Anthropometric and Somatotype Profiles of the National Teams at the 2011 Women's 19 European Handball Championship

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Introduction

The eighth edition of the Women's 19 European Handball Championship was hosted by the Dutch cities of Almelo, Arnhem, Leek, Maastricht and Rotterdam, which provided optimal conditions for preliminary, main and intermediate rounds, semifinal matches and the final. Over the period of 11 days, 16 national teams of young female handball players aged 19 or younger played a total of 56 matches. During the championship, players of 13 national teams participated in anthropometric measurements in order to complement scientific evidence on the anthropometric profiles and somatotypes in female handball players. The comparison of the number of research studies on anthropometric and somatotype parameters in male and female handball has revealed paucity of information on morphological profiles of female handball players (Zapartidis et al., 2009, Čavala, Katić, 2010, Vila et al., 2011, Urban, Kandráč, Táborský, 2011).

Aim

The purpose of the cross-sectional study was to determine anthropometric and somatotype profiles of female handball players on the national teams that took part in the 2011 W19 ECh from the aspect of respective playing positions.

Methods

The research sample consisted of 207 U19 female handball players of 13 national teams (except Norway, Sweden and Austria) that participated in the W19 ECh in Holland. At the time of the championship, the players were 19 years old or younger. We divided the players into position-specific groups: GKs – goalkeepers: n = 35, Ws – wings: n = 53, CBs - center backs: n = 30, Bs – backs: n = 58 and PVs – pivots: n = 31.

We measured the following standardized anthropometric parameters: a. *parameters of longitudinal dimension*:

- body height,
 - arm span (D-D),

b. *body mass*

- c. parameters of transversal dimension:
 - biacromial breadth (Shoulder width, A-A),
 - palm breadth (Palm),
 - biepicondylar breadth of the humerus (Humerus breadth HB),
 - biepicondylar breadth of the femur (Femur breadth FB),
- d. parameters of body volume (circumferential) dimension:
 - circumference of upper arm /contracted/ (Biceps),
 - circumference of forearm /contracted/ (Forearm),
 - circumference of calf /contracted/ (Calf),
- e. *body indexes*: percent subcutaneous fat (fat %).

The percent subcutaneous fat, based on the measurement of skinfold thickness on 10 body sites: head, neck, chest I, chest II, arm (triceps), back (subscapular), belly, hip (supraspinal), thigh and calf (medial calf), was calculated according to the method of Pařízková (1962).

The somatotypes were determined using the Heath, Carter (1967) method, which expresses somatotype using a three-number rating. The determination of somatotypes was based on the following parameters:

- 1. body height and body mass,
- 2. skinfold thickness: triceps skinfold, subscapular skinfold, supraspinal skinfold and medial calf skinfold,
- 3. biepicondylar breadths: humerus and femur,
- 4. circumferential dimensions: upper arm circumference (contracted) and calf circumference (contracted).

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 in 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.

Collected data were processed using basic statistical characteristics: \mathbf{x} - arithmetic mean, \mathbf{s} - standard deviation, **min** - minimum value and **max** - maximum value. The data required to determine somatotypes of female handball players were processed using the program SOMATO. The final somatotypes were projected onto the somatochart using somatopoints.

Results

Mean body height equaled 174.98 + 5.89 cm. The highest mean body height of 177.5 +5.65 cm was found in POL players, whereas the lowest mean body height 172.53 + 6.73 cm was observed in ESP players. As seen from table 1, above-average values of body height were observed in 6 national teams. Negative difference between body height and arm span equaling - 1.84 cm was recorded in NED players. The highest positive ratio of arm span and body height was found in FRA players: + 3.97 cm, who demonstrated mean biacromial breadth exceeding 40 cm. Mean shoulder width lower than 39 cm was observed in ESP and RUS players. The difference between the "heaviest" national team of DEN: 75.38 kg and the "lightest" national team of UKR: 66.77 equaled 8.61 kg. The lowest mean fat percentage was found in POL players, who demonstrated the mean value of 10.04 %. It should be noted that the national teams of SRB, ESP and DEN, which finished in the first eight, were found to have relatively high volume of subcutaneous fat. The palm breadth average equaled 7.88 + 0.36 cm. Mean palm breadth surpassing 8 cm was found in the GER national team. An interesting finding was that the mean humerus breadth ranged from 6.41 cm to 6.65 cm in the first and last national team of the championship. The difference between minimum and maximum value of femur breadth was greater compared to mean humerus breadth. Overall, DEN players demonstrated the highest average in both biepicondylar breadths. The lowest mean femur breadth was found in HUN national team. The differences between the champion team of DEN and last team of UKR were evident in circumferential dimensions as well. The highest and lowest averages of biceps circumference differed by 2.32 cm. The same finding was recorded in the forearm circumference, where the difference between the minimum and maximum value equaled 1.38 cm. The highest average of calf circumference was found in CRO players, where arithmetic means over 38 cm were recorded in the national teams of CRO, ROU and SRB. An interesting finding was that UKR players were found to have the lowest means in 5 anthropometric parameters of 11 measured. On the contrary, arithmetic means in 5 anthropometric parameters were highest in their DEN counterparts, who were dominant in the transversal dimensions.

The ratings of somatotype components showed that the highest mean endomorphy rating was found in ESP players and the lowest mean endomorphy rating was observed in the GER national team. Mean value of endomorphy lower than 2.00 was recorded in the GER national team only. Mesomorphy values not exceeding the rating of 4 were observed in four national teams: UKR, HUN, RUS and POL. The highest mesomorpy rating was found in GER players. The highest ectomorphy rating was recorded in the UKR national team: 2.64. Players on the DEN national team were found to have the lowest ectomorphy rating. Ectomorphy rating equaling or lower than 2 was found in ESP, CRO and DEN.

In terms of mean somatotypes of the U19 female handball players, mean somatotype was classified as *balanced mesomorph: 2.20 – 4.17 – 2.19* (category 1) showing dominance of mesomorphy and equality of endomorphy and ectomorphy. In total, mean somatotypes of all national teams fell into three categories. The somatotype of balanced mesomorph (somatotype category 1) was found in 10 national teams: CRO, DEN, FRA, GER, HUN, NED, POL, ROU, RUS and SLO. The mean somatotype of ectomorphic mesomorph (somatotype category 2) was observed in the UKR national team only. The somatotype of endomorphic mesomorph (somatotype category 12) was recorded in ESP and SRB players. Interestingly, the somatotypes of the players on the national teams that finished from the 1st to 4th place and the 5th to 8th place were classified in two somatotype categories: balanced mesomorph and endomorphic mesomorph. Higher homogeneity of somatotypes of the players on the national teams that finished mesomorph and endomorphic mesomorph. Higher homogeneity of somatotypes of the players on the national teams that placed 13th to 16th were classified in 2 categories: balanced mesomorph and ectomorphic mesomorph.

Team	Body height	D-D	A-A	Body mass	Fat	Palm	HB	FB	Biceps	Fore arm	Calf	SOM	ΙΑΤΟΊ	YPE
	(cm)	(cm)	(cm)	(kg)	%	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	Endo	Meso	Ecto
DEN	177.28	177.59	39.81	75.38	12.57	7.94	6.65	10.53	30.91	26.38	37.53	2.41	4.35	1.94
NED	172.56	170.72	39.41	68.34	11.73	7.79	6.63	10.07	29.31	25.59	36.72	2.28	4.28	2.01
AUT														
SRB	173.97	174.91	39.50	71.16	12.93	7.86	6.54	10.46	29.66	26.00	38.06	2.50	4.50	2.05
SWE														
ROU	176.47	177.78	39.66	72.24	10.86	7.88	6.59	10.12	29.66	26.03	38.06	2.03	4.06	2.24
CRO	175.59	176.19	39.47	73.20	10.49	7.96	6.63	10.31	29.63	25.91	38.88	2.28	4.43	1.98
ESP	172.53	173.63	38.44	71.94	12.92	7.80	6.54	10.12	30.25	25.81	37.25	2.53	4.45	2.00
RUS	176.15	175.60	38.53	70.40	11.21	7.69	6.49	10.13	29.47	25.93	37.60	2.16	3.87	2.55
FRA	173.75	177.72	40.13	69.63	10.78	7.95	6.52	10.14	29.78	25.78	36.41	2.08	4.11	2.19
GER	174.63	175.25	39.84	71.80	10.82	8.01	6.71	10.24	29.75	26.19	37.47	1.97	4.51	2.04
NOR														
POL	177.75	177.28	39.22	72.90	10.04	7.97	6.58	10.21	29.97	25.91	37.81	2.08	3.98	2.41
HUN	177.13	175.31	39.19	72.18	11.32	7.91	6.54	9.74	30.09	25.75	37.41	2.12	3.66	2.38
SLO	173.25	174.53	39.09	70.37	11.67	7.93	6.54	10.16	29.44	25.41	37.69	2.24	4.34	2.01
UKR	173.72	174.13	39.06	66.77	10.16	7.79	6.41	9.91	28.59	25.00	36.31	2.06	3.63	2.64
Χ	174.98	175.43	39.34	71.26	11.35	7.88	6.57	10.16	29.73	25.82	37.47	2.20	4.17	2.19
SD	5.89	7.05	1.71	8.02	3.95	0.36	0.32	0.63	1.92	1.27	2.24	0.84	1.09	0.92

Tab. 1 Anthropometric profiles of the national teams participating in W19 ECh

Legend: X - arithmetic mean SD - standard deviation D-D - arm span A-A - shoulder width Palm - palm breadthHB - humerus breadthFB - femur breadthRed field - maximum value

Endo - endomorphy Meso - mesomorphy Ecto - ectomorphy Blue field - minimum value



Fig. 1 Mean somatotypes of the national teams participating in W19 ECh

DENMARK

The greatest difference in body height was surprisingly found between Bs and CBs. Mean body height over 178 cm was recorded in GKs, PVs and Bs. Positive ratio of arm span and body height was observed in Bs and PVs. The highest average of shoulder width was found in PVs and the lowest in CBs. Among the heaviest playing positions on the team were PVs and GKs. The difference between the highest and the lowest mean body mass equaled 13.92 kg. The data on percent fat are consistent with body mass averages as the highest volume of subcutaneous fat was recorded in GKs and PVs. The mean palm breadth over 8 cm was observed in GKs and Bs. Players in the W and B positions were found to have the highest average values in biepicondylar breadths. The inter-position differences in biepicondylar breadths were minimal. The highest mean values of the circumferential dimensions were found in PVs and the lowest in CBs. Mean endomorphy value was highest in GKs and PVs. The mesomorphy rating under 4 was found in CBs only. The highest ectomorphy rating was recorded in CBs as well. Somatotype distribution was most homogeneous in Ws and PVs. In total, the somatotypes were distributed in 4 somatotype categories. It should be noted that somatotypes were evenly clustered as seen from the somatochart.

Pl.	Body height	D-D	A-A	Body mass	Fat	Palm	HB	FB	Biceps	Calf	Fore arm	SOM	ΙΑΤΟΤ	YPE
pos.	(cm)	(cm)	(cm)	(kg)	%	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	Endo	Meso	Ecto
GK	178.25	175.75	39.25	78.40	16.25	8.15	6.60	10.55	31.00	38.00	26.75	3.30	4.30	1.65
W	176.13	176.00	39.38	73.10	10.98	7.70	6.73	10.60	30.63	36.63	26.00	2.15	4.43	2.05
CB	174.25	172.00	38.00	67.55	10.70	7.95	6.45	10.15	29.00	35.25	25.50	1.85	3.65	2.50
В	178.40	179.40	40.00	75.46	11.12	8.06	6.72	10.66	31.20	37.90	26.30	2.06	4.50	2.10
PV	178.33	181.67	41.67	81.47	15.90	7.93	6.50	10.47	32.00	39.33	27.33	3.13	4.50	1.37

Tab. 2 Position-related anthropometr	ic profiles –	Denmark
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Fig. 2 Somatotype profiles of Danish handball players

NETHERLANDS

Among the tallest players on the Dutch team were Bs, GKs and CBs. Positive difference between arm span and body height equaling 1.5 cm was recorded in Bs and CBs. The greatest negative difference between arm span and body height was found in Ws. Mean shoulder width over 40 cm was observed in GKs and CBs. A surprising finding was that PVs were the "lightest" players on the team and Ws had the highest volume of subcutaneous fat. The highest mean value of palm breadth was observed in Bs and the lowest in Ws. The interposition differences in humerus breadth were minimal. Mean values of femur breadth over 10 cm were found in Ws and PVs. It should be noted that Ws demonstrated highest means in biceps and calf circumference. The highest mean forearm circumference was observed in Bs and CBs. Wing players showed the highest endomorphy as well as mesomorphy rating. The ectomorphy rating lower than 2 was found in Ws only. Overall, the somatotypes were distributed in 6 somatotype categories. The highest number of players' somatotypes was classified in somatotype category 12. It may be concluded that the somatotype distribution of NED players was more heterogeneous compared to their DEN counterparts.

Pl.	Body height	D-D	A-A	Body mass	Fat	Palm	нв	FB	Biceps	Calf	Fore arm	SOM	ΙΑΤΟΤ	YPE
pos.	(cm)	(cm)	(cm)	(kg)	%	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	Endo	Meso	Ecto
GK	175.50	172.33	40.50	69.87	12.87	7.73	6.67	9.73	28.83	37.33	25.00	2.47	3.73	2.40
W	166.30	161.60	38.00	66.62	13.38	7.72	6.44	10.34	29.70	37.40	25.60	2.58	5.24	1.26
CB	174.00	175.50	40.50	68.45	10.90	7.80	6.75	9.85	29.25	35.25	26.00	2.15	3.85	2.40
В	179.25	180.75	39.88	70.98	9.18	7.98	6.75	9.80	29.13	36.75	26.00	1.78	3.33	2.45
PV	169.00	166.25	39.25	64.95	11.85	7.65	6.70	10.65	29.50	35.50	25.25	2.35	5.00	2.00

Tab. 3 Position-related anthropometric profiles – Netherlands



Fig. 3 Somatotype profiles of Dutch handball players

SERBIA

The tallest players on the SRB team were Bs and the shortest were Ws. Difference between arm span and body height was positive in GKs, PVs and Bs. Negative difference between arm span and body height was highest in Ws. Mean value of shoulder width exceeding 40 cm was observed in GKs. The heaviest players on the team were PVs and the lightest ones were Ws. The difference between the highest and lowest body mass average equaled 17.03 kg. The volume of subcutaneous fat was consistent with body mass as CBs, GKs and PVs demonstrated high subcutaneous fatness. Mean palm breadth over 8 cm was found in PVs only. Mean values of transversal and circumferential dimensions were highest in PVs. As for the somatotype components, highest endomorphy ratings were observed in PVs and CBs, who showed moderate degree of endomorphy. As seen from figure 4, higher level of endomorphy in PVs may be attributed to the extreme somatotype of one of the pivots. Surprisingly, the highest mesomorphy ratings were found in GKs and CBs. Ectomorphy rating was highest in Ws and Bs. The playing positions differed profoundly in terms of somatotype distribution. The least homogeneous playing positions consisted of Ws, GKs, PVs and Bs, where each of the player's somatotype was classified in a different category.

Pl.	Body height	D-D	A-A	Body mass	Fat	Palm	HB	FB	Biceps	Calf	Fore arm	SOM	ΙΑΤΟΤ	YPE
pos.	(cm)	(cm)	(cm)	(kg)	%	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	Endo	Meso	Ecto
GK	175.33	179.00	40.67	73.80	14.17	7.93	6.63	10.93	29.83	39.67	25.83	2.47	4.90	1.83
W	170.83	166.67	37.83	63.07	10.33	7.53	6.50	10.10	27.83	36.00	25.00	2.07	4.03	2.63
CB	171.63	171.13	39.38	71.18	15.63	7.78	6.45	10.30	30.88	37.88	26.75	3.08	4.80	1.58
В	177.13	179.88	39.88	70.78	10.70	7.95	6.50	10.30	28.75	37.75	25.75	1.70	3.83	2.60
PV	175.00	178.75	39.75	80.10	14.00	8.25	6.75	10.90	31.50	39.75	26.75	3.20	5.35	1.35

Tab. 4 Position-related anthropometric profiles - Serbia



Fig. 4 Somatotype profiles of Serbian handball players

ROMANIA

The highest body height average was found in PVs, the lowest in Ws. The difference between arm span and body height was positive in 4 playing positions except PVs. Mean shoulder width exceeding 40 cm was recorded in Bs. Among the heaviest players on the ROU team were PVs, GKs and Bs. The highest amount of subcutaneous fat was found in PVs, whereas the lowest volume of fat was observed in Ws. Mean palm breadth surpassing 8 cm was recorded in GKs. The mean humerus breadth was highest in PVs. The average value of femur breadth over 10 cm was found in three playing positions: GKs, Bs and PVs. The highest mean values of circumferential dimensions were observed in PVs and the lowest ones were recorded in Ws. With regard to somatotype components, the lowest endomorphy ratings were found in Ws and CBs. The lowest mesomorphy rating was observed in CBs and the highest in PVs. The inter-position differences in ectomorphy were minimal demonstrating homogeneity of linearity. Overall, the players' somatotype category 1: balanced mesomorph. The most homogeneous playing positions in terms of somatotype distribution were CBs and PVs.

	Body			Body							Fore			
Pl.	height	D-D	A-A	mass	Fat	Palm	HB	FB	Biceps	Calf	arm	SOM	<mark>IATOT</mark>	YPE
pos.	(cm)	(cm)	(cm)	(kg)	%	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	Endo	Meso	Ecto
GK	179.50	181.97	38.67	75.47	11.00	8.10	6.70	10.43	28.67	38.00	25.33	2.00	3.77	2.27
W	168.83	169.67	38.67	64.33	8.60	7.70	6.40	9.73	28.33	36.17	25.00	1.70	4.13	2.03
CB	173.25	176.25	39.50	67.15	11.45	7.65	6.30	9.50	29.50	37.25	26.00	1.90	3.70	2.40
В	178.00	179.75	40.67	74.08	10.87	7.90	6.60	10.32	29.92	39.00	26.50	2.12	4.18	2.25
PV	182.00	179.25	39.75	78.85	13.45	7.95	7.00	10.25	32.50	39.00	27.25	2.45	4.35	2.30

Tab. 5 Position-related anthropometric prof	iles – Romania
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Fig. 5 Somatotype profiles of Romanian handball players

CROATIA

The tallest players on the CRO national team were CBs. The difference between arm span and body height was positive in GKs, Bs and CBs and negative in PVs and Ws. Mean shoulder width over 40 cm was recorded in GKs and PVs. Among the heaviest players were CBs, Bs and PVs. The highest volume of subcutaneous fat was found in Bs. Mean fat percent lower than 10 % was observed in PVs and Ws. Mean palm breadth exceeding 8 cm was found in PVs and CBs. The average value of humerus breadth was recorded in PVs, while the lowest average was observed in GKs. Mean femur breadth under 10 cm was found in Bs only. The circumferential dimensions were highest in both PVs and CBs. With regard to players' somatotypes, the lowest endomorphy rating and the highest mesomorphy rating were observed in PVs. A surprising finding was that PVs demonstrated the lowest ectomorphy rating of all playing positions. Overall, somatotypes of CRO players were distributed in 4 somatotype categories. Identical number of players (6) was classified in category 1 and category 12. The highest homogeneity of somatotype distribution was found in CBs. The playing positions GKs, Ws and Bs demonstrated considerable heterogeneity in terms of somatotype categorization.

Pl.	Body height	D-D	A-A	Body mass	Fat	Palm	HB	FB	Biceps	Calf	Fore arm	SOM	ΙΑΤΟΤ	YPE
pos.	(cm)	(cm)	(cm)	(kg)	%	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	Endo	Meso	Ecto
GK	176.83	180.83	40.67	71.87	10.00	7.87	6.47	10.23	27.33	38.33	25.00	2.33	3.57	2.33
W	172.10	170.80	38.30	68.98	9.68	7.90	6.56	10.58	29.00	37.70	25.60	2.20	4.72	2.00
CB	180.25	180.75	39.00	76.70	10.25	8.25	6.60	10.25	31.00	39.75	27.00	2.25	4.10	2.25
В	177.38	179.00	39.88	76.50	12.40	7.90	6.70	9.95	30.13	39.50	26.00	2.60	4.20	1.85
PV	174.25	172.50	40.25	75.65	9.65	8.05	6.95	10.55	32.25	40.50	26.75	1.80	5.80	1.40

Tab. 6 Position-related anthropometric profiles – Croa
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Fig. 6 Somatotype profiles of Croatian handball players

SPAIN

The highest body height average was found in Bs. Among the shortest players on the ESP national team were Ws and CBs. Positive difference between arm span and body height was recorded in GKs: 6.50 cm, Bs: 2.00 cm and PVs: 1.50 cm. The mean shoulder width equaling or exceeding 39 cm was recorded in three playing positions: GKs, Bs and PVs. Mean body mass was highest in GKs, where the difference in mean body mass between GKs and CBs equaled 39.60 kg. The mean volume of subcutaneous fat in GKs: 23.85 % was consistent with their mean body mass. Mean palm breadth over 8 cm was observed in GKs only. With respect to transversal and circumferential dimensions, highest mean values were found in GKs and PVs. As to the somatotype components, the endomorphy rating of 5.40 showed high degree of relative fatness. Mesomorphy rating exceeded the value of 7.5, which is indicative of very high degree of musculoskeletal robustness. The lowest ectomorphy rating was found in GKs as well. As seen from the somatochart, the somatotypes of ESP goalkeepers may be regarded extreme as the somatopoints are projected outside the triangle. Overall, players' somatotypes were distributed in 4 categories. The most heterogeneous in terms of somatotype distribution were Ws and Bs.

Pl.	Body height	D-D	A-A	Body mass	Fat	Palm	HB	FB	Biceps	Calf	Fore arm	SOM	ΙΑΤΟΤ	YPE
pos.	(cm)	(cm)	(cm)	(kg)	%	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	Endo	Meso	Ecto
GK	170.75	177.25	39.00	96.00	23.85	8.15	6.90	11.65	35.25	43.00	29.25	5.40	7.60	0.50
W	166.38	165.88	36.63	61.83	9.35	7.70	6.43	9.85	28.88	34.75	25.25	1.68	4.40	2.05
CB	167.25	163.25	38.25	56.40	6.20	7.50	6.20	8.95	27.25	32.50	23.00	1.30	2.90	3.10
В	178.40	180.40	39.20	73.10	12.50	7.86	6.60	9.96	30.40	37.50	25.80	2.24	3.72	2.46
PV	175.67	177.17	39.33	77.80	15.57	7.80	6.60	10.50	30.50	39.50	26.17	3.03	4.67	1.43



Fig. 7 Somatotype profiles of Spanish handball players

RUSSIA

The tallest players on the RUS national team were GKs ans the shortest ones were Ws. Positive difference between arm span and body height was found in CBs and PVs only. An interesting finding is that GKs demonstrated the lowest average shoulder width. Among the lightest players were GKs and Ws. The heaviest players were PVs. The mean amount of subcutaneous fat was lowest in GKs. Mean palm breadth over 8 cm was recorded in CBs. The transversal dimensions were highest in CBs and PVs. The PVs dominated in terms of circumferential dimensions. As for the somatotype components of the RUS players, the lowest endomorphy rating was found in GKs, while the highest was observed in CBs. The highest mesomorphy rating was recorded in PVs, whereas the highest ectomorphy rating was found in GKs. Overall, somatotypes were distributed in 6 somatotype categories. The largest number of players (5) was clustered in category 1: balanced mesomorph. One of the PVs and Ws demonstrated extreme somatotype rating of one of the goalkeepers, whose somatotype was classified as endomorphic ectomorph. The most homogeneous playing position in terms of somatotype distribution were Bs.

Pl.	Body height	D-D	A-A	Body mass	Fat	Palm	нв	FB	Biceps	Calf	Fore arm	SOM	IATOT	YPE
pos.	(cm)	(cm)	(cm)	(kg)	%	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	Endo	Meso	Ecto
GK	182.33	180.00	37.67	66.40	10.17	7.57	6.40	9.83	27.67	36.50	24.50	1.83	2.30	4.20
W	170.60	170.20	38.70	66.92	11.08	7.74	6.28	9.94	29.60	36.50	25.80	2.30	4.16	2.10
CB	177.30	179.20	39.00	74.30	12.70	8.10	6.80	10.40	31.00	38.00	27.00	2.50	4.50	2.00
В	177.63	176.75	38.88	71.78	10.68	7.80	6.60	10.38	29.38	38.25	26.38	2.00	3.98	2.48
PV	177.25	178.40	38.50	80.40	13.40	7.30	6.75	10.45	31.25	40.50	27.00	2.45	5.00	1.60

Tab.	81	Positior	n-related	l anthro	pometric	profiles -	Russia
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Fig. 8 Somatotype profiles of Russian handball players

FRANCE

Among the tallest players on the FRA national team were Bs, PVs and GKs. The shortest players were Ws. The difference between arm span and body height was positive in four playing positions: GKs: 0.25 cm, CBs: 5.00 cm, Ws: 7.38 cm and PVs: 8.33 cm. The highest shoulder width average was found in PVs, who were also the heaviest players on the team. The lowest mean volume of subcutaneous fat was recorded in Ws, while the highest amount was found in PVs. Mean palm breadth over 8 cm was observed in CBs, PVs and GKs. Among the players with profound transversal dimensions were GKs and PVs. The highest mean values in circumferential dimensions were found in PVs, who dominated in 8 anthropometric parameters out of 11 measured. As to the somatotype components, the highest endomorphy rating was recorded in PVs. Mean mesomorphy values showed moderate degree of musculoskeletal robustness in Bs, CBs, Ws and GKs. The highest ectomorphy rating was recorded in Bs, while the lowest one was observed in PVs. Overall, somatotypes were distributed over 6 categories. There was relative heterogeneity in terms of intra-position somatotype distribution. An interesting finding was that somatotypes of Ws, Bs, CBs and GKs were distributed in different categories.

Pl.	Body height	D-D	A-A	Body mass	Fat	Palm	HB	FB	Biceps	Calf	Fore arm	SOM	ΙΑΤΟΤ	YPE
pos.	(cm)	(cm)	(cm)	(kg)	%	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	Endo	Meso	Ecto
GK	176.75	177.00	40.25	75.35	10.70	8.45	6.60	10.85	30.00	36.50	26.00	2.05	4.25	1.85
W	167.50	174.88	39.38	62.70	7.90	7.63	6.28	9.60	28.38	35.00	24.88	1.55	4.00	2.10
CB	171.33	176.33	39.17	66.27	12.77	8.10	6.43	10.17	29.33	34.83	25.33	2.27	4.00	2.23
В	177.75	176.13	40.25	68.18	9.35	7.78	6.50	10.08	29.38	36.25	26.00	1.83	3.45	3.10
PV	177.17	185.50	41.83	80.37	14.60	8.13	6.90	10.47	32.50	39.50	27.00	2.97	5.13	1.30

Tab. 9 Position-related anthropometric profiles – France



Fig. 9 Somatotype profiles of French handball players

GERMANY

The tallest players on the GER national team were Bs followed by CBs and PVs. Positive ratio of arm span and body height was recorded in Ws, GKs and Bs. Negative difference between arm span and body height was found in CBs: - 4.25 cm. Mean shoulder width equaling or surpassing 41 cm was observed in PVs and Bs. Among the heaviest players on the team were GKs, CBs and Bs. The highest amount of subcutaneous fat was found in GKs and CBs. Mean palm breadth over 8 cm was found in Bs only. The lowest mean values of transversal dimensions were observed in Ws. GKs and Bs demonstrated higher values of biepicondylar breadths compared to other playing positions. Among the players with high mean value of circumferential dimensions were CBs, Bs and GKs. Mean endomorphy ratings were relatively low in all playing positions except GKs. The mean mesomorphy ratings ranged from 4.15 to 5.30, which is beneficial in terms of sports performance in handball. A surprising finding was that the lowest ectomorphy rating was found in GKs. In total, players' somatotypes were distributed in 4 categories. The largest number of players (7) was classified as balanced mesomorphs (category 1). The somatotype distribution was relatively heterogeneous in all playing positions.

Pl.	Body height	D-D	A-A	Body mass	Fat	Palm	HB	FB	Biceps	Calf	Fore arm	SOM	ΙΑΤΟΤ	YPE
pos.	(cm)	(cm)	(cm)	(kg)	%	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	Endo	Meso	Ecto
GK	175.17	176.33	38.33	77.90	15.20	7.93	6.83	10.93	30.50	38.50	26.83	2.77	5.30	1.33
W	168.50	171.00	39.00	62.78	9.02	7.96	6.46	9.74	28.60	35.80	25.30	1.72	4.28	2.26
CB	178.00	173.75	39.50	76.75	12.25	7.80	6.60	10.50	30.75	38.00	27.00	2.10	4.30	1.85
В	179.38	180.63	41.63	76.18	9.40	8.43	6.98	10.23	30.25	38.50	26.63	1.65	4.50	2.25
PV	176.25	175.00	41.00	71.50	10.15	7.65	6.75	10.20	29.50	37.50	25.75	1.90	4.15	2.30

Tab.1	0 Position	-related	anthro	pometric	profiles -	Germany
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Fig. 10 Somatotype profiles of German handball players

POLAND

Among the tallest players on the POL national team were CBs and Bs. Difference between arm span and body height was positive in GKs and CBs. Negative difference between arm span and body height was highest in Bs: - 1.25 cm. Mean shoulder width over 40 cm was observed in PVs, who were also the heaviest players, while Ws were the lightest players on the team. The difference between mean body mass of Ws and PVs equaled 19.62 kg. Relatively low mean values of subcutaneous fat were found in Ws, CBs and Bs. The largest percent fat was recorded in GKs and PVs. Mean palm breadth over 8 cm was observed in Bs and PVs. The lowest mean values of humerus breadth were found in CBs and Ws. Among the players with high values of circumferential dimensions were PVs, Bs and CBs. The circumferential dimensions were highest in PVs and lowest in Ws. With regard to somatotype components, highest endomorphy rating was found in PVs, who at the same time demonstrated the highest mesomorphy rating and the lowest ectomorphy rating. The players' somatotypes were classified in 6 somatotype categories. The largest number of players (5) was categorized as endomorphic mesomorph (category 12). Somatotypes of six back players on the POL team were distributed in 5 somatotype categories.

Pl.	Body height	D-D	A-A	Body mass	Fat	Palm	HB	FB	Biceps	Calf	Fore arm	SOM	ΙΑΤΟΤ	YPE
pos.	(cm)	(cm)	(cm)	(kg)	%	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	Endo	Meso	Ecto
GK	178.00	178.25	38.25	78.70	13.55	7.75	6.60	9.95	30.25	39.50	25.75	2.65	4.10	1.60
W	172.88	172.63	39.00	65.08	7.83	7.95	6.30	10.03	28.75	36.75	25.38	1.83	3.88	2.68
CB	181.00	181.50	39.75	71.35	7.95	7.75	6.25	10.45	28.75	37.00	25.75	1.95	3.10	3.15
В	180.00	178.75	39.17	72.77	9.23	8.07	6.82	10.17	30.00	37.33	25.92	1.72	3.80	2.78
PV	177.25	177.00	40.25	84.70	15.45	8.15	6.75	10.70	33.25	40.50	27.25	3.25	5.45	0.85

Tab.11 Position-related anthropometric profiles - Poland



Fig. 11 Somatotype profiles of Polish handball players

HUNGARY

The highest body height average was found in Bs and the lowest in Ws. Positive difference between arm span and body height was recorded in Ws and Bs. Negative difference between arm span and body height was found in both GKs: - 6.67 cm and PVs: - 5.00 cm. An interesting finding was that the lowest mean value of shoulder width was observed in PVs. Among the heaviest players on the team were Bs and PVs. The highest percent subcutaneous fat was found in PVs, whereas the lowest percent fat was recorded in Ws. The highest palm breadth average was recorded in Bs. The lowest mean values of transversal and circumferential dimensions were observed in Ws. The highest mean values of these dimensions were recorded in Bs and PVs. As for the somatotype components, PVs were predominantly endomorphic. Mean mesomorphy ratings in Ws, GKs, Bs and CBs were found to be relatively low. The highest magnitude of linearity was confirmed by ectomorphy rating in Ws. The players' somatotypes were distributed over 8 somatotype categories. The highest degree of heterogeneity in terms of somatotype categorization was found in Bs. The largest number of players was classified in category 1 as balanced mesomorphs. Overall, Ws demonstrated the lowest mean values in 9 anthropometric parameters of 11 measured.

Pl.	Body height	D-D	A-A	Body mass	Fat	Palm	HB	FB	Biceps	Calf	Fore arm	SOM	ΙΑΤΟΤ	YPE
pos.	(cm)	(cm)	(cm)	(kg)	%	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	Endo	Meso	Ecto
GK	177.50	170.83	38.17	72.93	12.10	7.87	6.53	9.83	29.17	37.17	25.67	2.13	3.43	2.33
W	173.50	173.83	39.50	64.67	7.37	7.70	6.43	9.20	28.83	35.67	24.83	1.37	3.27	2.87
CB	174.38	174.00	38.38	68.93	10.60	7.90	6.45	9.60	29.63	36.63	25.25	1.85	3.68	2.35
В	182.88	183.25	41.38	77.53	12.48	8.10	6.70	9.83	30.88	39.13	25.88	2.35	3.50	2.60
PV	176.00	171.00	37.50	78.10	15.20	7.95	6.55	10.50	32.75	38.50	28.00	3.30	4.85	1.35

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Fig. 12 Somatotype profiles of Hungarian handball players

SLOVENIA

The tallest players on the SLO national team were Bs, whereas the shortest players were players in the CB position. Positive difference between arm span and body height was found in Ws, PVs and Bs. The most profound negative difference between arm span and body height was found in CBs and equaled - 2.50 cm. Mean shoulder width over 40 cm was recorded in Bs only, who were also the heaviest players on the team. The largest volume of subcutaneous fat was observed in PVs as well as GKs. Mean palm breadth equaling or exceeding 8 cm was recorded in GKs and Bs. The mean values of transversal dimensions were highest in Bs and lowest in CBs. The players in B position demonstrated highest mean values of circumferential dimensions. The Bs and CBs differed most in 9 anthropometric parameters of 11 measured. The highest mean endomorphy rating was found in PVs, while the lowest one was observed in Ws. The lowest degree of musculoskeletal robustness indicated by the mesomorphy rating was found in CBs, who at the same time demonstrated the highest ectomorphy rating. Overall, the somatotypes of SLO players were distributed over 4 categories. The highest number of players (7) was categorized as endomorphic mesomorph (category 12). The highest degree of somatotype heterogeneity was found in Ws and Bs.

Pl.	Body height	D-D	A-A	Body mass	Fat	Palm	HB	FB	Biceps	Calf	Fore arm	SOM	ΙΑΤΟΤ	YPE
pos.	(cm)	(cm)	(cm)	(kg)	%	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	Endo	Meso	Ecto
GK	176.67	176.00	39.33	74.90	12.47	8.00	6.50	10.57	28.33	39.33	25.17	2.53	4.17	2.07
W	170.13	170.75	38.63	64.20	11.30	7.75	6.48	9.78	28.25	36.13	24.63	1.70	4.08	2.30
CB	167.00	164.50	36.50	59.80	8.60	7.50	6.30	8.95	27.75	35.25	25.50	1.90	3.55	2.50
В	178.38	182.88	40.50	77.38	11.25	8.43	6.80	10.63	31.75	39.50	26.25	2.28	4.85	1.83
PV	171.33	173.67	39.33	71.77	13.97	7.70	6.47	10.47	30.17	37.33	25.50	2.83	4.70	1.50

Tab.13 Position-related anthro	pometric profiles – Slovenia
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Fig. 13 Somatotype profiles of Slovenian handball players

UKRAINE

The mean body height was highest in GKs and lowest in Ws. The highest positive difference between arm span and body height was recorded in PVs: + 2.66 cm. Mean shoulder width surpassing 40 cm was found in PVs and Bs. The difference between the mean body mass of PVs and Ws equaled 21.08 kg. The lowest amount of subcutaneous fat: 2.27 kg was observed in Ws and the largest volume was recorded in PVs. Mean palm breadth over 8 cm was found in PVs, who also demonstrated the highest mean transversal and circumferential dimensions. In anthropometric parameters, Ws showed the lowest mean values in all 11 parameters measured. As to the respective somatotype components, the highest endomorphy rating was recorded in PVs, while the lowest was found in Ws. The W players demonstrated relative leanness, low magnitude of musculoskeletal robustness and predominance of ecromorphy. The highest ectomorphy rating was found in Ws. Players in all playing positions except PVs lacked sufficient amount of lean body mass. The players' somatotypes were classified in 7 categories. The somatotype of one of the PVs was extreme as seen from the somatochart. The highest degree of heterogeneity in terms of somatotype distribution was recorded in Bs and GKs. The largest number of players (4) was identically categorized in categories 3 and 12.

Pl.	Body height	D-D	A-A	Body mass	Fat	Palm	HB	FB	Biceps	Calf	Fore arm	SOM	ΙΑΤΟΤ	YPE
pos.	(cm)	(cm)	(cm)	(kg)	%	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	Endo	Meso	Ecto
GK	175.67	175.33	38.00	68.57	14.13	7.77	6.43	10.13	28.67	36.50	25.00	2.57	3.57	2.60
W	168.88	168.00	37.25	55.35	4.10	7.48	5.95	9.35	26.25	33.75	23.75	1.10	2.78	3.65
CB	171.75	171.75	39.00	62.15	10.10	7.50	6.20	9.35	27.75	34.50	24.50	1.80	2.90	2.95
В	178.13	178.88	40.75	71.90	10.95	7.90	6.65	10.00	29.75	37.00	25.50	2.33	3.63	2.58
PV	173.67	176.33	40.33	76.43	13.27	8.30	6.80	10.67	30.67	39.83	26.33	2.63	5.33	1.23

Tab.	14 H	Position-re	lated a	nthropom	etric pi	rofiles –	Ukraine
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Fig. 14 Somatotype profiles of Ukrainian handball players

Conclusions

The teams were assessed in terms of differences in anthropometric parameters and somatotypes between individual playing positions.

As for the examined anthropometric parameters, among the tallest players were Bs of eight national teams. The lowest mean value of body height was found in Ws on 11 national teams. The difference between arm span and body height: 3.90 cm was found to be highest in the FRA players. The mean values of the difference between arm span and body height ranged from -1.9 cm to +1.3 cm. With regard to body mass and percent subcutaneous fat, the greatest differences were recorded between Ws and PVs. The mean palm breadth ranged from 7.69 cm to 8.01 cm. From the aspect of playing positions, Ws of 6 national teams demonstrated the lowest mean value of palm breadth. In humerus breadth, mean values ranged from 6.41 cm to 6.65 cm, where Bs and PVs had the highest mean values and Ws and CBs were found to have the lowest mean values. In femur breadth, mean values ranged from 9.74 cm to 10.53 cm. GKs and PVs were found to have the highest mean values of femur breadth. In terms of all examined circumferential dimensions, the highest mean values were observed in PVs on all 9 national teams, whereas the lowest mean values were found in Ws. The champion team of DEN was found to have the highest mean values in the following anthropometric parameters: body mass, humerus breadth, femur breadth, biceps and forearm circumference. The lowest mean values of body mass, humerus breadth, biceps circumference, forearm circumference and calf circumference were recorded in the national team of UKR, which finished in last place.

The mean somatotype of the U19 female handball players was categorized as *balanced mesomorph*: 2.20 - 4.17 - 2.19 characterized by the dominance of endomorphy and equality of mesomorphy and ectomorphy. The mean somatotype of players on 10 national teams: CRO, DEN, FRA, GER, HUN, NED, POL, ROU, RUS and SLO were classified as *balanced mesomorphs*. The mean somatotype of *endomorphic mesomorph* was found in the players of ESP and SRB. The UKR players were categorized as *ectomorphic mesomorphs*. Overall, the somatotype distribution revealed both intra-position and inter-position differences.

With regard to the final placement in the championship, the players on the national teams that finished in the 1st to 8th place (except ROU) were found to have relatively higher mean values of endomorphy: 2.3 - 2.5 and mesomorphy: 4.3 - 4.5, lower mean values of ectomorphy: 1.9 - 2.0, which is indicative of *relatively lower degree of linearity with higher body mass values and percent subcutaneous fat, skeletal and muscular robustness*.

The teams that finished in the 9th to 16th place demonstrated relatively lower mean value of endomorphy: 2.0 - 2.2, lower mean value of mesomorphy: 3.6 - 4.1 and higher mean value of ectomorphy: 2.2 - 2.6. This finding revealed *relatively linear physique with longer body* segments, lower values of body mass and percent subcutaneous fat and relatively lower rate of muscular development.

In general, the players that took part in the championship demonstrated well-developed musculature with relatively high stature and adequate ratio of subcutaneous fat to body height.

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