Comparative analysis of the functional state of the cardiovascular system of underwater swimmers in different time periods

UDC 612.087

Associate Professor **E.V. Redi**[1]
[1]Reshetnev Siberian State University of Science and Technology, Krasnoyarsk

Corresponding author: Russlen90@mail.ru

Abstract

Objective of the study was a comparative assessment of the functional state of the cardiovascular system of underwater swimmers in different time periods.

Methods and structure of the study. The survey involved highly qualified underwater athletes, members of the national team of the Krasnoyarsk Territory (2004, 2014, 2022), 10 girls, 10 boys. The study was conducted at the sports bases of the city of Krasnoyarsk (sports complex "Avangard", "Water Sports Palace of the Siberian State University"). The following methods were used in the work: analysis of pedagogical and scientific-methodical literature, methods for assessing anthropometric indicators (measurement of body length, measurement of body weight, measurement of chest circumference, measurement of hand strength, calculation of weight-height index, calculation of life index), methods for assessing morphofunctional indicators (heart rate, systolic blood pressure).

Results and conclusions. The study made it possible to summarize that women involved in underwater sports in 2022 have higher indicators characterizing the morphological and functional capabilities of the body. They are taller, have the greatest weight, wrist muscle strength, higher weight-height index (WHI), life index (LI), resting heart rate (HR) than the athletes of 2004 and 2014. In men, the same trend persists, there is an increase in weight, height, hand strength, WHI, LI, heart rate at rest.

Keywords: *morphofunctional indicators, underwater sports, anthropometry, submariner, cardiovascular system, physical activity.*

Introduction. The cardiovascular system is a dynamic structure that quickly responds to various factors of the external and internal environment: psychoemotional state, physical activity, weather conditions, etc. [3, 4, 8, 9]. The study of the functional state of the cardiovascular system of athletes is important for assessing the adequacy of physical activity and adaptation to it, as well as for determining the morphological and functional characteristics of the body [7].

Objective of the study was a comparative assessment of the functional state of the cardiovascular system of underwater swimmers in different time periods.

Methods and structure of the study. The survey involved divers of three generations (conditionally divided into groups): group A - 2004, group B - 2014, group C - 2022. Each group consisted of 10 boys and 10 women aged 17 to 25 years. Each of the examined has high sports results and a sports title not lower than masters of sports (MS). The study was carried out in several stages, at the sports bases of the city of Krasnoyarsk (sports complex “Avangard”, “Water Sports Palace of the Siberian State University”).

Anthropometric indicators were assessed: body length (height), body weight (weight), chest circumference, hand strength, calculation of the weight-height index (WHI), life index (LI); morphological and functional indicators: heart rate (HR), systolic blood pressure (SBP).

Results of the study and their discussion. An assessment of the anthropometric indicators of swimmers revealed that the height of women involved in underwater sports in 2004 was 165-173 cm. In 2014, the same level remained, and in 2022, the average height increased by 3 cm. engaged in underwater sports in

2004, the growth was 167-184 cm. In 2014 and 2022 growth rates increased by 2-5 cm, respectively (Tables 1, 2).

Different dynamics of body weight was established. In women, the difference depending on the time period ranged from 1 to 3 kg. The largest body weight was noted in men in 2022, the difference from 2004 was 6 kg.

The muscle strength of the hands has slight fluctuations, both in women and men, within 1-3 kg, which can be explained by the specifics of this sport. Swimming in a monofin excludes the work of the hands, a slight increase over the years indicates the predominance of hand strength, which is associated with an increase in body weight.

An important indicator in scuba diving is the indicators of the *cardiovascular system*, which depend both on the biological characteristics of the body and on what distances the athlete specializes in. Regardless of specialization, a significant load in scuba diving falls on the circulatory system. Since the heart rate responds to emotional and physical stress, to the internal and external environment of the body, we studied heart rate and blood pressure at rest.

The highest rate of heart rate in men was noted in group C - 62 beats/min, in groups A and B it was 61 beats/min, which does not have statistically significant differences. The highest rate of heart rate in women, depending on the time period, in group A was 61 beats/min, in group B - 62 beats/min, in group C - 64 beats/min. There is a slight increase in heart rate at rest, which can be regarded as a positive effect on the cardiovascular system.

The highest rate of systolic blood pressure (SBP) was observed in men: in group A, its average values were 125 mm Hg. Art., in group B - 115 mm Hg. Art., in group B - 120 mm Hg. Art. All indicators are within the physiological norm for highly qualified athletes, which also indicates the favorable effect of underwater sports on the circulatory system. The highest indicator of systolic blood pressure in women: in group A - 125 mm Hg. Art., in groups B and C - 120 mm Hg. Art. These indicators are within the physiological norm for highly qualified athletes and correspond to the standards of healthy people.

The discussion of the results. Heart rate is a sensitive marker of the body's vegetative homeostasis, one of the first to respond to its changes during adaptation. The slowing of heart rate at rest is associated with an increase in parasympathetic influences on the automatism function of the heart. Some authors note a positive relationship between the volume of the heart and the power of contractions and an inverse relationship with heart rate (the larger the heart, the more powerful the contractions, the lower the pulse). A number of authors [1, 2, 5], who study the influence of the direction of the training process on cardiac performance, note that the highest values of heart rate are observed

Table 1. *Indicators of physical development of underwater swimmers according to anthropometric data in women*

Indicators	Time period		
	2004	2014	2022
Height, cm	165-173	166-174	165-177
Body weight, kg	56-68	59-69	53-70
Chest circumference, cm	75-83	74-84	75-86
WHI	339-400	355-404	325-409
LI	52-75	54-71	58-81
Wrist strength, kg (right hand)	27-29	28-29	27-32
Wrist strength, kg (left hand)	25-27	26-28	25-29

Table 2. *Indicators of physical development of underwater swimmers according to anthropometric data in men*

Indicators	Time period		
	2004	2014	2022
Height, cm	167-184	172-186	165-191
Body weight, kg	67-88	66-92	65-94
Chest circumference, cm	87-110	89-108	90-110
WHI	394-478	379-494	375-497
LI	67-79	71-81	75-84
Wrist strength, kg (right hand)	46-51	47-50	45-52
Wrist strength, kg (left hand)	46-49	47-50	43-50

in athletes who develop the quality of endurance. Our data are consistent with those of S.K. Andreeva, who notes that among highly qualified divers, the heart rate in men is 62 beats/min (intragroup variation 48-80 beats/min), in women - 65 beats/min (intragroup variation was 62-83 beats/min). It follows that underwater sports have a positive effect on the cardiovascular system. Arterial pressure is an integral indicator of hemodynamics and characterizes the state of the circulatory system.

Conclusions. The study made it possible to summarize that women involved in underwater sports in 2022 have higher indicators characterizing the morphological and functional capabilities of the body. They are taller, have the greatest weight, hand muscle strength, higher weight-height index (WHI), life index (LI), resting heart rate (HR) than athletes of 2004 and 2014. In men, the same trend persists, there is an increase in weight, height, hand strength, WHI, LI, heart rate at rest.

Thus, the monitoring of the functional state of athletes is of great importance in the distribution of loads in the process of sports activities. As a result of the competent construction of the training process, taking into account individual functional indicators, the reserve capabilities of the athlete's body increase, increasing its biological stability and system reliability.

References

1. Andreeva S.K., Martynov A.I., Pavlov V.I., et al. Podvodnyy sport i zdorovye [Underwater sport and health]. Moscow: DOSAAF USSR publ., 1980. 222 p.
2. Anishchenko V.S. Podvodnyy sport v kliniko-fiziologicheskom osveshchenii [Underwater sports in clinical and physiological lighting]. Fiziologicheskiye predposylki sportivnoy rabotosposobnosti v podvodnom sporte. Moscow, 1969. No. 9. p. 10.
3. Blinkov S.N., Bashmak A.F., Mezenceva V.A., Borodacheva S.E. Issledovanie morfofunkcionalnogo razvitiya i fizicheskogo zdorovya studentov 18-22 let [Study of Morphofunctional Development and Physical Health of Students Aged 18-22]. Uchenyye zapiski universiteta imeni P.F. Lesgafta. 2018. No. 7 (161), pp. 32-37. Vanyushin Yu.S., Fedorov N.A., Huzina G.K., Yarullin A.G. Kriterii biologicheskoy nadezhnosti rastushchego organizma i vzroslyh sportsmenov [The Criterion of Biological Reliability of a Growing Organism and Adult Athletes]. Pedagogiko-psikhologicheskiye i mediko-biologicheskiye problemy fizicheskoy kultury i sporta. 2019. Vol. 14. No. 2, pp. 97-102.
4. Moskovchenko O.N., Shumakov A.V. Valeologicheskiy podhod k otboru i upravleniyu podgotovkoy borcov greko-rimskogo stilya na etape uglublennoy specializacii [Valeological approach to the selection and management of training of Greco-Roman wrestlers at the stage of in-depth specialization]. Krasnoyarsk, CPI KSTU, 2005. 158 p.
5. Rakhimov M.I. Osobennosti hronotropnoy reakcii detey i podrostkov na fizicheskuyu nagruzku [The Peculiarities of chronotropic heart reaction among children and adolescents after doing physical activity]. Fundamentalnyye issledovaniya. 2015. No. 2-16, pp. 3536-3538.
6. Bogaard H.J., Woltjer H.H., Dekker B.M. et al. Haemodynamic Response to Exercise in Healthy Young and Elderly Subjects. European Journal Appl Physiology Occup Physiology, 1997. No. 75 (5), pp. 435-442. DOI: 10.1161/circresaha.117.305205. Lavie C.J., Arena R., Swift D.L. et al. Exercise and the Cardiovascular System: Clinical Science and Cardiovascular Outcomes. Circ Reserch, 2015. No. 117 (2), pp. 207-219. DOI: 10.1161/ CIRCRESAHA.117.305205. Lucini D., Di Fede G., Parati G., Pagani M. Impact of Chronic Psychosocial Stress on Autonomic Cardiovascular Regulation in Otherwise Health Subjects. Hypertension, 2005. Vol. 46. p. 1201. DOI: 10.1161/01.HYP.0000185147.32385.4b.