SportMont

ORIGINAL SCIENTIFIC PAPER

Impact of Time-Outs on Efficiency of Man-Up in Water Polo: An Analysis of the Differences between the Three Levels of Water Polo Players

Mladen Hraste[1], Igor Jelaska[2] and Cain C.T. Clark[3]

[1]University of Split, Faculty of Science, Split, Croatia, [2]University of Split, Faculty of Kinesiology, Split, Croatia, [3]Coventry University, Faculty Research Centre for Sport, Exercise, and Life Sciences, Coventry, UK

Abstract

In water polo, time-outs last one minute and only a team in possession of the ball can request one; although there are diverse opinions whether a time-out is advantageous for the team in possession. The aims of this study were, firstly, to identify and to explain the impact of time-out on the efficiency of man-up in water polo, and secondly, to identify and to explain the differences in the efficiency of man-up in water polo between three qualitative levels of players. The sample consisted of 132 matches of the Adriatic Water Polo League, who were observed for indicators of man-up efficiency. There was no statistically significant difference between man-up efficiency played after a time-out and man-up efficiency played without a time-out. Additionally, the Kruskal-Wallis test partially confirmed the existence of significant differences between three qualitative levels of water polo players. There is a reasonable possibility that the differences between levels are generated by the differences in tactical knowledge, motor ability, and scoring ability. Trainers can apply the results of this study for the selection of appropriate tactical solutions and the optimization of training processes among elite and sub-elite water polo players. Additionally, the study's results can be the basis for further research dealing with exploring the dynamics of water polo, observed through recent changes in the rules.

Keywords: _tactical knowledge, scoring ability, tactical solutions, training process_

Introduction

Time-outs in water polo were initially introduced around three decades ago (Hraste, Bebić, & Rudić, 2013). Until 2013, each team had the opportunity to call two time-outs during a match. However, from 2013 onward, time-out rules were modified so that each team can call a single time-out during every quarter of the match. Time-outs last one minute and only a team in possession of the ball can request it; although there are divided opinions whether a time-out is advantageous for the team in possession. Platanou (2008) observed that the percentage of the goals scored in man-up situations without time-out was significantly greater (44.7%) than the goals scored in man-up situations after time-outs (31.3%). Man-up efficiency in water polo is defined as the ability to score a goal in situations with numerical superiority (Hraste, Dizdar, & Trninić, 2008), and it is demonstrably very closely related to the shooting skill, specifically successful shooting performance in a man-up situation, which usually precipitate the execution of an open shot at goal. Given the time and skill constraints, optimal conditions for shot performance are needed (Hraste et al., 2008).

The efficiency of man-up in water polo is an important factor that influences the result of games (Takagi, Nishijima, Enomoto, & Stewart, 2005; Platanou, 2004). Some studies have reported a significant difference of man-up efficiency between different levels of competition in water polo teams (Garcia-Marin, Iturriaga, & Manuel, 2017; Tucher, Canossa, Cabral, Garrido, & De Souza Castro, 2015; Lupo, Condello, Capranica, & Tessitore, 2014). Similarly, significant differences in man-up

efficiency between different age groups and game roles of water polo players have been identified (Hraste, Jelaska, & Lozovina, 2014). Furthermore, it has been shown that the mean number of goals in man-up situations achieved in one game in elite-level water polo games was 2.9±1.7 (Platanou, 2004). Successful man-up situations are vital to the overall performance, and the progress and development of water polo players are achieved through the acquisition of new motor skills and development of certain motor abilities (Botonis, Toubekis, & Platanou, 2016). According to current rules, the penalty time for an excluded player is twenty seconds; clearly, the team on attack has more space-time manoeuvring possibilities for goal-scoring, because even after the expiration of twenty seconds, the excluded player takes time to return to a defensive position. Coaches and players generally decide on one of the three options in the man-up situation, according to the speed of realization. The first option refers to the so-called quick realization (the first six seconds of penalty time). Another possibility relates to the realization in the time interval from the 7th to 17th seconds of penalty time, which is referred to as medium-speed realization. The third possibility relates to the slow realization (from 17 to 30 seconds of the duration of the attack). Quick realization is usually employed on unprepared defences with a man-down to exploit goal-scoring opportunities; however, all three types of realization are dependent on the preference of the coach, and skill-level of the players in the man-up tactics.

Following the above considerations, the aims of this study were, firstly, to identify and to explain the impact of time-out on the efficiency of man-up in water polo, and secondly, to identify and to explain the differences in the efficiency of man-up in water polo between three qualitative levels of players. Accordingly, the following alternative hypotheses were set:

$H_{1,1}$ - a statistically significant difference between man-up efficiency played after time-outs and man-up efficiency played without time-outs exists;

$H_{1,2}$ - a statistically significant difference between the three levels of water polo players in the efficiency of man-up played after and without a time out exists.

Methods
Participants
The sample consisted of 132 games from the Adriatic Water Polo League (unofficially considered to be the highest quality league competition in the world). The Adriatic Water Polo League is a regional competition of the best Montenegrin, Croatian, and Slovenian teams. The following clubs were in this competition: Primorje, Mladost, Jug, Mornar, POSK, Jadran S, Medvešćak and Šibenik from Croatia, Budva, Jadran HN and Primorac from Montenegro and Branik from Slovenia. The consensus of seven water polo experts (of which one is the author of this article), yielded a division of teams into three qualitative levels. In a regular season, there are 22 rounds during the eight months of the competition.

Measures
The sample of variables includes twelve indicators of efficiency:
- Total realizations in man-up situation after time-out (RAT) - the total number of goals scored in the game with a numerical superiority that are preceded by a time-out;
- Quick realizations in man-up situation after time-out (QRAT) - the total number of quick realizations in the game

with a numerical superiority that are preceded by a time-out;
- Medium-speed realizations in man-up situation after time-out (MSRAT) - the total number of medium-speed realizations in the game with a numerical superiority that are preceded by a time-out;
- Slow realizations in man-up situation after time-out (SRAT) - the total number of slow realizations in the game with a numerical superiority that are preceded by a time-out;
- Extorted exclusion before time-out (EEBT) - the total number of extorted exclusions that occurred before the called time-out;
- Percentage of total realizations in man-up situation after time-out (%RAT) - the percentage of goals scored in the game with a numerical superiority that are preceded by a time-out;
- Total realizations in man-up situation without time-out (RWT) - the total number of goals scored in the game with a numerical superiority that are not preceded by a time-out;
- Quick realizations in man-up situation without time-out (QRWT) - the total number of quick realizations in the game with a numerical superiority that are not preceded by a time-out;
- Medium-speed realizations in man-up situation without time-out (MFRWT) - the total number of medium-speed realizations in the game with a numerical superiority that are not preceded by a time-out;
- Slow realizations in man-up situation without time-out (SRWT) - the total number of slow realizations in the game with a numerical superiority that are not preceded by a time-out;
- Extorted exclusion without time-out (EEWT) - the total number of extorted exclusion that occurred without a called time-out;
- Percentage of total realizations in man-up situation without a called time-out (%RWT).

Procedures
The data were collected from official records that are maintained during the playing of water polo games. Official staff registered all of the collected data. The reliability of the data was tested by the additional reviewing of 11 matches. Reviewing was made by two independent water polo experts, one of whom was the first author of this article. Each frequency of variable for each group of players was collected and compared to official records. Reliability coefficients for single data were calculated as the ratio of reviewed observed frequencies and official record frequencies.

Statistical Analysis
For the collected data, basic statistical parameters (mean, standard deviation, median, percentage, and total number of cases) were calculated. These parameters were calculated separately for each level and in total for all levels of water polo players. Differences between the realization in man-up situation after (RAT) and without time-out (RWT) for all water polo players and within groups of water polo players (high, medium, standard level) were calculated by using a Z-test for two proportions. Differences between three levels of water polo players in all 12 indicators of man-up efficiency played after and without a time out were calculated using the Kruskal-Wallis test due to the non-parametric nature of the data. When statistically significant differences were found, multiple comparisons of mean

ranks were used to determine the pairs responsible for the differences. The level of statistical significance was set to 5%. Data were processed using Statistica ver. 13.2 software (Dell Inc., Tulsa, OK, USA).

Results

Before data collection started, seven experts were asked to assess the quality of all teams; which yielded perfect alignment with official rankings at the end of the season. The group of high-level teams in this league were in the first four places of the official ranking list: Primorje, Jug, Mladost, and Jadran HN. Teams that were in fifth to eighth place (Mornar, Budva, POŠK,

and Primorac) are recognized as a group of medium level. A group of low-level teams were in the last four places: Jadran S, Medvešćak, Šibenik, and Branik. The reliability of official records was nearly perfect for all variables, ranging from 0.95 to 1.00. Table 1 shows the basic descriptive parameters of all variables (means, standard deviations, percentage and the total number of cases) for twelve indicators of man-up efficiency for all three levels of water polo players, as a total, and separately for each level (high, medium, and low level). The variable QRAT was removed from the further analysis because frequencies were 0 within all teams.

A within-group comparison of the proportions between

Table 1. Descriptive statistics of variables for 11 indicators of man-up efficiency for each group (N=88) and the overall sample of water polo players (N=264)

Variables	High level (N=88)			Medium level (N=88)			Law level (N=88)			All (N=264)		
	M±SD	%	Tot	M±SD	%	Tot	M±SD	%	Tot	M±SD	%	Tot
RAT	0.52±0.73	46	46	0.58±0.71	43,1	51	0.43±0.64	36,2	38	0.51±0.69	41,6	135
MSRAT	0.25±0.49	50	23	0.22±0.47	36	19	0.15±0.39	34,2	13	0.20±0.45	40,3	54
SRAT	0.26±0.54	50	23	0.36±0.57	64	32	0.28±0.52	65,8	25	0.30±0.54	59,7	81
EEBT	1.15±1.00	-	46	1.32±1.11	-	51	1.19±1.09	-	38	1.22±1.07	-	135
%RAT	0.46±0.44	-	-	0.48±0.42	-	-	0.37±0.42	-	-	0.44±0.43	-	-
RWT	0.62±0.76	51,7	361	0.75±0.95	42,6	300	0.76±0.91	35,2	236	0.71±0.88	43,2	895
QRWT	0.56±0.74	13,3	49	0.50±0.74	14,7	44	0.35±0.64	13,1	31	0.47±0.71	13,7	124
MSRWT	2.14±1.64	52,1	188	1.74±1.58	51	153	1.28±1.21	48,7	115	1.72±1.52	50,7	454
SRWT	1.42±1.18	34,6	125	1.17±0.95	34,3	103	1.02±0.98	38,1	90	1.20±1.05	35,5	318
EEWT	7.94±2.46	-	361	8.01.±2.72	-	300	7.57±2.40	-	236	7.84±2.53	-	895
%RWT	0.53±0.25	-	-	0.43±0.26	-	-	0.35±0.18	-	-	0.44±0.24	-	-

Legend: M±SD - means and standard deviations; % - percentage; Tot - total number of cases; RAT - total realization in man-up situation after time-out; MSRAT - medium-speed realization in man-up situation after time-out; SRAT - slow realization in man-up situation after time-out; EEBT - extorted exclusion before time-out; %RAT - percentage of total realization in man-up situation after time-out; RWT - total realization in man-up situation without time-out; QRWT - quick realization in man-up situation without time-out; MSRWT - medium-speed realization in man-up situation without time-out; SRWT - slow realization in man-up situation without time-out; EEWT - extorted exclusion without time-out; %RWT - percentage of total realization in man-up situation without time-out

realization in man-up situations after a time-out (RAT) and without time-out (RWT) for high, medium, and low groups and for the overall sample revealed no significant differences (p=0.466; p=0.947; p=0.901; p=0.726), respectively.

Table 2 presents the results of the Kruskal-Wallis test on the levels of water polo players (high, medium, and low level) in eleven indicators of man-up efficiency. The results show a statistically significant difference in the following variables:

Table 2. Kruskal-Wallis test and multiple comparisons of mean ranks of 11 indicators of efficiency for three levels of water polo players

Variables	H	p	I-II	I-III	II-III
RAT	2.07	0.36	-	-	-
MSRAT	2.47	0.29	-	-	-
SRAT	2.37	0.31	-	-	-
EEBT	1.07	0.59	-	-	-
%RAT	2.07	0.36	-	-	-
RWT	24.93	0.01	0.02	0.01	0.07
QRWT	4.33	0.11	-	-	-
MSRWT	12.34	0.01	0.25	0.01	0.26
SRWT	5.23	0.07	-	-	-
EEWT	2.31	0.32	-	-	-
%RWT	28.13	0.01	-	-	-

Legend: H - test value; p - significance level; I - high level of water polo players, II - medium level of water polo players, III - law level of water polo players

total realization in man-up situation without time-out (RWT); medium-speed realization in man-up situation without time-out (MSRWT); and percentage of total realization in man-up situation without time (%RWT).

Multiple comparisons of mean ranks for three indicators showed significant differences (p<0.05) among three pairs of observed groups.

Discussion

Analysing sports events is a pragmatic tool for better coaching and interpretation of team sports, giving coaches and scientists the ability to learn more about performances (Houghes & Franks, 2004). Water polo coaches and researchers commonly use certain game statistics for performance assessment and monitoring, such as total number of shots taken and number of goals scored, man-up efficiency, number of fast breaks, turnovers, steals, and others (Hraste et al., 2008). Focusing on the efficiency of water polo man-up and competition level, the present study showed a statistically significant difference in the three variables of man-up efficiency played without time out. Several studies have indicated that the competition level has a tangible impact in relation to man-up situations (Lupo, Tessitore, Minganti, & Capranica, 2010; Escalante et al., 2013; Escalante, Saavedra, Mansilla, & Tella, 2011).

As detailed in Table 1, it is evident that in all teams, the realization in a man-up situation (RWT) was better when it did not precede the time-out (43.2%), as compared to the realization in man-up situations after a time-out (RAT; 41.6%). Larger differences in the above-mentioned variables were recorded in a previous study (Platanou, 2008); however, it should be noted that between these two studies the water polo rules have changed in the number of permitted time-outs (two to four time-outs). The extorted exclusion before time-out (EEBT) averaged 1.22 times per match, compared to 7.84 times per match in the extorted exclusion without time-out (EEWT), which are similar to the findings of previous research (Platanou, 2004; Takagi et al., 2005). High-quality teams had significantly better realization of man-up scenarios, which were not preceded by a time-out, as compared to the realization of man-up after a time-out (RWT vs RAT). Therefore, it is plausible that the coaches of high-quality teams who called a time-out inadvertently reduced the odds of successful man-up realization, by permitting recovery and preparation of tactics by the opposing team defence. Based on these results, it is evident that some of the coaches mistakenly believe that time-out helps to achieve more successful man-up realization.

In the present study, there were no quick realizations after the time-out (QRAT) in any team, and it was, therefore, not included in the analysis of differences. It is conceivable that the time-out enabled the lower-ranked teams to prepare, so they did not concede a goal in the first six seconds of the man-down situations. After a time-out, high quality teams uniformly deploy medium-speed realization and slow realization (MSRAT and SRAT), while middle and low-quality teams prefer slow implementation. The observed differences are most likely because high-quality teams need less time for realization, while lower quality teams need more time to seek optimal conditions for realization, consistent with the findings of earlier studies (Takagi et al., 2005).

It is interesting that the structure of man-up realization without time-out according to the speed of realization for each water polo level was almost identical. For all three levels of water polo, the least represented was fast realization (QRAT; 13.7%), followed by slow realization (SRAT; 35.5 %,) and finally, medium-speed realization (MSRAT; 50.7%). Looking at the number of man-up realizations after a time-out, it is noticeable that high quality teams have a better realization compared to the remaining two team levels. Moreover, the medium quality teams performed better than the lower quality teams. Statistically significant differences were observed in three of twelve indicators of man-up efficiency. These differences are present in the total number of realizations in man-up situations without time-out (RWT), in the number of medium-speed realization in man-up situations without time-out (MFRWT), and in the percentage of total realization in man-up situations without time-out (%RAT). The importance of man-up efficiency in water polo has already been demonstrated in several studies, as well as in the present study (Takagi et al., 2005; Platanou, 2004; Lupo et al., 2014). Statistically significant differences in the number of realizations in man-up situations without time-out (RWT) between the high and low level, and between the medium and low level, water polo teams are likely attributable to the weaker performance of the players in the teams of the lower levels, and an inability to take advantage of the forced numeric advantage. Moreover, the lack of quality in medium-speed realization in the lower-ranked water polo players appears to be the greatest differentiator between high and low-ranked teams.

This research confirmed the hypothesis that there are no statistically significant differences between man-up efficiency played after a time-out and man-up efficiency played without a time-out for all water polo players within high, medium, and low-quality rankings. In this study, the range of the parameters that describe the man-up efficiency played after and without a time out of different levels of water polo players are established and explained. The hypothesis that there are significant differences between three levels of water polo players in man-up efficiency was confirmed for three of the twelve variables. Statistically significant differences were noted in the following variables; the number of realizations in a man-up situation without time-out (RWT), the number of medium-speed realization in a man-up situation without time-out (MFRWT), and the percentage of total realization in a man-up situation without time-out (%RWT).

From the above observations, it can be concluded that, on the basis of time-out man-up efficiency parameters, it is possible to differentiate three groups of water polo players, according to skill level. The differences are likely attributable to the varying degrees of tactical knowledge, motor ability, and scoring ability. The results of this study can be utilized in the selection of adequate man-up/man-less training methods to achieve the best results in situations with numerical superiority/inferiority.

References
Botonis, P.G., Toubekis, A.G., & Platanou, T.I. (2016). Physical performance during water-polo matches: the effect of the players' competitive level. *Journal of Human Kinetics, 54*, 135-142. doi: 10.1515/hukin-2016-0042

Escalante, Y., Saavedra, J.M., Mansilla, M., & Tella, V. (2011). Discriminatory power of water polo game-related statistics at the 2008 Olympic Games. *Journal of Sports Science, 29*, 291–298. https://doi.org/10.1080/02640414.2010.532230

Escalante, Y., Saavedra, J.M., Tella, V., Mansilla, M., García-Hermoso, A., & Domínguez, A.M. (2013). Differences and discriminatory power of water polo game-related statistics in men in international championships and their relationship with the phase of the competition. *Journal of Strength and Conditioning Research, 27*, 893–901. doi: 10.1519/JSC.0b013e318260ed85.

Garcia-Marin, P., Iturriaga, A., & Manuel, F. (2017). Water polo shot indicators according to the phase of the championship: medallist versus non-medallist players. *Interntional Journal of Performance Analysis in Sport, 17*, 642–655. doi: 10.1080/24748668.2017.1382215

Houghes, M., & Franks, I. (2004). *Notational Analysis of Sport: Systems for Better Coaching of Performnce in Sport*. London: Routledge.

Hraste, M., Dizdar, D., & Trninić, V. (2008). Experts Opinion about System of the Performance Evaluation Criteria Weighted per Positons in the Water Polo Game. *Collegium Antropologicum, 32*, 851–861. uri: https://hrcak.srce.hr/27053

Hraste, M., Bebić, M., & Rudić, R. (2013). Where is today's Water Polo Heading? An Analysis of the Stages of Development of the Game of Water Polo. *Nase More, 60*, 17–22. uri: https://hrcak.srce.hr/104451

Hraste, M., Jelaska, I., & Lozovina, M. (2014). An analysis of the differences between young water polo players based on indicators of efficiency. *Interntional Journal of Performance Analysis in Sport, 14*, 123–137. doi: 10.1080/24748668.2014.11868708

Lupo, C., Condello, G., Capranica, L., & Tessitore, A. (2014). Women's water polo world championships: technical and tactical aspects of winning and losing teams in close and unbalanced games. *Journal of Strength and Conditioning Research, 28*, 210–222. doi: 10.1519/JSC.0b013e3182955d90.

Lupo, C., Tessitore, A., Minganti, C., & Capranica, L. (2010). Notational Analysis of Elite and Sub-Elite Water Polo Matches. *Journal of Strength and Conditioning Research, 24*, 223–229. doi: 10.1519/JSC.0b013e3181c27d36.

Platanou, T. (2004). Analysis of the "Extra Man Offence" in Water Polo: A Comparison between Winning and Losing Teams and Players of Different Playing Position. *Journal of human movement studies, 46*, 205–212. from https://www.researchgate.net/publication/271522108

Platanou, T. (2008). The Effectiveness of Time-out for Feedback in Water Polo Game with "Extra Man." Paper presented at *the conference on Science in Swimming II* in Wroclaw, Poland. Retrieved August 20, 2019, from https://www.researchgate.net/publication/271521410

Takagi, H., Nishijima, T., Enomoto, I., & Stewart, A. (2005). Determining factors of game performance in the 2001 world water polo championships. *Journal of human movement studies, 49*, 333–352. from https://www.researchgate.net/publication/261474423

Tucher, G., Canossa, S., Cabral, R.G., Garrido, N.D., & De Souza Castro, F.A. (2015). Relationship between man-up play performance and match outcome in water polo. *Revista da Educação Física, 26*, 541–547. doi: 10.4025/reveducfis.v26i4.26914.