THE CANONICAL CONNECTION OF MOTOR SKILLS AND PERFORMANCE OF TECHNICAL ELEMENTS OF GOAL SHOOTING IN WATER POLO

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ABSTRACT: The main goal of this research is to determine and explain the connection between motor skills and the performance of technical elements of goal shooting in a water polo game. The sample includes 80 water polo players from Water Polo Clubs Sarajevo City Club, Varepolo Club Torpedo, Water Polo Club Akademija, and Water Polo Club Dabar. The testing included a sample of 80 water polo players, registered in Bosnian-Herzegovinian clubs. The determination of the level of basic motor abilities was performed using measuring instruments. Movement structuring mechanism: Air maneuverability (MOKZ), Hand taping (MTAP), Foot taping (MTAN), The synergistic-tone and tone control mechanism: Deep bench press (MDPK), Leaning with reach in sitting (MSJED), Transverse standing on the beam (MGRED), Excitation intensity control mechanism: Running at 20m - flying start (M20M), Triple jump from the place (MTRS), Long jump from the place (MDALJ), Excitation duration control mechanism: Hinge height (MVZG), Hull lift in 30 seconds (MDT30), Push-ups (MSKL). The sample of variables for assessing the performance of technical elements of shooting on goal in a water polo game - Shot accuracy test: Shooting from the left wing from a static position from six (6) meters - STLK, Shooting from the center from a static position from six (6) meters - STC and Shooting from the right-wing from a static position from six (6) meters - STDK. The canonical correlation analysis obtained a significant and homogeneous structure of the connection between the set of motor abilities and the set of performing the technical elements of shooting on goal in a water polo game. It has been shown that there is no high ability of precision when shooting and that more attention should be paid to the training process of precision in water polo players who are aged 12 to 14 years.

Keywords: *water polo, canonical correlation analysis of motor skills, and goal shooting*

INTRODUCTION

Water polo is a game that originated in the second half of the 19th century and was invented by the English who gave it the name water football. The first rules were made in 1870. Until then, it was played without any rules and was very rough. The ball was made of Indian rubber and the space was not limited. It was not until 1876 that the dimensions of the 50-yard court were prescribed and the number of players was limited to 7 per team, one head, and two-line referees. Instead of goals, rafts were used, and the task of the players was to place the ball on the raft of the opposing team if they wanted to score a goal. The water was not clean, and the ball would become heavier and heavier because it would absorb water. It was not forbidden to immerse the ball in the water, and players might hide the ball in large bathing suits and sometimes dive with it to the opponent's goal (Mirvić & Nurković, 2018). Water, as a medium in which kinesiological activity takes place, as well as most of the training process in water polo, represents a certain specificity concerning other sports (Hraste and Granić 2007). Water polo, as a poly structural and complex sport, requires a high level of many motor skills, among which are fundamental strength, speed, and endurance (Garbolewski et al., 2002). The influence and importance of coordination in water polo is still a rather unexplored space, but it is quite clear that it is important for the best possible performance of all technical and tactical elements of the water polo game. (Modrić, Veršić and Popović, 2011). The research tried to see the connection between motor skills and the performance of technical elements of shooting on goal in a water polo game. A person's motor abilities participate in solving motor tasks and condition a successful movement, regardless of whether they were acquired through training or not. Motor abilities include strength, speed, endurance, coordination, flexibility, balance, and precision (Malacko, Radjo, 2004). The game uses different movement techniques, with and without the ball (Trumbić, 2010). In the last ten years, there have been some changes in the rules of the game, such as the duration of the time attack from 35 to 30 seconds, and the shortened attack time with the player, from 25 to 20 seconds, which requires faster swimming with and without the ball. The influence of the training process on the development of some basic motor skills in young water polo players was examined (Šimenc et al. 1990). In their study, the authors Dopsaj et al. (2007) dealt with the assessment of the adoption of different modalities of swimming crawl technique in water polo players, as a function of age and competitive level. The main goal of this research is to determine and explain the connection between motor skills and the performance of technical elements of goal shooting in a water polo game.

RESEARCH METHODS

Definition of the sample of respondents

The sample of respondents includes 80 water polo players from Water Polo Clubs Sarajevo City Club, Varepolo Club Torpedo, Water Polo Club Academy, and Water Polo Club Dabar. All respondents are active members of water polo clubs and are therefore subject to regular medical examinations. The test included a sample of 80 water polo players, registered in Bosnian-Herzegovinian clubs.

A sample of variables for assessing motor skills

Determination of the level of basic - motor abilities was performed using measuring instruments recommended by Kurelić et al. (1975) and Eurofit battery tests. Movement structuring mechanism: Air maneuverability (MOKZ), Hand taping (MTAP), Foot

taping (MTAN), Synergistic and tone regulation mechanism: Deep bench press (MDPK), Leaning with reach in sitting (MSJED), Transverse beam standing (MGRED), Excitation intensity control mechanism: Running at 20m flying start (M20M), Triple jump from a place (MTRS), Long jump from places (MDALJ), Excitation duration regulation mechanism: Hinge height (MVZG), Hull lifting in 30 seconds (MDT30), Push-ups (MSKL).

A sample of variables to assess the performance of the technical elements of goal-scoring in a water polo game

- The shot accuracy test

1. Shooting from the left wing from a static position from six (6) meters - STLK
2. Shooting from the center from a static position from six (6) meters - STC
3. Shooting from the right-wing from a static position from six (6) meters - STDK

(The test is performed from three different positions, ie two wings and one central. Each subject performs one shot from each position.)

- Shooting from the left wing from a static position from six (6) meters -STLK respondent comes to the left wing, a distance of 6 meters, and takes a basic position, and shoots at the goal with a basic shot in water polo. A goal is scored.
- Shooting from the center from a static position from six (6) meters - STC respondent comes to the center, a distance of 6 meters, and takes a basic position and shoots at the goal with a basic shot in water polo. A goal is scored.
-Shooting from the right-wing from a static position from six (6) meters - STDK The respondent comes to the right-wing, a distance of 6 meters, and takes a basic position, and shoots on goal with a basic shot in water polo. A goal is scored.

Research description

- Mentoring supervision from the Faculty of Sports and Physical Education,
- The assistance of experts in the field of sports and physical education (verified pedagogues) in the implementation of the project. All subjects under the same conditions were subjected to measurement and testing (the entire study was conducted in the morning, from 08 to 12 h, the temperature was 18 to 24 degrees Celsius, the place of testing was the Olympic swimming pool of the island (indoor 50-meter pool).
- characteristics, motor skills, and then goal shooting tests.
- Before the measurement and testing process, the respondents were explained in an acceptable way what awaits them in the period of research implementation and what is required of them in their work. The main motive for the work will be curiosity and understanding of testing as an opportunity to check one's knowledge and cognition about one's abilities.
- Measurement was performed in groups of 20 to 25 respondents, up to 80 respondents during the day,
- One surveyor and recorder worked at each measuring point,
- During the measurement, the subjects were in the prescribed testing equipment,
- The team of surveyors consisted of professors of sports and physical education, who are familiar with the research project, measurement lists, and how to fill them,
- Measurements were performed according to the following schedule:
- from 08 to 12 h, during four days of motor ability,
- from 08 to 12 h, during five days from 08 to 12 h, during five days of goal shooting tests,
- After data collection, measurement lists were completed, and data were processed in the appropriate program.

Data processing methods

To determine the connection between some motor skills, and to perform the technical elements of shooting on goal in a water polo game, basic canonical correlation analysis was applied using the statistical package SPSS 12 for windows.

RESULTS

Canonical correlation analysis was used to determine the relations of motor abilities, and to perform technical elements of shooting on goal in a water polo game, which is an extremely suitable mathematical-statistical procedure in cases when it is necessary to determine the connection between two sets of variables.

The results of the canonical analysis for this research are presented in Tables 1 to 3.

Canonical correlation analysis of motor abilities and success in performing technical elements of goal shooting in water polo

Table 1.

	Canonicl R	Canonicl R-sqr.	Chi-sqr.	df	p	Lambda Prime
0	,56	,32	56,90	36	,01	,45
1	,47	,22	29,95	22	,12	,66
2	,39	,15	11,85	10	,30	,85

Table 2.

	KF 1
MOKZ	-,16
MTAPR	,07
MTAPN	-,44
MDPK	,65
MSJED	,27
MGRED	-,05
M20M	-,29
MTRS	,75
MSDALJ	-,71
MVZG	-,25
MDT30	-,42
MSKL	,17

Table 3.

	KF 1
STLK	,51
STC	-,12
STDK	-,94

Canonical relations of motor abilities and derivation of technical elements of goal shooting.

Canonical correlation analysis (Table 1), isolated one significant and positive canonical function (Canonical R) which explains the general relationship between motor skills and success in performing technical elements of goal shooting, at the level of significance p = .05. The only isolated canonical function of these two sets of variables is quite high (Canonical R) = .56, which could explain (Canonical R-SGR.) = 32% of the common variability of the set of motor variables and the set of variables for goal shooting performance. The significance of the connections of the investigated spaces is (Chi-SGR.) = 56.9.

The canonical factor (Table 2), in the space of variables for assessing motor abilities, can be seen that the largest number of variables has significant correlations with the isolated canonical dimension. Correlated variables can be divided into three groups:

- A group with a relative connection of conative space, in which we have a high coefficient from .75 to .65, and negative from -.71 to - .42, which is expected because the motor space assumes the expected connection when shooting at goal.
- In the group with a moderately significant correlation, in which we have a correlation of .27 in the positive sense, and in the negative, there is from -.29 to -, 16.
- Small correlation in other variables moving in the positive state, 07 and negative -, 05.

Considering that the first canonical factor in the space of motor abilities is most often projected by representatives of speed and exposure. This factor can be called the general factor of speed and exposure.

The canonical factor in the space of performing the technical elements of shooting on goal in a water polo game (Table 3) is the best-defined variable shooting from the left wing from a static position from six (6) meters –

STLK with the coefficient, 51, then shooting from the right-wing from a static position from six (6) meters - STLK -, 12 and shooting from the center from a static position from six (6) meters - STC (-, 94). This factor can be called the precision factor of the right-hand shot. The connection of the first pair of significant canonical dimensions suggests the conclusion that motor skills have a negative impact on the performance of technical elements of goal shooting in water polo on the accuracy of hitting the target, except in the abdomen.

Dealing with the relations of the isolated canonical function and the variables of both spaces, depending on the height of the mutual correlation (correlation with the canonical function), the following relations can be defined:

- The greatest connection exists between the variables of motor skills and the performance of technical elements of shooting on goal in a water polo game in the first group,

"High connectivity group" (MTAON, MDPK, MTRS, MSDALJ, MDT30, MSTLK, MSTDK, and MSTC) from the right-wing shooting variable.

- Statistically, a slightly lower correlation exists between the variables of motor abilities classified in the second group "Group with significant correlation" (MOKZ, MSJED, M20M, MVZG, and MSKL).

DISCUSSION

It can be said that the canonical correlation analysis obtained a significant and homogeneous structure of the connection between the set of motor abilities and the set of performing the technical elements of shooting on goal in a water polo game. These connections are real and significant, with medium and small projections of correlation coefficients on the isolated canonical factor, both in the space of motor abilities and in the space of performing technical elements of goal shooting in water polo and performing technical elements of goal shooting in water polo. Mirvić and associates (2016) in a similar study aimed to determine and explain the connection of some motor skills with the situational-motor abilities of the water polo game in water polo players 13 to 15 years of age. In the area of motor skills, 12 tests were applied, which represent the basic motor skills of the water polo game. And in the space of situational-motor tests, 6 tests of the basic elements of the water polo technique were applied in the situational conditions of the game. Based on the set goal of the research and based on the obtained results, it can be concluded that there is a connection between the researched areas, ie. between motor skills and situational-motor skills in the water polo game. Popo et al. (2011) in their research determined the hierarchy of water polo players classified according to their position in the team that is juniors, but many participated in senior leagues.

The results of the research clearly show the differences between different positions (outer wings, centers, defense, and goalkeepers)

identified after testing 10 variables of specific motor abilities of water polo players. It would probably be a better indicator if more respondents were involved, so the lack of motor tests would also be shown and new tests could be recommended or existing ones retained. This may be the main goal for further research. This research will determine a battery of tests of motor abilities of water polo players aged 12 to 14. And in that way, it will determine the current state of motor skills of cadets, adjust to the new plan and program for improving the competitive form and raise water polo to a higher competitive level. Other tests of motor abilities should be done and checked, to have more efficient indicators in the interest of improving the work program in the diagnosis of motor abilities. Such statements can be supported primarily by reviewing

the results of canonical correlation analysis of sets of variables used, and then by knowing the complexity of the movement structure (complexity of motor structure with success in performing technical elements of goal shooting in water polo, which undoubtedly has an impact here),

by knowing the very complexity of performing variables from success in performing shooting in a water polo game, as well as how to perform variables of motor ability.

CONCLUSION

It can be concluded that the wing positions (from the right and the left-wing) are problematic for performing the technical element of shooting, from the central one. The reason is probably less training during the training process, so this may be an instruction to coaches to pay more attention to it in the future. The greatest correlation exists between the variables of motor skills and the performance of technical elements of goal shooting in the water polo game in the first group, "High connectivity group" (MTAON, MDPK, MTRS, MSDALJ, MDT30, MSTLK, MSTDK, and MSTC) from the right-wing variable. Statistically, a slightly lower correlation exists between the variables of motor abilities classified in the second group "Group with significant correlation" (MOKZ, MSJED, M20M, MVZG, and MSKL). It should be said that the canonical correlation analysis obtained a significant and homogeneous structure of the connection between the set of motor abilities and the set of performing the technical elements of shooting on goal in a water polo game. It has been shown that there is no high ability of precision when shooting, and that more attention should be paid in the training process to precision in water polo players aged 12 to 14 years.

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