

SOMATOTYPE IN ADOLESCENT RHYTHMIC GYMNASTS FROM BULGARIA

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Abstract

A specific body constitution of rhythmic gymnasts (RGs) has a positive impact on their performance and is essential in selecting talents in the field of professional sports. The aim of this study is to assess the anthropometric characteristics of Bulgarian adolescent rhythmic gymnasts in order to identify their somatotypes. A total of 32 RGs divided into three age categories (16 pre-juniors, aged 8–10 years; 11 juniors, aged 11–12 years; and 5 seniors, aged 13–14 years) volunteered to participate in this study. All athletes participate in national championships and have training experience for at least two years, not less than 20 hours weekly. Using Martin–Saller’s anthropometric method (1957) ten anthropometric measurements are conducted. Heath–Carther’s methodology (1990) is used to determine the three somatotype components (endomorph, mesomorph, ectomorph). One-Way ANOVA and Tukey’s post hoc tests are used to compare intergroup differences ($p < 0.05$). All analyses are conducted using SPSS 16 statistics software for Windows. Body height and weight of adolescent Bulgarian RGs increase significantly from the age of 8 to 14 years. Comparative analysis of the other morphological characteristics has shown significant intergroup differences according to the biepicondylar diameter of the humerus and subscapular skinfold between the pre-junior and junior group and upper arm circumferences between a pre-junior and senior group. The somatotype of rhythmic gymnasts of all assessed categories is 2.36–3.79–1.13 and indicates the endo-mesomorphic dominant type. The current study emphasizes

the role of somatotypology in sports practice, in particular rhythmic gymnastics. The established somatotype in adolescent gymnasts from Bulgaria can be used as a basis in their sports training and selection process.

Key words: somatotype, rhythmic gymnasts, adolescent

Introduction. Rhythmic gymnastics is an Olympic sport, mainly for women, in which complex gymnastic exercises are performed accompanied by music. It is a blend of ballet, gymnastics, and dancing combined with the manipulation of a hand apparatus such as rope, hoop, clubs, ball, or ribbon. Top rhythmic gymnasts (RGs) must have good balance, flexibility, coordination, and strength. The competitive sport also requires an appropriate morphological profile of the athlete, in accordance with sport modality. A favourable genetic profile [1, 2] combined with the appropriate training programme at early ages [3, 4], and a specific diet [5] have an influence on the physical development of the RGs and give an advantage for the achievement of elite athletic status [1]. The intensity and specificity of sports training along the growth and development period of the RGs are the leading factors related to the formation of their somatotype [6–8]. A relatively strong relationship between several anthropometric variables and gymnastic performance in a sample of elite females is found [9]. DI CAGNO et al. [10] determine body height, thigh length, and fat-free mass, as good predictors of better performance in RGs. A specific body constitution of RGs has also a positive impact on their execution [9] and is a factor that prevents injuries in sports [11].

The aim of this study is to assess the anthropometric characteristics of Bulgarian adolescent rhythmic gymnasts in order to identify their somatotypes.

Material and methods. A total of 32 rhythmic gymnasts divided into three age categories (16 pre-juniors, aged 8–10 years; 11 juniors, aged 11–12 years and 5 seniors, aged 13–14 years), volunteered to participate in this study. All RGs participate in national championships and have training experience for at least two years, not less than 20 hours weekly. All girls and their parents volunteered for the research and gave their written informed consent. The study protocol was reviewed and approved by the Ethical Committee of the Institute of Experimental Morphology, Pathology, and Anthropology with Museum – Bulgarian Academy of Sciences (Protocol No. 8/12.11.2018) and was conducted in agreement with the principles stated in the Declaration of Helsinki for human studies [12]. The following anthropometric measurements were conducted: body height and weight, four skinfolds (triceps, subscapular, supraspinal, calf), biepicondylar diameters (humerus and femur), girths (upper arm-relaxed, upper arm-contracted and calf). Heath–Carther’s methodology was used to determine the three somatotype components [13]. The descriptive statistics were presented as means and standard deviations. One-Way analysis of variance and Tukey’s post hoc tests were used to compare intergroup differences (the mean difference is significant at $p \leq 0.05$).

All analyses were conducted using SPSS 16 statistics software for Windows (SPSS Inc, Chicago, IL, USA).

Results and discussion. Measurement of various anthropometric dimensions on 32 rhythmic gymnastics athletes was performed which aims to find out their somatotype.

Table 1 presents the data from descriptive statistics of investigated anthropometric features of young RGs from Bulgaria. The body height of adolescent Bulgarian RGs increased from 138.00 cm in eight-year-old athletes to 153.00 cm at the age of 14 years and a statistically significant difference, $F(2,29) 14.65 =$, $p \leq 0.001$ was found. The mean values of RGs' body weight also grew up significantly from 29.19 kg in the pre-junior group to 38.10 kg in the senior group, $F(2,29) 9.89 =$, $p \leq 0.001$. The Tukey HSD, post hoc test was used which shows that the arithmetic means value for height and weight between the three assessed age groups is statistically significant.

T a b l e 1

Anthropometric characteristics in adolescent Bulgarian RGs

Traits \ Groups	Pre-junior RG ($n = 16$)	Junior RG ($n = 11$)	Senior RG ($n = 5$)	Significance	
	Mean; SD	Mean; SD	Mean; SD	F-value	p -value
Age (yr)	8.88 \pm 0.72	11.55 \pm 0.52	13.40 \pm 0.55		
Height (cm)	138.0 \pm 7.46 b,c	145.0 \pm 3.23 a,c	153.0 \pm 4.73 a,b	14.65	0.001
Weight (kg)	29.19 \pm 4.12 b,c	33.56 \pm 3.13 a,c	38.10 \pm 6.00 a,b	9.88	0.001
Upper arm girth-relaxed (cm)	18.75 \pm 1.41 c	19.78 \pm 0.99	20.54 \pm 1.38 a,b	4.54	0.019
Upper arm girth-contracted (cm)	19.93 \pm 1.52 c	21.19 \pm 1.15	22.24 \pm 1.45 a,b	6.20	0.006
Calf girth (cm)	26.84 \pm 1.81	27.67 \pm 0.81	28.26 \pm 3.13	1.43	0.255
Biepicondylar diameter of the humerus (cm)	3.16 \pm 0.46 b,c	3.80 \pm 0.55 a	3.76 \pm 0.43 a	6.55	0.004
Biepicondylar diameter of the femur (cm)	5.79 \pm 0.70	6.12 \pm 0.48	5.98 \pm 0.45	0.969	0.391
Triceps skinfold (mm)	7.98 \pm 1.66	7.83 \pm 1.97	7.28 \pm 1.49	0.300	0.743
Subscapular skinfold (mm)	5.81 \pm 0.90 b,c	7.10 \pm 1.17 a	6.90 \pm 1.67 a	5.304	0.011
Supraspinal skinfold (mm)	4.42 \pm 1.26	4.25 \pm 1.01	4.20 \pm 0.92	0.112	0.894
Calf skinfold (mm)	7.74 \pm 2.89	7.25 \pm 1.98	7.58 \pm 3.10	0.109	0.897

ANOVA Tukey HSD test: **a** – significant differences compared with Pre-Junior RG, **b** – significant differences compared with Junior RG, **c** – significant differences compared with Senior RG

In the age group 8–14 years, the upper arm circumference in relaxing tension in girls training gymnastics increased from 18.75 cm to 20.54 cm. The mean values for the contracted upper arm in the same age period varied from 19.93 cm to 22.24 cm. Significant differences in terms of upper arm girths have been observed only between the pre-junior and senior RGs groups. According to the results from Tukey HSD, post hoc test statistically significant differences $F(2,29) 4.54 =, p \leq 0.05$ for the mean values of relax upper arm girth-relax and $F(2,29) 6.20 =, p \leq 0.01$ for the upper arm girth-contracted were found. The results of biepicondylar diameters and skinfolds measurement showed that the differences between the three age groups were insignificant. Comparing pre-junior and the junior RGs we observed significant differences only for the biepicondylar diameter of the humerus (Tukey HSD, $F(2,29) 6.55 =, p \leq 0.01$) and subscapular skinfold with F-value and degrees of freedom (2,29) 5.34, and p -values ≤ 0.01 .

The formation of the body's constitution is mainly determined by heredity, but socio-economic and environmental factors also have a great influence [14]. Somatotype is an important criterion for the good physical development of athletes and provides data to optimize training programs and sport selection [15]. According to CARTER [16], the best adolescent athletes have a somatotype similar to those of adult elite ones. The results obtained in the present research, showed a clear prevalence of the mesomorph component in all assessed categories RG that is more pronounced in the age of 11–12 years (Table 2). In the three examined age groups, the somatotype keeps relatively constant mean values and shows the endo-mesomorphic dominant type (2.36–3.79–1.13). That confirmed the results of previous a study that declared that sports activities like rhythmic gymnastics lead to a greater muscle mass accumulation [17]. Comparative analysis of somatotype components among examined groups showed an even increase in the mesomorphic and endomorphic components in the period up to 12 years, after that the values slightly decrease. The ectomorphic component is weakly developed and increases with increasing age and sports practice.

T a b l e 2
Somatotype of adolescent Bulgarian RGs

Somatotype \ Groups	Pre-junior RG ($n = 16$)	Junior RG ($n = 11$)	Senior RG ($n = 5$)	Significance	
	Mean; SD	Mean; SD	Mean; SD	F-value	p -value
Endomorph	2.38±0.61	2.42±0.63	2.15±0.41	0.355	0.900
Mesomorph	3.81±0.29	3.97±0.83	3.59±0.66	2.895	0.028*
Ectomorph	1.10±0.70	1.16±0.05	1.19±0.74	2.303	0.066
Somatotype	Endo- Mesomorphic	Endo- Mesomorphic	Endo- Mesomorphic		

ANOVA Tukey HSD test: * $p < 0.05$

Conclusion. The current study emphasizes the role of somatotypology in sports practice, in particular rhythmic gymnastics. The established somatotype in adolescent gymnasts from Bulgaria can be used as a basis in their sports training and selection process.

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