ANALYSIS OF CERTAIN INDICATORS OF THE LOAD IN THE PLAY OF GUARD IN TODAY WATER POLO

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Abstract

A representative sample of 161 entities (quarters in water polo) has been taken to register the total activity of the guard (back) during the international games of the Adriatic Water Polo League in the season of 2009/10. Various types and quantities of movement have been registered for different intensity, duration and frequency of events both in the horizontal and vertical phases of game. A sample of variables consisting of 21 originally measured and 8 derived variables has been used. For final multivariate analysis 11 variables have been retained. Data processing methods have been brought into accord with the aims of this research, and the basic statistical parameters as well as distributions of all the measured and derived variables have been calculated. Factor analysis under component model has been carried out, whereas the final factor solution has been determined using "Oblimin" rotation. Standard SPSS package has been used for data analysis. The results of this research clearly and definitely show that it is possible to determine the latent sources of variability related to guard (back) movements during a water polo match (number of actions, frequency, levels of load and the amount of movement measured in meters) in vertical as well as in horizontal phase in the game. From a wider choice of variables for measuring guard (back) activity it is possible to extract a sub-group of variables which describe the important target aspects of player load in water polo with satisfactory factor validity. The measuring instrument, constructed as a battery of tests, according to the obtained results, can be recommended for use in measuring of different aspects of load of any water polo player (role), which gives scientifically importance of this work. The practical importance of this work lies in the possibility of direct application of this work's results to practice, planning, programming, player selection and specialization for the guard role in water polo.

***Key words**: water polo, guard, levels of load, factor analysis*

Introduction

Water polo, as an activity, belongs in the category of polystructural complex motions. Motions, in all of sports activities, is possible observe and analyzed from two basic standpoints. Energetically standpoint that analyze quantity of movements, intensities and duration, as well informaticaly that analyzed techniques', tactics, strategies and theoretical acquirements of the players. Substantial, both, components always are present together and are divisible in the real conditions of the game, but their mutual relationships are different in different situations. Either training must start with information's about two essential components: Aim of these changes and Characteristics of those we want to change. How this two information would be served for programming of training, they must be explicitly defined to the objective characteristics of those which we changes. Practice in today's pedagogy is in contrast with these principles. Methods and modalities of the work applied in training is possible to divide into: Situational (situational training) and Partial (accessory training). For either type of training, on the base of objective analysis, it is necessary determinate over cover coefficients that are solitary condition for the regular training construction. Regarding task, and their roles in team, this relation varies, what consequently means different trainings for different positions and roles in the game (Lozovina,V. 1984; 1995).

In the structure of the game 35% of the time water polo player spends in horizontal phase (all swimming's in all intensities' during the game) as well as 65% in vertical phase (vertical position organized by leg activity) solved technical and tactical tasks (Lozovina, V., 1984). Water polo play 6 players in the field and goal-keeper. Typical for water polo game is hers characteristically play course. After attempt, but unrealized, contra attack, it is usual to organize positional attack to find a chance for realization. In this situation one player takes a position on 2-3 m in front of the rival's goal, half left or right regarding the center of the goal. Two wings take a position sideways 3-4 m from goal-out line, 3m away from goalpost. Their dominant role is to transfer the ball to center forward, as well as prevent the contra attack of rival's after ball possession losing. Next tree players are attackers from second line (external attackers) that individually or mutually by swimming tray to create space advantage for receive, pass the ball or shoot on rival's goal. The total activity of the guard during the international championships matches in the first division of the Adriatic water polo league 2008/09 has been taken to register. Scientific investigation, identical to this, have had been performed by author Lozovina at al. (2000) over the matches of Croatian I. water polo league, with old water polo rules, in that time existing, in favor of duration of the game was 4X9 min.

New rules significantly change the play. It is to believe that the parameters which have defined the play of the guard in 2000 in today's water polo look quite differently. This sense set forward this research.

Preliminary investigations

Lozovina & Pavičić (1985. and 2000.) establish methodology for estimation of vertical and horizontal component in the game of water polo. With a similar problem in the sense of the modeling of activity characteristics' of water polo players in vertical phase of the game during the play have be involved in authors Bratuša et al., 2002; 2003. Lozovina and Pavičić designate the model for analysis of the load in situational conditions regarding intensities, frequencies and time spent in the game as determinant of a load equivalent in the game (Lozovina at all 2002., 2003., 2004., 2006.). Authors and associates have been elaborated and published all fife position (role in the game). In article „Analysis of indicators of load during the game in the activity of the center in water polo", authors identify that existed resources of variability affiliated with intensity on the position of the center forward. In intensity is perceived that exists two aspects. One expressed across the quantity of actions and second as engagement level. These two aspects defined first and second factor assigned in this study. As a third latent dimension, arise the time spent in the game. In the article „Analysis of indicators of load during the game in activity of the second line attacker in water polo" authors defined three factors where the latent structures are in relations with intensity of activity and types of actions. In intensity, authors defined two aspects: quantity of actions and level of activity. In the article „Analysis of certain indicators of the load in the play of the wing in water polo"authors defined four factors. First defined as a intensity of activity, second as frequency of actions in vertical position, third as extensity of activity and fourth as a time spent in vertical phase of the game. In the article „Analysis of some indicators of the load in the play of heavy defender in water polo" authors acquire three latent structures and defined them as: quantity of actions, intensity of activity in vertical position and extensity of activity in horizontal phase expressed across slightly swimming. Series of other articles mentioned authors in addition elaborate Theme Field directly associated with Subject of this investigation. In football several authors analyzed modalities, quantities and intensities of the players movements during the game. According to Bašić, 2005. Okashi at all 1999., Castagna at all 2003.) from presented results it is observed that football players from Japan during the game run off a distance between 8,680-11,527 m. Analysis of the younger categories of football players (11-12 years) (Bašić 2005. according Castagna at all 2003. take out information that in the game in duration of 60 min. Young players run off about 6200 m, from what 5,5% less in the second half time regarding first. During the game the players was standing in the place 11% of totally time spent in the game. At the movies speed higher than 18 km/h they make 18 duels in average duration of 2,5 s with average break of 120 s between two duels. About 9% of the game time players were working on a high level of intensity. Football game comprises of 1000 – 1200 movement changes. Activity changes happen every in 5–6 s short intervals. Movements consist of a walk (25%), easy running (37 %), subamksimal running (20%), running in sprint (11%), backwards running (7%) (Bašić 2005. according Ekblom, 1994 according Jeffreys, 2004). In handball, differences between extensity and intensity of cyclic activities of handball players, on several playing positions and roles have bean analyzed by Šibila, M., Vuleta, D. i Pori, P. (2004). Data base were collected by SAGIT-system with computer software supporting. Output data were processed with chosen methods from programs Exel and SPSS. Statistically significant differences between groups was determinate regarding average distance pass trough the game. Mostly run the wings, hence external players, some less circuit attacker and at least goalkeeper. Differences are registries for the average tie of moving in average speed in all of rapidity categories. For second rapidity category were not registries differences between wings, external players and circuit attackers, but these tree groups are significantly different from goalkeepers. Statisticaly significant differences are registries in all four groups according to average moving speed. From provide it is obviously that the data collection is collected by different operations, as well as the methodologies of data processing are very similar. Acting of guard in the water polo comprises of holding respectively coverage the opponent and is the first and paramount element in the game. Successful coverage of opponent did not admit him to achieve advantage and from it realize. Guard their opponent could coverage in the place or in the motion using the different techniques. In the place, in the vertical position the opponent can be coverage behind, laterally and ahead. Choice dependent from currently situation and tactic choice. In the motion coverage the opponent is defined by the same principles. In every moment guard must be positioned on the centerline between opponent player with a ball and centre of own goal. Somewhat differences and variations can arise as a result of tactics choice; especially in the case of zone defense which can be perform in a different ways. Extraordinary is the implementation of "presing-play" as a drastic variant of the "man unto man" defense. In the defense tasks guard used various techniques as well as: water polo crawl, water polo egg better (bicycle), all holdings and keepings opponent, lead the ball when is necessary, all techniques of handling the ball including passing and shutting the ball, block with one hand, water polo start and jump with take up the ball, finally light foul, when is necessary. Guard participate in contra attack and usually remain in second attack line where becoming external attacker in the phase of positional attack. Regarding the body mass guards can be divided as a light-guards-contra attackers and heavy-guards,

contact players opponents of center forwards. In the play of the guard dominated over maximal and maximal loads in vertical phase of the game, means duels and play with player more or less, but also great quantity of the swimming in maximal and submaximal intensity, thus, very high intensity in horizontal phase of the game about what speak very high frequency of actions of a guard. For successful effect guard must be especially prepared (Lozovina, 2009). Regarding the guard based on his morphological characteristic it is possible to define him as a classical athleticus upon Kretchmer. His basically characteristics are extraordinary and proportional growth of skeletal system in length and breadth (measures of longitudinal and transversal dimensionality of skeleton). His average height are 1,95 m. On the this skeletal structure, he has excellently apply muscularly apparatus, especially in upper body zone what is caused by exceptionally wide biacromial span. Bicristal span of the guard is somewhat smaller in proportion wit biacromial, but muscle mass is property expressed in all region of leg. Thigh of the guard are unproportional regarding the Calf which is relatively thin, as well as the foot are long and wide. This specific structure of the guard legs are the consequence of selection, call processing, and specific training for the play in vertical phase of the game where the Calf with a foot directly participate in propulsion and , preservation of the vertical position in the game. Total body mass guard, with somewhat minor part, achieved on the base of the under skin fat tissue, proportionally distributed over the all regions. From the stand of the psychometrical abilities guard must bee extraordinarily specific enduring. Endurance, by definition, are required force, by type and size in the lengthened time for the given activity what mean that in its base are force or capability to produced of all types of force. Repetitive force of the hands and shoulder girdle guard utilize by one part in swimming (horizontal phase in the game) and others, in certain actions in the vertical phase of the game while repetitive force of the legs guard maximally applied in the vertical phase of the game next to duel and play with a player more or less. Explosive force of the guard dominated in the water polo jumps, ball cleanses, ball deprives and shots in attack phase. Psychomotor speed (with exceptional congenital coefficient) guard uses in all of velocity type operations, some more in vertical phase of the game in performing complex motric structures thru the tehnics and tactics tasks, than in horizontal, thru the speed of swimming. Coordination of the guard manifested in the subtitle regulation of the complex movements harmonized with a target (principally neutralization of opponent's goal achieving attempt. Muscule flexibility of the guard is necessary to produce the movements with optimal amplitude (in all of techniques during the game). The guards balance is very considerable and complex. Balance guard developed perfected technical usage elements over which construct defenders mission, in the long time. Measure of the good balance guards, achievement respectively game efficiency.

Aims, hypotheses and importance of the Work

Aims of this Work will be accomplished thru the determination of basically parameters of the load in the play of the guard in water polo. These parameters will be established on the base of objectively measured activities on the representative sample of entities. Hence, in this work, additional aim is defined battery of tests for such measurement and set out validity of that instrument. It can be presumed that objective description of activity in the play of guard in water polo are possible provided really register of the: various types; quantities of movements; upon different intensity's; durations; frequencies; as wall in horizontal therefore in vertical phase of the game. Based on that we appoint following hypotheses: H_1 Presumed that it will be possible determine latent sources of variability affiliated wit a number of actions (frequencies) in the play of the guard in water polo; H_2 Presumed that it will be possible determine latent sources of variability affiliated wit a levels of the load in the play of the guard in water polo; H_3 Presumed that it will be possible determine latent sources of variability affiliated wit a quantity of the movements in the play of the guard in water polo; H_4 Presumed that from a wider choice of variables provided for measuring the activity of the guard it will be possible extract a subset with satisfactory factor validity. Importance of the work manifested in the practical implementation of the results as well as in a scope of selection, routing and sports specialization such in planning and programming the training for „workplace" guard in water polo.

Methods

Experiment description

In the framework of implemented experiment the aim was objectively measured the quantity and intensities of players activity in the position of the guard in water polo. That is achieved by registration, respectively monitored of player's activity on international games of Jadran-water polo league in the season in 2009/10. All the games were played in Split. Registration and data sampling was performed by five qualified surveyors, professors of kinesiology, water polo trainers with over annually experience. In the game, in the time whose player spend in the play, was recorded all movements, intensity's and the body in horizontal and vertical positions. The criteria for estimation of work intensity, respectively burden: maximal, sub maximal and slightly, was determined, on the base of swimming speed in the course of actions takeoff. Measurerers was trained, measuring the same player on 10 games. Experiment is carried out after completely concordance of surveyors was acquired. They were positioned on the high placed stand which enabled optical coverage of the whole playing field. Standard water polo markers (2 m, 5 m, goal out line, center, etc.) enabled precise recording of swimming distances at various intensities of players.

Each official recorded all activities of their designated player. At every moment, they had view of the official time clock which showed a down count of the official, clean game time and smaller time clocks that shows ball possession and attack time. Each official consecutively recorded every action taken by his designated player. In case a player was thrown out of the game or has not been in the game (change of players) time was measured when the player exited the game and reentered the game.

Sample of entities

Entities or basic carriers of information in this experiment are part of the water polo game. According to rules, water polo is played in quarters of 8 minutes each (clean game time) or about 17 minutes real time per quarter. Each quarter starts the same way by swimming toward the ball which is placed in the center of the playing field. The quarter ends with an audible signal. Between the quarters are passive pauses (2 min., 5 min., 2 min.). From these reasons, one quarter is representative of one whole, and methodologically justified to use as an entity for measurement.

Sample of variables

Activities are recorded by the quantity and intensity of activity and movements made by guard. Frequency and actions are recorded by type and the quantity of passed distances of the playing field, recorded in meters. Various activities are realized by various types of swimming (crawl, backstroke and breaststroke), various intensity in various modalities (easy, sub maximal and maximal). The number and duration of duels are measured as well as time spends in the game with players more or less. Movements and intensities were measured in horizontal and vertical positions with respect to the water surface.

Based on measured source variables, new variables were produced which relate to intensity, frequency, and time spent in the game with a player more or less, the total number of actions and total quantity of distance swam. Duel is the time spent in contact with the opponent and is defined as over maximal load in the vertical position. Time spent in the game with a player more or less is defined as maximal load in the vertical position. Time spent with a player more or less is measured as real time in the game spent with an uneven number of players on either side.

Data analysis

Methods of data processing are harmonize wit the aim in this investigation. On the measured sample basic statistical parameters and distributions of measured variables are calculated, namely: arithmetical mean (A.S.), standard deviation (S.D), Kurtosis (K.) and Skewness (S.), minimal and maximal result of all of variables. Latent structure was calculated: intercorelations matrix, factor analysis under the component model was performed, the communalities of all variables was calculated.

Table 1. Authentic measured variables

FKRMAX	frequency unit crawl, maximal
FLEDMAX	frequency unit backstroke, maximal
FKRSMX	frequency unit crawl, sub maximal
FLEDSMX	frequency unit backstroke, sub maximal
FKRLAG	frequency unit crawl, easy
FLELAG	frequency unit backstroke, easy
FPRLAG	frequency unit breaststroke, easy
FDUEL	frequency of duels
FIGVIS	frequency of actions with players more
FIGMAN	frequency of actions with players less
MKRMX	distance in crawl in maximal speed in meters
MLEDMX	distance in backstroke in maximal speed in m
MKRSMX	distance in crawl in sub maximal speed in meters
MLEDSMX	distance in backstroke in sub maximal speed (m)
MKRLAG	distance in crawl at easy speed in meters
MLEDLAG	distance in backstroke at easy speed in meters
MPRLAG	distance in breaststroke at easy speed in meters
MDUEL	time duration of duels in seconds
SIGVIS	time duration with players more in seconds
SIGMAN	time duration with players less in seconds
SUKUPNO	total time spent in play in seconds

Table 2. Derived variables

FMXSMX=FKRMX+FLEDMX+FKRSMX+ FLEDSMX
Total of frequency units in crawl and backstroke in maximal and sub maximal
MMXSMX=MKRMX+MLEDMX+MKRSMX+ MLEDSMX
Total distance in meters in crawl and backstroke at maximal and sub maximal
FLAGAN=FKRLAG+FLEDLAG+FPRLAG
Total frequency units in crawl, backstroke, and breaststroke at easy
MLAGAN=MKRLAG+MLEDLAG+MPRLAG
Total distance in meters in crawl, backstroke, and breaststroke at easy
FIGVM=FIGVIS+FIGMAN
Total frequency with players more or less during the quarter
SIGVM=SIGVIS+SIGMAN
Total seconds played with players more or less
FAKCIJA=FMXSMX+FLAG+FIGVM
Total frequency units of distances at sub maximal, maximal, and easy plus frequency with players more or less
METARA=MMXSMX+MLAGAN
Total distance in meters in maximal, sub maximal and easy intensities

On the base of characteristics Eigen values of intercorelations matrix the percent of explained variance was calculated for any retained factor an cumulative, final factor solution is fixed by Oblimin solution and correlations between factor in Oblimin solution. For analysis standard statistical SPSS package were used.

Results and discussions

In Table 3. are display statistical parameters of all measured and derived variables: arithmetical means, (A.S.) , standard deviations (S.D.), Kurtosis (K.) and Skewness (S.) of distributions, minimal and maximal results.

Table 3. Central and dispersive parameters

Variable	A.S.	S.D.	S	K	Min	Max
FKRMAX	2,87	2,88	1,45	1,91	0	13
FLEDMAX	,20	,51	3,62	19,14	0	4
FKRSMAX	6,63	3,99	1,05	1,02	0	20
FLEDSMAX	,50	,89	2,18	5,36	0	5
FKRLAG	5,66	3,87	,88	,65	0	19
FLELAG	1,49	1,66	1,41	2,59	0	9
FPRLAG	1,45	1,57	1,30	1,25	0	7
FDUEL	3,09	2,02	,61	-,06	0	9
FIGVIS	1,11	1,10	,91	,44	0	5
FIGMAN	,84	,92	1,11	,97	0	4
MKRMAX	31,40	36,51	2,03	4,45	0	191
MLEDMAX	,71	1,88	3,42	14,14	0	13
MKRSMAX	82,66	53,63	1,02	,97	0	285
MLEDSMAX	2,06	4,15	2,72	8,11	0	22
MKRLAG	50,68	35,91	,76	,02	0	166
MLEDLAG	6,78	8,96	2,22	7,36	0	58
MPRLAG	6,88	7,67	1,50	2,49	0	38
MDUEL	21,79	16,28	,71	,12	0	75
SIGVIS	16,71	17,87	1,41	3,34	0	106
SIGMAN	13,58	15,66	1,25	1,56	0	77
SUKUPNO	298,12	123,36	-,00	-,85	25	480
FMXSMX	10,20	6,08	,82	,15	0	28
MMXSMX	116,82	72,43	1,10	1,24	0	379
FLAGAN	8,61	5,61	,88	,54	0	27
MLAGAN	64,34	42,40	,79	,11	0	203
FIGVM	1,95	1,68	,85	,38	0	7
SIGVM	30,30	28,03	1,22	2,17	0	144
FAKCIJA	20,76	9,70	,48	-,13	3	50
METARA	181,16	85,26	,66	,30	17	474

By inspection of Table 3. is establish that the variables FLEDMAX, FLEDSMX, MKRMAX, MLEDMAX, MLEDESMX, MLEDLAG, MPRLAG i SIGVIS have pronouncedly deviation from normal distribution, due to their rare prevalence in the game. Minimal results showed that almost all direct measured variables (underived) have results and null (0), respectively did not appear in every monitored quarter. Extremely high frequency have the variables by which is monitored activity crawl maximal and crawl sub maximal as well as number of duels. High frequency is noted in variables which measured play with player more or les. Statistics of en masse derived variables showed that all of them have normal or approximate normal distributions. For further and final multivariate analysis 11 variables are retain. By analysis of central and dispersive parameters it is possible to conclude: during the game guard in the play spends 19,67 min of a clean time, thus, full two quarters of the 8 min of the clean play and 3,67 min over. That is a great quantity of the time in respect to great intensities and loads of the guard during the game. Usually, I- division tims dispose of two good, and good trained guards in charge for the best opponents forwards, who changed during the game providing own maximum in every moment of the game. During the game guard swam average 724,67 m from what: in sub maximal and maximal intensity, totally, 467,28 m, respectively pro quarter average 116,82 m; in light intensity during the game guard swam 257,36 m, respectively pro quarter average 64,34 m; in the play with player more or less (vertical component) guard in the game spent 121,20 s, respectively, 30,30 s average pro quarter; in duels guard spend average 87,16 s or 21,79 s average pro quarter. In vertical position at maximal load (player more or less) and over maximal load (duels) guard in the game spent totally 208,36 s.

Table 4. Variables retained for final analysis

FDUEL	Frequency of duels
MDUEL	time duration of duels in seconds
sigvm	Total seconds played with players more or less
SUKUPNO	total time spent in play in seconds
fmxsmx	Total of frequency units in crawl and backstroke in maximal and sub maximal
mmxsmx	Total distance in meters in crawl and backstroke at maximal and sub maximal
flagan	Total frequency units in crawl, backstroke, and breaststroke at easy
mlagan	Total distance in meters in crawl, backstroke, and breaststroke at easy
figvm	Total frequency with players more or less during the quarter
fakcija	Total frequency units of distances at sub maximal, maximal, and easy plus frequency with players more or less
metara	Total distance in meters in maximal, sub maximal and easy intensities

Other vertical or quasi vertical positions, which guard during the game proceeds, are treated as positions upon light load, are not especially reiterated nor processed in this work. Intercoorelations matrix of reduced variables reunion was calculated (Table 5.). Inspection of correlations matrix display big range of variables connections, from null (0) correlation of variable FDUEL with variables SIGVM and FIGVM, as equally null correlation of variable FLAGAN with variables MMXSMX, until significantly great values of connection of variable FDUEL with variable MDUEL, variable SUKUPNO with variable figvm and variable fakcija with variables SUKUPNO, mmxsmx and flagan. Group of variables SUKUPNO, fmxsmx, mmxsmx, flagan,mlagan and fakcija are high correlated with variable METARA. From the Table 6. is possible to conclude that in the accordance of GK criterion four components' explain 93,87% of variance from total system. First main component explain 50,84% second 20,43% third 11,86% and fourth 10,78% of variance. First principal component is good defined with high projections of all of variables, except variables FDUEL, MDUEL, sigvm, and figvm, thus, frequencies and the time spent in duels and play with a player more or less.

This factor, dominantly, and by high coefficients of participation defined variables fakcija, SUKUPNO and metara (.,95, .93, .92). Them are added, with somewhat lower, but high coefficients variables mlagan,flagan, mmxsmx and fmxsmx (.65, .69, .70, .73). Second principal component is bipolar, and defined by relatively high projections of variables figvm, sigvm and mlagan (.61, .59, .54) with positive omen, and with variables mmxsmx, MDUEL and FDUEL (-.53, -.52, -.47) with negative omen.

Table 5. Correlation matrix

		1	2	3	4	5	6	7	8	9	10	11
1	FDUEL	1,00										
2	MDUEL	0,81	1,00									
3	sigvm	0,03	0,05	1,00								
4	Sukupno	0,46	0,41	0,50	1,00							
5	fmxsmx	0,38	0,36	0,12	0,64	1,00						
6	mmxsmx	0,34	0,44	0,16	0,60	0,87	1,00					
7	flagan	0,22	0,15	0,31	0,64	0,21	0,09	1,00				
8	mlagan	0,15	0,10	0,38	0,62	0,11	0,04	0,86	1,00			
9	figvm	0,04	0,05	0,95	0,51	0,11	0,14	0,19	0,23	1,00		
10	fakcija	0,37	0,32	0,42	0,86	0,77	0,62	0,74	0,50	0,44	1,00	
11	metara	0,36	0,43	0,33	0,82	0,79	0,87	0,70	0,65	0,33	0,87	1,00

Table 6. Initial Eigenvalues, percent of variance, cumulative variance of factors by GK criterion

Comp	Eigen-values	% of Variance	Cumulative %
1	5,59	50,80	50,80
2	2,25	20,43	71,23
3	1,30	11,86	83,09
4	1,19	10,78	93,87
5	0,28	2,55	96,42
6	0,17	1,56	97,97
7	0,11	1,03	98,99
8	0,06	0,56	99,56
9	0,05	0,44	100,00
10	0,00	0,00	100,00
11	0,00	0,00	100,00

Table 7. Component matrix, and communalities

	FAC 1	FAC 2	FAC 3	FAC 4	H2
FDUEL	0,50	-0,47	0,39	0,54	0,91
MDUEL	0,50	-0,52	0,28	0,56	0,91
sigvm	0,52	0,59	-0,45	0,40	0,97
SUKUPNO	0,93	0,05	0,00	0,01	0,87
fmxsmx	0,73	-0,48	-0,29	-0,27	0,92
mmxsmx	0,70	-0,53	-0,40	-0,16	0,95
flagan	0,69	0,44	0,50	-0,21	0,97
mlagan	0,65	0,54	0,46	-0,17	0,55
figvm	0,53	0,61	-0,40	0,40	0,97
fakcija	0,95	0,06	0,04	-0,22	0,95
metara	0,92	-0,18	-0,11	-0,22	0,94

Second principal component can be defined as those which is responsible for variability in variables in swimming in light intensity, variability of duels and play with player more or less. Third principal component is also bipolar and defined by variables flagan and mlagan (.50, .46) with positive omen and with variables sigvm and figvm (-.47, -.40) with negative omen, , thus, by frequencies and meters swam in light intensity and opposite orientated frequencies and time spent in duels. Fourth principal component is defined by variables MDUEL and FDUEL, sigvm and figvm (.54, .56, .40, .40). It is possible to interpreted it as that which describe, intensities in vertical phase in the play of the guard in modalities over maximal and maximal. From the pattern matrix in Oblimin solution, after slantwise rotation, it is perceive simplicity of the solution.

On the first factor the biggest projections have variables: mmxsmx, fmxsmx, metara, fakcija and SUKUPNO (.99 , .99 , .81 , .61 , .48).

Table 8. Patern Oblimin matrix

	FAC 1	FAC 2	FAC 3	FAC 4
FDUEL	-0,05	-0,04	0,05	0,97
MDUEL	0,02	0,01	-0,07	0,95
sigvm	-0,01	1,01	-0,05	-0,02
SUKUPNO	0,48	0,26	0,40	0,19
fmxsmx	0,99	-0,08	-0,05	0,00
mmxsmx	0,99	0,02	-0,22	0,05
flagan	-0,01	-0,04	1,00	0,03
mlagan	-0,08	0,07	0,97	-0,01
figvm	-0,04	0,99	0,01	-0,01
fakcija	0,61	0,10	0,55	0,02
metara	0,81	0,05	0,30	0,04

This factor are dominantly describe by variables anticipated for measuring the intensity of sub maximal and maximal swimming throughout the number of actions, quantity of the swam meters and the time spent in the game. This factor we entitled „quantity of actions, or action". Second factor is dominantly defined by high projections of variables sigvm and figvm (1.00 , .99). It can be defined as „intensity of the activity in vertical phase (M)", hear expressed trough the modality on the maximal level. If in this constellation of the factor, we demand a type of the guard, it is possible to describe him as a guard with small number of the duels on the 2 meters position, in the proportion with a time spent in the game and the time spent in the game with player more or less.

Third factor defined high projections of variables: flagan, mlagan, fakcija and SUKUPNO (1.00 , .97 , .55 , .40). Other variables have neutral influence on this factor. Dominant attribute of this factor, in the context of variables projections, are „intensity (extensity) of activity in horizontal phase", her expressed thru the light swimming over which this type of the guard achieved totally swam meters, total frequency of actions, during the time spent in the game. If in such constellation of factor we search for type of guard, it is possible to define him as untypical guard, who uncommon or never enter in the duels and do not forced counterattack to the player whose holds.

Fourth factor, dominantly and by great participation coefficients defined variables FDUEL and MDUEL (.97 , .95). This factor we defined as „intensity of activity in vertical phase in the game (NM)", here's expressed trough the modality over maximal (duels). In the constellation of the fourth factor we can recognized the type of guard which can be defined as a heavy guard who play against opponents centre forward in positional attack of opponent team, where generate the total time spent in the game.

Table 9. Factors correlations

	FAC 1	FAC 2	FAC 3	FAC 4
FAC 1	1,00			
FAC 2	0,24	1,00		
FAC 3	0,29	0,40	1,00	
FAC 4	0,42	0,09	0,19	1,00

According to the aims appointed in this research, results approved that wit a measurement, very good, are cowered main subject of measuring. It is affirm that existed resources of variability affiliated with intensity of the guards play. Two aspects existed in the intensity. First, expressed through the quantity of actions, which defined first factor assigned in this investigation and second assigned as a level of engagement, defined by second, third and fourth factor assigned in this research. It is interesting to notice that existed correlation between those structures about what speak correlations between factors. Correlation between first and fourth factor (.42) are logical because both factors activity of the guard describes trough the quantity of the swam stocks, total time spent in the game and frequency of actions but towards various intensity's in vertical and horizontal phase of the game. Correlation between second and third factor (.40) explicate the time spent in the game and frequency of actions which those two types of guard achieved by light swimming, what is mutually for them. That what make them different are the „ intensity of activity in the vertical phase of the game, on the second factor expressed trough modality on the maximal level and „intensity" (extensity) of activity in the horizontal phase in the game" on the third factor, expressed trough modality light. From other side level of the load are not affiliated wit a time spends in the game but is with a phases (vertical and horizontal phase in the game).

Conclusion

On the base of the objective measuring on the representative sample of entities and analyze of the central and dispersive parameters of all measured variables realized is the first aim set up in this research. Determined are the basically parameters of the load in the play of the guard defined by different types and quantities of the movements trough different intensities, frequencies and durations, as well in horizontal therefore in vertical phase of the game. For the purposes of perceived deviations from the normal distributions in further (factor) analysis it was not possible applied all of measured variables. For the final, multivariate, analysis retained was 11 variables, normal or approximately normal distributed. The latent space, given by factor analyses, resulted with a for factors explaining 93,87% of variance, where, first factor explaining 50,80%, second 20,43% third 11,86% and fourth 10,78% of variance from the total system. From the pattern matrix in Oblimin solution, after slantwise rotation, it is perceive the simplicity of the solution which enabled defining and nomination of the latent structures. Given factors nominated as: „quantity of actions, or action", „intensity of the activity in vertical phase (M)", „intensity (extensity) of activity in horizontal phase" and „intensity of activity in vertical phase in the game (NM)", satisfactorily describes four different manners in the play of the guards in water polo. All four hypotheses appointed in this research are confirmed. Defined are the resources of variability affiliated with a number of actions (frequencies), resources of variability affiliated with a quantity of the movements in the play of the guard as well in horizontal so in vertical phase of his play. Hypothesis that from a wide selection of variables for measuring a total activity of the guard it is possible to set a subgroup of variables with satisfactory factor validity describes all important activity aspects of the guard in water polo, is affirm in this investigation.. The measuring instrument, constructed as a battery of tests, according the given results, can be recommended for using in measuring of different aspects of the load of any player, what gives scientifically importance of this work. Practical importance of this work it's in the possibility four direct application of results in this work to practice, planning, programming, player selection and specialization for a guard in water polo.

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ANALIZA ODREĐENIH INDIKATORA OPTEREĆENJA U IGRI BRANIČA U DANAŠNJEM VATERPOLU

Sažetak

Reprezentativni uzorak od 161 entiteta (četvrtine u vaterpolu) uzet je za registraciju totalne aktivnosti braniča (beka) u vateroplu za vrijeme međunarodnih utakmica Jadranske vaterpolo lige u sezoni 2009/10. Različiti tipovi i kvantiteta gibanja su registrirani za različite intenzitete, trajanja i učestalosti i čak u obje faze igre – horizontalnoj i vertikalnoj. Korišten je uzorak varijabli koji je sadržavao 21 izvornu mjeru i 8 izvedenih. Za finalnu multivarijantnu analizu zadržano je 11 varijabli. Obrada podataka je dovedena u suglasje s ciljevima istraživanja, pa su izračunati temeljni statistički parametri kao i distribucije svih izmjerenih i izvedenih varijabli. Faktorska analiza pod komponentnim modelom je provedena, a konačna faktorska solucija je određena 'Oblimin' rotacijom. Za analizu podataka korišten je standardni SPSS paket. Rezultati ovog istraživanja su jasno i definitivno pokazali da je moguće odrediti latentne izvore varijabiliteta povezane s gibanjem braniča (beka) za vrijeme vaterpolo utakmice (broj akcija, učestalost, razine opterećenja i količina gibanja mjerena u metrima) u vertikalnoj kao i horizontalnoj fazi u igri. Iz šireg izbora varijabli za mjerenje aktivnosti braniča (beka) moguće je ekstrahirati pod-skupine varijabli koje opisuju važne ciljne aspekte igračevog angažmana u vaterpolu sa zadovoljavajućom faktoskom validnošću. Mjerni instrument, konstruiran kao baterija testova, u skladu s dobivenim rezultatima, može se preporučiti za korištenje u raznim aspektima opterećenja bilo kojeg igrača vaterpola (uloge u igri), što daje znanstveni značaj ovom članku. Praktična važnost ovog rada leži u mogućnosti direktne primjene rezultata ovog rada u praksu, planiranje, programiranje, selekciju igrača i specijalizaciju za ulogu braniča u vaterpolu.

Ključne riječi*: vaterpolo, branič, razine opterćenja, faktorska analiza*

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