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BODY COMPOSITION OF ITALIAN FEMALE HOCKEY PLAYERS

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Abstract: Objective: In this work the anthropometric features and the body composition of Italian hockey players, members of the Female National team, were analysed. The purpose of the research was to verify if morphological features could influence the performance of different positional groups. Materials and Methods: Each player was measured for her total and sitting height, weight, 9 skinfolds thickness and bioelectrical impedance analysis. Different equations were used to calculate the Fat% from skinfolds thickness. Results: Average height is not a crucial advantage for this sport. On the contrary the proportion trunk-limb seems to play an important role for the performance of the midfield players. Percentage of body fat of the hockey players was lower than the Fat% of the non-athletes women of the same age. Significant differences were found between Fat% determined by skinfolds thickness and Fat% obtained by bioelectrical impedance analysis. Conclusions: The results of this study indicate that there are significant differences in anthropometric features and in body composition between positional groups, stressing the importance of a specific training program. Keywords: field hockey, bioelectrical impedance, skinfolds thickness, anthropometry.

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Key words: Athletes - Field hockey - Bioimpedence analyses – Anthropometry

Introduction

During the last decades several researches focused their attention on the anthropometric features of elite athletes [5,4,9]. According to their results, some features seem characteristic for specific sports or for specific positional groups.

The analysis of body composition is nowadays an essential instrument to improve sport performance in elite athletes. It provides reliable information for

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accurately evaluating the efficiency of a nutritional and a training programme with relation to physical performance. An accurate monitoring of body composition changes is the first important step to identify possible feeding disorders and provides adequate nutritional advice.

Field hockey is a team sport, with both aerobic and anaerobic components. It is characterized by a random alternation of different phases: sub-aerobic with physiological task below the maximum aerobic capacity, aerobic, anaerobic, and at rest [8]. As hockey is a team sport, the alternation of these phases is random, that is each single athlete plays according to the circumstances of the match following a flexible pattern that takes several factors into account. The hockey player should train both her aerobic and anaerobic systems, even if the anaerobic phase is paramount [14]. Field hockey requires a high level of intra-, inter-, and neuromuscular coordination, since each action activates simultaneously different parts of the body, and a lack of coordination and self-control could make the action disjointed and pointless. Moreover, the hockey player should be fast and resilient.
Despite the fact that field hockey is quite popular, very few data so far are available on anthropometric features of female hockey players.

The main aim of the present work is to analyse the morphology and the body composition of a sample of field hockey female players, trying to underline the possible relations between biomechanics features of the technical movements of this sport, the performance and the body composition.

Materials and Methods

The research was carried out on the 24 female members of the Italian field hockey National Team, with an age ranging between 19 and 34 (average age = 28.8±3.59), from different Italian regions.

Each player was measured for total and sitting height, weight and skinfolds thickness at 9 sites (abdomen, axilla, triceps, subscapular, front thigh, chest, suprailiac, biceps, and calf). Through sitting and total height the skelic index was calculated according to the following formula: sitting height/total height x 100, to evaluate the proportion between trunk and limbs.

The body composition was reckoned with different methods: the Body Mass Index (BMI) was calculated in according to the formula: weight (kg)/total height^2 (m^2), skinfolds analysis was carried out to estimate the body density using 4 different equations: with 2 [17], 3 [10], 4 [6] and 7 skinfolds [10]; Siri's equation [16] was used to calculate the percentage of fat mass from body density values. Moreover, bioimpedance analysis (BIA) was carried out through a

multifrequencies instrument (BIA 101 by Akern) and the software BODYGRAM for Windows, provided by the same company, was used for data processing. BIA analysis allowed the calculation of absolute and percentage values of fat and fat-free mass, total water, intra-cellular and extra-cellular water volumes, and the percentage of muscular mass.

Statistical analysis was performed through STATISTICA program.

Results

Table 1 shows average, maximum and minimum values and standard deviations of the anthropometric variables under scrutiny. Total height was 163 cm, slightly higher than the Italian average of 160 cm [2].

Table 1
Average, minimum (min) and maximum (max) values and standard deviation (SD) of the anthropometric parameters

	average	SD	min	max
Age	25.75	3.59	19.00	34.00
Height	163.00	4.26	152.00	171.00
Weight	57.98	4.22	52.00	65.50
Skelic index	53.51	1.04	51.21	54.82
BMI	21.83	1.52	19.49	24.30
Fat% 2 skinfolds	14.39	5.04	6.06	29.54
Fat% 3 skinfolds	18.76	3.33	13.25	27.96
Fat% 4skinfolds	16.37	2.63	11.27	23.53
Fat% 7skinfolds	15.75	3.24	10.66	25.94
Fat% BIA	22.80	3.72	16.50	31.70
Muscular Mass (%)	55.47	8.68	29.30	77.4
Total Body Water %	56.65	2.76	50.00	61.10
Intra cellular water %	57.88	2.16	53.60	61.90
Extra cellular water %	42.13	2.16	38.10	46.40

The skelic index of 53.51 pointed out a mesatiskelic morphology, in according to the nomenclature of Giuffrida and Ruggeri. With a deeper analysis of the index distribution within the team, we noticed that 6 players are brachiskelics, and 5 out

of 6 play as midfield players, and only 3 are macroskelics (one goalkeeper and 2 forwards).

All the hockey players resulted normal weighted in according to the standard classification for the BMI, even if they fall within a quite wide range: from 19.5 to 24.3. However, their BMI was always lower than the one typical for Italian women [25.1] [2]. The percentage of total body water (56.65%) fell within the range expected for normal weighted women [11]. Also the mean values for intra and extracellular water were within the range expected for a healthy woman (50-60% for intracellular water and 40-50% for extracellular water), only two players were slightly beyond these ranges as they presented a higher quantity of extracellular water.

Fat percentage was calculated both through skinfolds thickness by five different equations and through bioelectrical impedance analysis (BIA). Fat% values, determined by different formulas, varied widely one from another: the minimum value was found using two skinfolds equations (14.39%), while BIA gave the maximum value (22.80%). To evaluate if these differences were statistical significant the test T of Student for pair values was applied, and their level of correlation was tested through the r coefficient of Pearson. Results are shown in Table 2.

Table 2
Correlation among Fat Mass values obtained by different methods

	2 skinfolds	3 skinfolds	4 skinfolds	7skinfolds	BIA
2 skinfolds	-				
3 skinfolds	0.9252	-			
4 skinfolds	0.6415	0.7788	-		
7skinfolds	0.7056	0.7901	0.8519	-	
BIA	0.0056	0.0622	0.0944	0.2102	-

It is obvious that the values obtained with skinfolds method are statistical correlated between them, whilst Fat% value obtained from BIA was not correlated with the other values available from skinfolds.

These results were only partially confirmed by test T of Student that stressed a significant difference between Fat% from BIA and from skinfolds methods. The test has also highlighted significant differences among Fat% values got from skinfolds analysis: Fat% obtained using 3 skinfolds showed different statistical values than those resulting from the other equations (data not shown).

Table 3
Anthropometric values of some compared samples (Philadelphia sample is from Bloomsburg University, MSU= Michigan State University). 1: present work, 2: Wassmer and Mookerjee, 2002, 3: Sparling et al., 1998, 4: Fornetti et al., 1999, 5: Marshall and Harber, 1996

	Height	Weight	BMI	Fat% (7 skinfolds)	Fat% (other methods)
Italy[1]	163.00	57.98	21.83	15.75	22.80 (BIA)
Philadelphia[2]	164.26	63.06	23.37	17.29	-
USA (Olympic)[3]	165.00	59.60	22.00	16.90	16.10 (DXA)
MSU[4]	165.70	62.70	22.70	-	20.90 (DXA)
Canada[5]	162.80	62.30	23.50	-	-

Anthropometric parameters of Italian sample were then compared with those of athletes playing field hockey from other countries. Because of insufficient bibliography it was only possible to compare Italian sample with American athletes.

As it is shown in Table 3, the values of total height, weight, BMI, and Fat% obtained with skinfolds method for Italian sample resulted only slightly lower than the values of American athletes [18,7,19,13]. Fat% got from BIA resulted greater than all the other compared values, being similar only to the value obtained with DEXA method for athletes from Michigan State University.

The data were then analyzed according to the playing positions as forwards, midfields/wings, and backs/goalkeepers. Variance analysis stressed significant differences among the above mentioned groups for the skelic index and the percentage of fat mass for the formula with 3 skinfolds. In order to evaluate the most differentiated group the test t of Student for independent samples was applied. Midfield players turned out to be significantly differentiated for the skelic index, having an index value greater than the other two groups. Other significant differences were found for the Fat% calculated with two and three skinfolds between the forwards and backs/goalkeepers, the last group was in fact characterized by a higher value of the Fat%.

For better understanding the distribution of body composition among the groups, the percentage of Fat% from BIA, an average of Fat% from the different skinfolds equations and the muscular mass were considered. From Fig. 1 it is obvious that the group formed by backs and goalkeepers presents the highest value

of body fat, whereas forwards show the minimum value. Wings and midfields players have intermediate values between the other groups. Muscular mass value presents an opposite trend: it is greater for the forwards and lower for backs and goalkeepers.

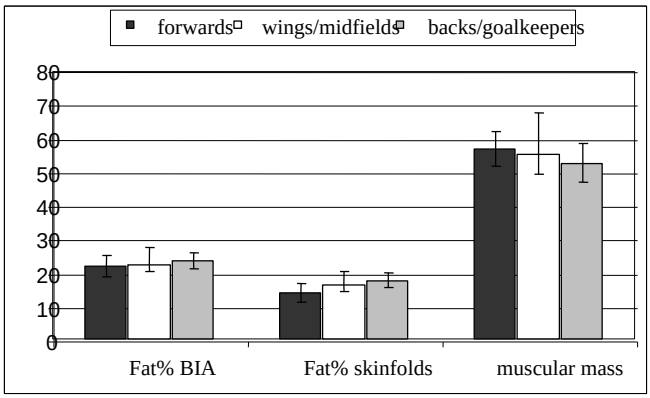

Fig. 1
Mean values and standard deviations of Fat% and muscular mass in the three groups of athletes.

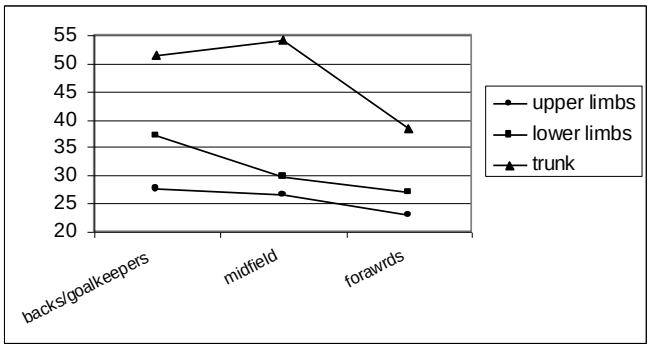

Fig. 2
Distribution of fat mass into different body districts (upper and lower limbs and trunk) for the three positional groups.

To evaluate the distribution of body fat it was estimate the quantity of subcutaneous fat in three body districts: upper limbs, lower limbs and trunk. Results are shown in Fig. 2.

The quantity both in upper limbs and in lower limbs presented the same trend of the total body fat, decreasing from backs/goalkeepers to forwards, whilst trunk fat shows the highest value among the midfield players and the minimum value among the forwards.

Discussion

The present work analysed the body composition in a sample of field hockey players members of the Italian Women Team.

Results showed a total height just slightly higher than the Italian average value. This confirms that height does not seem to have a crucial role in performance and in selection of the field hockey players, as it was previously suggested by other authors [14].

Then mean value of skelic index classified the sample as mesatiskelic, but it is interesting to stress that five out of six brachiskelic players identified were midfield players. This result can be explained by the fact that the brachiskelic individuals have a lower barycentre. This situation seems to be an advantage for the midfield players, as it would make them prone to agile and fast run, ready in reacting and in changing direction during the match.

Both BMI and Fat% through skinfolds values resulted lower than the ones of American athletes, but an unexpected higher value of Fat% calculated through BIA was found. This result could be explained by a greater development of visceral than subcutaneous fat mass, and, as a consequence it can underestimate the Fat% with skinfolds thickness analysis, as previously reported by other researches [3,15]. This result highlights the importance of the two complementary methods. Skinfolds analysis, in fact, even with possible under estimate of the total Fat%, provides important information on the distribution of subcutaneous fat mass.

Body composition analysis showed interesting results in the study of the sample for positional groups. Fat% resulted higher for the backs/goalkeepers and lower for forwards group. Opposite results were obtained for muscular mass. These data confirmed what had been highlighted in a previous study on Indian male field hockey players [12]. They seem to reflect a different training program carried out by the players: forwards should have developed their skill in aerobic and anaerobic system and should have a light, particularly reactive body.

All the players present a normal muscular mass development, not too high (55,47%) but suitable to the characteristics of the game. An harmonic development of muscle mass provides the percentage of strength that a field hockey players need (20%, [13] and, at the same time, allows them to carry out their movements with agility and precision, skills that would be obstructed by an excessive development muscular mass.

In conclusion, the research highlighted once more the importance of monitoring the morphology and the body composition in athletes, since it represents an useful instrument for improving the sport performance. Moreover, for field hockey, and, in general, for all the team sports, it was stressed the usefulness of the morpho-anthropometric analysis of the athletes in accordance to their positional groups previously suggested by other authors [12,1,9]. This demonstrates a morphological differentiation or a selection of the athletes on the base of the positional groups and underlines the importance of a specific and differentiated training program.

References

1. Belcastro M.G., P.Brasili, G.Pascucci (1996) Anthropometric profile in post-pubescent basketball players. *Italian J.Sport Sci.* 1:25-31

2. Briziarelli L., M.Mori, G.Pocetta (1994) ASSILS: Indagine di Medicine Preventiva sulle vasculopatie ischemiche. Rapporto conclusivo. Istituto di Medicina Sociale, Roma

3. Buffa R., P.Porcella, G.Vona (1998) Confronto tra impedenziometria, antropometria e interattanza dell'infrarosso vicino nell'analisi della composizione corporea. *Italian.J. Sport Sci.* 5:24-29

4. Calò C.M., M.I.Cireddu, P.Porcella, G.Vona (2001) Somatotipo e composizione corporea in giovani atlete di tre diversi sports. *Italian J.Sport Sci.* 8:37-41

5. Carter J.E.L., B.H.Heath (1990) Somatotypying development and application. Cambridge University Press, Cambridge

6. Durnin J.V., J.Womersley (1974) Body fat assessed from total body density and its estimation from skinfold thickness: measurements on 481 men and women aged from 16 to 72 years. *Br.J.Nutr.* 32:77-97

7. Fornetti W.C., J.M. Pivarnik, J.M.Foley, J.J.Fiechtner (1999) Reliability and validity of body composition measures in female athletes. *J.Appl.Physiol.* 87:1114-1122

8. Fox E.L. (1988) Fisiologia dello sport. Editoriale Grasso, Bologna

9. Gualdi Russo E., L.Zaccagni (2001) Somatotype, role and performance in elite volleyball players. *J.Sports Med.Phys.Fitness* 41:256-262

10. Jackson A.S., M.L.Pollock, A.Ward (1980) Generalized equations for predicting body density of women. *Med.Sci.Sports Exerc.* 12:175-182

11. Kushner R.F., D.A.Shoeller (1986) Estimation of total body water by bioelettrical impedence analysis. *Am.J.Clin.Nutr.* 44:417-424

12. Malhotra M.S., N.T.Joseph, J.Sen Gupta (1974) Body composition and endurance capacity of Indian hockey players. *J.Sports Med.* 14:272-277

13. Marshall J.D., .J.Harber (1996) Body dissatisfaction and drive for thinner in high performance field hockey athletes. *Nutrition* 17:541-544

14. Mignardi S., B.Ruscello (1993) L'hockey per tutti. Gremese editore, Roma

15. Ortega L., E.Novellòn, A.Sànchez-Andrès (2000) Composicion corporal en joven universitarios: antropometria frente a impedencia bioelectrica. In: T.A. Varela (ed.) Investigaciones en Biodiversidad Humana. Univesidad de Santiago de Compostela Press, Santiago di Compostela, pp. 640-647

16. Siri W.E. (1961) Body composition from fluid spaces and density. Analysis of methods. In: J. Broyek and A. Henschel (eds.) Techniques for Measuring Body Composition. National Academy of Sciences, Washington DC, pp. 223-244

17. Sloan A.W. (1967) Estimation of body fat in young men. *J.Appl.Physiol.* 23:311-315

18. Sparling P.B., T.K.Snow, L.B.Rosskopf, E.M.O'Donnell, P.S.Freedson, W.C.Byrnes (1998) Bone mineral density and body composition of the United States Olympic women's field hockey team. *Br.J.Sports Med.* 32:315-318

19. Wassmer D.J., S.A.Mookerjee (2002) Descriptive profile of elite U.S. women's collegiate field hockey players. *J.Sports Med.Phys.Fitness* 42:165-171

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