Fitness and the Fight Against Father Time

An Honors Thesis (ID 499)

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Fitness and the Fight Against Father Time

Imagine yourself as a fifty-year-old who is beginning to be aware of the effects of aging—feeling and looking older. Now suppose someone offered to help you feel better, improve your self-image, help you feel healthier, and perhaps even extend your life. Most likely you would accept the offer because it sounds very good—almost too good to be true. This wonder treatment, however, is possible. It's called EXERCISE. As Hal Higdon states in his book Fitness After Forty, "By conditioning yourself you can become younger physically and spiritually while aging chronologically"(5). After looking carefully at the physiological and psychological effects of aging, it will be obvious that these are degenerative changes. Next, a look at research on the effects of exercise will show how exercise can combat the effect of aging.

PART I

The process of aging can be divided into two components—biological and psychological aging. Biological aging consists of the physiological changes which occur as a person becomes older. More specifically, it involves the effects that aging has upon the body systems and their functions. Psychological aging consists of a person's ability to adapt to familiar and unfamiliar situations. Psychological aging can be measured by observing a person's behavior and reactions to situations. A more in-depth study of biological and psychological aging will lead to a clearer understanding of what this process entails.
The cardiovascular system, consisting of the heart and the blood vessels, is important because it is the system responsible for delivering oxygen and nutrients to all the cells in the body. It also removes the wastes produced by these cells so they can be eliminated from the body. With age, this system deteriorates and becomes less efficient. For example, with age the protein elastin in the blood vessels and heart walls is replaced by connective tissue, there is an accumulation of subpericardial fat, and the heart valves thicken. These factors combine to cause a decrease in cardiac output of about 1% per year after age 23(15). This decrease in cardiac output means a decrease in blood flow to the brain, kidneys, heart, liver, and other important organs. The fibrosis of the vessels and their decreased distensibility often causes an increase in the systolic blood pressure and therefore increases the workload of the heart. Because of the hearts decreased ability to pump blood, the rate of flow decreases causing pooling of blood and an increased clotting tendency. One of the most serious circulatory changes is the development of arterio-athero-sclerotic coronary heart disease. Today, heart disease is the most common cause of death of people age 65 and over. This disease occurs in four stages:

1. Below age 10--fatty streaks begin to appear in the aorta. (This stage is considered benign because it appears to occur in children all around the world, regardless of other factors such as diet and genetics.)

3. Age 20-40--fats continue to build up until they become fibrous plaque (at about age 35 or 40) and become covered by fibrous scars.

4. After age 40--areas of fibrous plaque are covered with more fatty substances until a clot is formed, occluding blood flow beyond the clot(9).

Together all of these degenerations in the cardiovascular system lead to impaired tissue nourishment and decreased waste removal. Unfortunately, the cardiovascular system is not the only system impaired by aging.

The respiratory system has the important function of gas exchange, but its efficiency is also affected by the aging process. With increased age, there is an increase in residual volume, creating an increased need of oxygen in order to perform work which unfortunately cannot be met by the aging system. This leads to distressed breathing and carbon dioxide retention. In addition, atrophy of the respiratory muscles leads to impaired ventilation, and calcification of the costal cartilage means a loss of chest wall elasticity and a decreased vital capacity. Finally, thickened membranes, alveoli and capillaries leads to a decreased diffusion of oxygen.

Aging also affects the skeletal system by an overall decrease in bone density. Osteoporosis is especially prevalent in post-menopausal women and causes chronic pain, diminished weight bearing ability, disability, an increased risk of fractures, and poor recovery from fractures. In addition to the degeneration of the bones themselves, the joints also deteriorate. Ossification of the joint cartilage causes a decrease in range of motion and joint stiffness. Also, the articulating surfaces deteriorate, contributing to arthritis.
The muscular system shows the effects of aging by a general atrophy due to a loss of muscle cells. This atrophy is reflected as a loss of strength, speed, and power. Also affecting the muscular system is the decreased speed of neuroconduction and spinal cord synapse degeneration in the nervous system. Therefore there is an overall decrease in coordination and kinetic ability of the neuromuscular system.

As a person grows older, in addition to the obvious physiological changes, there are numerous psychological changes which occur. Neurologically, atrophy of the brain surface and brain cells may lead to changes in the older persons state of mind including diminished emotions, less adaptibility, narrowing of interests, and confusion. Also, with age a persons self-image may be disrupted by feeling of incompetence, decreased abilities, and cosmetic changes due to aging of the skin, dental problems or hair loss.

PART II

Although the physiological effects of aging are inevitable, they are often accelerated as a result of disuse. By exercising and using the systems of the body, the aging process can be slowed and the body and mind will benefit. According to Alexander Leaf, M.D., "A striking difference between our bodies and a highquality mechanical device such as a bicycle or automobile is that we improve with usage, while the mechanical device can only deteriorate from wear and tear"(7). A closer look at the effects of exercise on the body will show the truth in this statement.
The advantages of regular exercise (three times per week, 20 minutes per session at 60% of maximum heart rate) to the cardiovascular system are many (9). First, because the heart is a muscle, it hypertrophies and gets stronger with activity. This leads to an increased stroke volume and cardiac output as well as a lower heart rate at rest and at any given workload. In addition, with exercise there is greater oxygen extraction from the blood, and smooth muscle tone is maintained in the vessels. The role of exercise in heart disease is also important because it effects several of the risk factors—high blood pressure, obesity, hyperlipidemia, and stress. Exercise has been proven to decrease blood pressure in those people who have high blood pressure, decrease fat and increase lean body mass, and decrease stress. Also, exercise increases the blood levels of HDL which in turn acts as a protective mechanism against lipid deposition on the vessel walls. Therefore, exercise can be viewed as valuable because it combats the effects of aging on the cardiovascular system by decreasing the risk of heart disease and increasing the blood flow and circulation throughout the body while decreasing the stress on the heart.

The effects of exercise on the respiratory system are less dramatic but are just as important. An increase in the strength of the skeletal muscles used in respiration may lead to an increased inspiratory reserve volume, expiratory reserve volume, residual volume, tidal volume, and total lung volume. Also, there is an increase in VO₂ max which shows an increased effectiveness of the heart, lungs, and vascular system to deliver
and use oxygen. Together these increases in lung volumes and increases in the effectiveness of the respiratory system compensates for the irreversible effects of aging and prevents those effects which appear solely due to lack of use.

Exercise can also be beneficial to the skeletal system—it has been proven important to the maintenance of normal skeletal volume. Muscular activity preserves bone in the three following ways:

1. Direct neural influence on bone,
2. vascular and blood flow changes associated with physical activity, and
3. mechanical stress and strain as a result of weight bearing and muscular tensions (11).

In this manner, exercise can help prevent the lightening of the bones associated with age and inactivity.

Exercise is important to the muscular system because hypertrophy occurs and because it helps to establish or maintain muscle tone throughout the body. Muscle biopsies have also shown that exercise leads to an increase in the ability of the exercised muscle to create energy anaerobically. This is caused by an increased number, size, and membrane area of the mitochondria as well as an increase in the enzymes that participate in reactions that produce aerobic energy (9). Therefore, exercise increases the speed, power, and strength of the muscles and offsets the effects of aging.

One theory of psychological aging called the "activity theory" (13) relates to exercise because it suggests that there is a positive relationship between activity and life satisfaction.
Results of a survey distributed to a group of Ball State University retirees who are engaged in an exercise program seem to support this theory. 80% of the retirees reported a better self-image and a better outlook on life since they began exercising. As Erdman Palmore reports in his book *Normal Aging II*, the most important factor in life satisfaction was self-rated health. Exercise can therefore improve life satisfaction by improving health and increasing feelings of well-being. The second most important factor was organizational activity. This is also reinforced by the retirees—many of them mentioned that the organized exercise was important to them by "adding structure to the week." The third most important variable was internal control orientation or a feeling of control over their life (13). As one retiree stated, "I feel pleased with myself...and am trying to do something to halt the slow deterioration (which is very depressing)—doing something to slow it." Others reported feeling a "sensation of control" and "accomplishment." Overall, people who exercise regularly have a more positive self-concept, are more confident, and are more self-sufficient.

In conclusion, there is one additional aspect of the relationship between exercise and aging that needs attention. Some older people who exercise do so with a companion or as part of a group. This type of exercise is recommended highly over exercising alone. By exercising with others, the older person does not lose touch with others and is given an opportunity to interact socially which they may not often get to do. Almost half of the retirees mentioned that being part of a group made
their outlook better. One retiree stated that because of the group interaction, "I looked forward to each day's meeting." Therefore, in order to reverse the aging process and get the maximum physiological and psychological benefit, group exercise for the older person is the answer.
SELECTED BIBLIOGRAPHY


4. Harris, Dorothy V. "Psychological Benefits of Aerobic Exercise."


1. How long have you been exercising?

2. Have you noticed a change in your self-image since you began exercising? Yes___ No____. If yes, please describe:

3. Have you noticed a difference in your outlook on life since you began to exercise? Yes____ No____. If yes, please describe:

4. Do you feel your quality of life has improved since you began exercising? Yes____ No____. If yes, please describe:

5. Do you feel you cope with stress better when you exercise? Yes____ No____. If yes, please describe: ____________________________

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