THE CANONICAL CONNECTION BETWEEN MOTOR ABILITIES AND SITUATIONAL-MOTOR ELEMENTS OF THE WATER POLO GAME

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Abstract: The main goal of this research is to determine the relations and the influence of motor abilities on the result in performing situational - motor elements of the water polo game in water polo players aged 13 to 15 years old. The variables measured in this sample are as follows: In the motor skills field, 12 tests were applied that represent the basis of motor skills in the water polo game. In the field of situational - motor tests, 6 tests were applied, which represent the basis for the application of elements of water polo technique in the situational conditions of the game. For a better quality analysis of the treated variables, as well as the magnitude of the mutual influences, canonical correlation analysis was applied. Based on the obtained re-sults of the canonical correlation analysis of motor abilities and situational - motor elements of the water polo game, significant connections between the treated areas were obtained. It can be concluded that water polo players, who have a higher (general) level of all applied basic motor skills, especially explosive and static strength, agility, speed endurance in swimming with water polo crawl, flexibility of the whole body have a greater opportunity to achieve better results in situational - motor elements of the water polo game which makes one team more successful.

Keywords: Water polo, canonical correlation analysis of motor abilities and situational-motor elements

INTRODUCION

Water polo, like any other sport, is a demonstration of various basic and specific motor skills through the application of technical elements of the game. Only well-developed basic motor skills can be a solid foundation for the development of specific motor skills. In the last few years, the game of water polo, given the system of competition at the top level that lasts for a long period of time, requires water polo players to have a high level of physical preparation that is carried out on land and in water. The game uses different movement tech-niques, without and with the ball (Trumbić, 2010). Research conducted by Polglaze et al. (2008) on the complexity of the water polo game for men, indicates the high intensity of repetitive technical elements of the players, due to the specificity in which the activities take place (water environment) as well as the fights with rival players. Coaches of younger age categories must pay more attention to the state of basic motor skills and pay special attention to the sensitive periods of their develop-ment and then the harmonization of these abilities, so that a certain movement can be reported in more complicated conditions, which is especially important for water polo. One of the important motor skills is coordination, which has a very important role for the best possible performance of all tech-nical and tactical elements of the game (Modrić et al., 2011), and ths indicates the need for even more intensive research of coordination in water polo. The research that has dealt with this problem so far is very scarce and does not provide too much information, so the importance of this paper is greater in theoretical and practical terms. The aim of this paper is to determine the connection between motor abilities and situational-motor abilities of the water polo game.

METHODS

Subjects

The sample consists of 70 male water polo players, aged 13-15, from the following water polo clubs of Sarajevo Canton, namely: Vaterpolo klub Akademija B, Vaterpolo klub Torpedo, Vaterpolo klub Mladost Sarajevo i Vaterpolo klub Dabar.

Procedures

A sample of predictor variables from the field of basic motor abilities of water polo players was per-formed using tests according to the tests of Kurelić et al., (1975) and tests of Eurofit battery (1988), as follows:

a) A movement structuring mechanism that represents the coordination and frequency of move-ments:

1. Agility in the air

2. Taping by hand

3. Taping by foot

b) The mechanism of synergistic regulation and regulation of tone, which represents the motor abil-ity of flexibility and balance:

1. A deep bow on the bench

2. Seat reach

3. Crossing on a low beam

c) The mechanism of regulation of the intensity of excitation, which represents the motor ability of speeds, explosive power:

1. Run 20m from a high start

2. Triple jump from place

3. Long jump from place

d) The mechanism of regulation of the duration of excitation, which represents the motor ability of repetitive power and static power.:

1. Hang in the joint

2. Torso lift in 30 seconds

3. Triceps dips

Sample of variables for assessment of situa-tional - motor abilities

Determining the level of situational-motor abilities was performed using measuring instruments rec-ommended by Volčanšek & Grčić-Zubčević (1984) and Bratuša (2010):

1. Swimming the 25m water polo crawl

2. Swimming the 50m water polo crawl

3. Swimming the 100m water polo crawl

4. Swimming 4x5m crawl-backstroke

5. Guide the ball 3x5m

6. Throwing a water polo ball out of the water

Description of the research

To ensure the regularity of this research process, approvals from relevant institutions and individuals were used in planning:

- all subjects were tested under the same conditions (air temperature ranged from 26 to 30 ° C, water temperature ranged from 24 to 26 degrees Celsius and the entire survey was conducted in the comlex of Olimpic pool Otoka Sarajevo);

- the research was conducted in such a maner that motor skills were measured first and then situational-motor skills;

- about all subjects prior to the measure-ment and testing process, explained in an acceptable way what was expected of them during the research period and what was required of them in this research, and the main motive was, curiosity and understanding of testing as an opportunity to test their own knowledge and knowledge about their motor skills;

- measurements were conducted in groups of 10 subjects each due to the limited space and time required for successful testing;

- one measurer and one scorer worked on each measurement

- during the measurement the subjects wore the proper testing equipment;

- after the test data were collected, the measurement lists were completed and the data were processed by appropriate meth-ods for this research work.

Data processing methods

To determine the relations between motor skills and situational-motor elements of the water polo game, canonical correlation analysis was applied using the statistical package SPSS 12 for Windows.

RESULTS

Canonical correlation analysis was used to deter-mine the relations between motor abilities and situational - motor abilities in water polo, which is an extremely suitable mathematical - statistical procedure in cases when it is necessary to deter-mine the connection between two sets of variables.

The results of the canonical analysis for this re-search are presented in the tables from no. 1 to no. 3rd:

- In the column labeled (Canonicl R), the co-efficients of canonical correlation (function) are marked, which explains the connection between the two sets of variables.

- In the column labeled (Canonicl R - sqr) there is a% of common variability of the investigated fields.

- Under the label (Chi - sqr) is marked the significance of the connections of the in-vestigated areas.

- Under the designation (df) are freedom degrees.

- The level of significance of the pairs of ca-nonical factors is presented in the column marked (p).

- In the column under the label (KF 1 and KF 2), the structure of isolated canon factors is marked.

Canonical correlation analysis (Table 1), isolated two significant pairs of canonical factors (Canonical R) which explained the general connection between motor skills and success in performing situational - motor elements in water polo, at the degree of significance p = .00. The canonical function of the first canonical factor of these two sets of variables is quite high (Canonical R) = .94 which explains (Canonicl R - sqr) = 88% of the total variability of the set of motor abilities and situational - motor abilities. Significance of connections of investigated areas (Chi - sgr.) = 210.70. The canonical function of the second canonical factor is also high (Canoni-cal R) = .82 and can explain (Canonicl R - sqr) = 67% of the common variability and the significance of the connections of the investigated spaces (Chi - sgr.) = 101.16.

First canonical factor in the space of variables for the assessment of motor abilities

The first canonical factor (Table 2) in the space of motor abilities, it is evident that a large number of variables have significant correlations with isolated canonical dimensions.

Correlated variables can be divided into three groups:

- The first group with the greatest correlation to which the following variables belong: Hang in the joint (-.59), Triple jump from the place (.59), Long jump from the place (-.54), A deep bow on the bench (.52).
- Another group with a weaker connection, which includes variables: Torso lift in 30 seconds (.34), Triceps dips (.30), Taping with the foot (.26) and Agility in the air (.21).
- The third group, which has zero connectivity, almost no connectivity, in this study have the following variables: Running 20 m from a high start (.03), Transverse stand-ing on a low beam (-.02) and Seat reach (.01).

DISCUSSION

As tests from the field of power (static and explosive power) and flexibility have the most frequent projections on the first canonical factor in the space of motor abilities, this factor can be called the factor of explosive power. Precisely because of this fact, water polo coaches in the training process must pay more attention to the development of explosive power in water and on land. Of course, in all this, flexibility is very important, without which movements cannot be performed with maximum amplitude. Flexibility is also needed for the best and most efficient execution of all technical and tactical elements both in attack and defense.

First canonical factor in the field of varia-bles for the assessment of situational - motor abilities

The first canonical factor (Table 3) in the space of variables for the assessment of situational - motor abilities, the largest number of variables has significant correlations with iso-lated canonical dimensions.

Correlated variables can be divided into three groups:

· The first group are the variables with the greatest correlation, which include: Swimming the 25m water polo crawl (.95) and Guide the ball 3x5m m (-.65);

· The second group are variables with lit-tle significant correlation, which include: Swimming the 50m water polo crawl (.17), Throwing a water polo ball out of the water (.31) and Swimming 4x5 m crawl-backstroke (.21);

· The third group includes a variable that has zero connection, almost no connection, and that is Swimming the 100m water polo crawl (.08).

Given that the first canonical factor in the field of variables for the assessment of situational - motor abilities have tests that are intended to assess the speed of swimming, this factor can be defined as a factor of the absolute speed of swimming with a water polo crawl. The water polo game consists of a lot of short-distance swimming, which requires a high speed of movement through the water in a vertical and horizontal position, large changes in the direction and pace of swimming, ie the transition from light swimming to sprint swimming.

From everything mentioned above, the general name for the first canonical factor in the area of motor and situational - motor abilities is the general speed endurance of swimming with a waTer polo crawl. Mirvić (2011) came to the conclu-sion that the flexibility of the complete body can not be derived from the correct crawl technique, and thus the maximum speed of swimming crawl technique in students of the Faculty of Sports and Physical Education, University of Sarajevo. In water polo matches, short sections with explosive and strong movements are mostly swum, so most work is done on the development of short section swimming. From this it can be concluded that water polo train-ing in the future should be more dedicated to the development of absolute swimming speed on short sections (25 meters water polo crawl), as well as endurance in speed on short sections, and pay attention to the development of static and explosive power and flexibility without which movements cannot be reported at maximum amplitude.

Therefore, the explosive and static power from the space of basic motor abilities has a great influence on the result achievements in the absolute speed of swimming with a water polo crawl, which has conditioned the connection of the first pair of significant canonical dimensions.

Second canonical factor in the space of variables for assessing motor abilities

The second canonical factor (Table 2) in the field of variables for assessing motor abilities, the largest number of variables has significant correlations with isolated canonical dimensions.

Correlated variables can be divided into three groups:

· The first group are the variables with the highest correlation, which include: Agility in the air (-.67), Hang in the joint (.58), Taping by hand (-.55), Lifting the torso in 30 seconds (-.44) and Crossing on a low beam (-.43);

- The second group are variables with little significant correlation where they include: Seat reach (.40), Push-ups (-.39), Taping by foot (.30), Deep bow on the bench (.23), Running 20 m from a high start (.19) and Triple jump from place (.16);
- The third group includes a variable that has zero connection, almost no connection, in this study, and that is the variable Long jump from place (-.02).

On the second canonical factor in the space of variables for the assessment of motor abilities, tests of coordination, static and repetitive strenght, speed of movement frequency and balance have significant projections, so this factor can be called the factor of general motor skills. The ability to quickly change the direction of movement depends on agility, ie the ability to slow down, accelerate and quickly change the direction of movement while maintaining control of movement without losing speed. Agility is characterized by rapid changes of direction and movement, abrupt stopping and then rapid start, therefore it is very complex and devel-ops only in later development periods in children, when a high level of coordination has already been achieved, more precisely at the age of 10 to 13 conduct basic proactive exercises to develop agility, with an emphasis on performance technique, coor-dination, and balance. The strength of the upper body, ie the arm as well as the speed of the arms is very important when performing technical ele-ments with the ball such as guiding the ball, catch-ing the ball, passing the ball and finally shooting.

Second canonical factor in the field of variables for the assessment of situational - motor abilities

The second canonical factor (Table 3) in the space of variables for the assessment of situational - motor abilities, the largest number of variables has significant correlations with isolated canonical dimensions.

Correlated variables can be divided into two groups:

· The first group are the variables with the highest correlation, which include Swim-ming 4x5m crawl-backstroke (.90), Swim-ming 100m water polo crawl (-.64) and Guiding the ball 3x5m (.47).

· The second group are variables with little significant correlation which include: Swimming 25m water polo crawl (.37), Throwing a water polo ball out of the water (.37) and Swimming 50m water polo crawl (.34).

On the second canonical factor in the field of variables for the assessment of situational - motor abilities, tests intended for the assessment of swimming speed and speed endurance have significant projections, this factor can be called the speed endurance of swimming water polo crawl factor. Dizdar and Mirvić (2014) confirmed that different motor abilities that have a significant impact on swimming with the water polo crawl technique at 25 meters without the ball are abilities that condense agility, coordination, flexibility and static strength. Water polo game abounds in fast and short sprints with the crawl or backstroke water polo technique. Water polo player often changes swimming tech-niques during the game, moving from water polo crawl to water polo backstroke, which is dictated by the situation in the game, ie whether he is in the attack phase, in the defense phase, or even in the counterattack phase, where he needs to swim fast, move away from the opponent and at the same time follow the ball passed by a teammate.

From everything mentioned above, general name for second canonical factor in the field of motor and situational - motor abilities has the highest correlation with agility and speed endurance, this factor can be called the general factor of locomotor swimming speed with water polo technique. Since water polo rules dictate playing 4 X 8 minutes of play time which requires great endurance in swimming. It should also be emphasized that the water polo game is dynamic with a lot of variable intensities in swimming, which requires special planning for the training process in order to adapt everything to the real game and solve tactical tasks. Mirvić et al. (2016) 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 fields, ie between motor skills and situational-motor skills in water polo. In his research, Ubović (2019) dealt with the basic motor characteristics of team sports athletes: football players, basketball players and water polo players aged 16 to 17, and a one-factor analysis of variance showed a significant impact of sports only on the STIF variable. In the modern water polo game, the performance of situa-tional - motor elements and their success cannot be imagined without good knowledge, ie learning the basic swimming crawl, with perfecting the water polo crawl and handling the ball in the water. The greatest attention should be paid to the speed of swimming and those clubs that have good swim-mers can expect success in the water polo game. Every coach or professional in water polo clubs should pay great attention to the development of motor skills such as: agility, speed, strength and flexibility.

CONCLUSION

Based on the basic goal of the research and based on the obtained results, it can be concluded that water polo players, who have a higher (general) level of all applied basic motor skills, especially explosive and static strength, agility, speed endurance in water polo crawl and whole body flexibility have greater opportunity to achieve a better result in performing situational - motor elements of the water polo game, which makes one team more successful. Also, it allows

to a certain extent, in certain situations to compensate for the lack of some other motor skills. the first canonical factor in the space of motor abilities is most often projected by tests from the field of strenght (static and explo-sive power) and flexibility, this factor can be called the factor of explosive power. First canonical factor in the field of variables for the assessment of situational-motor abilities are tests intended for the assessment of swimming speed, this factor can be defined as a factor of absolute swimming speed with water polo crawl. From everithyng mentioned above, the general name for the first canonical factor in the area of motor and situational - motor abilities is the general speed endurance of swimming with a water polo crawl. The second canonical factor in the space of variables for assessing motor abilities has significant projections of tests of coordination, static and repetitive power, speed of movement frequency and balance, so this factor can be called the factor of general motor skills. Second canonical factor in the space of variables for the assessment of situational - motor abilities has significant projections tests intended for the assessment of swimming speed and speed endur-ance, this factor can be called the factor of speed endurance of swimming water polo crawl. From everything mentioned above, the general name for the second canonical factor in the space of motor and situational - motor abilities has the highest correlation with agility and speed endurance, this factor can be called the general factor of locomotor swimming speed with water polo technique. If we talk about the dynamics of the water polo game, there are changes in the direction and direction of movement with certain loads, which makes it much more difficult and tiring for the players of the op-posing team. It should be emphasized that the player wants to reach the opponent's goal in the shortest possible time and score a goal so that they often change their body position, eg from a chest position to a back position. The research results can be used when constructing a set of measuring instruments that can provide quality information when planning and programming training, selection, guidance and training to determine the position in the game, as well as to create training periodization in both annual and semiannual training cycles. making a plan and program for each individual training.

Table 1. Canonical correlation analysis of motor abilities and success in performing situational-motor ele-ments in water polo

	Canonicl R	Canonicl R-sqr.	Chi-sqr.	df	p	Lambda Prime
0	,94	,88	210,70	72	,00	,02
1	,82	,67	101,16	55	,00	,14
2	,55	,30	43,34	40	,33	,43
3	,48	,23	24,69	27	,59	,62
4	,38	,14	10,97	16	,81	,81
5	,24	,06	3,00	7	,89	,94

Table 2. Canonical factors in field of motor abilities

	KF 1	KF 2
Agility in the air	,21	-,67
Taping by hand	-,42	-,55
Taping by foot	,26	,30
Deep bow on the bench	,52	,23
Seat reach	,01	,40
Crossing on a low beam	-,02	-,43
Run 20m from a high start	,03	,19
Triple jump from place	,59	,16
Long jump from place	-,54	-,02
Hang in the joint	-,59	,58
Torso lift in 30 seconds	,34	-,44
Triceps dips	,30	-,39

Table 3. Canonical factors in space situational - motor abilities

	KF 1	KF 2
Swimming 25m water polo crawl	**,95**	,37
Swimming 50m water polo crawl	,17	,34
Swimming 100m water polo crawl	,08	**-,64**
Swimming 4x5m crawl-backstroke	,21	**,90**
Guide the ball 3x5m	**-,65**	,47
Throwing a water polo ball out of the water	,31	,37

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