volume) and contractility (capacity to contract). However, the effects in terms of cardiovascular function are qualitatively and quantitatively relatively similar in the elderly compared with younger people at submaximum physical exertion.

The effects of aerobic exercise on cardiovascular function are the same in healthy elderly persons as in younger people (1). Several studies of aerobic exercise in the form of cycling, swimming and running have shown increases between 10 to 30 per cent of VO_2 max. The increase in VO_2 max among the elderly is related to the exercise intensity, as in younger people. The improvement of VO_2 max is explained by both changes in the heart muscle's function, with an impact on maximal stroke volume, heart-minute volume, left-chamber function and increased arteriovenous oxygen difference.

Several exercise studies have unanimously shown positive effects on various risk factors for cardiovascular disease among the elderly (1). Light to moderate aerobic exercise in the elderly has led to improved glucose metabolism, greater glucose tolerance and insulin sensitivity, decreased blood pressure and improvements in lipids, effects that can

be completely comparable to those obtained from pharmaceutical treatment. Exercise has also had a positive effect on body composition with a 1–4 per cent decrease in body fat and up to 25 per cent decrease in intraabdominal fat in men. In the majority of studies, these changes have been fully comparable to those observed in younger persons.

Exercise among the elderly with cardiovascular disease has, in several studies, led to positive effects of the same extent as in younger people with corresponding diseases. The changes comprise a decreased heart rate at rest and during submaximum exertion, which together lead to improved physical performance capacity and a decrease in exertion-triggered cardiac symptoms.

Muscle function and strength training

With increasing age, the body's muscle mass decreases, which gradually leads to a reduction in muscle strength (5). A healthy 80-year-old man or woman may have lost half of his or her original muscle mass in some muscles, leading to a halving of muscle strength. At the same time as the decrease in muscle mass, there is an increased storage of fat and connective tissue in the skeletal muscles. The decrease in the muscle mass is caused by a loss of muscle fibres, with a reduction of the size of the remaining muscle fibres, which is in turn due to a reduction in motor neurons of the ventral horns of the spinal cord. Other factors, such as hormonal changes and altered protein synthesis, also contribute to this regression. The reduced muscle mass and muscle strength also lead to changes in activity capacity, such as the ability to walk. In parallel with the decreased muscle mass, there is also a decrease in bone mass, which increases the risk of osteoporosis and fractures from falling accidents.

In a large number of studies, strength training – defined as training with weights or against a gradually increasing load – has proven to provide increases in muscle strength in the elderly, even over the age of 90, of between 50 to 200 per cent (6, 7). There is a strong correlation between the intensity of strength training, in other words the load, and the improvements achieved. In the studies that achieved major and practically significant results, the load during training has been high, often more than 80 per cent of the maximum strength (80% of a repetitive maximum). Training was done with weights and no more than three times a week. Every or every other week, the load was adjusted in pace with the increasing strength, to thereby always maintain a constant load.

In the majority of the studies, the strength increase has been of the same magnitude as in younger people. The main part of the strength increase, in both young and old, primarily comprises an adaptation in the nervous system at the beginning of training. Evaluation of the strength increase, through muscle biopsies, computed tomography or magnetic resonance imaging, has also shown that the muscle mass increased (5–10%) and that the muscle fibres became larger (10–30%) (6–8). When strength training continued for extended periods, up to one year, the increase in muscle mass and muscle fibre size was even larger. Some studies have also mapped the possibility of retaining the achieved strength increase. As in younger people, one exercise session per week can mean that the achieved strength increase is maintained.

In addition to effects on muscle strength, strength training also leads to positive effects on body composition in general, protein metabolism and bone mass (primarily among elderly women) (9). Studies of the addition of various dietary supplements and hormones (growth hormone, oestrogen, testosterone) in the elderly have not, however, shown any significant effects on muscle mass or muscle strength beyond that achieved by the actual strength training.

In recent years, interest has grown in the training of explosive strength, or power, and it has been shown that it is of equal or greater significance to functional ability than traditional strength training (10). An important observation is that power tends to decrease to a greater extent than muscle strength with increasing age. Compared with pure muscle strength, climbing stairs, standing up from a chair and walking speed are therefore affected to a greater extent by both increased and decreased power than by muscle strength alone.

Balance, flexibility and walking ability

Balance, flexibility and walking ability are also affected by increasing age (4). Changes in these functions and the relationship to mobility and falling accidents have led to a greater interest in the effects of physical activity and exercise. Balance is a compound function and is dependent on the coordination of information from sensory and motor systems in different parts of the peripheral and the central nervous system (including basal ganglia, the cerebellum, the vestibular system, vision, muscle and joint sensitivity as well as tactile sensibility).

Flexibility comprises the joints' ability to maintain a range of motion, which is not only dependent on the function of the joint, but the function of the surrounding structures as well (muscles, tendons, ligaments). The ability to walk is dependent on several factors such as balance and joint flexibility, as well as aerobic fitness, muscle strength and power.

A number of studies have shown that balance changes with increasing age. It has long been believed that there is a correlation between balance and falling accidents, but recent studies have shown that the cause of the majority of falling accidents is multi-factoral and that changes in balance are only one cause (11).

Individually adapted exercises to improve muscle strength and balance, combined with one walk a week, have been shown to be able to be reduce the propensity to falling among elderly with diminished function living at home (12). For people with a complex clinical picture and major disability, several other efforts are needed in addition to training to prevent falling accidents.

Studies of physical activity and exercise, often including several different types of exercise, have indicated both improved balance and a reduced risk of falling and proportion of falls (13). Large U.S. multicentre studies have included aerobic exercise, strength training, tai chi and flexibility training and indicated effects of various balance elements, but it has not been established what type of training has the greatest single effect (14). With the objective of improving and maintaining balance, general exercise programmes are therefore recommended that include both strength training and aerobic exercise as well as training for balance, flexibility and coordination.

An important factor that has received growing attention is confidence in one's own ability, often called self-efficacy (15). Those who have a low self-efficacy and a fear of

falling avoid activities with which they feel unsafe, and then receive less training and can end up in a vicious cycle of gradually decreasing activity and function. The feeling of safety and greater self-efficacy can, however, be affected by both exercise and information.

Increasing age affects the structures (bones, muscles, connective tissue) needed for retained joint flexibility. Diminished joint flexibility is also a risk factor for diminished functional capacity. With increasing age, the range of motion of several joints of the body is reduced in many people, both proximally and distally. In spite of this, there are few controlled studies of the effects of physical activity and exercise on joint flexibility. The studies that exist have been relatively small and several have lacked a control group. In some cases, the results have not indicated any effects, while others have shown significant effects on joint flexibility among the elderly. The intervention in these studies has consisted of both indirect exercises, such as walking, dance and callisthenics, and direct exercises such as stretching with the aim of increasing the range of motion. In light of this, there are no specific recommendations regarding programmes for the elderly with the aim of increasing joint flexibility and range of motion. Instead, general aerobic exercise programmes are recommended, such as aerobic training, callisthenics, walks and swimming, where flexibility is trained indirectly. Further studies are also needed to establish the intensity and duration of the training, as well as the significance of increased joint flexibility with regard to balance, mobility and the reduction of falling accidents.

The ability to walk is also affected positively by all-round training, but sometimes also needs to be trained specifically. In terms of walking speed, a correlation with muscle strength has only been able to be shown in persons with diminished strength (16, 17). It can therefore be assumed that strength training of the legs in particular has the best effect on the ability to walk in people with diminished functional capacity, such as fragile individuals.

Psychological function and quality of life

It is well known that physical activity has significant effects on various psychological functions and this has also been noted with regard to the elderly (18). Mainly cognitive function and depression, two areas in which the elderly can be affected, and the effects of physical activity and exercise have attracted interest.

A large number of studies have shown possible correlations between physical activity and cognitive function, such as memory, concentration, attention and reaction time (18). Several studies have also indicated large differences in these capacities in physically active elderly persons compared with inactive elderly persons. However, the design of these studies and the lack of descriptions of the test subjects' performance capacity in other respects make these results difficult to interpret. Several exercise studies in recent years have, however, been able to indicate a possible link between increased physical performance capacity and increased cognitive function among the elderly (19). It has also been shown that physically active persons run less risk of developing age-related dementia compared with persons who are less active (20, 21). However, more controlled studies are needed to establish the significance of physical activity and training to an improved cognitive function among the elderly.

Depression is relatively commonly occurring among the elderly. Symptoms of depression have been reported in up to 15 per cent of the elderly population. Physical activity and exercise are currently prescribed as a type of treatment for mild depression and increasing numbers of studies support the correlation between the degree of physical activity and depression, but the proportion of scientific studies that support this treatment is still low (22, 23). It is concluded here as well that more controlled studies are needed to establish the correlation between physical activity, exercise and depression among the elderly.

Health-related quality of life concerns how a person rates his or her own health. Several studies have found that elderly persons who are physically active report a higher health-related quality of life than less active persons (24, 25). There are also signs that indicate that health-related quality of life increases as a result of physical activity and exercise. However, there is a lack of knowledge regarding the correlation between the amount and type of physical activity and exercise and the improvement in health-related quality of life.

Prescription

In general, the individual is encouraged to find activities and types of exercise that he or she is comfortable with and finds enjoyable (26–28). The chance thereby increases that he or she will continue to be physically active over the years. It is important to build up a lifestyle that includes regular physical activity and exercise and that the activities recommended, in one form or another, already comprise a part of the elderly person's life.

Aerobic exercise

Mainly activities that involve major muscle groups are recommended, such as cycling, swimming, walking, jogging and skiing. The intensity and duration of the activity are crucial to the degree of change in cardiovascular function achieved with aerobic exercise. Mainly low to moderate intensity activity is recommended to affect risk factors of cardiovascular disease, while moderate to high intensity activity may be needed to be able to achieve improvements in cardiovascular function. The recommendation regarding intensity should therefore be guided by a total appraisal of multiple factors. Training should be done at least 2–3 times a week, at least 20 minutes at a time.

The contraindications for testing and aerobic exercise are the same for the elderly as for younger people. The most common absolute contraindications are ECG changes that have recently arisen or a recent heart attack, unstable angina, uncontrolled arrhythmia, total atrioventricular (AV) block and acute cardiac insufficiency. Relative contraindications comprise cardiomyopathies (heart muscle diseases), cardiac valve disease and uncontrolled metabolic diseases. These and other conditions, which are significantly more common among the elderly, mean that testing and consultation regarding participating in physical activity and exercise should be done based on set guidelines.

Muscle function and strength training

Based on the positive effects of strength training in the elderly, this type of exercise should be included as a significant part of the recommendations regarding physical activity and exercise for the elderly. Strength training should always be individualised and be progressive, in other words the load should be gradually adjusted in pace with increasing strength. Exercises should be done 1–2 times a week and include the body's major muscle groups in both the upper and lower extremities. The number of repetitions can be 10–12 for the elderly, although fewer repetitions, 8–10, with a higher load provide a greater effect. The previous recommendation regarding the number of sets to achieve a maximum effect was three, but more recent studies show that positive effects can also be achieved with fewer sets. The same contraindications can be observed for strength training as for aerobic exercise. Progressive strength training often presupposes access to weights or various machines and apparatus that make possible an adjustable resistance, which is why training can advantageously take place at a specially equipped gym. For many elderly persons, particularly those with some level of disability, training should, however, also be done in the form of various functional elements, such as rising from a chair and climbing stairs.

Balance, flexibility and walking ability

Training of balance, flexibility and walking ability is best done through all-round exercise, individually or in a group. Balance can be trained by challenging one's stability and control, such as by standing on one leg or walking in circles, sideways or over obstacles. It is crucial that the balance training be customised so that it provides the optimum effect based on the individual's needs. Different activities place different requirements on balance and training should therefore be done in body positions and movements that are important for the person to be able to function in everyday life.

Flexibility is best maintained by using the entire scale of exercise opportunities, in other words keeping the body going in an all-round way, both with physical activity and exercise, but just as much through various everyday and free-time activities. Regular walks, preferably in varying terrain and on different surfaces, contribute to good balance, flexibility and walking ability.

Psychological function and quality of life

Available data indicates a positive correlation with regard to aerobic fitness and strength training and psychological function, but clear guidelines are lacking with regard to intensity and duration of various types of exercise. Consequently, the recommendations are to stimulate various types of physical activity and exercise, where the individual should be encouraged to find activities and types of exercise that he or she is comfortable with and finds enjoyable. The social environment, in other words where and with whom the activity or exercise is done, is probably also very important to positively affecting memory, cognitive capacity, power of initiative, mood and perceived health.

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