SOMATOTYPE ANALYSIS BY AGE CATEGORIES IN SPANISH FEMALE ACROBATIC GYMNASTS

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Abstract
Somatotype is one of the variables seen as the key to success in sports and talent detection at different ages. This is confirmed by evidence in some gymnastic disciplines in different age categories, but no study has been conducted for Acrobatic Gymnastics. The objective is to establish the characteristic somatotype profile in Acrobatic Gymnastics for each age group, determining whether there are differences among them and between the roles in each one. The sample was made up of 54 female tops (X= 11.23 years; 29.62 Kg) and 75 female bases (X= 14.46 years; 50.48 Kg). The somatotype was calculated using the Heath-Carter method to determine the mesomorphy, endomorphy, and ectomorphy of each group. The statistical analysis carried out consisted of a descriptive and comparative analysis based on the component in particular and the mean somatotype dispersion in general. The results showed that mesomorphy was the most important component in all categories and roles. They indicated different somatotype classifications in each group, but the importance of ectomorphy in tops and endomorphy in bases should also be pointed out. Significant differences were obtained in mesomorphy (tops: p = .012; bases p = .026) and ectomorphy in both roles (tops p = .036; bases p = .001). Despite finding significant differences among certain categories, this did not follow a linear, chronological development. Therefore, one cannot conclude that the somatotype evolved with age, since this may be due to sports specialization. However, it was confirmed that mesomorphy, as in other gymnastics disciplines, is the predominant component in all categories and roles.

Keywords: *anthropometry; somatotypes; growth and development; age groups.*

INTRODUCTION

The somatotype has been recognized as one of the determining morphological variables in sport performance (Carter & Heath, 1990; Kutseryb, Vovkanych, Hrynkiv, Majevska, & Muzyka, 2017). It is not exceptional in different gymnastics disciplines, since athletes in each may have different body shapes. It could provide assistance in talent detection throughout the growth stage due to the stability of the somatotype in gymnasts during this period (Corbella & Barany, 1991; Irurtia et al., 2009b).

The International Gymnastics Federation (FIG) currently encompasses eight different gymnastics disciplines, ranging from the latest entry of Parkour to Gymnastics for All, Aerobic Gymnastics (AER), Acrobatic Gymnastics (AG), Trampoline, and to the more traditional Men's Artistic Gymnastics (MAG), Women's Artistic Gymnastics (WAG) and Rhythmic Gymnastics (RG). Anthropometric studies have been conducted on them all and many focused specifically on the somatotype. However, MAG, WAG and RG have been the preferred disciplines of study.

The studies carried out on MAG athletes noted a somatotype with a predominant mesomorphic component. The classification most commonly obtained in top-level gymnasts is the balanced mesomorph (Bies & De la Rosa, 2006; Claessens et al., 1991; João & Filho 2015). However, other studies pointed towards an ecto-mesomorphic classification (Irurtia, Busquets, Marina, & Galilea, 2009a), in which the ectomorphic component, related to longilinearity, was stronger than the endomorphic one.

It has also been noted that female artistic gymnasts have a predominantly mesomorphic somatotype. They have been mostly classified as ecto-mesomorph, with the ectomorphic component being the second most important (Claessens et al., 1991; Irurtia, Busquets, Marina, Pons, & Carrasco, 2008; João & Filho, 2015; Massidda, Toselli, Brasili, & Caló, 2013).

The somatotype is different in RG. There is evidence that allows for the classification of national- or higher-level gymnasts as balanced ectomorphs as the predominant somatotype (Menezes & Filho, 2006; Purenović-Ivanović & Popović, 2014). Other studies, despite providing different classifications for the distribution of the mesomorphic and endomorphic component, also agreed that the ectomorphic component was the most important in RG (Irurtia et al., 2009b; Purenović-Ivanović & Popović, 2014).

Research in trampoline gymnastics is more limited. Gómez-Landero, Vernetta and López Bedoya (2009) established the profile of top-level Spanish gymnasts. The authors defined the somatotype of the absolute category gymnasts (15+ years) as endomorphic mesomorph, while the U-15s were characterized as a central somatotype. On the other hand, in male trampoline the endomorphic component is much more important, defined as balanced mesomorph (Gómez-Landero, Vernetta, & López Bedoya, 2010).

Finally, there is not much evidence about AG either. The few studies carried out showed a predominance of mesomorphy in different competitive events (Taboada-Iglesias, Vernetta, & Gutiérrez-Sánchez, 2017) as well as in different performance roles, with greater predominance of the ectomorphic component in tops and of the mesomorphic component in bases (Taboada-Iglesias, Gutiérrez-Sánchez, & Vernetta, 2016).

In addition to the differentiated and characteristic profile of each sport that requires specific features for the execution of its motor patterns and conditions, the research focuses on the fact that different somatotype distributions can be conditioned by the development typical for specific age, as it happens with the non-sporting population (Corbella & Barany, 1991). The somatotype can be influenced by maturation development or diet; however, sports specialization may be of greater importance, hence these characteristics will not be analysed.

Research on the gymnastic disciplines provided answers by showing the profiles of each age category in MAG (Fontana, Soares, Santos, Molina, & Riehl, 2014), WAG (Bacciotti, Baxter-Jones, Gaya, & Maia, 2018; Massidda et al., 2013) and RG (Corbella & Barany, 1991; Oliveira et al., 2017; Purenović-Ivanović & Popović, 2014; Quintero, Martín, & Henríquez, 2011). However, there are no references to somatotype distribution in the different age categories of AG competitions.

In this gymnastic discipline, the Code of Points established different age range categories. The existence of age ranges derives from the fact that it is a motor and social sport, in which one competes in a group or in a pair, performing technical elements such as figures and throws (Vernetta, López Bedoya, & Gutiérrez-Sánchez, 2008), i.e., in which one gymnast plays the role of the top and the other the role of the base (FIG 2017).

In view of the lack of evidence in AG, the goal of this study is to establish the characteristic somatotype profile for each age group, determining whether there are differences among them and between the roles played in each one.

METHODS

All the procedures followed in this study were approved by the Autonomous Ethics Committee of Research of Xunta de Galicia (Spain) (Reference Number 2015/672). Participants volunteered their cooperation, and their participation was in the case of minors authorised by their parents or legal guardians.

The precepts of the Helsinki Declaration were followed. The procedures were explained, indicating that they were harmless, painless, and that the subjects could leave the study at any time.

There was a total of 129 female gymnasts in this study, 54 of them playing the role of the top and 75 the role of the base. Table 1 shows the classification by age categories according to the rules of participation in the Spanish championships.

Table 1
Distribution of the sample and ages of the different age categories of national Tops and Bases competition.

	Tops			Bases		
Group	N	Age		N	Age	
		X	SD		X	SD
Age Group 1 (6-13 years old)	5	7.28	0.83	4	11.08	1.37
Age Group 2 (7-14 years old)	7	9.94	1.70	9	13.53	0.93
Age Group 3 (8-15 years old)	12	10.79	3.04	14	13.26	1.78
Age Group 4 (9-16 years old)	18	11.39	1.95	29	14.83	1.46
Junior (10-19 years old)	9	14.14	3.99	17	15.94	2.32
Senior (+ de 12 years old)	3	12.93	0.38	2	15.98	1.90
Total	54	11.23	3.04	75	14.46	2.08

In order to calculate the components of the somatotype, certain variables were previously measured. These measurements were taken by a researcher who is an accredited expert level 2 in the field, following the recommendations of the International Society for the Advancement of Kinanthropometry (ISAK) (Marfell-Jones, Olds, Stewart, & Carter, 2006).

The kineantropometry variables were: height, weight, 4 skin folds (triceps, subscapular, supraspinal and medial calf), 2 diameters (humerus condylar-trochlear and femur bicondylar) and 2 circumferences (contracted arm and maximum leg). The height was taken with a portable stadiometer Seca 213 (GmbH & Co. KG, Germany) to 1 mm precision, the weight with a Tanita digital scale UM-040 (Tanita corporation, Japan) with precision of 100 g, the folds with a Holtain skinfold calliper (British Indicators, England) with 0.2 cm precision, and the circumferences with a Cercorf antropometric (Equipamentos Cercorf, Brasil) with 1 mm precision.

The calculation of the three components of the somatotype was performed using the Heath-Carter method (Carter & Heath, 1990) and the following formulas:

1. *ENDOMORPHY = -0.7182 + 0.1451Sc- 0.00068Sc^2 + 0.0000014Sc^3*

S=Σ Triceps, subscapular, supraspinal folds (mm)

Sc= S x (170.18 / height (cm))

2. *MESOMORPHY = [0.858HumD + 0.601FemD + 0.188CAc + 0.161MLc*] - [height (cm) x 0.131] + 4.5

Humerus condylar-trochlear diameter (HumD) in cm; femur bicondylar diameter (FemD) in cm; contracted arm circumference (CAc) in cm; maximum leg circumference (MLc) in cm.

CAc= Contracted Arm circumference (cm) – Triceps fold (cm)

MLc= Maximum leg circumference (cm) – medial calf fold (cm)

3. *ECTOMORPHY*

a. If the weight index (WI)< 40.75: Ectomorphy = (0.732WI) – 28.58.
b. If WI< 40.75 and > 38.25: Ectomorphy = (0.463WI) – 17.63.
c. If WI≤ 38.25: Ectomorphy = 0.1
Weight index (WI)
(WI= height(cm)/$^3\sqrt{}$weight (kg))

The somatotype was represented using a somatocard, and its dispersion and homogeneity were analysed by different specific indices. The somatotype dispersion index (SDI) was calculated to assess the homogeneity of each group, establishing heterogeneity with SDI>2. Likewise, for the comparison of the somatotype among groups, the mean somatotype dispersion distance (SDD_{SM}) was used, reflecting significant differences with SDD_{SM}>2. Differences among age categories and between roles were compared in each of them.

The statistical treatment of the data was performed using SPSS 22.0 0 (Statistical Package for the Social Sciences), and a significance level of $p < 0.05$ was applied in all performed tests. First, a descriptive analysis of each somatotype variable expressed by the mean (X) and the standard deviation (SD) was performed. The normality of each group was analysed using the Shapiro-Wilk test, and Levene's test was employed to check the variance homogeneity. Second, since not all variables behaved normally and homogeneously, different parametric and non-parametric tests were necessary for the comparative study. For normally distributed variables, we applied the one-way ANOVA test (F tests on homogeneous variables and Brown-Forsythe [B-F] on non-homogeneous variables), using Tukey's test for the multiple analysis of homogeneous variables, and the Games-Howell test for those that did not present homogeneity. Moreover, for the variables that did not follow a normal distribution, the Kruskal-Wallis H nonparametric test (K-W) was applied, along with the Mann-Whitney U test for multiple analysis. A comparative analysis between roles in the same category was also carried out with the Mann-Whitney U test.

RESULTS

Tops. Mesomorphy and ectomorphy followed a normal distribution ($p > 0.05$) and presented homogeneity of variance ($p < 0.05$). However, endomorphy did not follow a normal distribution, thus non-parametric tests were applied.

Table 2 shows the values of the different somatotype components. Analysing the means of each component, the highest endomorphic values were obtained by the tops in age group 2 and the lowest values corresponded to the junior category. However, no significant differences were found among groups (K-W = 8.14; $p = 0.148$). Since no differences were obtained, the multiple analysis was not relevant.

Ectomorphy was higher in juniors and lower in age group 1, finding significant differences in the overall analysis ($F = 2.62$; $p = 0.036$). Significant differences were established only between junior and age group 1 categories ($p = 0.023$) in the multiple analysis.

Significant differences among groups were also found in mesomorphy ($F = 3.33$; $p = 0.012$). The mesomorphic component had the highest mean value in age group 1 and the lowest in the junior category. The differences established in the multiple analysis were between junior and age group 1 ($p = 0.037$), and junior and age group 3 ($p = 0.016$).

If we analyse the classification of the tops' somatotype as a whole, mesomorphy is the predominant component in all categories, except in the junior category, where the ectomorphic component predominates. The most common somatotype was the balanced mesomorph, characteristic of age group 2, age group 3 and senior girls. Although in age group 1 mesomorphy is still the highest component, endomorphy is more important than ectomorphy and is therefore defined as endo-mesomorphy. However, when it comes to age group 4, the contrary is the case and can be classified as ecto-mesomorphic. In the junior category, ectomorphy comes first, followed by mesomorphy differing by more than one unit from endomorphy, thus these gymnasts are defined as ectomorphic mesomorph.

Figure 1 shows the somatocharts of each group of tops, including all the particular cases, as well as the mean. The SDI of the different age groups established that all of them presented a heterogeneous somatotype. On the other hand, SDD_{SM} only established significant differences between the somatotype of the age group 1 and age group 4 categories ($SDD_{SM} = 3.54$), the junior ($SDD_{SM} = 2.77$) and senior categories ($SDD_{SM} = 2.06$), and the age group 4 and junior categories ($SDD_{SM} = 2.45$).

Bases. Mesomorphy and ectomorphy followed a normal distribution ($p > 0.05$), which was not the case for endomorphy. Mesomorphy presented homogeneity of variance ($p < 0.05$), unlike ectomorphy.

Table 3 shows the values of the different somatotype components of the bases. When analysing the means of the components, ectomorphy obtained the highest values in age group 3 and the lowest in the senior category, finding significant differences between groups ($B\text{-}F = 5.26$; $p = 0.001$). The analysis of multiple comparisons found differences only between age group 2 and senior categories ($p = 0.006$), age group 3 and junior categories ($p = 0.023$), age group 3 and senior categories ($p = 0.000$), age group 4 and senior categories ($p = 0.000$), and the junior and senior categories ($p = 0.001$).

Regarding mesomorphy, the highest values were posted by seniors and the lowest by age group 4. This difference proved to be significant in the overall analysis ($F = 2.744$; $p = 0.026$). The only differences found in the multiple analysis were between age group 4 and senior categories ($p = 0.048$).

Despite the differences in the two components above, no significant difference was found in endomorphy ($K\text{-}W = 10.66$; $p = 0.059$). However, the highest results were recorded by the senior girls and the lowest by age group 1 and age group 4.

In the joint analysis of the somatotype of the bases, mesomorphy remains the predominant component in all categories. The balanced mesomorphic somatotype was characteristic of age group 1. The endomorphic component was the second most important in the age group 2, junior and senior categories, classified as endo-mesomorphic in the first two, and endomorphic mesomorphic in the seniors. Finally, age group 3 and age group 4 categories obtained a central somatotype, in which none of the components differed in more than one unit.

Table 2
Tops somatotype of the different categories (mean, SD).

	Age Group 1 (n=5)		Age Group 2 (n=7)		Age Group 3 (n=12)		Age Group 4 (n=18)		Junior (n=9)		Senior (n=3)		Sig.
	X	(SD)	X	(SD)	X	(SD)	X	(SD)	X	(SD)	X	(SD)	p
Heigth	120.70	5.55	128.73	6.87	129.30	5.22	135.96	5.73	143.74	7.79	147.03	3.80	-
Weigh	23.80	1.73	26.74	1.86	27.01	3.64	30.08	3.69	34.27	6.73	39.73	1.47	-
Trochlear condyle of the humerus breath D Femur	4.74	.25	5.24	.26	5.23	.26	5.33	.26	5.48	.20	5.87	.15	-
Bicondyle of the femur breadth	4.16	.17	4.47	.14	4.42	.21	4.56	.23	4.56	.25	5.07	.31	-
Corrected arm girth	19.09	0.89	19.54	1.07	19.96	1.44	20.54	1.50	21.40	2.22	24.15	0.98	-
Corrected calf girth	24.82	1.11	25.80	1.03	25.57	1.63	26.45	1.56	27.24	2.19	28.54	0.70	-
Σ triceps, subescapular, supraspinal skinfolds	19.90	3.26	21.76	5.92	18.19	2.57	17.93	3.23	21.08	9.20	25.53	9.44	-
Endomorphy	2.86	.58	2.91	.92	2.38	.37	2.21	.48	2.44	1.12	2.9	1.25	.148
Mesomorphy	4.67	.18	4.48	.91	4.52	.53	4.06	.72	3.50	.71	4.3	.70	.012*
Ectomorphy	2.14	.84	2.99	1.46	3.03	.66	3.48	1.00	3.97	1.07	2.97	.84	.036*

*p<0.05

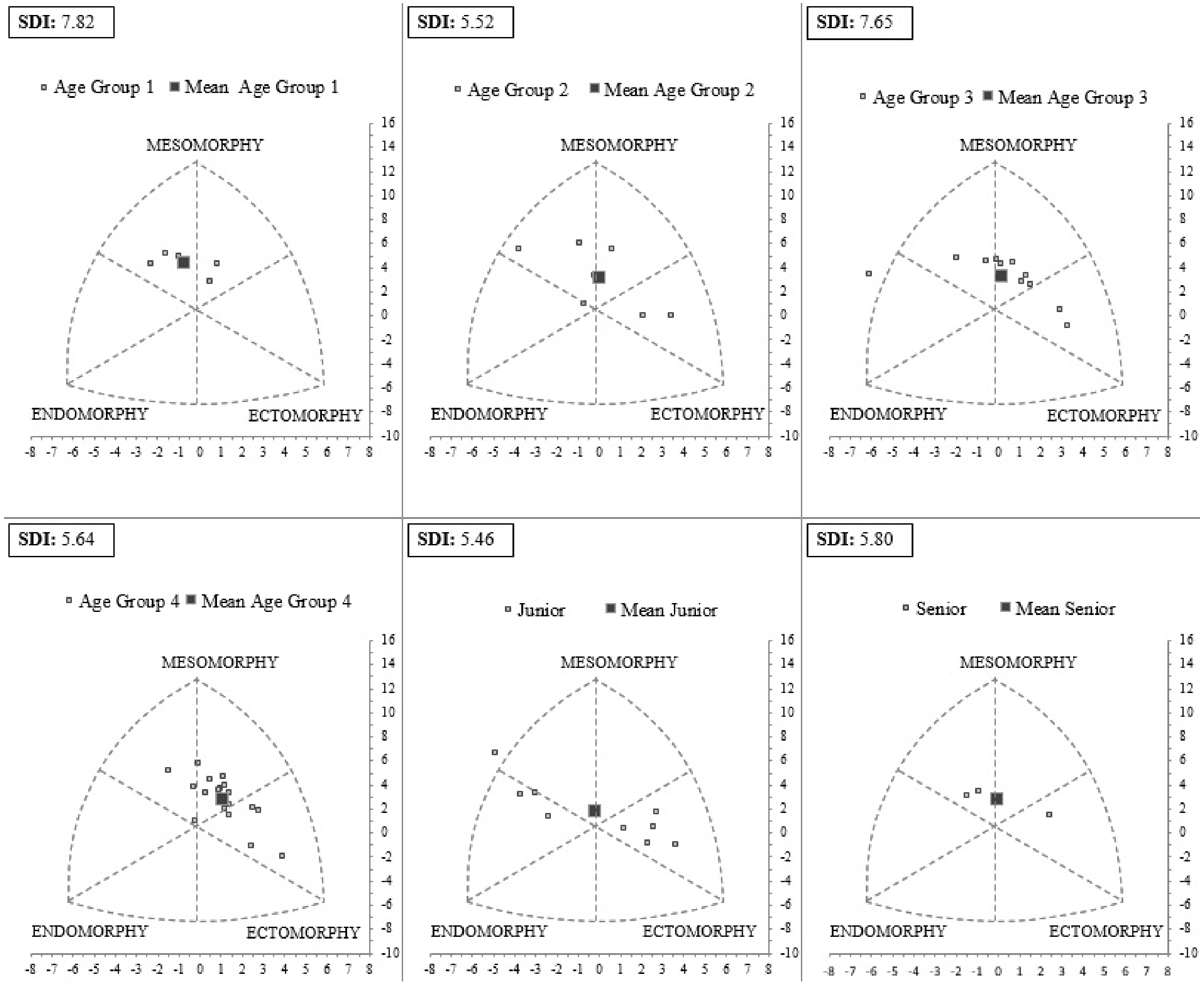

Figure 1. Somatocharts of different categories of tops and homogeneity (SDI).

Table 3
Bases somatotype of the different categories (mean, SD).

	Age Group 1 (n=4)		Age Group 2 (n=9)		Age Group 3 (n=14)		Age Group 4 (n=29)		Junior (n=17)		Senior (n=2)		Sig.
	X	(SD)	X	(SD)	X	(SD)	X	(SD)	X	(SD)	X	(SD)	p
Heigth	145.88	7.71	156.06	7.79	154.51	4.91	160.09	5.44	162.29	4.91	152.85	4.31	-
Weigh	39.33	8.41	48.90	6.20	44.34	4.57	50.73	6.96	57.98	7.62	55.55	4.17	-
Trochlear condyle of the humerus breath D_Femur	5.65	.26	5.90	.25	5.72	.24	5.88	.32	6.06	.37	5.85	.49	-
Bicondyle of the femur breadth	8.25	.25	8.51	.40	8.38	.32	8.34	.39	8.88	.57	8.95	.21	-
Corrected arm girth	23.11	1.76	24.83	1.81	24.08	1.56	25.82	2.10	26.99	2.03	27.90	1.79	-
Corrected calf girth	29.09	2.46	31.17	1.49	30.16	1.76	31.74	2.42	33.13	1.92	33.75	1.06	-
Σ triceps, subscapular, supraspinal skinfolds	26.25	12.93	31.19	7.78	27.59	6.26	28.17	8.65	34.81	11.68	47.45	7.28	-
Endomorphy	3.02	1.42	3.46	.90	3.08	.78	3.02	.93	3.66	1.09	5.25	.82	.059
Mesomorphy	4.22	.38	3.92	1.00	3.58	.81	3.55	.98	4.18	.90	5.55	1.62	.026*
Ectomorphy	2.97	.87	2.72	1.01	3.43	.99	3.18	1.30	2.22	.97	.92	.06	.001**

*p<0.05, **p<0.001.
(X: mean; SD: Standard Deviation)

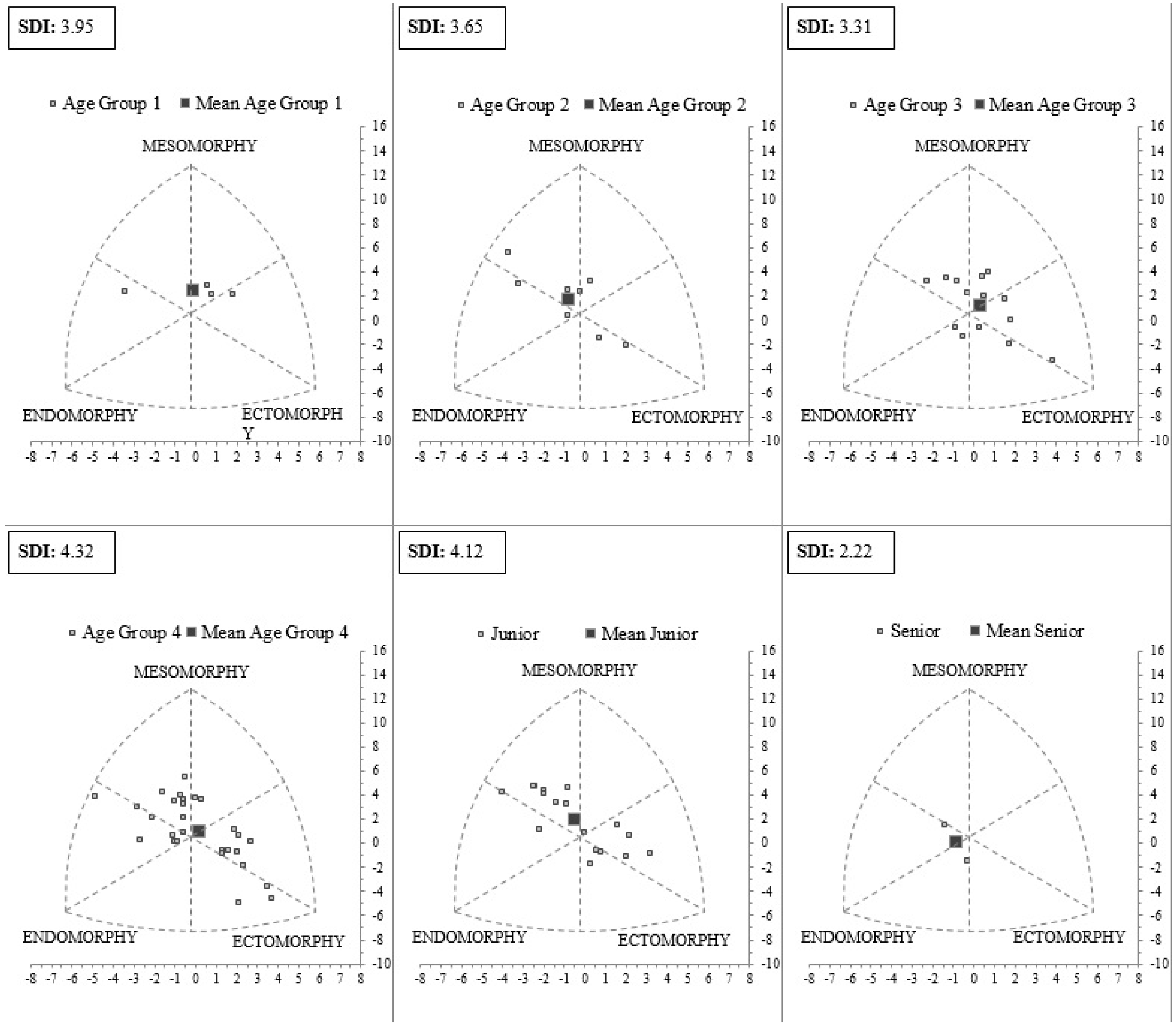

Figure 2. Somatocharts of different categories of bases and homogeneity (SDI).

Table 4
Comparison between roles in each of the age categories.

	Endomorphy		Mesomorphy		Ectomorphy	
	U	Sig. Exact (bilateral)	U	Sig. Exact (bilateral)	U	Sig. Exact (bilateral)
Age Group 1	7.50	0.556	2.00	0.063	17.00	0.111
Age Group2	44.50	0.174	24.00	0.470	27.00	0.681
Age Group 3	130.50	0.015*	26.00	0.002*	100.00	0.432
Age Group 4	406.50	0.001*	182.00	0.084	219.00	0.358
Junior	123.00	0.011*	110.00	0.075	21.00	0.002*
Senior	6.00	0.200	4.00	1.000	0.00	0.200

(U= U value of Mann-Whitney) *$p<0.05$

Figure 2 shows somatocharts for each group of bases, describing the individual cases and the group mean. The SDI of the bases also proved that all age groups had a heterogeneous somatotype. On the other hand, the SDD_{SM} showed significant differences between senior bases and the following age categories: age group 1 (SDD_{SM} = 2.79), age group 3 (SDD_{SM} = 2.34), age group 4 (SDD_{SM} = 2.03) and junior (SDD_{SM} = 2.05).

Role differences. The SDD_{SM} between roles for each category established significant differences in age group 1 (SDD_{SM} = 2.24), age group 3 (SDD_{SM} = 2.04), age group 4 (SDD_{SM} = 2.41) and seniors (SDD_{SM} = 3.07). However, no significant differences were found in either the age group 2 category (SDD_{SM} = 1.98) or the junior category (SDD_{SM} = 0.49). On the other hand, the differences of each component individually only indicated a significant superiority of endomorphy of the bases in the age group 3, age group 4 and junior categories. This means a significantly superior mesomorphy of tops in the age group 3 category, and a clear superiority of ectomorphy among junior tops (Table 4).

DISCUSSION

Sports like gymnastic disciplines where early specialisation is required need an approach to these anthropometric variables in each age group in order to understand what the physical evolution of gymnasts is like in terms of talent detection. This research provides data regarding one of the least studied disciplines, acrobatic gymnastics, and innovates in the determination of these values in each age category. The need to carry out a proper evaluation in AG arises from the fact that each gymnastic discipline presents a different physique. However, many of them stand out for their high levels of mesomorphy, reflecting common aspects. Previous evidence in AG research (Taboada-Iglesias et al., 2017) have shown that mesomorphy was the predominant component of both tops and bases in all categories of competition or female modality (women's pair, women's group or tops in a mixed pair).

This clear superiority of mesomorphy is even more important in MAG, where it is the predominant component (Bies & De la Rosa, 2006; Fontana et al., 2014; Irurtia et al., 2009a). The same trend is observed in WAG, with mesomorphy being the most important somatotype component, defined as ecto-mesomorph (Bacciotti, Baxter-Jones, Gaya, & Maia, 2017; Irurtia et al., 2008; Massida et al., 2013) as well as tops in the age group 4 category, pointing out the possible relationship between mesomorphy and sport performance. In general, all categories of AG tops and bases in the present study obtained the highest values in mesomorphy, confirming previous studies and providing evidence of their similarities with MAG and WAG disciplines.

However, in RG, mesomorphy is surpassed by ectomorphy, the latter being the predominant component throughout the history of this gymnastic specialty (Canda, Rabadán, Sainz, & Agorreta, 2019). This specialty shows a somatotype that differs from the rest. Similar results were found for the Portuguese national team; it has been defined as a balanced ectomorph. However, in Brazil, even though the ectomorphic component is predominant, endomorphy is the second most important (Batista, Garganta, & Ávila-Carvalho, 2019). Although mesomorphy is predominant in AG, Taboada-Iglesias et al. (2016) indicated that there was a clear difference between the acting roles except in mesomorphy. Endomorphy and ectomorphy presented significant differences between the roles, with ectomorphy being the second most important component in tops and endomorphy in bases. Thus, the somatotype of the tops is closer to that of the RG gymnasts than to that of the bases. This study follows this trend, given that ectomorphy in female tops is the second most important component in all categories, except for age group 1 and seniors, with significant differences in the junior category. In bases, however, the second most important component is endomorphy except for age group 3 and age group 4, where ectomorphy ranks second. In spite of high ectomorphy values obtained by bases in age group 3 and age group 4, in both categories along with juniors endomorphy is significantly higher in bases than in tops. The significant differences between the roles are confirmed through the SDD_{SM} in all categories except for age group 2 and juniors.

Studies suggest that across age categories gymnasts obtain different results that affect the distribution of components. In MAG it was observed that despite the higher mesomorphic component at younger ages, ectomorphy was the second most important component, above endomorphy, but that in older groups both components tended to be equal (Fontana et al., 2014).

Studies on WAG gymnasts show that the mesomorphic component is the most important in all age categories (Bacciotti et al., 2018; Massidda et al., 2013). Despite this, the authors observed a greater importance of ectomorphy in younger gymnasts, and an increase in endomorphy, even surpassing ectomorphy, in gymnasts over 16 (Bacciotti et al., 2018). This increase in the endomorphic component cannot be confirmed for AG, as no significant differences were found between categories in either tops or bases.

The results indicated that tops in age group 1 had a SDD_{SM} with significant differences from the older categories, and there may be a certain tendency associated with age. However, the endomorphic component did not present any significant differences between any categories. Hence, this increase in endomorphy with age was not observed as noted by Bacciotti et al. (2018) in gymnasts in WAG. It can only be stated that the junior category presented significantly greater differences in ectomorphy with respect to age group 1, and in mesomorphy with respect to age group 1 and age group 3.

This evolution towards an increase in bases' endomorphy is not observed, since no significant differences can be found among any categories. It should be noted that, except for age group 3, the endomorphic component is higher than the ectomorphic one. In contrast to the tops, the SDD_{SM} in bases indicated only significant differences between seniors and age group 1, age group 3, age group 4 and juniors, thus one cannot conclude that the somatotype has a linear relationship with age.

The absence of a linear relationship of the somatotype in AG gymnasts was also observed in the fact that, although there were no age differences between junior and senior bases, there were somatotypical differences. We should note that in senior bases, endomorphy and mesomorphy are practically equal, whereas the ectomorphic component is very low. However, in the junior category, the ectomorphic component is the most important. In fact, significant differences were obtained in the ectomorphy of both categories in the multiple comparison, which may be due to sports performance factors rather than age development. However, the results of this study are similar to those found by Irurtia et al. (2008), Irurtia et al. (2009a) and Corbella and Barany (1991) in WAG, MAG and RG respectively, in which authors found no significant differences in somatotype over age.

However, unlike the AG results in this study, for RG, WAG and MAG, there are also studies that point to a somatotype variation in relation to age. Research showed that ectomorphy is the most important component in the younger age categories, but mesomorphy and, to a greater extent, endomorphy increase over the years, possibly due to biological maturation, with endomorphy becoming the most important component in the senior category (Oliveira et al., 2017; Purenović-Ivanović & Popović, 2014). On this research line, Poliszczuk, Broda and Poliszczuk (2012) observed in a sample of RG gymnasts with an initial mean age of 9.79 years that over a two-year period they increased the proportion of the endomorphic and mesomorphic component. However, Quintero et al. (2011) indicated that ectomorphy was only dominant in the age group 1 and age group 2 categories, but with very similar endomorphy values, this being the highest component even in the junior and age group 4 categories. The difference from other studies may be due to the fact that it is an autonomous sample, as opposed to the high dependency level of the previous ones. Similarly, to interpret the results, we must note that in our sample we had to add up all the modalities (trios and pairs) and that the age categories of competition have such wide ranges that the average age is not always higher in higher categories. Likewise, another limitation derives from the characteristics of the modality that mixes athletes of very different ages with very varied numbers of years of sport experience. This trend of evolutionarily increasing endomorphy across age categories was not seen in either the tops or the bases in this research. In fact, the ectomorphic component that characterizes RG gymnasts, and which is more specific to the role of the tops, is more present in the age group 4 and junior categories, pointing out that the tops in age group 4 are older than seniors. This situation may be due to the creation of competition groups for a greater projection of the sport, as the Code of Points allows for age ranges, and it is not clear whether senior groups or pairs have the highest performance level.

CONCLUSIONS

Given the results obtained, despite finding certain differences, one cannot conclude that there is a clear evolution of the somatotype associated with maturation. This lack of differences may be due to the highly specialized roles of gymnasts from a very early age, as some studies in MAG, WAG and RG pointed out. Similarly, the heterogeneity of the sample level may have been the factor that established these small variations found in the study. However, we can state that mesomorphy, as in other gymnastics disciplines, is the predominant component in all categories and roles.

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