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Some Anthropologic Characteristics of Elite Female Handball Players at Different Playing Positions

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A B S T R A C T

Differences in motor and psychologic variables according to playing positions were analyzed in a sample of 53 elite female handball players, members of junior and senior national team. Motor status included 8 variables for assessment of explosive strength of landing and throwing, agility, speed strength, movement frequency, and flexibility. Psychologic status was analyzed through 4 dimensions according to Eysenck: extroversion, psychotic behavior, neurotic behavior, and lie. The anthropologic features analyzed showed statistically significant differences. Considering motor abilities, differences were recorded in the variables for assessment of speed strength, agility and leg movement frequency, where wings predominated, whereas goalkeepers showed predominance in flexibility. In psychologic status, differeces were present in the variable for assessment of extroversion, which was most pronounced in wings, whereas psychotic behavior was more expressed in those at pivot position. The differences were primarily consequential to the selection of players of a specific anthropologic profile for particular playing positions. The hypothesis of the impact of kinesiologic specificities of a particular playing position on the formation of the players' anthropologic profile should be scientifically tested. Study results may found application in training and contest practice, especially in forming anthropologic models for particular positions during the process of player selection.

Key words: *motor abilities, psychologic characteristics, female handball players*

Introduction

In complex kinesiologic activities such as sport games, successful performance is determined by a number of factors, first of all by anthropologic features of the players[1–3]. Motor abilities are the main anthropologic component that is responsible for kinesiologic performance[4–7]. In modern elite sports based on the scientific approach to the training process, athletes have been ever more aligned according to their motor, morphological and functional characteristics, thus psychologic features becoming ever more important for achievement of top results[8–10]. Kinesiologists are interested in motor abilities because some of them can to a considerable extent be modified *via* kinesiologic operators[11,12], whereas psychologic characteristics, being mostly genetically determined, are more important in player selection. In sport games including handball, some playing positions that require appropriate anthropologic types of players consistent with specific functions and needs of the position have been distinguished. According to playing positions, players mainly differ in their morphological features[13,14]. Studies tackling differences in other anthropologic and technical-tactical player properties according to playing position are lacking[15–17]. Considering the role of motor and psychologic characteristics in the players' performance in handball, and inadequate scientific knowledge of the respective variation according to particular playing positions, the aim of the present study was to identify differences in the basic motor abilities and psychologic characteristics of elite female handball players according to playing positions.

Material and Methods

Study sample consisted of 53 elite female handball players aged 17–36, members of the Croatian national junior and senior teams. The sample included all top Croatian female handball players. This is a case of a

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unique sample that includes all top Croatian female handball players who are involved in a common training programme, since the majority of junior female players permanently or occasionally plays for the senior Croatian nationall handball team. The sample consists of 23 female players specialized for back position, 15 specialized for wing position, 8 goalkeepers and 7 players specialized for pivot position.

Eight variables were used for assessment of basic motor abilities: standing long jump and standing high jump for landing explosive strength, medicine ball throw for throw explosive strength, stepping aside and Japan test for agility assessment, 30-m run for speed strength, foot tapping against wall to assess the frequency of leg movements, and astride touch-toe for flexibility. Psychologic characteristics were evaluated by Eysenck factorial multidimensional pesonality questionnaire, used to analyze 4 factors[18]: extroversion, psychotic behavior, neurotic behavior, and lie.

The following statistical parameters were used on basic descriptive analysis: arithmetic mean (X), standard deviation (SD), minimal result (Min), maximal result (Max), coefficient of asymmetry (a_3), coefficient of distortion (a_4), and maximal deviation of relative cumulative empirical frequency from relative cumulative theoretical frequency (Max D). Testing for distribution normality of the prediction variables was done by use of Kolmogorov-Smirnov test at the tolerated error level of 5%. Between group differences were determined by multivariate analysis of variance and canonic discriminative analysis with the following parameters: group arithmetic means (X), F values of statistical significance testing (F), Wilks' lambda value (Wilks' λ), respective value of the degree of freedom (df), respective value of discriminative function (λ), coefficient of canonic discrimination (Rc), χ^2 – test value, proportion of error (p), and orthogonal projections – correlations of variables with discriminative function (STRUC). Study subjects were divided into groups according to playing positions: goalkeeper, back, wing, and pivot.

Results and Discussion

Basic descriptive parameters are presented in Table 1. In all motor variables data showed normal distribution. In the set of psychologic variables, extroversion yielded a borderline value, whereas other variables had normal distribution parameters. In this variable, results showed a tendency toward higher values, which is quite understandable. The sample included national team players who are more straight in communication than the population at large, as required by the nature of this sport game predominated by cooperation, emphasized communication, fellowship, and social responsibility. These requirements cannot be met by uncommunicative and withdrawn players lacking the sense for cooperation within a sport team. Therefore, introverted players are being eliminated during the process of selection because such a psychologic profile precludes successful performance in contest conditions. Normal distribution characteristics were expected as the study sample consisted of national team players of uniform quality and comparable anthropologic status. Thus, there was no major variability of data in any of the variables analyzed.

In Tables 2a and 2b, results of differences, analysis of variance, and discriminative analysis are presented. Three discriminative functions were isolated, the first

TABLE 1
BASIC DESCRIPTIVE AND DISTRIBUTION PARAMETERS OF PREDICTION VARIABLES

Variable	X	Min	Max	SD	a_3	a_4	Max D
Motor abilities							
Standing high jump (cm)	36.81	24.00	47.00	5.68	–0.50	–0.59	0.14
Standing long jump (cm)	209.23	165.00	230.00	12.78	–1.20	3.42	0.14
Medicine ball throw (m)	11.08	7.50	14.00	1.48	–0.27	–0.73	0.15
Foot tapping (points)	25.49	19.00	31.00	3.05	–0.72	–0.35	0.18
Astride touch-toe (cm)	78.93	54.00	101.00	11.36	–0.03	–0.39	0.07
Stepping aside (s)	8.12	6.94	10.75	0.82	1.04	1.25	0.13
Japan test (s)	15.05	13.70	17.63	0.69	1.40	3.66	0.13
30-m run (s)	4.89	4.40	5.46	0.23	0.27	0.06	0.09
Psychological characteristics							
Psychotic (points)	4.11	0.00	9.00	1.98	0.49	0.08	0.15
Extroversion (points)	16.17	7.00	19.00	2.61	–1.78	3.52	0.23
Neurotic (points)	9.81	3.00	18.00	3.86	0.28	–0.59	0.11
Lie (points)	9.91	2.00	20.00	3.70	0.79	1.09	0.14

a_3 – coefficient of asymmetry, a_4 – coefficient of distortion, Max D – maximal deviation of relative cumulative empirical frequency from relative cumulative theoretical frequency (t-test = 0.22)

one at the level of statistical significance ($p<0.05$) identifying differences in the system of variables of the motor and psychologic status according to playing positions. Considering individual motor status variables, differences were especially pronounced in sprint speed strength ($p>0.1$), agility in terms of basic movement ($p<0.05$), and at the level of statistical significance in the variable for assessment of leg movement frequency. The wings predominated in speed strength, showing greatest difference from pivot players and goalkeepers. The specific function of wing players requires swift and frequent movement from the phase of defense to the phase of attack and *vice versa*, as they are the front ones, most commonly participating in counterattack and preventing counterattack, thus covering the largest field space. That is why the female handball players at wing positions need very high speed strength in the form of sprint to allow them fast establishment, performance and change of movement direction. On the other hand, there are no such requirements at the position of goalkeeper, and are present to a considerably lesser extent at the position of pivot. A similar explanation could also apply to the variable for assessment of agility in the form of basic movement. The wing position requires maximal speed of changing direction of movement within a limited space, mostly on vertical situation movement on attacking, jumping into the space, penetrating and feinting, abrupt starting a counterattack, and stopping if the ball has been lost by the attacking team. These tasks are also present at other playing positions, however, to a considerably lesser extent and intensity. Wings were also superior in the variable for assessment of leg movement frequency, which is necessary for swift movement needed for successful performance of technical-tactical tasks at this playing position. In this variable, differences were especially pronounced in comparison with the subgroup of goalkeepers, which was rather unexpected. Obviously, goalkeepers were inferior according to all motor abilities, except for flexibility, where they predominated all other playing positions, the difference from wings reaching borderline statistical significance ($p<0.05$). In this sample of the female handball national team players, however, goalkeepers ranked far behind other players according to objective playing performance and thus also according to motor potential, which was least pronounced in the variable for assessment of lateral agility, because their technical-tactical activity is predominated by lateral side-step movement on both following and setting as well as on preparing for defense movements. Considering flexibility, it is one of the prevailing motor abilities determining the goalkeeper's performance, and is especially important on achieving maximal amplitude on defense movements.

In the set of psychologic variables, statistically significant differences at the level of $p<0.01$ were found for the variable of extroversion between wing players and

TABLE 2a
RESULTS OF ANALYSIS OF VARIANCE AND CANONIC DISCRIMINATION ANALYSIS

No	λ	Rc	Wilks' λ	χ^2	df	p
1	1.25	0.75	0.28	55.87	36	0.02
2	0.36	0.52	0.63	20.22	22	0.57
3	0.16	0.37	0.86	6.54	10	0.77

λ – respective value of discriminative function, Rc – coefficient of canonic discrimination, Wilks' λ – Wilks' lambda value

Variable	X Goalkeeper	X Back	X Pivot	X Wing	F	p	STRUC
Motor abilities							
Standing high jump (cm)	33.75	37.96	37.00	36.60	1.10	0.36	–0.13
Standing long jump (cm)	198.88	210.17	210.57	212.67	2.35	0.08	–0.32
Medicine ball throw (m)	10.08	11.22	11.29	11.33	1.50	0.23	–0.24
Foot tapping (points)	23.13	25.52	25.29	26.80	2.79	0.05	–0.35
Astride touch-toe (cm)	86.00	78.48	78.00	76.27	1.36	0.26	0.25
Stepping aside (s)	8.68	8.18	8.03	7.78	2.35	0.08	0.34
Japan test (s)	15.60	14.93	15.25	14.84	2.89	0.04	0.30
30-m run (s)	5.09	4.87	4.97	4.77	4.52	0.01	0.40
Psychological characteristics							
Psychotic (points)	3.25	3.87	5.57	4.27	2.19	0.10	–0.21
Extroversion (points)	14.75	15.52	16.86	17.60	2.95	0.04	–0.37
Neurotic (points)	9.13	11.13	8.43	8.80	1.83	0.16	0.08
Lie (points)	11.75	10.26	10.00	8.33	1.50	0.23	0.28

F – values of statistical significance testing, STRUC – correlations of variables with discriminative function

TABLE 2b
POST HOC ANALYSIS OF VARIANCE

Variable	Goalkeeper-Back	Goalkeeper-Pivot	Goalkeeper-Wing	Back-Pivot	Back-Wing	Pivot-Wing
			Motor abilities			
Standing high jump (cm)	0.08	0.27	0.26	0.70	0.47	0.88
Standing long jump (cm)	0.03	0.07	0.01	0.94	0.54	0.71
Medicine ball throw (m)	0.06	0.12	0.06	0.91	0.82	0.95
Foot tapping (points)	0.05	0.16	0.01	0.85	0.19	0.26
Astride touch-toe (cm)	0.11	0.18	0.05	0.92	0.56	0.74
Stepping aside (s)	0.12	0.12	0.01	0.68	0.14	0.49
Japan test (s)	0.02	0.31	0.01	0.26	0.66	0.17
30-m run (s)	0.02	0.29	0.00	0.28	0.13	0.04
			Psychological characteristics			
Psychotic (points)	0.44	0.02	0.23	0.05	0.54	0.14
Extroversion (points)	0.45	0.10	0.01	0.21	0.01	0.51
Neurotic (points)	0.20	0.72	0.85	0.10	0.07	0.83
Lie (points)	0.32	0.36	0.04	0.87	0.12	0.32

goalkeepers, and between wing players and back players. Statistically significant differences at the level of $p<0.05$ were recorded for the variable of pyschotic behavior between pivot players and goalkeepers, and between pivot players and back players. The players at wing positions showed a high level of lie. This position, characterized by a small space of action, requires high aggressiveness, self-initiative as well as good communication with other positions, because these players frequently depend on cooperation and actions prepared by other team members. Extroversion is otherwise a desirable dimension in sports, thus also in handball, even more than in some other sports activities[19,20]. Handball demands high dynamics, communication, and fast and aggressive reaction. Constant confrontation with opponent defenders in physically demanding circumstances requires from the players controlled impulsiveness and aggressiveness as well as readiness to accept the risk. The pronounced psychotic behavior characterizing pivot players may also be in part explained by the kinesiologic specificities of this playing position. The position of pivot requires a certain degree of independence and uncompromising quality, even ruthlessness, along with a high pain threshold, because these players are much more than other players faced with irritant contacts with opponent defenders, constantly fighting to take and maintain favorable positions. Of course, this does not mean that successful performance in handball is warranted by inclusion of isolated, emotionally distant, unnecessarily aggressive and psychotic players. This game primarily requires from the players joint engagement, social responsibility, successive creation of actions rather than uncontrolled individual activities. Although not reaching statistical significance, the players at outside positions exhibited a higher level of neurotic behavior and psychologic instability than those at any other playing position. This probably resulted from inappropriate selection of players because outside positions, which are most demanding, burdened and responsible during the game, should be taken by players with the lowest level of neurotic behavior. Psychologic stability is of utmost importance in stressful, conflict, emotionally burdened and physically demanding situations, especially towards the end of the game characterized by high result related tension. Therefore, further selection of players should be focused on their anthropologic and especially psychologic properties.

Conclusion

Results of the study confirmed the existence of considerable variation in the anthropologic properties of female handball players according to playing positions. As the study sample included selected elite female national handball team players, the differences were primarily the consequence of the player selection on the very basis of their specific anthropologic characteristics needed for successful performance of the specific tasks at particular playing positions. The specific kinesiologic requirements associated with particular positions may have also (yet to a considerably lesser extent, especially in case of dimensions that are less determined by inheritance) influenced the development of the players' anthropologic properties, thus additionally emphasizing the differences identified in the present study. During years of training process and contests, investing all efforts to meet specific requirements of particular playing positions, the players have adjusted their anthropologic properties to these demands. This hypothesis should be scientifically tested in future studies.

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NEKA ANTROPOLOŠKA OBILJEŽJA VRHUNSKIH RUKOMETAŠICA NA RAZLIČITIM IGRAČKIM POZICIJAMA

SAŽETAK

Na uzorku od 53 vrhunske rukometašice, članice juniorske i seniorske reprezentacije Hrvatske analizirane su razlike u motoričkim i psihološkim varijablama u odnosu na pojedine igračke pozicije. Motorički prostor zahvaćen je s 8 varijabli za procjenu eksplozivne snagu odraza i izbačaja, agilnosti, brzinske snage, frekvencije pokreta i fleksibilnosti. Psihološki prostor je analiziran kroz 4 dimenzije prema Eisencku: ekstrovertiranost, psihotizam, neurotizam i iskrenost. Utvrđene su statistički značajne razlike u analiziranim antropološkim obilježjima. U odnosu na motoričke sposobnosti razlike su prisutne u varijablama za procjenu brzinske snage, agilnosti i frekvencije pokreta nogama u čemu su igračice na krilnim pozicijama dominantne, dok vratarke dominiraju u fleksibilnosti. U psihološkom prostoru razlike su prisutne u varijabli za procjenu ekstrovertnosti u kojoj dominiraju igračice na krilnim pozicijama i psihotičnosti koja je naglašenije izražena kod igračica na poziciji pivotmena. Postojeće razlike prvenstveno su posljedica odabira igračica odgovarajućeg antropološkog profila na pojedine igračke pozicije. Hipotezu o utjecaju kineziloških specifičnosti pojedine igračke pozicije na formiranje antropološkog profila igračica trebalo bi znanstveno utvrditi. Rezultati istraživanja mogu se primijeniti u trenažnoj i natjecateljskoj praksi, a posebno kod formiranja antropoloških modela za određena igračka mjesta u procesu odabira rukometašica.