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Original Article

Shooting performance in high level women's water polo according to the final ranking

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Abstract:
Introduction: The aim of this study was to analyze the situational framework (numerical equality, counterattack and numerical inequality) associated with shooting performance in women's Water polo considering three different levels in the final ranking (high -1st-4th-, medium -5th-8th- and worst -9th-12th-). **Material and Methods**: All shots (2698) made in 34th European Championship in 2020 were analyzed in the present study. The study was developed with an observational design. The reliability between three observers was verified using the Kappa concordance index. The shots were registered using Polo Direct Analysis v1.0 software. **Results**: There are differences between the high level teams (ranked at 1st-4th) and the rest of the teams, appreciating a greater scoring efficiency in equality lob shots (.5; 1.0; 1.2) and reverse shot [.7; .5; .2]) inequality short post (3.0; 1.8; 1.7) and counterattack in the situations shots from left side (1.6; .7; .5), shots from center with feint (2.9; 1.5; .7), drive (2.0; .8; .7) and rebound shot (.9; .7; .3). **Discussion**: The existence of differences between the top-ranked teams, those in the intermediate zones and the lowest-ranked teams are found. There is a greater scoring efficiency in the top-ranked teams. **Conclusions**: It is concluded that in order to achieve a higher performance in women's water polo, athletes must have the ability to withstand great efforts and perform fast swims to convert counterattack situations. Likewise, and in static situations, it is necessary to have fast ball circulation, lining up players with a great versatility of shooting in the different game situations, which therefore allows them to have more resources and take advantage of the opportunities generated by the opponent.
Key Words*:* team sport, ranking, situational frameworks, shots

Introduction

The analysis of the game action as a whole is a very complex task because many factors are involved simultaneously. This is why the need to divide the game action into smaller units to enable analysis (micro situation), understood as the set of motor actions predetermined by the factors of symmetry, organization of tactical game systems and ball possession (Argudo, 2000). Due to the particular characteristics of each micro situation (numerical equality, counterattack, numerical inequality and penalties), several authors have shown significant differences between the condition of winner or loser (García-Marín & Argudo, 2017; Lupo, Condello, & Tessitore, 2012), both in men's and women's water polo (Lupo et al., 2014; Saavedra et al., 2014).

In this sense, in water polo performance research, the shot indicators have been the most studied (Tucher et al., 2014) because shooting is the technical and tactical action that allows a goal to be scored, influencing the score during a match and contributing to the final match score (Platanou & Varamenti, 2011; Vila et al., 2011). Also have made it possible to compare the shot dynamics depending on the national leagues of different levels (Lupo et al., 2012b, Prieto, Gómez, & Pollard, 2013), or the players specific positions in attack (Özkol, Turunç, & Dopsaj, 2013).

In addition, throwing is usually executed under the defensive pressure of the opponent (Platanou, 2009) and the influence of fatigue (Smith, 1998). However, there have been no studies of other indicators, such as the area of origin and distance of the last pass before shooting, type of ball reception, presence or absence of contact between the shooter and the defender, position of the defender, position of the goalkeeper, and the type of arm movement of the latter. These indicators could better explain shooting performance.

Since all these antecedents, Alcaraz et al. (2011) and Lupo et al. (2012a), have allowed knowing the shots number per game, their distribution in each situational framework, the characteristics of the teams with the highest shot frequency, the most common positions, types and shooting directions, efficiency achieved, etc. However, hardly any studies have focused on analyzing the effects of rules changes on the shots dynamics in this sport. In this line, Platanou et al. (2007), find that regulatory changes have significantly increased the number of shots since the 2004 Olympics, but did not significantly increase the number of goals.

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On the other hand, Tucher et al. (2014) took a different approach, observing the occurrence of goals and the origin of shots, splitting the pool into three vertical slices relative to the goalie: left lateral, right lateral, and centre. Finding Gullikson, Mayberry, Gale and Killick (2020) that shots originating from the centre third were almost twice as likely to result in a goal as shots originating from the lateral thirds.

The aim of this study was to analyze the situational framework (numerical equality, counterattack and numerical inequality) associated with shooting performance in women's Water polo considering three different levels in the final ranking (high -1st-4th-, medium -5th-8th- and worst -9th-12th-).

Material & methods

Participants

This was a descriptive study following the observational methodology proposed by Anguera (2003) that analyzed all shots performed in 44 women matches from the 34th European Championship in 2020 (Budapest, Hungary). The total sample comprised 2698 shots.

Procedures and tools

The matches were recorded with a video camera (JVC, GZ-MG50E, JAPAN) that was placed on one side of midfield of the pool, at a height and distance greater than 10m. *S*ubsequently, three experienced observers analysed all shots. Inter-observer reliability was assessed using the Kappa concordance index, ensuring concordance coefficients greater than .95 in all cases. The match analysis was performed with the field format (Argudo et al., 2021) designed using the software LINCE (Gabín, Camerino, Anguera, & Castañer, 2012). Considering as i*ndependent variables:* Situational framework (Equality, Counterattack and Inequality) and Level ranking, (1st-4th, 5th-8th, *9th-12th). For dependent variables: Frequency of shots, Result (Goal, Post, Stop, Block, Outside), Shot position (Left, Center, Right), Feint (with or without feint), Technique (Drive shot, Drive shot with rebound, Lob shot, Reverse shot, Others). Free shot (with or without previous foul), Shot direction (Short post, Center, Long post).*

Statistical Analysis

Descriptive statistics (mean and standard deviation) were calculated for the frequencies of shooting in each situational framework (equality, counterattack and inequality), as well as for all the technical-tactical indicators of shooting according to the ranking of the championship (1st-4th; 5th-8th; 9th-12th).

Subsequently, multivariate analysis of variance (MANOVA) was applied to compare the frequencies of shooting in equality, counterattack and inequality, as well as the technical-tactical indicators of shooting in each situational framework according to the classification in the championship. Initially, the effect of the independent variable (IV) on all the dependent variables (DVs) was evaluated. The choice of the most robust multivariate test was determined from the Box's Test for Equivalence of Covariance Matrices. Wilks' Lambda was applied when the assumption of homoscedasticity was met and the covariance of the groups were equal. Otherwise, the test used was Pillai's Trace. The effect size (η2) in multivariate tests was considered small .01, medium .06 and large .14 (Cohen, 1988). Subsequently, the analysis of the ANOVA variance was applied to identify the technical-tactical variables of the set of DVs of the multivariate model influenced by the IV. The effect size (partial η2) in the univariate analysis was considered small .10, medium .25 and large .40 (Cohen, 1988). The analyses of variance were carried out with the IBM SPSS Statistics 24 software assuming a 95% confidence level ($p < .05$).

Results

The shot frequencies for the different situational frameworks differed according to championship ranking ($F_{8,342} = 3.422$; $p = .001$; multivariate $\eta 2 = .074$) (Table 1). Specifically, higher ranked teams (3.73±5.53) shot more on counterattack ($F_{2,173} = 6.112$; $p = .003$; partial $\eta 2 = .066$) than middle ranked teams (1.84±3.00; $p = .019$) and lower ranked teams (1.36±1.50; $p = .005$).

Table 1. *Frequency of shots in each situational framework by championship ranking*.

	Ranking		
	1st-4th	**5th-8th**	**9th-12th**
Equality	7.55±5.38	9.14±6.17	8.89±7.51
Inequality	4.75±3.85	3.40±3.33	3.21±3.14
Counterattack	3.73±5.53	1.84±3.00*	1.36±1.50*

** Differences with 1st-4th; p < .05.*

In numerical equality, shooting technique ($F_{10,340} = 5.555$; $p < .001$; multivariate $\eta 2 = .140$); foul ($F_{4,346} = 4.001$; $p = .003$; multivariate $\eta 2 = .044$), shooting direction ($F_{6,344} = 4.210$; $p < .001$; multivariate $\eta 2 = .068$) and shooting result ($F_{10,340} = 4.103$; $p < .001$; multivariate $\eta 2 = .108$) reached differences according to ranking at the end of the championship. Regarding the shooting technique, the lowest ranked teams (.68±.93) shot less with bounce ($F_{2,173} = 6.633$; $p = .002$; partial $\eta 2 = .071$) than those ranked in the middle zone

(1.69±1.74; p = .001). In addition, the top-ranked teams shot less from the lob shot (F2,173 = 5.664; p = .004; partial η2 = .061) (1st-4th = .5±.8; 5th-8th = 1.2±1.5; p < .001) and more from the backhand (F2,173 = 7.525; p = .001; partial η2 = .080) (1st-4th = .7±.9; 5th-8th = .2±.4; p < .001) than the bottom-ranked teams. On the other hand, the lowest ranked teams (.68±1.00) shot more after fouls (F2,173 = 6.864; p = .001; partial η2 = .074) than the middle (0.26±0.73; p = .009) and high (0.18±0.43; P = .002) ranked teams. In relation to the direction of the shot, the lowest ranked teams (4.93±4.23) shot more towards the long post (F2,173 = 5.316; p = .006; partial η2 = .058) than the highest ranked teams (2.89±2.47; P = .004). With respect to the shooting score, the higher ranked teams (2.64±2.46) scored more goals (F2,173 = 5.810; P = .004; partial η2 = .063) than the lower ranked teams (1.29±1.28; p = .002). Conversely, the top-ranked teams (.67±.73) took fewer shots away (F2,173 = 9.781; P < .001; partial η2 = .102) than teams ranked in the middle (1.27±1.34; P = .004) and bottom (1.74±1.71; p < .001).

In numerical inequality, differences as a function of championship ranking were reached in the direction of shots (F6,344 = 2.879; p = .009; multivariate η2 = .048) and in the outcome (F10,340 = 3.272; p < .001; multivariate η2 = .088) (Table 2). Specifically, the top-ranked teams (2.98±2.51) shot more towards the short post (F2,173 = 6.904; p = .001; partial η2 = .74) than those ranked in the middle (1.77±2.00; P = .004) and low (1.70±1.71; p = .006). Likewise, higher ranked teams (2.47±2.18) scored more inequality goals (F2,173 = 13.176; p < .001; partial η2 = .132) compared to mid (1.34±1.83; p = .001) and low ranked teams (.77±0.98; p = .006).

In counterattack, differences as a function of championship classification were reached in: shooting position (F6,344 = 2.352; p = .031; multivariate η2 = .039), feint (F4,346 = 3.162; p = .014; multivariate η2 = .035), shooting technique (F6,344 = 3.413; p = .003; multivariate η2 = .056) and shooting result (F10,340 = 2.762; P = .003; multivariate η2 = .075). Regarding shooting position, higher ranked teams (1.16±1.84) threw more from the left (F2,173 = 3.407; p = .035; partial η2 = .038) than lower ranked teams (.49±.68; p = .045). In addition, the top-ranked teams (1.64±2.69) shot more from the centre (F2,173 = 7.206; P = .001; partial η2 = .077) than those ranked in the middle (.65±1.12; p = .006) and bottom (.47±.83; p = .003). On the other hand, the top ranked teams (.81±1.48) shot more with feint (F2,173 = 4.957; p = .008; partial η2 = .054) than those ranked in the middle (.31±.76; p = .025) and low zone (.26±.67; Pp = .022).

In relation to shooting technique, the top ranked teams (2.02±3.14) made more Drive shot (F2,173 = 6.933; p = .001; partial η2 = .074) than those ranked in the middle (.75±1.51; p = .042) and low zone (.74±0.98; p = .010). Likewise, the best classified (.89±1.44) performed more Drive shot with rebound (F2,173 = 3.558; p = .031; partial η2 = .040) than the worst classified (.26±.48; p = .029). Regarding the shooting score, the top-ranked teams (2.33±3.90) scored more goals (F2,173 = 8.064; p < .001; partial η2 = .085) than those ranked in the middle (.92±1.88; p = .009) and bottom (.43±.71; p = .001). In addition, the top-ranked teams (.47±.92) shot more in the post (F2,173 = 4.672; p = .011; partial η2 = .051) than those ranked in the middle zone (.14±.39; p = .013).

Table 2. *Frequency of shots in equality according to the final ranking in the championship*.

		Ranking		
		1st-4th	**5th-8th**	**9th-12th**
Shot position	Left	2.12±2.14	2.52±2.26	2.57±2.62
	Center	3.75±2.80	4.09±3.07	3.57±3.48
	Right	1.67±1.76	2.52±2.30	2.74±2.89
Feint	With feint	2.15±2.20	2.12±2.11	2.02±2.25
	Without feint	5.39±3.97	7.01±4.94	6.87±5.94
Technique	Drive shot	4.62±3.64	5.43±4.02	6.4r±5.80
	Drive shot with rebound	1.25±1.42	1.69±1.74	.68±.93^
	Lob shot	.50±.79	0.95±1.13	1.21±1.48*
	Reverse shot	.73±.94	.52±.64	.19±.44*
	Others	.42±.73	.53±.73	.36±.67
Foul	With foul	.18±.43	.26±.73	.68±1.00*^
	Without foul	7.35±5.27	8.87±5.94	8.21±7.10
Shot direction	Short post	3.84±3.22	4.20±3.29	3.14±3.20
	Center	.81±1.15	0.96±1.22	.80±1.07
	Long post	2.89±2.47	3.96±3.22	4.93±4.23*
Result	Goal	2.64±2.46	2.03±2.05	1.29±1.28*
	Post	1.10±1.16	1.58±1.51	1.80±2.00
	Stop	2.04±2.07	2.95±2.68	2.74±2.73
	Block	1.07±1.37	1.29±1.64	1.29±2.12
	Outside	.67±.73	1.27±1.34	1.74±1.71*^

** Differences with 1st-4th; ^ Differences with 5th-8th; p < .05*.

Dicussion

The aim of this study was to analyse the situational framework (numerical equality, counterattack and numerical inequality) associated with shooting performance in women's Water polo considering three different levels in the final ranking (high -1st-4th-, medium -5th-8th- and worst -9th-12th-).

When analysing the 2698 shootings produced in the 44 women matches from the 34th European Championship in 2020 (Budapest, Hungary), the existence of differences between the top-ranked teams, those in the intermediate zones and the lowest-ranked teams can be seen. As was to be expected, there is a greater scoring efficiency in the top-ranked teams. In this sense, significant differences are found when comparing the three ranking levels considered, in relation to the position of the shooting, the presence of a previous feint or the existence of a foul before the shooting. As well as the direction and the result of the shooting, depending on the microsituation of the game (equality, inequality and counterattack), as has been found in previous studies (Argudo, García, Borges, & Sillero, 2020).

In relation to shooting efficiency, this study has found similar values to those reported by García-Marín & Argudo (2017a, 2017b) in previous world championships. They found an average of two shots per minute and an efficiency of 60% for the top teams and 47% for the lowest ranked teams (García-Marín & Argudo 2017a). Specifically, looking at the efficiency of the shooting as a function of position, we find similarities to the results reported by Sabio et al. (2020) and Tucher et al. (2014), where the efficiency of the shooters in close positions and from the centre is more important. Likewise, the position and location of goalkeepers should be considered for the different types of shots received, as Yang, Park, Kim and Ryu (2017) have done in their observations on goalkeeper positioning in football. This serves to adjust the offensive shooting situations based on the observed results.

On the other hand, and in terms of the influence on the result of shooting, this study has found that the higher ranked teams not only shoot more, but also score more goals, finding significant differences in the number and scoring efficiency of counterattacks. Therefore, and in terms of the type of shooting and the previous situation behind it, this study finds opposite data to those reported by García-Marín and Argudo (2017a) in terms of the preference of the shots. In their studies, they found a predominance of tense or bouncing shots, while in this study the shots that achieve greater efficiency and therefore score more goals are the lob shots, where the best classified try fewer times, but score more goals; or backhand, where in addition to shooting more times, better efficiency is achieved. This data demonstrates the importance that the game of the buoy continues to have in the sporting success of the teams, in order to score goals and obtain superiority, which can subsequently be translated into goal scoring opportunities despite the regulatory modifications that try to minimise its impact on the game.

In the case of shooting in situations of inequality, there is a greater efficiency in shooting at the short post by the higher ranked teams, which seems to indicate that the speed of passing has an important influence on scoring goals in these situations. This may be due to the fact that, after the latest regulatory modifications and the consequent reduction in the duration of superiority situations, rapid circulation and an increase in the number of finishes in this type of situation prevail and continue to make the difference between teams that opt for the medals and the rest of the teams (Argudo et al., 2021). For this reason, during the preparation of the championships, importance has been given to their training, and given that the teams are studied and analysed, we believe that the differences in efficiency in these shootings are due to the individual quality of the players to shoot after a fastball circulation. Therefore, future studies could consider analysing the training methods used by teams, as García-Herrero, Sánchez-Sánchez, Luis-Pereira and Menayo (2016) have done with shooting in football. Meanwhile, in counterattack situations, there is greater efficiency in shooting from the left side, centre with feint, drive and rebound shot; as well as more shots to the stick by the better-ranked teams. Data, in this sense, similar to those found by (García-Marín & Argudo, 2017a), in previous studies in which the shooting performed in the XV Water polo World Championship was analysed, which demonstrates the importance that a high swimming speed that allows the creation of 1vs1 situations continues to have for this sport.

In relation to the influence of defensive systems on incoming shooting, there is a predominance of defences known as "pressing with help". This variable should be considered for future studies, as has been done in basketball by Bredt et al. (2017) and Zuccolotto, Manisera and Sandri (2018), analysing which type of defence achieves better results. Similarly, it seems relevant to study how stressful game situations influence the blocking efficiency of goalkeepers, an analysis carried out in football by Liu, Gómez and Lago-Peñas (2015). Using statistical methods, they found differences in different specific technical-tactical actions of goalkeepers in competition. In these studies, it was concluded that the better ranked teams were more efficient in defensive situations, because they caused the opponents to take fewer and worse shots. In addition, the lower ranked teams developed more shooting outside the goal.

At the same time, it may be very interesting to analyse the game situations prior to shooting in greater depth. Future studies should consider the analysis of players' gaze, as has been done before in basketball (Oudejans, 2012) or use statistical tests such as neural networks to understand the relationship between players and their occupation of space. In addition, such analysis can focus exclusively on specific moments of a match, such as the influence of starting attacking in each period on the final score (Argudo, Arias, Ruiz, & Alonso,

2011). Finally, as in other sports such as basketball (Christmann et al., 2018) or football (Lupo & Tessitore, 2016), it seems relevant to consider partial scores and scoring efficiency after critical situations or moments of the match. For example in the initial or final moments of a quarter (Ruano, Serna, Lupo, & Sampaio, 2016), after a time-out (Ruiz-Lara, Borges-Hernández, Ruiz-Barquín, & Argudo-Iturriaga, 2018), or during the last minute of the game, checking the adaptation of the teams and players to these stressful situations of the game. So all this information can be used to modify training situations (Liu, Gómez, & Lago-Peñas, 2015) and thus achieve better efficiency in shooting, thus scoring more goals and therefore developing a higher performance. Alternatively, on the other hand, try to make the opposing teams not to shoot in the best conditions and thus reduce their scoring efficiency.

Ultimately, it seems relevant to consider and delve deeper into the influence of the regulatory changes made in recent years, in order to understand how players have adapted to them. This will allow us to understand and ensure, on the one hand, that the regulatory changes made fulfil the purpose for which they were created and, on the other hand, that the clubs and national teams are adapting to what is expected to happen.

Conclusions

It is concluded that in order to achieve greater performance in women's water polo, it is necessary to obtain a greater scoring efficiency in equality lob shots and reverse shot; in situations of inequality to generate chances to shoot at the short post and to generate counter-attacking situations. Therefore, it seems it is necessary to have athletes with the capacity to withstand great effort and who are capable of making continuous movements, at high swimming speed during the game, to provoke counter-attacking situations and finish them successfully. Likewise, and in static situations, it is necessary to have a fast ball circulation, lining up players with a great versatility of shooting in the different game situations which allows them to have more resources and to take advantage of the opponent's mistakes in defence.

Conflicts of interest - The authors declare no conflict of interest.

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