Body Composition Characteristics in Bulgarian Rhythmic Gymnasts

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The aim is to determine the influence of sport activity on the body composition compartments in young rhythmic gymnasts at different age categories. A total of 27 rhythmic gymnasts, who had trained at least for two years and not less than 20 hours weekly, were tested. Athletes were divided into two groups: pre junior (mean age 8.87 ± 0.72 years) and junior (mean age 11.55 ± 0.52 years). The bioelectrical impedance analysis was used to evaluate the body composition. The gymnasts in pre junior` group had significantly lower mean values of height, weight, muscle mass, total body water and fat free mass compared to junior group. A significant positive correlation with strong intensity between muscle mass and height, weight, total body water and fat free mass in both assessed groups was established. The muscle mass of the gymnasts rises with increasing the sport experience but the body fat percentage and other obesity parameters keep relatively constant mean values.

Key words: body composition, rhythmic gymnasts, bioelectrical impedance analysis, young athletes.

Introduction

The development of contemporary sport requires more comprehensive research of the relationship between the body structure and the type and intensity of physical activity.

The morphological characteristic of young athletes is an important indicator for the success and talent identification in each sport. Although the morphological profile in athletes is determined by genetic factors [5], it is influenced by external factors such as proper nutrition, the type and level of sport training, etc. [2, 15, 22]. In many sports the morphological components are not homogeneous. A significant difference is also established in terms of the playing position within the same sport [19].

Specificity and intensity of training in rhythmic gymnasts (RG) along the growth period leads to changes in muscle and skeletal system and determine the specific morphological profile – linear body development, low level of body fat and predominant ectomorph somatotype [7, 16, 18, 21]. In aesthetics sports an increase of body weight, especially body fat can negatively influence sport performance. For this reason body composition profile is a supportive tool in sports, where the body structure may influence

the biomechanics of movement and balance between muscle strength and flexibility [6, 11, 14]. The skin-folds measurements and bioelectrical impedance analysis (BIA), as non-invasive and fast methods are the most commonly used for estimating of body composition [20].

The aim of the study is to determine the influence of sport activity on the body composition compartments in young rhythmic gymnasts (RG) at different age categories.

Materials and Methods

A sample includes 27 rhythmic gymnasts (RG), who have trained at least for two years and not less than 20 hours weekly. All participants in the present study took part at the national championships. Athletes were divided into two experimental groups: pre – junior (mean age 8.87± 0.72 years) and junior (mean age 11.55 ± 0.52 years). All girls and their parents completed an inform consent and voluntarily participated in the study. The study protocol was reviewed and approved by the Ethical Committee of Institute of Experimental Morphology, Pathology and Anthropology with Museum – Bulgarian Academy of Sciences (Protocol № 8/12.11.2018) and was conducted in agreement with the principles stated in the Declaration of Helsinki for human studies [24]. The Martin-Saller's anthropometric method was used for measured the athletes' height. The BIA method (with the use of InBody 170 analyzer) was applied to evaluate the RGs' body composition. Body composition profile included: weight (Wt), muscle mass (MM), total body water (TBW), fat free mass (FFM), fat mass (FM), body mass index (BMI), body fat percentage (PBF), waist-to-hip ratio (WHR) and visceral fat (VF). Statistical analysis was performed by SPSS16 for Windows. T-test was used to identify statistically significant intergroup differences ($p<0.05$). A Pearson's correlation analysis was applied to establish the relationship between body composition compartments.

Results

The study presented the peculiarities of the body composition compartments in young competitive Bulgarian RG. The descriptive analysis of age and basic anthropometric features are presented in **Table 1.**

There were significant differences in the mean values of basic anthropometric features (height and weight) between 8-10 and 11-12 years old Bulgarian RG athletes ($p <0.05$). The gymnasts from junior group are 8.00 cm taller and 4.36 kg heavier than those from pre-junior group. It is due to the growing stage of the athletes.

Table 1. Basic Anthropometric Characteristics

Traits	Pre - junior RG (n=16)	Junior RG (n= 11)	Total (n= 27)	P-value
Age (yr)	8.87 ± 0.72	11.55 ± 0.52	9.96 ± 1.48	0.000*
Height (cm)	138.00 ± 7.46	146.00 ± 3.23	141.00 ± 7.14	0.004*
Weight (kg)	29.20 ± 4.12	33.56 ± 3.13	30.97 ± 4.28	0.006*

Table 2 contains data of body composition characteristics in Bulgarian athletes. Pre-junior group has significantly lower mean values of muscle mass, total body water and fat free mass compared to junior group ($p<0.05$). Fat mass are equal in both investigated groups.

Table 2. Body Composition Parameters in Young Bulgarian Rhythmic Gymnasts

Traits	Pre - junior RG (n=16)	Junior RG (n= 11)	Total (n= 27)	P-value
Muscle mass (kg)	12.81 ± 2.31	15.17 ± 1.24	13.77 ± 2.25	0.005*
Fat mass (kg)	4.15 ± 1.38	4.55 ± 1.77	4.31 ± 1.53	0.520
Fat free mass (kg)	25.04 ± 3.78	29.02 ± 2.07	26.66 ± 3.72	0.004*
Total body water (l)	18.36 ± 2.83	21.28 ±1.50	19.55 ± 2.76	0.004*

No significant intergroup differences were found for fat mass, body fat percentage, visceral fat, waist- to- hip ratio and BMI (p>0.05) **(Table. 3)**.

Table. 3. Obesity Parameters in Young Bulgarian Rhythmic Gymnasts

Traits	Pre - junior RG (n=16)	Junior RG (n= 11)	Total (n =27)	P-value
BMI (kg/cm²)	15.31± 1.19	15.82 ± 1.13	15.51 ± 1.17	0.273
PBF (%)	14.19 ± 4.11	13.29 ± 4.48	13.82 ± 4.21	0.596
WHR	0.71 ± 0.32	0.73 ± 0.24	0.72 ± 0.03	0.066
Visceral fat	1.31 ± 0.60	1.45 ± 0.52	1.37 ± 0.56	0.531

The correlation coefficients between the body composition compartments in RG athletes are presented in **Table 4** and **Table 5**.

Table 4. Correlation between assessed anthropometric and body composition traits in young junior RG

	Ht	Wt	MM	FM	TBW	FFM	BMI	PBF	WHR	VF
Ht	1	0.857**	0.915**	0.031	0.923**	0.925**	0.188	-0.355	0.230	0.033
Wt		1	0.938**	0.408	0.943**	0.943**	0.664**	0.006	0.570*	0.245
MM			1	0.069	0.999**	0.999**	0.454	-0.336	0.356	-0.040
FM				1	0.080	0.080	0.754**	0.913**	0.726**	0.789**
TBW					1	1.000**	0.451	-0.328	0.362	-0.023
FFM						1	0.449	-0.328	0.357	-0.021
BMI							1	0.550*	0.775**	0.416
PBF								1	0.532*	0.731**
WHR									1	0.641**
VF										1

**Statistically significant differences at p<0.01; * Statistically significant differences at p<0.05; HT-height; Wt- weight; MM- muscle mass; FM- fat mass; TBW- total body water; FFM- fat free mass; BMI- body mass index; PBF- body fat percentage; WHR- waist- to- hip ratio; VF- visceral fat;

Table 5. Correlation between assessed anthropometric and body composition traits in junior RG

	Ht	Wt	MM	FM	TBW	FFM	BMI	PBF	WHR	VF
Ht	1	0.699*	0.810**	0.270	0.822**	0.827**	0.298	0.146	0.045	0.268
Wt		1	0.816**	0.781**	0.835**	0.845**	0.890**	0.671*	0.591	0.575
MM			1	0.279	0.996**	0.996**	0.574	0.122	0.392	0.114
FM				1	0.308	0.325	0.869**	0.985**	0.551	0.798**
TBW					1	1.000**	0.592	0.155	0.426	0.165
FFM						1	0.603*	0.172	0.422	0.186
BMI							1	0.802**	0.765**	0.595
PBF								1	0.513	0.797**
WHR									1	0.358
VF										1

**Statistically significant differences at $p<0.01$; * Statistically significant differences at $p<0.05$; HT-height; Wt- weight; MM- muscle mass; FM- fat mass; TBW- total body water; FFM- fat free mass; BMI- body mass index; PBF- body fat percentage; WHR- waist- to- hip ratio; VF- visceral fat;

A significant positive corrrelation with high intensity between muscle mass and height, weight, TBW and FFM in both assessed groups was established ($p <0.01$).

In the pre-junior RG group, a moderate and negative correlation of body fat percentage with MM, FFM and TBW was observed. Contrary, there was a high and positive correlation of PBF with FM and BMI in the junior RG group.

Discussion

Monitoring of the body composition profile in young competitive RG athletes proves to be basic for the routine practices for good health of athletes and better sport performance [9]. In references of body composition, females who are physically active and have improper nutrition or under-nutrition may lead to very low values of fat mass associated with menstrual disorders (oligomenorrhoea or amenorrhoea) and increase the risk of bone fractures and osteoporosis in adulthood [3, 4, 8, 10].

The results of the present study indicate that rhythmic gymnastic is a sport where the muscle mass of athletes increases with increasing the sport experience but the PBF and the other obesity parameters keep relatively constant mean values.

The mean values of basic anthropometric and body composition characteristics in Bulgarian RG were close to those established by Ariazza et al. [1]. The authors investigated the Chilean RG at the same age and reported data of height, weight and BMI 138.57 cm, 29.85 kg, 15.49 kg/cm², respectively. They also determined insignificant differences in the percentage of fat mass and significant difference in the percentage of MM among these age categories [1]. However the Bulgarian gymnasts had lower mean values of body mass, height, BMI and FFM and similar PBF than the Brazilian rhythmic gymnasts [17]. In comparison with Russian rhythmic gymnasts, aged 10 years, Bulgarian athletes are taller, but lighter and have significantly lower values of BMI and FM [23].

Most of the studies emphasized a close correlation between morphological profile (characterized with under-average adipose tissue and development of the skeleton and muscular tissue) and motor ability of young RG athletes [6, 11, 12, 13]. According to our data, there was a significant positive relationship between height, weight, TBW, FFM and muscle mass in athletes aged 8-12 years.

Conclusion

Body composition profile of Bulgarian rhythmic gymnasts is characterized with high level of muscle mass and fat free mass and low level of fat mass, within the expected sport modality.

We concluded that rhythmic gymnastics is a sport where the muscle mass of athletes increases with increment of the age and sport experience, but the PBF and the other obesity parameters keep relatively constant mean values.

Following the changes in morphological characteristics during the early stage of the rhythmic gymnastic training process would be very helpful for coach programs and selecting process as well as the talent identification.

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