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# STUDY OF GENDER-BASED INDICATORS OF LONG-TERM ADAPTATION OF HIGH-QUALIFIED SAMBO ATHLETES' BODIES

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***Abstract.*** *Directly proportional dependence of the morpho-functional indicators of preparedness on height-weight characteristics of men and women is common for the high-qualified sambo athletes. Nevertheless, the current knowledge about the female body specifics and its reactions to the intensive, often extreme effort, typical for particular sports, is insufficient. The female body's capacity to adapt to physical effort has not been sufficiently studded. An acceptable from piratical point of view and impartial method to appreciate the possibilities of the female body is the comparative analysis with the typical male body.*

***Keywords:*** *adaptation, capacity for work, functionality, cardio-respiratory system, proper rules.*

Development of international top achievement sport is accompanied by a more active involvement of women. A growing number of competitive disciplines wherein women participate on equal terms with men. World championships are held in such sports, which were earlier considered as a purely male: female weightlifting, boxing, wrestling, martial arts, modern pentathlon etc. Knowledge of the female body peculiarities, stages of biological maturation, the period of ovarian-menstrual cycle, the functional capacity of organs and systems of the body in terms of long-term adaptation is necessary when the structure-oriented planning of the training loads, the choice of means for development of physical qualities in conjunction with the technical, tactical and psychological preparation [8, 17].

This circumstance determined the objectives of the present study regarding knowledge on the following issues:

- on the morpho-functional peculiarities of the male and female body specified with their adaptation capabilities;

- on the diagnostic concept of functional training in the gender-based indicators of long-term adaptation of sambo athletes' bodies to justify separate long-term peculiarities of adaptation.

The peculiarities of long-term adaptation of the male and female bodies in the process of sports perfection as members of national teams of Russia in sambo, were studied using modern methods, widely used in physical education [3, 5, 6, 11].

Intensive development of women's wrestling necessitates to undertake special investigations to establish the most effective ways of achievement of high sports results without negative effects to their health. The urgency of this problem is observed not only in significant expansion programs, sports competitions for women, but also in the substantial growth of sport achievements in Moldova, and international rug or tatami [10, 11, 14].

The indicators of physical development, providing a significant impact on the manifestation of motor abilities in conjunction with the technical and tactical skills are of professional interest among many individual characteristics of athletes [11, 15, 18].

Table 1 shows that the sambo athletes of the 48, 52, 74 and 82 kg weight categories of are higher than female sambo athletes from 2 to 10 cm and at 62 and 68 kg weight female athletes surpass men by 2-4 cm, respectively. In the weight category of 57 kg the differences between men and women were not observed. Analysis of the Vital capacity of lungs values and total body area, providing an aerobic capacity of sambo athletes with weight gain have a distinct tendency to increase with 4000-2090 ml in the weight category of 48 kg to 5656-4500 ml in 82 kg weight with a clear advantage of men. At the same time in weight categories of 48,52 and 57 the differences between men range are from 21,3 up to 28,0%; with weight gain athletes the difference is reduced and reaches a level of 19.1 and 20.4%.

***Table 1. The weight and gender-based indicators of physical development of high-qualified sambo athletes (individual data)***

| Weight categories, kg | Indicators of physical development | | | | | |
|---|---|---|---|---|---|---|
| | Gender | Height, cm | Weight, kg | Vital capacity of lungs, ml | Wrist strength of the strongest arm, kg | Total body area, $m^2$ |
| 48 | M | 156,0 | 46,0 | 4000 | 46 | 1,40 |
| | F | 146,0 | 47,0 | 2900 | 32 | 1,42 |
| Differences – % | | 6,4 | 2,2 | 27,5 | 30,4 | 1,4 |
| 52 | M | 161,0 | 52,0 | 4300 | 50 | 1,54 |
| | F | 159,0 | 52,0 | 3100 | 34 | 1,54 |
| Differences – % | | 1,2 | 0,0 | 28,0 | 32,0 | 0,0 |
| 57 | M | 165,0 | 58,0 | 4450 | 53 | 1,61 |
| | F | 165,0 | 57,0 | 3500 | 35 | 1,60 |
| Differences – % | | 0,0 | 1,7 | 21,3 | 40,0 | 0,7 |
| 62 | M | 167,0 | 61,0 | 4700 | 55 | 1,61 |
| | F | 169,0 | 62,0 | 3800 | 37 | 1,67 |
| Differences in % | | 1,2 | 1,6 | 59,1 | 32,7 | 3,6 |
| 68 | M | 168,0 | 68,0 | 5050 | 60 | 1,76 |
| | F | 172,0 | 67,0 | 4050 | 40 | 1,75 |
| Differences in % | | 2,3 | 1,4 | 19,2 | 33,4 | 0,6 |
| 74 | M | 175,0 | 74 | 5300 | 63 | 1,85 |
| | F | 180,0 | 73 | 4300 | 42 | 1,83 |
| Differences in % | | 2,9 | 1,4 | 49,9 | 33,4 | 1,1 |
| 82 | M | 184,0 | 82,0 | 5650 | 65 | 1,95 |
| | F | 178,0 | 82,0 | 4500 | 45 | 1,95 |
| Differences in % | | 3,4 | 0,0 | 20,4 | 30,8 | 0,0 |

Indicators of the maximum strength of the strongest wrist, too, in absolute values are in direct proportion to the athlete's weight with a considerable superiority of men by 30.4 and 33.4%, except for the weight category of 57 kg – men surpass women by 40.0%. The superiority of men was due to the higher mass of skeletal muscle in men – 41% compared with women - 36,0% [4] on the one hand, and the higher volitional abilities of men on the other hand [1].

A comprehensive assessment of the functional state of the physical development of sambo athletes in relative terms with the method of indices [8] showed (Table 2) that with the increase in growth-weight indicators of sambo athletes, there is a rise of athleticism according to the Quetelet index with the correlation of body mass index (BMI), reflecting the similarity of power orientation for men and women with a slight superiority of the first ones, except for the weight category of 82 kg in which women surpass men by 3.7%.

In addition, the dynamics of the wrist relative force also has a marked dependence on the athlete's weight with weight increase of the athlete from 48 to 82 kg the relative force increases with the dominance of the male in the range of 6,5-8,7%, in addition to weight classes of 52,57,68 kg – the level of relative force is the same. At the same time the birth-death ratio (BDR), determining aerobic capacity with weight increase in both men and women decreases with a significant superiority of the first ones by 17.7-29.1 %. The decrease of the relative force, according to N.A. Fomin (1992) is caused by the fact that bodyweight is proportional to body volume, i.e. the cube of its linear dimensions, and the relative force is proportional to the area of the physiological diameter of the muscle, i.e. the square of the linear dimensions. It should be noted that the values of the studied indices correspond to the expected standards and reflect the relatively high level of morphological and functional preparedness of sambo athletes of both genders.

***Table 2. The gender-based indicators of functional state of physical development of high-qualified sambo athletes (individual data)***

| Weight categories, kg | Indicators of physical development | | | | |
|---|---|---|---|---|---|
| | Gender | Weight-height, g/cm | Birth-death ratio, ml/kg | Body mass index, kg/m$^2$ | Index of wrist relative force, % |
| 48 | M | 295 | 97,0 | 100,0 | 20,0 |
| | F | 322 | 61,7 | 68,0 | 21,4 |
| Differences – % | | 8,4 | 29,1 | 32,0 | 6,5 |
| 52 | M | 322 | 82,7 | 96,0 | 20,3 |
| | F | 327 | 59,6 | 65,0 | 20,3 |
| Differences – % | | 1,5 | 28,0 | 32,3 | 0,0 |
| 57 | M | 351 | 76,7 | 93,0 | 21,0 |
| | F | 345 | 61,4 | 61,4 | 21,0 |
| Differences – % | | 1,7 | 20,0 | 34,0 | 0,0 |
| 62 | M | 365 | 77,0 | 88,7 | 22,8 |
| | F | 366 | 61,3 | 59,7 | 22,8 |
| Differences – % | | 0,3 | 20,4 | 47,1 | 0,0 |
| 68 | M | 405 | 74,3 | 88,3 | 23,5 |
| | F | 389 | 60,4 | 59,7 | 23,5 |
| Differences – % | | 1,7 | 18,7 | 32,4 | 0,0 |
| 74 | M | 423 | 71,6 | 85,2 | 24,2 |
| | F | 405 | 58,9 | 57,7 | 22,8 |
| Differences – % | | 4,3 | 17,7 | 32,5 | 5,8 |
| 82 | M | 445 | 68,9 | 79,3 | 25,3 |
| | F | 460 | 54,9 | 54,9 | 27,7 |
| Differences – % | | 3,7 | 20,3 | 30,8 | 8,7 |

For a more complete assessment of preparedness of high-qualified sambo athletes we have investigated the functional state of the cardio-respiratory system as one of the factors determining the efficiency of athletes, knowing that the morpho-functional states does not always correspond to functional preparedness and the likelihood of compensatory reactions that can provide a high level of technical-tactical activity in training activities with a high risk of failure of long-term adaptation [12].

It was determined (Table 3) that the level of physical efficiency according to the indicators $PWC_{170}$ and maximal oxygen consumption, both in absolute and in relative terms are proportional to the weight classes with the advantage of male sambo athletes, except for the weight class of 57 kg wherein women in the absolute value of the efficiency achieved the same level – 1025 kg-m/min, and relative dimensions surpass men by 1,7%. In the weights 62 and 68 kg there is observed the superiority of women in all $PWC_{170}$ and maximal oxygen consumption values, and the weight classes of 74 and 82 kg men surpass women.

Thus, the long-term training, participation in competitions are accompanied by profound changes in the body of sambo athletes of both genders, which are both structural and functional, reflected on the positive adaptation changes in the cardio-respiratory system providing oxygen-transport function of the central circulation, in particular the physiological heart volume, reflecting its backup capabilities.

It is resulting in an increase in systolic discharge (SD) as one of the most important factors of efficiency of an athlete's body. It should be noted that the values of the heart volume (HV cm3) and SD in other equal conditions are also susceptible to dependence on the height and weight morpho-functional indicators of physical development and gender. However, in weight of 57, 62 and 68 kg female sambo athletes surpass male sambo athletes in absolute and relative terms.

HV, SD and Minute blood volume which define a high level of functional preparedness against the backdrop of sport bradycardia, with a more pronounced economization of cardio-respiratory system in men.

***Table 3. The gender-based indicators of physical efficiency and the central circulatory of high-qualified sambo athletes (individual data)***

| Weight category, kg | Indicators of functional preparedness | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Gender | $PWC_{170}$ kg-m/min | $PWC_{170}$ kg-m/min/kg | MOC l/min | MOC l/min/kg | HV cm | HV cm/kg | Systolic discharge, ml | Heart rate rates/min at rest | Minute blood volume l/min at resr |
| 48 | M | 750 | 16,3 | 2,32 | 51,2 | 556 | 12,0 | 85 | 54 | 4590 |
| | F | 675 | 14,4 | 2,10 | 45,0 | 498 | 10,6 | 79 | 63 | 4977 |
| Differences – % | | 10,0 | 11,7 | 9,5 | 13,7 | 10,4 | 11,7 | 7,0 | 14,3 | 7,8 |
| 52 | M | 850 | 16,3 | 2,43 | 47,1 | 685 | 13,2 | 93 | 53 | 49,29 |
| | F | 775 | 14,9 | 2,55 | 47,2 | 629 | 12,1 | 84 | 64 | 5376 |
| Differences – % | | 8,9 | 8,6 | 4,7 | 0,2 | 8,2 | 8,4 | 9,7 | 17,2 | 8,3 |
| 57 | M | 1025 | 17,7 | 3,20 | 54,8 | 746 | 19,9 | 107 | 52 | 5564 |
| | F | 1025 | 18,0 | 3,08 | 54,6 | 750 | 13,0 | 107 | 63 | 67,41 |
| Differences – % | | 0,0 | 1,7 | 5,7 | 0,4 | 0,2 | 0,8 | 0,0 | 17,5 | 17,5 |
| 62 | M | 1050 | 17,2 | 3,20 | 53,0 | 762 | 12,5 | 109 | 52 | 5668 |
| | F | 1150 | 18,5 | 3,47 | 56,0 | 834 | 13,5 | 117 | 64 | 7488 |
| Differences – % | | 9,5 | 7,0 | 7,18 | 5,6 | 8,6 | 7,4 | 6,8 | 18,7 | 24,3 |
| 68 | M | 1200 | 17,6 | 3,61 | 53,2 | 849 | 12,5 | 121 | 53 | 6413 |
| | F | 1275 | 19,0 | 3,79 | 56,6 | 889 | 13,3 | 127 | 65 | 8255 |
| Differences – % | | 5,9 | 7,4 | 4,7 | | 4,5 | 6,1 | 4,7 | 18,5 | 22,3 |
| 74 | M | 1475 | 19,9 | 4,34 | 52,3 | 982 | 13,3 | 143 | 56 | 8008 |
| | F | 1150 | 15,8 | 3,21 | 48,4 | 817 | 11,2 | 117 | 68 | 7956 |
| Differences – % | | 28,2 | 20,6 | 26,0 | 8,0 | 16,8 | 15,8 | 18,2 | 17,6 | 0,6 |
| 82 | M | 1550 | 18,9 | 4,53 | 54,6 | 1003 | 12,2 | 149 | 59 | 8791 |
| | F | 1275 | 15,4 | 3,74 | 45,0 | 890 | 11,0 | 127 | 70 | 8890 |
| Differences – % | | 17,7 | 18,5 | 17,5 | 21,3 | 11,3 | 11,0 | 17,3 | 15,7 | 1,1 |

Thus, we have determined that with a height-weight increase of morphological and functional characteristics of physical development of high-qualified sambo athletes of the same preparedness there is an explicit trend of improvement of $PWC_{170}$ and MOC health indicators in conjunction with the indicators of cardio-respiratory system with some advantage for men compared to women. At the same time in separate weight classes women are approaching those in absolute values and in relative ones they surpass men in proper individual sport standards of functional preparedness that contribute to the realization of hidden reserves of the body [2]. However, female athletes do not reach adaptation possibilities and manifestations of basic motor abilities, which are peculiar to men. The possibility of high sports achievements is the more realizable, the closer is their constitution to the men's.

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