INDICATORS OF SITUATIONAL EFFICIENCY OF WINNING AND DEFEATED MALE HANDBALL TEAMS IN MATCHES OF THE OLYMPIC TOURNAMENT 2012.

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Abstract

The aim of the study was to determine indicators of situational efficiency between winning and defeated male handball teams of the Olympic tournament in 2012. The sample of entities in this study consisted of 30 games that were played by handball teams of the preliminary part of the competition. The sample of variables consists frequency of successfully and unsuccessfully executed elements of technical and tactical actions during a handball match in the phases of attack and defense (14 variables in the phase of attack and 3 variables in the phase of defense). For determination of differences between winning and defeated teams among variables of situational efficiency Mann-Whitney U-test was used. The results showed statistically significant differences between winning and defeated teams in variables: shoot from 9 meters-successfully (p=0.00), shoot from the wing position-successfully (p=0.02), shoot from the wing position-unsuccessfully (p=0.01), shoot from 6 meters-unsuccessfully (p=0.00), shoot from 7 meters-successfully (p=0.00), assistance (p=0.00), lost balls-turnovers (p=0.04) and blocked balls (p=0.01). Winning teams dominated with variables that defined the effectiveness of the game in the phase of the attack, and because of that, they made advantages over the opponentand won the matches. Because of the dinamic of the handball game and differences in a way of playing, more studies need to be done in the future.

***Key words**: technical-tactical elements, handball, the Olympics, analysis*

Introduction

Hierarchic structure of efficiency indicators in sports games could be created from the point of view of dimensional analysis of the players (Milanović, 2013) which combines of four interconnected factors. On the first level of the pyramid are capacities of handball player's preparation i.e basic antrophological characteristics which are prerequisite for development of the specific abilities and knowledge of handball player which are situated on the second level. On the third level are situational and action efficiency parametres of handball player which are reached on the basis of all situations registration during the game or whole competition. On the fourth level, which is the final level of handball player competitive impact is sport result. Indicators of situational effectiveness are collected by existing methods of registration in the course of the competition, subsequent viewing images and so on. Each method is a specific manifestation of all abilities, traits, skills and other characteristics of the athlete, but also coaches and other supporting logistics. That is why the clash of two opponents produces similar but never the same development or outcome-course of the game (Vuleta et al., 2005). Using indicators arising from the aim of handball game, we can assess situational effectiveness of the games, individual or team. If we recognize the elements that provide good results, it is possible to reach better results based on indicators of situational efficiency in attack, defense and transition during the handball game. Unfortunately, there is not yet defined a unified way for the registration of such data to us after the game that could give us a precise insight about the events on the field. Videos have a particular value, because by using them handball experts can assess and analyze technical - tactical and other situational elements in the game. In the modern sports structure parameters of competitive activities are the basis for comparative analysis of athletes and the entire team and, what is especially important, for rational programming sports training. Therefore, it is necessary to precisely shape the profile of individual structures indicators of situational effectiveness of each player. By registering situational efficiency, the required team efficiency values can be reached as well as model of individual performance of each player in all phases of the game. Application of notation analysis in the process of modern training and competition in handball and other team sports is greatly important and indispensable in achieving top results. Handball game is characterized by different typical and atypical situations in the game, therefore, the need for an objective registration of certain situations in the game and the parameters of situational effectiveness of each player in competitive conditions (Vuleta et al., 2003).

During the game it is possible to record every successful and unsuccessful move each player has made as an example. Dialed number of balls into the net, number of goals with different playing positions, percentage realization of the goal kick, turnovers, technical mistakes, penalties, defense goalkeeper and more. That is how the objective indicators of, or the efficiency of players and teams, thus avoiding the subjective assessment of the condition on which the coach and coaching staff can competently evaluate the contribution of each player in offense or defense in the success or failure of the team.

The system of criteria to assess the actual quality of handball players must provide situational assessment of the success or effectiveness of game by each player in relation to the positions of the game and the phases of the game (Vuleta et al., 2009). In this way, we can get objective indicators of conditions or the efficiency of players and teams, and there is no more subjective evaluation and based on indicators, coach can competently assess the contribution of each player's successful and unsuccessful actions inside the team during the attack or defense. The first group consists of research frequency of various events in the game, and the frequency and success of a number of technical and tactical elements of handball during a game conducted by: Vuleta Vuleta D. and D. et al. (1996, 2003. 2004, 2005, 2009, 2011, 2013, 2014). Rogulj et al. (2004., 2005, 2011)., (Czerwinski, 1998, 2000); Seco (2008); Taborsky, (2008), Foretić, N. et al. (2011); Hianik (2011) and Skarbalius, A. (2011) These studies are predominantly based on standard descriptive analysis of monitored parameters in individual championships, in general, and for each of the participant of the Championship separately. Another group of studies focus on identifying the contributions and different standard of performance indicators and differently defined criteria of success on the World and European championships and the Olympic tournament (Srhoj et al., 2001; Vuleta, et al., 2003; Rogulj, 2003; Rogulj , et al., 2004; Vuleta et al., 2005; Gruić, et al., 2006; Herginson, 2008; Vuleta et al. 2012). Srhoj et al. (2001) on a sample of 80 matches of the World Handball Championship (Egypt 1999), found significant that the outcome of the match affect all efficiency variables of realization (goals scored), apart from the position of the circular header.

Especially significant impact accomplish variables of realization from positions of outside attackers, from individual action "passage" and counter-attack. They compared the team given the final result and success in the competition. It has been shown that successful team dominated in the successful execution of a number of parameters situational efficiency of the defense and attack. A significant impact on the outcome of the match accomlished all the variables that define the effectiveness of implementation (goals scored), except that the position of the circular-header. Especially significant impact on the end of result of the match accomplish variables of realization from the position of external attackers, from individual action by passing and counter-attack. The variables associated with the frequency of the shot with a certain position didn't make a significant impact on the result, which means that the performance results don't dependent on quantity, but on the quality of the shot. Vuleta et al. (2003) on a sample of 38 matches of the European Handball Championship in Croatia in 2000 determined the relation between the variables of shooting on goal with a final score of the handball match. Regression analysis found that the final result of the game depended significantly on the realization of shooting from different distances and different playing places. They concluded that the efficiency of shooting from a distance and line of 6 meters and 7 meters had most influence on the final result of the match. Vuleta et al. (2012) in a sample of 30 games (60 opponents) who played 12 handball teams in the preliminary part of the competition at the Olympic Games in Beijing in 2008 determined the association between the variables of shooting on goal with a final score of the handball match. The results obtained by regression analysis shown a statistically significant impact on indicators of situational efficiency criteria defined by goal difference in the variables: shot from nine meters unsuccessfully, shot from the wing successful, shot from the wing failed, powerful counter-attack successfully, powerful counter-attack failed and fired from a passage successfully.

The third group of research was focused on determining the difference between handball teams grouped according to various criteria (winner or loser, for better or worse-ranked team in the official competition) (Rogulj, 2000; Rogulj and Srhoj, 2000, Rogulj et al. 2004; Foretić, Rogulj and Trninić, 2010). The authors analyzed the differences between successful and unsuccessful teams in indicators of situational efficiency in matches of European and World championships. Rogulj (2000) analyzed the differences between successful and unsuccessful teams in 80 matches of the same competition by using 27 parameters of situational efficiency in the stages of defense and attack. There were statistically significant differences found and defined with two discriminatory factors: number of goals scored, the efficiency of the implementation of attack, the efficiency of players in the defense and situational performance of goalkeeper defense from external position. A variable that particularly affected the negative outcome of handball match was the number of unsuccessful realization from the external position. Rogulj and Srhoj (2000) analyzed the contribution of the individual parameters of situational efficiency of the final outcome of handball matches on the World Handball Championship for men in Egypt in 1999. 10 official situational efficiency parameters in the defense showed a statistically significant effect in distinguishing between successful and unsuccessful teams. In this sense, the authors specifically highlight the efficiency of goalkeeper's shoot defences from external position. Rogulj et al. (2004) analyzed the efficiency parameters of 19 elements of the collective skill games in the attack phase with successful and unsuccessful men's team that competed in the Croatian championship in the 1998/99 season. Duration, continuity and systematic organization and spatial orientation of different attacks have contributed to the success of collective tactics in the attack of successful and unsuccessful teams. It was found that the winning team performed much more rapid attack on unlined defense that ended with counterattacks and realization of the line of six meters and defeated teams performed much more intermittent positional

attack on prepaired defense with excessive technical and tactical action. Foretić et al. (2010) analyzed the impact of situational effectiveness of the result of a handball match in terms of determining factors of winning and defeated teams based on situational indicators of attack finalization in top senior handball. In matches of the world championship for men 2009, the differences (ANOVA) of the total sample of the matches at various levels of the group to the final part of the competition were analyzed. For this purpose three groups of variables kicking on a goal were used: the number of shots on goal, goals scored and percentage of realization in positional play and transition attack. The research results showed that the impact of situational variables on the final result of a handball match was lower among rival of equal quality, and higher in larger differences in quality. The winning teams were more effective in all parameters of the final action of attack. Number of hits from the position of the pivot contributed significantly on the victory with quality team. The result of a handball match between two quality teams was determined by the efficiency of shooting with external position which suggested the importance of foreign players in the creation of results in top handball. The aim of this study was to determine the differences between successful and unsuccessful male handball teams participating on the Olympic tournament in London in 2012, in the indicators of situational efficiency. On this basis it will be determined which variables of situational action among handball players in the game mostly affect the positive outcome or victory in a handball match. The basic hypothesis of this study are: H1 - There is a statistically significant difference between successful and unsuccessful men's handball teams in certain indicators of situational efficiency registered during matches played. H2 - There is a different contribution of individual indicators of situational effectiveness of the game in distinguishing successful and unsuccessful teams.

Methods

The sample of entities

The sample of entities in this study consists of 30 games that were played by handball teams of the preliminary part of the competition at the Olympic Games in London in 2012. The tournament was attended by 12 teams that were divided into two groups (groups A and B, each with 6 teams). In each group, teams have played the same number of 15 matches. The study will analyze only the matches that ended with victory or defeat of one of the teams. The teams who finished the game with no winners will not be analyzed. Considering that, no match has ended without a winner and actual sample entities was 60 opponents of which 30 were winners and 30 were defeated teams. The number of entities will be sufficient and with the determined number of degrees of freedom successfully test the proposed hypotheses. This will be fulfilled the criterion of statistical power of inference and generalization of the results.

12 teams that participated in the Olympic tournament passed selection competition at the Continental Championships with a team that had the largest number of teams from Europe (9) and by one team from South America, Africa and Asia. The tournament were competed by groups following representations: Group A: France FRA, Iceland ISL, SWE Sweden, Argentina ARG, Tunisia TUN, Great Britain GBR; Group B: Croatia CRO, DEN Denmark, Spain ESP, Hungary UNG, Serbia SRB, South Korea KOR. The tournament will be played like league and cup system, so the first part was played by groups (league system) where the first four teams qualified for the second round.

The sample of variables

The sample of variables consists frequency of successfully and unsuccessfully executed elements of technical and tactical actions during a handball match in the phases of attack and defense. Objective registration of situational efficiency is used to get to this results. All data are based on the official statistics of the IHF which are posted on their official website www.ihf.info/. Most of the analyzed variables present indicators of situational efficiency in the phase of attack: SH9MSU-shoot from 9 meters successful, SH9MUN-shoot from 9 meters unsuccessful, SHWIPOS-shoot from the wing position successful, SHWIPOUN-shoot from the wing position unsuccessful, SH6MSU-shoot from 6 meters successful, SH6MUN-shoot from 6 meters unsuccessful, SHCSSU-shoot from counter-strike successful, SHCSUN-shoot from counter-strike unsuccessful, SH7MSU-shoot from 7 meters successful, SH7MUN- shoot from 7 meters unsuccessful, SHPASU-shoot from the passage successful, SHPAUN-shoot from the passage unsuccessful, ASS-assistance and LB-lost balls, while the three indicators of situational efficiency of technical and tactical actions related to the phase of defense are: WB-won balls, BLB-blocked balls and 2MEX-2 minutes exclusion.

Data processing methods

Within the descriptive statistics it will be determined if the central and dispersion parameters of the observed variables. Following parameters will be calculated: A.S.-Arithmetic mean, Me-median or central value is the value that is in the middle of the arranged series of data (in ascending or descending sorting), or a value that ordered sequence data divided into two equal parts, Min-minimum value, Max-maximum value, SD-standard deviation is a statistical measure that shows how densely the results of a measurement cluster is around the mean, as-asymmetry (skewness) is the degree where the distribution curve deviates from the (complete) symmetry. For-curvature (kurtosis) is a term used to describe the general shape of the bell-shaped curve in terms of its curvature, and graphically shows what is the concentration of results about the mean, KS Kolmogorov - Smirnov test tests the normality of variables. For determination of differences between winning and defeated teams among variables of situational efficiency Mann-Whitney U-test was used and

calculated: ∑rwinn-sum of rang values of the winning teams, ∑rdef-sum of rang values of the defeated teams, U-obtained value for testing statistical signifficant differences and in paper is presented as: Z-value for the approximation U for big samples, p-the amount of error that makes the acceptance of the hypothesis where difference is statistically significant.

Statistical level of significance is set up with error p=0.05. For the analysis of data Statistica ver 7.0 (Statsoft, Tulsa, OK) was used.

Results and discussion

In this paper, results and discussion will be presented in three parts. The first part will analyze the central and dispersion parameters of variables of situational efficiency by winning handball team, after that the same indicators will be analyzed among defeated teams, while the third part analyze the differences between successful and unsuccessful handball teams in the indicators of situational effectiveness in the game.

Basic statistical indicators of variables of situational efficiency by victorious handball teams

Table 1 Basic descriptive statistical indicators among variables of situational efficiency by the winning handball teams

Variable	N	AS	MIN	MAX	SD	SKEW	KURT	MAX D
SH9MSU	30	6,20	0,00	14,00	2,77	0,41	1,52	0,15
SH9MUN	30	2,13	0,00	7,00	1,89	1,01	0,36	0,27
SHWIPOS	30	4,70	2,00	10,00	2,14	1,08	0,84	0,19
SHWIPOUN	30	3,80	1,00	7,00	1,45	0,52	0,23	0,21
SH6MSU	30	8,20	3,00	16,00	3,36	0,59	-0,12	0,14
SH6MUN	30	8,20	2,00	17,00	3,48	0,45	-0,02	0,14
SHCSSU	30	2,60	1,00	6,00	1,54	0,61	-0,77	0,18
SHCSUN	30	0,57	0,00	2,00	0,68	0,80	-0,40	0,33
SH7MSU	30	5,43	1,00	11,00	2,94	0,06	-0,98	0,14
SH7MUN	30	1,27	0,00	4,00	1,05	0,58	0,07	0,20
SHPASU	30	3,03	0,00	7,00	1,71	0,34	-0,52	0,19
SHPAUN	30	1,23	0,00	4,00	1,17	0,77	0,19	0,19
ASS	30	15,93	9,00	34,00	5,46	1,24	2,57	0,16
LB	30	11,33	5,00	17,00	3,18	-0,41	-0,77	0,18
WB	30	4,47	1,00	9,00	2,21	0,20	-0,84	0,13
BLB	30	3,77	0,00	14,00	3,09	1,35	2,62	0,18
2MEX	30	4,20	1,00	8,00	1,67	0,14	-0,32	0,15

K.S. test = 0,24

(N-sample entities, AS-arithmetic mean, MIN-minimum value of the results, MAX-maximum value of the results, SD-standard deviation, SKEW-asimmetry coefficient, KURT-curvature coefficient, D–MAX-discrepancies between theoretical and cumulative proportions, K-S p-significance Kolmogorov-Smirnov test of distribution normality)

SH9MSU-shoot from 9 meters successful, SH9MUN-shoot from 9 meters unsuccessful, SHWIPOS-shoot from the wing position successful, SHWIPOUN-shoot from the wing position unsuccessful, SH6MSU-shoot from 6 meters successful, SH6MUN-shoot from 6 meters unsuccessful, SHCSSU-shoot from counter-strike successful, SHCSUN-shoot from counter-strike unsuccessful, SH7MSU-shoot from 7 meters successful, SH7MUN- shoot from 7 meters unsuccessful, SHPASU-shoot from the passage successful, SHPAUN-shoot from the passage unsuccessful, ASS-assistance, LB-lost balls, WB-won balls, BLB-blocked balls and 2MEX-2 minutes exclusion.

Table 1 showed the basic descriptive statistical indicators variables of situational efficiency among winning handball team. The highest average frequency per game had variables assists: assistents-ASS (15.93), lost balls-LB (11.33), shot with 9m successfully- SH9MSU (8.20) and shot from 9m unsuccessfull –SH9MUN (8.20), while the lowest frequency have variables: shot from seven meters unsuccessfully- SH7MUN (0.57), shot from the passage unsuccessfully-SHPAUN (1.07), and powerful counter-attack unsuccessfully-SHCSUN (1.23). This means that analyzed matches of the winning teams adorn the game with a lot of assistance with a relatively risky game which increases the number of turnovers and realization of shooting from a distance, which nevertheless takes into account the selection of rubble in order to minimize the number of unsuccessful implementation, as well as kicking a counterattack and passages. Comparing each of the indicators of situational effectiveness of the winning team obtained in this study with research conducted by Rogulj (2000), Vuleta et al. (2003), Gruić et al. (2006), Šibila et al. (2011), it can be said that the indicators of situational performance are quite similar with respect to the frequency in relation to the efficiency of performance. For example, the variable shooting the ball from wing position-SHWIPOS, in this study yielded 4.70 with 55.29% efficiency, while Rogulj (2000) on the World Cup matches in Egypt got 5.54 successful realization with 59.96% efficiency, and Vuleta et al. (2003) were obtained with a percentage efficiency 4.11and shooting percentage of 54.73%, while Gruić et al. (2006) at the World Championships in Portugal get 5.56 of successful realization average per game with 62.16% efficiency. Thus, the resulting differences are relatively small and are the result of the teams power, the current sports form and the importance of each game with respect to the course of the tournament competition. It can also be analytically observed that number of successful shooting with 9mSH9MSU- where in all studies the

number was 7.58 to 8.37 after the successful realization of the match with the efficiency of shooting from 43.20% to 50%. In this study, the matches of the Olympic tournament in 2012 obtained a high level of efficiency of 50%. The obtained values which represented shooting success from the wing position were (60%) and from outside positions (50 in line with the long-established model of efficiency of Czerwinsky (2000). A very important variable of situational success was the number of successful implementation of the counter-strike-SHCSSU. In this study, the winning team were carried out by an average of 5.43 per game to counter-strike with the efficiency of 81.04%, which was slightly less than 6.22 that got Rogulj (2000) with 64.26% efficiency and considerably more than the number that received Vuleta et al. (2003) 3.66 and the successful realization with 73.94% efficiency while Gruić et al. (2006) got the successful realization of 2.00 per game with 72.73% efficiency of implementation. Particularly interesting data refered to the number of assists- ASS by winning team of 15.93 obtained in this work, which was greater than the number of assissts which got Rogulj (2000) – 14.51, (Foretić, 2011) – 13.52, (Gruić et al. 2006) – 12.04 and 10.9 assists per match got Šibila et al. (2011). It should be noted that the resulting number of assists in a game of the Olympic tournament 2012 was a peculiar model of the game in modern handball which is focused on the growing number of assists as the best way method for constructing tactical actions for achieving the goals. The average number of lost balls-LB by winning team in this study was 11.33, practically identical number of lost by the survey received by Rogulj (2000) from 12.24. In the same way, blocked the ball-BLB in this study can be commented, the average per game is 3.77 blocked balls while Rogulj (2000) received a 4.45 while Šibila (2011) gained 3.81 blocks per game. The winning team in this study had average number of 4.22 per game among a 2 min exclusion- 2MEX, which was less than the number of exclusions of 4.41 set by the Rogulj and Srhoj (2000), or 4.47 Srhoj et al. (2001), while Gruić et al. (2006) found a very large 4.65 stops per game. After examining the dispersion of results about arithmetic means, the number of standard deviations of variables of situational effectiveness by winning teams ranged from the smallest value (3.40)-a shot from the counter-strike successfully and (3.70)-a shot from six meters unsuccessfully-SH6MUN to the largest value (5.05)- shot from six meters successful-SH6MSU and (5.98)- shot from a passage successfully-SHPASU. It was safe to say that the variables with the highest frequency had the highest dispersion around the arithmetic mean.

This was confirmed by the results of elongation and curvature of the distribution of variables (Skewnis and Kurtosis). All variables of situational success in the game by winning team were analyzed by the Kolmogorov-Smirnov test for determining the normality of distribution and 15 variables satisfied the criteria of normal distribution at a significance level of 95% (MaxD <Test). Two variables shot from seven meters unsuccessfully-SH7MUN (0.33) and shot from 6m unsuccessfully – SH6MUN (0.27) differed from the normal distribution (Max> D Test) which was due to low frequency performances of these situational parameters by the winning team.Table 2 showed the basic descriptive statistical indicators among variables of situational efficiency among defeated handball teams. The highest average frequency of all variables had variables: shoot from 9m unsuccessfully- SH9MUN (15.13), lost balls-LB (13.83) assists - ASS (11.10) and variable shoot from 9m successfully – SH9MSU (7.27) while the lowest frequency variables had shot from seven meters unsuccessfully- SH7MUN (0.57), shot from the passage unsuccessfully-SHPAUN (1.07), and powerful counter-strike unsuccessfully- SHCSUN (1.23) per game.

Basic statistical indicators of variables of situational efficiency by victorious handball teams

Table 1 Basic descriptive statistical indicators among variables of situational efficiency by the defeated handball teams

Variable	N	AS	MIN	MAX	SD	SKEW	KURT	MAX D
SH9MSU	30	4,20	0,00	8,00	1,75	-0,20	0,72	0,19
SH9MUN	30	2,47	1,00	6,00	1,33	0,92	0,53	0,20
SHWIPOS	30	3,37	1,00	8,00	1,73	0,63	0,17	0,15
SHWIPOUN	30	2,90	1,00	6,00	1,18	0,61	0,57	0,23
SH6MSU	30	7,27	2,00	13,00	2,64	0,09	-0,22	0,16
SH6MUN	30	15,13	7,00	29,00	5,02	0,81	0,82	0,12
SHCSSU	30	2,33	0,00	6,00	1,52	0,15	-0,01	0,17
SHCSUN	30	1,03	0,00	3,00	0,96	0,67	-0,36	0,25
SH7MSU	30	2,87	0,00	8,00	1,93	0,67	0,40	0,17
SH7MUN	30	1,33	0,00	4,00	1,30	0,65	-0,74	0,23
SHPASU	30	2,23	0,00	6,00	1,57	0,45	-0,35	0,16
SHPAUN	30	1,13	0,00	6,00	1,53	1,88	3,53	0,27
ASS	30	11,10	4,00	20,00	3,74	0,58	0,30	0,14
LB	30	13,83	7,00	28,00	4,46	1,28	2,48	0,14
WB	30	3,53	0,00	8,00	2,00	0,34	-0,52	0,14
BLB	30	1,97	0,00	6,00	1,73	0,87	0,26	0,19
2MEX	30	3,93	1,00	9,00	2,03	0,57	-0,16	0,15

K.S. test = 0,24

(N-sample entities, AS-arithmetic mean, MIN-minimum value of the results, MAX-maximum value of the results, SD-standard deviation, SKEW-asimmetry coefficient, KURT-curvature coefficient, D–MAX-discrepancies between theoretical and cumulative proportions, K-S p-significance Kolmogorov-Smirnov test of distribution normality)

SH9MSU-shoot from 9 meters successful, SH9MUN-shoot from 9 meters unsuccessful, SHWIPOS-shoot from the wing position successful, SHWIPOUN-shoot from the wing position unsuccessful, SH6MSU-shoot from 6 meters successful, SH6MUN-shoot from 6 meters unsuccessful, SHCSSU-shoot from counter-strike successful, SHCSUN-shoot from counter-strike unsuccessful, SH7MSU-shoot from 7 meters successful, SH7MUN- shoot from 7 meters unsuccessful, SHPASU-shoot from the passage successful, SHPAUN-shoot from the passage unsuccessful, ASS-assistance, LB-lost balls, WB-won balls, BLB-blocked balls and 2MEX-2 minutes exclusion. Based on this we could conclude that the game with the defeated teams characterized, among other things, a large number of unsuccessful 15.93 shooting from 9m- SH9MUN and a large number of lost balls 13.83-LB. Defeated teams had a relatively high number of assists- ASS (11.10) and the number of successful shooting from 9m SH9MSU (7.27), but these frequencies were significantly less than those achieved by the winning team. The lowest frequencies by defeated teams as well as the winning teams were in the situational variables shot from 7M unsuccessfully-SH7MUN (0.57), shot from the passage unsuccessfully-SHPAUN (1.07) and powerful counter-strike unsuccessfully- SHCSUN (1.23) per game. If the results of this study were compared with the results got by Rogulj (2000), Vuleta et al. (2003), Gruić et al. (2006), Foretić (2011) and Šibila et al. (2011), we could observe similar results of numerical values and percent efficiency. This especially applied to the number of goals scored from the wing position- SHWIPOS (3.20 to 3.53) and the efficiency of 47.64% - 53.75% and powerful counter-strike successfully - SHCSSU 2.56 to 3.31 with the efficiency of 59.40 - 72.43%, and in particular number of goals scored by shooting with 9m-SH9MSU from 7.27 to 7.86 with an efficiency of 28.62 - 32.46% and the number of shoots from the passagge- SHPASU 1.33 to 2.33 with the efficiency of realization of 66.37% to 76.84%. In relation to the above studies this paper obtained significant differences in some indicators of situational success by defeated teams. In this study, for example, the average number of assists among defeated teams was 11.10 as of 8.36 as Rogulj (2000) and 9.81 assists as Gruić et al. 2006th got. Šibila et al. (2011), at the European Championships found that the number of assists in the European Championships of 2002 - 2010 decreased from 15.92 to 10.96. The average number of turnovers-LB among defeated in this study was 13.83, practically identical number of turnovers by the survey received by Rogulj (2000) of 14.84. Variable blocked ball – BLB in this study the average per game was 1.99 blocked balls while Rogulj (2000) got the 2.20 blocked balls per game. Defeated in this study had an average of 4.20and reducing for 2 min exclusion-2MEX which was less than 4.41 exclusions that Rogulj and Srhoj (2000) found, or 4.47 Srhoj et al. (2001) and 4.65 stops per game as Gruić et al. (2006) found. After examining the dispersion of results about arithmetic means the number of standard deviations of variables of situational efficiencyamong defeated ranged from the smallest value (3.47)- blocked ball- BLB and (3.76) - a shot from six meters unsuccessfully – SH6MUN to the largest value (4.38)- a shot from nine meters unsuccessfully-SH9MUN and (4.57) - a shot from six meters successfully- SH6MSU. It was certain that the variables with the highest frequency had the highest dispersion around the arithmetic means. This was confirmed by the results of elongation and curvature of the distribution of variables (Skewnis and Kurtosis)- All variables of situational success in the game by defeated were analyzed by the Kolmogorov - Smirnov test to determine the normality of distribution and 15 variables satisfied the criteria of normal distribution at a significance level of 95 % (Max D < Test). Two variables deviated from the normal distribution (Max > D test), shoot from passages unsuccessfully- SHPAUN (0.27) and shot from seven meters unsuccessfully-SH7MUN (0.25) which was due to low frequency performances of these situational parameters by defeated teams. Table 3 showed the statistical indicators among variables of situational efficiency in the game by winning (WINN) and defeated (DEF) handball teams in matches of the Olympic tournament in 2012. Already at the level of the average values can be observed some numerical differences between the observed teams. Interestingly, the winning teams sent per game more successful shots at goal with 9m – SH9MSU (8.20) than the defeated teams (7.27) while the defeated teams sent an average of (15.13) which was almost 85% more unsuccessful shoots on the door from 9m than the winning team (8.20) that was 7.27 or 32.46%, while in the study Vuleta et al. (2012) was 7.78. The winning team have carried out on average more successful shots on goal, especially with 6m (6.20), from the wing position (4.70) and counter (5:43) and had more assists to achieve successful results (15.93) as well as less lost balls (11,33) considering on defeated teams. The variables kicking a counter-strike, winning teams achieved almost 90% more attack considering on defeated teams in average (5.43) and defeated (2.87) which was an indicator of good games in the defense and in support of more stealing, blocking more balls or more players got exclusioned.

This spoke in favor of a greater variety of technical and tactical actions of the victorious team in offense (Czerwinski, 1998, 2000). For the theory and practice of handball game could be interesting relationship between successful and unsuccessful implementation of shooting from different positions in the game. The results showed that the winning team achieved greater efficiency of shooting in all variables and the maximum situational efficiency of the winning team achieved shooting with 7m (82.02%) and defeated (69.35%), shooting from counterstrike by winners (81.04%) and defeated (68.33%), shooting with 6m by winners (74.43%) and defeated (62.97%), shooting from the insulation by winners (71.13%) and defeated (66.37%).

The differences between successful and unsuccessful handball teams in the indicators of situational effectiveness of the game in a matches of the Olympic tournament in 2012

Table 3 Mann Whitney test for testing the difference between successful and unsuccessful handball teams among indicators of situational effectiveness in the game

Variables		A.S.	M_e	S.D.	Z	p-value
SH9MSU	WINN. DEF.	6,20 4,20	6,00 4,00	2,77 1,75	*3,35*	*0,00*
SH9MUN	WINN. DEF.	2,13 2,47	1,50 2,00	1,89 1,33	-1,33	0,18
SHWIPOS	WINN DEF.	4,70 3,37	4,00 3,00	2,14 1,73	*2,42*	*0,02*
SHWIPOUN	WINN. DEF.	3,80 2,90	4,00 3,00	1,45 1,18	*2,48*	*0,01*
SH6MSU	WINN. DEF.	8,20 7,27	8,00 7,50	3,36 2,64	0,94	0,35
SH6MUN	WINN. DEF.	8,20 15,13	7,50 14,00	3,48 5,02	*-5,07*	*0,00*
SHCSSU	WINN. DEF.	2,60 2,33	2,00 2,50	1,54 1,52	0,39	0,70
SHCSUN	WINN. DEF.	0,57 1,03	0,00 1,00	0,68 0,96	-1,77	0,08
SH7MSU	WINN DEF.	5,43 2,87	5,50 3,00	2,94 1,93	*3,31*	*0,00*
SH7MUN	WINN. DEF.	1,27 1,33	1,00 1,00	1,05 1,30	0,05	0,96
SHPASU	WINN. DEF.	3,03 2,23	3,00 2,00	1,71 1,57	1,75	0,08
SHPAUN	WINN. DEF.	1,23 1,13	1,00 1,00	1,17 1,53	0,84	0,40
ASS	WINN. DEF.	15,93 11,10	15,00 10,50	5,46 3,74	*3,65*	*0,00*
LB	WINN. DEF.	11,33 13,83	12,00 13,00	3,18 4,46	*-2,01*	*0,04*
WB	WINN. DEF.	4,47 3,53	5,00 3,00	2,21 2,00	1,55	0,12
BLB	WINN DEF.	3,77 1,97	3,00 2,00	3,09 1,73	*2,45*	*0,01*
2MEX	WINN. DEF.	4,20 3,93	4,00 4,00	1,67 2,03	0,75	0,45

(A.S.-arithmetic mean, Me-median or central value of the value which is arranged in the middle of the data string (ascending or descending sorting), or a value that divides data into two equal goups, SD–standard deviation is a statistical measure that shows how densely the results are of a measurement cluster around the mean, Z–value according to which approximates U for large samples, p-value-the amount of errors that make the acceptance of the hypothesis that the difference is statistically significant.)

SH9MSU-shoot from 9 meters successful, SH9MUN-shoot from 9 meters unsuccessful, SHWIPOS-shoot from the wing position successful, SHWIPOUN-shoot from the wing position unsuccessful, SH6MSU-shoot from 6 meters successful, SH6MUN-shoot from 6 meters unsuccessful, SHCSSU-shoot from counter-strike successful, SHCSUN-shoot from counter-strike unsuccessful, SH7MSU-shoot from 7 meters successful, SH7MUN- shoot from 7 meters unsuccessful, SHPASU-shoot from the passage successful, SHPAUN-shoot from the passage unsuccessful, ASS-assistance, LB-lost balls, WB-won balls, BLB-blocked balls and 2MEX-2 minutes exclusion. Slightly lower but the expected situational efficiency achieved among winning teams that ended their attacks was by shooting from the wing position (55.29%) and the losing team (53.75%), while the lowest logical efficiency was kicking with external position (50%) and in Fallen (32.46%). Indicators of situational efficiency in the game in defense phase were within the expected and so far recorded values at major international competitions. Notable was a very poor representation of blocked shots by winners (3.77) and defeated (1.99) teams, otherwise very effective part of games in the defense, in relation to a relatively large number of shoots and average dialed shoots with external position by winners (16.40) and defeated (22.40). Applying this element in situational conditions trainers and teams should definitely pay more attention. In table 3. is shown statistically significant differences between winning and defeated handball teams among indicators of situational efficiency in the game established by Mann-whitney test. To determine the significance of differences of level of statistical inference security is set at a level of 95% security concluding with error p=0.05. From a total of 17 variables applied in this study (14 variables attacks and three variables of defense), among 8 obtained variables a statistically significant difference was shown between successful and unsuccessful teams. At the level of significance p= 0.01 were obtained differences in the six variables, as follows: Shot with 9m unsuccessfully- (SH9MUN), Assists -(ASS), shoot with a successful six meters (SH6MSU), a shot from a counter-strike successfully-(SHCSSU), blocked ball-(BLB), shot from the wing unsuccessfully-(SHWPSUN), shot from the wing successfully-(SHWPSU) and lost balls-(LB). A significant statistical difference among the victorious (8.20) and defeated (15.13) teams was obtained in the variable shot from 9m unsuccessfully-SH9MUN (Z =- 5.07 at p=0.00). It is evident that the winning teams performed much less unsuccessful shooting from a distance in

relation to the defeated teams. This means that the winning team successfully selected a shot from the distance, because the efficiency of shooting from a distance was slightly lower (about 50%)where individual quality of players and tactical team level allowed to perform other types of attack in the big finish. The results also gave a significant statistical difference between winning (15.93) and defeated (11.10) teams in the number of assists- ASS (Z =3.65 with p=0.00). This can be explained by the fact that the winning teams have better organized game in the final stages of the attack which was based mostly on group interaction, while the defeated or result-unsuccessful teams based their game more on an individual realization of the attack. The quality of the game of one team in the attack phase was reflected from the number of services which represented last pass before successfully shooting at the goal. A large number of assists in the tactical sense meant that the team that was under attack brought the simplest tactical decisions that result in achieving a goal. The winning (6.20) and defeated (4.20) teams differed significantly in variables shot from the 6M successful-SH6MSU (Z=3.35 with p=0.00). These differences simply meant that the winning teams came to the position of realization of attacks by shooting from the 6 meters with higher quality of circular attackers whose efficiency was around 70%. In terms of tactical goal of the game in the attack phase was just to achieve such cooperation between external players and pivot players that they implemented a greater number of successful attacks. A significant statistical difference among the victorious (5.43) and defeated (2.87) teams was obtained in the variable counter-strike successfully- SHCSSU with p=0.00. It was evident that the winning teams game was based on the implementation of the fast attack (counter and quick center) in unorganized defense, while the losing team forced to play longer positional attack as long as possible in order to retain the ball. The reason of a large number of goals scored on average counter-strike in favor of the winning team (5:43) in relation to the defeated teams (2.87) layed in part in their defense of higher quality, and in technical and tactical and physical conditioning preparedness. Winning (3.77) and defeated (1.97) teams statistically significantly differed in variables blocked ball-BLB(Z=2.45 with p=0.01). A larger number of successfully blocked balls by the winning teams was the result of a successful organization and execution of the game in the attack phase, whichwas being implemented on an individual or a double block. A significant statistical difference among the victorious (3.80) and defeated (2.90) teams was also obtained in the variable shot from the wing unsuccessfully-SHWPUN (Z=2:.48 with p= 0.01) and between the victorious (4.70) and defeated (3:37) teams in variables shot from the wing successfully-SHWPSU (Z=2.42 with p=0.05). It was interesting that the winning and defeated teams significantly differed in the number of unsuccessful as well as in the number of successful realization from the wing position. The winning team performed a larger number of shots from the wing position but at the same time achieved a higher number of unsuccessful realization of the defeated team. The reason for this layed in the fact that the lowest efficiency in the game which ended with shots from the line of 6 meters was the realization attack from the wing position (about 64%). At the end there was a significant statistical difference between winning (11.33) and defeated (13.83) teams in variable lost balls-LB (Z =-2.01 at p=0.05). The goal of well-organized play in the attack phase had as few turnoversas posibble and that means to make as little technical errors and bad passing that end or in the out or by cutting the ball by the opponent. Of course, that the opposing team had a number of turnovers, which was smaller number opposed to defeated teams in handball game since in the recent time the dynamics results fast and risky passes, which often end up by losing the ball. It was interesting that indicators of situational performance were not significant different between successful and unsuccessful teams in: shot from six meters successfully- SH6MSU, shoot from 9M successfully-SH9MSU, shoot from 7M successfully- SH7MSU, shoot from 7M unsuccessfully-SH7MUN, shoot from a counter-strike unsuccessfully-SHCSUN, shoot from the passage successfully-SHPASU, shoot from the passage unsuccessfully-SHPAUN, won balls-WB and 2 minutes exclusion- 2MEX. This means that in these variables the winning and defeated teams attained equal frequency of performance of technical and tactical elements during the game.

For example, there are differences in performance realization of penalty shots and passes of both teams because of ending with equal efficiency. By considering a variable 2-minutes execution, then it can be said that the winning and the defeated teams had numeric lack of players in the defense and in the attack phase, and successfully compensated the increased engagement of other players and the choice of pre-selected and trained technical variants and tactical actions in the realization of the games with the shortness of one player. Based on a review and synthesis of the results of the differences between successful and unsuccessful teams, the model best performance of the game in offense and defense can be formed, which results in a positive outcome of the match. Model game of the successful teams was based on strict selection of a shot from the external position (the minimum number of unsuccessful implementation with 9 meters), as many assists, successful realizations with 6 meters and counter-strike (more than 5 counter-strikes contribute significantly to the victory), the high efficiency of shooting from the wing positions and as many balls as blocked and small number of turnovers (lost balls). All these indicators of situational success in the game are deeply rooted in various types of technical and tactical actions in the phases of attack and defense and they are base for preparation for many years or one-year cycle of handball players of different age categories, but also in the immediate preparation of a tactical plan for each specific opponent.

Conclusion

The study was conducted on a sample of 30 handball matches, the preliminary part of the competition at the Olympic Games in London in 2012. Sample entities represented 60 opponents, out of which 30 winning and 30 defeated team. Indicators of situational effectiveness in offense and in defense were presented with 17 variables of technical and tactical actions recorded with official statistical protocol. Central and dispersion parameters as well as the results of the Kolmogorov-Smirnov test indicated that the resulting psychometric properties and variables in the victorious and the defeated team which allowed the hypotheses testing. The differences between successful and unsuccessful handball teams in the indicators of situational effectiveness in the game were analyzed using Mann withney test the difference. From a total of 17 variables (14 variables attacks and three variables defense) applied in this study, in 8 of them obtained the difference between successful and unsuccessful teams. The resulting differences in variables: shot from six meters successfully-SH6MSU, shoot from the wing successfully-SHWPSU, shoot from the wing position unsuccessfully- SHWPUN, shoot from 9m unsuccessfully- SH9MUN, powerful counter-stike successfully-SHCSSU, assists- ASS,lost balls-LB and blocked balls-BLB. It was evident that the applied system of variables relatively well explained the differences between successful and unsuccessful teams. Results of the analyzed differences showed that the winning team dominated with variables that defined the effectiveness of the game in the attack phase and this in mind the successful implementation of attack with a strict selection of the number of shoot balls with external positions with a number of assists that preceded the successful realization of the attack and with the performance of the largest possible number of successful realization of 6 meters, to counter-attack and wing positions. Teams that matches ended in a victory achieved at the same time increasing the number of blocked balls as an important element of the game in the defense and made a small number of technical mistakes (turnovers). The following research is necessary in as many matches to follow the trends of changes in certain variables, situational performance handball teams through more Olympic tournament last few Olympic cycles.

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INDIKATORI SITUACIJSKE UČINKOVITOSTI POBJEDNIČKIH I PORAŽENIH MUŠKIH RUKOMETNIH EKIPA U MEČEVIMA NA OLIMPIJSKOM TURNIRU 2012.

Sažetak

Cilj istraživanja bio je utvrditi pokazatelje situacijske učinkovitosti između uspješnih i neuspješnih muških rukometnih ekipa olimpijskog turnira 2012. Godine. Uzorak subjekata u ovoj studiji sastojao se od 30 utakmica koje su se igrale u preliminarnom dijelu natjecanja. Uzorak varijabli sastojao se od uspješno i neuspješno izvršenih elemenata tehničkih i taktičkih radnji tijekom rukometne utakmice u fazama napada i obrane (14 varijabli u fazi napada i 3 varijable u fazi obrane). Za određivanje razlika između uspješnih i neuspješnih ekipa među varijablama situacijske učinkovitosti koristio se Mann-Whitney U-test. Rezultati su pokazali statistički značajnu razliku između uspješnih i neuspješnih timovi u varijablama: šut s 9 metara-uspješno (p=0.00), šut s krilnog položaja-uspješno (p=0.02), šut s krilnog položaja-neuspješno (p=0.01), šut sa 6 metara-neuspješno (p=0.00), šut sa 7 metara-uspješno (p=0.00), asistencija (p=0.00), izgubljene lopte (p=0.04) i blokirane lopte (p=0.01). Pobjednički timovi dominiraju s varijablama koje definiraju učinkovitost igre u fazi napada, a zbog toga su napravili prednost nad protivnicima i pobjedili na utakmicama. Zbog dinamike rukometne igre i razlike u načinu igranja, više istraživanja treba učiniti u budućnosti.

Ključne riječi: tehničko-taktički elemente, rukomet, Olimpijske igre, analiza

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