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Original Article

Effect of rules changes on water polo shooting performance according to the final classification: high, medium, and worst level

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Abstract
Introduction: The aim of this study compare the influence of rules changes on shots performance considering three different levels, in the final classification, between two male European championships with different rules. **Material and Methods**: All shots made by the first, second, sixth, seventh, eleventh and twelfth classified in 27th European Championship in 2006 (Belgrade, Serbia) and all shots made by the first, second, eighth, ninth, fifteenth and sixteenth classified in 34th European Championship in 2020 (Budapest, Hungary) were analysed. **Results**: The total sample was composed of 3,467 shots (1,813 in Belgrade Championship and 1,654 in Budapest). The study was developed with an observational design. Three observers with more than 300h of experience in observational studies of water polo consensually quantified all the actions. **Discussion**: The effectiveness of the shots, considering only those that have taken place in equality and counterattack, shows greater scoring efficiency by the HL teams against the WL; and specifically among the shots made with a balanced period score (+-1) (F = 3.637; p = .032; S.E. = .107) and unbalanced (+-2) (F = 3.835; p = .027; S.E. = .106) stand out. In inequality situations its noted the existence of lower efficiency for WL teams when shot from the center stands out against the HL. **Conclusions**: It is concluded that the regulatory changes have reduced the importance, in the performance of the teams, of effectiveness in situations of inequality, giving rise to a more dynamic game, balanced according to the skill of the players and not their body size, but above all less static.
Keywords: team sport, ranking, situational frameworks, rule modification

Introduction

Water polo, as many other team sports, is of English origin, appearing from the second half of the 19th century (Majoni, 1954). As in many other sports, throughout its 150 years of history, almost all aspects of the game have changed, due to the evolution of society itself, sports, materials, facilities or the search for a greater showiness that attracts more practitioners and spectators and, therefore, greater income from sponsorship for teams and athletes.

A review of the scientific literature regarding normative changes, in relation to the evolution in other sports, returns that this has not been a very developed topic, and only some studies in boxing with the intention of reducing the blows of the fighters are appreciated (Davis et al., 2018). On the other hand, performs a rule simulation from one competition to another with the intention of predicting the effect that regulatory changes would have on the development of the game in netball (Hammond et al., 1999; O´Donoghue, 2012). In addition, among others, Calmet et al. (2017) compared the technical actions in judo with the normative changes and the penalty of negative actions, finding no differences between championships in most of the actions considered according to the category and phase. Furthermore, in this sport, Samuel et al. (2019) found that the perception of athletes and coaches regarding changes is negative. Similarly, another justification for imposing regulatory changes in rugby is the safety of athletes and continuity in the game, so they have analysed the regulatory changes of recent years (Eaves, Lamb & Hughes, 2008). It was found that the introduction of the 10-m offside rule (1993) appears to have resulted in a significant change at the ruck; increasing the speed of the 'play the ball, although not without which would address criticism from the players, spectators and the media (Williams et al., 2005).

As for another of the modifications implemented in water polo, such as the reduction of the playing field, they have also been seen in beach volleyball, where the scoring system was also modified, eliminating the need to have the service. Comparative analyses showed a reduction in serve efficiency and attack efficiency after the change of regulations, as well as a significant increase in block actions and block efficiency. In the same way,

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the self-sacrifice of an incoming foul increases the speed and continuity of play in both water polo and field hockey (Tromp & Holmes, 2011). Also showing a significant difference with most penetrations occurring by dribbling (33% in 2008, 57% in 2009).

In relation to the studies that have analysed this sport, there is difficulty in its analysis, since the theory of complexity (Robertson et al., 2016), in which all actions depend on time and are not linear, performance has traditionally been measured, from a discreet scientific perspective, taking into account various observable variables such as completed passes, throws, effectiveness, etc. This is done by identifying anthropometric characteristics of players (Tsekouras et al. 2005; Kavouras et al., 2006; Steel et al, 2007), physiological (Platanou& Geladas, 2006; Borges-Hernández et al, 2017), psychological (Lupo et al., 2014) and biomechanical (Elliot, 1988; Feltner& Nelson, 1996; Feltner& Taylor, 1997). Also technical/tactical aspects (Lloret, 1998; Argudo, 2000; Platanou, 2004; García-Marín, 2009;Lupo et al., 2009), tactical roles (Lupo, Minganti, et al., 2012), a competition level (Lupo et al., 2010), match outcomes (Argudo et al., 2007, 2009; Lupo et al., 2011) and margin of victory (Lupo et al., 2012, 2014; Gómez et al., 2014) profiles of success in the sport.

In this line, the analysis of regulatory changes carried out in recent years by Argudo et al. (2016), Donev and Aleksandrović (2008) and Madera et al. (2017). Although these have remained a mere description of existing regulations or very superficial analysis of the game, they are not interested in knowing how these changes have affected the development of the game, its actions and transfers to training (Ávila-Moreno et al., 2018). Highlighting the results of Lozovina and Lozovina (2019b), who find no difference in their influence on the outcome of the game in terms of the number of possessions and estimate that only a third of the fouls are useful. Based on previous studies Hraste et al. (2013) and Lozovina and Lozovina (2019a) propose to regain the 4-meter line for penalty shots and introduce a "Bonus" when receiving more than 7 faults per period. They also allow two-handed shots to be blocked, and add that the midfield must be passed within 20 seconds, with a penalty if the ball returns to the goalkeeper.

Purpose of Research

Beginning with the precedents, is necessary to emphasize the importance of this study whose aim was to compare the influence of rules changes between two male European championships with different rules, and shots performance considering three different levels, in the final classification in those championship.

Methodology

This was an observational study (Anguera, 2003) that analysed all shots made in 32 matches played by the first, second, sixth, seventh, eleventh and twelfth classified in 27th European Championship in 2006 (Belgrade, Serbia) and all shots made in 28 matches played by the first, second, eighth, ninth, fifteenth and sixteenth classified in 34th European Championship in 2020 (Budapest, Hungary).

Match analysis and participants

The total sample comprised 1,813 shots (2006), and 1,654 (2020). As it is public, event and its participants are of legal age, as well as having been authorized by the different committees and agencies, did not proceed to request the approval of the ethical committee.

Procedures

With the intention of analysing the performance of the best and worst ranked teams, was selected the shots made by the two best and the last teams. Adding an intermediate level in which they have selected those classified in 6-7 place in the Belgrade Championship in 2006 and the teams that occupy the position 8-9 in the Budapest Championship in 2020, given the existence of differences between the participating teams in such tournaments.

The analysed images were obtained with a video camera (JVC, GZ-MG50E, JAPAN) and from recordings rebroadcast by Spanish Radio Television. Both resources made it possible to combine horizontal plane images obtained with the video camera with those of the frontal plane provided by the television operator. In the entire ball possessions examined, the shooter and the goalkeeper could be clearly seen.

Using the software LINCE (Gabín et al., 2012) was performed the match analysis with the field format designed (Table 1).

Table 1. Field format.

VARIABLES
INDEPENDENTS
(1) Championship: Belgrade 2006 and Budapest 2020
(2) Championship phase: Preliminary and final
(3) Situational framework (Argudo, 2000):
1 Equality: Both teams have the same number of players, and they play on one of the two sides of the field
2 Counterattack: Numerical advantage of the attacking team originated by a change in ball possession and swimming to the other field
3 Inequality: Numerical advantage of the attacking team originated by one or more defenders being temporarily removed for a serious foul
4 Penalty: Shot from 5 m against the goalie due to a serious foul by a defender
(4) Periods: 1º, 2º, 3º and 4º
(5) Classification:
1 HL: Two first place finishers in each championship

2 ML: Ranked sixth and seventh in 2006; and, ranked eighth and ninth in 2020
3 WL: The last two finishers in each championship

DEPENDENTS
(6) Frequency of shots
(7) Goals
(8) Shot position: Field zone from which the shot comes (Figure 1)
(9) Feint: Presence or absence of feints in the shot
(10) Technique:
1 Drive shot: The ball follows a trajectory parallel to the water
2 Drive shot with rebound: The ball follows a descending trajectory and then ascends after bouncing off the water
3 Lob shot: The ball follows a parabolic trajectory, first ascending and then descending
4 Reverse shot: The player with their back to the goal performs a turn in place and releases the ball at the same time
5 Others: Gestural forms distinct from those previously described and that appear with lower frequency in the game
(11) Free shot: Shot from behind the 4 (Belgrade 2006) or 5 m line (Budapest 2020) as a consequence of an ordinary foul by a defender
(12) Direction: Determined by taking as reference the shooter's position, the goal zones, and, when the shot produces from the central zones of the field, the executing arm (left or right): short post, center and long post (Figure 1)
(13) Partial score:
1 Draw or one goal difference
2 Two or more goal difference

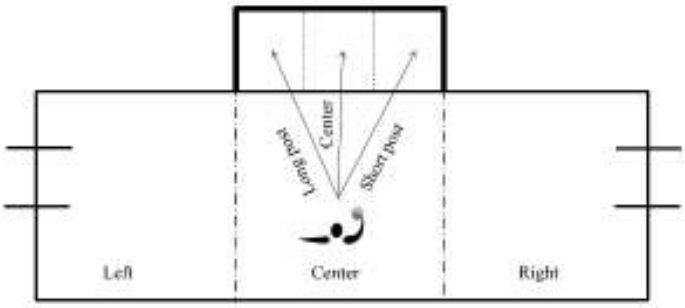

Figure 1. *Shot positions, goal zones and shot directions.*

Subsequently, three observers with more than 300h of experience in observational studies of water polo consensually quantified the actions. The reliability of the observers was verified using the kappa agreement index, ensuring than in all cases this value was greater than .95.

Data analyses

First, the averages and standard deviations of the efficiency percentages were calculated for each level of the championship classification (HL, ML and WL) according to the situational framework phase of the championship and period of play. Then, for each situational framework, the averages and standard deviations of the frequencies of shots and goals were calculated, as well as the efficiency percentages of the dependent variables (shot position, feint, technique, foul, direction and partial score).

Through the analysis of the ANOVA variance, the averages between the different classification levels and between both European Championships were compared. Previously, the assumptions of normality were confirmed with the Kolmogorov-Smirnov. Effect sizes (EZ) were calculated using the square eta ($\eta 2$) statistic and their interpretation was based on the following criterion: .01 small effect, .06 medium effect, .14 high effect (Cohen, 1988). Analyses were undertaken using the IBM SPSS Statistics 20 software program. A confidence level of 95% was established ($p<.05$).

Results

The Table 2 shows the percentages of effectiveness (mean and standard deviation, statistical significance and effect size) between the different situational frameworks, time of the tournament and period of the match, depending on the position of the teams in the championship. The observation of greater effectiveness for HL teams in their shots in equality than ML teams ($p = .023$) and those ending in WL ($p < .001$) stands out. Similarly, HL teams are also observed to be more effective when shooting counterattacks than WL teams ($p = .030$). A lower efficiency of WL teams is found when they shot in inequality compared to HL ($p = .030$) and ML ($p = .030$) teams. If we look at the championship phase, we can see that HL teams are more efficient in the previous phase than ML teams ($p = .001$) and WL teams ($p < .001$). At the same time, ML teams are more effective in the preliminary phase than WL teams ($p = .030$). Finally, and attending to the period in which the

shots take place, it is appreciated more effectiveness in the HL teams in the second period than the ML teams (p = .020) and the WL (p < .001). Similarly, there is more efficiency in HL in the third period than the ML group (p = .010) and WL (p < .001), as well as in the fourth period there is more efficiency in HL teams than WL (p = .003).

Regarding the differences found when comparing the effectiveness between championships, it can be seen that in 2020 the effectiveness in inequality was lower than in 2006 (F = 8,422; p = .005; S.E. = .115), especially for WL teams (F = 4,034; p = .049; S.E. = .058). In turn, it was found that overall in 2020 there was a lower efficiency in period 1 than in 2006 (F = 10,439; p = .002; S.E. = .138), specifically finding a lower efficiency in period 1 for WL compared to the efficiency found in 2006 (F = 13,541; p < .001; S.E. = .172).

Table 2. Percentage of efficiency according to the classification in the championship.

		HL	ML	WL	Total
Equality	2006	35.4±12.6	28.0±7.5	18.7±6.4	27.4±11.2
	2020	33.8±16.0	24.2±10.1	19.7±12.4	26.1±13.7
	Total	34.7±14.0	26.1±9.0*	19.1±9.2*	26.8±12.4
Counterattack	2006	57.7±18.2	33.6±24.0	36.8±37.0	42.2±28.7
	2020	46.5±31.6	36.1±33.1	21.1±22.2	35.5±30.8
	Total	52.3±25.6	34.9±28.4	30.1±31.8*	39.0±29.7
Inequality	2006	66.7±9.1	59.9±23.6	45.3±25.8	57.5±22.3
	2020	52.9±19.0	48.3±24.2	26.6±19.2^	43.9±23.3^
	Total	60.1±16.0	54.3±24.2	37.3±24.6*ǂ	51.2±23.6
Penalty	2006	62.5±44.3	90.0±22.4	16.7±28.9	62.5±42.8
	2020	78.2±32.4	66.7±51.6	55.6±50.2	68.9±42.2
	Total	71.2±37.8	77.3±41.0	42.6±46.5	66.2±42.0
Preliminaryphase	2006	50.1±10.1	39.3±12.2	27.9±9.1	39.5±13.7
	2020	56.1±11.3	30.9±11.2	21.7±12.0	35.0±18.1
	Total	52.1±10.5	36.2±12.2*	25.4±10.4*ǂ	37.8±15.4
Final phase	2006	50.7±5.0	35.7±8.7	30.9±9.0	37.4±10.6
	2020	37.2±6.4	37.3±8.9	28.3±16.9	35.6±9.8
	Total	40.6±8.5	36.7±8.4	29.6±12.2	36.2±9.9
Period 1	2006	58.0±17.8	37.7±19.3	37.8±15.2	44.1±19.6
	2020	31.1±19.2^	35.3±15.9	26.4±16.7	31.5±17.1^
	Total	45.1±22.7	36.6±17.5	32.9±16.5	38.3±19.4
Period 2	2006	46.6±14.1	36.5±22.5	18.9±16.6	34.1±21.2
	2020	48.0±14.5	32.6±18.5	25.9±15.3	35.9±18.3
	Total	47.3±14.0	34.6±20.4*	21.9±16.1*	34.9±19.8
Period 3	2006	51.5±23.7	38.9±18.6	29.6±17.7	40.0±21.5
	2020	49.3±21.0	27.9±20.7	17.3±13.1	32.0±22.6
	Total	50.4±22.0	33.4±20.1*	24.3±16.8*	36.2±22.2
Period 4	2006	49.1±10.2	41.9±19.1	28.2±22.9	39.8±19.7
	2020	49.2±22.3	39.0±24.9	27.8±23.1	39.4±24.4
	Total	49.2±16.7	40.5±21.8	28.0±22.4*	39.6±21.9

HL: High Level; ML: Medium level; WL: Worst level. * Differences with HL; ǂ Differences with ML; ^ Differences between 2006 and 2020 Championships (*p*< .05).

When analysing the effectiveness of the shots, considering only those that have taken place in equality, Table 3 shows the percentages of effectiveness. The appearance of greater scoring efficiency by the HL teams against the WLs (F = 5.092; p = .007; S.E. = .134) and specifically among the shots made with a balanced period score (+-1) (F = 3.637; p = .032; S.E. = .107) and unbalanced (+-2) (F = 3.835; p = .027; S.E. = .106) stand out. In addition, there is a greater efficiency for HL teams in their shots from the left position compared to ML teams (p = .007) and WL (p = .003).

There is also greater efficiency for HL teams when shooting without a feint, compared to ML (p = .012) and WL (p < .001). If we look at the types of shots, we see more efficiency by the HL teams when shooting tense than the WL teams (p = .005), and when these same HL teams shot with rebound, when compared to the ML (p = .050) and WL (p = .029). Finally, HL teams are more effective when the shot is not taken after a foul, compared to WL teams (p < .001), and when the shot is directed to the short post of the ML teams against the WL (p = .001) and WL (p < .001).

With respect to the differences found in the comparisons between championships, in equality, it can be seen that the WL teams achieved more efficiency in 2020 in the left shooting position (F = 4.178; p = .045; S.E. = .060). HL teams were more efficient in the 2020 championship when they shot to the center of the goalpost (F = 10.471; p = .002; S.E. = .139). HL teams were less effective in 2020 in shots that were performed with an adjusted partial score (+-1) (F = 4,567; p = .037; S.E. = .070).

Table 3. Frequency of shots, goals, and percentage of efficiency on equality according to the classification in the championship.

			HL	ML	WL	Total
	Frecuency	2006	13.9±4.6	17.4±5.1	15.7±3.3	15.8±4.5
		2020	16.6±5.5	15.3±4.3	15.7±4.5	15.8±4.7
		Total	15.2±5.1	16.4±4.8	15.7±3.7	15.8±4.6
	Goals	2006	4.9±2.2	4.8±1.6	2.9±1.0	4.2±1.9
		2020	5.5±2.8	3.7±1.8	3.4±3.2	4.2±2.7
		Total	5.2±2.5	4.3±1.8	3.1±2.1*	4.2±2.3
Shot position	Left	2006	43.5±29.3	29.0±23.0	5.8±10.6	26.2±26.6
		2020	43.2±37.6	10.1±14.1	28.7±31.2^	26.2±31.1
		Total	43.4±32.7	19.9±21.1*	15.6±24.2*	26.2±28.6
	Center	2006	33.7±18.2	33.4±12.5	23.4±7.5	30.2±13.8
		2020	29.8±15.8	29.8±18.2	22.0±20.5	27.7±17.9
		Total	31.8±16.8	31.7±15.3	22.8±13.9	29.0±15.7
	Right	2006	32.5±30.3	19.8±25.8	18.2±18.4	23.1±25.3
		2020	38.1±27.5	26.1±24.0	15.4±32.8	27.2±28.4
		Total	35.2±28.5	22.7±24.7	17.1±24.6	25.0±26.7
Feint	WithFeint	2006	42.7±47.8	29.1±24.6	16.0±24.9	28.6±34.0
		2020	33.1±30.3	28.1±27.5	29.2±21.4	29.9±26.0
		Total	38.4±40.1	28.6±25.5	21.0±24.0	29.2±30.6
	WithoutFeint	2006	35.8±10.5	27.3±12.2	18.7±6.5	27.1±12.0
		2020	36.5±19.3	24.1±11.6	18.0±12.6	26.6±16.3
		Total	36.1±15.0	25.8±11.8*	18.4±9.2*	26.8±14.0
Technique	Drive shot	2006	27.6±12.7	27.3±11.2	16.4±9.8	23.7±12.1
		2020	28.9±18.8	20.6±10.7	15.4±11.2	21.9±14.6
		Total	28.2±15.5	24.1±11.3	16.0±10.1*	22.9±13.3
	Drive shotwithrebound	2006	64.3±32.4	29.3±31.2	33.6±37.1	41.3±36.0
		2020	49.2±29.7	41.7±22.9	26.7±27.8	41.0±27.0
		Total	56.7±31.3	35.2±27.7*	31.0±33.1*	41.1±31.9
	Lob shot	2006	55.6±50.2	41.7±49.2	14.3±37.8	36.0±46.6
		2020	33.3±577	25.0±50.0	18.8±37.2	23.3±41.7
		Total	48.1±50.3	35.0±47.4	16.7±36.2	30.4±44.3
	Reverse shot	2006	50.0±50.0	18.8±37.2	26.2±38.3	29.2±40.8
		2020	10.0±22.4	33.3±57.7	25.0±50.0	20.8±39.6
		Total	30.0±42.2	22.7±41.0	25.8±40.4	26.0±39.9
	Others	2006	21.4±39.3	27.8±44.1	10.2±22.7	19.7±35.6
		2020	50.0±50.0	25.0±38.2	50.0±43.0	39.1±42.2
		Total	33.3±44.4	26.6±40.3	22.4±34.3	27.2±39.0
Foul	Afterfoul	2006	47.6±30.9	25.0±33.3	34.5±28.2	35.8±31.6
		2020	36.1±24.3	14.3±37.8	16.2±20.2	22.8±28.2
		Total	42.2±27.8	20.6±34.5	24.2±25.0	29.6±30.4
	Withoutfoul	2006	32.9±14.2	27.7±7.7	17.2±7.0	25.8±11.7
		2020	32.2±16.3	25.4±10.7	20.2±14.3	26.2±14.1
		Total	32.5±14.9	26.6±9.2	18.4±10.4*	25.9±12.7
Direction	Short post	2006	50.8±20.5	32.0±11.9	24.4±19.5	35.5±20.2
		2020	46.6±30.4	24.7±15.5	22.0±13.5	31.3±23.4
		Total	48.8±25.2	28.5±14.0*	23.4±16.9*	33.6±21.7
	Center	2006	4.9±11.5	20.1±17.7	15.6±18.4	13.9±17.1
		2020	31.1±31.2^	7.2±19.6	5.6±11.8	15.0±25.0
		Total	17.4±26.2	14.2±19.3	11.5±16.5	14.4±20.9
	Long post	2006	37.3±21.5	24.1±17.3	17.7±13.3	26.1±18.9
		2020	28.7±23.5	31.4±20.6	21.5±19.5	27.8±21.1
		Total	33.2±22.4	27.6±19.0	19.3±15.8	26.9±19.8
Partial score	Draw or one goal difference	2006	58.2±27.4	33.6±21.4	28.3±28.8	37.8±27.8
		2020	34.7±24.9^	32.0±25.6	22.8±8.9	30.9±22.5
		Total	45.3±28.0	32.8±23.1	26.4±23.6*	34.6±25.5
	Two or more goal difference	2006	32.7±14.9	28.4±26.6	17.5±10.3	26.1±19.5
		2020	34.3±19.3	18.8±13.6	19.3±19.9	23.8±18.3
		Total	33.4±16.6	23.8±21.5	18.2±14.6*	25.1±18.9

HL: High Level; ML: Medium level; WL: Worst level. * Differences with HL; ǂ Differences with ML; ^ Differences between 2006 and 2020 Championships ($p < .05$).

When analysing the effectiveness of the shots produced in a counterattack, Table 4 shows the percentages of effectiveness. The observation of a greater number of counterattacking shots by the HL teams than the ML (p = .043) and WL (p = .007), (F = 5.542; S.E. = .150) stands out, appreciating a greater number of goals in counterattack by HL than ML (p = .017) and WL (p = .008), (F = 5.991; S.E. = .160). Specifically, there is greater efficiency for HL teams in their midfield shots than ML teams (p = .006), as well as more efficiency in the shots directed to large post of HL teams versus WL teams (p = .007).

With regard to the differences found between the two championships, in counterattack, it can be seen globally that in 2020 less efficiency was achieved in shots without feint than in 2006 (F = 3,992; p = .05; S.E. = .06). As well as a lower efficiency in drive shots in 2020 compared to those of the 2006 Championship (F = 5,249; p = .026; S.E. = .089). Similarly, in 2020, the WL teams developed lower efficiency in the drive shots than in 2006 (F = 6,166; p = .016; S.E. = .100), appreciating less efficiency in the HL teams when the partial score was balanced (+-1) (F = 5,210; p = .028; S.E. = .100).

Table 4. Frequency of shots, goals, and percentage of efficiency on counterattack according to the classification in the championship.

			HL	ML	WL	Total
	Frecuency	2006	7.2±3.1	5.4±3.2	3.7±2.9	5.5±3.3
		2020	7.2±4.9	3.8±2.8	3.7±4.4	4.8±4.2
		Total	7.2±3.9	4.6±3.1*	3.7±3.6*	5.2±3.7
	Goals	2006	4.1±2.2	2.0±2.0	1.7±1.9	2.6±2.3
		2020	3.7±3.9	1.8±1.8	1.3±2.5	2.3±2.9
		Total	3.9±3.0	1.9±1.9*	1.6±2.2*	2.4±2.6
Shot position	Left	2006	34.7±31.3	42.2±43.8	40.6±49.9	38.7±39.6
		2020	39.7±33.6	36.7±39.5	5.7±15.1	28.9±33.8
		Total	37.0±31.7	39.8±40.7	24.3±40.8	34.3±37.1
	Center	2006	81.3±32.9	22.8±24.4	41.5±34.8	46.3±38.6
		2020	48.5±46.5	37.5±45.2	31.3±37.2	39.1±41.9
		Total	66.7±41.8	28.4±33.5*	36.7±35.2	43.2±39.8
	Right	2006	50.0±32.5	36.4±50.5	66.7±57.7	46.0±43.4
		2020	52.4±36.6	53.7±39.8	83.3±23.6	56.5±36.7
		Total	50.9±33.1	44.2±45.7	73.3±43.5	50.4±40.6
Feint	WithFeint	2006	54.2±50.2	50.0±53.5	40.0±54.8	49.2±50.1
		2020	86.3±20.7	61.1±37.5	50.0±70.7	72.3±35.0
		Total	70.2±40.6	54.8±46.0	42.9±53.5	59.2±45.2
	WithoutFeint	2006	61.8±20.6	33.1±23.0	43.0±40.5	45.4±30.4
		2020	38.6±39.4	34.5±31.3	20.9±21.1	32.0±31.6^
		Total	51.2±32.0	33.8±26.8	33.1±34.3	39.1±31.5
Technique	Drive shot	2006	51.5±31.5	42.3±38.9	51.9±35.8	48.1±34.8
		2020	41.8±34.9	34.3±34.0	7.4±18.1^	31.0±33.3^
		Total	47.1±32.6	38.8±36.2	34.1±36.8	40.7±34.9
	Drive shotwithrebound	2006	68.9±41.2	39.7±42.2	54.2±50.2	53.4±44.4
		2020	48.3±45.8	54.2±42.5	25.0±31.9	45.6±40.6
		Total	62.5±42.3	45.2±41.9	44.4±45.7	50.7±42.9
	Lob shot	2006	60.0±54.8	0.0±0.0	50.0±0.0	35.0±47.4
		2020	66.7±47.1	33.3±57.7	50.0±70.7	51.9±50.3
		Total	63.0±48.4	14.3±37.8	50.0±50.0	43.0±48.2
Direction	Short post	2006	60.6±31.0	43.5±41.3	54.6±43.9	52.4±38.1
		2020	48.5±41.4	37.5±42.9	31.3±37.0	39.3±39.7
		Total	55.5±35.2	40.8±41.1	43.7±41.2	6.6±39.1
	Center	2006	37.9±34.2	29.6±34.1	55.6±46.7	39.1±37.1
		2020	34.4±43.9	20.0±27.4	20.0±44.7	26.8±39.0
		Total	36.3±37.8	26.2±31.2	39.4±47.3	33.9±38.0
	Long post	2006	61.9±31.6	34.3±41.7	12.5±23.1	38.5±38.5
		2020	58.2±21.0	43.5±41.2	32.0±46.0	45.6±36.8
		Total	60.5±27.3	38.5±40.8	20.0±33.4*	41.4±37.6
Partial score	Draw or one goal difference	2006	73.6±28.8	36.2±40.8	48.8±47.2	52.5±40.8
		2020	34.2±42.4^	75.0±35.4	100±0.0	46.5±44.2
		Total	56.7±39.7	41.1±41.3	55.2±47.3	50.9±41.3
	Two or more goal difference	2006	57.0±23.3	41.4±39.4	34.2±42.0	44.5±35.8
		2020	58.1±32.1	14.6±17.2	0.0±0.0	38.8±35.1
		Total	57.4±26.2	34.3±36.4	31.1±41.2	42.9±35.3

HL: High Level; ML: Medium level; WL: Worst level. * Differences with HL; ǂ Differences with ML; ^ Differences between 2006 and 2020 Championships (*p*< .05).

Table 5 shows the percentages of effectiveness of the shots produced in inequality. The existence of lower efficiency for WL teams when shot from the center stands out against the HL group (p = .004) and ML (p = .023). Similarly, there is less efficiency for WL teams when shot with feint compared to HL (p = .003) and ML (p = .010). However, greater efficiency is seen by HL teams when shot without feint than WL (p = .013). In relation to the type of shot, a lower efficiency is seen in the WL group when shot drive, in relation to the rest of the HL (p = .003) and ML (p = .011) teams. As for the location, a lower efficiency appears again in the WL teams when shot to the short post, in relation to the HL (p = .003) and ML (p = .032). There is a greater efficiency of HL teams when shot at the center, compared to WL teams (p = .031). Finally, when analysing the partial score, WL teams are less effective when shot with unbalanced scores (+-2) than HL (p = .003) and ML (p = .005) teams.

With regard to the differences found in the comparisons between the two championships in inequality, it is observed that in 2020 there are more shots in inequality than in 2006 (F = 4,715; p = .034; S.E. = .070), and more goals are appreciated (F = 4,715; p = .034; S.E. = .070). In this respect, there is a lower efficiency for shots without feint in 2020 than in 2006 (F = 4,223; p = .044; S.E. = .100), as well as for drive shots (F = 8,615; p = .005; S.E. = .100), where the ML teams also displayed a lower efficiency (F = 4,096; p = .047; S.E. = .100). In shot direction, less efficiency is seen in shots directed to the short post in 2020 than in 2006 (F= 5,509; p = .022; S.E. = .083). As well as in shots directed to the center (F= 21. 077; p < .001; S.E. = .292), where LH teams also developed less efficiency (F = 8,836; p = .004; S.E. = .148), as did LH teams (F = 14,820; p < .001; S.E. = .225). Also, less efficiency was observed in 2020 than in 2006 when the partial score was balanced (+-1) (F = 11,436; p = .001; S.E. = .167) and unbalanced (+-2) (F = 5,770; p = .019; S.E. = .086), specifically noting that WL teams achieved less efficiency when the partial score was balanced (+-1) in 2020 than in 2006 (F = 5,112; p = .028; S.E. = .082).

Table 5. Frequency of shots, goals, and percentage of efficiency on inequality according to the classification in the championship.

			HL	ML	WL	Total
	Frecuency	2006	9.2±3.7	8.7±3.7	8.4±4.2	8.8±3.8
		2020	12.2±5.7	9.5±3.4	11.2±4.6	10.8±4.6^
		Total	10.5±4.8	9.1±3.5	9.7±4.5	9.7±4.2
	Goals	2006	10.2±3.7	10.7±3.7	11.4±4.2	10.7±3.8
		2020	13.2±5.7	11.5±3.4	14.2±4.6	12.8±4.6^
		Total	11.5±4.8	11.1±3.5	12.7±4.5	11.7±4.2
Shot Position	Left	2006	71.4±22.3	50.1±36.8	46.4±36.2	55.6±33.6
		2020	51.4±23.3	50.6±32.5	33.5±30.6	46.0±29.5
		Total	61.9±24.4	50.4±34.0	40.6±33.6	51.1±31.9
	Center	2006	65.5±22.3	58.9±32.1	32.4±26.1	53.6±30.0
		2020	54.3±30.0	49.5±31.2	29.9±22.0	45.5±29.4
		Total	60.4±26.0	54.2±31.4	31.2±23.6*♯	49.7±29.7
	Right	2006	64.4±30.3	63.7±40.2	37.5±44.3	57.6±38.8
		2020	54.8±35.5	41.2±38.5	25.0±34.5	41.4±37.1
		Total	59.8±32.4	52.9±40.3	31.3±38.9	49.8±38.6
Feint	WithFeint	2006	66.7±41.5	59.2±30.7	19.2±27.7	51.5±38.5
		2020	54.2±25.7	50.6±43.3	24.8±22.1	44.9±34.5
		Total	60.7±34.6	54.9±36.9	22.0±24.4*♯	48.3±36.4
	WithoutFeint	2006	65.9±12.4	56.9±29.3	46.2±27.9	56.6±25.2
		2020	55.4±32.0	48.6±24.9	26.6±22.2	44.5±28.3^
		Total	61.1±23.4	52.9±27.1	37.4±26.8*	51.0±27.2
Technique	Drive shot	2006	65.5±14.0	63.3±30.4	38.9±29.8	56.8±27.9
		2020	50.3±23.5	43.4±29.8^	19.4±16.0	38.8±27.1^
		Total	58.6±20.0	53.7±31.2	30.1±26.0*♯	48.4±28.8
	Drive shotwithrebound	2006	72.0±32.5	46.7±41.4	56.3±49.6	58.9±40.8
		2020	72.8±38.5	54.5±41.6	45.4±36.0	57.8±39.2
		Total	72.3±34.4	50.8±40.6	50.8±42.2	58.4±39.7
	Others	2006	57.1±53.5	55.0±49.7	40.0±41.8	52.3±47.5
		2020	47.9±46.7	39.7±44.7	26.4±38.9	39.1±43.0
		Total	52.2±48.3	47.0±46.6	32.6±38.8	45.3±45.2

Direction	Short post	2006	78.3±18.4	68.7±28.1	49.2±34.1	67.0±28.6
		2020	61.3±27.9	55.8±32.7	29.9±25.5	50.2±31.3^
		Total	70.6±24.2	62.5±30.5	39.6±30.9*ǂ	59.0±30.9
	Center	2006	71.3±29.2	58.5±35.9	28.2±31.6	52.4±36.3
		2020	27.4±36.9^	11.4±20.5^	10.4±14.6	15.4±24.7^
		Total	52.1±38.8	35.9±37.6	20.3±26.5*	35.5±36.4
	Long post	2006	55.4±23.8	40.7±30.6	42.6±17.6	46.4±25.5
		2020	50.7±25.2	58.5±32.6	35.4±34.7	49.4±31.2
		Total	53.3±24.0	48.9±32.1	39.2±26.4	47.8±28.1
Partial Score	Draw or one goal difference	2006	74.8±33.7	58.5±35.8	55.9±34.7	63.0±34.8
		2020	50.6±25.2	34.5±33.2	19.8±26.7^	36.5±30.5^
		Total	63.3±31.7	47.0±36.0	41.0±35.8	50.8±35.3
	Two or more goal difference	2006	68.4±16.6	66.5±31.2	38.3±33.4	58.7±30.5
		2020	52.9±29.5	50.2±26.0	21.4±20.7	43.3±28.4^
		Total	61.7±23.7	58.6±29.5	31.2±29.3*ǂ	51.8±30.3

HL: High Level; ML: Medium level; WL: Worst level. * Differences with HL; ǂ Differences with ML; ^ Differences between 2006 and 2020 Championships (p< .05).

In any case, when analysing the penalty shots, no significant differences found depending on the technique, direction and the partial result, as shown in Table 6. It can be seen that HL teams scored more penalty shots than ML (p = .002) and WL (p = .020), (F = 7.103; S.E. = .184) and that HL teams scored more goals than ML (p = .009) and WL (p = .013), (F = 6.037; S.E. = .161).

Comparing effectiveness by championship, HL teams had more penalties in 2020 than in 2006 (F = 6,548; p = .013; S.E. = .094). In this more recent championship, effectiveness was higher for shots directed to the short post compared to 2006 (F = 8. 335; p = .009; S.E. = .294), and that WL teams achieved greater efficiency in shot to the short post compared to 2006 (F = 18,161; p < .001; S.E. = .476).

Table 6. Frequency of shots, goals, and percentage of efficiency on penalty according to the classification in the championship.

			HL	ML	WL	Total
	Frecuency	2006	1,2±1,2	0.6±0.9	0.4±0.7	0.7±1.0
		2020	2,8±3,3^	0.3±0.5	1.0±1.0	1.3±2.2
		Total	1,9±2,5	0.4±0.7*	0.7±0.9*	1.0±1.7
	Goals	2006	0,8±1,1	0.5±0.8	0.1±0.3	0.5±0.8
		2020	2,2±2,8	0.2±0.4	0.6±0.7	0.9±1.8
		Total	1,4±2,1	0.4±0.6*	0.3±0.6*	0.7±1.4
Technique	Drive shot	2006	50.0±57.7	100.0±0.0	33.3±57.7	60.0±51.6
		2020	75.0±41.8	100.0±0.0	44.4±50.9	71.2±42.2
		Total	65.0±47.4	100.0±0.0	38.9±49.1	65.9±46.1
	Drive shotwithrebound	2006	83.3±40.8	75.0±50.0	0.0±0.0	72.7±46.7
		2020	71.1±39.3	50.0±57.7	75.0±50.0	66.2±45.3
		Total	77.2±38.7	62.5±51.8	60.0±54.8	69.1±45.1
Direction	Short post	2006	75.0±41.8	87.5±25.0	0.0±0.0	61.5±46.3
		2020	76.2±37.1	100.0±0.0	100.0±0.0^	87.2±29.0^
		Total	75.6±37.6	91.7±20.4	57.1±53.5	74.4±40.1
	Long post	2006	66.7±57.7	100.0±0.0	100.0±0.0	85.7±37.8
		2020	82.5±23.6	50.0±57.7	25.0±50.0	52.5±48.5
		Total	75.7±38.2	71.4±48.8	40.0±54.8	64.7±46.7
Partial score	Draw or one goal difference	2006	50.0±57.7	100.0±0.0		75.0±46.3
		2020	73.0±41.7	66.7±57.7	100.0±0.0	76.5±41.0
		Total	62.8±47.6	85.7±37.8	100.0±0.0	75.8±42.1
	Two or more goal difference	2006	80.0±27.4	75.0±50.0	16.7±28.9	62.5±43.3
		2020	83.3±23.6	66.7±57.7	46.7±50.6	65.4±43.3
		Total	81.7±24.2	71.4±48.8	35.4±44.0	64.0±42.4

HL: High Level; ML: Medium level; WL: Worst level. * Differences with HL; ǂ Differences with ML; ^ Differences between 2006 and 2020 Championships (p< .05).

Discussion

The aim of this study was to compare the influence of rules changes on shots performance considering three different levels, in the final classification, between two male European championships with different rules. For this, and given the complexity of the game, with the intention of knowing how the regulatory changes have affected the development of top-level water polo, it is necessary to make models of the game, players and matches (Donev&Aleksandrović, 2008). Previous studies have analysed the influence of shooting speed, scoring efficiency, percentage of saves respect received shots, as well as the result of the matches, among other discrete statistics of the game (Saavedra et al., 2020). It is novel to establish the comparison of the shots made in two European Water polo Championships, considering the location of: shot position (left, center, right); technique (drive shot, drive shot with rebound, lob shot, reverse shot, other); existence or absence of feint; direction (short post, center, long post); and partial score (adjusted or not). In addition, considering the situational framework (equality, counterattack, inequality and penalty), the phase of the game (previous or final) and the period; depending in the final classification of the Championship.

There is no evidence of the existence of a similar previous study in the case of water polo, except for a few approaches such as those done by Iglesias et al. (2016) or the notational studies by Lupo et al. (2012, 2014) in the same competition and under the same rules. Although there are other sports such as football (Lago & Lago, 2010), basketball (Sampaio et al., 2010; Mikolajec et al., 2013; Pérez-Ferreirós et al., 2018), rugby (Thomas & Wilson, 2015) or different invasion sports (Ávila-Moreno et al., 2018).

In this sense, the analysis of the shots effectiveness, considering the final classification of the Championship, hardly allows to infer the existence of significant differences between the two competitions. Therefore, the analyses are developed considering both Championships, since it is considered that the regulations affect all the teams equally and the differences observed in this case are due to the level of the teams and not for the regulatory modifications or even the result of the matches (Lupo et al., 2014).

In general, there is less effectiveness in inequality between championships (observing less effectiveness, although more frequently, in Budapest 2020), since this situation had acquired a predominant role in the result of the teams and the coaches have given more importance in the training programming during these years. Regarding the decrease in scoring efficiency in the first period, this fact is not consistent with the results of Lupo et al. (2014), who find differences in the third period. This shows the technical improvement of the teams and the increasing similarity between them, furthermore showing that the final performance in the Championship can be influenced by water polo physical factor, but above all, by the quality of the teams' substitutes, who are the ones who make the difference in the last period.

Our results shows differences, according to the final position in the Championships, in the number and effectiveness of the shots made finding more effectiveness for the top teams in equality, counterattack and inequality, compared to the rest. Curiously, this greater effectiveness disappears in the final phase considering the comparison between the HL teams versus the ML. Which shows the equality between the first classified and is reflected in the adjusted results, where small details allow fighting for the medals or for the eighth position. Reason why these studies make sense to discern the differentiating situations between the successful teams from the rest and, offering the technical staff objective information to improve performance.

Although this study has only analysed the shots taken, similar data to previous notational studies by Argudo, Ruiz &Abraldes (2010) are found, in the line that the first classified commit fewer fouls in attack and use less time in possession (Escalante et al., 2013; Saavedra et al., 2014), shooting more times to goalpost and more effectively (García-Marín& Argudo, 2017a). This shows the goalkeepers' importance and defensive blocks in the game (Palao et al., 2004; Lupo et al, 2010).

In relation to shots effectiveness respect to the final classification in the championship, there is more effectiveness in the shots made from the left position (for the worst classified teams), against expectations in equality, as reported by García-Ordóñez et al. (2016);Sabio et al. (2020) and Argudo et al. (in press). Remarking once again the low importance and influence on the game of left-handed shooters from the right zone.This data coincides with that exposed by Argudo et al. (in press) and García-Marín (2009), who find that a third of the shots are made from this zone. However, in this study, we appreciate higher values than those reported by these authors regarding shots from the center and those found by Lupo et al. (2010). In this line, García-Ordoñez et al., (2016) find similar values with respect to the winning teams, in balanced matches, in the shots from the central zone. In the feint, the ML and WL achieve less performance conditioned by the higher speed of the ball circulation and by a bad shot selection. Drive shot with rebound are more technically demanding as it is more difficult to anticipate the trajectory after the ball bounces. For this reason, LHs could prove more effective in this technical gesture. WLs prove to be underperforming in all phases of the championship, both in matches with even results and in matches with a large goal difference. It should be noted that the partial scoreboard is a new variable, introduced for the first time, which reports on the performance of the teams according to the result of the match. The LHs show their best performance in shots aimed at the short post. These shots are characterized by a low angle of shotting and are well defended by the even-handed defender and goalkeeper.

Previous studies on regulatory modifications and shots in top-level competitions (García-Marín& Argudo, 2017a,b; Argudo et al., in press), shows a greater number of counterattacks (and greater effectiveness from the

center and aimed at the long post). Although, Iglesias et al. (2016), find that the best teams make more counterattacks and penalties than the worst, even if that is not appreciated in this study and perhaps is due to the improvement of the teams and the reigning sports equality, as well as the regulatory modifications developed in these last years and that are analysed here. In the rest of the game situations (equality and inequality) and in a similar way to the findings of previous studies (Iglesias et al., 2016), the best-classified teams are more effective than the rest. However, in this study it is appreciated that ML make more shots than the best classified (although their effectiveness does not differ statistically).This may be because the stronger teams obtain better values than weak in steals, which forces to make shots with less advantage (Gómez et al., 2015). In this sense, Lupo et al. (2012) find similar data identifying shorter duration of plays and speculate that the winning teams could obtain more offensive opportunities to successfully shot; throwing less, but with more chance of scoring.

In the case of inequality, and considering their growing importance in the game, previous studies found lower efficacy values of 29.4% (Soares, 2004) and 31.74% (García-Marín, 2009); than those found in this study. Only Platanou (2004) with 40.2% and Canossa (2001) with 46% found effectiveness values higher than the effectiveness of the worst classified teams in this study. Therefore, ML an HL teams have a inequality shot effectiveness higher than 54%, we can affirm the importance that has acquired to train and improve the efficiency of these game situations in order to obtain a better performance in a continental competition.

In the same way, recently rules changes produced modifications on plays definition, as we have mentioned before and has been reported by Argudo et al., (2020). Specifically, the frequency of shots decreased and more goals were scored at close range, from the side and with rebound. This fact is confirmed by observing how the HL of shooting efficiency on inequality occur in shots to short post with rebound, from zone 1 or 5, although further research is needed to determine the influence of these situations on the final performance of the matches and the future of the competition.

As far as the penalty is concerned, it can be seen how the WL teams are more favoured and have more scoring efficiency in relation to the ML teams. As far as the direction is concerned, the WL teams are more efficient in shots at the short post, which is similar to the results proposed by Argudo et al. (2016). ML and WL get fewer penalty situations because it is more difficult to get a player to beat the defenders in the 4-meter area. ML and WL are less effective in penalty situations because of the lower performance of their shooters and the quality of the goalkeepers in the HL.

Practical application/Recommendations

To know the most relevant performance indicators for sporting success, as shown by the results of this study, are drive shots (thanks to the enormous speeds that are being reached at present), as it is common to find differences in all the game situations considered in short post shots. On the other hand, successful teams achieve higher efficiency rates in shooting than the rest of the teams from the second period onwards, so it is necessary to improve athletes' endurance and attention span in times of fatigue, especially when scores are adjusted and psychological pressure affects performance.

In this sense, future studies should consider, due to its importance in the game, to verify that network analysis confirmed the coaches' perceptions of the performance of their players and team (Sarmento et al., 2020) or athlete's playing time (Melchiorri et al., 2020). The time line of action in inequality, since these determine between 23% and 46% of the goals of a match and has a frequency of appearance of 4 to 12 times per match (Platanou, 2004; Takagi et al., 2005; García-Marín et al., 2012, 2015).

Conclusions

It´s concluded that the regulatory changes have been successful in reducing the importance, in the performance of the teams, of effectiveness in situations of inequality, as has been observed in recent years. This has led to a more dynamic game, balanced according to the players' expertise and not their body size, but above all less static. Consequently, it follows that the proposed amendments on flying replacements should be continued and adopted, which would make the sport even more attractive and tactically richer.

Disclosure statement

No potential conflict of interest was reported by the authors.

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