Morphofunctional characteristics of highly sports qualified badminton players

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Abstract
Objective of the study was to identify the morphofunctional characteristics of successful highly qualified badminton players with a high competitive rating, performing in men's singles.
Methods and structure of the study. The survey involved 14 athletes - badminton players - highly qualified men with a high rating in the Russian Federation, regularly participating in prestigious competitions with high sporting results. For a comparative analysis, anthropometric indicators of 248 healthy untrained men, aged 19-23 years, living in Moscow, were used.
Results and conclusions. It has been established that the weight and height parameters of badminton players with a high rating in badminton in the Russian Federation do not differ from those of badminton players with high ratings in the BWF. When studying the girth dimensions of the body of badminton players, an asymmetry was noted in the girth sizes of the extremities of the playing arms and legs, more pronounced in the girth sizes of large muscle masses of the shoulder and thigh. When performing the Romberg test with the leg fixed on the knee, athletes showed high results in vertical stability. The results of badminton players performing the Ruffier test indicate the dominance of a satisfactory test result, which indicates the need to develop aerobic endurance when practicing badminton.

Keywords: badminton, morphofunctional state, asymmetry of the girth dimensions of the limbs of playing arms and legs, Romberg test by limiting the area of support, Yarotsky test, performance indicators of the cardiovascular system, Ruffier test, aerobic endurance.

Introduction. Studying the characteristics of the morphofunctional characteristics of highly qualified athletes who perform effectively in competitions is a priority task of sports physiology. A successful badminton athlete needs to accurately determine in a short period of time the direction of the shuttlecock's flight, its meeting point with the rocket, quickly move to take a comfortable position, strike taking into account the angle and trajectory of the shuttlecock's flight, monitor the opponent's reaction and take an advantageous position on the court [1, 3, 4]. To successfully carry out such actions, a badminton athlete must have a whole arsenal of distinctive morphofunctional characteristics and physical qualities that allow him to successfully perform in competitions [8]. The literature describes a few similar studies devoted to revealing the genetic characteristics of successful male badminton athletes, highly qualified athletes with a high rating in the BWF [6, 9]. Despite the growing popularity of badminton in the Russian Federation, the process of sports selection of productive, highly qualified badminton players who are successful in competitions based on the characteristics of morphofunctional status needs to highlight criteria for morphofunctional characteristics and scientific justification, which determines the relevance of the area under study.

Objective of the study was to identify the morphofunctional characteristics of successful highly qualified badminton players with a high competitive rating, performing in men's singles.

Methods and structure of the study. The morphofunctional status of badminton athletes included measuring the height (cm) and weight (kg) of athletes carried out in the morning from 7.00 to 7.15 using medical scales with a stadiometer MIDL MP 300 VDA (50/100; R) XM7 (40x50) "Health". Body mass index (BMI) (Quetelet-2) was calculated using the formula BMI = m/h2, where m - body weight, h - height. The state of vertical stability was assessed based on the results of Yarotsky and Romberg functional tests (3rd version of the test with limited support area - fixing the leg on the knee) [7]. To assess hemodynamic parameters at rest and after exercise, a semi-automatic Omron S1 tonometer was used to determine systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate (HR). The parameters were determined arithmetically using the following formulas: 1. pulse pressure (PP) mm Hg. Art. = SBP-DBP; 2. average hemodynamic pressure (AHP) mmHg Art. = DBP+PP/3; 3. systolic volume (SV) ml = {(101 + 0.5*PP) – (0.6*DBP)} – 0.6*A (Starr formula) [1, p. 105]; 4. minute blood volume (MBV) l/min = SV×HR [1, 2, 8].

The survey involved 14 athletes - badminton players - highly qualified men with a high rating in the Russian Federation, regularly participating in prestigious competitions with high sporting results. Average age: 21.35 ±3.29 years; The average badminton experience was: 12.57±3.61 years; volume of training load in hours per week: 22.14±1.79. Collecting a sports history, questioning, survey and conversation were carried out in person/in absentia format. Badminton players signed a protocol of voluntary informed consent for physiological testing. For a comparative analysis, we used anthropometric indicators of healthy untrained men of 248 people, aged 19-23 years, living in Moscow, which were provided by M.A. Negasheva, Doctor of Biological Sciences, Professor of the Department of Anthropology, Faculty of Biology, Moscow State University. [5].

Results of the study and discussion. As the survey results showed, in men's singles the following morphofunctional characteristics of successful badminton players were noted: average height – 180.35±5.86 (cm); minimum height – 171 (cm), maximum height 190 (cm); average weight: 73.07±6.40 (kg); BMI ranges from 20.57 to 23.67. Data on the morphofunctional characteristics of successful Russian badminton players of high qualification were compared with data on the weight and height parameters of badminton players with a high world rating in men's doubles [9, 10]. It was revealed that Russian successful badminton players who successfully perform in men's singles do not differ in height and weight from badminton players with a high rating in the BWF.

Comparing the data of weight-height parameters with the average values of the weight-height status of healthy untrained men from 17 to 23 years old, examined in Moscow (2022) and Kazan (2018-2020) [5, 6], it was found that the height values successful, highly qualified badminton players are on average 5.35 -3.65 cm higher in comparison with population growth data in the Russian Federation. When compared with healthy untrained men in terms of weight, badminton athletes are lighter on average by 0.93 kg

Data on hemodynamic characteristics and respiratory reserves of badminton players in a state of conditional rest

Name	HR, rate bpm	SBP, mm Hg. Art.	DBP, mm Hg. Art.	PP, mm Hg. Art.	AHP mm Hg. Art.	SV, ml	MBV, ml	Stange test, s	Genche's test, s
A	60	116	78	38	90,7	54,2	3253,2	63	52
B	54	126	81	45	96,0	56,3	3039,7	60	51
C	72	119	82	37	94,3	51,4	3700,8	59	48
D	66	122	85	37	97,3	50,9	3360,1	73	61
E	60	118	80	38	92,7	48,8	2928,6	61	50
F	60	120	77	43	91,3	56,9	3412,8	73	59
G	66	125	83	42	97,0	54,1	3573,2	63	50
H	72	121	79	42	93,0	57,6	4150,1	64	52
J	66	117	80	37	92,3	54,4	3588,4	72	58
K	60	120	78	42	92,0	57,0	3419,4	67	55
L	60	124	83	41	96,7	53,0	3179,4	56	45
M	66	125	81	44	95,7	57,0	3760,0	67	51
N	60	121	79	42	93,0	50,9	3055,8	52	46
O	66	117	76	41	89,7	56,4	3720,4	71	60
Aver. valuex±σ	63,4±5,1	120,7±4,1	80,1±2,5	40,6±2,7	93,7±2,5	54,2±2,8	3438,7±336,6	65,4±6,5	52,7±2,5
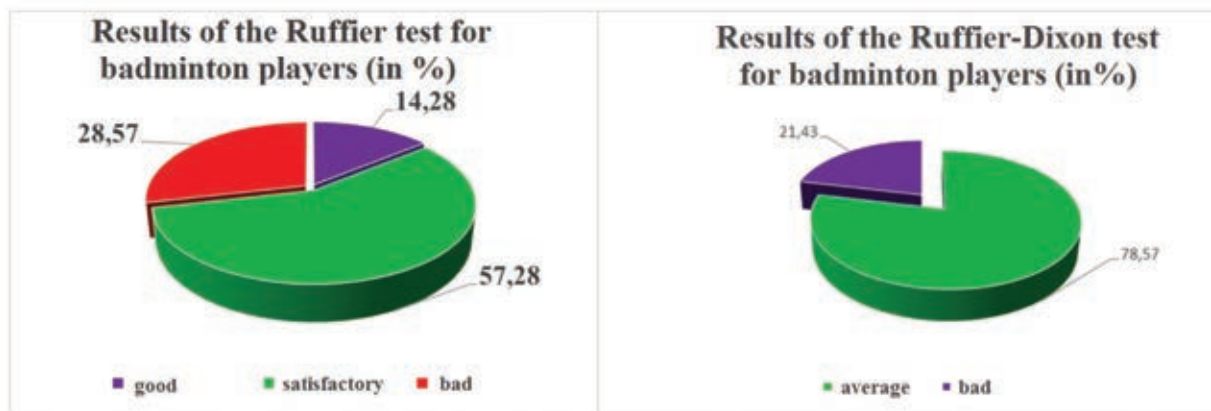
Results of assessing the physical performance of badminton athletes by performing the Ruffier and Ruffier-Dixon functional tests (in %).

(comparison with data according to T.V. Prokopchuk, A.U. Kadyrov (2020) or in comparison with data from M.A. Negasheva et al. (2018), their weight values correspond to the low weight norm of healthy untrained men [5]; according to the indicator BMI among badminton players ranged from 20.57 to 23.67, which is less than the average values for the population in the Russian Federation up to 0.99 [6].

It is believed that physique has little effect on the athletic performance of badminton players [9], however, the data obtained clarify that male badminton players with a high rating in the Russian Federation have above average height and below average weight in comparison with the population of healthy untrained men in the Russian Federation.

Noteworthy is the identification of asymmetry in the girth dimensions of the limbs in favor of the playing arms and legs of badminton players at the stage of high qualification. Our results of testing the girth sizes of the extremities of the right and left arms and legs revealed the most pronounced asymmetry of the girth of the hips and shoulders, where there was significant difference in the difference between the right and left sizes of the girths of the thigh and shoulder (p <0.05); to a lesser extent, differences in the girths of the lower leg and forearms.

The level of development of coordination abilities plays a dominant role in the success of badminton athletes, which directly affects the accuracy and speed of the athlete's movements. In our study, the vestibular stability of athletes was determined by the indicators of functional tests: "Stability in the Romberg pose" (the 3rd version of the test with a decrease in the support area was performed with the leg fixed on the knee) and the Yarotsky test for assessing a person's dynamic stability.

As the results showed, highly qualified badminton players have excellent results in performing a simple test "Stability in the Romberg Pose", which evaluates vestibular stability. For comparison, the results of trained athletes in the "Stability in the Romberg pose" test from 100 to 120 s [7]. The results of vertical stability in the Yarotsky position among badminton players were: 66.86±10.11, which is slightly reduced in comparison with the standards of athletes (90 and > s) [7].

The level of development of the athletes' functional fitness was assessed by the hemodynamic characteristics of SBP, DBP, PP, AHP, HR, MBV, SV, which is presented in the table.

All examined badminton players have a fairly high functional readiness according to the results of the Stange test (the norm for trained ones is 60-120 s) and Genche [7]. At rest, all the examined athletes showed a predominance of parasympathetic vagal influences, which is reflected by: heart rate = 63.42 ± 5.1 (bpm) and a tendency towards hypotension according to SBP values = 119.7 ± 4.19 (mm Hg. Art.), which reflects the prevalence of vagal influence and the development of athletes' fitness.

The assessment of the physical performance of athletes was carried out based on the results of the dynamic test of Ruffier and Ruffier-Dixon. It is noted that for the vast majority of badminton players, the results of the Ruffier and Ruffier-Dixon test emphasize satisfactory and average indicators of physical performance of athletes, while a third of badminton players show poor physical performance (see figure) [7].

Conclusions. As shown by the results of a morphofunctional examination, badminton athletes performing in the men's singles category must have above average height and low weight, good vestibular stability and functional readiness of the cardiovascular system and satisfactory results of physical performance in the Ruffier test, which dictates the need for the mandatory inclusion of physical exercises, developing aerobic endurance in the training process. Perhaps the insufficient level of development of aerobic endurance does not allow our badminton players to occupy leading places in the rankings in the BWF. The priority for achieving high sports results among badminton players is the development of speed and coordination abilities, as well as general and special endurance.

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