

EXERCISE AND GERIATRICS

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Process of Ageing

Though there is not a generally accepted theory of aging, current literature provides solid description of age related changes as well as their impact on daily life and wellbeing. Among them, the most relevant are the morphological and functional changes of cardiorespiratory and muscular system.

Though a mild linear loss has been described for various measures already from the third decade, more accelerated decline of cardiorespiratory function starts after the age of 60. However, in spite of age related decline, if not affected by a disease, cardiorespiratory functions remain adequate to support the muscle mass requirements of oxygen even in novenarians. Thus, despite the diminishing of endurance exercise capacity with age, the ability to sustain an intensity of aerobic exercise, required by activities of daily living, remains preserved.

Concerning the muscular functions, studies demonstrate that strength decreases by approximately 1.5 % per year in the sixth and seventh decade. Thereafter the loss is further accelerated, reaching about 3 % annually. Even more pronounced (almost twice) is the loss of power, a parameter reflecting the capability to generate force at given velocity, i.e. while performing dynamic movements.

The loss of strength and muscular power is largely brought about by deteriorating of neuroregulatory functions and namely by loss of muscle mass. This is due to shrinking of muscle fibers (atrophy) and their partial loss, or both. It is namely deterioration of type II muscle fibers, which negatively affects muscular power. Histological analyses also revealed that loss of muscular function is due to structural changes in mitochondria and their displacement from contracting machinery of the muscle cell.

It is worth mentioning that a significant loss of muscle mass and strength occurring from sixth decade of life is usually more pronounced in women. This can be particularly problematic because the loss starts from already lower muscle mass.

Strength and muscular power are important in maintaining functional abilities to allow performing activities of daily living such as carrying groceries, getting out of a chair, taking out the trash, climbing stairs, etc. Therefore, severe deterioration in muscle functions may dramatically impair basic daily activities. If decreased below a critical level (called disability threshold) subjects lose the ability to take care of themselves and become dependent on nursing care.

Traditionally, a decrease in cardiorespiratory function with subsequent limitation of endurance type activities has been considered a crucial factor limiting quality of life. However, recent data indicate that limitation is to be ascribed to a deterioration of muscles and a resulting lack of strength. Lack of strength is also a key factor responsible for dramatically increasing incidence of falling and related injuries in elderly population.

Ageing also brings about a steady decrease of cognitive function. Characteristic for senior years is not only potentially debilitating deterioration of organ functions, but also higher incidence of chronic diseases, namely ischemic heart disease, type 2 diabetes mellitus and cancer. They do not only decrease life expectancy, but further contribute to the functional loss and negatively affect quality of life.

Exercise as a powerful anti-ageing tool

Though diet and environmental factors have an important impact on the process of ageing, a plethora of studies indicate that a key anti-ageing tool is physical exercise.

Positive effect was traditionally ascribed to endurance aerobic exercise. Among their recognized benefits are namely increase in circulation efficiency and capacity of transporting of oxygen. This happens by means of mechanisms such as increasing blood volume, stroke volume, extraction of oxygen in muscles and improved endothelial function leading to better distribution of blood while exercise and increased absolute number of red blood cells. Improved cardiorespiratory function complemented by increased activity of aerobic enzymes in mitochondria leads to higher capability of using oxygen to produce energy for muscle work. Together with decrease of sensitivity of ergo receptors in muscles they enable to tolerate exercise of higher intensity for a given period of time.

In addition to improved tolerance to exercise, regular aerobic activities have numerous additional health related effects, e.g. mild decrease of blood pressure, better tolerance to stress, improving blood lipid spectrum and endothelial function. As a result, aerobic exercise can reduce the risk of death due to cardiovascular problems. Not to be forgotten are the psychological effects, namely lowering the incidence of depression, increasing cognitive

capacity and enhancing psychosocial functioning outcomes. There is also solid evidence that aerobic activities reduce risk for diabetes through increasing sensitivity of insulin receptors. In addition, high-impact aerobic activities, such as jogging, walking or rope skipping, may also stimulate bone growth, as well as reduce the risk of osteoporosis.

Contrary to aerobic activities, resistance exercise has not been traditionally considered to have a significant health promoting effects. However, evidence accumulated over recent 30 years show beneficial effect across every age group of seniors and even those suffering from chronic illnesses. Some of the most noteworthy benefits include diminished age-related declines in muscle mass, strength, muscular power and improvement of proprioceptive function. Though at the first sight improvement of strength and power may not appear as a health related benefit, in elderly it is an important and highly desirable effect. Tasks of daily living are becoming easier to perform, velocity of walking increases with positive effect on spontaneous physical activity. Augmented strength and power improve control of balance with resulting decrease of risk of falling. Positive effect on muscle mass is highly desirable for subjects with pronounced muscle catabolism due to various, namely oncological diseases. Resistance training is in fact the only effective means to counteract negative effect of androgen deprivation therapy aggravating muscle wasting in patients with prostate cancer. Another positive result of increased muscle mass is the rise of resting metabolic rate with a positive effect on the energy balance and body weight control. There is also solid evidence that resistance training improves sensitivity of insulin receptors. Resulting positive effects on glycaemia help in prevention and treatment of type 2 diabetes mellitus. Enhancement of bowel function leads up to 50 % shorter transport of digested food through gut, namely colon, an effect which is supposed to prevent common gastrointestinal problems as obstipation, diverticulosis, haemorrhoids and last, but not least colon cancer.

Based on today's knowledge it can be concluded that a combination of both aerobic and strength exercise provides powerful anti-aging modality, which not only fosters life expectancy, but more importantly, adds life to years.