Coll. Antropol. **30** (2006) 3: 601–605
Original scientific paper

# A New Model of Selection in Women's Handball

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**A B S T R A C T**

*The aim of the study was to assess the basic motor abilities that determine top performance in women's handball, and to identify test panel for primary selection at handball school. The study included 155 female attendants of the Split Handball School, mean age 12.5 years. Differences in the basic motor abilities between the subjects that developed into elite handball players after 7-year training process and those that abandoned handball for being unable to meet the competition criteria were evaluated by use of discriminative analysis. The former were found to have also been superior initially in all variables analyzed, and in arm coordination, overall body coordination, throw and jump explosive strength, arm movement frequency and repetitive trunk strength in particular. Motor superiority based on the abilities of coordination, explosive strength and speed determines performance in women's handball, qualifying these abilities as reliable selection criteria. Based on this study results, a new model of selection in women's handball, with fine arm coordination as the major limiting factor of performance, has been proposed.*

***Key words:*** *women's handball, selection, motor abilities*

## Introduction

Recognizing true talents for a particular sport is a very complex process because definitive conditions that determine performance in this sport have to be reliably predicted on the basis of initial anthropologic characteristics at the youngest age possible. The process requires good knowledge of the developmental pattern of anthropologic characteristics that are relevant for top performance in this particular sport, in this case women's handball. These requirements include knowledge of the congenital and acquired developmental components of these anthropologic characteristics as well as the sequence and magnitude of this development. As the performance in any sport, including handball, cannot be explained simply as the sum of individual abilities and characteristics but implies their active relationships, the monitoring should address development of the functions describing the anthropologic system of female handball players of a particular age group, i.e. according to a particular stage of performance development.

There are two methodological procedures and/or models to obtain relevant information on the factors determining particular sport performance: regression model and discriminative model. The use of either model depends on the data available. Regression correlation analysis is generally employed in case of results expressed in variables assessing the anthropologic status of an individual and this individual's achievement in a particular sport[1–6]. Regression analysis yields an equation of the respective sport specification, containing three crucial sets of information: which factors influence the performance and to what extent, and what is the correlation between the factors influencing the result in that particular sport. However, when results are expressed in variables assessing the anthropologic status of an individual but without data on the performance achieved by this individual in the respective sport, the overall athlete population in this sport can be divided into groups achieving top results and average results; in this case, discriminative analysis is employed[7–10], however, the respective sport specification equation can then be less precisely determined. When both regression and discriminative models are applicable, then prediction of the study phenomenon is almost complete.

In the present study, discriminative approach was used to obtain information relevant for orientation and selection in women's handball. The model was set in an

Received for publication August 28, 2006

original fashion to enable prediction of definitive status of performance at age 19 and 20, based on the initial motor status at age 13. The aim of the study was to identify motor abilities that differed between the group of players that initially attended handball training program to discontinue it during the 7-year selection procedure and those that continued their handball training program to grow into elite handball players, all this based on the measurements recorded during their initial handball school attendance. The question to answer was whether the present elite handball players (some of them national team members) and those that had to give up handball for being unable to meet the competition criteria had differed significantly according to their motor status at the mean age of 12.5 years. In this way, the motor abilities yielding significant between-group differences at baseline would be identified as crucial for handball performance, thus also serving as reliable criteria for efficient player selection.

## Subjects and Methods

A battery of 13 motor variables were used in a sample of 155 female handball players, mean age 12.5 years, after three years of work at Split Handball School[2]:

- for psychomotor speed assessment (movement frequency) – hand tapping, foot tapping, hand rounds and foot rounds;
- for (explosive and repetitive) strength assessment: standing long jump, medicine ball throw from supine position, front support and support pushups; and
- for (arm, leg and whole body) coordination assessment – ball bouncing with tennis racket, juggling with matchboxes, foot slalom around stands with two balls, agility on the ground, and polygon backward.

Seven years later, the study sample was divided into two subgroups: subgroup of 136 subjects who had given up handball in the meantime due to their inability to meet the competitive selection criteria, and subgroup of 19 subjects who had remained active in handball and become elite handball players.

Canonical discriminative analysis was used to solve the set problem, i.e. to determine between-group differences according to motor variables.

## Results

Table 1 presents the basic descriptive parameters of motor variables, results of univariate ANOVA analysis of variance, and results of canonical discriminative analysis of motor variables between the study subjects that abandoned handball training and those that continued handball training to turn to elite handball players. The data presented clearly indicate the players having become elite players to have initially achieved considerably better results than those who abandoned handball training in the meantime. This means that the elite handball players were superior according to their motor characteristics already at the beginning of the training process, suggesting the higher level of motor abilities to have significantly contributed to their superior handball performance.

**TABLE 1**
BASIC DESCRIPTIVE PARAMETERS OF MOTOR VARIABLES IN TOTAL STUDY SAMPLE (T) AND RESULTS OF CANONICAL DISCRIMINATIVE ANALYSIS BETWEEN ELITE HANDBALL PLAYERS (E) AND OTHERS (O)

| Variable | T(n=155) X±SD | E(n=19) $X^1$ | O(n=136) $X^2$ | DF | $F^A$ | $p^A$ |
|---|---|---|---|---|---|---|
| Hand tapping | 28.46±2.79 | 29.76 | 28.28 | 0.43 | 4.76 | 0.03 |
| Foot tapping | 39.00±3.67 | 40.00 | 38.87 | 0.25 | 1.57 | 0.21 |
| Hand rounds | 29.31±3.96 | 29.67 | 29.26 | 0.09 | 0.18 | 0.67 |
| Foot rounds | 19.06±2.46 | 19.51 | 19.00 | 0.17 | 0.72 | 0.60 |
| Standing long jump | 169.65±17.16 | 177.17 | 168.59 | 0.41 | 4.23 | 0.04 |
| Medicine ball throw | 3.71±0.63 | 4.08 | 3.66 | 0.55 | 7.76 | 0.01 |
| Front support | 50.74±26.30 | 63.11 | 49.01 | 0.44 | 4.88 | 0.03 |
| Support pushups | 17.74±8.39 | 20.21 | 17.39 | 0.27 | 1.88 | 0.17 |
| Ball bouncing | 2.57±1.62 | 2.74 | 2.54 | 0.10 | 0.24 | 0.63 |
| Matchbox juggling | 18.57±6.69 | 23.13 | 17.83 | 0.66 | 11.07 | 0.00 |
| Slalom with 2 balls# | 46.76±7.87 | 44.70 | 47.04 | –0.24 | 1.47 | 0.22 |
| Ground agility# | 18.72±3.36 | 16.68 | 19.00 | –0.56 | 8.26 | 0.00 |
| Backward polygon# | 21.45±4.75 | 19.23 | 21.76 | –0.44 | 4.82 | 0.03 |
| Centroids | | | 0.09 | –0.09 | | |
| Delta | | | | | 0.40* | |

#variable with opposite metric orientation, *$p<0.01$

$X^1$, $X^2$ – means for groups 1 and 2, DF – discriminant function, FA – F-test for ANOVA, pA – probability for ANOVA, Delta – canonical discrimination

The highest between-group difference was recorded in the variable of matchbox juggling to assess arm coordination, in handball manifesting as manipulative ability of ball handling. Between-group differences were also found in the variables assessing the ability of solving complex motor problems, the variable of agility on the ground in particular, which represents whole body coordination. In handball, this ability manifests in the performance of complex technical elements of attack and defense such as feinting, falls, blockade, etc.

Analysis of variance yielded considerable between--group differences in explosive strength of throw and jump type. The difference was especially pronounced in the explosive strength of throw type (throwing medicine ball from supine position), in handball manifesting in the pass force. Situation performance is predominantly determined by explosive strength because elite handball imposes the need of maximal utilization of the jump, throw or sprint. Numerous studies have confirmed the prognostic value of explosive strength tests to predict situation efficiency[1,2,7–9].

Significant between-group differences were also obtained in the variables of the trunk repetitive strength and movement frequency (hand tapping). These motor abilities significantly determine the quality of performance because the trunk strength and speed are necessary for efficient performance of structural movement entities, especially in the conditions of situation confrontation with the opponents.

Discriminative function confirmed the results obtained by the analysis of variance and clearly discriminated the two subgroups, i.e. those who continued their handball training with pronounced abilities of upper extremity and whole body coordination, explosive strength of throw type, hand movement frequency and trunk repetitive strength, and those that discontinued their handball training with a lower level of development of these specific abilities.

Based on the results of the present and previous studies, handball could be characterized as a sport of high complexity, where successful performance depends on a number of basic motor abilities, predominantly on the ability of cortical regulation of movement, explosive strength, throwing in particular, basic trunk strength, and psychomotor speed. Obviously, top results in handball cannot be achieved without the above-average levels of motor abilities. Therefore, the selection process should include the use of measuring instruments intended specifically for assessment of those motor abilities that predominantly determine the quality of performance.

## Discussion

In 1982, Pavlin *et al.*[11] isolated five factors or five situation motor abilities that exist in senior handball players, ranking them according to their importance as follows: situation precision, skill of ball handling, speed of movement with ball, speed of movement without ball, and explosive strength of ball throw. However, in particular stages of performance development in female handball, the predominance of the mentioned specific motor abilities follow an inverse pattern, in parallel with the quality of acquiring specific motor skills. In stage 1, age 9–11 years, the performance in handball mostly depends on the speed of movement without ball and speed of movement with ball; in stage 2, age 12–14 years, it predominantly depends on the explosive strength of ball throw; and at age 15–17 years on situation precision and skill of ball handling. The timing of particular stages in the process of developing performance quality in women's handball should be taken as approximate figures, while the main concept is that the performance of specific motor skills is closely associated with the development of specific and basic motor abilities, which definitely results in the integration of specific and basic motor abilities into the locomotor system. This is consistent with the results reported from the studies performed in female elementary school fifth- to eighth-graders training handball[2,7], elite female handball players[1,8,9], and studies investigating motor development in general[12–17].

Based on the results obtained in the present study and studies carried out in subjects of various age and level of performance, a model of selection in women's handball can be established, which should be conducted step-wise, in stages (as it has been done in women's volleyball[6]):

- stage 1: after age 9, selection should be done on the basis of psychomotor speed and psychomotor coordination. These motor abilities will eventually limit top performance quality; psychomotor speed through facilitated technique performance, and coordination through faster motor learning and efficient situation solutions. The abilities of movement frequency (hand tapping test), repetitive strength of the trunk that is considerably saturated by movement frequency (test of front support to sitting position), and explosive strength of jump type (standing long jump test) should primarily be developed to the level that enables integration of these basic motor abilities into specific abilities of movement speed without and with ball. This stage of the performance quality development is predominated by acute, i.e. rapid and simple action which limits handball performance, so-called »catch and run« pattern; it can be objectively and reliably assessed by 20-m standing-start run;

- stage 2: after age 11, upon selection based on the running speed (sprint) performed in the preceding stage, this motor ability will not predominantly influence handball performance anymore but will be substituted by explosive strength of throw type (medicine ball throw from supine position), manifesting in the explosive strength of ball throw, i.e. pass force. This stage is characterized by marked development of arm and shoulder girdle strength and musculature, thus enabling active performance in defense or attack;

- stage 3: upon selection based on explosive strength of throw type, i.e. explosive strength of ball pass, performed in the previous stage, the players will not vary significantly in this ability anymore; now, after age 13, their performance will be predominantly influenced by whole body coordination (agility on the ground test), ensuring integration of the mentioned basic and specific motor abilities in the general motor efficiency to solve all play situations. This will manifest in high speed of technique performance and speed of movement direction exchange in handball game. The formation of performance quality is gradually transferred to a higher level;
- stage 4: after age 15, having achieved a satisfactory level of pass force and its integration with specific agility, selection should be based on the pass precision and skill of ball handling because these specific motor abilities now take the leading role in the determination of performance quality; and
- stage 5: after age 17, selection should be done by evaluation of all specific motor abilities, especially the ability of ball handling, for which hand coordination in terms of object manipulation (matchbox juggling test) is responsible. This facilitates the performance of catching and throwing the ball, which eventually mostly determines the level of performance in women's handball by significantly reducing the number of lost balls.

Accordingly, in the presented model of selection in women's handball the skill of ball handling is the specific motor ability that limits the achievement of top performance to the greatest extent. The skill of ball handling requires finely coordinated regulation of arm movement, from the upper arm and forearm through the wrist and hand, which depends on functional coordination of primary motor abilities that is highly genetically determined. Therefore the skill of ball handling in the play can fully manifest only when other basic and specific motor abilities have reached a satisfactory level. Thus, the following sequence should be followed: speed of movement without ball and with ball from selection stage 1 through stage 3 (determined by basic motor abilities of speed, explosive strength of jump type, and coordination); explosive strength of ball pass and specific agility in selection stages 2 and 3 (determined by basic explosive strength and basic coordination of the whole body); pass precision in selection stage 4 (determined by basic precision and basic explosive strength of throw type); and skill of ball handling in selection stages 4 and 5 (determined by arm coordination).

## Acknowledgments

This research is part of a project supported by the Ministry of Science, Education and Sports of the Republic of Croatia (No: 0177190; principal investigator: Prof. R. Katić).

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## NOVI MODEL SELEKCIJE U ŽENSKOM RUKOMETU

## SAŽETAK

Cilj rada je bio utvrditi bazične motoričke sposobnosti koje determiniraju vrhunsku igračku kvalitetu u ženskom rukometu, te izvršiti izbor testova za primarnu selekciju u rukometnoj školi. U tu svrhu, na uzorku od 155 polaznica rukometne škole grada Splita, prosječne starosne dobi od 12.5 godina, putem diskriminativne analize utvrđene su razlike u bazičnim motoričkim sposobnostima između ispitanica koje su kasnije nakon sedmogodišnjeg trenažnog procesa

postale kvalitetne rukometašice i onih koje su napustile rukomet jer nisu zadovoljile natjecateljski kriterij. Utvrđeno je da su ispitanice koje su ostale u rukometu bile superiornije i na početku u svim analiziranim varijablama, a osobito u koordinaciji ruku, koordinaciji cijelog tijela, eksplozivnoj snazi bacanja i skoka, frekvenciji pokreta rukom i repetitivnoj snazi trupa. Motorička superiornost temeljena na sposobnostima koordinacije, eksplozivne snage i brzine uslovljava igračku kvalitetu u ženskom rukometu. Zato te sposobnosti možemo smatrati pouzdanim selekcijskim kriterijem. Temeljem rezultata ovog istraživanja predložen je novi model selekcije u ženskom rukometu u kojem fina koordinacija ruku u najvećoj mjeri limitira igračku kvalitetu.