DIFFERENTIAL ANALYSIS OF THE CENTER FORWARD ROLE IN THE TEAM TACTICS IN WATER POLO (MALE)

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Original scientific paper

Abstract
Collective tactics is based on the division of roles in all phases of the game. There are several roles or positions in water polo: center forward, guard, wing, external attacker and goal keeper, all of which are instruments in the realization of collective tactics. The aim of this study was to describe the play on the position of center forward (C.F). and compare it with other roles. The subject of this investigation was the description of all the activities in the game without contact with the ball (all swimming, duels, man up/down situations). Data collection was performed by registering players' activity on official games of the International Adriatic Water Polo League in the season 2009/10. The main units of measurement, i.e. entities were: position-player-quarter. The results were registered using 21 indicators and basic statistics was performed. Differential analysis for the position of C.F. regarding other players (positions) was carried out on the basis of testing the model of binary logistic regression equation. Markedly light frequency of total actions was noted on the position of C.F. compared to other players' roles. We noted differences in the range from (1:0.66) in crawl swimming in light and sub maximal intensity, up to even (1:4) in back stroke swimming in sub maximal and maximal intensity. C.F. is equal with other players in the meters swum in crawl technique in sub maximal and light intensity, as well as in total meters swum in sub maximal intensity. Compared to other players, C.F. spent generally less time in the game and, proportionally, less time playing in man up/down situations. A remarkable characteristic in the play of C.F. are duels, in accordance with frequencies and the time spent in the game. By applying binary logistic regression, we defined the differential characteristics of the C.F. in contrast to other roles in the game, which resulted in the equation of play structure on the position of C.F: Solitary contributions in the prediction of the role of C.F. are represented in the linear equation for the position C.F. The results of this investigation will contribute to the elaboration of water polo game model in the domain of situational play without the ball (realization of the collective tactics regardless of the choice of the type of tactics in either attack or defense). The results bring statistical descriptions of the role of C.F. In addition to this, such unusual analysis brings out specific properties of the role C.F. in comparison to others.

Key words: *water polo, game, center forward, statistics, model, logistic regression*

Introduction

The tactic of collective Olympic sport game Water Polo is a plan which relies on the partition of players' roles in the game. A water polo team consists of 7 players with allocated roles: center forward, wing, guard, external attacker and goal keeper. Depending on the development of the play any player can take up the given roles, but it is usual for players to play only one given role (Lozovina et al., 2002, 2003, 2007; Lozovina 2009.). Collective tactics in the defense is divided into two main types: zone defense, man to man defense on the team's own half, on the whole playfield and pressing as a drastic type of such defense (Pavičić, 1991; Lozovina, 2009). In attack, the tactics focus on efficiency of goal scoring. In the simplest tactics, attack is performed as an attempted counter attack and subsequently as positional attack. For any position (role) in the game, tactics defines the playground area in which a player carries out activities, i.e. types of tasks in both attack and defense. In such a manner, players realize their own tactical roles in the game. From the tactical point of view, man up/down situations, are particularly interesting and important. As such situations arise from penalty expulsion (20 seconds); they are a great advantage or handicap for teams and represent extremely important fragments of tactics. Actions carried out in movement are defined by horizontal positions (horizontal phase of the game). All man up/down situations as well as duels are defined by the vertical position (vertical phase of the game), regarding the surface of water line in the swimming pool (Lozovina, 1979, 1985; Bratuša et al., 2002, 2003; Platonou & Geladas, 2006; Lozovina & Lozovina, 2009). In the total game duration, it is possible to describe two main phases of players' activity: active and idle phase. The idle phase is a situation in which a player participates in the game only by overlooking the development of the game, but in situ and without contact with the ball. The idle phase directly raises the time spent in the quarter, and, of course, belongs to the vertical phase of the game and was not included in this investigation. C.F., from the moment when he takes his position on the two meters, in continuo, carries the opponent guard on the shoulder. The conditions in an anyway complicated balance in the water between the C.F. and the Guard thus become extremely complex and demand an extraordinary

readiness to endure such loads. That is why the best prepared Centers Forward spends a little more than two quarters in the game, constantly playing at extremely high load. In such time spent in the game, centers are efficient. If the C.F. has to play longer (half- forced play), their effectiveness drastically decreases, as well as in the case when they play all the game (total-forced play). Consequently, their effectiveness is practically null. In positional attack, duel dominates in the play of the C.F., which is treated as over-maximal load. Centers cannot be prepared to sustain such high intensities in the full time of the game. Playing, spontaneously, on the lower range of intensity, the center's effectiveness in the game falls considerably. An important part of the play of the C.F. is man up/down situations, which are treated as maximal load in the vertical phase of the game. In the horizontal component (all the swimming in water polo) C.F. usually swims distances of 20 m, mainly in the crawl technique, using high speed and great intensity. For this part of the game (transition phase from attack into defense and inversely) C.F. has to be specifically and very well prepared (Lozovina & Pavičić, 2000, 2004; Lozovina et al., 2004; Lozovina et al., 2006). In the experimental phase we registered activities of players on the official water polo games. A model was placed and verified for the play for one position (role) in the game by virtue of comparison of model elements of one position with all others. The article discusses basic tactical aspects of C.F. play in differential analysis with other positions (Pavičić 1991; Bratuša et al., 2002, 2003; Platonou & Geladas, 2006; Lozovina et al., 2007; Lozovina & Lozovina, 2009; Lozovina, 2009): (H1) It assumes that in indicators of DUEL (frequencies and duration) C.F. will have statistically significantly greater values than the players in other roles in the game; (H2) It assumes that the activities of the C.F. explained by the quantities of meters swum in crawl in sub maximal and light intensity will be similar to or same as the activity of players in other roles in the game; (H3) It assumes that, statistically, the C.F. spends significantly less total time in the game than players in others roles.

Methods

In the experimental phase, the following were objectively registered during official water polo games: quantities, means, frequencies and intensities of players' activities in the roles of wing, guard, center forward, and external attacker. This was achieved by monitoring and registration of players' activity on the official games of the International Adriatic Water Polo League in the season 2009/10. The basic statistics were calculated for: frequency of actions, quantities according to techniques of swimming in three intensities for the phases where the players were in horizontal position. For the vertical phase, duels and man up/down situations in the game were registered. Activities were monitored by the system of 21 indicators on the 28 official matches. However, play with the ball was not registered in this experiment, regardless of the types of tactic applied. The entities in this investigation were players – in given roles – in one quarter. Totally, 665 such entities were registered. Although the indicator values in the model were registered by frequencies, meters and seconds, these registered values found themselves on the real and ordinal scale with expected normal and Poisson distribution. Placed is the model for C.F.'s role expressed by binary logistic regression equation:

$$ln[odds(Y=1)=Y=b0 + b1X1 + b2X2 + .. bmXm + e \quad (1)$$

where Y is the play on the position of C.F., b coefficient of the ponder for variable X.

Measurements

Data collection was carried out on the official games of the International Adriatic Water Polo League in the season 2009/10. Registration and data sampling was performed by five qualified surveyors, professors of kinesiology, and experienced water polo trainers. In the game, during the time the player spent playing, all his movements, intensities and positions of the body (horizontal and vertical) were recorded. The criteria for estimation of work intensity, namely of burden, were: maximal, sub maximal and slight. They were determined on the basis of swimming speed in the course of actions. The vertical phase in the play was registered using frequencies and time spent in duels as over-maximal load as well as frequencies and time spent in man up/down situations as maximal load . The measurers were trained in measuring the same player on 10 games. The survey was carried out only after a complete concordance among surveyors was achieved. They were positioned on high-visibility positions, 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 full view of the official time clock, which showed a down count of the official, clean game time and of smaller time clocks that showed 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 had not been in the game (excluding time or change of players), time was measured when the player exited the game and re-entered the game.

Data analysis

All variables are presented by statistics: Min. Max, Med. A.M. and S.D. . . For testing the normality of distributions K.S.-test was performed. For the purpose of identification of structure and the comparative relevance of individual measures for differentiation of the role C.F. from others, regression algorithm was applied, i.e. in respect with metric characteristics of results on indicators the Binary Logistic Regression Model was applied. Adequacy of placed model was tested by Hosmer and Lemeshow tests whereas quantity of explained variance was obtained by Cox & Snell R Square and

Nagelkerke R Square determination coefficients (multiple correlations). Calculated and presented are tables with frequencies and guess percents of the Model. For any variable B (Logistic beta), Wald (Sig.), (Odd Ratio – Exp (B), and 95% CI Exp (B) were calculated. All results were plotted in graphics (center forward against other roles), given as relations of expected probabilities on the Y axis, and as expected standardized residuals on the X axis. For the purpose of interpretation the C.F. activity, indicators per swimming techniques (crawl and back stroke) in intensities (maximal, sub maximal and light) were added up. In addition, the total number of actions expressed by frequencies, as well as the total number of meters swum, was calculated. These results are presented in histograms. For statistical conclusions we used lower rigorous criteria $p<0.05$ and higher rigorous $p<0.001$ (LaValley, 2008; Lames, 2006; Waal, 2010).

Results

Table 1. Minimum, Median, Maximum, Mean and Std. Deviation Statistics of Frequencies

Case Summaries															
	center														
	0					1					Total				
	Min	Median	Max	Mean	S.D.	Min	Median	Max	Mean	S.D.	Min	Median	Max	Mean	S.D.
FKRMAX	0	2	17	2.98	2.76	0	1	9	1.28	1.54	0	2	17	2.44	2.57
FKRSMAX	0	7	26	7.28	4.36	0	6	18	6.13	3.45	0	6	26	6.92	4.13
FKRLAG	0	6	20	6.43	4.25	0	5	17	5.27	3.27	0	5	20	6.06	4.00
FKraul	1	16	45	16.69	7.60	0	13	33	12.68	5.55	0	15	45	15.42	7.25
FLEDMAX	0	0	4	0.18	0.53	0	0	1	0.04	0.20	0	0	4	0.13	0.46
FLESMAX	0	0	6	0.75	1.15	0	0	2	0.16	0.47	0	0	6	0.56	1.02
FLELAG	0	2	10	1.94	1.91	0	1	4	0.86	1.02	0	1	10	1.60	1.75
FLed	0	2	14	2.86	2.43	0	1	7	1.06	1.20	0	2	14	2.29	2.28
FPRLAG	0	1	12	1.43	1.77	0	0	5	0.47	0.82	0	1	12	1.13	1.60
FMax	0	2	21	3.15	3.02	0	1	9	1.32	1.60	0	2	21	2.57	2.78
FsMax	0	7	27	8.03	4.98	0	6	19	6.29	3.57	0	7	27	7.48	4.65
FLag	0	9	39	9.80	6.00	0	6	19	6.60	3.92	0	8	39	8.78	5.62
FUkupn	1	19	71	20.98	9.76	0	15	39	14.21	6.21	0	17	71	18.83	9.33

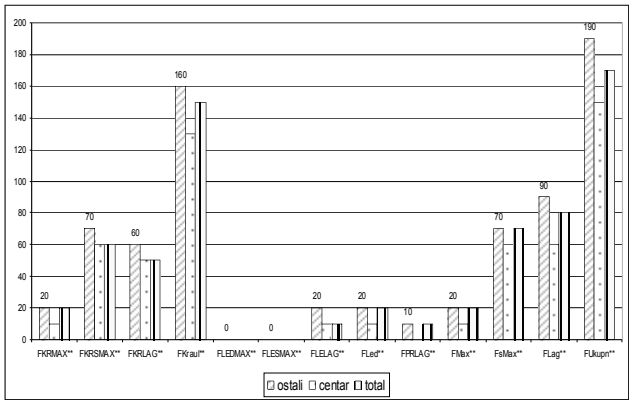
Table 2. Minimum, Median, Maximum, Mean and Std. Deviation – Statistics meters swum in various intensities – horizontal phase

Case Summaries															
	center														
	0					1					Total				
	Min	Median	Max	Mean	S.D.	Min	Median	Max	Mean	S.D.	Min	Median	Max	Mean	S.D.
MKRMAX**	0	21	191	29.39	31.29	0	6	94	11.54	15.35	0	15	191	23.73	28.49
MKRSMAX	0	78	398	87.65	55.22	0	81	275	85.59	51.36	0	79	398	87.00	53.99
MKRLAG	0	48	183	56.72	39.85	0	52	213	53.42	38.21	0	49	213	55.67	39.34
MKraul**	8	166	463	173.77	77.07	0	155	318	150.55	65.89	0	162	463	166.40	74.45
MLEMAX**	0	0	20	0.60	1.92	0	0	4	0.10	0.50	0	0	20	0.44	1.63
MLESMAX**	0	0	67	3.47	6.67	0	0	25	0.80	2.90	0	0	67	2.63	5.88
MLELAG**	0	6	75	9.15	10.10	0	2	29	3.96	5.70	0	5	75	7.51	9.26
MLed**	0	10	75	13.23	12.52	0	2	40	4.86	6.57	0	7	75	10.57	11.66
MPRLAG	0	5	47	6.86	8.31	0	0	21	2.39	4.18	0	2	47	5.44	7.55
MMax**	0	21	191	30.00	32.04	0	6	94	11.64	15.38	0	15	191	24.17	29.12
MsMax	0	81	400	91.13	56.66	0	81	277	86.39	51.61	0	81	400	89.63	55.11
MIag**	0	61	216	72.73	47.03	0	58	215	59.77	41.05	0	60	216	68.62	45.59
MUkupno**	8	191	499	196.15	85.03	0	164	342	159.37	69.51	0	179	499	184.48	82.18

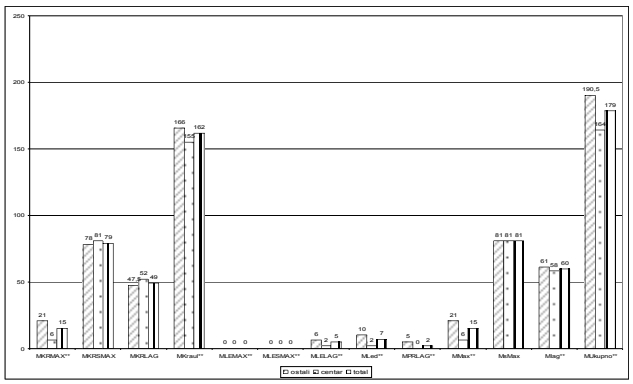
Table 3. Minimum, Median, Maximum, Mean and Std. Deviation - Statistics duels, unequal number of players, total time in the play – vertical phase

Case Summaries															
	center														
	0					1					Total				
	Min	Median	Max	Mean	S.D.	Min	Median	Max	Mean	S.D.	Min	Median	Max	Mean	S.D.
FDUEL	0	2	10	2.12	2.10	0	4	10	4.06	2.08	0	2	10	2.74	2.28
MDUEL	0	6	75	11.81	13.98	0	23	78	24.89	14.96	0	12	78	15.96	15.53
FIGVIS	0	1	7	1.33	1.17	0	1	5	1.08	1.05	0	1	7	1.25	1.14
SIGVIS	0	18	106	19.35	18.07	0	14	94	15.51	16.88	0	16	106	18.14	17.77
FIGMAN	0	1	5	0.98	0.95	0	1	4	0.81	0.85	0	1	5	0.93	0.92
SIGMAN	0	13	77	15.25	16.01	0	11	71	12.44	14.18	0	13	77	14.36	15.50
SUKUPNO	24	319	480	319.27	125.19	24	261	480	257.43	105.90	24	298	480	299.65	122.75

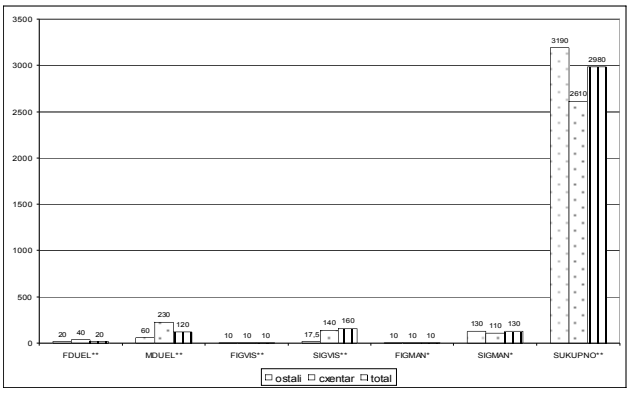
Analyzing the frequencies of actions on the position C.F., it is perceived that in all of registered indicators the C.F. is significantly different from other players, always with inferior values on observed indicators. The same is with intensities in swimming. Comparing the values according to intensities, the biggest comparative difference is in maximal intensity, where the C.F. has markedly light frequency of swimming (relation 1:2.5 regarding others). In intensities light and sub maximal relation is (0.66:1).



Graph 1. Histogram of Medians –frequencies of actions in various intensities – horizontal phase



Graph 2. Histogram of Medians –meters swam in various intensities – horizontal phase



Graph 3. Histogram of Medians – vertical phase

In respect to techniques these relations are (1:3 in back stroke), (1:1.3 in crawl) and (1:3 in breast stroke).

In crawl technique swimming, compared to others, the differences are low for intensities sub maximal and light but significant and high in sub maximal intensity, in relation (1:3) with others. In back stroke, in maximal and sub maximal intensities relations with other positions are (1:4) and in light intensity (1:2). Position C.F. (Table 2, Graph 2.) is not statistically significantly different in meters swum, in various techniques and various intensities, except in crawl technique swimming, in light and sub maximal intensity. Center forward's total number of meters swum, in absolute sense, is smaller in relation with others (160:196), but the differences are statistically significant. Analyzing the meters swum according to intensities, statistically significant differences are in maximal (12:30) and light (60:73) swimming. In sub maximal swimming there are no differences regarding other positions (86:91). In maximal intensity the given relationships are proportionally large (1:3) as opposed to light intensity, where the relationship is (0.82:1). The differences vary from one swimming technique to another; in crawl that difference is (151m: 174 m) while in back stroke it is (5m: 13m). Furthermore, significant differences are noted in breast technique in light swimming (2.4 m: 6.9m). In the meters swum in crawl technique in light and sub maximal intensity the C.F. is equal with other players, while in maximal intensity the C.F. has three times less meters swum. In back stroke swimming in all intensities the C.F. swims markedly less meters regarding other players, pronouncedly less in maximal intensity. From total time of the quarter (480 s) the C.F. spent (260 s) in the play, compared to other players who spent (320s). The difference of (- 60 s) is statistically significant. In duels, the C.F. is statistically different from other players, both through frequencies and time. In the frequencies of duels, the given relation is (4.1:2.1). In time spent in duels the given relation is (24.9s:11.8s). In indicators which recorded man up/down situations (unequal number of players), the C.F. is statistically different from other players, but in absolute values those differences are small. By applying binary logistic regression model, the differential characteristics of the C.F. regarding other roles in the game are defined and typified in the equation of play structure on the position C.F. The adequacy of placed model was tested by Hosmer and Lemeshow tests. We conclude: The Model is very well calibrated (HI ^{2} = 6.007 with 8 degrees of freedom and p=0.65). Coefficients of determination, (R^2) Cox &Snell (0.47) and Nagelkerke (0.65), are quite high, providing for 65% of variance. Prediction for total is (85.7%), for the position of C.F. it is the high (74.4%) and for other roles (91.0%) (Table 4.). Solitary contributions in prediction for the role of C.F. are represented in (Table 5.). Linear equation for the position of C.F. is:

$$ln[odds(Y=1)=Y= 0.05 - 0.23\ _{FKRLAG} + 1.57_{FLEDMAX} - 1.23\ _{FLESMAX} - 0.49\ _{MFLELAG} - 0.92_{FPRLAG} - 0.03_{MKRMAX} + 0.02\ _{FMKRSMX} + 0.04\ _{MKRLAG} - 0.70\ _{FMLEMAX} + 0.80\ _{FDUEL} --0.01_{SUKUPNO.}$$

Table 4 Significance

	B	S.E.	Wald	df	Sig.	Exp(B)
Constant	-,766	,083	84,58	1	,000	,465

Table 5 Model summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	412,857[a]	,467	,654
a. Estimation terminated at iteration number 7 because parameter estimates changed by less than 0,001.			

Table 6 Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	6,007	8	,646

Table 7 Classification

Classification Table[a]					
			Predicted		
			center		Percentage Correct
	Observed		,00	1,00	
Step 1	center	,00	413	41	91,0
		1,00	54	157	74,4
	Overall Percentage				85,7
a. The cut value is ,500					

Table 8 Variables in the Equation

	B	S.E.	Wald	Sig.	Exp(B)	95% C.I.for Lower	95% C.I.for Upper
FKRMAX	0.06	0.14	0.19	0.67	1.06	0.81	1.39
FKRSMAX	-0.17	0.10	2.84	0.09	0.84	0.69	1.03
FKRLAG	-0.23	0.11	4.24	0.04	0.80	0.64	0.99
FLEDMAX	1.57	0.73	4.57	0.03	4.80	1.14	20.19
FLESMAX	-1.23	0.47	6.84	0.01	0.29	0.12	0.74
FLELAG	-0.49	0.21	5.20	0.02	0.62	0.41	0.93
FPRLAG	-0.92	0.33	7.79	0.01	0.40	0.21	0.76
MKRMAX	-0.03	0.01	4.56	0.03	0.97	0.95	1.00
MKRSMAX	0.02	0.01	9.70	0.00	1.02	1.01	1.03
MKRLAG	0.04	0.01	11.53	0.00	1.04	1.02	1.06
MLEMAX	-0.70	0.29	5.62	0.02	0.50	0.28	0.89
MLESMAX	0.07	0.08	0.77	0.38	1.07	0.92	1.26
MLELAG	0.05	0.04	1.63	0.20	1.05	0.97	1.13
MPRLAG	-0.02	0.06	0.06	0.81	0.99	0.87	1.11
FDUEL	0.80	0.14	33.42	0.00	2.22	1.69	2.91
MDUEL	0.02	0.02	0.75	0.39	1.02	0.98	1.05
FIGVIS	0.31	0.25	1.62	0.20	1.37	0.84	2.22
SIGVIS	-0.02	0.02	0.89	0.35	0.99	0.96	1.02
FIGMAN	0.53	0.40	1.76	0.19	1.70	0.78	3.70
SIGMAN	-0.02	0.02	0.60	0.44	0.98	0.94	1.03
SUKUPNO	-0.01	0.00	17.84	0.00	0.99	0.98	0.99
Constant	0.05	0.31	0.03	0.86	1.05		

From all indicators which registered the crawl technique, only light swimming participates in the equation. Frequencies in all intensities in back stroke swimming are inherent in the equation, as well as frequencies of breast swimming. Regarding meters swum, all intensities are represented in the equation. In back stroke swimming only maximal intensity is represented in the equation. It is interesting to notice that duels in the equation are represented only by frequencies but not by spent time. With regression Exp (B) higher than 1, the prediction for the role of C.F. with great positive coefficients B are explained by FLEDMAX 1.6 and FDUEL 0.8, which are joined by MKRSMAX 0.02 and MKRLAG 0.04. At maximal intensity, the C.F. mostly uses back stroke technique for choosing his position on the two meters in attack. However, he uses the same technique much less often to control the opponent player in defense. The frequency of duels with high coefficient (0.8) directly speaks about the primary mission of the C.F. within team tactics. Ranked, with (Exp (B) > 1 are indicators (FLELAG 0.6; MKRMAX 0.7; FKRLAG 0.8 & SUKUPNO 0.99). With bottom negative coefficients B in the play of the C.F. are indicators (FLESMX (-1.73) and FPRLAG (-0.92). Regarding the contribution of these indicators, the C.F. with less back stroke swimming in sub maximal intensity and breast in light intensity will play his own tactical role better. The remaining indicators with negative B indicators, but with low values, are: FKRLAG (-0.23) and SUKUPNO (-0.01). Indicators: FLELAG 0.6; MKRMAX 0.7; FKRLAG 0.8 & SUKUPNO 0.99 have (Exp (B) <1.

Discussion and conclusion

Frequencies of total actions are low on the position C.F. regarding other player roles. These differences are in the range from (1:0.66) in crawl swimming in light and sub maximal intensity, to even (1:4) in back stroke swimming in sub maximal and maximal intensity. Smaller frequency of actions, in all the swimming in all intensities characterizes the play of the C.F. in the tactical sense and designates tasks under general team tactics. The role of C.F. differs from other roles by the quantity of meters swum. Only in the meters swum in the crawl technique in sub maximal and light intensity and in total meters swum in sub maximal intensity, is he equal with other players. This arises after ball possession loss and counter attack of the opponent team. The C.F. is constrained to follow counter attack, which he executes by swimming at least in sub maximal intensity. In contrast to this, the superfluity of opponent players arises in counter attack (counter with handicap). The C.F. spends an overall lower period in the game than other players. Proportionally, center forward spends less time in man up/down situations. A remarkable characteristic in the play of the C.F. are duels, expressed in frequencies and spent time. This fact determines the center forward's basic tactic role in the collective team tactics. On the basis of coefficients B it is possible to conclude that the C.F. realizes the basic tactics in attack by duels. In addition to this, back stroke swimming in maximal intensity is an important part in his play, wherewith he generates his position choice in attacker's mission, but also in defense mission through the covering and control of the opponent's attacker. On the other hand, indicators which have negative coefficients B, speak about actions which were objectively performed but were not advisable for orderly execution of center forward's role under collective tactics. The analyzed position of the C.F. is statistically described by indicators of frequencies, types and quantities of movements,

intensities in various modalities in the horizontal and vertical phases of the game, regardless of the type of tactics and phase of the play (attack, transition and defense). A markedly light frequency of total actions is noted on the position center forward regarding other player roles. We find differences in the range from (1:0.66) in crawl swimming in light and sub maximal intensity, to even (1:4) in back stroke swimming in sub maximal and maximal intensity. This is in accordance with the play of the C.F. on the general tactics plan. The C.F. is equal with other players in the meters swum in the crawl technique in sub maximal and light intensity, as well as in the total meters swum in sub maximal intensity. Such swimming defines the play of the C.F. in the transitional phase, where the tactical tasks for all players including centers forward are defined by quantities, techniques and intensities of the swimming in order to attempt a faster and more effective counter attack. The C.F. spends totally lower period in the game than other players. Proportionally, he spends lower time in man up/down situations. A remarkable characteristic in the play of the C.F. are duels, expressed in frequencies and spent time. This fact determines the center forward's basic tactic role in the collective team tactics. By applying the binary logistic regression we defined differential characteristics of the C.F. regarding other roles in the game, which is typified in the equation of play structure on the position of C.F.

Solitary contributions in the prediction of the role of C.F. are represented in the linear equation for the position of C.F.:

$$ln[odds(Y=1)=Y= 0.05 - 0.23_{FKRLAG} + 1.57_{FLEDMAX} - 1.23_{FLESMAX} - 0.49_{MFLELAG} - 0.92_{FPRLAG} - 0.03_{MKRMAX} + 0.02_{FMKRSMX} + 0.04_{MKRLAG} - 0.70_{FMLEMAX} + 0.80_{FDUEL} --0.01_{SUKUPNO}$$

The hypothesis, formulated in the context of the differences between the C.F. and the remaining positions within the borders of the chosen tactics expressed in: frequencies, time duration, meters swum in different techniques as well as in different intensities in horizontal and vertical phases of the game and in man up/down situations, has been confirmed in this investigation. Logistic regression manifests itself as a good choice of methodology for efficiently analyzing such kind of problems in this segment of water polo game (tactics) which is defined by indicators on unequal measurement scales with specific distributions. The results of this investigation will be a contribution to elaboration of water polo game model in the domain of situational play without ball (realization of the collective tactics regardless of the choice of the type of tactics in either attack or defense). These results not only comprise statistical descriptions of the role of C.F. but also offer an unusual analysis which brings to light the comparative properties of the tactic role of C.F. in contrast to others.

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DIFERENCIJALNA ANALIZA ULOGE NAPADAČKOG CENTRA U MOMČADSKOJ TAKTICI U VATERPOLU (MUŠKARCI)

Sažetak

Kolektivna taktika temelji se na podjeli uloga u svim fazama igre. Postoji nekoliko uloga odnosno pozicija u vaterpolu: centar, branič, krilo, vanjski napadač i vratar, od kojih je svaki instrument u realizaciji kolektivne taktike. Cilj ovog istraživanja bio je opisati igru na poziciji centar (CF) i komparirati je sa ostalim ulogama u igri. Predmet ovog istraživanja jest deskripcija svih aktivnosti u igri van kontakta s loptom (sva plivanja, dueli, i situacije s igračem više/manje). Prikupljanje podataka obavljeno je registracijom igračevih aktivnosti na službenim utakmicama Internacionalne Jadranske vaterpolo Lige u sezoni 2009/10. Osnovne jedinice mjerenja ili entitete predstavljali su: pozicija-igrač-četvrtina. Rezultati su registrirani preko 21 indikatora nad kojima su izračunate osnovne statistike. Diferencijalna analiza za poziciju centra u odnosu na ostale igrače (uloge u igri) napravljena je na osnovi testiranja modela binarne logističke regresijske jednadžbe. Izrazito manje frekvencije totalnog broja akcija zabilježene su na pozicije centar (CF) u odnosu na ostale pozicije. Zabilježene su razlike u rangu od (1:0,66) u kraul plivanju laganim i submaksimalnim intenzitetom intenzitetom, do naglašenih (1:4) u leđnom plivanju u submaksimalnom i maksimalnom intenzitetu. Centar je podjednak sa ostalim igračima u metrima isplivanim kraul tehnikom pri submaksimalnom i laganom intenzitetu, jednako kao u ukupnim metrima isplivanim submaksimalnim intenzitetom. U usporedbi s ostalim igračima C. F. provede manje ukupnog vremena u igri i proporcionalno tomu manje vremena provede u igri s igračem više/manje. Upečatljiva karakteristika u igri centra su dueli, kako po frekvenciji (broju) tako i u vremenu provedenom u njima. Primjenom binarne logističke regresije definirali smo diferencijalne karakteristike C. F. u odnosu na ostale uloge u igri, što je rezultiralo jednadžbom strukture igre na poziciji centar. Pojedinačni doprinos u predikciji uloge centar predstavljen je u linearnoj jednadžbi za ulogu centra. Rezultati ovog istraživanja doprinijet će objašnjenju modela vaterpolo igre u situacijskim uvjetima u igri bez lopte (realizacija kolektivne taktike u odnosu na izbor tipa taktike kako u napadu tako i u obrani). Rezultati donose statističku deskripciju uloge C. F. kao i specifične karakteristike uloge centra u usporedbi s drugim ulogama u igri.

***Ključne riječi**: vaterpolo, igra, centar, statistike, model, logistička regresija*

Received: August 22, 2011
Accepted: December 10. 2011
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