Original article

Evaluation of high-level handball players in morphological characteristics and various motor abilities by playing position

Oxyzoglou Nikolaos[1], Hatzimanouil Dimitrios[2], Iconomou Charalambos[4], Ioannidis Theodoros[2], Lazaridis Savvas[2], Kanioglou Aggelos[3], Papadopoulos Konstantinos[2]

[1]Laboratory of Neuromuscular Control and Therapeutic Exercise, Department of Physical Education and Sport Sciences, Aristotle University of Thessaloniki at Serres, Greece.
[2]Laboratory of Coaching and Sport Performance, Department of Physical Education and Sports Sciences, Aristotle University of Thessaloniki, Greece.
[3]Laboratory of Psychology, Department of Physical Education and Sport Sciences, Aristotle University of Thessaloniki, Greece.
[4]Technological Educational Institution of Serres, Department of Physical Activity, Greece

ABSTRACT

Objectives: The aim of this study was to evaluate handball players' morphological characteristics and motor abilities according to their playing position.
Materials & Methods: Participants were 46 handball players, aged from 18 to 21years old from the national teams of Greece and former Yugoslavia republics. They were divided into four subgroups corresponding to playing positions. Their morphological characteristics of body height, body mass, hand extension, bioacromial distance and palm diameter were measured. Special tests of motor abilities were used for strength, speed and coordination. Kruskal-Wallis and Mann-Whitney U analyses were applied for the comparison of groups. Results: The results revealed few differences between all four playing positions in almost all measurements of morphological characteristics and motor abilities.
Conclusions: There was homogeneity among players in different playing position with few exceptions.

Key words: handball players, morphological profile, motor abilities

Correspondence to: Lazaridis Savvas, Post Doc, Laboratory of Coaching and Sport Performance, Department of Physical Education and Sports Sciences, Aristotle University of Thessaloniki, Giannakopoulos 16, 56123, Thessaloniki. Tel: ++30 6932587801. Fax: ++30 2310 720843
E-mail: sav200m@gmail.com

INTRODUCTION

Athletes' morphological characteristics play an important role in team sports' performance.[1] Handball is a complex intermittent sport event, which requires players to adopt well developed aerobic and anaerobic capacities.[2] In addition to this, several motor abilities such as sprinting, jumping, flexibility and acceleration are considered important parameters of the event that contribute to the high performance of the player and generally for the team.[2-5] In recent studies, it was concluded that there is a significant correlation between body composition and athletic performance in high-level handball players.[1] In addition to this, in a similar study, it was found that all high-level handball players had differentiation in body height and body mass at the four playing positions.[6] Apart from morphological characteristics, a team's performance is also related to the athletes' motor abilities. The above mentioned study concluded that when comparing morphological characteristics and motor abilities of team handball athletes at different performance levels, significant differences were observed in both parameters depending on the athletes playing position. In a relevant study, by measuring wrist strength in high-level handball players, it was concluded that pivotal players revealed better scores in that parameter among all players. The same was true regarding muscle strength of knee and elbow extension muscles.

A successful handball player should display adequate coordination while dribbling and throwing. Team handball consists of different playing positions which contribute to the total performance. Each position has its characteristics and specific demands. These facts lead players of each position to have or to adapt to specific morphological characteristics and motor abilities. These values may be used as one of the criteria for classification between players at different playing positions according to their ages. The main hypothesis of our research was that there were differences between each playing position in morphological characteristics and motor abilities. The literature focuses mainly on the differences of players' morphological characteristics and motor abilities between teams and not between playing positions. Especially, in regard to speed and movement coordination there is no recognized research and scientific data. Moreover, the sample of the present study consists of junior players while most researchers had examined senior men's teams. Although it is known that in these age groups handball players differ in morphological characteristics by position, motor abilities are poorly recorded. From the relevant literature, it seems that there is little information available concerning the motor abilities by playing position.[4]

As a consequence of our potential conclusions of the current study, it will be easier for coaches to select the appropriate player in each position and to make a more efficient enquiry regarding performance of their teams. Additionally, results from motor performance will allow coaches to identify players' weaknesses and design training models for improving specific deficiencies of their athletes' during a championship season. Last but not least, data of the present study could be included in the International research literature and help to improve the talent identification.

The main aim of the study was to evaluate and determine the essential motor abilities and morphological characteristics of high level handball players by playing position.

MATERIALS & METHODS

The sample consisted of 46 handball players, aged 18-21 (M=19.5, SD=±4.5), from the national teams of Greece and former Yugoslavia Republic (Servia, Montenegro, Vosnia and Herzegovina, Croatia). It was concluded that these players represent a high level of morphological characteristics and motor abilities. The sample was divided into four experimental subgroups corresponding to four playing positions, goalkeepers (n=8), wings (n=14), backcourt players (n=16) and pivotal players (n=8) (Table 1).

The protocol for the measurements included the following morphological characteristics: body

TABLE 1. Mean±standard deviation values and mean rankings of morphological characteristics and motor abilities of position team handball players

Wingers		Backcourt Players		Pivot Players		Goalkeepers	
M	Rang$_M$	M	Rang$_M$	M	Rang$_M$	M	Rang$_M$
Body height							
183.62±6.94	11.44	191.81±6.40	24.83	190.57±8.69	22.21	189.18±4.22	20.88
Weight							
80.18±8.00	11.88	91.08±9.65	24.44	88.71±10.68	20.93	87.25±8.17	20.69
Hand extension							
190.87±8.23	15.94	196.19±6.28	25.22	194.97±7.99	22.21	190.37±5.35	14.63
Biacromial distance							
41.18±3.26	16.56	42.77±2.69	22.25	42.71±2.44	22.29	42.50±2.28	21.50
Palm diameter							
22.31±.84	10.94	24.17±1.86	24.39	24.78±1.165	26.79	23.12±1.95	18.38
Handgrip							
53.23±8.09	23.75	52.85±5.41	25.03	45.64±5.15	11.14	49.30±6.93	17.81
Bench-press							
75.12±12.40	16.81	82.94±8.06	24.58	81.42±5.74	23.71	75.00±7.55	14.75
Strength endurance by holding weight at 50% of body weight							
53.12±22.13	19.38	57.77±20.37	22.64	54.71±16.34	19.71	55.00±19.91	20.06
Body sit ups							
32.62±3.85	23.81	32.88±1.36	25.00	30.57±4.31	18.57	29.12±2.99	11.31
Push ups							
29.37±6.92	17.44	32.86±6.44	23.43	29.71±7.40	17.71	28.00±8.56	15.75
Hand tapping							
50.25±6.38	22.50	46.83±8.07	18.81	54.00±3.21	30.14	47.87±3.44	16.44
Foot tapping							
39.12±3.09	23.56	38.05±2.48	18.78	39.71±2.56	25.71	38.25±2.37	19.31
Sprint 10m							
1.84±0.16	21.44	1.82±0.15	19.44	1.84±0.16	20.07	1.88±0.18	22.19
Sprint 30m							
4.49±0.12	14.81	4.59±0.25	19.00	4.53±0.15	19.67	4.65±0.16	24.19
30m rectilinear dribbling of the ball							
4.56±0.12	14.13	4.72±0.28	20.50	4.69±0.18	21.57	4.82±0.33	23.50
30m slalom dribbling of the ball							
5.22±0.24	16.13	5.33±0.24	19.84	5.34±0.32	19.00	5.52±0.40	25.06
10m simultan. rolling 3 balls							
20.22±2.11	18.19	22.02±2.03	26.00	20.12±1.43	15.79	19.95±1.36	15.25

European Journal of Sports Medicine

height in cm, body mass in kg, hand length in cm, biacromial distance in cm and palm diameter (hand spread) in cm. Measurements were conducted for three motor indexes based on the 12 variables explained below. Strength was measured with the handgrip test (maximum isometric force), bench press, strength endurance determined by the number of seconds by maintaining weight at 50% of body weight with the knee angle fixed at 90º, sit ups (Abalakov device) in 30 sec, and number of push ups in 30 sec. For speed, the number of hand tappings in 30 sec, and the number of foot tappings in 30 sec were measured. Sprint times at 10-m and 30-m were recorded. Coordination was evaluated by a 30-m rectilinear dribbling with a ball (start from standing position with the ball), 30-m slalom dribbling with the ball (cones were put at straight line) and 10-m slalom sprinting and simultaneous rolling three handball balls.

A decimal measurement tape (SECA-220), a hand-dynamometer (GRIP-D, Takey, Scientific Instruments CO., LTD., Tokyo, Japan), Auto tonics Photocell, (BEAM SENSOR, BLSM-MFR, Korea) and Abalakov device were enrolled for equipment purposes in order to evaluate performance in different field tests. EUROFIT indications and instructions were followed to classify individual scores.

Measurements were carried out in the morning and evening prior to training and after warm-up, according to the measures provided by the International Biological Program. Measurement conditions were strictly adhered to, while the measurement used and further processed was the best one between the two efforts. Approval for the experiment was obtained from Aristotle's University Ethics Committee on Human Research.

The principles of the descriptive and non-parametric statistics were applied, for quantitative analysis of the data. The mean and standard deviation were calculated. Kruskal-Wallis and Mann-Whitney U analyses were used for the comparison among groups. The significance level was set at $p \leq .05$.

RESULTS

The Kruskal-Wallis test indicated statistical differences between playing position in palm diameter ($H=9.13$, $p=.02$), handgrip ($H=7.77$, $p=.05$), and sit ups ($H=8.13$, $p=.04$). Mann-Whitney U analysis indicated statistically significant differences in body height (Backcourt Players and Goalkeepers > Wingers), body mass (Backcourt Players > Wingers), hand extension (Backcourt Players > Goalkeepers), palm diameter (Backcourt Players and Pivot Players > Wingers), handgrip (Backcourt Players and Wingers > Pivot Players), bench press (Backcourt Players > Goalkeepers), sit ups (Wingers and Backcourt Players > Goalkeepers), hand tapping (Pivot Players > Goalkeepers and Backcourt Players), 30m sprint (Wingers > Goalkeepers) and 10m simultaneously rolling 3 balls (Goalkeepers > Backcourt players and Pivot Players > Backcourt Players). There were no statistically significant differences between the remaining variables among groups considered in the study (Table 2).

DISCUSSION

The values of morphological characteristics and motor abilities by playing position are indicated. It was shown that, although anthropometric characteristics relate to sport performance, they are not crucial in defining which team will win in a match.[4,7] Technical, tactical and psychological factors affect players' sport performance. As a result of this, the values of morphological characteristics and motor abilities must not be taken as unique criterion for evaluation, selection, and improvement of sport performance.

TABLE 2. Rank comparison among position team handball players

Goalkeepers vs Wingers		Goalkeepers vs Backcourt		Goalkeepers vs Pivot		Wingers vs Backcourt		Wingers vs Pivot		Backcourt vs Pivot	
Mann-Whitney U	p	Mann-Whitney U	p	Mann-Whitney U	p	Mann-Whitney U	p	Mann-Whitney U	p	Mann-Whitney U	p
Body height											
15.00	Ns	57.00	Ns	25.00	Ns	**25.00**	**.00**	15.50	Ns	56.00	Ns
Weight											
18.50	Ns	62.00	Ns	22.00	Ns	**25.50**	**.01**	15.00	Ns	57.00	Ns
Hand extension											
31.50	Ns	**32.50**	**.02**	16.00	Ns	41.50	Ns	18.50	Ns	57.00	Ns
Bioacromial dist.											
25.00	Ns	70.50	Ns	26.50	Ns	51.50	Ns	20.00	Ns	62.50	Ns
Palm diameter											
20.50	Ns	50.50	Ns	17.00	Ns	**27.50**	**.01**	**3.50**	**.00**	58.00	Ns
Handgrip											
23.50	Ns	46.00	Ns	19.00	Ns	67.50	Ns	**10.00**	**.04**	**21.00**	**.00**
Bench-press											
30.50	Ns	**35.04**	**.04**	13.50	Ns	47.50	Ns	20.50	Ns	60.00	Ns
Strength endurance by holding weight at 50% of body weight											
31.50	Ns	63.50	Ns	27.50	Ns	60.50	Ns	27.00	Ns	53.50	Ns
Body sit ups											
14.00	**.05**	**19.00**	**.00**	21.05	Ns	69.00	Ns	20.50	Ns	47.00	Ns
Push ups											
26.50	Ns	40.00	Ns	23.50	Ns	40.50	Ns	25.50	Ns	33.00	Ns
Hand tapping											
17.50	Ns	69.50	Ns	**3.50**	**.00**	64.00	Ns	17.50	Ns	34.00	.05
Foot tapping											
24.00	Ns	68.00	Ns	18.50	Ns	57.00	Ns	25.50	Ns	42.00	Ns
Sprint 10m											
29.00	Ns	59.50	Ns	20.00	Ns	65.50	Ns	26.00	Ns	52.50	Ns
Sprint 30m											
13.00	**.05**	45.50	Ns	16.00	Ns	51.00	Ns	18.50	Ns	39.50	Ns
30m rectilinear dribbling of he ball											
17.00	Ns	53.50	Ns	25.50	Ns	44.50	Ns	15.50	Ns	55.00	Ns
30m slalom dribbling of the ball											
18.50	Ns	47.00	Ns	18.00	Ns	48.50	Ns	26.00	Ns	55.00	Ns
10m simultan. rolling 3 balls											
29.00	Ns	**29.00**	**.02**	28.00	Ns	44.00	Ns	25.50	Ns	**29.00**	**.05**

Significant differences between groups ($p<0.05$) are highlighted in bold.

European Journal of Sports Medicine

Wingers

Our results showed that winger's height and weight values were less than in other player's positions. This observation is probably related to the fact that these players need to be flexible and agile because they usually start and finish the counter attack. As well as that, it was concluded that the bioacromial distance ranges between 42 and 44 cm, whereas palm diameter ranges between 24 and 25 cm. The same results also were found by a similar study.[7,8] Winger's palm diameter was shorter than backcourt and pivot players and possible this occurs because of their somatotype.

Regarding maximum isometric palm strength, the present results showed that wingers revealed higher values than pivot players did. Probably this fact helps them to gain better manipulation and to give the so-called "spins" to the ball when they throw it from the corners of the field.[8] In addition, wingers were better in body sit ups than goalkeepers. Possible these players developed the abdominal muscles to a higher extend as a result of manifold feints and side falls.

Lastly, in 30m speed wingers presented better scores than goalkeepers did. The requirement of a winger's position needs a lot of speed to cope with the high number of counter attacks as wingers are almost always the first players to start and perform the counter attack.

Backcourt players

The results showed that backcourt players were taller and heavier than wingers. Moreover, they presented longer hand extension. These results agree with previous studies which classified backcourt and goalkeepers as having ectomorphic somatotype and wingers and pivot as mesomorhic somatotype.[8,9] It is necessary for these players to execute many jumps and overhand throws of the defenders' blocks during the game.

Regarding bench press, body sit up and hand grip, backcourts presented higher values compared to goalkeepers and pivotal players. From this finding, is clear that elbow joint muscular strength was more developed in backcourts players, because they frequently execute throws from a distance of 9 to 12 meters. Backcourts players due to their guarding position, frequently try to overwhelm their opponents and so they manage to develop their muscle strength of upper body. The same probably occurs during the execution of a long distance throws when they try to target on the post. Concerning repeated movement speed (hand-tapping), these players presented better scores than pivot did. One can speculate that this occurred due to the fact that they usually handle the ball (dribble) during the game more than other court players.

Finally, as regards coordination abilities, the only statistically significant difference concerned 10m speed test. Backcourt players presented the lowest values compared to any other playing position. This fact showed that these players because of their somatotype (ectomorphic) did not have enough flexibility and agility to cope with and to manipulate the ball easily in low position.

Pivotal players

Pivotal players did not present any differences in morphological characteristics with other playing positions except for palm diameter. They displayed longer palm diameter than wingers. It is necessary for these players to have long palm diameter, because it is usual for them to receive and grab the ball during the game. Researchers suggested that a pivotal player is a highly specific position in handball due to the fact that during organized attack pivotal players stand on the 6 m line and as a result they are isolated from the rest of the team.[8,10] With reference to maximum palm isometric strength, pivotal players presented lower values than backcourt and winger players. Probably these players need more technique than strength when they throw the ball to the post (a small distance shot). Concerning repeated movement speed (hand tapping), pivots performed

better scores than backcourts and goalkeepers did. Possibly these differences should be attributed to the fact that pivots possess high level throw effectiveness and reception skill. Finally, as regards coordination abilities a statistically significant difference between pivots and backcourts was observed. This is possibly attributed to the fact that line players are distinguished for their orientation ability in space due to the fact that they often have to perform "blind", i.e. automatic throws from 6 m line.[10,11]

Goalkeepers

Goalkeepers predominated in height over wingers but scarcely without statistical significance. These players need to be tall to cover enough space between the posts. Recently it was stated that goalkeepers were among the tallest players of a team.[10,12] Moreover, goalkeepers presented lower values in hand extension than backcourt players. Possibly this is due to the height of present backcourt players. In addition to this, it was stated that there was a relationship between height and hand extension.[3,4,13] More specifically it was revealed that there was a 200cm extended arms distance average in goalkeepers and a ratio between extended arms distance and height which range from 106 to 100. Concerning sit ups and elbow flexion repetitions, goalkeepers presented lower values than wingers and backcourt players. Probably this occurred due to their playing position role which is more static than the others as they did not have enough dynamic movement actions during the game. As regards repeated movement variables (hand tapping), they revealed differences with pivotal players which was statistically significant. Goalkeepers' most important playing activity is to react, block and save the ball. Thus, they do not use frequently repeated movements with the ball. With reference to the 30m parameter, there was a statistically significant difference between goalkeepers and wingers. Possibly goalkeepers, because of their playing position, do not move more than 5 to 7 meters in distance.

Team handball consists of different playing positions which contribute to the total performance. Each position has its' characteristics and specific demands. The specific kinesiologic requirements associated with particular positions may have also influenced the development of the players' anthropologic properties, thus emphasizing the differences identified in the current study. During years of training process, the players have adjusted their anthropologic properties to specific demands.[1,6] These values may be used as one of the criteria for classification between players in different playing position, but as our limitation of this study, these must be taken into account only in this age level and in this classification.

CONCLUSION

The present study compared the anthropometric and physical fitness characteristics of specific playing positions in young male handball players. The results revealed that few differences exist in anthropometric and physical fitness characteristics between playing positions in the current sample. These conclusions due to differentiation of playing position can be applied by trainers and coaches as they are based on specific tests and in fact show the demands characteristics of individual playing positions. Specificity of training , based upon the position of the player, is of great importance when planning strength and conditioning programs.

It is suggested that, additional profiling studies of elite young male and female handball players should be enrolled in order to record and obtain normative data. These findings could be added to the International scientific research and the upper target would be to identify potential talents of this sport.

European Journal of Sports Medicine

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