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# Anthropometric and functional indicators of athletes with different types of body constitution

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***Purpose:*** *to determine the main anthropometric indicators, the level of the functional state of the cardiovascular and respiratory systems of athletes, depending on the type of constitution of their body.*

***Material & Methods:*** *in the course of the study, measurements were made of the type of body constitution, morphological indicators and indicators of the functional state of the cardiovascular and respiratory systems of athletes. Two experimental groups were formed from specialized sport school athletes.*

***Results:*** *the analysis of anthropometric and functional indicators of the cardiovascular and respiratory systems of athletes specializing in freestyle wrestling and rowing from specialized sport school is carried out. The dependence of the state of morphological and functional parameters of athletes depending on the type of body constitution is shown.*

***Conclusion:*** *the dependence is established between the type of body constitution with the morphological and functional indicators of athletes specializing in freestyle wrestling and canoeing.*

**Keywords:** *freestyle wrestling, rowing, anthropometric and functional indicators.*

## Introduction

At the present stage of development and in the future for further research and development, the actual task of constitutional science is to study the processes of adaptation – identifying the advantages of certain constitutional types in certain cases of changing environment conditions. No less important theoretical and practical importance of research in sports morphology are the study of individual constitutions as genetic markers of the younger generation with a tendency to engage in various sports [3; 6; 7].

The effectiveness of competitive activity largely depends on the morphofunctional characteristics of the athlete's body, an integral indicator of which is the constitution of his body and its morphological manifestation - the somatotype. A number of papers [4–7] are devoted to evaluating the type analysis of the body of athletes, but different authors used different constitutional schemes to examine athletes in particular sports, and therefore their research results are often difficult to compare.

In modern literature there are scientific studies on the study of the morphological features of karatekas [4], wrestlers [10] representatives of team sports [5], swimming [1], all-around [9], rowing [2]. However, due attention is not devoted to the study of morphological characteristics and their relationship with functional indicators of athletes. At the same time, it is the constitutional features of athletes that influence the manifestations of many physical qualities, the performance of athletes and their adaptation to external influences, in particular, to physical loads.

**Purpose of the study:** to determine the main anthropometric indicators, the level of the functional state of the cardiovascular and respiratory systems of athletes, depending on the type of constitution of their body.

## Material and Methods of the research

42 young men were studied on the basis of specialized sport school at the age of 15–18 years old, who were divided into 2 groups according to the types of sports: 20 people involved in rowing and 22 people involved in freestyle wrestling. Both groups of athletes were divided into three groups according to the type of body constitution (TBC) (method of M. V. Chornorutsky): Group I – persons of asthenic type, Group II – persons of hypersthenic type and Group III – persons of normostenic type. In the course of the study, measurements were made of morphological indicators and indicators of the functional state of the cardiovascular system (pulsometry, tonometry, Martine-Kushelevsky test) and respiratory system (vital capacity (VC), vital index (VI), Shange test, Skibinsky index).

## Results of the research

Having determined the TBC by M. V. Chornorutsky in both groups of athletes who participated in the surveys, it turned out that the normostenic type of constitution prevails in them, namely 12 people each (60,0% are rowers and 54,5% are wrestlers). The asthenic type included 8 people, which accounted for 40,0% of the number of surveyed who are engaged in rowing, and 6 (22,7%) – wrestlers. We detected the hypersthenic TBC in 4 people, which is 18,2% of the total number of wrestlers, and not a single person was found in the group of rowers with this type of body constitution.

The average morphological data of the physical development of athletes of various types of body constitution are presented in Table 1. When analyzing the obtained morphological data of athletes-rowers of various TBC using Student's criterion, we found significant differences only between the torso length indicators of normostenic and astenic ($t=3,22$, $p<0,01$). During the statistical comparison of other indicators of the rowers' anthropometry of the normostenic and asthenic TBC,

we found no significant significant differences (t=0,38–1,36, p>0,05). According to the morphological surveys of the wrestler group, it can be noted that the average wrestlers turned out to be relatively low data of rowers, both with normostenic and asthenic TBC.

Comparative characteristics of the values of morphological parameters of the surveyed both groups showed that in relation to higher growth was observed in asthenic TBC persons who were characterized by high indicators of the length of the body, arms and legs. It should be noted that the width of the shoulders and pelvis were significantly higher in the examined normostenic type. In the group of wrestlers with hypersthenic TBC, as expected, we observed high rates of body weight, chest circumference (CC) and shoulder width. In a statistical analysis of the obtained anthropometric data of athletes involved in the wrestling of various TBC, we found significant differences only between the normal body mass indexes for hypersthenic values (t=2,23, p<0,05), the astenic values for hypersthene indicators (t=3,24, p<0,01). Other indicators of anthropometry of wrestlers of normostenic, asthenic and hypersthenic TBC did not differ significantly between themselves (t=0,12–1,08, p>0,05).

As you know, the functional state of the cardiovascular system is widely used in practice to determine the level of adaptation of the circulatory system to the conditions of muscle activity, therefore one of the directions of our study was to study its performance in the examined athletes of different body constitution. The average indicators are presented in Table 2.

The results of the study showed that in the group of rowers of the normostenic type of body constitution, the heart rate ranged from 64 beats·min$^{-1}$ to 80 beats·min$^{-1}$ with an average value of 72,8±1,5 beats·min$^{-1}$, corresponds to the age standard value. In the group of asthenic rowers, this indicators was 75,0±1,9 beats·min$^{-1}$. For comparison, it should be noted that the heart rate indicators of the wrestlers of various TBC averaged: in the normostenic – 76,4±1,7 beats·min$^{-1}$, asthenics – 78,2±2,8 beats·min$^{-1}$ and hypersthenics – 75,5±2,6 beats·min$^{-1}$.

All the obtained HR indices in both groups of sportsmen of various TBC did not differ significantly among themselves (t=0,29–1,21, p>0,05) (Table 2).

Indicators BPsyst. in the rowers of normostenic TBC were in the range of 110–140 mmHg (On average – 122,5±1,5), BPdiast – from 60–80 mmHg (with an average value of 71,5±1,2) (Table 2). Whereas in the rowers of asthenic TBC, the average values are BPsyst made – 120,5±2,5 mmHg (t=0,69, p>0,05), and BPdiast – 73,9±1,6 mmHg (t=1,20, p>0,05).

It should be noted that only 10% of the surveyed registered high blood pressure; in other cases, its normative values are noted.

Analysis of the results of the heart rate in the group of wrestlers of various TBC suggests that there are no significant differences between the averages of the three groups (t=0,29–1,21, p>0,05). The average group indicators of HR were higher in the group of asthenic type and amounted to 78,2±2,8 beats·min$^{-1}$, and the lowest in the group of hypersthenics – 75,5±2,6 beats·min$^{-1}$.

n the group of examined wrestlers normostenic TBC indicators BPsyst and BPdiast on average, respectively: 120,5±1,4 mm Hg and 72,5±1,3 mmHg. In the group of asthenic wrestlers average scores were 118,7±1,8 mmHg, BPdiast – 75,3±1,8 mmHg. In the group of wrestlers hypersthenic TBC BPsyst was on average 123,8±2,2 mmHg, and BPdiast – 76,7±1,4 mmHg (Table 2). Statistical analysis did not allow us to identify significant differences between the indicators of the BPsyst. wrestlers of asthenic type with corresponding indicators of wrestlers of hyperstenic type (t=2,1, p<0,05) between indicators of BPdiast wrestlers of normostenic type with corresponding indicators of wrestlers of asthenic type (t=2,21–2,25, p<0,05) (Table 2).

We determined the analysis of the state of the respiratory system using the parameters of the VC, breath holding while inhaling (Stange test) and VI (Table 2). At the same time, we identified significant differences between the indices of the VC of rowers of the asthenic type with the corresponding indicators of rowers of the normostenic type (t=3,26, p<0,01); between indicators of rowers of normostenic type of rowers with corresponding indicators of asthenic rowers (t=2,03, p<0,05). We also found significant differences between indicators of the normostenic type wrestlers with corresponding indicators of wrestlers of asthenic type (t=2,83, p<0,05) between indicators of asthenic and hypersthenic types (t=2,36, p<0,05). Significant differences were found between the performance of the test Stange wrestlers normosthenic hypersthenic and TBC of the wrestlers of normostenic and hypersthenic TBC (t=2,47, p<0,05) (Table 2).

Breathing, like blood circulation, is extremely important to

**Table 1**

**Main morphological parameters of the surveyed with different TBC**

| Groups | Body mass, (kg) | Body length, (cm) | Chest circumference, (cm) | Torso length (cm) | Arm length (cm) | Leg length (cm) | Shoulder width (cm) |
|---|---|---|---|---|---|---|---|
| **Rowers** | | | | | | | |
| Normostenic | 71,1±2,6 | 174,2±3,8 | 83,6±1,7 | 56,4±0,9 | 75,6±3, 2 | 91,1±4,2 | 43,4±3,1 |
| Asthenic | 74,8±1,5 | 183,8±5,01 | 85,5±1,8 | 61,5±1,3 | 78,3±2,8 | 93,8±2,5 | 34,8±2,4 |
| $t_{1-2}$ | 1,23 | 1,76 | 0,48 | 3,22 | 0,44 | 0,38 | 1,48 |
| **Wrestlers** | | | | | | | |
| Normostenic | 69,3±2,2 | 173,6±3,4 | 85,1±1,3 | 55,7±1,1 | 75,2±2,3 | 88,4±3,2 | 41,7±2,3 |
| Asthenic | 66,0±0,8 | 176,8±3,4 | 83,3±3,7 | 58,4±3,2 | 74,1±3,8 | 89,4±3,1 | 33,4±1,6 |
| Hypersthenic | 78,7±3,8 | 171,2±4,5 | 88,6±3,3 | 52,6±3,7 | 75,0±3,7 | 87,1±4,7 | 45,7±5,3 |
| $t_{1-2}$ | 0,76 | 0,51 | 0,87 | 0,38 | 0,47 | 0,32 | 2,85 |
| $t_{1-3}$ | 2,23 | 0,28 | 0,43 | 0,50 | 0,12 | 0,28 | 0,56 |
| $t_{2-3}$ | 3.24 | 0,56 | 1,08 | 1,25 | 0,28 | 0,41 | 2,23 |

**Table 2**

**Main functional indicators of the cardiorespiratory system of the surveyed with a different type of body constitution**

| Groups | HR (beats·min⁻¹) | BP syst. (mmHg) | BP diast. (mmHg) | VC (ml) | VI (ml·kg⁻¹) | Stange test (s) |
|---|---|---|---|---|---|---|
| **Rowers** | | | | | | |
| Normostenic | 72,8±1,5 | 122,5±1,5 | 71,5±1,2 | 4450±24 | 62,6±1,7 | 51,5±1,2 |
| Asthenic | 75,0±1,9 | 120,5±2,5 | 73,9±1,6 | 4250±40 | 56,8±2,3 | 53,6±2,2 |
| $t_{1-2}$ | 0,91 | 0,69 | 1,20 | 3,26 | 2,03 | 0,84 |
| **Wrestlers** | | | | | | |
| Normostenic | 76,4±1,7 | 120,5±1,4 | 72,5±1,3 | 4150±30 | 59,8±1,4 | 52,1±1,3 |
| Asthenic | 78,2±2,8 | 118,7±1,8 | 75,3±1,8 | 3950±64 | 59,2±2,5 | 48,3±1,8 |
| Hypersthenic | 75,5±2,6 | 123,8±2,2 | 76,7±1,4 | 4200±85 | 53,4±3,2 | 47,4±1,4 |
| $t_{1-2}$ | 0,56 | 0,92 | 1,45 | 2,83 | 0,29 | 1,80 |
| $t_{1-3}$ | 0,29 | 0,78 | 2,21 | 0,92 | 1,84 | 2,47 |
| $t_{2-3}$ | 1,21 | 2,10 | 0,54 | 2,36 | 1,65 | 0,12 |

ensure the homeostasis of the body. Violation of respiration leads not only to changes in the gas composition of the internal environment of the body, but also to profound changes in all metabolic reactions, in all processes of life activity. Breathing is a complex of physiological processes that occur in the body and ensure oxygen consumption and removal of carbon dioxide. It is provided by the interaction of the respiratory system, blood circulation, blood and regulatory mechanisms.

As one of the methods of studying the functional state of the cardiovascular system, we used the Martine-Krushelevsky test, based on the indicators of heart rate and blood pressure during the recovery period. In norosthenic, which are engaged in rowing, heart rate indicators in 1 min of recovery averaged 124,1±2,0 beats·min$^{-1}$ and during the next recovery period almost completely returned to the rest state indicator. The reaction of astenic was more reactive, was accompanied by a significant rise in heart rate, but after the entire recovery period it also almost returned to the resting state indicator.

In normostenic, who are engaged in wrestling, as well as in rowing athletes, a rise in the heart rate index was observed even after the first minute of work, and averaged 125,2±1,6 mmHg, and during the recovery period almost returned to the previous indicator rest state. The reaction of asthenics was more reactive, was accompanied by a significant rise in heart rate, and after three minutes of recovery has not fully returned to the previous indicator. And in hypersthenics, a significant increase in heart rate and a slow drop were observed, and the final heart rate exceeded the rest indicator.

BPsyst among the normosthenics, the group of rowers increased significantly, but the final indicator returned to the initial values. The reaction of aasthenics was more, their performance significantly exceeded the norm, the final BPsyst was significantly higher than the previous figure. BPdiast. in nomosthenics increased slightly and returned to the previous indicator. In asthenics there was a higher rise in BPdiast., Which also returned to the previous indicator. The hypersthenic type reacted with a relatively high growth rate of BPdiast. and incomplete recovery after three minutes of rest.

BPsyst for the wrestlers' normosthenics, it increased slightly, and, accordingly, the final indicator returned to the previous one within 1–2 minutes. Reaction of asthenics was more, their performance significantly exceeded the norm, the final BPsyst was significantly higher than the previous figure. The hypertensive reaction of the cardiovascular system was very reactive, which was accompanied by a very high rise in the BPsyst.

Bdiast in normosthenics increased slightly and returned to the previous indicator after 1-2 minutes of recovery. In asthenics, a higher elevation of BPdiast was observed. It also almost returned to the previous indicator. The organism of representatives of the hypersthenic type reacted with a strong increase

**Table 3**

**Indicators of Martine-Kushelevsky test among athletes'**

| Groups | I minute | | II minute | | III minute | |
|---|---|---|---|---|---|---|
| | HR | BPs/BPd | HR | BPs/BPd | HR | BPs/BPd |
| **Rowers** | | | | | | |
| Normostenic | 124,1 ±2,0 | 131,3±3,2 /77,3±1,8 | 86,2 ±1,7 | 126,2±2,0 /72,6±1,3 | 73,7 ±1,4 | 115,5±1,7 /72,4±1,7 |
| Asthenic | 134,2 ±2,3 | 141,3±2,8 /70,5±1,0 | 90,3 ±2,0 | 137,3±1,8 /81,1±1,0 | 76,2 ±1,5 | 125,0±1,6 /74,5±2,3 |
| **Wrestlers** | | | | | | |
| Normostenic | 125,2 ±1,6 | 128,2±2,0 /79,0±2,1 | 89,1 ±1,7 | 124,2±1,7 /76,3±1,1 | 76,1 ±13 | 124,1±1,5 /71,6±1,3 |
| Asthenic | 128,3 ±2,6 | 140,0± 2,5 /84,2±3,2 | 94,4 ±2,2 | 135,2±2,3 /81,2±2,1 | 79,4 ±2,2 | 121,2±1,8 /75±2,3 |
| Hypersthenic | 138,2 ±2,2 | 145,1±3,0 /86,0±1,9 | 96,2 ±2,1 | 139,0±2,6 /82,2±1,8 | 78,3 ±2,1 | 128,2±2,5 /81,3±1,9 |

in BPdiast, which, after recovery, was significantly higher than the rest state indicator.

## Conclusions / Discussion

In this study, we studied the morphological and functional indicators, the reaction of the cardiovascular system to the dosed load of athletes, characterized by various types of body constitution (according to M. V. Chornorutsky).

As a result of the study, it was established that there is a relationship between the type of body constitution and the morphological and functional indicators of athletes who specialize in freestyle wrestling and rowing and canoeing.

This study complements the theoretical basis for studying the types of body constitution and the physical development of athletes of various kinds [1; 2; 4; 5; 9; 10]. At the same time, for the first time, we have carried out a comparative description of morphological and functional indicators of the physical development of freestyle wrestlers and rowers. The data obtained morphological and functional indicators of athletes of various types of body constitution fully confirm our vision of solving the problem of improving the various aspects of sports training of fighters and rowers, taking into account their individual characteristics of physical development. The results obtained can be applied in the practice of coaches in freestyle wrestling and rowing on canoes and canoes during the implementation of the training process and sports selection.

**Prospects for further res**earch in this direction are to study the characteristics of the type of constitution of the body of athletes and their relationship with the level of technical and physical preparedness.

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