Differences in Height and Weight in Young Female Gymnasts

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ABSTRACT

Following the changes in basic anthropological characteristics of the young gymnast can help coaches to recognize how the process of training influences the growth and development of gymnasts. This also can be useful in the specialization of specific apparatus. The aim of this investigation was to find the differences in weight and height between young female gymnasts in compulsory and free program. The sample consisted of 26 female gymnasts: 10 years old who are competing at different levels – compulsory (16) and free (10) programs. Compulsory program training was three times per week, each lasting two hours. Training in the free program lasted two and a half-hour five times per week. The K-S test was used for testing the normality of distribution. Differences between height and weight are calculated by ANOVA at the level of statistical significance of $p < 0.05$. Results show that there is a statistically significant difference in height and weight between categories. Girls from the compulsory program are taller and heavier than girls in the free program. The free program is the hardest program and physically more demanding for execution than a compulsory program.

Keywords: artistic gymnastics, anthropological characteristics, children

INTRODUCTION

Height and weight are important measures in children not only for following the normality of growth and development, but also to see how each generation has own curve. Gymnasts are somewhat shorter than average on entering the sport (4–6 years of age), and have heights within the normal range (Malina et al., 2013). Peak height velocity and peak velocities in female gymnasts overlap those

for short- and late-maturing girls who are not athletes (Malina et al., 2013). A compulsory program is planned for girls who are unable to participate in the top FIG absolute program or free program, due to organizational, professional or financial reasons. Exercises in compulsory program are obligatory while free program are consisted of basic exercises with additional elements. This free program prepares gymnasts for FIG program. Differences in the elements, e.g., on the balance beam, free program has elements: press handstand mount, back handspring, back walkover connected with a handspring, round-off back somersault. The elements in the compulsory program are cat jump, turn, back walkover (front walkover), cartwheel, and round-off dismount. Compulsory program training lasted 2 hours/training, 3 times/week and totally 6 hours/week. Training hours in free program are 12,5 hours/week, 5 times/week, and 2,5 hours/training.

There is not a lot of investigation of anthropological characteristics in artistic gymnastics, especially since there is no investigation of children involved in competitive gymnastics and differences in categories and programs. We found, an investigation of body somatotype and the effect of gymnastics training. A group of authors Massidda, Toselli, Brasili & Calo (2013), investigated somatotypes of elite Italian gymnasts. Malina et al. (2013) investigated the effect of gymnastics training on growth and maturation. The influence of intensive training on adult final height in elite female artistic gymnasts was investigated by Georgopoulos et al. (2012). Anthropometric characteristic of young girls is mostly investigated. Authors Madić, Popović & Kaličanin (2009) investigated anthropometric characteristics of girls included in program of development gymnastics with girls who are not included in any sport. Similar investigations are done by Kutac, Jurkova & Farana (2019) which analyze the somatic parameters of artistic gymnasts in 625 girls (pupil competition category) and compare them with the general population. At the base stage of training in 8–9-year-old girls, authors Pilewska, Pilewski & Barczewska (2015) determine the specificity of somatic indicators. Genc & Cigerci (2020) examine the effects of 12-week gymnastics training on some physical and performance characteristics in 6–7 age group pre-school girls. Those anthropological investigations are also carried out on pubertal girls involved in elite gymnastics. Courteix, Lespessailles, Jaffre, Obert & Benhamou (1999) investigate skeletal and somatic developments in a group of highly trained 14 prepubertal girl gymnasts who had trained 12–15 h per week for 3 years before starting the study. Some preliminary work was carried out in the early 1990s prospectively studied elite gymnast training for a five-year in twenty-two female teenagers in a period of their pubertal development (Lindholm, And & Ringertz, 1994). A group of authors Kalichová, Hedbávný, Pyrochtová & Příhonská (2019) compared the attained and predicted height and length of body segments in 11 elite male gymnasts from the Czech Republic who have undergone intense training for 12 years or more. Theintz, Howald, Allemann & Sizonenko (1989) investigated growth and pubertal development of young female gymnasts. One old investigation performed by Malina et al. (1984) investigated growth status of young Olympic athletes.

Amigó, Faciabén, Evrard, Ballarini & Marginet (2009) investigated height, weight, somatotype and body composition in elite Spanish gymnasts from childhood to adulthood. In female gymnasts there is also an investigation of growth by Peltenburg et al. (1984) an also Malina (1999). Bacciotti, Baxter-Jones, Gaya & Maia (2017) investigated the growth and maturation in elite young female athletes. As there are no studies of the differences between competition categories in young female gymnasts, which will be useful to coaches in selection and one day in specialization.

The aim of this investigation was to find the differences in weight and height between young female gymnasts in compulsory and free program.

METHODS

The sample consisted of 26 young female gymnasts: 10 years old who are competing at different levels – compulsory (16) and free (10) programs. All girls were born 2011. and the biggest age differences between them were six months. Compulsory program training was three times per week, each lasting two hours. Training in the free program lasted two and a half-hour five times per week. Girls from both programs started with gymnastics training from six years old. Sample of variables was height (H) and weight (W) measured at the competition. Height was measured by an anthropometer (cm) and the weight with Tanita (Segmental Body Composition Monitor, Inner ScanV, Amsterdam The Netherlands) (kg).

The data were collected 2021. at the national competition, and the sample is small because some children did not want to participate in the research. In esthetic sport, especially in gymnastics it is difficult to obtain such data. Ethics Committee of the Faculty of Kinesiology approved the research and parents signed the consent for the children.

The software package Statistica 14.0.0.15 (TIBCO Dana Science Software) was used to process the obtained data. To determine the normality of data distribution, the K-S test was used, at the $p<0.05$ level. Basic descriptive statistics of all variables were calculated. Univariate analysis of variance, ANOVA was used to determine statistically significant differences in height and weight.

RESULTS

The basic descriptive indicators of compulsory program of height and weight are shown in table 1. The average height of the body (H) is 141.94 ± 9.50 cm, with the smallest value of 117.00 cm and the largest value of 156.40 cm. The average for the variable body weight (W) is 32.93 ± 6.48 kg, ranging from 17.40 kg to 42.30 kg.

Table 1. Descriptive statistics of compulsory program

Variable	Valid N	Mean	Minimum	Maximum	Std.Dev.
H	16	141.94	117.00	156.40	9.50
W	16	32.93	17.40	42.30	6.48

Table 2 is shown basic descriptive indicators of a free program of height and weight. The average height of the body (H) is 138.10 ± 5. cm, with the smallest value of 128.00 cm and the largest value of 148.10 cm. The average for the variable body weight (W) are 30.95 ± 3.99 kg, ranging from 24.40 kg to 38.80 kg.

Table 2. Descriptive statistics of free program

Variable	Valid N	Mean	Minimum	Maximum	Std.Dev.
H	10	138.10	128.00	148.10	5.40
W	10	30.95	24.40	38.80	3.99

The results of the Anova test (Table 3) indicate that there is a statistically significant difference between young female gymnasts in the variable body height (H), p = 0,00 and body weight (W), p = 0.01.

Table 3. One-Way Anova results of height and weight

Dependent Variable	Multiple R	Multiple R^2	Adjusted R^2	SS Model	df Model	MS Model	SS Residual	df Residual	MS Residual	F	p
H	0.66	0.44	0.39	754	2	376.98	952.54	23	41.41	9.10	0.00*
W	0.59	0.35	0.30	281	2	140.55	516.96	23	22.48	6.25	0.01*

Legend: *=statistically significant difference

DISCUSSION

When we compare the differences in height and weight between compulsory and free program, we can conclude that generally, girls from compulsory program are 3,84 cm taller than girls in free program and 1,98 kg heavier than free program girls. The reason can be in timing of peak height velocity, which happens about 10.55–14.52 years, and peak velocities, 4.58–9.23 cm/year, among individual gymnasts (Malina et al., 2013). Girls from compulsory program was (141.94 ± 9.50 cm), where 117.00 cm were the smallest one and 156.40cm where the highest one. As expected, girls from free program were smaller than girls from compulsory program with a mean value (138.10 ± 5.40cm) and the highest one was 148.10 cm and smallest one was 128.0 cm. Maybe the reason in height differences can be that some girls start with puberty earlier and some later, despite they are the same age (the highest differences are six months). Before more than 30 years researches Theintz et al. (1989) where found the smallest height values (144.7 ± 7 cm) in the youngest girls (12.6 ± 1.1 yrs), weighing 34.9 ± 5.5 kg. Also, older girls (16.8 ± 0.5 yrs), weighing 53.6 ± 3.1 kg and body height was (163.2 ± 4.5 cm) (Malina et al., 1984). It seems that today's children are taller and heavier than children before more than 30 years.

Apparatus requirements of free program are bigger than in compulsory program, e.g., balance beam exercises are composed of difficulty higher elements than compulsory program. There are statistically significant differences in girls included in development gymnastics with girls who are not included in almost all anthropometric measures (except body height) (Madić et al., 2009). We can say that weight can be under the influence of training, but height not. The high volume of gymnastics training of the gymnasts, influences body composition parameters, gymnasts have lower body fat (%), visceral fat (cm^2), and higher skeletal muscle mass (%), (Kutac et al., 2019). This can be the reason why

girls in free program are lighter than girls in compulsory program by almost two kilograms. When we compare general population with gymnasts there is a difference in somatic parameters. There are several possible explanations for this claim. 652 girls from the youngest competition category have a lower body height and lower body weight than the girls from general population (Kutac et al., 2019). Spanish gymnasts are shorter and lighter than the reference sample throughout the whole range of ages studied (Amigó et al., 2009). Russian male gymnasts' weight 56 to 70 kg and height as 160–170 cm and female gymnasts 150–160 cm and 38–50 kg (Arkaev & Suchilin, 2009).

Values of morphological indicators showed to be related to the gymnasts' technical level in 8–9-year-old girl in the early stages of training (Pilewska et al., 2015). Here the requirements of discipline in young girls do not match with somatic model of adult gymnasts because the demands of disciplines are not the same for beginners and adult gymnasts. In elite gymnast who trained for 12 years or more, they have lower body height, longer trunk, medium-long upper limbs, and shorter lower limbs (Kalichová et al., 2019). This state of some parameters is obvious just when looking at the competition. 12-week of gymnastics training has a positive effect on some physical and performance characteristics in 6–7 age group pre-school girls (Genc & Cigerci, 2020). In our investigation girls which trained 18 hours/week are lighter, but we do not know if they are better in some physical and performance characteristics. We can suppose that they already are better than girls from the compulsory program because the exercises are heavier, so this requires a good level of physical preparation. There is a lot of benefit to high-volume training. An investigation conducted by highly trained prepubertal girl gymnasts says that high-volume impact training could stimulate a higher annual gain in bone mineral acquisition in prepubertal girls without affecting somatic growth dimensions (Courteix et al., 1999). In Swedish gymnast girls, it is noted that they have significantly delayed age of menarche, less body fat, and were shorter and lighter than the control group (Lindholm et al., 1994). However, heights and weights have changed little from 1987 (154 cm, 45 kg) to 2000 (152 cm, 43 kg) and 2008 (153 cm, 45 kg) Olympic Games (Claessens, 2007; Malina et al., 2013). One of the newest investigations resulted in some constatations. Height in adult gymnasts (male, female) is not conceded by intensive gymnastics training, also gymnastics training does not reduce pubertal growth and maturation (Malina et al., 2013). Each external stimulus, like training, will change some physical and technical parameters, but some anthropological measures are under the influence of genetics. Previous work addresses that the smaller size of elite gymnasts is evident if we exclude any systematic training (Peltenburg et al., 1984), and is hereditary, i.e., gymnasts have parents who are shorter than average (Malina, 1999; Baxter-Jones, Thompson & Malina, 2002).

The characteristics of gymnasts are unique as the result of the selection of natural genetic characteristics, but the differences in body composition between competition levels was not well understood because of difficult to find (Bacciotti et al., 2017).

CONCLUSION

From obtained results, we can conclude that gymnast from the free program is shorter and lighter than girls from the compulsory program. These facts can be attributed to a high volume of training which mostly influences body weight. Height is obviously under the influence of genetics. In the free

program, coaches selected girls which are capable of a free program and have the predisposition to be in the FIG program. Since the requirements for items in the mandatory program are lower than in the free program, it is assumed that the body should be lighter and smaller. In artistic gymnastics are very hard to get to anthropometric measures, because girls are shy and usually refuse to take measures. In the future will be very helpful to monitor the progress of anthropological measurements so that we can say how should look like a gymnast in each competition program.

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