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CHARACTERISTICS OF PHYSICAL CONDITION INDICATORS OF ELDERLY MEN

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Abstract

Introduction. . According to WHO, the accelerated aging of the population in the European region has led to a substantial increase in the proportion of individuals aged 65 years and older, which highlights the relevance of maintaining sufficient physical activity as a factor for slowing involutional changes and improving quality of life in old age. Given that low physical activity is considered a major health risk factor, the substantiation and implementation of effective measures aimed at involving older adults in regular health-oriented physical activity acquires particular scientific and social significance.

The aim of the study is to determine the features of the physical condition indicators of the elderly men.

*Material and methods. T*he work used a set of methods, including the analysis of scientific literature, anthropometric and biomedical studies, as well as mathematical and statistical methods. The research was conducted at the Ternopil Volodymyr Hnatiuk National Pedagogical University (Ternopil), 50 men took part in it (average age – 65.06 ± 3.06 years).

Results. The results of the study showed the presence of regressive changes in morphological characteristics: there is a tendency to increase individual somatometric parameters and decrease physiometric indicators. A significant decrease in cardiorespiratory capabilities was detected, which requires correction in 84% of the study participants. In addition, 60% of the respondents have elevated blood pressure. The data obtained indicate a decrease in the adaptive potential and an increase in the tension of regulatory mechanisms. Only 8% of participants demonstrated a satisfactory state of the cardiovascular system, while 20% had stress adaptation mechanisms, 40% had unsatisfactory adaptation, and 32% had impaired adaptation processes.

Conclusions. The study findings indicate the need to take these changes into account when developing comprehensive programs of health and recreational physical activity for elderly men.

Keywords: elderly men, physical development, functional state, physical health.

ХАРАКТЕРИСТИКИ ПОКАЗНИКІВ ФІЗИЧНОГО СТАНУ ЛЮДЕЙ ПОХИЛОГО ВІКУ

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Внесок автора:

A — концепція та дизайн дослідження; B — збір даних;
C — аналіз та інтерпретація даних; D — написання статті;
E — редагування статті; F — остаточне затвердження статті

Анотація

Актуальність. За даними ВООЗ, темпи старіння населення в Європейському регіоні зумовлюють суттєве зростання частки осіб віком 65+ років, що актуалізує потребу у підтриманні достатнього рівня рухової активності як чинника уповільнення інволюційних змін та підвищення якості життя людей старшого віку. Низька фізична активність розглядається провідними експертами як вагомий фактор ризику для здоров'я, тому обґрунтування та впровадження ефективних заходів щодо залучення літніх осіб до регулярних оздоровчих занять набу́ває особливої наукової та соціальної значущості.

Мета дослідження – визначити особливості показників фізичного стану літніх чоловіків.

Матеріал і методи: . У роботі використовувався комплекс методів, що включав аналіз наукової літератури, антропометричні та біомедичні дослідження, а також математичні та статистичні методи. Дослідження проводилося в Тернопільському національному педагогічному університеті імені Володимира Гнатюка (м. Тернопіль), у ньому взяли участь 50 чоловіків (середній вік – 65,06 ± 3,06 років).

Результати. Результати дослідження показали наявність регресивних змін морфологічних характеристик: спостерігається тенденція до збільшення окремих соматометричних параметрів і зменшення фізіометричних показників. Виявлено значне зниження кардіореспіраторних можливостей, що вимагає корекції у 84% учасників дослідження. Крім того, 60% респондентів мають підвищений артеріальний тиск. Отримані дані свідчать про зниження адаптаційного потенціалу та підвищення напруженості регуляторних механізмів. Лише 8% учасників продемонстрували задовільний стан серцево-судинної системи, тоді як 20% мали механізми адаптації до стресу, 40% – незадовільну адаптацію, а 32% – порушення адаптаційних процесів.

Висновки. Результати дослідження вказують на необхідність враховувати ці зміни при розробці комплексних програм оздоровчої та рекреаційної фізичної активності для літніх чоловіків.

Ключові слова: літні чоловіки, фізичний розвиток, функціональний стан, фізичне здоров'я.

Introduction

According to the World Health Organization (WHO), the population in the European region, as in the whole world, is aging rapidly: its median age is already the highest in the world, and the proportion of people aged 65 years and older is expected to increase from 14% in 2010 to 25% in 2050 [23]. Therefore, the importance of maintaining an adequate level of physical activity to slow down involutional changes and improve the quality of life is increasing. WHO experts consider a low level of physical activity to be one of the important risk factors for health and one of the significant causes of mortality and emphasize the need for regular physical education and sports for all population groups, regardless of age [1; 3; 23; 26].

Scientists recommend paying considerable attention to the justification and development of special measures to increase the level of involvement of older people in regular physical activity, noting that this age group is usually the least physically active [7; 11; 13].

Despite the growing interest of specialists in the problem of increasing the level of physical activity of older people, the assessment and consideration of physical condition indicators for this contingent when developing health and recreation programs seems to be debatable [5; 6; 17; 19].

Since involutional changes in the body that begin in adulthood occur in all human systems and organs without exception, it is necessary to prevent involutional changes in the levels of manifestation of physical qualities, especially strength abilities, general endurance, flexibility and coordination abilities. It is because of this that scientists emphasize the importance and expediency of involving mature and elderly people in regular recreational and health activities [2; 9; 10; 12; 18]. Due to the daily activities of an elderly men are characterized by weak motor activity, the problem of eliminating motor deficit by increasing the general motor component in the activities of elderly people and choosing motor influence adequate to individual characteristics, in order to increase their level of physical condition, acquires particular importance.

Aim of the study

The study aimed to determine the features of the physical condition indicators of the elderly men.

Material and methods

Participants. The study was conducted at the Volodymyr Hnatyuk Ternopil National Pedagogical University. 50 men aged 61 to 70 years (average age was 65.06 ± 3.06 years) participated in the pedagogical experiment. The study was planned and carried out in accordance with the principles of bioethics set out in the Declaration of Helsinki "Ethical Principles of Medical Research Involving Humans" and the "Universal Declaration on Bioethics and Human Rights (UNESCO)". During the organization and conduct of the study, the principles of voluntariness, anonymity and trust were applied. All elderly men who participated in the study provided written informed consent to participate in it.

Procedure. Diagnostics of physical condition indicators of men aged 60–70 years was carried out on the basis of measuring somatometric, physiometric indicators and indicators of physical fitness. The study used the anthropometric method to characterize

the indicators of physical development of elderly men. In general, the following anthropometric indicators were determined: body length (L, cm), body weight (W, kg), chest circumference (CRC, cm). The methodology for measuring anthropometric indicators is based on the use of standard equipment according to generally accepted and unified methods modified by E. Martirosov [11].

Body weight was measured on conventional standard decimal medical scales with a sensitivity of up to 50 g. Chest circumference and its excursion were measured with a centimeter tape in the vertical position of the subject. The centimeter tape was applied behind under the lower corners of the shoulder blades, in front - under the lower segment of the nipple circles.

Vital capacity of the lungs (VC) was determined using an air spirometer. During spirometry, the subject first took 1–2 deep breaths and exhales, then quickly took a maximum breath, taking the spirometer mouthpiece with his lips and slowly, smoothly exhaling into it until it failed. The average VC for adult men is 3500–4000 ml.

Muscle strength was determined using dynamometry. The strength of the muscles of the hands was determined with a hand dynamometer. The subject, standing, took the dynamometer in his hand, then without tension in the shoulder joint, moved his arm to the side and without jerks or any additional movements squeezed the dynamometer with maximum force (it was not allowed to get up and bend the arm at the elbow joint). The study was conducted 2 times for each hand, the best result was recorded with an accuracy of 2 kg [14, p. 115]. The average strength of the right (working) hand for adult men is 40–45 kg. Dividing the obtained dynamometry result (in kg) by the body weight (in kg), the correspondence of the actual strength to age and gender was assessed.

The method of anthropometric standards was used, which allows to assess the level of physical development by comparing the main anthropometric indicators of the subject with the average indicators (standards of physical development) in the corresponding age group. The method of anthropometric indices was also used, which allows to make an approximate assessment of physical development by determining the relationships between individual anthropometric indicators.

Statistical processing was carried out according to generally accepted methods of variational statistics, with the determination of the arithmetic mean ($\bar{x}$), the error of the arithmetic mean ($m\bar{x}$), the maximum value (max) and the minimum (min), the standard deviation (sx), the confidence interval for the arithmetic mean (95% CI), the coefficient of variation (V).

Results and Discussion

The obtained research results indicate regressive changes in morphological characteristics - a tendency to increase individual somatometric and decrease physiometric indicators of elderly men. It should be noted that at this age only 14% of men had normal body weight, 64% were overweight, 8%, 10% and 4% - obesity of I, II and III degrees, respectively (Fig. 1). This is obviously due, in addition to a decrease in the level of motor activity, to a decrease in the proportion of functionally active tissue, thinning of bone substance, and an increase in fatty and connective tissue inclusions.

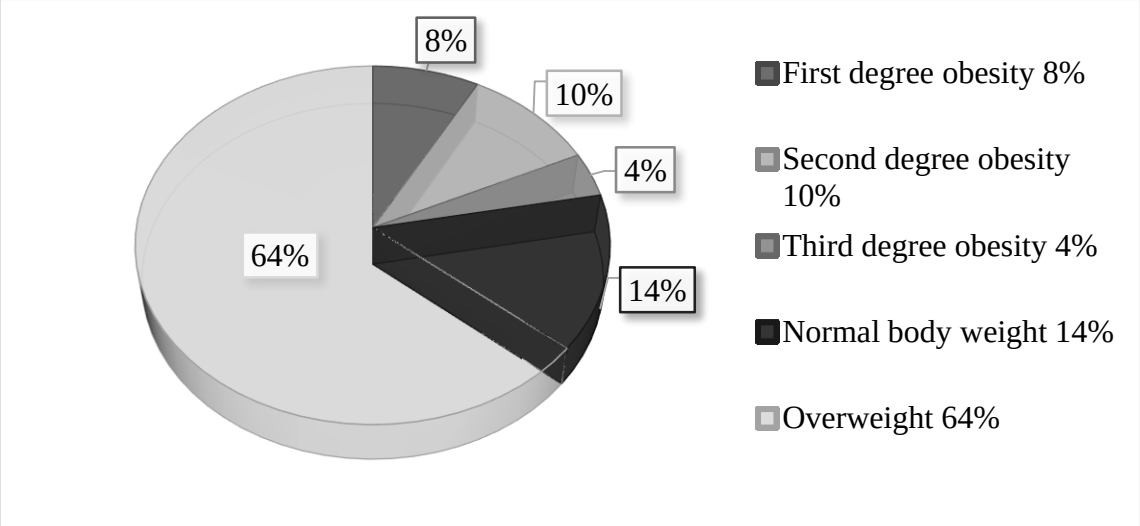

Figure 1 – **Distribution of elderly men by body mass index (BMI, kg*m-2),** % (n = 50)

However, in the studied contingent, the average value of the resting heart rate was $\bar{x}$ (SD) 82.4 (11.9) beats per minute, which slightly exceeds the physiological norms for men over 60 years of age – 60–80 beats per minute (Table 1) [16].

Studies have shown that 60% of elderly men have an increased heart rate at rest, and in 40% it corresponds to the age norm. This indicates a decrease in the level of functioning of the cardiovascular system (CVS), which can be caused by various factors, including non-compliance with the rules of a healthy lifestyle, a sedentary lifestyle, or the presence of diseases.

Taking into account that the maximum permissible heart rate after exercise should not exceed the pulse rate of 150–160 beats per minute [24], problems in the work of the CVS are also confirmed by the fact that the average value of the heart rate after exercise (20 squats in 30 seconds) in elderly male respondents is quite high - $\bar{x}$ (SD) 168.1 (35.7) beats per minute. It should be noted that only 20% of respondents after exercise had a heart rate below the maximum permissible for this age.

We acknowledge the concern regarding the post-exercise heart rate values reported in Table 1 (mean = 167.74 bpm; maximum = 190.0 bpm). These figures reflect short-duration, high-intensity functional tests rather than prolonged endurance exertion, and were obtained under continuous medical supervision with real-time monitoring of vital parameters.

The exercise protocols were designed in accordance with established safety guidelines for older adults, ensuring that peak heart rates did not exceed individualized age-adjusted thresholds.

According to the American Heart Association, the target heart rate range for persons aged 60 and above during moderate to vigorous physical activity is approximately 85–145 bpm, with higher transient peaks acceptable in well-screened individuals if monitored appropriately and returned promptly to baseline following cessation of activity (e.g., target heart rate calculations available at *heart.org*).

We have now included this reference and a brief justification of the safety measures implemented in the revised manuscript to ensure clarity and compliance with normative standards.

Table 1 – **Physical condition indicators of elderly males** (n=50)

Indicator	Minimum	Maximum	Median	Interquartile range	Mean	Standard deviation	[95 % CI]	Coefficient of variation %
Age, years	60.0	70.0	65.0	6.0	65.0	3.2	[64.1–66.0]	5.0
Body weight, kg	64.0	96.0	83.0	8.5	82.4	10.7	[80.5–84.3]	13.0
Body length, cm	160.0	190.0	170.0	10.0	170.8	16.4	[168.99–172.65]	9.6
BMI, kg·m-2	18.8	39.4	28.0	2.8	28.1	7.2	[26.6–29.6]	25.6
atsystolic, mm Hg	120.0	170.0	140.0	25.0	143.2	13.0	[139.5–146.9]	9.1
atdiastolic, mm Hg	60.0	100.0	90.0	10.0	88.8	8.49	[86.3–91.2]	9.5
Heart rate at rest, beats·min-1	60.0	98.0	85.0	15.0	82.4	11.9	[79.6–85.2]	14.4
Heart rate after exercise, beats·min-1	128.0	190.0	173.0	13.2	167.7	35.7	[163.2–172.2]	21.2
Respiratory rate, min-1	12.0	26.0	18.0	6.2	21.25	8.5	[18.8–23.6]	40.0
Spirometry, ml	2400.0	4500.0	2700.0	387.5	2989.0	764.8	[2800.0–3177.9]	25.5
Stange test, s	15.0	65.0	40.0	28.0	33.8	11.4	[34.2–42.4]	33.7
Genche test, s	5.0	30.0	10.0	10.5	13.7	7.1	[11.7–15.8]	51.6
Dynamometry of the leading hand, kg	20.0	60.0	33.0	17.5	35.4	10.7	[32.3–38.4]	30.2

The average systolic and diastolic blood pressure of elderly men was $\bar{x}$ (SD) 143.2 (13.0) mm Hg and $\bar{x}$ (SD) 8.8 (8.4) mm Hg, respectively, and were outside the age norm - 133-139/70-90 mm Hg [17].

Only 4% of men aged 60–70 had low blood pressure. At the same time, a larger proportion (60%) of respondents had high blood pressure, and 36% of men in this age group made up a smaller proportion with normal blood pressure.

The frequency of respiratory movements, which corresponded to the norm, was observed in 42% of elderly men.

At the same time, bradypnea was noted in a smaller number (18%), and tachypnea was detected in 40% of the contingent. Vital capacity of the lungs (VC) was lower than the lower limit of the norm (NFVC) (the norm for elderly men is 3.2–3.5 l) and was $\bar{x}$ (SD) 2989.0 (764.81) ml.

Having calculated the VC and compared it with the actual values of VC, we found that in 38% of men of this age the deviation of this indicator is within the normal range, in 26% there is a mild violation of the pulmonary system, and in 36% there was weakness of the pulmonary system (Fig. 2).

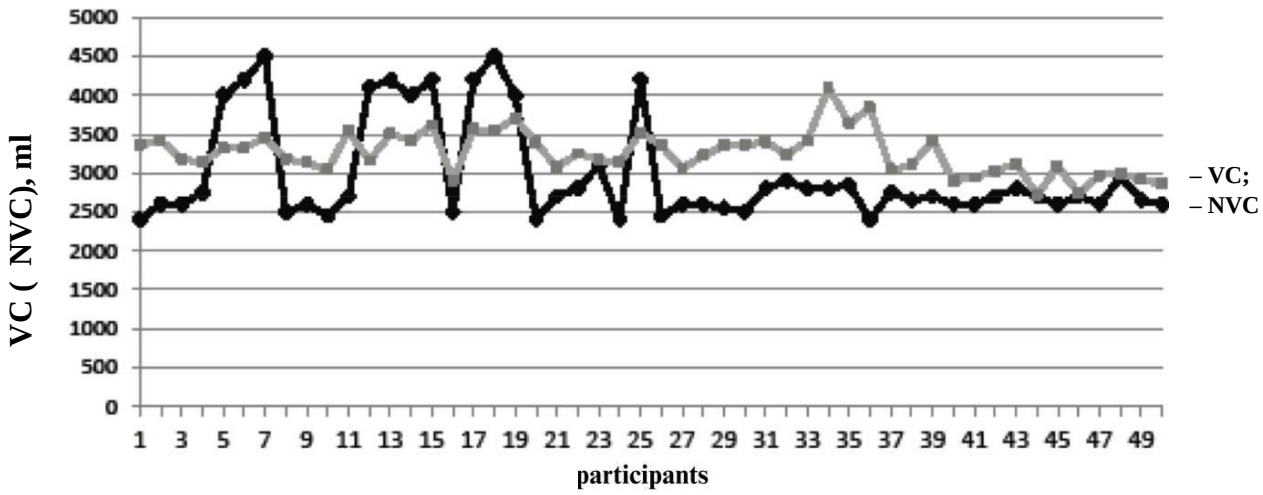

Figure 2 - **Values of vital capacity (VC) and normal vital capacity (NVC) in elderly men**, ml (n = 50): – VC; – NVC

The decrease in vital capacity with age, in our opinion, is mainly associated with the rigidity of the chest, a decrease in the strength of the respiratory muscles, a decrease in lung elasticity, bronchial patency and reflects the limitations of the potential possibilities of external respiration.

To assess the functional state of the cardiorespiratory system as a whole and the body's resistance to hypoxia, tests were performed with arbitrary breath holding on inspiration (Shtange test) and on expiration (Genchi test). The breath holding time on inspiration in elderly men was $\bar{x}$ (SD) 33.8 (11.4) s, which is within the age norm, and on expiration only $\bar{x}$ (SD) 13.8 (7.1) s, which is significantly lower than the age norm (less than 20 s).

This means that during exhalation in the studied contingent, the lungs are very quickly saturated with CO_2, which indicates a low level of their fitness. As is known, during training, on the one hand, the vital capacity of the lungs increases, and on the other hand, the processes of decay and oxidation in the tissues proceed more economically, and therefore the value of the maximum breath hold is extended both on inhalation and exhalation.

Thus, a significant decrease in the cardiorespiratory capabilities of the studied contingent of elderly men was revealed.

To obtain more reliable information about the somatic state of the studied contingent, we determined the indices of functional systems – body mass index (BMI), vital index (VI), strength index (SI), Robinson index (RI) and Kerdo index (KI) (see in Table 2).

The value of the vital index (VI) characterizes the relative capabilities of the respiratory system of an individual. The vital index of the lungs in elderly men was significantly below the norm - 36.5 (95% CI: 34.0–39.0) ml·kg-1 with the norm for this age not less than 50 ml·kg-1.

According to the value of VI, 80% of elderly men are in the “risk group” - they have low (4%) and lower than average (76%) levels. But the “risk group” can also include people with an average level (4%), since according to the theory of G. Apanasenko, the “safe” level of indicators for health is considered high and higher than average [4]. Thus, in the group of the

studied contingent, 84% of elderly men require correction of the functional state of the respiratory system.

The norm of SI for elderly men is 50–60% [15], while in our respondents it was 43.3% (95% CI: 39.4–47.3%).

Table 2 – **Physical health indicators of elderly men** (n=50)

Indicator	Median	Interquartile range	Mean	Standard deviation	95% CI	Coefficient of variation, %
Body mass index, kg·m-2	28.0	2.8	28.1	7.2	[26.6–29.6]	25.6
Vital index, ml·kg-1	33.1	8.5	36.5	8.8	[34.0–39.0]	24.1
Strength index, %	40.2	23.6	43.3	13.9	[39.4–47.3]	32.1
Robinson index, c.o.	118.2	34.8	119.0	23.4	[112.3–125.6]	19.6
Kerdo index, c.o.	-5.8	14.5	-8.3	8.2	[-10.6–(-5.9)]	99.7

A strength index with a high value of the indicator was recorded in 14% of elderly men, higher than average – in 12%, average – in 4%, lower than average – in 20%, in the rest (50%) the values of the indicator corresponded to a low level.

It is known that the autonomic nervous system participates in the adaptation process. The centers of the sympathetic and parasympathetic nervous systems are in a state of "tonus" – continuous excitation, which is one of the manifestations of the state of homeostasis and a stabilization mechanism.

The study of the vegetative status is determined by the adequate selection of means of health-improving and recreational motor activity, and also allows to identify premorbid states - states of the organism in which there are no clinical manifestations yet, but there are already certain deviations in the mechanisms of regulation. In addition, the assessment of the vegetative status reveals the adaptive reserve of various physiological systems, which allows to ensure the prevention of the disease at the early stage of the pre-disease. As can be seen from Table 2, the average value of the Kerdo index was less than zero, which indicated the parasympathetic influence of the autonomic nervous system on the circulatory system - -8.3 (95% CI: -10.67–(-5.9)).

The pronounced parasympathetic reaction indicates the decentralization of the process of heart rate regulation in the process of work. This type of reaction in 72% of our respondents may probably be due to the development of fatigue and inhibition processes in the central nervous system, which is a protective reaction of the body to stress.

In 18% of elderly men, eutonia was observed, which indicates a balanced influence of the parasympathetic and sympathetic divisions of the ANS.

10% of men aged 60–70 had a pronounced sympathetic reaction, which reflects age-related biological changes in the body associated with impaired autonomic and neurohumoral regulation, accumulation of changes caused by stress, and requires the appointment of

appropriate measures. As a rule, these are individuals with a tendency to arterial hypertension and tachycardia.

For quantitative assessment of the energy potential of the human body, the Robinson index was used, which characterizes the level of metabolic and energy processes occurring in the body and the degree of oxygen consumption by the myocardium, as well as the systolic work of the heart.

As our studies have shown, in 10% of men aged 60–70, the registered values of the Robinson index characterized the optimal functioning of the circulatory system and indicated the economical and effective contractile activity of the myocardium, which increases the reserve capabilities of the circulatory system as a whole.

In 8%, the values corresponded to the average level, which indicates certain problems in the functioning of the circulatory system. In 22% of elderly men with below average and 60% with low levels, the value of the Kerdo index indicated inefficient functioning of the circulatory system, as well as a decrease in the adaptive response of the cardiovascular system to stress factors. This leads to a decrease in the efficiency of the functions of life support systems. As a result, fatigue occurs, which, in turn, contributes to a decrease in physiological reserves, which affects the adaptive reserves of the body.

As studies have shown, the average value of the Index of Physical Fitness (IPF) of men aged 60–70 years, determined by Baevsky, was 3.5 (95% CI: 3.4–3.6), which indicates a decrease in the adaptive potential and an increase in the tension of regulatory systems.

Satisfactory adaptation of the cardiovascular system was found in 8% of elderly men; tension of adaptation mechanisms – in 20%; unsatisfactory adaptation – in 40%; impaired adaptation – in 32%.

This was also confirmed in the test of 20 squats in 30 s, the average recovery period in which was 2.4 (95% CI: 2.1–2.6), and the average value of the HR shift was +85.6 (95% CI: 83.6–86.9). 16% of elderly men demonstrated a normotonic type of reaction, indicating normal cardiovascular activity.

In 68% of the studied contingent, there was a slight increase in systolic blood pressure and a more significant increase in diastolic, indicating a hypotonic or asthenic type of reaction of the cardiovascular system to physical exertion. This, in turn, is the earliest sign of deterioration in the functional state associated with the disease or overfatigue.

In 10% of the studied contingent, a hypertensive type of reaction was observed, and in 6% - dystonic. These types of reactions indicate a deterioration in the functional state of the cardiovascular system and a violation of the mechanism of blood circulation regulation. The recovery period in these cases is long and slow.

Thus, the recovery time after a functional test and the type of body reaction to this load in 84% of the contingent corresponds to a low level of health according to G. Apanasenko.

Corresponding results were obtained in the Rufier test, the result of which depends on the values of the heart rate at different recovery periods after relatively small loads. The change in heart rate ensures the adaptation of the circulatory system to the needs of the body and environmental conditions. In male respondents of this age (Table 3).

Table 3 – **Ruffier index values for elderly men** (n=50)

Index value	Score	%
≤0	**Athletic heart**	2
0.1-5.0	**Excellent**	8
5.1-10.0	**Good**	14
10.1-15.0	**Fair**	56
15.1-20.0	**Heart failure**	20

In particular, 10% of the elderly men had excellent cardiac muscle function, and 14% had good condition, but 20% of men had heart failure.

Discussion

Anatomical and physiological changes that occur in the body of elderly people lead to a decrease in their vitality. Modern research in the field of gerontology has accumulated a large amount of scientific and methodological material on the main structural, metabolic and functional changes in the aging process of the body. Against the background of these changes, various diseases often develop. Elderly people have problems with the respiratory and cardiovascular systems.

At the same time, elderly people often have a tendency to reduce motor activity, which, on the one hand, causes various diseases, and on the other hand, reduces the ability to adapt to various environmental factors.

Numerous studies by domestic and foreign scientists show that the aging process of the body can be significantly slowed down by systematic physical exercises that stimulate the activity of the endocrine system, improve metabolism, prevent the development of degenerative changes in organs and tissues, increase the endurance of the nervous system and the ability of a person to adapt to environmental conditions [8; 21; 25].

It is well known that in the human body, under the influence of regular aerobic training, a number of favorable functional changes occur: the functioning of the heart muscle improves, stroke and minute blood volume increase, tissue oxygen supply and nutrition improve; the total blood volume increases, improving oxygen transport capabilities and contributing to increased endurance during strenuous physical work; biochemical changes occur in the blood, which contribute to the prevention of atherosclerosis, ischemic heart disease, stroke and other diseases; the vital capacity of the lungs increases, which increases the adaptive capabilities of the body; the musculoskeletal system is strengthened, endurance, strength and power of various muscle groups develop; human performance increases, adaptation to environmental conditions [8;20;22;26].

We confirmed the results of the authors' research on a significant decrease in health and physical performance of the studied contingent, as well as a deterioration in the indicators of the morpho-functional state [3; 5; 15].

The obtained research results are planned to be used to substantiate and build a program based on the use of means of health and recreational motor activity in conditions of quarantine restrictions.

Conclusions

According to the results of the study, indicators of the level of physical condition of elderly men were determined. It was found that deviations from the norm are noted for most indicators: 84% of elderly men need correction of the functional state of the cardiovascular system, 60% of respondents have elevated blood pressure, satisfactory adaptation of the cardiovascular system was found in 8% of elderly men; tension of adaptation mechanisms - in 20%; unsatisfactory adaptation - in 40%; adaptation disorders – in 32%.

Prospects for further research

Prospects for further developments consist in substantiating and developing a program of classes based on the use of means of health and recreational physical activity for the elderly, aimed at slowing down the processes of involutional changes.

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