

The Impact of the Change of Water Polo Rules on the Game Dynamics



Novica Gardasevic^a, **Marko Joksimovic**^{b,*}

^a Elementary School Dobrislav D. Perunovic, Niksic, Montenegro

^b Football club National, Podgorica, Montenegro

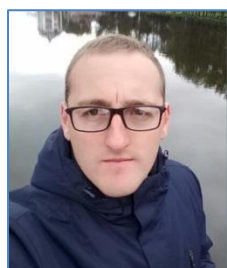
*Corresponding author email: nicifor007@outlook.com

DOI: <https://doi.org/10.34256/ijpefs2027>

Received: 18-04-2020, Accepted: 04-06-2020

Abstract: This research aimed to identify a change in the dynamics of the water polo game related to identifying differences in the number of goals scored before and after the introduction of the current 2019 rules. The sample analyzed 96 matches from the 2018 and 2020 European Water Polo Championships. The sample of variables included five variables for both subsamples, which referred to the total number of goals scored in the match, as well as the total number of goals per quarter. By applying the T-test for small independent samples, it was determined that at a statistically significant level, a higher number of goals was achieved in the third and fourth quarters, as well as the total number of goals in the 2020 European Championship in Hungary, compared to the 2018 European Championship in Spain. No statistically significant differences were found in the variables related to the total number of goals in the first and second quarters of the water polo match. The rule change, which came into force in 2019, was driven by changes in the game that directly reflected in a more dynamic game that resulted in more goals per game as well as in the final quarter of the game. These changes were undoubtedly preceded by changes in the total number of attacks, faster swimming, more frequent shots, which should definitely be determined by additional research.

Keywords: Goals, Quarters, Water polo match, Rules



Joksimović Marko completed his MSc studies at the Faculty of Physical Education and Sports, University of East Sarajevo. Currently, he is working as a sports scientist at the GSF diagnostic center in Serbia. He is working in the National football club of East Sarajevo, in the position of strength and conditioning coach. His research interests focus on Soccer, Exercise physiology, sports and rehabilitation science, biomechanics, strength and conditioning.



Gardašević Novica is a Ph.D. Scholar of the Faculty of Physical Education and Sports, University of East Sarajevo - Bosnia and Herzegovina. He also serves as a lecturer of physical education, in a primary school for the past seven years and ten years as a coach in the universal school of sports "TALENT", with children aged between 4 to 10. He is a

licensed person to perform sports and recreational activities in Montenegro.

1. Introduction

Water polo is a collective sports game that has a very long and rich tradition. The beginnings of water polo are found at water festivals, called galas, which were popular in the mid-19th century at the summer resorts of English cities [1]. In order to popularize water polo and increase the level of attractiveness to its audience, water polo rules have changed throughout history. From the first rules written in 1876 by William Wilson in Scotland to the last of their changes at the 2018 FINA [2] International Convention in China, the water polo game has changed to such a degree that contemporary water polo bears very little resemblance to its roots from the mid-19th century, or even to the game that was presented at the second modern Olympic Games in Paris in 1900. Water polo is a very stressful body-contact team sport that places

heavy emphasis on swimming, jumping, swimming speed and throwing, and requires substantial strength levels to hit, block, push and hold during game actions [3]. Elite water polo players need significant technical and tactical abilities and physical and anthropometric characteristics appropriate to the unique demands of this water-based sport [4, 5]. In addition to the fact that water polo rules are constantly changing, there is very little research that deals with a specific analysis of the impact of the rule change on water polo, both in terms of technical and tactical changes and in terms of the psychophysical workload that water polo players are exposed to with each new rule change. One of the more extensive analyzes of the effects of the rule change on the statistical parameters of a match in men's water polo was given by Madera *et al.*, [6], who analyzed 856 water polo matches, where they found a significant effect of a rule change, on statistical parameters such as; the total number of goals scored in the game, the total number of goals scored by the winning and losing teams, the time of possession and more. Lozovina & Lozovina [7] point out that changes in water polo rules do not always produce a positive effect on faster and more attractive play. The authors stated that the water polo was unattractive and uninteresting to the spectators at the time, for which the evidence was empty seats in halls during league matches. Among the few studies that deal with the rules of the game of water polo, it is undoubtedly worth mentioning those that deal with the retrospective of crucial changes through the history of the evolution of water polo games, on the basis of which it is possible to see key changes in time periods [8-9]. The latest changes to the water polo rules were determined at the extraordinary Congress of the International Water Sports Organization FINA, [10] in the Chinese city of Hangzhou in 2018. The proposed changes to the water polo game rules were supported after 161 votes in favor, 6 against and 2 abstentions. Process of changing of water polo rules lasted almost a year, series of conferences and seminars were held around the world, and some games and tournaments were played with proposed and now adopted rules [11]. The first application of the new rules was at the 2019 Euro-Cup in Zagreb [12], where, among other things, the following rules were introduced: after the cornerkick and the exclusion of a player of a defending team, there is time for another 20 seconds attack; within 6 meters of a goal foul from the back on the striker who has the ball and moves towards the opponent's goal and tries to shoot, punishes with a penalty; it is possible to score a goal with a direct shot

from a free kick outside 6 meters; a corner performer can score with a direct corner kick or by swimming from a corner and a shot; "flying changes" of players to the midfield line are possible; the team is entitled to two time outs per match; the judges are equipped with audio technology for easier communication between each other and more. These changes to the rules definitely have a certain impact on the game itself, especially in its dynamics (speed of play, number of goals scored, more attacks) due to the shortening of the time of the "second" attack, the more severe sanctioning of the offense from the back within 6 meters and the like. Accordingly, the problem of this paper is to determine the situation that should answer the question of whether the new rules of water polo, which started in 2019, affected the total number of goals scored, both by quarters and the game in general? From all the above, the aim of the research is to determine the impact of changing water polo rules on the dynamics of the game by analyzing the differences in the total number of goals scored per game and quarters, before and after the introduction of the current rules.

2. Material and Methods

2.1 Participants

The study sample includes analysis of 96 water polo games divided in two subsamples:

- 48 matches European Water Polo Championship 2018 (Barcelona - Spain) and
- 48 matches European Water Polo Championship 2020 (Budapest - Hungary).

2.2 Research Design

The sample was represented by 5 variables, which related to the total number of goals scored in the match and the total number of goals scored by quarter of the match, before and after the introduction of the current water polo rules. For research purposes, the following variables were applied:

- 1st Quarter – total goal number in the 1st quarter
- 2nd Quarter - total goal number in the 2nd quarter
- 3rd Quarter - total goal number in the 3rd quarter
- 4th Quarter - total goal number in the 4th quarter and
- Total goal – total goal number in a game.

The results for all variables applied were collected from the official website of the European Water Sports Association LEN [13]. In order to accurately retrieve the results, the two authors of this

paper independently retrieved the results and statistically processed the same. Based on the final result process, it was concluded that the both author's result match.

2.3 Statistical analysis

The results were processed by the statistical program for IBM SPSS 20.0 personal computers. In order to obtain basic information about the applied sample of variables, the following parameters were determined at the level of descriptive statistics: arithmetic mean (Mean) and standard deviation (Std.Dev.). The normality of the distribution of results was determined by the Kolmogorov-Smirnov test, while the T-test module for small independent samples was used to determine differences in game dynamics due to rule change.

3. Results

The results of descriptive statistics for all the variables used are presented in Table 1 and displayed in Figure 1. Analysis of the level of statistical significance (p), for the Kolmogorov-Smirnov test (KS), it was found that a normal distribution of results was present for all variables, which is a good basis for further analysis and application of T-test for small independent samples in order to determine differences.

Based on the value of the arithmetic mean, it was determined that at the EP2018 in Barcelona, teams averaged 17.95 goals per game, while at the EP2020 in Budapest they averaged 20.58 goals per game.

Based on the values shown in Table 1, which is also graphically presented, it is evident that in both analyzed European Championships (2018-2020), the most goals were scored in the second quarter (4.75-5.37). The smallest number of goals in the 2018 Championships was scored in the fourth quarter (4.10), while the smallest number of goals in the 2020 Championships was recorded in the first quarter. Individually, in all quarters of the European Championships in Budapest 2020, on average, more goals were scored compared to the EP2018 in Barcelona.

Table 2 presents the t-test results for small independent samples. Statistically significant differences were observed in the average scores for the variables: the total number of goals in the third and fourth quarters and the total number of goals per game at the expense of higher values at the European Championships in Budapest 2020. For the variables, the total number of goals in the first and second quarters was not determined statistically significant differences between the two championships.

Table 1 Descriptive statistics

European Championship 2018 Barcelona (Spain)					European Championship 2020 Budapest (Hungary)			
Variables	N	Mean	Std.Dev.	KS-(p)	N	Mean	Std.Dev.	KS-(p)
1 st Quarter	48	4.40	2.03	0.17	48	4.91	1.98	0.42
2 nd Quarter	48	4.75	1.87	0.56	48	5.37	1.65	0.38
3 rd Quarter	48	4.54	1.73	0.27	48	5.20	1.70	0.51
4 th Quarter	48	4.10	1.77	0.24	48	5.08	2.00	0.35
Total gol	48	17.95	4.22	0.48	48	20.58	4.69	0.66

Table 2 Differences in scored goals by quarters

Variables	N	Mean±Std.Dev	t-value	p
I Quarter 2018	48	4.4±2.03	1.26	.20
I Quarter 2020	48	4.91±1.98		
II Quarter 2018	48	4.75±1.87	1.73	.08
II Quarter 2020	48	5.37±1.65		
III Quarter 2018	48	4.54±1.73	1.90	.05
III Quarter 2020	48	5.20±1.70		
IV Quarter 2018	48	4.10±1.77	2.52	.01
IV Quarter 2020	48	5.08±2.00		
Total gol 2018	48	17.95±4.22	2.87	.00
Total gol 2020	48	20.58±4.69		

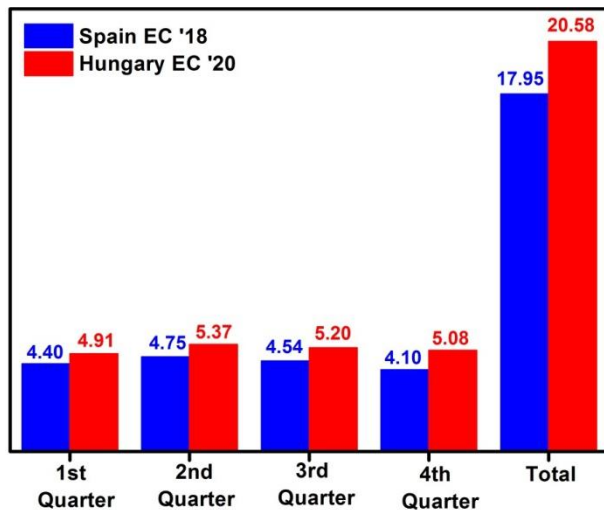


Figure 1 Average values of scored goals.

4. Discussion

The aim of the study was to determine the impact of changes in water polo rules on the dynamics of the game through the analysis of differences in the total number of goals scored per game and quarters, before and after the introduction of the current rules between the two European Water Polo Championships (2018-2020). The current water polo rules, which have been in force since 2019, have led to a statistically significantly higher number of goals at the EP2020 in the third quarter $p < .05$ and $p < .01$ in the fourth quarter. Individual differences by quarters, caused a total of more goals per game with a statistical significance of $p < .00$ on account of EP2020. The reasons for the statistically significantly higher number of goals on EP2020 compared to EP2018, refer to the changes in the rules in terms of shortening the time of the "second" attack to 20 seconds compared to the previous 30 seconds. Shortening the time after re-conquering the ball after the first attack, requires a faster reaction to organize a new attack and faster realization of the shot. Thanks to this rule, the game has become more dynamic in terms of more shots on goal and thus more goals. Trivun *et al.*, [12] determined that the teams that win matches have a more dominant total percentage of shots (42.65%), a better percentage of shots from the game (35.85%) and (62.22%) a better percentage of shots with a player more. Also, the new rule, which refers to stricter sanctioning of offenses within 6 meters from the back of the attacker who has the ball and moves towards the opponent's goal while trying to shoot, is punished with a penalty, which caused more frequent penalties, as one of the most effective used shots in general. A higher number of goals at the EP2020 compared to the

EP2018 was also contributed to by the facilitated possibility of "flying" changes to the middle of the field, which also facilitates the realization of counter-attacks and the realization of victory. A flying substitute may be made at any time while the game is being played by a player whose team owns the ball and those who are defending at that time. It certainly contributes to the formation and use of different tactics and tactical variants and thus improves water polo. There is no theoretical chance that a flying substitute would give the team a direct advantage, either in attack or defense, but well-designed and executed substitutions can directly affect certain tactical solutions and thus directly enrich the game for the player entering the game [11]

In a study by Madera *et al.*, [6] it was stated that at the Olympic Games and World Championships played according to the rules of water polo from 2005 to 2017, teams scored an average of 18.07 goals, which is approximately equal to our results of 17.95 goals at EP2018 and which is 2.41 goals less than on the number of goals scored (20.58) per game on EP2020. The same authors found that at the Olympic Games and World Championships played in the period from 1981 to 2005 when the water polo match lasted 4x7 minutes, an average of 16.57 goals were scored per game, which is only 1.38 goals less than the EP2018 despite the fact that is the total playing time according to the rules from 2005 increased by 4 minutes (4x8min.). However, it should be noted that the dimensions of the field after the rules from 2005 were increased from the previous 30x20m to the current 30x25m, which certainly affected the game does not gain significantly in terms of higher goals scored in matches, due to greater ability to move players around the field in the transition phase, as well as in situations of "stretching" the game due to "saving" the results.

The results of the study by Madera, *et al.*, [6], it was found that in the time period when water polo was played according to the rules of the game 2x10 minutes on average scored 7.72 goals per game, while in the time period when the water polo game lasted 4x5 minutes a total of 11.23 goals were scored per game. The overall analysis of the presented results shows that the current rules of water polo, which came into force in 2019, had the greatest impact on the dynamics of the game in terms of achieving more goals per game Figure 2

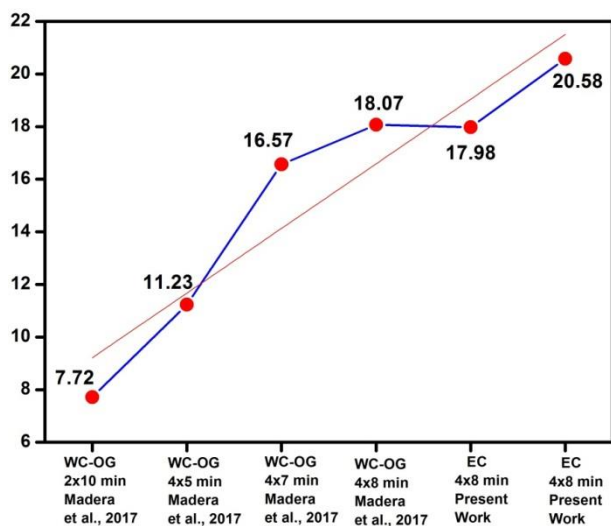


Figure 2 The dynamics of the game concerning match duration.

The expression of a more dynamic water polo game after the introduction of current rules, it is necessary to keep in mind when it comes to the physiological load of players because water polo has become more physically demanding than ever before [14]. Given the duration of the game and the flow of energy processes, water polo belongs to the category of mixed (aerobic-anaerobic) sports in which the anaerobic phase dominates [15]. Despite the popularity of water polo, there is very little research that deals with the analysis of physiological requirements in male top water polo [16], which requires excellent physical and physiological adaptation [17]. According to the research of Melchiorri *et al.*, [16] and according to the rules from 2005, the average concentration of lactate in the blood after the game was 7.7 ± 1.0 mmol/L. During the first, second, third and fourth quarters, the average values of lactate were: 7.7 ± 1.2 ; 7.8 ± 0.6 , 7.5 ± 0.9 and 7.2 ± 1.6 mmol/L. Concerning the playing position, the highest values of lactate concentration were recorded in Center Forwards 11.2 ± 1.0 with a range of (3-14.3 mmol/L), Center Defenders 6.7 ± 0.9 (1.4-8 mmol/L), and Field Players 5.3 ± 0.9 (2.2-11.9 mmol/L). Also, the results of this study showed that top water polo players swim $1,612 \pm 150$ meters during a competitive match, which should be considered a significant distance because none of the tested water polo players played continuously throughout the match. Castagna, *et al.*, [18] points out that a better picture of the degree of game coverage can be provided by a distance that swims in one minute of play, which is confirmed by the results of research by Hollander, *et al.*, [19] where players swam 54.10 ± 5.6 m / min. Each new change

of rules additionally exposes water polo players to physiological loads, so it is necessary to follow the trend of changes in the physiological parameters of players, which is noticeable in the Platano [20] study where the linear distance changed during the game the mean value was from 500 to 1000 meters and the peak value from 1500 to 1800 meters. The level of the game reached by the current rules is undoubtedly close to the limit of the physiological possibilities of water polo players and respect for sports ethics, which is necessary to specifically investigate before embarking on a new change in the rules.

5. Conclusion

According to the goal of this paper, to determine the impact of changing water polo rules on game dynamics through the analysis of differences in the total number of goals scored per game and quarters, before and after the introduction of current rules, there were statistically significant differences in three of the five analyzed variables. The new rules from 2019 conditioned a statistically higher number of goals in the third and fourth quarters, as well as in the game in general. Also, it was determined that according to the new rules, the most goals fall on average in the fourth quarter, while according to the rules before 2019, the fewest goals were scored in the fourth quarter. The current rules of the game have brought significant dynamism to water polo, with a large number of goals, so it is necessary to consider whether changes to the rules are needed in the coming period and in which direction they would go. The impact of changing the rules of the game in water polo is necessary to analyze more often scientifically, including monitoring as many parameters as possible. By following different segments due to the change of rules, one can avoid the potential lousy impact of the evolution of rules on the technical and tactical beauty of water polo and the health status of water polo players.

References

- [1] P. Snyder, (2008) Waterpolo for players & teachers of aquatics: California-Fullerton: Fullerton College.
- [2] FINA. Book (2005-2009), (2008) Lausanne, Switzerland: Federation Internationale de Natation Amater.
- [3] H.K. Smith, Applied physiology of water polo, Sports Medicine, 26 (1998) 317-334.
<https://doi.org/10.2165/00007256-199826050-00003>

- [4] F.H. Tan, T. Polglaze, B. Dawson, G. Cox, Anthropometric and fitness characteristics of elite Australian female water polo players, *Journal of Strength and Conditioning Research*, 23 (2009) 1530–1536. <https://doi.org/10.1519/jsc.0b013e3181a39261>
- [5] P.E. Alcaraz, J.A. Abalades, C. Ferragut, N. Rodriguez, F.M. Argudo, H. Vila, Throwing velocities, anthropometric characteristics, and efficacy indices of women's European water polo subchampions, *Journal of Strength and Conditioning Research*, 25 (2011) 3051–3058. <https://doi.org/10.1519/JSC.0b013e318212e20f>
- [6] J. Madera, V. Tella, J.M. Saavedra, Effects of Rule Changes on Game-Related Statistics in Men's Water Polo Matches, *Sports*, 5 (2017) 84. <https://doi.org/10.3390/sports5040084>
- [7] M. Lozovina, V. Lozovina, Attractiveness lost in the water polo rules, *Sport Science*, 2 (2009) 85–89.
- [8] J. Donev, M. Aleksandrović, History of rule changes in water polo, *Sport Science*, 1 (2008) 16–22.
- [9] M. Hraste, M. Bebic, R. Rudic, Where is today's Water Polo Heading? An Analysis of the Stages of Development of the Game of Water Polo, *Our Sea, Scientific-Professional Journal for Sea and Marine*, 60 (2013) 17–22.
- [10] FINA Water Polo Rules 2019 – 2021, (2019) Amendments, Additions, Interpretations and Explanations: Effective as of 10 February.
- [11] M. Lozovina, V. Lozovina, Proposal for changing the rules of water polo, *Sport Science*, 12 (Suppl. 1) (2019) 14–26.
- [12] M. Trivun, N. Gardašević, B. Janjić, Situation efficiency indicators relations depending on the outcome of water polo matches, *Sport and Health*, 14(1) (2019) 47–53. <https://doi.org/10.7251/SIZEN0119047T>
- [13] LEN (<http://www2.len.eu/>, accessed on 15 February 2020.)
- [14] D. Radovanović, T. Okičić, A. Ignjatović, Physiological Profile of Elite Woman Water Polo Players, *Acta Medica Mediane*, 46 (2007) 48–51.
- [15] V. Lozovina, L. Pavičić, (2002) Analysis of indicators of load during the game in activity of the heavy defender in water polo. In Milanović, D. & Prot, F. (eds.) *Proceedings Book – 4th International scientific conference Kinesiology New Perspectives*, pp 357–360, Zagreb: Fakultet za fizičku kulturu.
- [16] G. Melchiori, C. Castagna, R. Sorge, M. Bonifazi, Game Activity and Blood Lactate in Men's Elite Water-Polo Players, *Journal of Strength and Conditioning Research*, 24 (2010) 2647–2651. <https://doi.org/10.1519/JSC.0b013e3181e3486b>
- [17] D. Radovanović, M. Aleksandrović, G. Ranković, The Effects of Water Polo Training on Aerobic Power and Pulmonary Function in 11 and 12 years Old Boys, *Acta Facultatis Medicae Naissensis*, 21 (2004) 137–141
- [18] C. Castagna, S. D'Ottavio, J. Granda-Vera, J.C. Barbero A'lvare, Match demands of professional futsal: A case study, *Journal of Science and Medicine in Sport*, 12 (2009) 490–494. <https://doi.org/10.1016/j.jsams.2008.02.001>
- [19] A.P. Hollander, S.H.J. Dupont, S.M. Volkerijk, eds. *Physiological strain during competitive water polo games and training*. In: *Medicine and Science in Aquatic Sports* (Vol. 39). M.Y. Miyashita, and A.B. Richardson, eds. Basel, Switzerland: Karger Publishers, 1994. pp. 178–185. <https://doi.org/10.1159/000423725>
- [20] T. Platanou, Cardiovascular and metabolic requirements of water polo, *Serbian Journal of Sports Sciences*, 3(3) (2009) 85–97.

Acknowledgement

This work was supported by the Charles University, Progress, No. Q41 Biological aspects of the investigation of human movement.

Conflict of interest

None of the authors have any conflicts of interest to declare.

About The License

© The author(s) 2020. The text of this article is open access and licensed under a Creative Commons Attribution 4.0 International License.