# Bioimpedance indicators of combat athletes depending on the somatotype

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**Abstract**

**Objective of the study** was to establish bioimpedansometric indicators of the body of combat athletes in Yakutia, depending on the somatotype according to the Ries-Eysenck index.

**Methods and structure of the study.** A total of 49 Yakutia combat athletes of high sports qualifications were examined. An anthropometric examination was carried out. Bioelectrical indicators and body components of athletes were determined by bioimpedansometry using the ABC-01 Medass apparatus. The protocols contained an assessment of fat mass, active cell mass, skeletal muscle mass, lean mass, active and reactive tissue resistance measured at a frequency of 5 and 50 kHz, as well as the phase angle. Body mass index was calculated. Somatotyping was carried out using the Ries-Eysenck index.

**Results and conclusions.** It has been determined that as the weight category increases, the value of the absolute, relative fat component and the absolute value of the musculoskeletal component of the body increases. Establishing the somatotypological and bioimpedance characteristics of an athlete will help to personalize training loads, reduce the risk of sports injury in order to achieve high sports results.

***Keywords:*** *athletes, martial artists, Yakutia, somatotype, Ries-Eysenck index.*

**Introduction.** The use of an individual approach is an effective and targeted tool for the full realization of the morphofunctional capabilities of an athlete both at the training and competitive stages [2, 7]. One of the individual typological characteristics of a person is the determination of somatotype. To form a complete technical arsenal for a martial artist, it is necessary to take into account his somatotypological profile [6]. The organization of medical and biological support, based on individual somatotypological characteristics, is necessary to correct the training process, which will undoubtedly lead to high sports achievements and a reduction in sports injuries [1, 5].

**Objective of the study** was to establish bioimpedansometric indicators of the body of athletes - martial artists of Yakutia, depending on the somatotype according to the Ries-Eysenck index.

**Methods and structure of the study.** 49 martial artists from Yakutia training at the Republican Center for Sports Training of National Teams of the Republic of Sakha (Yakutia) were examined. The average age of the athletes is 21.32±3.47 years. All those examined were male. The level of qualification of the athletes varied from master of sports to international master of sports. The work was carried out after obtaining voluntary consent to participate in the study. Exclusion criteria were refusal to participate, exacerbation of chronic diseases and the presence of acute diseases at the time of the study.

Anthropometric parameters - body length and weight, waist and hip circumference were measured

using an anthropometer, floor scales and a measuring tape. Body mass index (BMI) was calculated. Somatotyping was carried out using the Reese-Eysenck index [3]. Bioelectric indicators and body components of athletes were determined by the bioimpedansometry (BIA) method using the ABC-01 Medass apparatus. BIA protocols contained an assessment of fat mass (FM), active cell mass (ACM), skeletal muscle mass (SMM), lean mass (LM), active (R5, R50) and reactive (Xc5, Xc50) tissue resistance measured at frequency 5 and 50 kHz, phase angle.

Statistical processing of the obtained material was carried out using the SPSS 22.0 application package. To describe the results obtained, the average value of the value (M) and the error of the average deviation of the value (m) were used. The normality of the distribution of characteristics was determined by the Kolmogorov-Smirnov method. The significance of intergroup differences was carried out using the Kruskal–Wallis H test, followed by pairwise comparisons using the Mann–Whitney U test. Differences were considered statistically significant at $p<0.05$.

**Results of the study and discussion.** Determination of the somatotypological profile of martial arts athletes according to the Rees-Eysenck index revealed that a significantly larger number of athletes belonged to the normosthenic type 57.1% (n=28). 28.6% (n=14) of athletes belonged to the asthenic type, 14.3% (n=7) belonged to the picnic type.

Analysis of anthropometric parameters of individuals with different body types identified significant somatotypological differences in body weight and BMI. The lowest body weight and BMI values were recorded in athletes with an asthenic somatotype (62.42±6.89 kg; 20.74±1.55 kg/m2). Body weight and BMI parameters in individuals with a normosthenic somatotype were equal to 67.03±10.68 kg and 22.48±1.93 kg/ $m^2$. Significantly higher rates ($p<0.001$) were found in individuals with a pyknic somatotype - 94.14±20.01 kg and 29.71±6.14 kg/$m^2$. The parameters of the bioelectrical indicators of the athletes' body, depending on the somatotype according to the Reese-Eysenck index, are presented in Table 1.

The average values of active (R50) and reactive (Xc50) tissue resistances at a frequency of 50 kHz in representatives of all somatotypes were within normal limits. Among the individuals we examined, these parameters were significantly lower in individuals with the pyknic somatotype when compared with the indicators of representatives of other somatotypes ($p<0.01$). Tissue reactance at a frequency of 5 kHz (Xc5) is significantly higher in individuals with an asthenic somatotype. It is known that the magnitude of reactance depends on the dynamics of muscle contractions of the individual.

**Table 1.** *Bioelectric indicators of athletes with different somatotypes according to the Ries-Eysenck index*

| Parameters | Asthenic (n=14) 1 | Normosthenic (n=28) 2 | Picnical (n=7) 3 | Reliability |
|---|---|---|---|---|
| R50, Ом | 536,95±63,70 | 500,50±41,07 | 444,71±76,55 | $P_{1-3}$=0,008 |
| R5, Ом | 559,21±98,73 | 559,82±77,96 | 503,71±97,0 | - |
| Xc50, Ом | 68,43±10,39 | 63,17±5,50 | 56,51±11,23 | $P_{1-3}$=0,013 |
| Xc5, Ом | 212,81±175,40 | 82,47±115,68 | 69,0±108,62 | $P_{1-3}$=0,032; $P_{1-2}$=0,021 |
| Phase angle,° | 7,26±0,58 | 7,21±0,47 | 7,22±0,53 | - |

**Table 2.** *Indicators of body components of athletes with different somatotypes according to the Ries-Eysenck index*

| Parameters | Asthenic (n=14) 1 | Normosthenic (n=28) 2 | Picnical (n=7) 3 | Reliability |
|---|---|---|---|---|
| FM, kg | 8,44±3,10 | 10,37±5,19 | 24,54±8,89 | $P_{1-3}$<0,001; $P_{2-3}$=0,002 |
| FM, % | 13,42±4,58 | 14,90±4,40 | 25,43±5,08 | $P_{1-3}$=0,002; $P_{2-3}$=0,003 |
| ACM, kg | 32,01±3,63 | 33,56±4,01 | 41,24±7,19 | $P_{1-3}$=0,004; $P_{2-3}$=0,025 |
| ACM, % | 51,34±2,90 | 50,36±3,13 | 44,25±3,96 | $P_{1-3}$=0,003; $P_{2-3}$=0,007 |
| SMM, kg | 30,25±3,66 | 31,37±3,11 | 36,90±6,13 | $P_{1-3}$=0,013 |
| SMM, % | 48,51±3,15 | 47,21±3,30 | 39,60±3,54 | $P_{1-3}$=0,001; $P_{2-3}$=0,003 |
| LM, kg | 53,98±6,11 | 56,66±6,10 | 69,60±11,92 | $P_{1-3}$=0,004; $P_{2-3}$=0,033 |
| LM, % | 86,57±4,58 | 85,09±4,40 | 74,57±5,08 | $P_{1-3}$=0,002; $P_{2-3}$=0,003 |

Using individual parameters of the bioimpedance response to physical activity for a particular athlete, the reactance parameter can be used to individualize the norms of physical activity, which will reduce the risk of injury during training and competitions [4]. The average value of the phase angle in individuals with different somatotypes did not differ significantly. The body composition of athletes, determined by the BIA method, is presented in Table 2.

The absolute values of all body components are significantly lower in athletes with an asthenic somatotype. Analysis of relative indicators established that active cell mass, skeletal muscle mass, and lean mass are significantly greater in the same asthenics. Relative and absolute fat mass was significantly higher in picnics. It was determined that as the weight category increases, the value of the absolute and relative fat component increases from 8.44 to 24.54 kg and from 13.42 to 25.43%. The same dynamics were determined when assessing the absolute value of skeletal muscle mass (from 30.25 to 36.90 kg).

**Conclusions.** The somatotypological profile of highly qualified martial artists of Yakutia has been revealed. The dominant somatotype was the normosthenic type. Differences in body weight, BMI, bioelectrical parameters and body components were established depending on the somatotype. Establishing the somatotypological and bioimpedanceometric characteristics of an athlete will help to personalize training loads, reduce the risk of sports injury, to achieve high sports results.

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