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ORIGINAL

ANTHROPOMETRIC PROFILE OF THE MADRID WOMEN'S SOCCER TEAM U-16 AND U-18

PERFIL ANTROPOMÉTRICO DE LA SELECCIÓN MADRILEÑA DE FÚTBOL FEMENINO SUB-16 Y SUB-18

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ABSTRACT

During the 2017-2018 season and following the protocol of the International Society for the Advancement of Kinanthropometry, the body composition, somatotype and proportionality of 25 female elite Spanish soccers players aged 15-18 were evaluated (15.48 ± 1.05). The percentage of body fat (%BF) analyzed by anthropometry was in the range of 14.21% - 17.30% and by BIA between 24.20%- 29.63%. The lowest adiposity corresponded to female wing players and the highest to female goalkeepers and strikers. The average somatotype was 3.67-4.10-1.90 for the whole sample; in the under 18 years category (3.10-4.33-1.82) the somatotypic dispersion was lower and the mesomorphia higher than in the under 16 years category (3.20-3.97-1.95). In

proportionality analysis, it showed that the players, especially the under 18 players, had lower subcutaneous skinfolds and higher perimeters in the lower limb than the Phantom model.

KEY-WORDS: Kinanthropometry; Body composition; Body proportionality; Women´s football, Phantom.

RESUMEN

Durante la temporada 2017-2018 y siguiendo el protocolo de la Sociedad Internacional para el Avance de la Cineantropometría, se evaluó la composición corporal el somatotipo y proporcionalidad de 25 jugadoras españolas de elite de 15-18 años (15,48 ± 1,05). El porcentaje de grasa corporal (%GC) analizado por antropometría estuvo en un rango de 14,21% - 17,30 % y mediante BIA entre 24,20%-29,63%. La menor adiposidad correspondió a jugadoras de banda y la mayor a porteras y delanteras. El somatotipo medio fue 3,67-4,10-1,90 para el conjunto de la muestra; En la categoría sub-18 (3,10-4,33-1,82) la dispersión somatotípica fue menor y la mesomorfia mayor que en la categoría Sub 16 (3,20-3,97-1,95). En análisis de proporcionalidad, mostro que las jugadoras, sobre todo las Sub18, presentan menores pliegues subcutáneos y mayores perímetros en la extremidad inferior que el modelo Phantom.

PALABRAS CLAVE: Cineantropometría; Composición corporal; Proporcionalidad corporal, fútbol femenino, Phantom.

1. INTRODUCTION

Football is one of the most widely practiced collective sports in the world and its recognition as such dates back to 1863, when it was separated from rugby-football and the first governing body, the Football Association of England, was created. Today, it is played worldwide by men and women of different nationalities and ages (Fédération Internationale de Football Association FIFA, 2018)

During the 21st century, women's football categories have had the greatest media impact, culminating in the representation of 135 national teams. The first kick in women's football took place in Mexico during the FIFA Congress associated with the 1986 Men's World Cup. There, the Norwegian women's footballers demanded a worldwide women's competition, with an experimental tournament being organized in 1990 in China (Almagà et al., 2008). The success was such that the following year, the FIFA Women's World Cup was held at odd-numbered intervals over four years. In this way, women have been gradually positioning themselves in the game, incorporating various training categories and increasing local, regional and university competitions in Spain. At a national level, it is worth mentioning the official creation of the Spanish Women's Football Team by the Royal Spanish Football Federation (RFEF) in 1983, although it had already existed since 1971 when women's football was not officially recognized by either the RFEF or FIFA.

In Spain, women's football is growing at a dizzying rate. In 2004, the U-19 team was crowned European champion, while the U-17 team played in the World Cup final and was runner-up. Subsequently, in 2015 the Absolute Selection managed to qualify for the first time in its history for the Final Phase of the World Championship. It was in 2018 when the most successful women's football youth categories at national level took place: the U-19 team became European champions; the U-20 team was runner-up in the World Cup and the U-17 team was European and World champions, thus winning the first Spanish women's football world title.

Football demands an intense and intervallic physical activity, determined by the alternation of short and intense efforts, in periods of low or moderate-intensity work and anarchic recovery breaks, using aerobic metabolic pathways, but with 70-80% of the anaerobic profile. In this way, oxygen consumption is what differentiates the elite footballer from the rest of the athletes (Cabañas and Esparza, 2009). Within this sport discipline, motor performance depends on different levels such as technical, tactical, physical, physiological and psychological (Stolen et al., 2005). This physiological level usually includes nutritional and sports performance assessment through anthropometry. This aspect is considered fundamental (Garganta et al., 1993; Casajús and Aragonés, 1997; Clark et al., 2003) since form, proportionality and body composition (BCC) play a determining role in the potential for success in a given sports specialty (Norton et al., 1996). Anthropometry is therefore a tool for the detection of young talent that allows for the evaluation of progress and the most appropriate morphotype for a sports specialty based on the similarity of the young athletes with the elite reference for the sport they wish to practice. (Carrasco et al., 2005 Reilly, 2008.)

Clubs and players interested in acquiring information about their sporting projection, from the very beginning, can orient and personalize training towards the characteristic reference values of their position on the field of play, minimize injuries and obtain maximum sporting performance (Pacheco, 1993; Maestre, 2004; Mujika et al., 2009). However, the scientific literature offers few studies that use CC for the direct evaluation of performance in women's football, because most studies consider the use of GPS systems, heart rate assessment, lactate indicators, subjective perception of effort scales, jumping tests and endurance tests, among others, as performance indicators (Brocherie et al., 2014).

1. OBJECTIVES

Under the hypothesis that the age category and position on the field of play can lead to differences in the physical and bodily condition of female athletes, the general objective of this study is to analyze the somatotype, body composition and proportionality concerning the Phantom of a sample of Spanish football players.

2. MATERIAL AND METHODS

According to the complete ISAK 2018 protocol, the anthropometric profile of 25 players belonging to the Madrid Women's Soccer Team, 16 from the U-16 team and 9 from the U-18 team was evaluated during the second phase of the 2017-18 Women's Soccer National Championship in the Community of Madrid, Spain. Following the recommendations of the Declaration of Helsinki (WMA, 2013), the players were given prior informed consent, signed by the players who were of legal age or by their parents or legal guardians in the case of minors, as well as permission from the club's management, coaching staff and medical staff.
The measurements were taken with homologated material and duly calibrated by ISAK Level 3 and 1 accredited personnel, collecting the data in duplicate. Four basic measurements were taken: Body Mass (BM) employing a SECA digital scale, with an accuracy of 100 grams; height (cm) and sitting height (cm) through a portable stadiometer (GPM) with an instrument error of 0.1 cm and arm span (cm). Using an adipometer (Holtain) accurate to 0.2mm, the thickness of 7 skin panniculus (mm) was taken and using a flexible metal tape measure (Cescorf) accurate to 0.1 cm, 12 body circumferences (cm). Using a Roscraff segmometer with precision (0.1 cm), 8 lengths were measured and with the Cescorf Innovare 4 pachymeter with precision 0.1 mm, 8 bone diameters. In all cases the technical measurement error was calculated.

From the direct measurements, the body mass index (BMI= Kg/m2) was estimated and the nutritional status of the players was classified using the cut points for BMI from Cole et al.(20090). Following the protocol of Alvero et al. (2009), for the estimation of the adipose component, the %BF was recorded using tetrapolar electrical bioimpedance (BIA) (Tanita) and utilizing the formula of Yuhasz (1977), which contemplates the sum of six subcutaneous folds (triceps fold, subscapular, suprailiac or iliac crest, abdominal, thigh-frontal and medial calf). From both %BF and BM, the fat mass (FM) and lean weight or fat-free mass (FFM) were estimated, according to the bicompartmental model and the fat mass (FM), muscle mass (MM), residual mass (RM) (Würch, 1974) and bone mass (BOM) (Rocha, 1975), according to the tetra-compartmental model (Matiegka, 1921). The three components of the somatotype were calculated according to Heath-Carter (1967), studying proportionality using the Phantom model (Ross and Wilson, 1974). Compared to classical analysis based on indices, this model allows the proportions of an individual or group to be evaluated regardless of their particular characteristics such as sex, age, ethnicity or physical activity (Cabañas et al 2008).

For its analysis, the sample was subdivided according to the age category of the players and the position on the pitch, following the five protocolized categories: goalkeepers, defenders, midfielders, strikers and wingers. The statistical procedure was carried out using IBM SPSS Statistics 23.0. software, estimating descriptive statistics and employing parametric or non-parametric tests for the comparison of means.

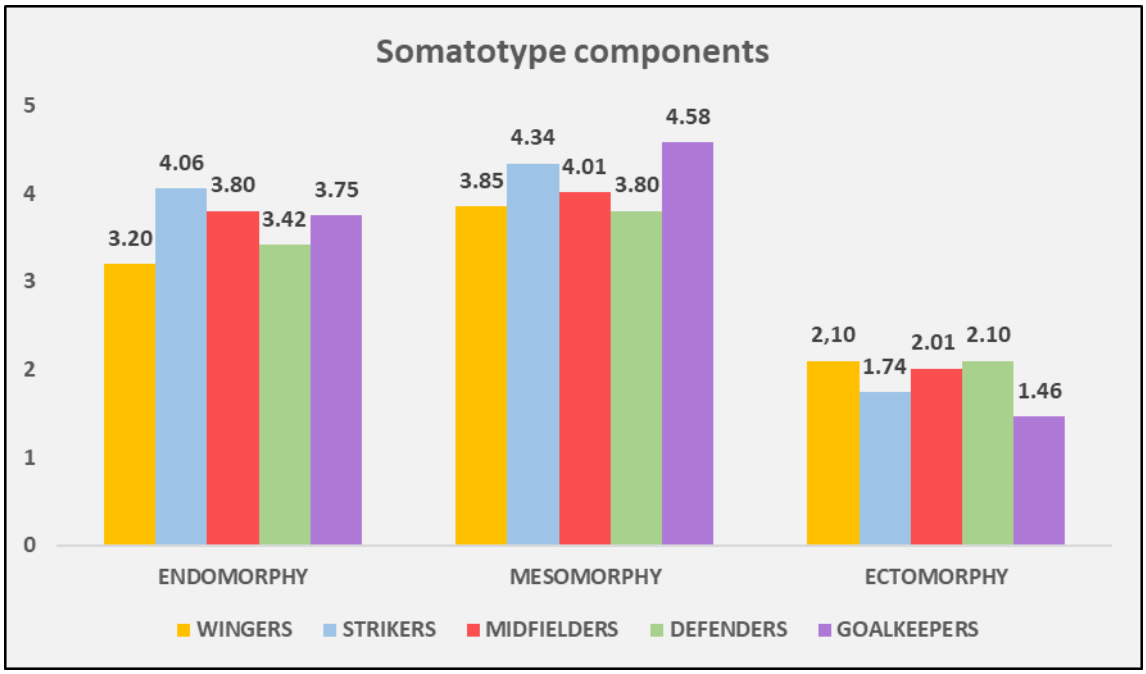
3. RESULTS

Table 1 shows the average values according to the position in the field, obtained for BM, height, wingspan, BM, RM and %BF, FM, FFM and MM obtained by BIA and anthropometry. As you can see, there is greater contrast between the demarcation of goalkeeper and wing player. Goalkeepers have a higher BM, height, and wingspan, as well as a higher %BF, FM, FFM, RM and MM regardless of the method used to estimate them. Midfielders and strikers recorded higher values for %BF. In contrast, wing players had the lowest values for all measures taken and estimated. It is noteworthy that the %BF and FM obtained by BIA are higher than those obtained by anthropometry, while the opposite is true for FFM and MM. This is true for all subseries regardless of field positions.

Table 1. *Anthropometric profile of the players of the Madrid U-16 and U-18 national teams by positions on the field. Mean and Standard Deviation (SD).*

	Goalkeepers N=4		Defenders N=5		Midfielders N=7		Strikers N=5		Wingers N=4	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Body mass (Kg)	65.55	3.38	58.42	4.93	57.27	3.99	62.70	8.38	51.98	4.11
Height (cm)	164.93	6.14	161.60	4.44	160.96	4.02	162.26	8.88	156.23	3.00
Wingspan (cm)	164.93	5.49	162.30	4.04	158.29	4.91	163.50	11.56	158.18	6.25
%BF (BIA)	29.63	2.97	27.36	1.92	24.80	3.57	25.50	5.72	24.20	5.01
FM (BIA) (Kg)	19.43	2.35	16.04	2.23	14.24	2.48	16.36	5.12	12.73	3.64
FFM (BIA) (Kg)	46.12	2.70	42.38	2.97	43.03	3.13	46.36	3.42	39.24	0.65
MM (BIA) (Kg)	22.96	1.83	21.21	1.00	22.23	2.53	23.54	0.87	20.13	0.84
%BF(Yuhasz)	15.99	3.06	15.55	2.48	17.47	3.27	17.30	3.66	14.21	2.24
FM (Yuhasz) (Kg)	10.49	2.10	9.14	2.05	10.05	2.21	11.00	3.21	7.45	1.78
FFM (Yuhasz) (Kg)	55.06	3.25	49.28	3.59	47.22	3.05	51.72	6.15	44.52	2.40
MM (Yuhasz) (Kg)	31.91	2.17	28.11	2.77	26.42	2.40	28.90	3.64	25.41	1.44
BM (Kg)	9.46	0.73	8.96	1.45	8.83	0.62	9.71	1.01	8.25	0.43
RM (Kg)	13.70	0.71	12.21	1.03	11.97	0.83	13.11	1.75	10.86	0.86

According to the classification proposed by Cole et al. (2000, 2007) for the BMI, only three overweight players from the U-16 team were detected: two goalkeepers and one striker. However, their %BF is below 22% (estimated by anthropometry) and below 30% (estimated by BIA).



In figure 1 where the somatotypic components are represented, a predominance of mesomorphy is observed, regardless of the position on the field, followed by endomorphy and ectomorphy, respectively. This changes according to the age categories, as in the U-16 players the endomorphy (3.99 ± 0.96) and mesomorphy (3.97 ± 1.07) show similar values, while in the U-18 category there is the mesomorphic component (4.33 ± 0.51) which is superior to the endomorphic (3.10 ± 0.62), as shown in Figure 2.

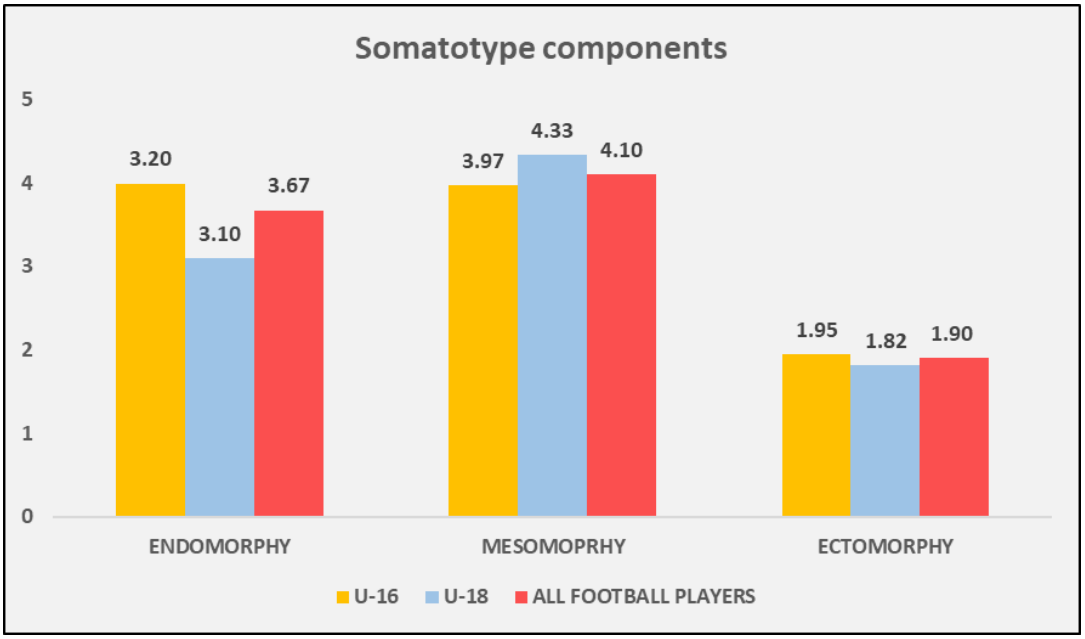


Figure 2. *Somatotypical components of the football players of the Madrid National Team according to the age category.*

Figure 3 shows a lower somatotype dispersion of the U-18 players: four players have a balanced mesomorphic somatotype, four a meso-endomorphic somatotype and one a central one. In contrast, the U-16 players have a greater variety of somatotypes: five meso-endomorphic players, seven endomorphic-mesomorphic, four central, one endo-mesomorphic and one ectomorphic-endomorphic.

There is no clear relationship between somatotype and position on the field of play. However, it is worth noting the presence of players with a meso-endomorphic somatotype in all positions on the field, except for defenders, and the presence of four different somatotypes within midfielders (Figure 4).

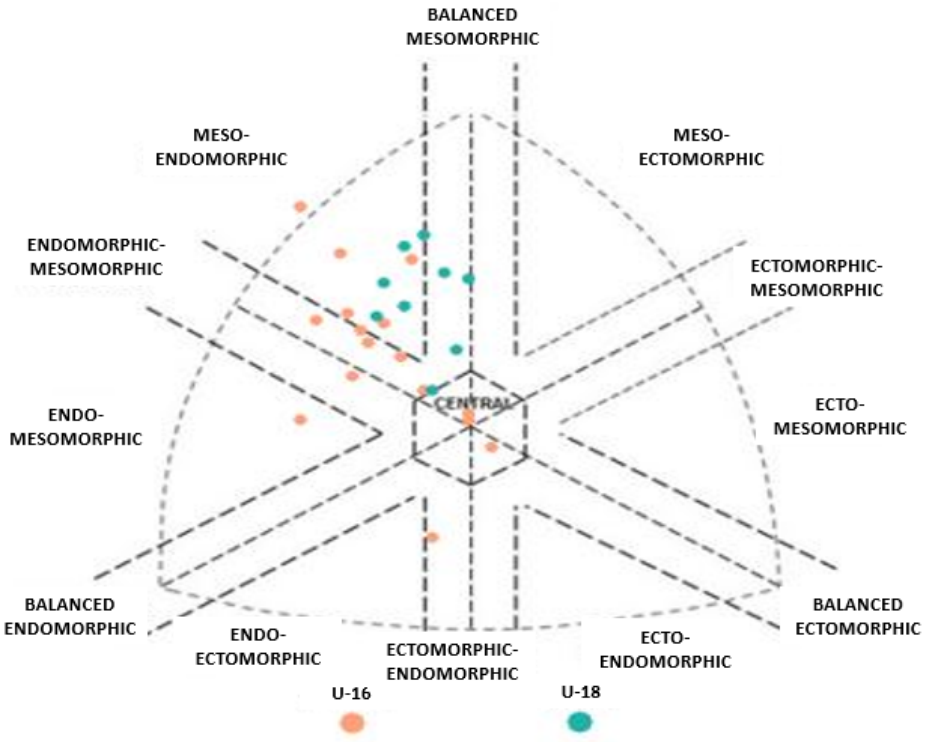


Figure 3. *Somatochart of the football players of the Madrid National Team U-16 and U-18.*

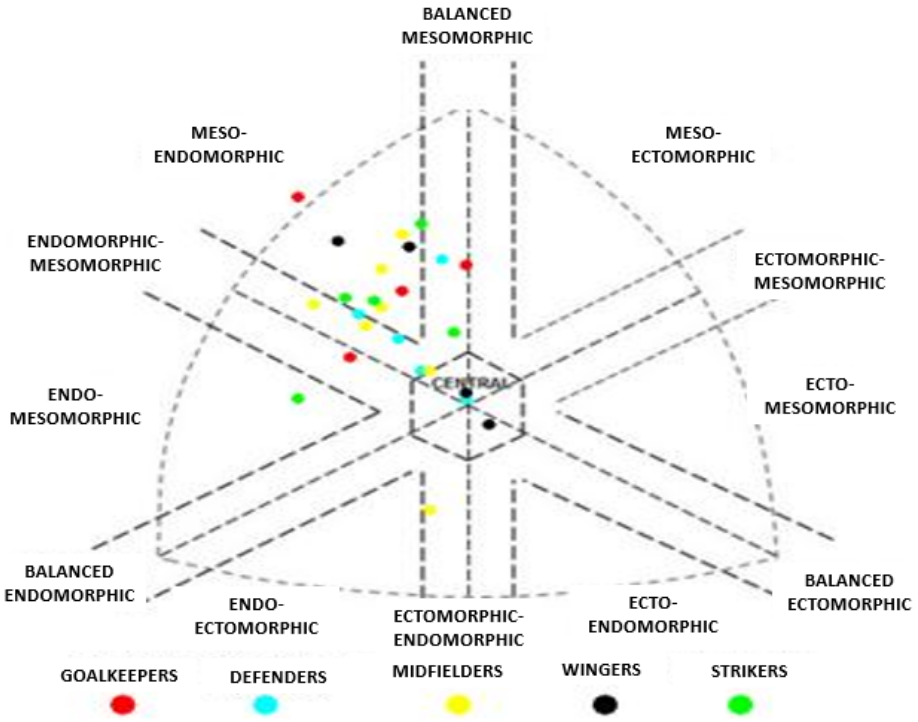
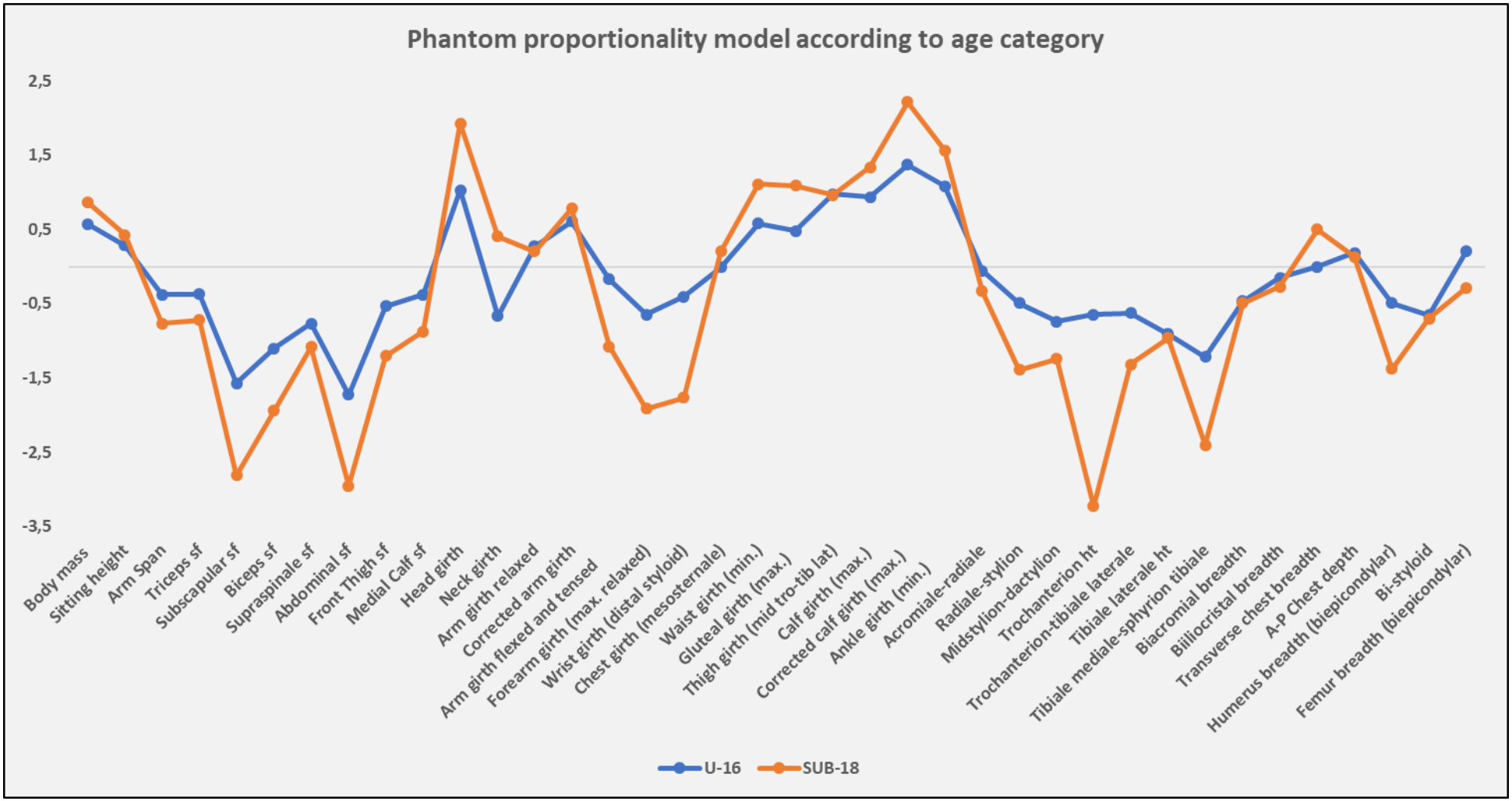


Figure 4. *Somatochart of the Madrid U-16 and U-18 women's footballers grouped by position on the field.*

The proportionality model illustrated in Figure 5 shows that the adiposity of the players studied here is lower than that of the Phantom model, particularly those belonging to the U-18 category. On the contrary, certain perimeters such as the gluteal, thigh and calf are increased. On the other hand, in figure 6, five different proportionality profiles are clearly distinguished according to the position on the pitch. Thus, the greatest deviations from the model (whether positive or negative) correspond to the wing players, followed by the strikers, midfielders, defenders, and goalkeepers in that order.


Phantom proportionality model according to age category
2,5
1,5
0,5
-0,5
-1,5
-2,5
-3,5
Body mass
Sitting height
Arm Span
Triceps sf
Subscapular sf
Biceps sf
Supraspinale sf
Abdominal sf
Front Thigh sf
Medial Calf sf
Head girth
Neck girth
Arm girth relaxed
Corrected arm girth
Arm girth flexed and tensed
Forearm girth (max. relaxed)
Wrist girth (distal styloid)
Chest girth (mesosternale)
Waist girth (min.)
Gluteal girth (max.)
Thigh girth (mid tro-tib lat)
Calf girth (max.)
Corrected calf girth (max.)
Ankle girth (min.)
Acromiale-radiale
Radiale-stylion
Midstylion-dactylion
Trochanterion ht
Trochanterion-tibiale laterale
Tibiale laterale ht
Tibiale mediale-sphyrion tibiale
Biacromial breadth
Biiliocristal breadth
Transverse chest breadth
A-P Chest depth
Humerus breadth (biepicondylar)
Bi-styloid
Femur breadth (biepicondylar)
U-16
SUB-18

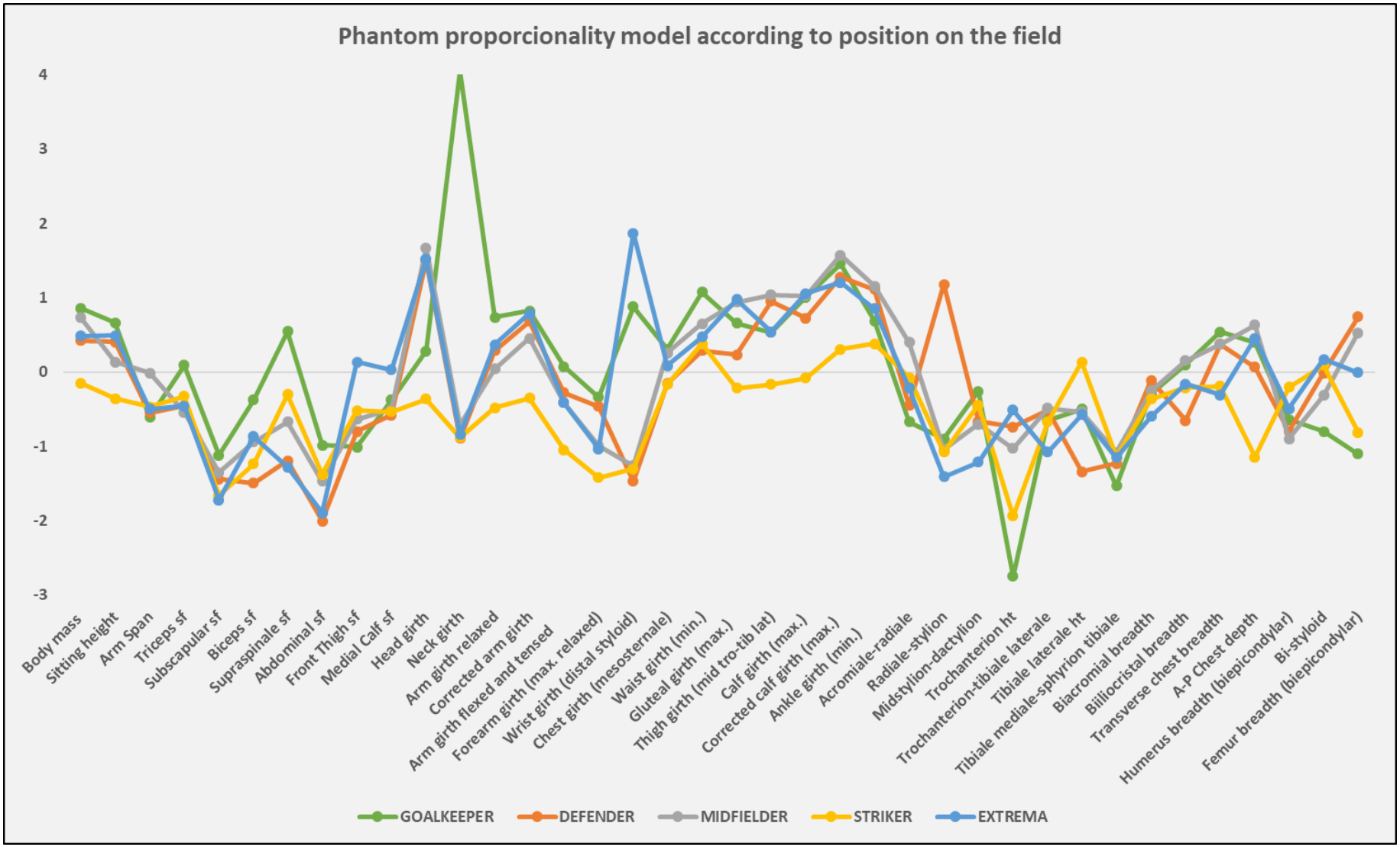


Figure 6. *Phantom proportionality model of the players of the Madrid U-16 and U-18 women's football teams according to their position on the pitch.*

4. DISCUSSION

In the scientific literature there are numerous works in which the anthropometric profile of Spanish male football players is studied, but not of female football players, which limits the possibility of finding references (Garrido et al., 2004). The scarcity of literature on the subject must be added to the variability in the sporting performance of footballers with a similar body type (Liparotti, 2004). Thus, while some authors consider football to be a low-FM sport in which technique and physical appearance are judged (Cabañas and Esparza, 2009), others consider that body weight, height and %BF are not determining factors in sports performance, because the range of values observed in elite football players is very wide and the skill of each player must be taken into account (Ekblom, 2004).

After analyzing the anthropometric profile of the players of the Madrid National Football Team according to their position on the field, we observed that those on the sidelines have the lowest estimated values for %BF, FM, FFM and MM, both by BIA and by anthropometry. In this sense, women players on the sidelines are more physically active than goalkeepers or defenders, and they travel longer distances during matches. Following the same line, goalkeepers are the players with the greatest height and wingspan, which allows them to cover and defend a larger goal area. These results coincide with those obtained by González-De Los Reyes et al. (2019), who also register a greater height in the group of youth players composed of goalkeepers and central defenders. It should be noted that perhaps against expectations, goalkeepers are not the most ectomorphic; despite being the players with the greatest height and wingspan, they also have the greatest weight and level of adiposity, which reduces the weight index that supports the third somatotype component.

On the other hand, when we analyzed the anthropometric profile of the players according to their age category, we observed a lower %BF, FM and the endomorphic component of the somatotype in favor of an increase in the FFM, MM and mesomorphic component in the U18 players. Furthermore, while all U18 players are in the normal weight range, three U16 players are overweight. These differences can be explained by a greater professionalization of the sport in the U-18 category, where there are greater nutritional control and a greater volume of training and games (Cabañas and Esparza, 2009). But we must not forget that BMI is an indicator that does not distinguish whether excess weight for height corresponds to musculoskeletal mass or FM. Many authors have highlighted the limitations of BMI for the assessment of overweight and obesity during adolescence, when there are great variations in CC and particularly in sport (Teixeira et al., 2018; Carvalho et al.,2017)

The results obtained in the present study coincide with those of Bahamondes et al. (2012), who showed the beneficial effect of training to reduce the adipose component throughout the season. They are also in line with the studies carried out by Pacheco (1993) or Rebato and Rosique (2003), which show the predominance of the mesomorphic component in athletes of both sexes, about the non-sporting population, which presents greater endomorphism.

Concerning the somatotypic variability detected in this study, the U-16 players present a greater diversity of somatotypes whose common denominator is a predominance of muscle-adipose, where the negative values of X would correspond with rounded body shape and the positive values of Y with a predominance of muscle-skeletal (Cabañas and Esparza, 2009). On the other hand, under-18 players present a lower somatotypical dispersion, characterized by a predominance of the mesomorphic component. Thus, as age increases, the variation in somatotype components is less, identifying a more restricted somatotypic distribution area, which indicates that U18 players would constitute a more homogeneous subpopulation. About the position on the field of play, it is worth mentioning the presence of meso-endomorphic somatotypes in all possible demarcations, except defensive ones, and the high variability of somatotypes recorded in midfielders, who combine defensive and offensive tasks during matches.

In a study with a similar approach to ours, Caballero-Ruiz et al. (2019) analyzed the CC of 19 female soccer players from a Mexican university team. These players had a higher average age than those in the present study (20.6 ± 2.2). In their average somatotype (4.30 - 3.60 - 2.00) the endomorphic component predominates, being their mesomorphism lower and their ectomorphism similar to the Spanish ones (3.67-4.10-1.90). Regarding the position on the field of play, the highest endomorphism is reported in the Mexican defenses (5.10) against the Spanish forwards (4.06). In the case of the Mexican players the mesomorphic component reached the highest figure among the goalkeepers (4.58) and the ectomorphic component among the defenders (1.5).

It should be added that after an exhaustive bibliographic search, very few scientific references on women's football have been found, even fewer in Spain. The few investigations carried out, are focused on describing the anthropometric and physiological characteristics of the players leaving aside the analysis of the distribution of adiposity or the analysis of proportionality. Gómez's study (2006) of 52 Spanish players from the Atlético B club with an average age of 20.73 years, during the 2003-04 season, analyzes only averages of height (163 ± 0.06 cm); weight (50.1 ± 8.16) and %BF (16.01± 3.08). The works of Juric et al. (2007) on Croatian football players or those of Ritschard and Tschopp (2012) on women who participated in the FIFA World Cup have a very descriptive orientation. The review by Oyon et al. (2016) firstly highlights that the studies on a global level have very limited samples, as the vast majority of publications are based on series of between 10 and 22 players. Secondly, that the methods of analysis, especially of %BF, are varied and make comparison difficult. Thirdly, that the anthropometric dimensions evaluated focus mainly on size description, but provide little information on detailed CC or proportionality and none on somatotypic profile.

This event highlights the need to promote somatotype, CC and proportionality studies within professional teams and/or clubs to improve players' health and performance, as well as to contribute positively to the talent selection process that will result in greater individual and collective sporting success in this genre, which is on the rise because the press now regularly includes comments on the sport.

5. CONCLUSIONS

The present study provides current values on proportionality, body composition and somatotype of a sample of Spanish football players in the U-16 and U-18 categories, which can serve as reference values for coaches, researchers and football professionals.

The relative adiposity ranges from 24.20% of the female wing players to 29.63% of the goalkeepers (applying BIA) and between 14.21% of the former and 17.30% of the latter (applying anthropometric method) The FFM estimated by BIA was in the range of 39.24 kg (wingers) and 46.36 kg (strikers) and the range of 44.52 (wingers) and 55.06 (goalkeeprs) if it was estimated by anthropometry.

The average somatotype was meso-endomorphic (3.67-4.10-1.90) for the whole sample, although the mesomorphism was higher in the U-18 series (3.10-4.33-1.82) than in the U-16 series (3.20-3.97-1.95) which also showed a higher somatotypic dispersion. No association between somatotype and position on the field was detected, although midfielders are the most heterogeneous group.

The proportionality analysis shows those female players as a whole, and in particular those at U-18 level, show less adiposity in all subcutaneous folds and greater perimeter in all locations of the lower limb with the Phantom model.

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