SOMATIC PROFILE OF YOUNG FEMALE GYMNASTS

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- Body composition.
- InBody 720.
- Somatotype.
- Young female gymnasts.

Abstract:

The present study deals with body composition and somatotypes of 13 young female gymnasts of TJ Slávia PU – Club of Gymnastic Sports. The gymnasts were divided into three groups according to their level of performance and number of training units per week. Group S1 consisted of 4 female gymnasts with average age 13.3 ±0.4. The gymnasts in this group participated in 4 to 5 training units per week and were classified in 1st and 2nd performance class. Group S2 consisted of 5 female gymnasts with average age 10.0 ±0.6. The gymnasts participated in 3 to 4 training units per week and were classified in 3rd performance class. Group S3 consisted of 4 female gymnasts with average age 7.5 ±0.5 classified in 3rd performance class and having participated in 2 training units per week. The gymnasts were tested for basic somatic indexes: body height and body mass, body composition by means of bioelectrical impedance analysis using InBody 720. Somatotypes were determined according to Heath-Carter (1967). The analysis of body composition revealed that body fat percentage in 12 female gymnasts (92.3%) was below recommended norm that was up to low values of endomorphic component. The volume of muscle mass in 8 female gymnasts (61.5 %) fell within the recommended range. The results showed low volume of muscle mass in 3 female gymnasts (23 %) and only one female gymnast had higher volume of muscle mass The average somatotype of older and younger female age categories of S3 group was categorized as ectomorph-mesomorph (category 2), which is predominantly mesomorphic. Average somatotype of female gymnasts in group S2 was classified as mesomorph-ectomorph (category 4) characterized by low mesomorphy rating.

INTRODUCTION

Every person is endowed with specific genetic information that determine not only adult body height, body mass and the degree of somatic development, but also the course of the growth curve from birth to adulthood. Somatic development is determined by co-action of heredity and environment that influence the individual morphological variability of human body. The knowledge about the degree of genetic endowment and the effect of athletic training in gymnastics is incomplete and often misleading. Despite the fact that the cause of retarded biological maturation in female athletes playing various sports, including sports gymnasts, has not been fully clarified, several negative opinions have originated. The objections of other studies against such conclusions concern cross-sectional studies, absence of longitudinal research, insufficient processing of anthropometric data as well as absence of thorough analysis of conservative and dynamic factors. The statements saying that the process of selection adjusts to the requirements of gymnastic sports in terms of physically esthetic and

adequate future female gymnasts (Claessens et al., 1991, Perečinská, 1995) appear to be more objective. Athletic fitness of an individual is determined by a variety of factors the composition of which is the result of a long-term effect of various stimuli, especially athletic training. One of the manifestations of this long-term effect is the change in body composition and body build. A typical change induced by increased physical activity is higher volume of fat-free body mass compared to volume of fat mass. This is manifested through predominance of mesomorphic somatotype component (Pavlík, 2003). Somatic factors as relative stable and genetically determined factors play an important role in various sports. They concern mainly skeleton, musculature, ligaments, tendons and thus form biomechanical conditions for particular sports activities (Dovalil et al., 2002). Among primary somatic factors determining athletic performance are body height, body mass, longitudinal body dimensions, body composition and body build. Optimal athletic performance in gymnastic sports (artistic gymnastics, aerobic gymnastics) requires higher level of motor abilities. At present, sport success in gymnastics is achieved by gymnasts able to master more complex and difficult routines in terms of motor coordination, accuracy of neuromuscular and sensorimotor coordination. The performance in gymnastics is underlain by relative strength, lower body mass, which is directly proportionate to relative strength (Pavlík, 2003). The acquisition of skills in gymnastics is fully dependent on other limiting conditioning and conditioning-coordination capabilities, especially joint flexibility, muscle elasticity, relative speed of movement, balance, rhythmic and kinesthetic-differentiation abilities. Only complex development of limiting and complementary conditioning, conditioning-coordination and coordination abilities is the precondition of an effective acquisition of correct technique, dynamics and economy of movement in gymnastic sports (Perečinská, 1995). Therefore, gymnasts with higher stature and higher body mass are disadvantaged. As reported by Riegerová, Vodička (1992) morphological profile of an individual may to certain extent predict level of athletic fitness. Present studies have revealed higher contribution of somatotype to athletic performance in various sports. Therefore, the purpose of the study was to determine body composition, body build in young female gymnasts of varying levels of performance as body composition develops since early childhood depending on the training workload.

METHODS

The sample comprised 13 young female gymnasts of TJ Slávia PU – Club of Gymnastic Sports. The gymnasts were divided into three groups according to their level of performance and number of training units per week. Group S1 consisted of 4 female gymnasts with average age 13.3 ±0.4. The gymnasts in this group participated in 4 to 5 training units per week and were classified in 1st and 2nd performance class. Group S2 consisted of 5 female gymnasts with average age 10.0 ±0.6. The gymnasts participated in 3 to 4 training units per week and were classified in 3rd performance class. Group S3 consisted of 4 female gymnasts with average age 7.5 ±0.5 classified in 3rd performance class and having participated in 2 training units per week.

Young female gymnasts were tested for basic somatic parameters, body composition and somatotype. Body height was measured using anthropometer with 0.1 cm accuracy. Body mass and body composition were measured using InBody 720 based on the principle of bioelectrical impedance (Hainer et al., 2011). All gymnasts were instructed about the maintenance of standard conditions prior to body composition measurement using InBody 720 analyzer. The collected data were processed using software LookinBody 3.0. Somatotypes were determined according to Heath, Carter (1967). The somatotypes of gymnasts were determined using anthropometric parameters of body height, body mass, circumferential dimensions of flexed arm and tensed calf and biepicondylar breadths of the

humerus and femur. Skinfold thickness at four body landmarks was measured using Caliper Best. The somatotypes were calculated using software SOMATO and particular somatotypes were assessed relative to motor fitness according to Chytráčková (1990).

RESULTS AND DISCUSSION

Achieving optimal level of athletic performance requires respecting to the greatest extent individual limiting factors including the parameter of body build that is undoubtedly relevant in gymnastic sports. Female artistic gymnasts differ from their peers by both lower body height and body mass and lower body fat percentage. However, their volume of muscle mass is higher. The gymnasts have longer extremities, greater shoulder width and narrower lower part of the trunk. These characteristics are important from the standpoint of biomechanics. Somatic factors contribute to performance of female gymnasts approximately by 32 to 45 %. The most important factor is the endomorphy rating indicative of the body fat percentage and closely related to body mass and relative strength. Female gymnasts with lower stature have their center of gravity positioned lower during rotational movements and demonstrate higher level of relative strength (Grasgruber, Cacek, 2008).

Contemporary female gymnasts are often characterized by retarded growth, delayed onset of menarche and lower body height. This was caused by the selection of girls with lower stature, however, the effect may be attributed to high volume of training often combined with strict dietary restrictions. Therefore, it should be noted that there is an ideal value of subcutaneous fat and BMI in gymnastic sports. The negative effect in artistic gymnastics and gymnastic aerobics is induced by both high and low volume of subcutaneous fat (Grasgruber, Cacek, 2008). Table 1 shows basic statistical characteristics of somatic parameters in the samples of young female gymnasts. Due to age range and different level of performance, the gymnasts were assigned to three different groups that were assessed separately.

Table 1 Basic statistical characteristics of somatic parameters of female gymnasts

Somatic parameter	**S1 (n = 4, age x = 13.3)**		**S2 (n = 5, age x = 10.0)**		**S3 (n = 4, age x = 7.5)**	
	x	**s**	**x**	**s**	**x**	**s**
Body height (cm)	**161.2**	9.8	**135.7**	3.0	**128.3**	4.4
Body mass (kg)	**50.5**	12.9	**25.1**	2.1	**23.3**	2.6
BMI ($kg.m^{-2}$)	**19.1**	2.9	**13.6**	0.6	**14.1**	0.7
Body fat (%)	**14.1**	4.7	**6.7**	3.2	**8.2**	2.9
Muscle mass (kg)	**23.4**	5.2	**11.8**	1.1	**10.7**	1.2

Legend concerns tables 1 a 2 as well
x – arithmetic mean s – standard deviation n – sample size BMI – body mass index

Mean values of body height, body mass and BMI of the groups of female gymnasts were compared with growth graphs for children and youth according to Nováková, Hameda (2006). The comparison showed that the values of basic somatic parameters in gymnasts of group S1 fell within the average range of general age-matched Slovak population. The mean values of body height, body mass and BMI in this group were 161.2 cm, 50.5 kg and 19.1, respectively. In group S2, the values of body height and body mass were lower compared to group S1. The mean value of body height (135.7 cm) was at the level of 10^{th} percentile and mean body mass equaling 25.1 kg was just below 3^{rd} percentile, which is indicative of low body height and very low body mass relative to age. The intra-individual analysis revealed that the individual percentile values of body height as plotted on growth graph were located approximately at the level of 10^{th} percentile and mean values of body mass at the level of 3^{rd}

percentile. The values of basic parameters resulted in low value of BMI (13.6), which in the observed group was at the level of 3rd percentile. Mean value of body height in the second group of female gymnasts who trained twice weekly was at the level of 50th percentile for the age-matched category. However, mean value of body mass equalling 23.3 kg was at the level of 25th percentile, which is indicative of decreased body mass. The mean BMI value (14.1) fell a bit higher than 10th percentile. This shows that gymnasts of younger age groups fall behind their age-matched counterparts of general Slovak population in terms of somatic development.

With regard to athletic performance, athletic population should be monitored in terms of body composition and body build. Body composition analysis conducted using InBody 720 showed that body fat percentage in 12 female gymnasts (92.3 %) was below the recommended norm. The volume of muscle mass in 8 gymnasts (61.5 %) fell within the recommended range. The volume of muscle mass was low in 3 gymnasts (23 %). Only one gymnast had higher volume of muscle mass.

Table 2 shows basic statistical characteristics of somatotype components in individual groups of gymnasts. As reported by Riegerová (1994), somatotype changes through lifetime with most significant changes occurring during puberty. In girls, somatotype changes are accompanied by increase in endomorphy and ectomorphy. Mean somatotype in group S1 and group S3 was classified as ectomorphic mesomorph characterized by predominance of mesomorphy. Mean somatotype of gymnasts in group S2 was categorized as mesomorphic ectomorph characterized by predominant ectomorphic component and low mesomorphy rating.

Table 2 Basic statistical characteristics of somatotype components of female gymnasts

Somatotype components	**S1 (n = 4, age x = 13.3)**		**S2 (n = 5, age x = 10.0)**		**S3 (n = 4, age x = 7.5)**	
	x	**s**	**x**	**s**	**x**	**s**
Endomorphic component	**2.1**	1.1	**0.8**	0.2	**0.9**	0.3
Mesomorphic component	**3.8**	0.8	**2.6**	0.5	**3.7**	0.3
Ectomorphic component	**2.9**	0.9	**4.2**	0.3	**3.0**	0.3

The analysis of individual somatotypes in relation to motor fitness (Chytráčková, 1990) showed that 43 % gymnasts including all five from S2 group fell within the D category that includes gracile individuals with low level of strength capabilities. Despite falling within the D category, one gymnast in the older age group demonstrated relatively high level of strength. With respect to her level of athletic fitness, this appears to be an appropriate somatotype for top-level performance in gymnastics (at the time of research the female gymnast was the member of the Slovak Gymnastics national team.

Remaining gymnasts (57 %) were classified in category B, which includes individuals with predominance of mesomorphic component and low endomorphy rating. With regard to motor fitness, such individual are one of the most all-rounded athletes.

CONCLUSIONS AND RECOMMENDATIONS

The paper deals with actual somatic profile of young female gymnasts of TJ Slávia University of Prešov in Prešov – Club of Gymnastic Sports.

1. The comparison with growth graphs for age-matched Slovak population showed that basic somatic parameters in gymnasts with average age 13.3 years fall within the range for their age-matched counterparts. However, body mass and BMI in younger female

gymnasts were found to be low, which may be attributed to selection of an appropriate sport-specific somatotype.

2. Body composition analysis using InBody 720 revealed low body fat percentage in 92.3 % female gymnasts. In two thirds of gymnasts the volume of muscle mass fell within the recommended range and one fifth of gymnasts showed lack of muscular development.
3. Somatotype assessment showed that somatotypes of 57 % gymnasts were predominantly mesomorphic. This component is crucial in terms of athletic fitness. Somatotypes of 43 % of gymnasts of lower age groups were predominantly ectomorphic. In relation to motor fitness, these gymnasts fell within the D category characterized by low level of strength capabilities.
4. We may conclude that monitoring of body composition and body build provides relevant information about the nutritional status of athletes. In young athletes, monitoring of body composition and body build is beneficial in terms of prevention of health disorders caused by excessive training load and insufficient caloric intake. Monitoring may also be beneficial when determining the magnitude of workload during various periods of physical growth and development.

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