POSITION-SPECIFIC CATEGORIZATION OF SOMATOTYPES: 2011 WOMEN'S 17 EUROPEAN HANDBALL CHAMPIONSHIP

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Introduction

Sports performance in team sports is based on the co-action of both individual and team performance-determining factors. One of the factors that enable to optimize sports performance is that of somatotype. As shown by previous studies, body build is specific with respect to age (Zapartidis et al., 2009), level of performance (Manchado et al., 2012) and playing position (Čavala, Katić, 2010, Urban, Kandráč, Táborský, 2011, Vila et al., 2011). In order to optimize overall performance of the team a coach should have adequate knowledge of the somatotype categorization of the players on the team.

Purpose

The purpose of the present anthropometric study was to determine and compare position-specific somatotypes in U17 top level female handball players who participated in 2011 Women's 17 European Handball Championship.

Tasks

1. To determine somatotypes according to Heath, Carter (1967) in top level female handball players who participated in 2011 Women's 17 European Handball Championship.
2. To calculate mean somatotypes and categorize somatotypes for individual playing positions according to Carter (2002).
3. To compare mean somatotypes and somatotype components between playing positions.

Methods

In total, 240 players of 15 national teams (except Norway) that participated in 2011 Women's 17 European Handball Championship (W17 ECh) in Brno and Zlín, Czech Republic took part in the anthropometric cross-sectional study. The players participating in the study were between 16-17 years. Mean somatotypes and somatotype components of players are described and compared with respect to playing position: goalkeepers (GKs): n = 43, wings (Ws): n = 57, center backs (CBs): n = 40, backs (Bs): n = 64 and pivots (PVs): n = 36.

The somatotypes were determined according to Heath, Carter (1967) using the following parameters:

1. body height and body mass,
2. skinfold thickness: triceps skinfold, subscapular skinfold, supraspinale skinfold and medial calf skinfold,
3. biepicondylar breadths: biepicondylar humerus breadth and biepicondylar femur breadth,
4. girths: upper arm girth, flexed and tensed and standing calf girth.

Somatotypes with similar relationships between the dominance of the components are grouped into categories named to reflect these relationships (Carter, 2002). The definitions of somatotype categories as represented on the somatochart are given below:

1. **Balanced mesomorph:** mesomorphy is dominant and endomorphy and ectomorphy are equal (or do not differ by more than one-half unit).
2. **Ectomorphic mesomorph:** mesomorphy is dominant and ectomorphy is greater than endomorphy.
3. **Mesomorph-ectomorph:** mesomorphy and ectomorphy are equal (or do not differ by more than onehalf unit), and endomorphy is smaller.
4. **Mesomorphic ectomorph:** ectomorphy is dominant and mesomorphy is greater than endomorphy.
5. **Balanced ectomorph:** ectomorphy is dominant and endomorphy and mesomorphy are equal (or do not differ by more than one-half unit).
6. **Endomorphic ectomorph:** ectomorphy is dominant and endomorphy is greater than mesomorphy.
7. **Endomorph-ectomorph:** endomorphy and ectomorphy are equal (or do not differ by more than onehalf unit), and mesomorphy is lower.
8. **Ectomorphic endomorph:** endomorphy is dominant and ectomorphy is greater than mesomorphy.
9. **Balanced endomorph:** endomorphy is dominant and mesomorphy and ectomorphy are equal (or do not differ by more than one-half unit).
10. **Mesomorphic endomorph:** endomorphy is dominant and mesomorphy is greater than ectomorphy.
11. **Mesomorph-endomorph:** endomorphy and mesomorphy are equal (or do not differ by more than onehalf unit), and ectomorphy is smaller.
12. **Endomorphic mesomorph:** mesomorphy is dominant and endomorphy is greater than ectomorphy.
13. **Central:** no component differs by more than one unit from the other two.

The collected data were processed using basic statistical characteristics: **x** - arithmetic mean, **SD** - standard deviation, **min** - minimum value and **max** - maximum value. The data necessary to determine somatotypes of handball players were processed using SOMATO software. The resultant somatotypes were plotted on a somatochart. Somatocharts for plotting somatotypes were designed using CorelDRAW X5 software.

Results and discussion

Goalkeepers - the mean somatotype of GKs was *2.51 - 3.90 - 2.32*, which is *balanced mesomorph*. Overall, the somatotype categorization in GKs should be regarded as relative. 24 GKs fell in categories predominant in mesomorphy (1, 2 and12), however, the same number of GKs demonstrated mesomorphy rating lower than 4.00.

The category of balanced mesomorph is typical by the location of somatopoints in the center of the longitudinal axis and upper right-hand section of the somatochart. As shown in the GKs' somatochart (Fig. 2), there were two types of GKs:

1st type (21 GKs): the somatopoints are located to the left of the longitudinal axis, which shows predominant mesomorphy, higher endomorphy than ectomorphy. Mean somatotype was 1.8 - 3.3 - 3.1. The mean values of body height, body weight and percent subcutaneous fat were 178.7 cm, 69.3 kg and 8.7 %, respectively.

2nd type (22 GKs), the somatopoints of GKs are located to the right of the longitudinal axis: predominance of mesomorphy, higher ectomorphy than endomorphy. Mean somatotype was 3.1 - 4.4 - 1.7. The mean values of body height, body weight and percent subcutaneous fat were 175.2 cm, 75.3 kg and 15.3 %, respectively.

Table 1 Mean somatotype and somatic parameters: Goalkeepers

GKs (n=43)	SOMATOTYPE			Body height	Body mass	% Fat
	ENDOMORPHY	MESOMORPHY	ECTOMORPHY			
X	**2.51**	**3.90**	**2.32**	**176.81**	**72.50**	**12.24**
SD	0.93	1.04	0.93	5.13	6.33	4.57
min	0.8	2.0	0.5	163.0	60.8	3.8
max	5.0	7.2	4.0	187.0	85.9	21.0

Extreme somatotypes were found in the goalkeepers of POL and SVK, which were teams that placed in 13th to 16th place. With respect to the number of somatotype categories, somatotypes of GKs were categorized in 10 out of 13 categories. The highest number of somatotypes was observed in categories 1, 3 and 12. The GKs on the teams that finished in 1st to 4th place may be regarded as homogenous as the somatotypes were categorized in 3 categories. Relative somatotype homogeneity demonstrated by 4 somatotype categories was also found in GKs on teams that finished 9th to 12th. The somatotypes of GKs on the national teams that placed 13th to 16th and 5th to 8th were observed in 5 and 7 categories, respectively.

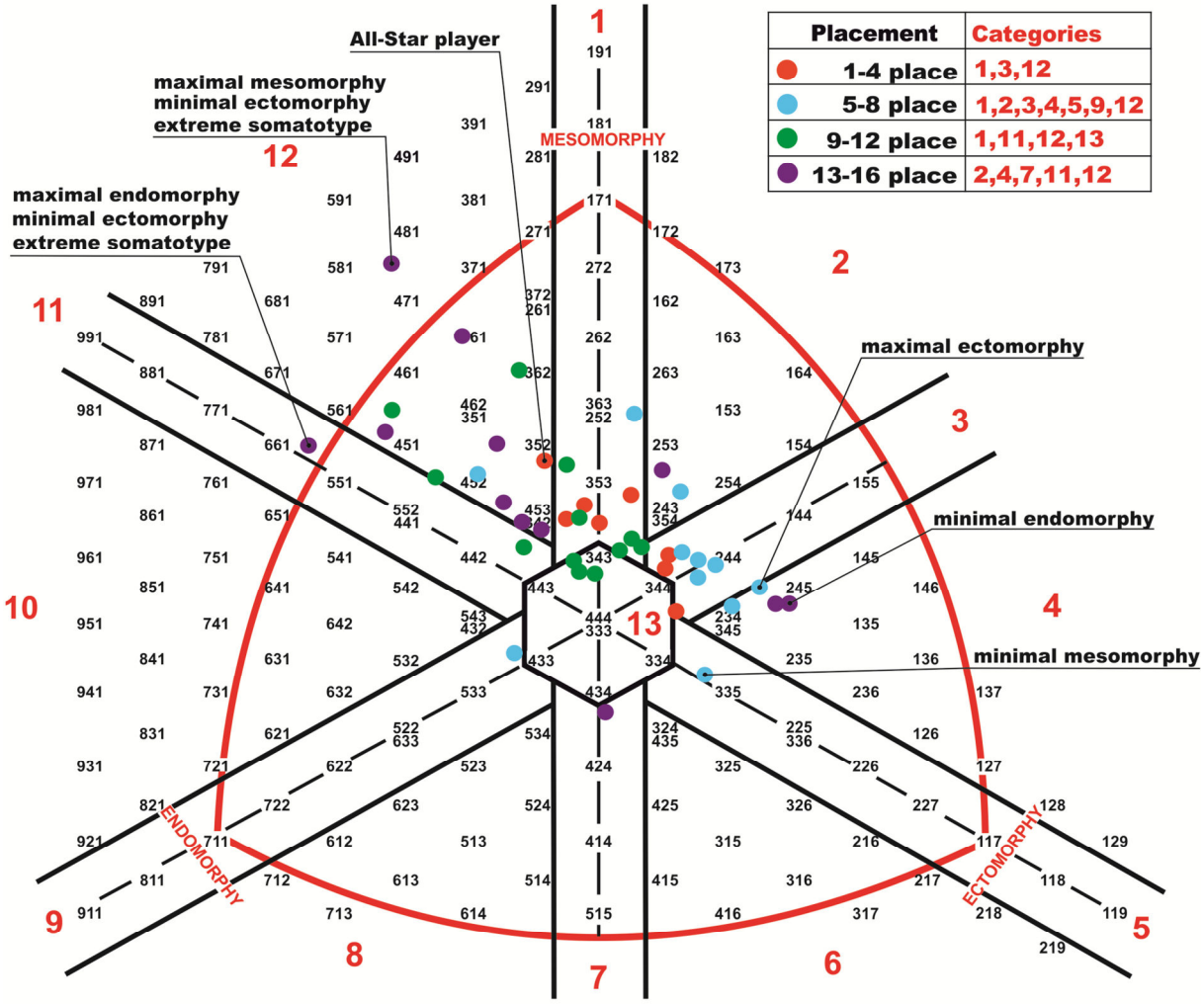

Figure 1 Somatotypes of goalkeepers

Wings - mean somatotype *2.00 - 4.26 - 2.20*, Ws were categorized as *balanced mesomorphs*. Overall, 21 Ws were categorized as balanced mesomorphs (category 1) while 16 Ws were endomorphic mesomorphs, out of whom 11 Ws were close to category 1. Mesomorphy rating over 4.00 was observed in 39 Ws. With respect to somatotype components, the highest rate of homogeneity was found in endomorphy. Most Ws had an athletic physique with well-developed musculature (somatopoints in the upper part of the somatochart) and low percent subcutaneous fat (location to the right of the longitudinal axis) (Fig. 2). Mesomorphy rating over 4.00 was found in 39 Ws. Endomorphy value lower than 2.5 was found in 48 Ws and percent subcutaneous fat lower than 10 % was observed in 32 Ws.

Table 2 Mean somatotype and somatic parameters: Wings

Ws (n=58)	SOMATOTYPE			Body height	Body mass	% Fat
	ENDOMORPHY	MESOMORPHY	ECTOMORPHY			
X	**2.00**	**4.26**	**2.20**	**167.42**	**61.92**	**9.62**
SD	0.68	0.94	0.91	4.64	5.24	3.50
min	0.9	2.1	0.5	157.5	51.3	3.4
max	3.5	6.4	4.2	179.8	78.5	16.8

Somatotypes of Ws were categorized in 6 categories. The highest number of somatotypes was observed in the somatotype category 12 (16 Ws). The remaining somatotypes of 21 Ws were categorized in categories 2, 3, 4 and 13). With respect to the order of finish, Ws were homogeneous as the somatopoints were plotted in categories 1, 2, 3 and 12. On the other hand, with regard to final placement, there was relative heterogeneity as Ws on the teams that finished 1st to 4th place as well as 5th to 8th place and Ws that finished in 9th to 12th and 13th and 16th in 6 categories in total. As shown in Figure 3, the Ws who were on the teams having placed 1st to 4th were most homogeneous. The somatopoint of the All-Stars team player is, as shown in Fig. 2, encircled by a relatively high number of similar somatotypes.

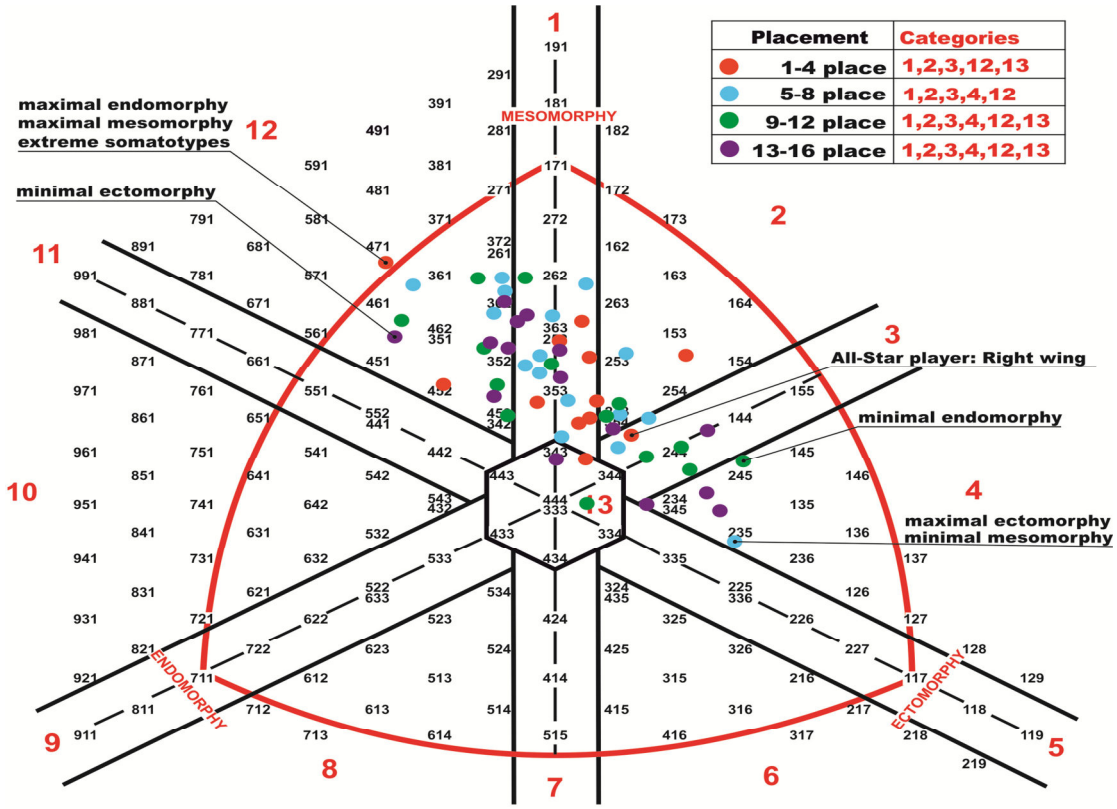

Figure 2 Somatotypes of wings

Center backs - the mean somatotype of CBs was *2.31 - 3.97 - 2.38*, which is the category of *balanced mesomorph*. Such mean somatotype rating is located in category 1 close to category 13. This does not demonstrate athletic physique as is the case of balanced mesomorphs. The primary function of CBs in the offensive phase of the game is to organize and to create game situations. Among their specific tasks is to prepare appropriate shooting positions for Bs and PVs. In such situations, CBs are confronted with the opposing team's defense based on the defensive activity of robust and tall players. CBs also end their offensive play from more difficult positions and from a longer range. This confirms the benefits of adequate somatotype in this playing position with regard to proper execution of game skills.

Table 3 Mean somatotype and somatic parameters: Center backs

CBs (n=40)	SOMATOTYPE			Body height	Body mass	% Fat
	ENDOMORPHY	MESOMORPHY	ECTOMORPHY			
X	**2.31**	**3.97**	**2.38**	**172.37**	**66.47**	**10.85**
SD	0.81	0.85	0.68	5.32	6.20	4.09
min	0.9	2.5	1.3	163.5	53.8	3.4
max	4.3	6.1	4.0	187.0	82.8	21.0

Overall, somatotypes of CBs were categorized in 7 categories. In total, somatotypes of 17 players were classified in category 1. The incidence of somatotypes in the remaining categories was almost identical. It should be noted that somatotypes of CBs were observed in category 1 irrespective of the order of finish. Most somatopoints of CBs were located in the upper part of the somatochart. With regard to the final standings, the CBs on the teams having finished in 9th to 12th place were most homogeneous. The categorization in category 5 was identical in CBs on the teams that placed 1st to 4th, 5th to 8th and 13th to 16th. The somatotype distribution around the somatopoint of the All-Stars player and MVP player was low.

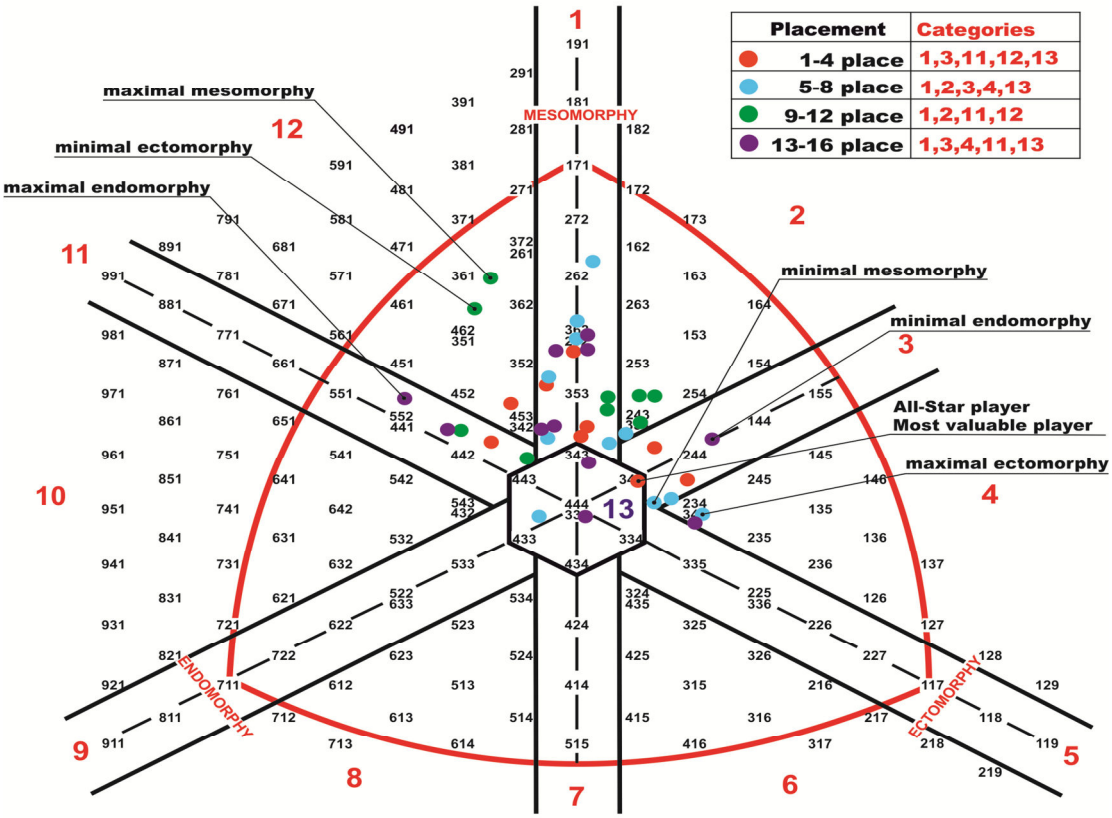

Figure 3 Somatotypes of center backs

Backs - the mean somatotype of Bs was *2.36 - 3.96 - 2.43* categorized as *balanced mesomorph*. Similarly to CBs, mean somatotype is located in category 1 close to category 13. This means that Bs cannot be regarded as players with athletic physique. Bs showed a similar somatotype to GKs and CBs as most players' somatopoints (Fig. 4) are located above the midline of the somatochart.

Table 4 Mean somatotype and somatic parameters: Backs

Bs (n=64)	SOMATOTYPE			Body height	Body mass	% Fat
	ENDOMORPHY	MESOMORPHY	ECTOMORPHY			
X	**2.36**	**3.96**	**2.43**	**176.71**	**71.33**	**11.25**
SD	0.74	1.00	0.81	5.52	5.79	3.52
min	0.9	1.4	0.6	165.4	59.6	3.8
max	4.2	6.6	4.3	190.5	83.4	18.6

Somatotypes of Bs were classified in 9 categories in total. The highest number of somatotypes was found in category 1: 19 Bs and category 2: 15 Bs. The number of somatotypes classified in categories 2, 4, 11 and 13 was identical: 5. The highest degree of homogeneity was observed in category 1 (Fig. 4). The Bs on the teams that placed 5th to 8th place were most homogeneous with classification in 3 categories. Bs on the teams that placed in 1st to 4th, 13th to 16th and 9th to 12th were categorized in 7 or 8 categories, which shows high level of heterogeneity. The number of somatotypes located around the somatopoint of the All-Stars team player was relatively low.

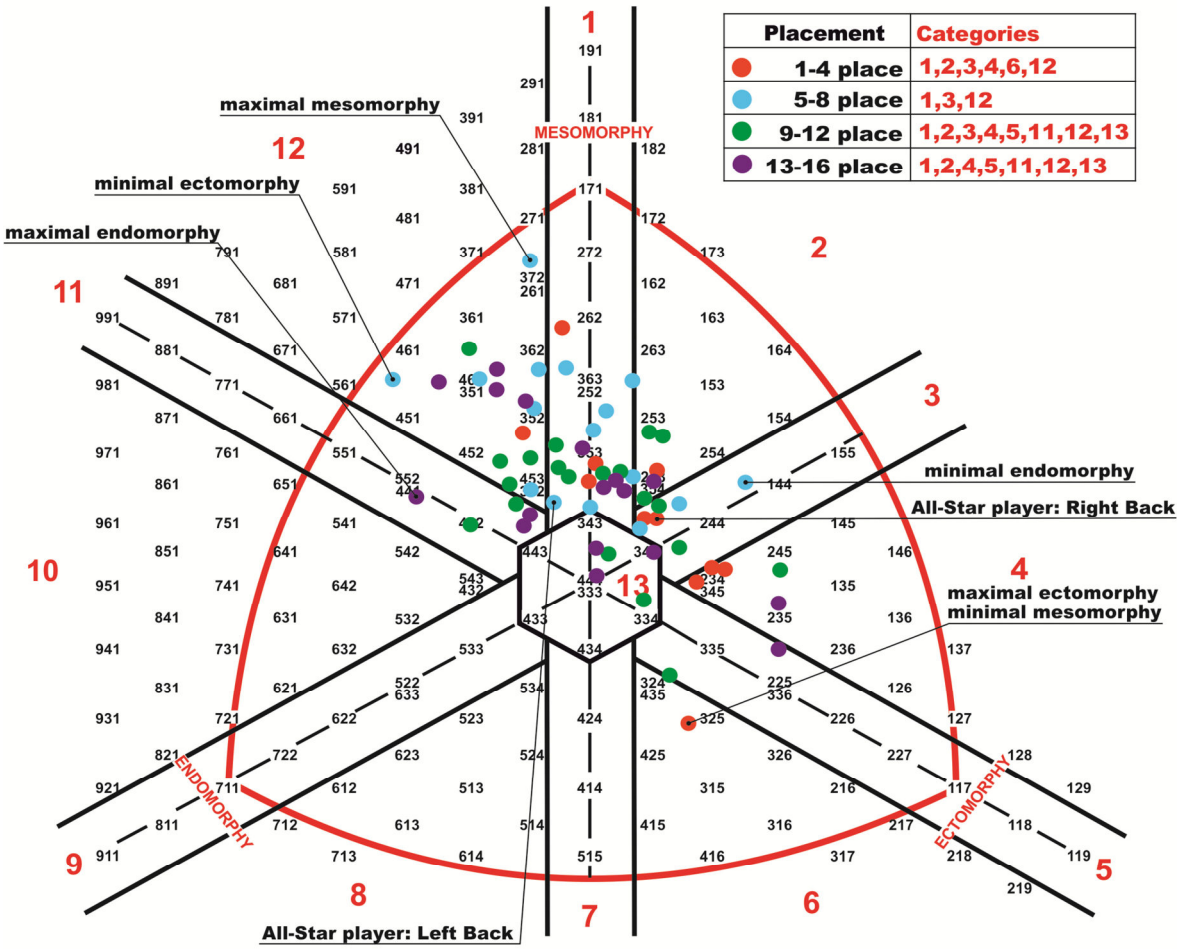

Figure 4 Somatotypes of backs

Pivots - the mean somatotype of PVs was *2.80 - 4.98 - 1.55*, which is the category *endomorphic mesomorph*. The ratio of endomorphy to ectomoprhy is highest among all playing positions, which is the evidence of less linear physique. Such ratio shows robust body build confirmed by higher mean endomorphy values: 2.80, percent subcutaneous fat: 13.58 %, body mass: 76.01 kg and body height: 174.65 cm. On the other hand, PVs demonstrated the highest mesomorphy value. Mesomorphy rating lower than 4 was found in 5 players only. In PVs, higher values of body height and body mass are favorable to increase the efficiency in physical encounters in both the defensive and offensive phases of the game.

Table 5 Mean somatotype and somatic parameters: Pivots

PVs (n=35)	SOMATOTYPE			Body height	Body mass	% Fat
	ENDOMORPHY	MESOMORPHY	ECTOMORPHY			
X	**2.80**	**4.98**	**1.55**	**174.65**	**76.01**	**13.58**
SD	0.85	1.07	0.91	5.67	8.76	4.26
min	1.0	2.4	0.5	163.8	53.2	4.5
max	4.5	6.6	4.3	185.0	91.1	21.7

Somatotypes of PVs were categorized in 7 categories. In total, 20 and 6 players were categorized in categories 12 and 1, respectively. Each of categories 3, 5 and 13 included only one player. What is surprising is that 6 somatotypes were classified as extreme in category 12. It should be noted that 3 out of these extreme somatotypes were recorded in players on the 1st to 4th teams. The somatotype distribution around the somatopoint of the best shooter and the best pivot of the championship was low. The PVs on the teams that placed 1st to 4th were classified in categories 1 and 12, while 3 PVs were found to have extreme somatotypes plotted outside the somatochart. The number of somatotypes of PVs on the teams having finished 5th to 8th and 9th to 12th was identical.

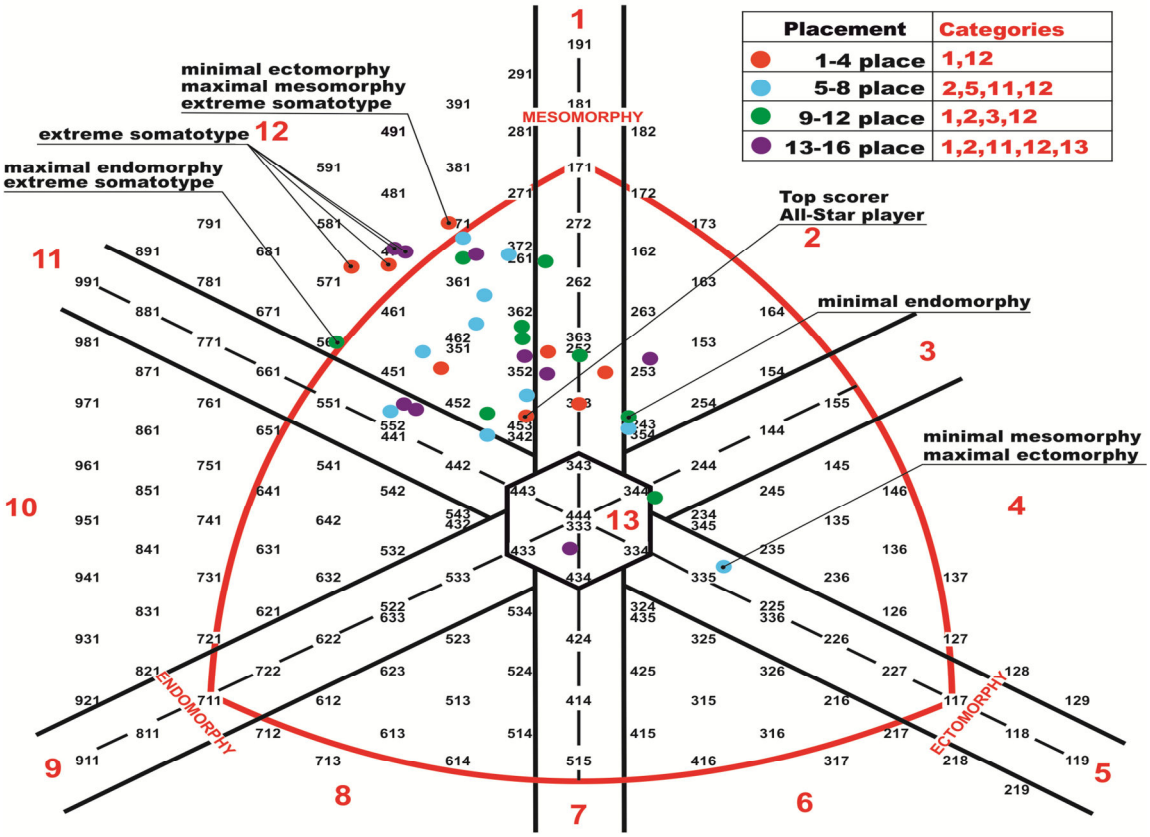

Figure 5 Somatotypes of pivots

Table 6 Overall somatotype categorization with respect to playing position

Playing position	CATEGORIES													∑
	1	2	3	4	5	6	7	8	9	10	11	12	13	
Goalkeeper	10	2	7	4	1	-	1	-	1	-	2	12	3	**43**
Wing	20	6	7	5	-	-	-	-	-	-	-	16	3	**57**
Center back	17	4	5	2	-	-	-	-	-	-	5	3	4	**40**
Back	19	5	7	5	2	1	-	-	-	-	5	15	5	**64**
Pivot	6	3	1	-	1	-	-	-	-	-	4	20	1	**36**
∑	**72**	**20**	**27**	**16**	**4**	**1**	**1**	-	**1**	-	**16**	**66**	**16**	**240**

As shown in Table 6, the highest number of somatotypes was classified in category 1: *balanced mesomorph* and category 12: *endomorphic mesomorph*. The number of somatotypes in categories 6, 7, 8 and 9 were minimal. With respect to playing position, the wing players were dominant in the balanced mesomorph category. In category 12, PVs were found to be the largest group characterized as endomorphic mesomorphs.

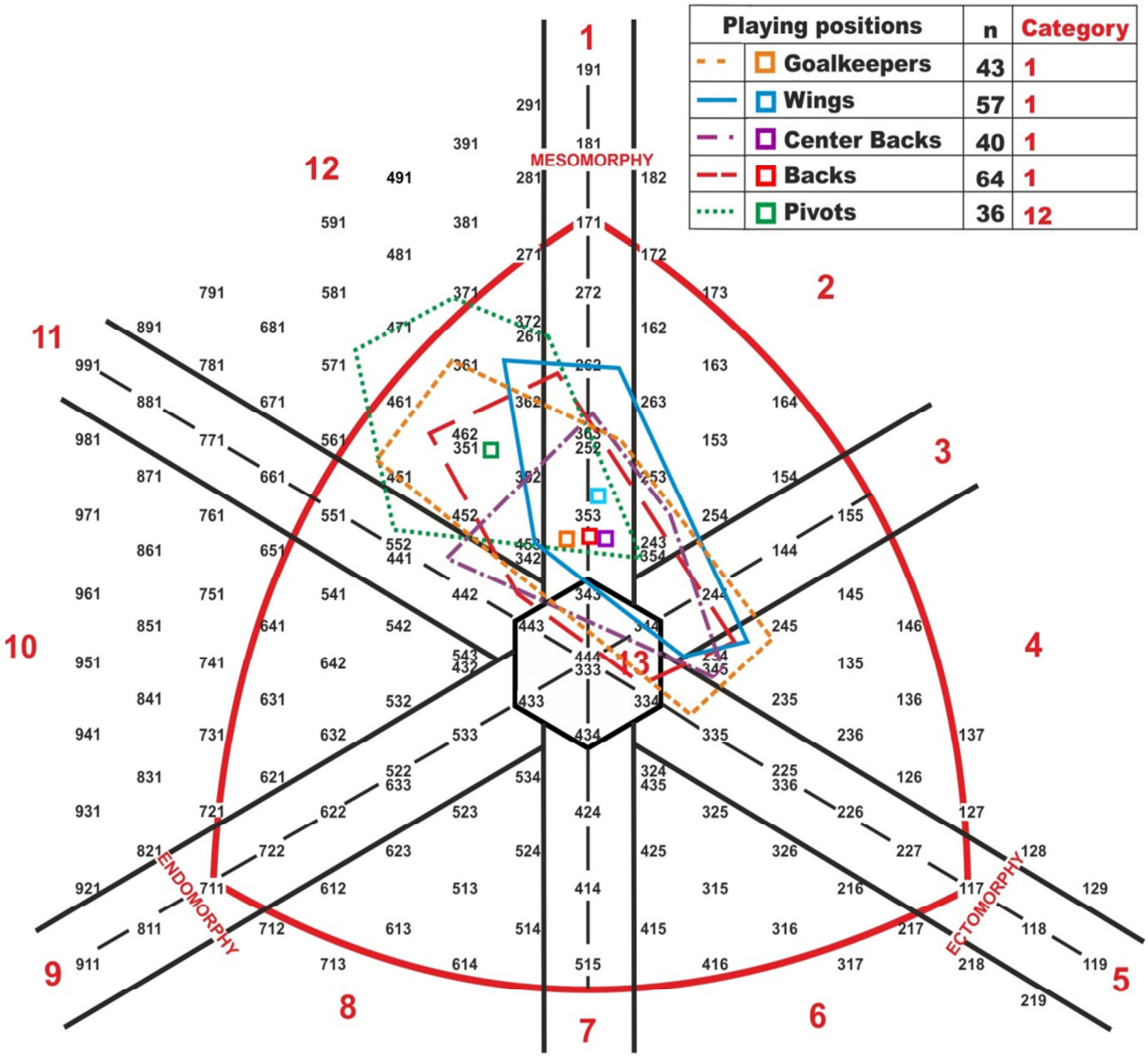

Figure 6 Somatotype with respect to playing position

Conclusions

With respect to the individual somatotype components, the highest degree of adiposity indicated by endomorphy was found in pivots and the lowest degree was observed in wing players. The mesomorphy rating describing the relative musculo-skeletal development was also observed in pivot playing position. The highest degree of relative slenderness indicated by ectomorphy was found in backs while the lowest was observed in pivots.

	ENDO	**MESO**	**ECTO**	
Goalkeeper:	**2.51**	**3.90**	**2.32**	***balanced mesomorph***
Wing:	**2.00**	**4.26**	**2.20**	***balanced mesomorph***
Center back:	**2.31**	**3.97**	**2.38**	***balanced mesomorph***
Back:	**2.36**	**3.96**	**2.43**	***balanced mesomorph***
Pivot:	**2.80**	**4.98**	**1.55**	***endomorphic mesomorph***

The somatotype categorization has shown that all playing positions are predominantly mesomorphic. The mean somatotype in GKs, Ws, CBs and Bs has been categorized as *balanced mesomorph*. The only position with a different mean somatotype *endomorphic mesomorph* is the PV playing position.

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