ANTHROPOMETRIC PROFILE OF GYMNASTS PARTICIPATING IN THE EUROPEAN GAMES 2015 IN BAKU, AZERBAIJAN

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Abstract

Sports performance is strongly influenced by the athletes' anthropometric profile. In the specific case of Gymnastics, body weight assumes particular relevance, given the aesthetic character of this sport. Anthropometric data were collected from 309 gymnasts (20.9 ± 4.1 years old) participating in the 2015 European Games: age, body weight and height, from a database of the organization of this competition available online in the 5 disciplines of the Gymnastics included in the competition, namely Men´s and Women´s Artistic Gymnastics, Rhythmic Gymnastics, Acrobatic Gymnastics and Aerobic. Body mass index was calculated. Female gymnasts were significantly younger and lighter than male gymnasts and had a lower body mass index than males (P = 0.000). Female athletes were in the 25th percentile for weight and BMI and in the 15th percentile for height, according to their age. Male gymnasts were in the 25th percentile for weight, height and BMI. Female acrobatic gymnasts were younger and lighter (25th percentile) than other gymnastics disciplines; rhythmic gymnasts presented the lowest BMI (5th percentile). Male artistic gymnasts were the lightest (15th percentile) and with the lowest BMI (25th percentile) within the male participants. BMI was dependent on weight, height and gender, with exception for exclusive-gender disciplines and, surprisingly, also in Aerobics. Gymnasts presented an anthropometric profile with results for body weight, height and body mass index below the normal for their age.

Keywords: *body weight, gymnastics, athlete, gender-participation, European Games.*

INTRODUCTION

Gymnastics is an aesthetic sport in which a reduced body weight is important for the athlete's performance in training, and especially, in competition given the artistic component strongly associated with the performance of competition routines (Silva, 2015).

Although it is a sport whose sporting career is usually short, the International Gymnastics Federation has shown some concern about the anthropometric profile of gymnasts from various competition disciplines (Binder, 2011) with a particular emphasis on Men's Artistic Gymnastics (MAG), Women´s Artistic Gymnastics (WAG), Rhythmic Gymnastics (RG), Acrobatic Gymnastics (ACRO) and Aerobic Gymnastics (AERO).

Depending on the discipline, the duration of the exercises is slightly variable, that is a competition exercise can last 4-5s (for example, in vault), or 60 to 90s (for example, a routine in RG). Some athletes need a more muscular body, as is the case of MAG's athletes (Mkaouer et al., 2018), while others need a lighter and more

flexible body (Binder, 2011), as is the case of rhythmic and acrobatic gymnasts.

Regardless of the routine's duration, its intensity is high, mostly appealing to anaerobic metabolism, and resulting from the combination of body technique combined with the mastery in apparatus technique (Silva & Paiva, 2015a). Flexibility combined with strength are the most obvious capabilities when performing a routine, in addition to high levels of coordination and motor control.

Thus, a thin body becomes more appealing in the eyes of the public, judges (Donti et al., 2016) and coaches (Mkaouer et al., 2018; Silva & Paiva, 2015a; Michopoulou et al., 2011), specifically in RG and ACRO. However, a reduced body weight can lead to imbalances in the energy availability, which may compromise gymnast´s growth and development, as well as, her/his performance in daily and sport demands (Silva & Paiva, 2015b).

In a study that evaluated dietary intake and body composition of elite RG athletes prior to a World competition (Silva & Paiva, 2015a), gymnasts demonstrated low energy availability (31.5±11.9kcal/kg fat-free mass/day), and mean body mass (48.4±4.9kg) and body mass index (BMI, 17.4±1.1kg/m^2) below the normal for age; mean height for age (1.66±0.05m) was normal or slightly above normal and higher than in previous data (Georgopoulos et al., 2012). In a research study with high performance RG gymnasts, no significant differences (P=0.102) were found in BMI according to athletes' ranking in an international competition; however, in both groups, this variable was below the normal for gymnasts' age (Silva & Paiva, 2015b). Considering another recent study about precompetitive sleep behaviour in RG gymnasts (67.1% adolescents and 32.8% adults) competing at a high level (36.6±7.6 hours of training/week), BMI<18.5kg/m^2 was not a risk factor for gymnasts' short sleep duration; however, it was, indeed, a risk factor for reduced sleep quality and abnormal daytime sleepiness prior to competition (Silva & Paiva, 2019).

From the five Gymnastics disciplines aforementioned, ACRO and AERO have been less studied with ACRO presenting an increasing number of athletes around the world in the last decade. Additionally, in a research with Portuguese acrobatic gymnasts, significant differences between children and adolescents were observed for BM, height and BMI according to gender, with exception for BMI in males; adolescents' mean BM was below the normal for age and gender (25th to 50th percentiles) and only female children showed a normal height for age (Silva, Silva & Paiva, 2018).

According to the experience of Silva & Paiva (2015a), in high intensity gym training, energy restriction is a common practice in female athletes aiming to reduce body weight (Baldari & Guidetti, 2001; Deutz et al., 2000). On the other hand, daily or frequent assessment of gymnasts' body weight is not a reliable or accurate way of assessing their energy balance, being even a particularly delicate/stressful moment for the gymnast, which may encourage poor eating and hydration behaviors (Binder, 2011). Research on acrobatic gymnasts' body composition and eating habits related to training habits and energy availability is much needed due to the recent ascending character of ACRO.

The aim of this study was to analyze the anthropometric profile (weight, height and body mass index according to age) of gymnasts participating in the 2015 European Games in Baku, Azerbaijan.

METHODS

From the 309 gymnasts (20.9±4.1years old, 57.8±10.7kg, 1.47±0.51m, 21.1±2.6kg/m^2) who participated in the European Games 2015, 59.2% (n=183) were female (19.4±3.5 years old, 50.4±7.9kg, 1.31±0.62m, 19.5±2.2kg/m^2) and 40.8% (n=126) were male

(23.0±4.0years old, 66.6±6.3kg, 1.31±0.72m, 22.9±1.2kg/m^2).

Anthropometric data were collected from gymnasts participating in the 2015 European Games: age (years), weight (kg) and height (m). These data come from a credible database of the organization of this European competition available online (European Games, 2015). It should be said that, although, this was the official competition website, the reliability and validity of data are dependent on the accuracy of data collection, which was not from the authors' responsibility. The five Gymnastics disciplines covered in the competition were accessed, namely ACRO, RG, MAG, WAG and AERO. A database was created and the BMI was calculated according to the formula: BMI = Weight (kg)/Height^2 (m^2) and interpreted according to public and research data from Frisancho (2008). In this study, informed consent was not required as all data were publicly available.

Results will be presented as mean, standard deviation, minimum and maximum. Spearman correlation coefficient was used to determine associations between variables. The significance level was 5% (P <0.05). Statistical treatment was performed using the statistical program SPSS for Windows, version 25.0 (New York, USA).

RESULTS

Artistic Gymnastics was the most represented discipline at the competition (28.5% of MAG and 27.5% of WAG) and RG was the least represented with only 6.1% of participants (Figure 1).

The discipline most represented by both genders was the Artistic Gymnastics (MAG = 69.8% and WAG = 46.4%). The less represented by male athletes was the ACRO (7.1%), and the AERO in females (19.1%, Figure 2). Excluding the RG (female-only discipline, n = 19), there were significant gender differences (P <0.05) in ACRO. However, in Artistic Gymanstics and AERO no significant gender differences were observed (P≥0.05) (Figure 2).

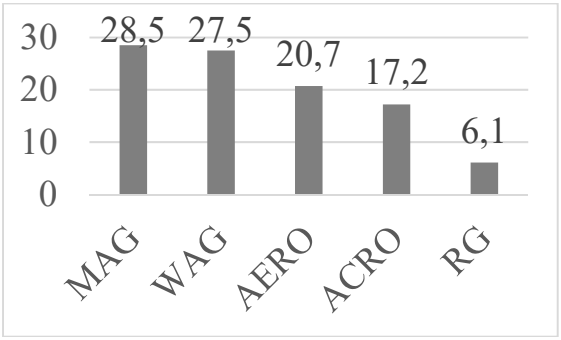

Figure 1. Gymnastics disciplines represented at the 2015 European Games. ACRO: Acrobatic Gymnastics. AERO: Aerobics Gymnastics. MAG: Men´s Artistic Gymnastics. RG: Rhythmic Gymnastics. WAG: Women´s Artistic Gymnastics.

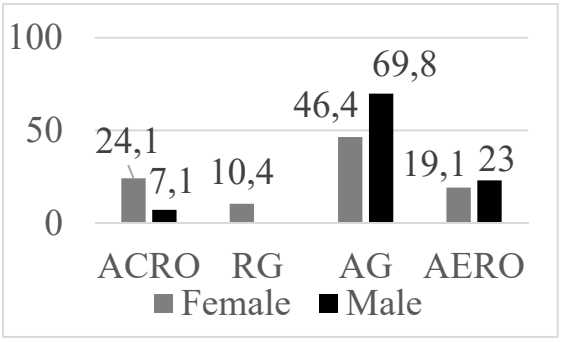

Figure 2. Gymnastics disciplines represented at the 2015 European Games, according to the participants' gender. ACRO: Acrobatic Gymnastics. AERO: Aerobics Gymnastics. AG: Artistic Gymnastics. RG: Rhythmic Gymnastics.

Female gymnasts were significantly younger, lighter and had a lower BMI than males (P=0.000) (Table 1). Male gymnasts were in the 25th percentile for weight, height and BMI according to their age (Frisancho, 2008), as well as female gymnasts, with exception for the height, that was in the 15th percentile.

Analysing by gender, and according to the disciplines of Gymnastics, female ACRO gymnasts were younger and lighter (ranked in the 25th percentile) than other female participants, while WAG athletes were the shortest (in the 25th percentile); rhythmic gymnasts had the lowest BMI (in the 5th percentile).

In males, ACRO gymnasts were younger than other athletes, while AERO gymnasts were the shortest (ranked in the 25th percentile); MAG were the lightest (15th percentile) and with the lowest BMI (25th percentile) (Table 2). As expected, Person correlation coefficients (r) indicated that BMI was positively correlated with age (r=0.458, p=0.000), weight (r=0.875, p=0.000) and height (r=0.487, p=0.000).

Table 1
Age, body weight, height and body mass index of gymnasts (n = 280), according to gender (female: n = 183 and male: n = 97).

	Total (n=280)		**Female** (n=183)		**Male** (n=97)		***P***
	Mean±sd	*Min.-Max.*	*Mean±sd*	*Min.-Max.*	*Mean±sd*	*Min.-Max.*	
Age (years)	20.9±4.1	14-37	19.4±3.5	14-37	23.0±4.0	17-34	0.000*
Weight (kg)	57.8±10.7	29-85	50.4±7.9	29-72	66.6±6.0	54-85	0.000*
Stature (m)	1.47±0.51	1.26-1.93	1.55±0.62	1.46-1.75	1.70±0.06	1.58-1.93	0.997
BMI (kg/m^2)	21.1±2.6	14.3-27.6	19.5±2.2	14.3-25.5	22.9±1.5	17.4-27.6	0.000*

*P<0.01.

Table 2
Age, body weight, height and body mass index (BMI) according to gymnasts' gender (female: n = 183 and male: n = 97).

	Female (n=183)				**Male** (n=97)		
	ACRO (n=44) *Mean±sd (min-max)*	RG (n=19) *Mean±sd (min-max)*	WAG (n=85) *Mean±sd (min-max)*	AERO (n=35) *Mean±sd (min-max)*	ACRO (n=9) *Mean±sd (min-max)*	MAG (n=88) *Mean±sd (min-max)*	AERO (n=35) *Mean±sd (min-max)*
Age (years)	17.5±2.5 (14-22)	20.3±3.2 (16-29)	19.3±3.1 (15-31)	21.3±4.3 (17-37)	20.7±4.2 (17-30)	23.5±4.0 (17-34)	22.5±3.7 (17-31)
Weight (kg)	48.5±11.3 (29-65)	50.0±5.0 (40-58)	51.4±6.0 (35-72)	53.5±2.1 (52-55)	76.1±6.5 (64.0-85.0)	65.7±5.4 (54-83)	66.6±5.0 (57-77)
Stature (m)	1.60±0.09 (1.40-1.73)	1.68±0.04 (1.60-1.75)	1.59±0.06 (1.40-1.74)	1.65±0.39 (1.62-1.66)	1.79±0.06 (1.70-1.93)	1.70±0.05 (1.58-1.83)	1.69±0.53 (1.60-1.83)
BMI (kg/m^2)	18.7±2.70 (23.1-18.7)	17.6±1.5 (14.9-20.7)	20.4±1.67 (16.2-25.5)	19.8±0.3 (19.6--20)	23.6±1.4 (21.6-26.2)	22.8±1.2 (19.4-25.6)	23.3±2.2 (17.4-27.6)

DISCUSSION AND CONCLUSIONS

This is the first work that compares at the same time more than two Gymnastics disciplines in terms of the gymnasts' anthropometric profile. Currently available data on the height and weight of elite gymnasts are not extensive. Athletes in question are considered high performance athletes, given the European character of the competition. As reported in two recent studies conducted by the Portuguese Gymnastics Federation (Silva & Barata, 2016; Silva et al., 2017), also in this competition female gymnasts (59.2%) were represented in a greater number than male gymnasts (40.8%) and were significantly younger than the latter.

A research with high performance gymnasts (Silva & Paiva, 2015b) concluded that the performance of these athletes in competition was positively influenced by age and other variables that were not available for the present study (number of daily training hours and daily sleep duration, and negatively due to low energy

availability, reduced sleep quality, daytime sleepiness and daily protein intake).

According to the anthropometric data evaluated, gymnasts of both genders were below normal for age, namely between the 15th and 25th percentiles, which may reflect aesthetic and physical demands of this sport on the athletes' body composition.Although BMI is a relative indicator of body composition, because it does not differentiate between the various components of an individual's body composition (fat mass, muscle mass, total body water, bone mass, etc.), it is often used in scientific publications that evaluated this type of high-performance athletes.

Thus, and although this is a limitation of the study, there seems to be a tendency for a lower BMI-for-age in gymnasts than average, according to recent scientific publications (Taboada-Iglesias, Gutiérrez-Sánchez & Santana, 2017; Silva & Paiva, 2015a).

In a study with 67 elite rhythmic gymnasts (18.7 ± 2.9 years), who trained 36.6 ± 7.6 hours per week, it was found that their body weight (48.4 ± 4.9kg) and BMI (17.4 ± 1.1kg/m^2) were below normal for age (between the 10th to 50th percentiles), while height (1.66 ± 0.05m) was normal or slightly elevated for age (between 50th to 75th percentiles, Silva & Paiva, 2015a).

Arazi et al. (2013) found average BMI values in Iranian artistic junior male gymnasts (19.6kg / m2), which were lower than those found in our study.

In another study with 82 Portuguese ACRO gymnasts (48 children and 34 adolescents), 23 female adolescents gymnasts (16.1 ± 2.1 years) training 17.6 ± 5.3 hours/week and 11 male adolescents (16.3 ± 2.7 years) training 19.9 ± 5.9 hours per week showed 21.0 ± 2.3kg/m^2 and 21.3 ± 3.1kg/m^2 for BMI, respectively (Silva, Silva & Paiva, 2018), which were below the normal for their age.

In contrast, Taboada-Iglesias, Gutiérrez-Sánchez & Santana (2017) evaluated 151 Spanish ACRO gymnasts (13.31 ± 3.1 years) and found that the tops suffered from underweight, especially female ones, and female bases had a normal body weight for their age.

It is noteworthy that Silva, Silva & Paiva (2018) found that 8.5% of the bases suffered from overweight (BMI> P85 and> P95 and fat mass> P50) and 2.4% also of the bases were obese (BMI> P95 and fat mass> P75) (Silva, Silva & Paiva, 2018), which may translate to a different evolution in ACRO than usual in other Gymnastics disciplines.

In a study evaluating the risk factors associated with the sleep of elite rhythmic gymnasts just before a major competition, BMI <18.5kg / m^2 was found to be a risk factor for: short-term sleep (OR = 2.05; 95% CI 0.49-8.70), reduced sleep quality (OR = 4.16; 95% CI 1.47-11.75) and abnormal daytime sleepiness (OR = 1.14 95% CI 0.93-1.38) (Silva & Paiva, 2019).

In the study of Galetta et al. (2015), in which 16 controls and 16 Italian rhythmic gymnasts were evaluated, it was found that the gymnasts' BMI was lower than controls' (16.9±1.1kg/m^2 vs. 18.7±1.0kg/m^2, P <0.001); this value is lower than that of our study. In addition, they concluded that intense training, eating behaviour and thinness were not associated with cardiac abnormalities, as is the pathological leanness.

Although the number of gymnasts' weekly training hours and their role in competition were not available, results from this study are in line with previous studies in other Gymnastics disciplines.

Differences observed may reflect an emphasis on a controlled body weight among gymnasts compared to the general population of adolescent girls and a reduced variation among gymnasts, which was also observed by Claessens et al. (2006), who considered elite gymnasts as a group being short compared to reference data for the general population. In fact, these authors have classified a small sample of the 17-year-old pre-menarcheal gymnasts as presenting idiopathic short stature as their mean stature was 153.8±8.7 cm, while the

fifth percentile for the reference sample is 154.5 at 17.5 years (Simons et al., 1990). In addition, the mean mass for that group was 44.6±4.8 kg (Claessens et al., 2006), which was less than the fifth percentile of the Belgian reference sample, 46.3 kg (Simons et al., 1990).Gymnasts participating in the European Games 2015 presented an anthropometric profile below the normal for weight, height and BMI, according to their age. These results are based on a cross-sectional analysis of data from the official competition website, which reliability and validity are dependent on the accuracy of data collection, which was not from the authors' responsibility; therefore, caution is warranted in making inferences. Nevertheless, the trends apparent in this study highlight the need for longitudinal studies on the influence of body composition, food intake and regular training regime in high-performance gymnasts.

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