

Dynamics of other functional state of cardiovascular and respiratory systems indicators at women under the influence of swimming occupations

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Purpose: to determine degree of recreational swimming occupations influence on functional state of cardiovascular and respiratory systems of women.

Materials & Methods: 52 women aged 25–45 years have participated in research. Data collection was carried out in recreational groups of Y. Bliznuks author's school of swimming and the "Pioneer" pool. Examinees had identical swimming readiness. Were applied: poll, testing, tool research methods of cardiovascular and respiratory systems. The obtained quantitative data was processed by methods of mathematical statistics.

Results: the research demonstrates that occupations in recreational swimming cause positive changes of functional state of cardiovascular and respiratory systems of women aged 25–45 years; considerable improvement of state is cardiovascular and respiratory systems indicators was most shown after 2 years of occupations.

Conclusions: it is established that occupations in recreational swimming for 2 years have positively affected state of cardiovascular and respiratory systems of women aged 25–45 years.

Keywords: swimming, women, indicators, systems of organism, functional state.

Introduction

As a result of long observations many researchers have come to conclusion that violations of age character in human body are very similar to violation, being consequence of weak physical activity. The people being inactive have similar changes. "Physical activity of the person – necessary condition of their existence": specifies in his works N. Kardamonov [7]. According to A. Solodkov muscular activity is the main condition of intellectual and working capacity, guarantee of good health and positive emotions [8]. It means that physical activity of the person is determined by social and physiological needs.

Certain "dose" of physical activity is necessary for normal functioning of human body and maintaining health. Dubrovsky specifies that only physical activity, regular physical exercises are capable: to prevent the degenerate changes caused by ageing and hypodynamia; to substantially suspend age changes of various functions of organism and process of aging, to make it less obvious [5].

The improving effect of physical culture occupations is linked first of all with increase in aerobic ability of organism, level of its general endurance and working capacity. The positive effect of occupations is caused by an increase in functionality of cardiovascular system. It consists in development of more efficient cardiovascular activity and lower need of myocardium for oxygen. Besides the expressed increase in reserve of cardiovascular system abilities, the physical culture is also a powerful prophylaxis of cardiovascular diseases [1; 6; 8; 10].

To prevent overall unfitnes the most of athletes and ordinary people should train their cardiovascular system. Heart is the only organ which may suffer from exercise stress of an unfit individual. But in too time, heart trains at any kind of an exercise stresses and of course during swimming. Swimming to a large extent, than all other exercises, exerts versatile

impact on organism, and, thanks to regular trainings by improving swimming, the big improving effect can be reached. Yu. M. Danko [4] says that improving action of physical exercises in water is shown at any age because swimming is one of the most effective sports in the improving relation, powerful tool of prevention of various diseases. Range of influence of swimming on organism is huge: from the gradual growth of consumption of oxygen and increase in functionality warmly – vascular system before the reaction exceeding the usual level of activity of respiratory organs and blood circulation by 8–10 times [2; 3].

Focusing the attention to a role of swimming as improving factor, most of researchers pay much less attention to studying of dynamics of the changes, occurring under the influence of occupations in recreational swimming, whereas they are one of the main conditions not only of physical, but also of mental health of the person [6; 9–11].

B. Belyayeva considers that long-term practical experience and scientific research of the last years contribute to formation and the further development of modern technique for recreational swimming classes. One of the main tasks of training process in recreational swimming is to obtain objective information on how the exercise stress influences people of different age directly on training occupation and certain time after regular trainings. Insufficiency of data on the positive changes of physical health of trainees under the influence of improving swimming has also induced us to carry out this research. The relevance of the chosen subject is that distribution of such working experience answers practice inquiries, and the offered data will help teachers, instructors, methodologists of physical culture, doctors and also independently engaged to use means of recreational swimming for strengthening of health and increase in physical fitness more effectively [3].

Purpose of the study: to determine extent of recreational

swimming occupations influence on indicators of functional state of cardio-vascular and respiratory systems of women.

Research problems:

1. To analyses literature data about influence of recreational training in swimming on physical development and physical fitness and also the general indicators of women's health.
2. To establish dynamics of functional state indicators of cardio-vascular and respiratory systems of women aged 25–45 engaged in recreational swimming classes.
3. To determine extent of swimming occupations influence on functional state of cardiovascular and respiratory systems indicators of this contingent.

Material and Methods of the research

Data collection was carried out in recreational groups of Y Bliznuk's experimental school of swimming at the "Pioneer" swimming pool. 52 women aged 25–45, who regularly (2–3 times a week) have recreational swimming occupations, participated in our research. Duration of one occupation – 45 minutes. Examinees having identical swimming readiness have been divided into two groups. First group consisted of women aged 25–35 (n=26), second – 36–45 years (n=26).

During the period from October, 2014 to June, 2016 dynamics of cardiovascular and respiratory system functional state indicators of the women engaged in recreational swimming was investigated; also extent of swimming occupations influence on these systems at this contingent has been defined (in October, 2014 – initial metrics were collected; in June, 2015 – indicators after 1 year of recreational occupations were collected; in June, 2016 – after 2 years of occupations).

During data collection the following methods were applied: poll, testing, tool methods of cardio-vascular and respiratory systems research. The obtained quantitative data were processed by methods of mathematical statistics.

Results of the research and their discussion

With age, in cardio-vascular system of the person there are structural and functional changes: the relative hypertrophy of heart increases; its functional abilities decrease; there are short wind, unpleasant feelings in heart, heartbeat; there is atrophy and partial replacement of muscle fibers of heart with connecting tissue that leads to loss of cardiac muscle elas-

tic properties and obstructs blood traffic in coronary vessels; delivery of cardiac muscle decreases; in arteries there is diffusion growth of fibrous tissue, the aorta and coronal vessels are getting strucked [2; 4–8].

Since heart is the weakest link in the trainees organism, over-seeing by its state is especially important since knowledge of hearts reserve opportunities allows to make swimming loadings more safe and efficient and to control the changes happening in cardiovascular system during the course of the occupations.

Were measured in our research two widely used in practice, high-informative and simple indexes – the heart rate and arterial blood pressure as most important indexes of the cardiovascular system functional state (Tab. 1).

Apparently from tab. 1 under the influence of swimming occupations there were reliable changes on all indexes. Among various objects of the recorded indexes, heart rate is extremely important indicator for assessment of the organism functional condition and training efficiency. It is known that increase in fitness is followed by a decrease in heart rate. In our research, as a result of the regular use of the offered swimming programs, after the first year of occupations in group where the age of examinees was 25–35 years, heart rate decreased by 2,5 bpm (p<0,001). On the second year of occupations decrease of heart rate continued (by 2,1 bpm) and stabilized on indexes 71,1±0,38 bpm (p<0,001).

In a group of women aged 36–45 the similar tendency was observed. Indicators of the heart rate considerably decreased both after the first year of occupations (by 2,2 bpm, p<0,001) and after the second (by 2,8 bpm, p<0,01). Stabilization happened on indexes 69,9±1,2 bpm (p<0,01). Besides, while counting pulse, examinees paid an attention to its rhythm. By estimates of most of women (45 people – 86,5%), as a result of the regular trainings in recreational swimming, ictuses began to follow one by one at regular intervals that also confirms increase in fitness and functionality of cardiovascular system.

Other factor of beneficial influence of swimming on cardiovascular system is a normalization of arterial blood pressure. The reliability of distinctions on an index of systolic arterial blood pressure is revealed in both groups of examinees both after the first year of occupations (p<0,01), and after the second (p<0,01). During research, indicators of systolic arterial blood pressure in group of women aged 25–35 decreased with 118,1±0,68 to 112,6±0,97 mm Hg., and in group of 36–

Table 1
Dynamics of cardiovascular system indexes at women under the influence of occupations in swimming within 2 years

| Indicators | Input data | After 1 year | Reliability level | | After 2 years | Reliability level | | |
|---------------------------------|------------|--------------|-------------------|--------|---------------|-------------------|--------|--|
| | | | t | p | | t | p | |
| Aged 25–35 (n=26) | | | | | | | | |
| Heart rate, bpm | 75,7±0,61 | 73,2±0,45 | 3,28 | <0,001 | 71,1±0,38 | 3,57 | <0,001 | |
| Systolic blood pressure, mm Hg | 118,1±0,68 | 115,4±0,72 | 2,73 | <0,01 | 112,6±0,97 | 2,32 | <0,01 | |
| Dyastolic blood pressure, mm Hg | 74,9±0,57 | 72,4±0,59 | 3,04 | <0,001 | 70,1±0,38 | 3,28 | <0,001 | |
| Aged 36–45 (n=26) | | | | | | | | |
| Heart rate, bpm | 74,9±0,58 | 72,7±0,3 | 3,37 | <0,001 | 69,9±1,2 | 2,26 | <0,01 | |
| Systolic blood pressure, mm Hg | 122,1±0,98 | 119,1±0,73 | 2,5 | <0,01 | 116,8±0,4 | 2,77 | <0,01 | |
| Dyastolic blood pressure, mm Hg | 76,6±0,43 | 74,1±0,67 | 3,14 | <0,001 | 71,25±0,43 | 3,58 | <0,001 | |

45 years old – with 122,18±0,98 to 116,8±0,4 mm Hg.

At all women taking part in research distinctions of these indexes of diastolic arterial blood pressure are noticeable ($p < 0,001$ – after the first year of occupations; and especially noticeable distinctions of these indexes are revealed between initial indexes and indexes of the second year of occupations – $p < 0,001$). For 2 years of systematic occupations swimming at young women indicators of diastolic pressure decreased with 74,9±0,57 mm Hg. to 70,1±0,38 mm Hg. and at more mature women – with 76,6±0,43 mm Hg. to 71,25±0,43 mm Hg.

Analyzing results of a arterial blood pressure indexes research, it is possible to note that as a result of occupations in swimming most of examined women managed to reduce amplitude of arterial blood pressure (a difference between the maximal and minimum pressure) and to get indicators of blood pressure closer to those they had in youth.

For healthy people 25 years old and pulse at rest fluctuates within 62–70 bpm for men and 64–72 bpm for women. It's important to note that after two years of occupations in recreational swimming most of the women, who took part in researches, got not only a decrease in indexes of heart rate, but also their normalization (Tab. 2) [6–8].

Table 2 shows that after 1 year of occupations index of heart rate – 72 bpm, was recorded at 12 women (46,1%) aged 25–35 and 9 women (34,6%) aged 36–45 years. After the second year of occupations number of women who normalized their heart rate to 72 was 13 persons (50%) in young people group and 17 persons (65,4%) in group of more mature women.

With age morphological and functional changes in respiratory system are shown in an atrophy of the copular device, weakening of respiratory muscles. A failure of external respiration is shown in a hyperventilation of lungs at rest, in gradual decrease in thorax excursion and vital capacity of lungs (VC). Swimming, like no other sport, develops, strengthens and improves human respiratory system, promotes optimization of oxygen mode of an organism. By means of the functional measurements at women aged 25–40 years, taking parting in a research for 2 years, indexes of the functional condition of respiratory system under the influence of swimming occupations were defined and analyzed (Tab. 3) [2; 4–8].

Chest volume, chest excursion and vital capacity are reflecting the functional condition of respiratory system. Analyzing data from Tab. 3, it is possible to draw a conclusion that under the influence of swimming occupations there were reliable changes of all respiratory system functional condition indexes. Thus, for 2 years of occupations, indexes of chest volume ($p < 0,01$ – in group of women aged 25–35; $p < 0,001$ – in group of women aged 36–45) and chest excursion ($p < 0,01$ and $p < 0,001$ accordingly) considerably changed. The reliability of distinctions on these indexes is revealed both after the first year of occupations, and after the second.

One of the major indicators of respiratory system condition, physical fitness, training abilities and common state of health of the person, is vital capacity. It depends both on the lungs measures and on strength of the muscles participating in respiration. Vital capacity increases when the trainings are held correctly. The greater is the vital capacity, the deeper is breath, the greater are volume of pulmonary ventilation volume and

Table 2
Normalization of heart rate at women aged 25–40 under the influence of swimming occupations within 2 years (quantity of cases)

| Age | Experience | Quantity of heartbeats per minute | | | | | | | | |
|-------|---------------|-----------------------------------|-----|----|----|----|----|----|----|----|
| | | 108 | 102 | 96 | 90 | 84 | 78 | 72 | 66 | 60 |
| 25–35 | Input data | 2 | 3 | 1 | 6 | 13 | – | – | 1 | – |
| | After 1 year | – | – | – | 3 | 5 | 5 | 12 | 1 | – |
| | After 2 years | – | – | – | 1 | 3 | 4 | 13 | 4 | 1 |
| 36–45 | Input data | 1 | 1 | 5 | 7 | 11 | – | 1 | – | – |
| | After 1 year | – | – | 2 | 3 | 3 | 7 | 9 | 1 | 1 |
| | After 2 years | – | – | – | 1 | 1 | 5 | 17 | 1 | 1 |

Table 3
Dynamics of the functional indexes of respiratory system at women under the influence of swimming occupations

| Index | Input data | After 1 year | Reliability level | | After 2 years | Reliability level | |
|--|------------|--------------|-------------------|--------|---------------|-------------------|--------|
| | | | t | p | | t | p |
| 25–35 (n=26) | | | | | | | |
| Chest volume, cm | 91,7±0,58 | 89,2±0,36 | 3,66 | <0,001 | 87,5±0,7 | 2,16 | <0,01 |
| Chest excursion, cm | 5,65±0,14 | 6,71±0,33 | 2,96 | <0,001 | 7,73±0,12 | 2,90 | <0,001 |
| Vital capacity, ml | 3115±25,6 | 3218±21,7 | 3,07 | <0,001 | 3325±23,9 | 3,31 | <0,001 |
| Stange's test, sec. | 47,19±1,2 | 57,26±2,6 | 3,52 | <0,001 | 66,96±2,1 | 2,9 | <0,001 |
| Respiration rate at rest | 15,32±0,78 | 12,24±0,81 | 2,74 | <0,001 | 10,75±0,85 | 2,12 | <0,001 |
| 36–45 (n=26) | | | | | | | |
| Chest volume, cm | 92,6±0,41 | 90,8±0,57 | 2,57 | <0,01 | 88,5±0,36 | 3,41 | <0,001 |
| Chest excursion, cm | 5,02±0,42 | 6,48±0,39 | 2,54 | <0,01 | 7,63±0,38 | 2,11 | <0,01 |
| Vital capacity, ml | 3013±25,1 | 3112±23,2 | 2,9 | <0,001 | 3176±20,1 | 2,09 | <0,001 |
| Stange's test, sec. | 46,61±1,89 | 54,63±1,64 | 3,2 | <0,001 | 63,12±1,75 | 3,54 | <0,001 |
| Respiration rate at rest, breaths per minute | 15,68±0,95 | 12,68±0,87 | 2,36 | <0,01 | 10,82±0,71 | 2,55 | <0,01 |

respiratory surface. The research revealed that after first year of swimming occupations vital capacity increased (in group aged 25–35 – with $3115 \pm 25,6$ to $3218 \pm 21,7$; in group aged 36–45 – with $3013 \pm 25,1$ to $3112 \pm 23,2$) and during second year of occupations, or long kept at this level, or continued to increase. Indexes of vital capacity after the second year of occupations in group of women aged 25–35 were $3325 \pm 23,9$ ($p < 0,001$); in group aged 36–45 years – $3176 \pm 20,1$ ($p < 0,001$) [4; 6; 8].

In our research a very simple, but at the same time rather informative functional test of holding breath on inhale (Stange's test). The duration of breath holding indicates condition of all organism, not just respiratory system. Thus, less than in a year of swimming occupations duration of breath holding was about 1 minute (group of women aged 25–35 – $57,26 \pm 2,6$ s, $p < 0,001$; group of women aged 36–45 – $54,63 \pm 1,64$ s, $p < 0,001$), and after the second year examinees aged 25–35 years were able to hold their breath for $66,96 \pm 2,1$ s ($p < 0,001$), and women aged 36–45 years for $63,12 \pm 1,75$ s ($p < 0,001$). Increase of breath-holding duration, although insignificant, demonstrates that occupations improve health of examinees.

The index of respiration rate also changed over time. After the first year of occupations at younger women it decreased with $15,32 \pm 0,78$ breaths per minute to $12,24 \pm 0,81$ ($p < 0,001$),

and at elder women with $15,68 \pm 0,95$ breaths per minute to $12,68 \pm 0,87$ ($p < 0,01$). During the second year of occupations indexes of respiration rate continued to decrease and made $10,75 \pm 0,86$ breaths per minute ($p < 0,001$) for group of 25–35 years old, and $10,82 \pm 0,71$ ($p < 0,01$) for group of women aged 36–45.

Thus, researches showed that at women of both groups a number functions of respiratory system considerably improved in comparison with input data. The difference swimming was especially noticeable after 2 years of occupations.

Conclusions

After 2-year research it is possible to note that occupations in improving swimming positively affected a state of cardiovascular and respiratory systems of women aged 25–45 years. It is established that there were reliable improvements of cardiovascular ($p < 0,01$; $p < 0,001$) and respiratory ($p < 0,01$; $p < 0,001$) systems functional state indexes. It is revealed that indexes of the functional condition of these systems in comparison with input data are reliably high. Improvements were more noticeable after two years of occupations.

Prospects of further researches can be determined by indicators of the dominating condition of women which do swimming, in different phases of a menstrual cycle.

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