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BIOIMPEDANCE ANALYSIS OF THE BODY COMPOSITION OF FEMALE WRESTLERS AT TRAINING CAMPS IN THE MIDDLE ALTITUDE CONDITIONS

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Annotation. The aim of the work was to assess the dynamics of body composition indices of female wrestlers at training camps in the middle altitude conditions taking into account conditional weight groups. We examined the representatives of the Russian freestyle wrestling youth team during training camps in the middle altitude conditions of Kislovodsk. The age was 18.5 ± 1.1 years, sports qualification – Candidate for Master of Sports and Master of Sports. Female athletes were divided into three conditional weight groups: light – 50-57 kg, medium – 59-65 kg and heavy – 68-76 kg. The results of the body composition study revealed significant differences in active cell mass among the female athletes in the heavy weight group. A comparative assessment of the body composition indices in terms of conditional weight groups has shown the lack of geometric similarity of the constitution of female athletes, which allows the coach to select the ways and methods of sports training, taking into account the weight categories.

Keywords: women's wrestling, female wrestlers, athletes, body composition, bioimpedance analysis.

Introduction. The competitive success of athletes is largely determined by the structure of body mass components [1]. There are no uniform standards of body composition in athletes, "they vary depending on the sport, specific specialization and level of fitness. However, it is known that reducing the proportion of fat mass to 5-6%, and musculoskeletal mass to 46% in the competitive period is undesirable and may indicate overfatigue in athletes" [2]. Experts have previously studied the relationship between athletic success and the features of body type of female wrestlers [3-5]. However, a content search of scientific publications devoted to the dynamics of changes in body constitution parameters during training camps in middle altitude conditions revealed an insufficient number studies.

Evaluation of body composition of female athletes at training camps allows the coach to quickly adjust the individual training taking into account the weight categories, and to plan the correction of body composition in a targeted manner (muscle gain and/or loss of fat mass), which can help to improve athletes'

performance. This information will allow us to create an understanding of the variability of body composition values of female wrestlers with regard to weight categories during the training period, which can be used in practice to assess the current state of female athletes.

Aim of the study: to assess the dynamics of body composition indices of female wrestlers at training camps in middle altitude conditions taking into account conditional weight groups.

Methods and organization. Female wrestlers, representatives of the Russian youth team, were examined during the training camps in the middle altitude conditions of Kislovodsk. The average age was 18.5 ± 1.1 years, sports qualification – Candidate for Master of Sports (85%) and Master of Sports (15%). Female athletes were divided into three conditional weight groups: light – 50-57 kg ($n=7$), medium – 59-65 kg ($n=7$) and heavy – 68-76 kg ($n=9$). Materials were collected in compliance with Bioethics rules and were depersonalized.

We measured body length (BL) and mass (BM). Bioimpedance analysis of body composition was made with the AVS-01 “Medass” analyser (“Medass” Scientific and Technical Center, Russia) using a standard wrist and ankle electrodes scheme in a supine position [6]. Following body composition indices were analyzed: body mass index (BMI, kg/m²), fat (FM), lean (LM), active cell (ACM), musculoskeletal (MSM) mass in absolute and relative values, total body water (TBW, kg), extracellular (ECF, kg) and cellular fluid (CF, kg), basal metabolic rate (BMR, calories/day), and specific metabolic rate (SM, calories/day/m²).

All participants gave informed consent to participate in the study in accordance with the Declaration of Helsinki of the World Medical Association, as well as permission to process

personal data. For underage participants, consent was given by their legal representatives.

The Statistica software (version 12, StatSoft Inc., USA) was used for data processing. The hypothesis of normal distribution was tested with the Shapiro-Wilk test. To check the significance of differences in the values for the 2 dependent samples we used the nonparametric Wilcoxon signed-rank test and Mann-Whitney U test for unrelated groups, differences were considered statistically significant if $p \leq 0.05$.

Results and discussion. The table shows the dynamics of average values of body composition indices of female wrestlers, taking into account conditional weight groups during the training camps in the middle altitude conditions (table).

Table

Dynamics of body composition indicators of female wrestlers during the training camps in the middle altitude conditions, taking into account the conditional weight groups

Indices	Conditional weight groups											
	Light (n=7)				Medium (n=7)				Heavy (n=9)			
	beginning		end		beginning		end		beginning		end	
	m	s	m	s	m	s	m	s	m	s	m	s
BL, cm	159.6 ³	5.3	159.6	5.3	163.4	4.2	163.4	4.2	167.6	4.6	167.6	4.6
BM, kg	54.7 ^{2,3}	2.9	54.9	2.9	62.7 ³	2.8	62.4	2.6	71.3	3.0	71.4	3.5
BMI, kg/m ²	21.5 ^{2,3}	1.3	21.6	1.4	23.5 ³	1.2	23.4	1.2	25.5	2.1	25.5	2.2
FM, kg	10.5 ^{2,3}	1.7	10.8	1.9	16.4 ³	1.2	16.5	1.7	20.1	3.5	20.6	3.7
FM, %	19.2 ^{2,3}	2.7	19.7	3.0	26.2	2.0	26.5	2.4	28.1	4.1	28.7	3.9
LM, kg	44.2 ³	2.2	44.1	2.6	46.3 ³	2.9	45.9	2.4	51.3	2.5	50.8	2.1
ACM, kg	27.6 ³	1.9	27.5	1.6	28.6 ³	1.6	28.0	1.3	31.7	1.7	32.1	1.9
ACM %	62.6	2.9	62.4	1.4	61.9	1.6	61.0	1.8	61.9*	1.7	63.2*	2.2
MSM, kg	22.4 ³	1.7	22.3	1.7	23.5 ³	2.1	23.2	1.7	26.2	2.1	25.9	1.8
MSM, % of LM	50.6	1.9	50.5	1.5	50.6	1.5	50.5	1.4	51.1	1.8	50.8	1.7
TBW, kg	32.3 ³	1.6	32.3	1.9	33.9 ³	2.1	33.6	1.7	37.5	1.8	37.2	1.6
ECF, kg	13.5 ³	0.7	13.4	0.8	14.3 ³	1.0	14.3	0.8	16.0	0.9	15.7	0.8
CF, kg	18.9 ³	0.9	18.9	1.1	19.6 ³	1.2	19.4	0.9	21.6	1.0	21.5	0.9
BMR, calories/day	1489 ³	59	1485	50	1520 ³	51	1500	42	1618	52	1631	59
SMR, calories/day/m ²	966 ³	49	963	40	915	21	905	31	905	32	911	34

Note: m – mean arithmetic; s – standard deviation; BL – body length; BM – body mass; BMI – body mass index; FM – fat mass; LM – lean mass; ACM – active cell mass; MSM – musculoskeletal mass; TBW – total body water; ECF – extracellular fluid; CF – cellular fluid; BMR – basal metabolic rate; SMR – specific metabolic rate; * – significant statistical differences in dynamics; ² – significant statistical differences from the average weight group; ³ – significant statistical differences from the heavy weight group ($p \leq 0.05$); beginning\end – beginning and end of the training camps

Analysis of the body composition values of female athletes at the beginning and at the end of the training camps, taking into account conditional weight groups, found statistically significant differences ($p \leq 0.03$) only in the index of active cell mass in % among representatives of the heavy weight group. Thus, the ACM% values changed upward by 1.02 times by the end of the camps. All the other indices of body composition showed no significant differences in all weight groups (table). Dynamics of the indices at the beginning and at the end of the training camps had insignificant changes up and down within the measurement error limits of the AVS-01 "Medass" body composition analyzer [6].

Comparison of estimates of the body composition indices with regard to conditional weight groups demonstrated that athletes of the light weight group have significant differences from the average group in terms of body mass ($p \leq 0.002$), BMI ($p \leq 0.03$) and fat mass ($p \leq 0.002$) in absolute and relative values and from the heavy group – for all indices except active cell mass in % and musculoskeletal mass in % of lean mass. Women in the medium weight group had significant differences from the heavier group in all absolute values of body composition, but no significant differences were found in the relative values of fat, active cell mass, musculoskeletal mass in % of lean mass and specific metabolic rate (table).

In female athletes with increasing weight category, all the body composition indices increase in absolute values, and the relative fat mass characterizes the lack of geometric similarity of body constitution. That is, the geometric similarity of the constitution manifested in the body composition indices of female athletes implies the similarity of their relative values regardless of weight category [1, 7]. The relative values of active cell mass in % and musculoskeletal mass in % of lean mass and specific metabolic rate regardless of weight group have similar values, indicating that female wrestlers are athletically fit [3].

Conclusion. The analysis of the dynamics in the body composition indices of female wrestlers revealed statistically significant differences only in ACM% in the heavy weight group. For a better assessment of the training camps' efficiency it is necessary to conduct functional tests in addition to the body composition evaluation. Based on the results of comprehensive studies, it is possible to carry out targeted correction of body composition and, in general, to construct and monitor the training process of female wrestlers.

A comparative assessment of the body composition indices in terms of conditional weight groups has shown that there is no geometric similarity in the constitution of female athletes, which allows the coach to choose the ways and methods of sports training, taking into account the weight categories.

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