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COMPARATIVE ANALYSISOF SOMATOMETRIC AND ORCHIDOMETRIC INDICATORS OF YOUNG MEN LIVING IN THE REPUBLIC OF SAKHA (YAKUTIA), ENGAGED AND NOT ENGAGED IN SPORTS

In sports practice, high motor activity is heavily demanding on the physique of a person and body composition – a factor which largely affects body's functional capabilities. Many authors emphasize the urgent need for constant monitoring of the physiological development of the reproductive functions of the male body. This determined the purpose of the study: to conduct a comparative morphological analysis of somatometric and orchidometric parameters in young men living in the Republic of Sakha (Yakutia) and their sports activity.

We have established statistically significant intergroup differences between young men not engaged in sports and engaged in sports: there were higher indicators of body weight, body mass index, higher phase angle indicators, rates of lean body mass (LBM), active cell mass (ACM), %ACM, and ejection fraction (EF) yet the latitudinal dimensions of the body are inferior to those of young men not engaged in sports. In addition, in this group, there were marked differences between the minimum and maximum values of weight, height and body mass index. This indicates a more intense metabolism and the level of metabolic processes of basal metabolic rate (BMR) and mass-specific basal metabolic rate (mass-specific BMR) in young men involved in sports.

A comparative analysis showed that the volume of the left testicle in non-athletes is greater than that of athletes, while the right testicle is the opposite.

All orchidometric parameters of the studied groups had statistically significant bilateral differences with their right-sided predominance. The results of the study can become an information basis for the consultative and diagnostic practice of sports medicine doctors, exercise therapy. These results can also help trainers dealing with practical issues of clinical, instrumjental, and laboratory monitoring of the current state of athletes and working on methods of maintaining and improving sports performance.

Keywords: somatometry, orchidometry, body composition, athletes, young men.

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Introduction. In sports practice, motor activity imposes special requirements on the physique of a person, largely affecting their functional capabilities — that being the manifestations of physical qualities (speed, strength, endurance, etc.). One of the most adequate approaches in assessing the physical condition of a person is the method of complex research, which allows to control the health status and dynamics of the development of athletes objectively, effectively, and based on standardized approaches [5, 7, 13].

The most widely recommended somatometric measurements include body length and weight, body mass index (BMI), and circumference of body parts. Other useful measurements include the shoulder, thigh, and lower leg, the thickness of the subcutaneous fat fold on the back and inner surface of the shoulder and forearm, thigh and lower leg, as well as the abdominal region [3, 5, 7]. Also, many authors emphasize the urgent need for constant monitoring of the physiological development of the reproductive functions of the male body [8]. It should be noted that some domestic and foreign

researchers analyzed the relationship of genitometric parameters with general anthropometry data and somatotype as conjugate parameters of physical status and reproductive functions [2, 8, 12, 14, 17].

When analyzing scientific sources, we did not find previous data containing information on complex studies of the effect of directed physical activity on somatometric or orchidometric indicators of the male population living in the Republic of Sakha (Yakutia). Due to the technical and ethical features of such studies, there are limitations to their comprehensive assessment, but despite this, the problem requires special analysis. In connection with the foregoing, a comparative analysis of somatometric and orchidometric indicators of young men in the Republic of Sakha (Yakutia) engaged and not engaged in sports is relevant.

Aim: conducting a comparative morphological analysis of somatometric and orchidometric parameters in young men living in the Republic of Sakha (Yakutia) engaged and not engaged in sports.

Materials and Methods: The work was carried out on the basis of the Medical Institute of the M.K. Ammosov North-Eastern Federal University (NEFU) and the Churapcha Institute of Physical Culture and Sports (CIPCS) in 2019–2022. The subjects were divided into 2 groups: Group 1 — 79 students of NEFU of different specialties not engaged in sports, Group 2 — 74 students of CIPCS engaged in different sports for at least 6 years. In both groups we examined young men of indigenous nationality aged 18-20, permanently residing in the Republic of Sakha (Yakutia). We used the standard accepted methods for the study [9, 10]. Anthropometric measurements included measurements of total dimensions and body weight: length (cm), body mass (BM, kg), chest circumference (CC, cm), waist circumference (WC, cm) and hip circumference (HC, cm). We assessed body composition using the method of bioimpedancemetry with Medass-ABC-01.

We performed ultrasound examination of the scrotum in the supine position on a high-end portable Mindray M7 Ultrasonic Sonograph using a linear transducer with a frequency of 7.5 MHz. According to the generally accepted standard, ultrasound scanning of the testicles was done in three projections: the width and thickness were determined in the transverse projection, and the length in the longitudinal projection. Testicular volume in ml was calculated according to the formula described by Brown (1981): V=0.52*ABC where A is the length, B is the width and C is the thickness of the testis in mm, while 0.52 is the corrected coefficient of π/6. We carried out statistical processing of the obtained results using the SOMAX analytical database system. For data with a normal distribution, the mean (M) and the step of the confidence interval (m) were calculated. We assessed the significance of differences in the mean values of the samples using Student's t-test; for features with non-parametric distribution, we used the Mann-Whitney method U-test. The results were considered statistically significant at $p < 0.05$. This approach provided a comprehensive and reliable study of the material obtained.

The measurements were carried out in compliance with the principles of voluntariness, the rights and freedoms of the individual, guaranteed by Articles 21 and 22 of the Constitution of the Russian Federation. The work performed does not infringe on the rights and does not endanger the well-being of research subjects in accordance with the requirements of biomedical ethics, approved by the Declaration of Helsinki of the World Medical Association (2000). All participants gave individual informed consent to participate in the study.

Results and Discussion. Results obtained by us in terms of height and BMI correspond to the average indicators for assessing the physical development of children at puberty, according to WHO clinical recommendations [9]. The average BMI of young men was 22.08±3.58 in Group 1 and 22.78±0.97 in Group 2, $p \leq 0.05$. Normal body weight was determined in 74.7% of young men, while 13.3% of young men not engaged in sports were overweight; in the second Group, everyone had normal body weight. We did not find cases of obesity in the surveyed groups of young men.

As can be seen from Table 1, the data obtained confirm the main patterns of differences in anthropometric indicators between young men not engaged in sports and engaged in sports: in Group 1, there are higher indicators of body mass, body mass index, but the latitude dimensions of the body are inferior to those of young men in Group 2. In addition, in Group 1, there are pronounced differences between the minimum and maximum indicators of weight, height and body mass index.

In earlier studies, we saw that chest circumference in Group 2 is 87.72±10.63 cm; in Group 1 — 84.30±10.53 cm, which we associated with indicators of lung vital capacity (VC): 3734.32±162.49 ml and 3454.93±157.82 ml ($p < 0.01$), respectively. Higher VC values in Group 2 indicate high functional reserve capabilities, which is an important mechanism for adaptation to physical loads [4].

Assessing body composition is an essential part of the constitutional diagnosis of athletes and is important in indirectly assessing their physical performance and their bodies' adaptation to the physical load, as well as in correcting their training structure [6]. Comparative analysis of the results of bioimpedance analysis (BIA) of the two groups is presented in Table 2.

As can be seen from Table 2, in the group of young men engaged in sports, there are higher phase angle indicators than among young men not engaged in sports. The values of the phase angle (PA) are commonly interpreted as follows: PA < 4.4° — high probability of catabolic shifts; 4.4° < PA < 5.4° — hypodynamia; 5.4° < FU < 7.8° — normal; 7.8° < FU — increased values typical for athletes [6]. The maximum indicator for young athletes in our study is 7.96°. The pre-start performance of an athlete in high-achievement sports is predicted by the magnitude of their phase angle.

Table 2 of the bioimpedance body composition study also reflects the differences between groups in the following parameters: body fat mass (BFM), percentage of body fat (%BFM), lean body mass (LBM), active cell mass (ACM), percentage of ACM content in lean body mass (%ACM), skeletal muscle mass (SMM), percentage of skeletal muscle mass in lean mass (%SMM), basal metabolic rate (BMR), mass-specific (normalized to body surface area) basal metabolic rate (MSBMR), total body water (TOW), and extracellular fluid volume (ECF).

As the study showed, in Group 2 the numbers for BFM and %BFM are lower, while LBM, ACM, and %ACM are higher than in Group 1. This indicates the absence of problems with the consumption and assimilation of the protein part of the diet. %ACM in lean mass serves as a correlate of motor activity and physical performance of the athletes. The value of %ACM in the group of young athletes is lower than the accepted norms of current masters of sports in cyclic and game sports types, where the values of %ACM should exceed 62–63% [11].

In addition, the study showed low SMM and %SMM values in athletes. The value of SMM relative to the interval of normal values is used for a general characteristic of physical development. The value of %SMM in lean mass is one of the three key characteristics of the physical performance of an athlete, along with

%BFM and phase angle. Any decrease in the muscle component indicates a lack of energy resources in the athlete's body and accumulated or current under-recovery and inhibition of protein synthesis processes, which can lead to a decrease in performance and recovery.

We established an increase in the content of extracellular fluid in the group of non-athletes, which indicates fluid retention, due, for example, to the consumption of foods with a high content of table salt. Sports weight loss procedures can lead to a short-term decrease in the content of extracellular fluid.

In addition, higher rates of LBM, ACM, %ACM, and PA indicate a more intense metabolism and the level of metabolic processes of BMR and MSBMR in young athletes than in non-athletes. The reason for changes in the MSBMR in the latter may be endocrinological disorders, the effects of drugs, etc.

Studies available in the literature show that the size of the penis and other genitometric parameters, even within the same age groups, are subject to significant individual, group, racial, and ethnic variability [8]. The data on the correlation of phallometric data and the principles of their typology from the point of view of the constitutional approach are contradictory. There are few studies in which the dimensional characteristics of the external genitalia would be compared with the corresponding data on the hormonal background and orchidometry. Despite the colossal volume of various data, including data from foreign scientific literature, the results of studies of genitometric parameters in Russian groups published in scientific literature sources for the last ten years are not available. Undoubtedly, the best and most objective clinical marker of puberty in men is the assessment of testicular volume [15].

Comparative analysis of orchidometric indicators of young men of the two groups found that the volume of the left testicle in Group 1 is greater than in Group 2: 15.36±0.57 and 15.29±0.98 mm^3; the results for the right testicle are vice versa: Group 1 — 15.46±0.51 and Group 2 — 16.31±1.19 mm^3, $p \leq 0.05$. The total volume of testicles was higher in Group 2. All orchidometric parameters of the studied groups have statistically significant bilateral differences with their right-sided predominance.

These data correlate with the data of a large study by Tambov State University, which shows significant differences between different ethnic groups: Russians, Africans, Indians, Greeks, etc. In general, the average volume of the right testicle in the whole sample was 12.10 mm^3, the left — 12.13 mm, both — 24.22 mm^3 [8].

To further clarify the nature of the relationship between the absolute values of the measured traits and indicators of body composition, we carried out a factor analysis. However, we found no statistically significant correlation coefficients between orchidometric and somatometric parameters. In our previous studies, we found a weak correlation between the average testicular volume and indicators of active cell mass, skeletal muscle mass, and a moderate correlation with the phase angle. The results obtained are of interest and require further study.

Table 1

Statistical characteristics of general anthropometric parameters. p ≤0.05

Data	Group 1		Group 2	
	min	max	min	max
Body weight, kg	65.61	74.39	65.18	71.45
Height, m	168.19	176.53	170.58	175.45
Waist circumference, cm	75.52	79.30	76.50	82.07
Hip circumference, cm	90.37	95.04	91.44	95.56
Waist/hip ratio	0.81	0.88	0.83	0.87
Body mass index	16.51	27.66	21.80	23.75

Table 2

Indicators of bioimpedansiometry of young men, p ≤ 0,05

Data	Group 1		Group 2	
	min	max	min	max
Phase angle 50 kHz(deg.)	6.89	7.37	7.47	7.96
Fat mass (kg)	9.68	17.85	8.76	11.49
Proportion of fat mass (%)	14.59	19.31	13.19	15.91
Lean mass (kg)	54.97	57.48	55.92	60.46
Active cell mass (kg)	32.83	35.52	33.98	37.26
Proportion of active cell mass (%)	58.97	62.39	60.25	62.09
Skeletal muscle mass (kg)	31.92	39.84	30.90	33.46
Proportion of skeletal muscle mass (%)	57.01	69.42	54.96	55.66
Basic metabolism (kcal)	1652.89	1738.06	1689.83	1793.13
Specific basal metabolism (kcal/sq.m)	910.88	950.15	942.97	977.58
Water (kg)	40.24	42.07	40.94	44.27
Extracellular water (kg)	18.33	25.57	15.94	17.28
Intracellular water (kg)	22.71	26.84	23.47	27.14

Conclusions

We show the main patterns of differences in anthropometric indicators between young men not engaged and engaged in sports: in Group 1, there are higher indicators of body mass, body mass index, but the latitudinal dimensions of the body are inferior to those of young men in Group 2. In addition, in Group 1, there are pronounced differences between the minimum and maximum indicators of weight, height, and body mass index. We have established that in the group of young men engaged in sports, there are higher phase angle indicators than among young men not engaged in sports. The maximum indicator of young athletes in our study is 7.96°. We show that in young athletes the rates of BFM and %BFM are lower, while LBM, ACM, %ACM are higher than that of non-athletes. In addition, the study showed low SMM and %SMM values in athletes. We establish an increase in the content of extracellular fluid in the group of non-athletes, which indicates fluid retention. Higher rates of LBM, ACM, %ACM, and PA indicate a more intense metabolism and the level of metabolic processes of BMR and MSBMR in young athletes than in non-athletes. A comparative analysis showed that the volume of the left testicle in non-athletes is greater than that of athletes, the right testicle is the opposite. All orchidometric parameters of the studied groups have statistically significant bilateral differences with their right-sided predominance.

The scientific and practical significance of the results of the study is in the analysis of the main somatometric and orchidometric indicators of pubertal youths engaged and not engaged in sports, which can be used to assess their reproductive health and somatic pathology resulting from poor reproductive health (occurring due to individual anthropometric indicators and changes in body composition). The results of the study can become an information basis for the consultative and diagnostic practice of sports medicine doctors, exercise therapists, trainers dealing with practical issues of clinical, instrumental and laboratory monitoring of athletes, as well as for creating methods of maintaining and improving sports performance.

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