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overview

A physical exercise and quality of life

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Abstract

Physiological aging of the human organism begins with the onset of the 4th decade of life. The article presents some changes in the organism during the so-called primary aging, as well as those occurring due to secondary aging with diseases in the background. The most frequent diseases in the so-called elderly people are cardio-metabolic X syndrome, consisting of obesity, diabetes or glucose intolerance, with the occurring insulin resistance, hyperliporoteinemia: hyperglyceridemia with low HDL and elevated LDL cholesterol, arterial hypertension, hyperfibrinogenemia and high C-reactive protein concentration in the serum. Along with preventive measures and treatment of these diseases, physical exercise has a prominent place. In the so-called elderly persons it should be regular and frequent: at least 2–3 times a week, although it would be best every day, with adequate intensity: usually moderate and/or modified according to the criteria of physiological age and the degree of health or illness, lasting for at least 15 minutes. Physical exercise in the elderly should be adjusted to age, gender, health and functional capacities, taking into account previous experience with physical exercise or sports activities. Special attention should be paid to physical exercises in elderly persons who have not practiced them previously, but want to do it. Priority should be given to activities stimulating functional improvement of the heart function, blood flow, and breathing – general endurance exercises that activate at least 1/7 of all skeletal muscles, about 50 % of possible blood flow, and which last at least 5 minutes. It would be best to perform them daily. Measuring of quality of life due to aging could be expressed by parameters of physical fitness by assessing walking, somatic symptoms and mental state.

INTRODUCTION

The human organism starts to age after the 30th year of life. In that connection some fundamental questions of civilizational survival of man are posed, as for example: how to maintain working ability; how to have a quality life and how to reduce health problems. Life quality measurement can be performed in the following way: by analyzing subjective symptoms, the length of walking, one-time total length of walking and mental state. The quality of life scale can be calculated by summing up points from all these data *(1–15)*.

PRIMARY AND SECONDARY AGING

When speaking about aging, we distinguish two notions: one is primary aging, i.e. normal or physiological aging, and the other is secondary aging, occurring due to the presence of an illness. The population of the elderly is considerably heterogeneous in many parameters, including differing onset and progression of aging, influenced

by both genetic and environmental factors. Differences between chronological and biological ages are growing and we should aim at the estimation of biological age on the basis of physiological, i.e. biological and functional indicators, comprising changes in the function of inner organs, firstly of the heart and vascular system, lungs and respiratory system, as well as of kidneys. There is a great variety in the changes of functional abilities due to aging. Changes do not occur simultaneously and do not develop in the same pace inter- and intraindividually *(1, 7, 8)*. The organism of "an elderly person" shows a series of peculiarities in comparison to "younger" age.

Physiological aging could be defined as the individual capability of adaptation to environmental conditions, mostly expressed by the following parameters: endurance, strength, flexibility, coordination and working capacity. Physiological aging is in fact the reduction of abilities for body activity. The organism capabilities reach their maximum at the age of about 30, and then decline. Various organ systems lower their functional capacity at different pace. According to physiological age, the so-called elderly persons could be classified regarding functional body capacities into the following categories:

1. "*the younger older*": chronological age 55–75 years, having the highest body capacity of 57 MET (MET =metabolic unit, i.e. 3.5 ml O_2 to kg of body mass in one minute);
2. "*the older older*" with the highest body capacity of 2–3 MET, and
3. "*the sporting older*" who regardless of chronological age have the highest body ability of enduring load of 9–10 MET *(14)*. Nowadays is considered that at least 50 % of changes attributed to aging in the populations of the developed world are not the consequences of aging itself, but the sequels of atrophy due to inactivity. The function of vascular system is decreasing with age, starting from the onset of the 4th decade of life, the beat volume decreases, and peripheral vascular resistance is increasing. Cardiac respiratory capability decreases in persons very actively engaged in physical exercise for only 1–2 %, in those actively engaged in it for about 4 %, while in physically inactive persons it decreases for at least 8–10 % *(1, 7, 8)*.

The forced expiratory lung volume and the mean expiration flow diminish, as well as the highest breathing capacity. The functional residual capacity rises to approx. 60 %, while in the younger it amounts to approx. 50 %.

Functional changes in kidneys are also affected by aging: glomerular filtration diminishes, the blood flow slows down, and the size of kidneys reduces for up to one third. This can be examined by creatinine clearance as the reflection of glomerular filtration. A denotes body surface assessed according to nomograms for body height and mass. Muscle-skeletal system is almost evenly diminishing with aging and nonuse. Functional ability is significantly decreasing, particularly in women: about 40 % of women aged 55–64 cannot raise load of 4.5 kg, it cannot be raised by 45 % of women aged 65–74 and 65 % of women aged 75–84 yrs *(1, 7, 8, 14–16)*. Working capacity lessens for 25–30 % during aging, and implies decreased working ability during which large muscle groups are used through a longer period. The highest oxygen intake after the age of 30 (not infrequently already after the 25th year) is annually decreasing for 0.75–1 % (0.40–0.50 ml/kg/min) i.e. for 8–10 % during each decade. After the 30th year of life, working capacity is averagely diminishing for 25–30 %, minute heart volume for about 25 %, systolic blood pressure increases for 10–40 %, diastolic pressure rises for 5–10 %, vital lung capacity diminishes for approx 40–50 %, residual lung volume lessens for 30–50 %, and basal metabolism decreases for about 10 % (8–12 %). The strength of fist squeeze lessens for 25–30 %, the speed of nerve impulse conductivity averagely decreases for 10–15 %, skeletal mass in women diminishes for 25–30 %, in men for 15–20 %, and kidney function for roughly 30–50 %.

THE MOST FREQUENT DISEASES IN OLDER AGE

A frequent disease in a population today is cardio-metabolic syndrome (CMS). It is a complex process and in our time one of the most important groups of diseases and a major health problem in developed and developing countries. It amounts to 40 percent at the ages of 60 and 10 percent at the ages of 20 *(17,18)*. Its prevalence in an island population of the Eastern Adriatic coast of Croatia, a distinctly homogenous population living in relative isolation with a traditional living pattern of the island Hvar, is 28 percent of the total population, 32 percent in males and 24 percent in females with body mass index above 30 kg/m^2. In the Baranja region of Croatia, 40 % of the total population: 35 % males and 42 % females had body mass index above 30 kg/m^2 as measures of obesity. CMS increases the risk for coronary heart disease, stroke and peripheral angiopahty *(19–22)*. CMXS primarily consists of overweight and abdominal (intraperitoneal) apple shape obesity (high body mass index). Intraperitoneal adipose tissue is a better predictor than visceral adipose tissue which drains systemically. It also comprises insulin resistance or glucose intolerance (type 2 diabetes mellitus – some persons are genetically predisposed to insulin resistance), hypertriglyceridemia with low level of HDL and high level of LDL cholesterol, arterial hypertension, prothrombotic state with high serum fibrinogen level or high plasminogen activator inhibitor-1 level, and pro-inflammatory state with the high serum level of C-reactive protein. About 12 percent of school student population fulfills at least three criteria for CMXS *(17, 18)*. An assemblage of risk factors for CMXS includes age, obesity, anamnestic data for diabetes mellitus and other diseases, such as polycistic ovarian syndrome with metabolic consequences in women, hormones and reproductive system, arterial hypertension etc. *(19)*.

PHYSICAL EXERCISE AS A MEASURE OF THE TREATMENT

The dominant disease today is atherosclerosis (not the normal consequence of aging, but an inflammatory disease) and its complications. Physical exercise can be a considerable bonus in preventing atherosclerosis in a way that it can elevate the serum concentration of HDL, i.e. those protecting from atherosclerosis (HDL), and can decrease the LDL and VLDL, those dangerous for the development of atherosclerosis. The third thing can happen as well: HDL may rise and LDL lipoproteins can go down, but the fourth thing may occur too, what is rarer: no crucial change in the concentration of these lipoproteins might be observed. Physical activity of only 30 minutes leads to optimal use of lipids in the engaged muscles, the lipoprotein lipase activity increases while the serum triglyceride level decreases *(20)*. During training a "burn out" of free fatty acids occurs, as well as the increase in the number of capillaries in skeletal muscles. The causes for this phenomenon are numerous: increased oxygen supply in that area, enlarged surface needed for the supply of free fatty acids to muscles, longer contact of free fatty acids with muscles: the removal of metabolic products is easier and simpler. Physical exercise is effective against the occurrence of thromboses, because it induces the formation of the so-called dilution pseudo--anemia, decreases blood viscosity, blood aggregability, blood elements adhesion and activates the fibrinolytic system. For example, in marathon runners immediately after the race can be observed the increase in the concentration of tissue plasminogen for even 31 times, but this effect disappears already three hours later *(20)*.

Diabetes mellitus type 2B, is one of the most frequent diseases of the civilized man. In these patients, particularly in elderly age, serum triglycerides are elevated, HDL is lower and VLDL are of higher concentration. Moderate exercise increases glucose metabolism, sensitivity to insulin, elevates HDL serum concentration and decreases serum concentration of triglycerides. Moreover, in many investigations of the acute effects of physical exercise the serum lipid concentration is decreased. This effect is more prominent in those regularly practicing exercise. Better results are achieved by exercise undertaken several hours after a meal than with exercise performed in the morning before food intake. Persons of both sexes practicing physical exercise, in comparison with the "sedentary" way of living, have lower body mass, lower concentrations of serum triglycerides and VLDL, thus the lower risk for atherosclerosis. According to some data, exercise that lowers LDL lipoproteins leads to relative increase of HDL. As for anaerobic exercise, it must be said that it does not elevate the HDL cholesterol concentration in the serum and does not change the concentration of risk factors for the occurrence of atherosclerosis *(1–12)*.

Physical exercise contributes to primary or secondary prevention of coronary heart disease. It enables maintenance and even increase of myocardiac oxygen load, diminishes myocardiac rhythm and its need for oxygen, increases myocardiac electrical stability, myocardiac function at rest and at maximal load, as well as the pump out function, myocardiac contraction capability and lessens systolic load *(20)*.

Elevated blood pressure is nowadays the most frequent disease in the civilized world. Numerous measures are being undertaken in treatment: changes of life and nutritional habits, medication, implementation of physical exercise. The immediate effects of physical exercise are numerous, among others the increase in systolic pressure, minute increase in diastolic pressure, activation of skeletal muscles, what increases the recurrence of venous blood to the heart and increase in the minute heart volume. Arterial dilatation diminishes peripheral vascular resistance resulting in lowered blood pressure. Upon cessation of exercise, blood pressure can be lower than before physical effort, and that effect can last for hours (20). However, if systolic pressure at load increases over 200 mmHg and/or diastolic rises over 95 mmHg, the blood pressure is elevated, i.e. the risk for the development of diseases caused by blood pressure in the future is increased. Lasting effects of physical exercise, particularly if performed three times a week are often related to lower blood pressure and lower risk for the development of heart and coronary diseases. On the other hand, exercise performed seven times a week has minimal additional impact in the sense of improving the condition. In many investigations, the lasting impacts of physical exercise have averagely brought to decrease in blood pressure for approx 10 mmHg. Recommended is exercise with the participation of large muscle groups lasting 20 to 60 minutes and the intensity of 50–85 % of the maximal oxygen input, if there are no contraindications *(1, 7, 8)*. Physical exercise helps in regulating the 1st degree elevated blood pressure (values of systolic pressure or S: 140–159 mmHg, diastolic pressure or D: 90–99 mmHg). In the 2nd degree elevated blood pressure (S 160–179, D 100–109 mmHg) it should be applied after regulating the pressure by a drug and after an ergometric estimation of the allowed load. In the 3rd degree elevated pressure (S=>180, D=>110–119 mmHg), physical exercise should be considered after the normalization of pressure or after the achievement of acceptable limit by changing the lifestyle and applied medication, and previous assessment by ergometry which load can be allowed. In diseases with the 4th degree elevated blood pressure (S =>210, D =>120 mmHg) physical exercise is forbidden!

SPECIFIC AIM OF PHYSICAL EXERCISE

Specific aims of physical exercise are: maintenance or improvement of functional capacity of the human organism, prevention, treatment and/or rehabilitation of some chronic diseases. If performed regularly, it postpones the occurrence of complications. However, static load (isometric, like weight-lifting) should be avoided, as it can be extremely harmful in persons with elevated blood pressure by causing rise in both systolic and

TABLE 1

Quality of life parameters assessed by walking.

length of walking (walking on even terrain)	one-time total length of walking	walking speed
more than 1000 m=4 pts	over 200 m=4 pts	normal speed=4 pts
100–1000 m=3 pts	300–2000 m=3 pts	lessened speed=3 pts
10–100 m=2 pts	30–300 m=2 pts	slow moving=2 pts
up to 10 m=1 pt	less than 30 m=1 pt	markedly slow =1 pt
0 m=0 pts		standstill=0 pts

interpretation: 4 pts =excellent; 3 pts=good; 2 pts=poor; 1 pt=bad; 0 pts=very bad.

diastolic pressure. Such activities are contraindicated in patients with high blood pressure.

Physical exercise in the so–called elderly persons is undoubtedly beneficial for health. It should be regular, frequent (at least 2–3 times a week, although best every day), of adequate intensity (mostly moderate and/or modified according to the criteria of physiological aging and to the degree of health and illness respectively), and of adequate duration (at least 15 minutes). Physical exercise in the elderly should be adjusted to age, gender, health and functional ability, as well as to previous experience with physical activity or sports. Special attention must be paid to exercises in persons who have not practiced physical activities before, but would like to. Priority should be given to activities that stimulate functional improvement of heart rhythm, blood flow, breathing – exercises of general endurance, that activate at least 1/7 of all skeletal muscles and about 50 % of possible blood flow, lasting at least 5 minutes. It would be best to perform them every day. Strength exercises of moderate intensity and number of repeats will contribute to the preservation of muscle mass. Inclusion of untrained persons should be gradual regarding intensity and the manner of exercise. Exercise must always be preceded by a "warm-up"(e.g. walking), and activities should be ended by gradually decreasing intensity. When choosing the exercise and appropriate intensity, one should be able to answer the following question: has the elderly person been engaged in physical exercises before, i.e. how long was the break? Load should be assessed and each training must be dosed so that it remains the individual's wish to be active further on. A man is capable of physical activity the whole life and chronological age is not an impediment.

SOME PARAMETERS OF QUALITY OF LIFE ESTIMATION

Some parameters (among many others) of quality of life assessment regarding walking, somatic and mental symptoms are listed in table 1 *(23–30)*. The quality of life scale is made by summing up all the obtained points. If physical activity amounts to 7–8 points, that is excellent; if it is 5–6 points, the result is good; if it is 3–4 points, that is poor, if it is 0–2 points that is estimated as bad. If the

TABLE 2

Quality of life parameters asses by somatic symptoms and mental state.

somatic symptoms	mental state
short breath=0–1 pt	social contact=0–1 pt
leg edema=0–1 pt	mental capacity=0–1 pt
wide neck veins=0–1 pt of	memory=0–1 pt
lung rattles=0–1 pt	reading=0–1 pt
cough=0–1 pt	watching TV =0–1 pt
nausea=0–1 pt	house chores=0–1 pt
increased liver=0–1 pt	outdoor tasks=0–1 pt
abdominal pain=0–1 pt	
insomnia=0–1 pt	
harmful adverse reactions to medication=0–1 pt	
interpretation: 0 pts=present symptoms; 1 pt=no symptoms.	interpretation: 7=excellent; 5–6=good; 3–4=poor; 0–2=bad.

symptoms of wellbeing are 9–10 pts, that is excellent; if they are 7–8 pts, that is good; at 4–6 points the result is poor; the sum of 0–3 points is assessed as bad. If mental state of 6–7 points is excellent; that of 4–5 pts is good; 2–3 pts denote poor state; 0–2 pts are considered as bad. If the total score of adding up all the points is 22–25, that is excellent; the score of 6–19 is good; if it is 9–13, that is poor, and the result of 0–6 pts is bad.

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