Guidelines and Benefits for Exercising the Elderly

Nita Farbo
University of North Dakota

Follow this and additional works at: https://commons.und.edu/pt-grad

Part of the Physical Therapy Commons

Recommended Citation
https://commons.und.edu/pt-grad/132
GUIDELINES AND BENEFITS FOR EXERCISING THE ELDERLY

by

Nita Farbo
Bachelor of Science in Physical Therapy
University of North Dakota, 1994

An Independent Study
Submitted to the Graduate Faculty of the
Department of Physical Therapy
School of Medicine
University of North Dakota
in partial fulfillment of the requirements
for the degree of
Master of Physical Therapy

Grand Forks, North Dakota
May
1995
This Independent Study, submitted by Nita Farbo in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Faculty Preceptor, Advisor, and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

Renee Mabey
(Faculty Preceptor)

Elizelle Johnson
(Graduate School Advisor)

James Mac
(Chairperson, Physical Therapy)
PERMISSION

Title Guidelines and Benefits for Exercising the Elderly

Department Physical Therapy

Degree Master of Physical Therapy

In presenting this Independent Study Report in partial fulfillment of the requirements for a graduate degree from the University of North Dakota, I agree that the Department of Physical Therapy shall make it freely available for inspection. I further agree that permission for extensive copying for scholarly purposes may be granted by the professor who supervised my Independent Study Report or, in her absence, by the Chairperson of the department. It is understood that any copying or publication or other use of this Independent Study Report or part thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to the University of North Dakota in any scholarly use which may be made of any material in my Independent Study Report.

Signature

Date 12-8-94
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>ABSTRACT</th>
<th>vi</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHAPTER</td>
<td></td>
</tr>
<tr>
<td>I.  INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>II. PHYSIOLOGICAL CHANGES THROUGHOUT AGING</td>
<td>4</td>
</tr>
<tr>
<td>Flexibility Changes</td>
<td>5</td>
</tr>
<tr>
<td>Strength Changes</td>
<td>6</td>
</tr>
<tr>
<td>Cardiorespiratory Changes</td>
<td>7</td>
</tr>
<tr>
<td>Skeletal Changes</td>
<td>9</td>
</tr>
<tr>
<td>Metabolic Changes</td>
<td>10</td>
</tr>
<tr>
<td>Psychological Changes</td>
<td>11</td>
</tr>
<tr>
<td>III. THE BENEFITS OF EXERCISE</td>
<td>12</td>
</tr>
<tr>
<td>Flexibility Benefits</td>
<td>12</td>
</tr>
<tr>
<td>Strength Benefits</td>
<td>13</td>
</tr>
<tr>
<td>Cardiorespiratory Benefits</td>
<td>14</td>
</tr>
<tr>
<td>Skeletal Benefits</td>
<td>16</td>
</tr>
<tr>
<td>Metabolic Benefits</td>
<td>16</td>
</tr>
<tr>
<td>Psychological Benefits</td>
<td>17</td>
</tr>
</tbody>
</table>
IV.  PRE-EXERCISE EVALUATION .......................... 19
    Subjective Information .................................. 19
    Objective Information .................................. 20

V.  THE EXERCISE PROGRAM AND PRESCRIPTION ...... 24
    Warm-up ................................................... 24
    Flexibility Exercise Guidelines ....................... 25
    Strengthening Exercise Guidelines ..................... 27
    Aerobic Exercise Guidelines ............................ 29
    Cool-down ............................................... 31
    General Precautions .................................... 32

VI. CONCLUSIONS ........................................... 35

REFERENCES ................................................. 38
ABSTRACT

The population of elderly individuals is continually growing due to advancements in medicine and technology. Several physiological and psychological changes occur throughout the aging process. Regular physical activity is an effective therapy for slowing the aging process and preventing many of the conditions that occur with aging, such as hypertension, coronary artery disease, obesity, diabetes, depression, and anxiety. In addition, the active individual is more independent and functional in his or her activities of daily living compared to the person who remains sedentary. Older individuals who maintain functional levels of flexibility, strength, and cardiovascular endurance are rarely candidates for nursing home placement.

The purpose of this literature review is to provide physical therapists and other health care professionals with recommended exercise guidelines for the elderly population. The most common physiological changes that occur among the elderly will be discussed as well as the benefits of an exercise program. The basic components of a pre-exercise examination will be given. The exam will provide a basis for each individual's exercise prescription. The exercise prescription will include flexibility, strengthening, and aerobic exercises as well
as guidelines for the frequency, duration, and intensity of each of these exercises. Lastly, the signs and symptoms of overexertion will be discussed.

The results of this literature review will provide a basic understanding of the importance of an exercise program. Individuals who engage in physical activity are able to function at their optimal physical and emotional levels. The key to optimal health is preventive care that includes an exercise program.
CHAPTER I

INTRODUCTION

The population of elderly individuals is continually growing larger; advancements in medicine and technology have led to an increased life expectancy for both men and women. By the year 2000, it is expected that the elderly will make up 14.7% of the United States' total population.\(^1\) From 60% to 70% of older adults are sedentary, without routine physical activity, and less than 20% regularly participate in an exercise program sufficient for cardiorespiratory fitness and health benefits.\(^2\)

Although the elder years are often looked upon negatively, the elderly should strive to maintain their highest level of physical functioning and attempt to decrease the effects of the aging process. Even though physiological changes are inevitable as one ages, one may be able to slow down this process through diet, exercise, and an active lifestyle. Exercise will maintain or increase one's cardiovascular endurance and strength at any age, including 65 years of age and older. The challenge is to keep mentally and physically stimulated.\(^1\)

The goal of prescribing exercise for the geriatric population is to promote a healthy, independent lifestyle during the retirement years. Many physical and
psychological conditions that commonly occur with aging can be prevented or delayed in asymptomatic persons with physical activity. Physical activity can also play a preventive role as treatment for symptomatic persons in limiting dysfunction and disability and preventing recurrence of other conditions, such as cardiovascular compromises. By maintaining mobility in the elderly population, the placement of the elderly into nursing homes will decline. The key in health care today is prevention. Exercise is considered to play a major role in the prevention of disease and disability.

The prescription of exercise begins with a balanced program consisting of flexibility exercises, strengthening exercises, and aerobic activities. Flexibility exercises are important for maintaining functional range of motion. Resistance training improves general muscle strength needed for functional activities, such as rising from a chair. Aerobic activities benefit the function of the heart and lungs. The intensity, frequency, and duration of exercise should be gradually increased as cardiovascular endurance and muscular strength improve. A comprehensive program incorporates all three aspects—flexibility, strengthening, and endurance—for optimal benefits. However, the best exercise prescription is one that includes a variety of activities the individual enjoys.

As Dr. Raymond Harris reported in his testimony to a Senate subcommittee on fitness for older persons, "Impaired mobility in middle age and older people, often the result of poor physical fitness, leads to social isolation, personality and emotional deterioration and poor mental health. Muscular
degeneration and physiological changes resulting from restriction of physical exercise lead to greater clumsiness, and increased fear of physical activity. Physical exercise programs that encourage older persons to be more active, independent, and mobile provide economic benefit by reducing medical problems and hospital costs."

This literature review will discuss exercise programs for the elderly. First, the physiological changes which occur with aging will be addressed. Next, the benefits of an exercise program will be discussed. An outline of a pre-exercise assessment will be given. An exercise program will be outlined including flexibility, strengthening, and endurance exercises, as well as guidelines for the frequency, duration, and intensity for each of these exercises. General exercise precautions specific for elderly individuals will be addressed as well. The results of this literature review should provide a basic understanding of the importance of an exercise program for the elderly population.
CHAPTER II

PHYSIOLOGICAL CHANGES THROUGHOUT AGING

Physical decline is inevitable. From the fourth decade onward, a gradual decline in vigor and resistance eventually gives way to various types of dysfunction. However, each individual is unique and ages in different ways and at different rates. Even within the same person, there are differences within body systems as to the rate and extent of decline. Nevertheless, these changes are gradual and somewhat predictable unless a pathology accelerates the decline.

Physiological changes occur with age and these changes affect flexibility, strength, and endurance. Eventually these changes limit motor performance. Motor performance is the execution of tasks that require coordinated muscle activity and is the basis for activities of daily living and work related tasks. Such activities include walking, eating, bathing, grooming, writing, lifting, and reaching. All recreational activities are also motor performance tasks. Ultimately, loss of motor performance affects functional independence.

Each system, is influenced by biological, pathological, and functional causes of change. Each of these areas will be discussed in further detail.
Flexibility Changes

There may be a general loss of flexibility and range of motion as a result of biological, functional, and pathological causes. Biologic changes in aging collagen alter flexibility. Characteristics of altered collagen include irregular shaping, lack of parallel formation of the collagen fibers, and reduced mobility, with a slowed response to stretch. There is also less collagen degraded and synthesized. Altered collagen causes muscles, skin, tendons, capsules, and discs to lose flexibility. This results in altered extremity range of motion and an inflexible spine.

The functional cause of decreased flexibility is a lack of activity or hypokinesis. Many older individuals sit for prolonged periods of time causing the flexor group of muscles to become extremely tight. Tight hip and knee flexors ultimately lead to problems with walking.

The pathological cause of decreased flexibility is osteoarthritis. Osteoarthritis is a noninflammatory, degenerative joint disorder in which there is a progressive loss of articular cartilage accompanied by new bone formation and capsular fibrosis. It affects mostly weight-bearing joints, particularly the knees, hips, and the distal interphalangeal joints. As the disease progresses, joint motion becomes diminished; flexion contractures occur; tenderness, crepitus, or grating sensations appear. Disuse of the joint and surrounding musculature due to pain or osteophyte formation ultimately causes weakness and limited range of motion.
Muscles lose some of their strength and tone as one ages due to biological, pathological, and functional causes. Strength changes do not become noticeable until very late in life. Strength levels are relatively well maintained up through the 5th decade of life. The decline amounts to about 15% per decade in the 6th and 7th decade after which time the loss in muscle strength approximates 30% per decade.\textsuperscript{9} Similar decreases occur in both men and women. Biologically, there is decreased muscle mass due to decreases in the number and area of the muscle fibers.\textsuperscript{10} A reduction in type II fiber area accounts for the significant decrease in muscle size and strength that occurs with aging.\textsuperscript{5,9,11}

Not every elderly patient's weakness is due just from old age. The weakness may be from a pathologic cause. One pathologic cause of strength loss is polymyalgia rheumatica. It is a syndrome characterized by pain, weakness, and stiffness in proximal muscle groups. The areas most affected are the neck, back, pelvis, and shoulder girdle. The origin is not known and the disease affects both genders mostly over the age of 65. The only effective treatment is cortisone in the acute phases.\textsuperscript{6}

The functional cause of strength loss is a lack of activity and a decreased use of muscles. Disuse causes atrophy or wasting away of muscle tissue very rapidly. Movements tend to be slower and there is accompanying deficit in motor coordination.\textsuperscript{7} Recent studies indicate that sensorimotor behavior
changes, such as slowing of movement, reduction of strength, and impairment of balance, are significantly affected by activity level. With an impairment of these factors comes a greater chance of falling among the elderly population. As many as 28% to 45% of community-dwelling elders and 45% to 61% of elders living in a nursing home fall each year. With the combined effects of injury and fear of falling again comes a state of decreased mobility and increased dependency.

Cardiorespiratory Changes

Cardiorespiratory changes occur gradually throughout one's life span. Biological, pathological, and functional changes may all contribute together or act alone to alter the cardiorespiratory status. Changes within the cardiorespiratory system may ultimately reduce exercise capacity and limit motor performance.

Arteriosclerosis is the most common type of heart disease and the usual cause of heart failure of the elderly. It is a pathological hardening of the blood vessel walls. This is due to changes in the amount and nature of elastin and collagen and from calcium deposition. Changes in the cross-linking of collagen, in particular, may cause the vessels to be more rigid.

Atherosclerosis is a common vascular disease in which there is a narrowing of the blood vessels. With the occlusion of coronary arteries, blood flow gradually decreases. There may then be inadequate oxygenation of the
myocardium resulting in ischemia. Atherosclerosis and arteriosclerosis are frequent causes of ischemic heart disease.\textsuperscript{11}

Hypertension, or high blood pressure, accelerates the potential for acute heart and vascular diseases.\textsuperscript{11} The average systolic blood pressure is 150 mmHg and the average diastolic blood pressure of the aged is 90 mmHg.\textsuperscript{13} If 160/95 mmHg is considered high blood pressure, then 22\% of men and 34\% of women 65 to 74 years of age are hypertensive.\textsuperscript{14} Hypertension results from an increased peripheral vascular resistance and may decrease cardiac output ultimately leading to impaired activity tolerance.\textsuperscript{13}

Cardiac output declines an average of 7 liters per minute to 3.4 liters per minute from age 19 to 86 years.\textsuperscript{15} Cardiac output is the product of heart rate (HR) times the stroke volume (SV).\textsuperscript{16} There is a 10\% to 20\% decrease in maximum stroke volume. Resting heart rate during exercise declines.\textsuperscript{16} Clinically, this implies that the elderly patient has a lower exercise capacity and can reach an intense level of exercise at lower pulse rates than a younger person.\textsuperscript{16} Cardiac output, specifically the maximal heart rate, is thought to be the single most important factor for reduced exercise capacity in the elderly patient.\textsuperscript{16}

Maximum oxygen consumption, the maximum ability of the body to use oxygen during exercise decreases with age.\textsuperscript{7,16} The maximum oxygen consumption averages 28.5 ml/kg of body weight per minute for a 65-year-old man and is about 25.5 ml/kg/min for a 65-year-old woman, compared to 43
ml/kg/min for men and 35 ml/kg/min for women at 25 years of age. This decline may be due to a functional cause of physical inactivity. Other factors that contribute to this decline are a decrease in maximum heart rate, maximum stroke volume, and maximum arteriovenous oxygen difference. However, an elderly person in good physical condition can meet or exceed the work capacity of a non-conditioned younger person.

Changes within the pulmonary system include the following: decreased thoracic wall compliance, decreased vital capacity and increased residual volume, decreased pulmonary diffusion, increased airway resistance, decreased arterial oxygenation at rest and exercise, and decreased partial pressures of arterial oxygen. The efficiency of the lungs is reduced, causing the respiratory muscles to work harder. Therefore, the elderly person has more difficulty performing simple aerobic type of tasks.

If oxygen delivery is inadequate to meet the metabolic demands of the muscle, work must be performed anaerobically. Lactic acid is produced as a result of anaerobic work. The capacity of processing lactic acid is lessened. Thus, the individual will quickly fatigue, particularly the unfit older person.

Skeletal Changes

The aging skeletal system is often prone to develop osteoporosis. Osteoporosis is a generalized reduction in bone tissue mass which ultimately causes weakness of skeletal strength, even though the ratio of mineral to organic elements is unchanged. From the age of 40 years and on, bone
mass slowly but steadily decreases. The rate of bone loss is about 1% per year for women after 30 and slightly less for men after 50. The increased rate of bone loss for women may be due to the reduction of estrogen being produced during menopause. Other factors which reduce bone mass are calcium absorption, chronic illnesses, long periods of bed rest, and insufficient physical activity. Research studies increasingly point to poor nutrition and lack of exercise as central to the cause of bone loss and a subsequent decline in bone strength.

With weakness and thinning of the bones, fractures will occur easily, sometimes with little or no trauma. Vertebral crush fractures, hip and Colles' fractures are more common in the elderly because of the preexisting osteoporosis.

### Metabolic Changes

Metabolic changes occur within the body, particularly within the pancreas. The pancreas synthesizes powerful enzymes which enhance the digestion and absorption of food. Loss of function of the pancreas is manifested by diminished insulin binding sites and a decrease in glucose tolerance. This decrease in function is classified as Non-Insulin Dependent Diabetes Mellitus or Type II Diabetes. Complications include nephropathy, retinopathy, neuropathy, and accelerated atherosclerosis. Ninety percent of the people with Type II Diabetes are overweight, which makes matters worse.
The vascular and neurological problems of diabetes are major causes of disability and mortality in older people. Insulin-dependent diabetics suffer a higher than average incidence of cardiovascular diseases. Abnormally high levels of low-density lipoprotein cholesterol clog the arteries and lead to heart attacks and strokes.

Psychological Changes

Numerous psychological changes may occur throughout the aging process that may be secondary to prolonged inactivity. Psychological problems may include depression, anger, agitation, frustration, anxiety, paranoia, reduction in mental activity, disorientation, and decline in memory. Depression affects 12.6% of nursing home patients. Many times there is a relationship between depression and a decline in function or lack of mobility.

In summary, older individuals have limitations in physical activities due to the numerous physiological changes which occur. Consequently, they are looked upon as frail and decrepit. The reality is that they are very capable of performing physical exercise and achieving benefits from exercise training. Individuals who age successfully are those who are able to function at their optimal physical and emotional levels. The key to optimal health is preventive care that includes an exercise program.
CHAPTER III
THE BENEFITS OF EXERCISE

The Council on Scientific Affairs of the American Medical Association (AMA) in the summer of 1984 issued a report stating "many of the changes in body structure and function commonly attributed to aging can be retarded by an active exercise program." Exercise has the potential to improve overall health and well-being as well as provide an opportunity for social contacts. An exercise program is beneficial to a healthy and active elderly person as well as the more sedentary individual. It is also beneficial to those with chronic illnesses, such as osteoarthritis, osteoporosis, diabetes, and cardiac conditions.

Flexibility Benefits

A stretching program is beneficial to the individual who has limited motion due to biological, functional, and pathological causes. Stretching reduces tightness within the joint by breaking down collagenous adhesions. Stretching may also prevent shortening and tightening of the ligamentous joint capsule, tendon, and muscle tissues. These tissues may be elongated as a result of stretching exercises. However, the stretch must be slow and prolonged to effectively lengthen the tissues.
Activity also forestalls the onset of arthritis by maintaining healthy cartilage and range of motion. Exercise breaks up the cycle of pain and swelling which leads to disuse and further loss of motion. Frequency of exercise rather than a large number of repetitions is important in breaking up this cycle in the arthritic patient.

The most important exercises for maintaining flexibility are stretching and strengthening exercises done on a consistent basis. This allows the muscles surrounding the joint to remain strong and mobile, thus helping to decrease the likelihood of joint contractures, disability, and deformity.

Strength Benefits

The rate of decline of muscular strength can be slowed down with regular physical activity that includes some form of resistive exercise. The strength and endurance of men approaching age 65 does not differ from that of men as young as 22 if they are involved in equivalent work activities. For those individuals undergoing strength training, the most significant gains are seen within the previously sedentary elderly person who is initially the weakest, but without severe muscle atrophy. However, strength gains occur in the healthy, elderly person as well.

There is some controversy as to the mechanism for the increase in muscle strength that occurs in the elderly person from exercise training. Frontera et al suggest that strength training leads to muscle hypertrophy due to an increase in the size of type I and type II fibers.
accompanied by an increase in the rate of actomyosin protein turnover. This suggests that the ability for elderly individuals to increase muscle mass is retained.

However, several studies suggest that muscle mass measured via muscle girth increases very little. In a study done by deVries, arm strength improved by 11.9% compared to a 1% increase in muscle girth. According to both deVries and Moritani, the increase in strength is due to greater activation by the central nervous system (CNS) rather than by any hypertrophic changes in the muscle tissue. Activation by the CNS results in an increase in motor unit recruitment. Therefore, as more motor units are recruited, strength tends to increase.

The incidence of hip fracture is reduced in the elderly with improvements in the lower extremity strength. An increase in muscle strength will also aid elderly persons in performing their daily activities, such as walking, climbing stairs, and rising from the toilet seat. Independent ambulation could, therefore, be maintained for a longer time, thus reducing the need for nursing care and nursing home placement.

Cardiorespiratory Benefits

As detailed in the 1990 American Heart Association (AHA) statement, the benefits of exercise training include increased cardiovascular functional capacity and decreased myocardial oxygen demand for a given level of physical activity both in healthy persons and in persons with cardiovascular disease. Even
daily low-intensity activities, such as gardening, pleasure walking, and house cleaning, may have some long-term health benefits in terms of a lowered risk of cardiovascular disease.\textsuperscript{33}

Endurance training will inevitably improve the efficiency of the heart. Beneficial effects of exercise for cardiovascular disorders include the following: a reduction in body fat and an increase in lean body mass; an increase in high density lipoprotein (HDL) and a decrease in low density lipoprotein (LDL) cholesterol; a decrease in systolic blood pressure, a lowered heart rate; and an increase in cardiac output and peripheral circulation.\textsuperscript{2,21,34,35} There is an increase in stroke volume which directly increases cardiac output and maximum oxygen consumption. As a result of these factors, there is a modification of coronary risk factors and cardiovascular diseases, such as arteriosclerosis, atherosclerosis, and hypertension.\textsuperscript{7,36}

Participation in a conditioning program can increase the aerobic capacity of the sedentary, elderly patient by at least 20%. An improvement of 20% of aerobic capacity is comparable to a 10- to 20-year reduction in functional age.\textsuperscript{28,29} An increase in aerobic capacity directly relates to an increase in maximum oxygen consumption.\textsuperscript{36} There is an increase in the ability of the blood to absorb and transport oxygen to the tissues. The tissues also develop an increased ability to absorb oxygen.\textsuperscript{21} Therefore, the individual is able to tolerate more physical activities throughout the day.
Exercise develops the lungs which increases their ability to oxygenate blood. Regular endurance training increases the peak oxygen transport to the working muscles by 5 to 10 ml/min/kg body mass at any given age. An adequate oxygen transport will meet the needs of the muscles during light aerobic work. Thus, the elderly person who follows an exercise program will not fatigue as quickly during light aerobic activities compared to the sedentary individual.

Skeletal Benefits

Exercise is not a means for preventing osteoporosis. However, resistance and weight-bearing exercises will retard the progression of osteoporosis by slowing the rate of bone loss, stimulating new bone growth, and strengthening the postural muscles. The mechanism of enhanced bone growth involves improved circulation in the bone and increased gravitational and muscular stress that influences the bones' cellular activity. Bone mineralization is improved due to the resultant stress put on the bone. Overall, exercise is vital for healthy bone. Immobilization should be minimized and a consistent exercise regimen is encouraged.

Metabolic Benefits

Individuals with Diabetes Mellitus, particularly Type II, will benefit substantially from regularly performed exercise. An endurance type of exercise will increase insulin sensitivity and normalize glucose tolerance. Glucose tolerance normalizes by reducing the resistance to insulin which
facilitates the uptake of glucose by the muscles.\textsuperscript{20,37} Thus, blood sugar levels are lowered to within acceptable limits. These beneficial effects are short-lived, usually being lost within a few days after exercise is stopped.\textsuperscript{20} Therefore, it is essential that exercise be performed regularly, at least every other day and preferably 5 to 6 days per week.\textsuperscript{20}

Exercise will also aid in lowering the elevated cholesterol levels which are so common among the diabetic patient.\textsuperscript{21} As cholesterol levels lower, the incidence of cardiovascular diseases will lower as well.

Psychological Benefits

One of the most obvious benefits of physical activity is an immediate elevation of mood.\textsuperscript{17} This is particularly helpful for the elderly individual who suffers from symptoms of depression.\textsuperscript{17,37} The elevation of mood in turn has a favorable effect upon perceived health and well-being.\textsuperscript{17} Endorphins released during exercise play an important part in pain reduction, stress management, and the feeling of well-being.\textsuperscript{36} The increased release of endorphins, therefore, may explain this feeling after exercise.

An exercise program will also improve one's self-image, resulting from both physical conditioning and more opportunities for social interaction with peers.\textsuperscript{29,37} There is an increase in lean body mass resulting in an improved figure and general appearance.\textsuperscript{21} This ultimately improves one's self-image. Exercise increases the ability to handle stress and cope with daily environmental hazards.\textsuperscript{21} Participating in an exercise program also provides an
opportunity for an individual to interact with a variety of peers, which may improve one's self-image.

With an active lifestyle, there is an improvement in the unity of body and mind and a more positive approach to life. Thus, an exercise program will motivate the older person to live a more independent and fulfilling life.
CHAPTER IV
PRE-EXERCISE EVALUATION

Before beginning an exercise program, a thorough examination should be conducted. The evaluation is used to determine the older patient’s functional capacity and to develop an exercise prescription suitable for that individual. Certain modifications need to be considered when developing an exercise prescription for the elderly patient. The prescription is individualized based on subjective and objective information obtained during the evaluation.

Subjective Information

Subjective information begins with a medical history which includes medications, current symptoms, and risk factors which may be modified with exercise. Risk factors that may be seen in the elderly include the following: anemia, hypoglycemia, inadequate calcium intake, hypokalemia, nutritional deficiencies, neuropathy or other sensory impairments, orthostatic hypotension, hypertension, impaired equilibrium, coronary and peripheral vascular disease, arrhythmias, and degenerative bone and joint disease. These conditions often occur in elderly patients and should be thoroughly evaluated before and monitored during an exercise program. However, in most instances, these
conditions will not prevent the individual from safely participating in an exercise program.\textsuperscript{38}

The subjective portion of the assessment should include previous and present exercise programs. Frequency, duration, and intensity of each activity needs to be noted. Before an exercise program is prescribed, the individuals should express their personal goals, interest, and lifestyle preferences.

Objective Information

The physical examination or objective information focuses on the musculoskeletal, cardiovascular, and respiratory systems. Specific items pertaining to the musculoskeletal system include range of motion, balance, gait stability, and strength testing. Height and weight measurements should be taken initially in order to monitor changes that may occur throughout an exercise program.

Recommendations for evaluating the cardiovascular system include measuring vital signs and cardiac function. The American College of Sports Medicine (ACSM) recommends exercise stress testing before vigorous exercise for men over 40, women over 50, and all high-risk patients with or without symptoms.\textsuperscript{2} Exercise testing is done for a number of reasons. First, it is done to aid in the diagnosis of coronary heart disease in asymptomatic or symptomatic individuals.\textsuperscript{1} Secondly, it is done to assess the cardiopulmonary functional capacity of apparently healthy or diseased individuals.\textsuperscript{1} Finally, it is done to assess the safety of exercise prior to beginning an exercise program.
and identify a safe range for heart rate and maximal oxygen uptake during exercise.¹,³⁷

Maximal oxygen uptake reflects the maximum functional capacity of the cardiovascular system. The maximal functional capacity of an individual is usually the most important factor determining one's cardiovascular endurance.³⁹

Oxygen consumption increases linearly with increasing workloads up to the maximal rate of oxygen uptake. A plateau of oxygen uptake with an increasing workload is considered to be the subject's maximum oxygen uptake.³⁷,³⁹

The achievement of near maximal heat rate may also support the conclusion of a peak oxygen uptake.³⁹ The individual should exercise until 80% to 85% of predicted maximal heart rate is achieved. Predicted maximal heart rate is calculated as 200 minus the patient's age.²⁴,⁴⁰ However, more than a third of elderly patients will not be able to meet 85% of the predicted maximal heart rate.³⁷ Furthermore, the maximum heart rate that an elderly person can attain may be significantly less than the calculated maximal heart rate.²⁴ This is especially true for individuals at risk for coronary artery disease and other chronic diseases. Therefore, the symptom-limited heart rate is considered the maximal heart rate for elderly patients.¹³ The symptom-limited heart rate is determined from the stress test. The target heart rate for exercise should never exceed the symptom-limited heart rate.

The target heart rate range is approximately 65% to 80% of the predicted maximum heart rate.³⁷ Target heart rate range is calculated as follows:
1. 220 - age (years) = maximal heart rate (MHR)
2. MHR - resting heart rate (RHR) = HR reserve
3. Take 30% and 45% of HR reserve
4. Add to RHR - Target HR range

An aerobic training response occurs when 30% to 45% of the heart rate reserve is added to the resting heart rate.\(^{37}\) This method of calculation is somewhat lower than the 70% to 85% of maximum heart rate recommended by the AHA.\(^{37}\) However, this method allows for the target heart rate to be individualized based on the person's resting heart rate. Sedentary individuals generally have a higher resting heart rate and thus a smaller heart rate reserve.\(^{37}\) Therefore, a small increase in the elderly patient's heart rate will produce a training benefit.

The maximum heart rate and the exercise heart rate are measures of the intensity of the exercise. If symptoms and electrocardiographic changes occur near maximal exertion, it is a contraindication to an unsupervised exercise program.\(^{37}\) Exercise may still be prescribed at a lower heart rate. The exercise heart rate is generally 75% of that at which symptoms or abnormalities occurred.\(^{37}\) If the elderly patient does tolerate 85% of his/her predicted maximal heart rate, then that individual will be given an exercise program at a level somewhat lower than achieved during the testing. However, elderly individuals should be monitored periodically or have supervision throughout an exercise program.
A pulmonary exam is necessary to determine an individual's respiratory function. Respiratory function is obtained by checking the vital signs, such as heart rate, rate of respiration, and blood pressure, of the patient prior to, during, and after exercise. The patient's forced vital capacity (FVC) and forced expiratory volume (FEV) can be easily checked to measure lung volumes and capacities. FVC and FEV are used as a general screening test for detection of abnormal breathing patterns and lung obstruction or restriction.

In conclusion, it is important to use both subjective and objective information obtained during the evaluation in developing an exercise program. Each exercise program will be individualized to fit the needs of that person. The intensity, duration, frequency, and type of exercise prescribed will be based on the examination of each individual.
CHAPTER V
THE EXERCISE PROGRAM AND PRESCRIPTION
For optimal benefits, an exercise program should incorporate flexibility, strengthening, and aerobic exercises. Flexibility exercises are needed to maintain range of motion and prevent shortening of the muscles. Strengthening exercises are included to tone the muscles and increase strength. Aerobic exercises increase endurance and stamina by conditioning the respiratory and cardiovascular systems. Each of these areas will be discussed and will include the recommended frequency, duration, intensity, and precautions of each one. General precautions of exercise and signs of overexertion will be identified. Guidelines for a proper warm-up prior to exercise and a cool-down at the end of the routine will be reviewed as well.

Warm-up
Before beginning any of the conditioned exercises, a proper warm-up should be performed. The main purposes of the warm-up are to raise both the general body and muscle temperatures. An increase in muscle temperature increases the efficiency of muscular contractions by reducing muscle viscosity and increasing the rate of nerve conduction. At higher temperatures, there is a greater extraction of oxygen from hemoglobin which improves the oxygen
supply during work. There is an increase in circulation which facilitates the delivery of oxygen to the working muscles and minimizes an oxygen deficit and formation of lactic acid. The warm-up period will also stretch collagenous tissue to permit greater flexibility and reduce the risk of a musculoskeletal injury. The warm-up should be gradual and sufficient enough to increase general body and muscle temperature, but not cause fatigue. It should be a five- to ten-minute period of mild activity, such as walking, calisthenics, or cycling. Some gentle stretching may be done at this time.

**Flexibility Exercise Guidelines**

Flexibility exercises are stretching exercises used to maintain or increase range of motion. Only 15 to 20 minutes per day of stretching exercises can result in significant increases in flexibility. Stretching exercises are ideally performed prior to and after muscular strengthening or cardiovascular endurance exercises.

Active static stretches are the most ideal stretches for the older person. Active static stretching is a slow-hold form of movement performed by the individual without the assistance of a partner. The intensity and duration of the stretch is dependent upon the individual. The individual should move to the point of mild tension without causing pain or discomfort and maintain this position for 15 seconds, 30 seconds, or longer. The individual should be comfortable and be able to tolerate the stretch.
Basic stretches should include the lower extremity, pelvic girdle, low back, and pectoral girdle muscle groups. Stretching these muscle groups, particularly the pectoral muscles, will help to prevent kyphosis and the slouched posture appearance. Stretching the calf muscles can prevent shin splints and spasms of the gastrocnemius muscles. Stretching the hamstrings and low back muscles will help alleviate low back pain. Overall, flexibility of these muscles is beneficial for performing functional tasks, such as bending and reaching.

At least one session of the stretches should be supervised by a physical therapist. A follow-up session is recommended to make sure the stretches are being performed properly. Proper body positioning during a stretch is essential in order to obtain optimal benefits and reduce the risk of injury.

There are general precautions to be taken when performing stretching exercises. First, one should not bounce while stretching. This facilitates the stretch reflex and causes an increase in tension in the muscle being stretched. The muscles are more prone to microtrauma with bouncing as compared to a slow, gentle stretch performed at the end range of motion.

Special attention is needed when stretching musculature that crosses joints affected by pathology, such as arthritis and osteoporosis. One should not force a stretch beyond its normal range of motion and one should avoid overstretches weak muscles, particularly those that support the body in relation to gravity. It is important to find a balance between flexibility and strength.
develop this balance, strengthening exercises should be incorporated into an exercise program.\textsuperscript{13}

**Strengthening Exercise Guidelines**

The overall purpose of strengthening is to improve physical function. In order to increase strength, the muscle needs to be loaded beyond its normal everyday load of work. This is known as the overload principle and will lead to muscle hypertrophy and an increase in the recruitment of motor units.\textsuperscript{13,27} Therefore, an increase in strength will occur. The overload principle may be applied by increasing the weight of a load, increasing the number of repetitions, or changing the position of the body to alter the lever arm of movement.\textsuperscript{11} An example of changing the lever arm is to perform a sit-up with the hands behind the head or crossed at the chest; the lever arm is greater when the arms are placed behind the head. Therefore, the resistance is greater and a greater force is created.

However, the older adult should not exercise to the point of maximum loading.\textsuperscript{11} A load of 50\% to 60\% maximum effort is usually tolerated well. The safest formula for resistance training utilizes light handweights, 1 to 6 pounds, and high repetitions.\textsuperscript{2} This method minimizes the potential danger to the musculoskeletal and cardiovascular system.

Overall, emphasis should be placed on areas where muscle weakness commonly occur in older adults, such as the thigh, ankle, back, abdominal, and arm muscles.\textsuperscript{7} The rubber tubing or handweight exercises are sufficient for
upper body strengthening. Examples of upper extremity exercises are lateral raises, shoulder shrugs, biceps curls, wrist curls, triceps press, and the bench press. For the lower extremities, common techniques include the use of rubber-tubing exercises, water-resistive exercises in a pool, and the use of specialized equipment, such as Nautilus equipment. Nautilus equipment utilizes the principle of variable resistance to load a muscle throughout the full range of motion. One has to contract the muscles both to lift and lower the weights. Therefore, this method not only strengthens the muscles, but also adds to endurance because it extends the duration of muscle contraction.

The recommended frequency and duration of strengthening exercises begins with two sets of 12 repetitions per exercise three to five times per week. A total of 8 to 10 exercises that condition the major muscle groups should be performed during each session. Over a period of weeks, workload is gradually increased, first by increasing the repetitions, up to 25 to 30, and then by adding a third set. The weight may be increased, but high repetitions and low weight are recommended. The strengthening portion should generally last 15 to 20 minutes per exercise session.

Critical to the success of a strengthening program is a timely increase in the number of repetitions. Each exercise needs to be performed with enough repetitions to reach the point of fatigue. In general, the last one or two repetitions should be difficult to perform. If they are not difficult, the workload needs to be increased in order for strength gains to occur.
Caution needs to be advised if isometric exercises are incorporated into the strengthening program. Isometric exercises cause muscles to contract without moving the limbs or joints; there is an associated Valsalva maneuver.\textsuperscript{7,10} This maneuver produces closure of the glottis and involves a sustained pressure in the thoracic and abdominal regions.\textsuperscript{7} Consequently, blood pressure may rise and put a tremendous amount of strain on the cardiovascular system.\textsuperscript{10,29} Close monitoring or complete avoidance of isometric exercises is needed for patients with a history of cardiovascular problems. To help prevent problems, instruct the patient to exhale when performing the motion and avoid holding his/her breath.

**Aerobic Exercise Guidelines**

Cardiovascular endurance activities should be the foundation of a fitness program.\textsuperscript{2} Cardiovascular endurance increases the total amount of physical work one is able to perform, thus increasing the scope of possible activities in a given day, week, or lifetime.\textsuperscript{2} Any activity that uses large muscle groups, is rhythmic and aerobic in nature, and is maintained for a prolonged period of time will produce aerobic benefits.\textsuperscript{1,3} Activities may include walking or hiking, bicycling, swimming, dancing, stair climbing, and possibly jogging.\textsuperscript{11,33,38} Walking may be the best option for deconditioned adults initially starting a fitness program.\textsuperscript{7} It is a very functional activity that may be performed for long durations, thus improving the cardiorespiratory system. A stationary bicycle is a good choice because it afford less impact on the joints and provides good
stability. Swimming is a good non-weight-bearing exercise which provides both endurance and resistive training. Dancing should be aerobic in nature and utilize low-impact dance steps to prevent jarring of the joints. The type of activity performed is dependent upon the individual's preference and physical fitness status. In general, the activity chosen should be one that the individual tolerates and personally enjoys. To maximize enjoyment and compliance, the individual should vary his/her activity throughout the week. This will prevent the individual from getting bored and quitting the exercise program.

The intensity of exercise is very individualized and takes into account the results of the exercise test and the individual's effort. Optimal intensity may be based on the individual's maximum heart rate obtained from the exercise test or from the calculated target heart rate obtained from the exercise test or from the calculated target heart rate range. The American College of Sports Medicine recommends an intensity level at 60% to 80% of maximum heart rate reserve or 50% to 85% of maximum oxygen uptake for older healthy adults. However, for sedentary elderly people, 40% of oxygen uptake may be of sufficient intensity to significantly improve aerobic fitness.

Older patients can easily monitor their own workload intensity. Their rate and depth of breathing should increase noticeably, but not to the point of gasping. The individual should still be able to carry on a conversation with a partner.
The recommended duration and frequency of the aerobic portion is 20 to 30 minutes at least three times per week for minimal conditioning results. The training should begin gradually and slowly increase in intensity. As endurance levels increase, the frequency and duration may be increased to five days per week for 20 to 60 minutes per session. However, even beginning levels of exercise may be difficult for the severely deconditioned individual. The program may be modified by exercising intermittently or using an interval-training type of program. An example of interval training would be to exercise for five minutes and take one to two minutes to rest. The total time of work should still be 20 to 30 minutes. In general, lower intensity activities should be performed for a longer duration.

Cool-down

A five- to ten-minute cool-down should follow the exercise period. The purpose of a cool-down is to avoid lightheadedness, syncope, or other cardiovascular complications. The cool-down prevents pooling of the blood in the extremities by continuing to use the muscles to promote venous return. An active recovery allows blood and muscle lactic acid levels to decrease more rapidly and enhances the replacement of energy stores. The activities for the cool-down are similar to those of the warm-up period, such as slow walking and stretching activities.

In summary, the exercise program should begin with a 5- to 10-minute warm-up period. Activities may include slow walking or cycling, followed by
stretching exercises. Flexibility and range of motion exercises and gentle stretching should be performed for at least four to six minutes. Strengthening exercises involving some form of weight lifting at a moderate intensity should be performed for 15 to 20 minutes per session. Aerobic activities at 40% to 85% of maximal oxygen uptake should be performed for 20 to 30 minutes. A 5- to 10-minute cool-down follows this training period. Cool-down activities include slow walking, flexibility, range of motion, and gentle stretching exercises. For optimal benefits, the exercise program is performed three to five days per week.\(^1\),\(^{16}\),\(^{38}\) A comprehensive exercise program that includes flexibility, strength, and cardiovascular fitness can safely improve all three parameters and enhance the quality of one's life. Nevertheless, there are particular precautions of which an elderly individual must be aware when participating in an exercise program.

General Precautions

Precautions need to be taken by the elderly individual taking part in an exercise program. Some of the areas that need to be discussed with a patient include general exercise precautions, signs of overexertion, and the impact of the environment on exercise tolerance.\(^7\)

Exercise should be started in moderation, especially for the previously sedentary individual. Individuals should initially exercise at low intensities and place more emphasis on the duration of exercise rather than the intensity.\(^{38}\) Periods of rest need to be incorporated throughout the exercise session and
between days of intense training. In general, the older the individual, the longer
the period of recovery from exercise.\textsuperscript{16}

Each individual's exercising heart rate should be identified to the patient
prior to beginning an exercise program. The individual should be able to
monitor his or her heart rate using the radial or carotid artery before, during,
and after exercise. This allows the individual to monitor the intensity of the
workout and stay within acceptable heart rate limits.

A health professional or a family member may also measure an
individual's blood pressure before, during, and after exercise. Systolic blood
pressure should not exceed 220 mmHg to 240 mmHg.\textsuperscript{38} There should not be a
hypotensive response in which the systolic blood pressure drops more than 20
mmHg.\textsuperscript{38} Diastolic pressure should not exceed a 20 mmHg increase with arm
exercises and should remain the same with leg exercises.\textsuperscript{40}

The patient should be able to recognize the signs of overexertion and
stop exercising if any of the following symptoms develop: chest pain, shortness
of breath, significant muscle or joint pain, pain in the neck or jaw, feeling faint
or dizzy, nausea or vomiting, or excessive fatigue.\textsuperscript{2} The patient should not
exhibit problems with coordination or equilibrium. The diabetic patient should
recognize the signs of incoordination and disequilibrium due to hypoglycemia.\textsuperscript{21}
At the onset of any of these signs or symptoms, exercise should be
discontinued and the patient should be evaluated further.
The older patient has difficulty with adapting to extreme environmental conditions. There is an increased risk of death from heart failure or heat stroke if he/she attempts to exercise under hot or humid conditions.\textsuperscript{29,38} This may be due to problems with thermoregulation, such as an inadequate sweat response.\textsuperscript{7} It is best to have the elderly person exercise in an air-conditioned facility during the coolest part of the day or in the water.\textsuperscript{29,38}

The cold weather may also pose problems. In a severely cold environment, cutaneous vasoconstriction, a rise in blood pressure, and reflex coronary vasoconstriction may occur.\textsuperscript{29} This may provoke myocardial ischemia.\textsuperscript{29} Once again, it is best to have the individual exercise indoors under a controlled environment.

These precautions are very important for all elderly individuals participating in an exercise program. It may be hazardous to one's health if the precautions are not taken.\textsuperscript{7} The physical therapist must share this information with the elderly patient who is beginning an exercise program.
CHAPTER VI
CONCLUSION

Many common conditions of aging can be prevented, delayed, or controlled by retaining an active lifestyle. However, less than 20% of older adults regularly participate in an exercise program sufficient enough to lead to cardiorespiratory and health benefits. As the elderly population and medical care costs continue to rise, preventive medicine becomes a major component in health care. The key to preventive care is to promote a healthy lifestyle which includes an exercise program.

The benefits of exercise for the older person are numerous. Many of the physiological and psychological changes which occur as an individual ages may be delayed or prevented by engaging in an exercise program. The primary goal of an exercise program is to promote a healthy, independent lifestyle. However, before physical activity is prescribed for an older person, a thorough pre-exercise evaluation must be conducted. The evaluation should include a history of medications, current symptoms, risk factors, and previous and present exercise routines. A physical examination should focus on an individual's musculoskeletal, cardiovascular, and respiratory systems at the time of the exercise prescription.
A balanced exercise program includes activities which can increase flexibility, strength, and endurance. Prior to beginning each exercise session, a five- to ten-minute warm-up should be done to prepare the body for more vigorous activities. Stretching is ideally performed as part of the warm-up. Gentle static stretches performed at the end range of motion are ideal. Strength training can begin with 12 repetitions per exercise three to five times per week. A total of eight to ten exercises can be performed during each session. As the individual gains strength, repetitions may be increased. Equipment such as hand weights, rubber tubing, and Nautilus equipment may be used. Cardiovascular endurance activities should be the base of the program. Aerobic activities at 40% to 85% of maximal oxygen consumption should be performed for 20 to 30 minutes, three to five times per week. Activities may include walking, hiking, biking, swimming, stair climbing, and possibly jogging. The exercise session should end with a cool-down which includes gentle stretching exercises.

The exercise prescription should be designed for each individual. It should include the type of activities to be performed and the frequency, duration, and intensity of each activity. General exercise precautions and signs of overexertion need to be addressed with each individual.

To enhance patient compliance and enjoyment, individuals should be informed of the benefits of exercise, encouraged to exercise regularly, increase their level of activity gradually, and vary the activities throughout the week.
Most importantly, the individual should engage in a variety of activities which are personally enjoyable.

The purpose of this literature review is to provide physical therapists with recommended exercise guidelines for an elderly patient. The therapist should be able to explain the importance of an exercise program to the older individual and be aware of the precautions associated with exercise training.
REFERENCES


3. Piscopo J. Selected Research on Various Programs to Develop Strength. Presented at the Research Section of the New York State Convention for Health, Physical Education and Recreation; January, 1975; Syracuse, NY.


