Performance Indicators of the Winning and Defeated Male Handball Teams in the Matches of the 2016 Olympic Tournament

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Abstract—The aim was to find out which match performance variables had the greatest influence on the outcome of a match. Therefore, the differences between the winning and defeated male handball teams in the indicators of their match performances at the 2016 Olympic tournament in Rio were determined. The sample of entities consisted of 28 matches played by the participant teams in the preliminary round of the competition. The sample of variables was extracted from the official IHF statistics' data as frequencies of the completed and failed executions of technical and tactical elements and actions during matches in the phases of attack (14 indicators) and defence (three indicators). The differences were established by the Mann-Whitney U-test. The statistically significant differences between the winning and defeated teams were found in the following variables: missed long-range shots (p=.00), blocked shots (p=.00), assists (p=0,01), scored shots from fast breaks (p=.01), and scored long-range shots (p=.03). The winning teams' play in defence was characterized by a good shot blocking which then enabled them to quickly and easily score from fast breaks. In attack, in positional attacks, they attempted many quality assists by which the teammates in the scoring favourable positions were found. Since handball game evolves rather fast, similar research are warrant in the future as well.

Keywords—effectiveness, match performance analysis, technical-tactical elements.

I. Introduction

IN the professional sports structure at both the national and international level parameters of competition activities are the basis for comparative analyses of athletes and entire teams the eventual purposes of which is rational sports training programming and targeted sports accomplishments. Therefore, it is necessary to precisely shape profiles of situational competition effectiveness of each player. By monitoring situational efficiency, the required team efficiency values can be reached as well and these values figure as a model of each players' individual performance.

Indicators of situational effectiveness are collected in the course of the competition or by a subsequent viewing of footages and provide sports experts with a precise insight into the events on the court. Clashes of opponents in a match produce similar but never exactly the same course of game or outcome [1]. If we recognize the elements that provide good results, we can elaborate our training and competition strategies to underpin accomplishments and reduce uncertainty in the future matches. To date the most popular method of performance indicators collection is the application of notational analysis. Handball game is characterized by different typical and atypical situations in the game that can be objectively registered, analysed and used for profiling of situational behaviour of each

player during competition [2]. For example, during a game it is possible to record successful and unsuccessful outcomes of moves each player has made like the number of dialled balls into the net, number of goals scored from different playing positions, shot efficiency, turnovers, technical mistakes, penalties, goalkeeper's saves and more. Coaches and coaching staff should avoid the subjective assessment; objective information enables the coach to competently evaluate the contribution of each player in attack and/or defence in the success or failure of the team.

To create model profile of successful performance in handball it is most profitable to analyse matches of national teams at either Olympic Games, World or European Championships [3]. Since 90ies quite a number of performance research studies appeared. Unfortunately, a unified way of match performance indicators registration has not yet been defined so it is difficult to compare findings of a relatively many research studies on performance in team games. These research studies can be divided into two groups. The first group of predominantly descriptive studies focused on frequencies of various events in the game and on either completion or failure in the execution of various technical and tactical elements of handball: Vuleta et al. [1]–[8], Rogulj, et al. [9]–[11], Czerwinski [12], [13], Seco [14], Taborsky [15], Foretić et al. [16], [17], Hianik [18], and Skarbalius [19]. Another group of studies focused on identifying the contributions of different standard performance indicators to differently defined criteria of success at the World and European championships and the Olympic tournament: Srhoj et al. [20], Rogulj [9], Vuleta et al. [1], Gruić et al. [21], and Vuleta et al. [23].

These studies presented many variable, sometimes disparate, findings on relevance of particular technical-tactical elements for outcome of a match, thus confirming dynamic, elusive nature of team games that can be hardly harnessed by the existent analytical and statistical methods.

Nevertheless, we hypothesized that statistically significant differences can be established between the successful and less successful men's handball teams by analysing certain indicators of their play performances registered during matches.

II. Methods

A. Sample of Entities

The two draw matches out of 30 of the preliminary round of the 2016 Olympic Games handball tournament were not considered in the study, therefore the sample of entities consisted of 28 matches played by 12 national teams divided into two groups: group A – Croatia, Qatar, Denmark, Argentina, France, Iceland,

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Sweden, and Tunisia, and group B – Sweden, Germany, Poland, Brazil, Slovenia, and Egypt. IHF official statistics of match play performances of 56 teams was analysed out of which 28 were winners and 28 were the defeated. The number of entities with the determined number of degrees of freedom was sufficient to successfully test the hypotheses. Also, the criterion of statistical power of inference and generalization of the results was met.

B. Sample of Variables

The sample of variables consisted of frequencies of either successful or unsuccessful execution of technical-tactical elements or actions during a handball match in the phases of attack and defence. All the data were extracted from the IHF official game statistics posted on their official website www.ihf.info/.

Most of the analysed variables (14 out of 17) presented play in attack: 9MSHOTSCOR – scored long-range shots, 9MSHOTMISS – missed long-range shots, WINGSCOR – scored shots taken from either wing position, WINGMISS – missed shots taken from either wing position, 6MSHOTSCOR – scored shots from the middle of the 6m-line, 6MSHOTMISS – missed shots from the middle of the 6m-line, FBSCOR – scored shots from fast breaks, FBMISS – missed shots from fast breaks, 7MSCOR – scored penalty throws, 7MMISS – missed penalty throws, BTSCOR – scored shots after breakthroughs, BTMISS – missed shots after breakthroughs, ASS – assists, and TO – turnover, whereas three variables presented play in defence: ST – steals, BS – blocked shots, and 2MIN – 2-minute suspension.All tables and figures you insert in your document are only to help you gauge the size of your paper, for the convenience of the referees, and to make it easy for you to distribute preprints.

C. Data Processing Methods

Central and dispersion parameters of the variables were calculated: Mean – arithmetic mean, Me – median or central value, Min and Max – minimum and maximum value, and SD – standard deviation. Kolmogorov-Smirnov test (K-S) was used to determine the goodness of fit.

For the determination of differences between the winning and defeated teams in the match performance variables Mann-Whitney U-test was used and the following was calculated: Σrwinn – sum of rang values of the winning teams, Σrdef – sum of rang values of the defeated teams, U – obtained value for testing the statistically significant differences and in paper it is presented as: Z-value, p – level of significance.

Statistical level of significance was set at p=.05. Software package Statistica, ver 7.0 (Statsoft, Tulsa, OK) was used for data processing.

III. RESULTS AND DISCUSSION

Tables 1 and 2 present the basic descriptive statistics of the performance indicators of the winning and defeated teams, respectively.

TABLE 1.
BASIC DESCRIPTIVE STATISTICS OF MATCH PERFORMANCE INDICATORS OF THE WIINNING HANDBALL TEAMS

Variables	N	Mean	Median	SD
6MSHOTSCOR	28	6.75	6.00	2.47
6MSHOTMISS	28	2.93	3.00	1.56
WINGSCOR	28	4.46	5.00	2.50
WINGMISS	28	2.07	2.00	1.15
9MSHOTSCOR	28	7.57	7.50	3.23
9MSHOTMISS	28	7.61	8.00	3.96
7MSCOR	28	3.04	3.00	1.69
7MMISS	28	0.82	0.50	1.16
FBSCOR	28	5.00	4.50	2.52
FBMISS	28	1.21	1.00	1.10
BTSCOR	28	2.50	2.00	1.60
BTMISS	28	0.50	0.00	0.92
ASS	28	12.93	13.00	4.16
TO	28	10.82	10.50	3.52
ST	28	2.71	2.00	2.05
BS	28	3.11	3.00	2.22
2MIN	28	5.54	5.00	2.57

TABLE 2.
BASIC DESCRIPTIVE STATISTICS OF MATCH PERFORMANCE INDICATORS OF THE DEFEATED HANDBALL TEAMS

Variables	N	Mean	Median	SD
6MSHOTSCOR	28	6.04	6.00	2.49
6MSHOTMISS	28	3.50	4.00	1.80
WINGSCOR	28	3.68	3.00	2.14
WINGMISS	28	1.86	2.00	1.35
9MSHOTSCOR	28	6.11	5.00	2.63
9MSHOTMISS	28	11.00	11.00	4.28
7MSCOR	28	2.71	2.00	1.72
7MMISS	28	0.82	0.50	1.09
FBSCOR	28	3.43	3.00	2.56
FBMISS	28	0.82	1.00	0.82
BTSCOR	28	2.71	2.00	1.36
BTMISS	28	1.00	1.00	1.22
ASS	28	10.43	10.00	3.01
TO	28	11.79	11.00	3.10
ST	28	2.50	2.00	2.15
BS	28	1.61	1.00	1.71
2 MIN	28	4.68	5.00	1.87

Statistically significant differences (p=.05) are presented in Table 3 between the winning and defeated handball teams in the match performance indicators as established by Mann-Whitney test. From the total of 17 variables applied in this study (14 indicators of play in attack and three indicators of play in defence), in the five of them the statistically significant differences were obtained between the successful, victorious, and less successful, defeated, national teams participating in the 2016 OG handball tournament. The differentiating variables were the following: missed long-range shots (9MSHOTMISS), scored shots from fast breaks (FBSCOR), assists (ASS) and blocked shots (BS) at significance level of p=.01, whereas the difference in the variable scored long-range shots (9MSHOTSCOR) was obtained at the level of p=.05. The findings are similar to those of Srhoj et al. [19], Vuleta at al. [2], [23], but only as it regards long-range shots and shots from fast break as well as to Vuleta et al. [7] also only as regards

long-range shots, assists, and blocked shots.

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TABLE 3.
RESULTS OF MANN WHITNEY U-TEST

Variables		Mean	M$_e$	SD	Z-value	p-value
6MSHOTSCOR	WINN.	6.75	6.00	2.47	0.77	0.44
	DEF.	6.04	6.00	2.49		
6MSHOTMISS	WINN.	2.93	3.00	1.56	-1.43	0.15
	DEF.	3.50	4.00	1.80		
WINGSCOR	WINN	4.46	5.00	2.50	1.15	0.25
	DEF.	3.68	3.00	2.14		
WINGMISS	WINN.	2.07	2.00	1.15	0.57	0.57
	DEF.	1.86	2.00	1.35		
9MSHOTSCOR	WINN.	7.57	7.50	3.23	**2.20**	**0.03**
	DEF.	6.11	5.00	2.63		
9MSHOTMISS	WINN.	7.61	8.00	3.96	**-2.88**	**0.00**
	DEF.	11.00	11.00	4.28		
7MSCOR	WINN.	3.04	3.00	1.69	0.82	0.41
	DEF.	2.71	2.00	1.72		
7MMISS	WINN.	0.82	0.50	1.16	-0.02	0.99
	DEF.	0.82	0.50	1.09		
FBSCOR	WINN.	5.00	4.50	2.52	**2.50**	**0.01**
	DEF.	3.43	3.00	2.56		
FBMISS	WINN.	1.21	1.00	1.00	1.27	0.20
	DEF.	0.82	1.00	0.82		
BTSCOR	WINN.	2.50	2.00	1.60	-0.47	0.64
	DEF.	2.71	2.00	1.36		
BTMISS	WINN.	0.50	0.00	0.92	-1.68	0.09
	DEF.	1.00	1.00	1.22		
ASS	WINN.	12.93	13.00	4.16	**2.45**	**0.01**
	DEF.	10.43	10.00	3.01		
TO	WINN.	10.82	10.50	3.52	-0.97	0.33
	DEF.	11.79	11.00	3.10		
ST	WINN.	2.71	2.00	2.05	0.40	0.69
	DEF.	2.50	2.00	2.15		
BS	WINN	3.11	3.00	2.22	**2.83**	**0.00**
	DEF.	1.61	1.00	1.71		
2MIN	WINN.	5.54	5.00	2.57	1.06	0.29
	DEF.	4.68	5.00	1.87		

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Note. **6MSHOTSCOR** – completed shots from from the middle of the 6m-line. **6MSHOTMISS** – missed shots from the middle of the 6m-line. **WINGSCOR** – scored shots taken from either wing position. **WINGMISS** – missed shots taken from either wing position. **9MSHOTSCOR** – completed long-range shots. **9MSHOTMISS** – missed long-range shots. **7MSCOR** – scored penalty throw. **7MMISS** – missed penalty throw. **FBSCOR** – scored shots from fast breaks. **FBMISS** – missed shots from fast breaks. **BTSCOR** – scored shots after breakthroughs. **BTMISS** – missed shots after breakthroughs. **ASS** – assists. **TO** – turnovers. **ST** – steals. **BS** - blocked shots. and **2MIN** – 2-minute suspension.

We would like to emphasize here the statistically significant difference in the variable missed long-range shots – 9MSHOTMISS (Z=-2.88 at p=0.00) since it makes evident that the victorious teams had a considerably higher long-range shot efficiency than their defeated counterparts. This finding indicates an effective long-range shot selection in the winners who were apt enough to finish their attacks in a variety of ways, mostly based on group cooperation and quality team -work, as the difference in the variable assists (ASS: Z=2.45, p=.01) suggests.

As regards the difference in the variable scored shots from fast breaks – FBSCOR (Z=2.50 at p=.01) it indicates that the winning teams' play was based on fast attacks (fast breaks and fast throw-offs) against the yet unorganized defence, whereas their opponents applied longer positional attacks, to which they were mostly forced, and usually finished them by individual actions; the defeated teams struggled to score and/or to retain possession. A few origins of the difference in the variable scored shots from fast breaks may be named here: the winners' tougher and more effective defensive play (e.g., blocked shots, BS: Z=2.83 p=.00), and probably their higher technical-tactical proficiency underpinned by a better fitness level.

In summary, the following model of successful, i.e. winning teams' play can be outlined: winners are tactically responsible, and they tend to base their play on a strict long-range shot selection, on numerous assists and on as many as possible fast (short-lasting) attacks as well as on disciplined and focused play in defence (blocked shots).

IV. CONCLUSION

The study was conducted on a sample of 28 handball matches of the handball tournament's preliminary round of the 2016 Olympic Games in Rio with 28 winning and 28 defeated teams. Seventeen match performance indicators were extracted from the official statistical protocol. Mann Withney U test was used to establish the differences between the winning and defeated handball teams. Five indicators were shown to have high relevance for the differentiation: 9MSHOTSCOR – scored long-range shots. 9MSHOTMISS – missed long-range shots. FBSCOR – scored shots from fast breaks. ASS – assist and BS – blocked shots. Winners were superior in the variables describing play effectiveness in attack; if they did not score from fast breaks or prolonged counter-attacks, they were tactically disciplined in positional attacks and strictly selected shots from the backcourt positions to maximally reduce the number of missed long-range shots. The number of assists and a very small number of turnovers corroborate the said. Winners were also better in their play in defence (blocked shots). Given the dynamic evolution of the game of handball, further research of match performance indicators is warrant.

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