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# Analysis of associated variables with shooting performance in Beach Water polo

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**ABSTRACT**

Beach Water polo is a newly created team water sport derived from Water polo. The first time official matches were played at a major international event was at the 18th FINA World Championship in 2019. For that reason, the aim of this study was to analyse some associated variables with shooting performance in female Beach Water polo. The total sample was composed of 857 shots from the Beach Water Polo Tournament (Gwangju, South Korea). The study was developed with an observational design. The reliability between the two observers was verified using the intra class correlation coefficient, ensuring that in all cases this value was greater than .75. The results show that the most effective shots were those taken after a previous foul, close to the goal, from the left position, with rebound, with a feint movement, directed at the short post. It is also concluded that beach water polo as a much more physically and mentally demanding sport than classic water polo.

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Team sport; aquatic sports; playing actions; technique

## 1. Introduction

Beach Water polo is a collective sport derived from Water polo. The main difference between the two modalities is the context in which they are developed and which are covered by the specific sport's regulations (Federación Internacional de Natación Amaetur [FINA], 2021). One is in a freshwater pool, with or without a roof, and the other is usually in an open-air saltwater space. Other changes are the dimensions of the field of play (15×10m), the number of players in a team (seven), with the possibility of being four at the same time, being one goalkeeper and three outfield players, with the possibility of the goalkeeper becoming a fourth outfield player losing his privileges (stopping the ball with two hands, for example). The goalposts are also reduced (2.50 x 0.80 m) and the playing time (two periods of 10 minutes of real play each, with a break of 5 minutes between them and with 20 seconds possessions). After each goal is taken from the goalpost and not from the middle of the field, like basketball.

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Players who are excluded do not have any time to stay out, as soon as the player touches a corner marker he can return to the field of play. Changes can be made while the game is in progress, without the need for time to stand still as is the case with handball.

The finishing of attacking actions in team sports are decisive situations in matches, as they define success or failure, influencing the final position of each team in tournaments (Dol et al., 2020).

Studies on Water polo has been a surge in interest in the technical-tactical aspect in recent years due to its influence on performance (Argudo et al., 2008). In particular, technical and tactical studies have been focused on team efficacy (Argudo et al., 2007, Argudo et al., 2008; Lupo et al., 2009), tactical roles (Lupo et al., 2012), a competition level (Lupo et al., 2010), match outcomes and margin of victory (Gómez et al., 2014; Lupo et al., 2014, 2012). Descriptive studies of the game (Canossa et al., 2009), analysis of technical actions (Alcaraz et al., 2011; Vila et al., 2011), specific playing positions (Sabio et al., 2020) and notational analysis (Argudo et al. 2007; Lupo et al., 2014).

Also the analysis of the playing action in Water polo has looked for technical and tactical performance indicators (Escalante et al., 2012; Mirvić et al., 2011), characterised the type of actions and their physical demands in relation to their intensity (D´Auria & Gabbett, 2008; Lupo et al., 2009), described the game profiles for each specific position (V. Lozovina et al., 2010; M. Lozovina et al., 2011; Lupo et al., 2012), found the effects of the regulatory changes (Argudo et al., 2020), analysed the influence of time out (Platanou, 2008), game location (Prieto et al., 2013), scoreboard result (Lupo et al., 2012), for having the first ball possession of each period (Argudo, 2010); and, calculated the effectiveness in each situational framework (Argudo et al., 2010).

In almost all of these studies, the methods used to analyse technical and tactical actions in sports performance are match analysis (Haydée et al., 2016) or notational analysis (Özkol et al., 2013), where one or more experts quantify the previously selected indicators to define sports performance factors over a set time (Hughes & Bartlett, 2002).

Studies on attacking and specifically shooting efficiency have been previously studied in classical water polo. Because there have hardly been any official international Beach Water polo tournaments, there are no studies that have analysed it with a sample of high-level players. For all of these reasons, the aim of this study was to analyse some associated variables with shooting performance in female Beach Water polo.

## 2. Method

This was a descriptive study following the observational methodology proposed by Anguera et al. (2017) that analysed the shots performed from female Beach Water Polo Tournament (Gwangju, South Korea) in 2019.

### *2.1. Match analysis and participants*

The total sample comprised 857 shots in 12 games. As it is public, event and its participants are of legal age, as well as having been authorised by the different committees and agencies, did not proceed to request the approval of the ethical committee.

**Table 1.** Field format.

| Variables | |
|---|---|
| (1) Condition: | 1- Winner<br>2- Loser |
| (2) Free shot: | 1- After foul<br>2- Without previous foul |
| (3) Distance: | 1- Close (0–5 m)<br>2- Far (> 5 m) |
| (4) Position (Figure 1): | 1- Right<br>2- Centre<br>3- Left |
| (5) Technique: | 1- Drive shot<br>2- Drive shot with rebound<br>3- Lob shot<br>4- Others |
| (6) Feint: | 1- Without<br>2- With 1 arm movement<br>3- With 2 or more arm movements |
| (7) Direction: | 1- Short post<br>2- Centre<br>3- Long post |
| (8) Result: | 1- Goal<br>2- Post<br>3- Stop<br>4- Block<br>5- Out |

### 2.2. Procedures

The playing actions analysed were recorded with a video camera (SONY, FDRAXP33B. CEN, JAPAN) that was placed on one side of midfield of the pool, at a height and distance greater than 15 m. All the shots examined could be clearly seen with the images obtained with the video camera.

The match analysis was performed with the field format (Table 1) designed using the software LINCE (Gabín et al., 2012). By adapting instruments previously used in sport such as the one proposed by Sabio et al. (2018).

Subsequently, two observers who were not involved in this research and with more than 600 h of experience in observational studies of water polo consensually quantified the 857 shots taken at the tournament. To calculate the reliability intra-observer, each

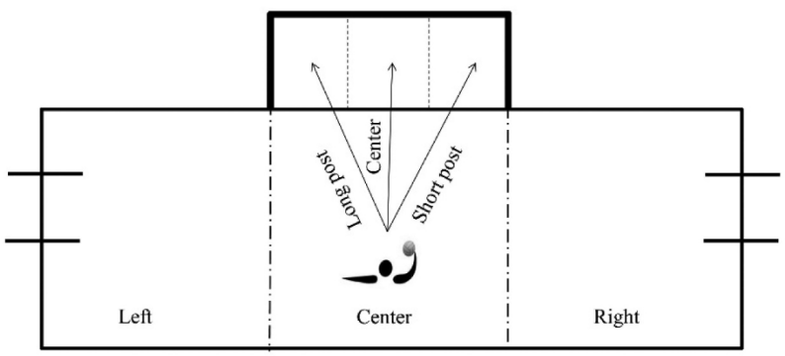


**Figure 1.** Shot positions, goal zones and shot directions.

observer analyses one match of the championship twice with a two weeks of separation. The reliability of the inter-observer was verified using el intra-class correlation coefficient. The reliability of the observers was verified in three of twelve analysed games ensuring than in all cases this value was greater than .75.

### 2.3. Statistics

First, the basic descriptors (mean and standard deviation) of the frequencies and efficiencies of the technical-tactical indicators of shooting (foul, distance, position, technique, feint, direction and result) were calculated according to the condition of winner or loser at the end of the match. T-test for paired samples ($p < .05$) was used to compare the means of the variables that conformed to the normal distribution with the Kolgomorov-Smirnov test ($p > .05$). Effect sizes (ES) were calculated using the square eta ($\eta 2$) statistic and their interpretation was based on the following criterion: .20 small effect, .50 medium effect, .80 high effect (Cohen, 1988). Analyses were undertaken using the IBM SPSS Statistics 20 software programme. A confidence level of 95% was established ($p < .05$).

## 3. Results

After analysing the shots made in the tournament, as shown in Table 2, it can be seen that on average 35.7 ± 2.5 shots were made per team and match, appreciating differences between the winning and losing teams ($p = .044$; ES = .511). Likewise, an overall efficiency of 40.1 ± 15.0% was observed, finding that the winning teams (52.3 ± 10.7%) were more efficient than the losing teams (28.0 ± 6.0%, $p < .001$; ES = 2.44).

If we look at the previous action that triggers the shot, the highest frequency is seen in shots after a previous foul, close to goalpost, from the centre, drive shot, without feint, aimed at the short post and ending in a goal. We found that the most effective shots were those taken after a previous foul, close to goalpost, from the left position, with a rebound, with a feint movement, aimed at the short post.

The comparison of means showed that the winning teams made more shots from positions close to the goalpost (W = 29.00 ± 2.62; L = 21.33 ± 5.80; $p = .004$; ES = 1.31), finishing at goal (W = 18.17 ± 3.68; L = 10.33 ± 2.80; $p < .001$; ES = 1.97). On the contrary, the losing teams shot more free shots (W = 2.33 ± .98; L = 5.00 ± 2.17; $p = .004$; ES = 1.51), from positions far from the goalpost (W = 5.50 ± 3.06; L = 15.17 ± 5.47; $p = .001$; ES = 1.79), of drive shot (W = 17.00 ± 2.41; L = 20.00 ± 3.19; $p < .001$; ES = .75), directed to the long post (W = 12.17 ± 1.11; L = 14.83 ± 2.03; $p = .008$; ES = 1.16), and ending in a stop (W = 10.50 ± 3.06; L = 16.50 ± 2. 23; $p < .001$; ES = 2.39), blocked (W = .83 ± .71; L = 3.17 ± 1.26; $p < .001$; ES = 1.74) and out (W = . .83 ± .93; L = 3.83 ± 1.11; $p < .001$; ES = 2.18).

In addition, winners achieved more efficiency in shots taken after foul (W = 51.14 ± 11.62; L = 30.63 ± 6.51; $p < .001$; ES = 2.25), without foul (W = 61.11 ± 46.78; L = 6.48 ± 9.71; $p = .006$; ES = 1.14), from positions close to the goalpost (W = 59.84 ± 7.05; L = 40.41 ± 10.12; $p < .001$; ES = 1.78), from the right (W = 38.91 ± 6.70; L = 22.28 ± 11.12; $p = .001$; ES = 2.46), the centre (W = 51.64 ± 19.61; L = 26.23 ± 6.98; $p < .001$; ES = 1.22), drive shot (W = 48.64 ± 9.66; L = 18.79 ± 6.77;

**Table 2.** Frequency and effectiveness of the technical-tactical indicators of shooting according to the condition of the team at the end of the match.

| | Shots | | | | Efficiency % | | | |
|---|---|---|---|---|---|---|---|---|
| | Winners | Losers | *p* | ES | Winners | Losers | *p* | ES |
| Total | 34.83 ± 1.52 | 36.50 ± 3.00 | .044 | .511 | 52.25 ± 10.70 | 28.03 ± 5.98 | < .001 | 2.44 |
| Foul | | | | | | | | |
| After foul | 32.50 ± 1.16 | 31.50 ± 3.39 | .383 | | 51.14 ± 11.62 | 30.63 ± 6.51 | < .001 | 2.25 |
| Without previuos foul | 2.33 ± .98 | 5.00 ± 2.17 | .004 | 1.51 | 61.11 ± 46.78 | 6.48 ± 9.71 | .006 | 1.14 |
| Distance | | | | | | | | |
| Close (0–5 m) | 29.00 ± 2.62 | 21.33 ± 5.80 | .004 | 1.31 | 59.84 ± 7.05 | 40.41 ± 10.12 | < .001 | 1.78 |
| Far (>5 m) | 5.50 ± 3.06 | 15.17 ± 5.47 | .001 | 1.79 | 11.42 ± 14.92 | 6.12 ± 5.63 | .324 | |
| Position | | | | | | | | |
| Right | 8.50 ± 4.25 | 9.33 ± 2.30 | .597 | | 38.91 ± 6.70 | 22.28 ± 11.12 | .001 | 2.46 |
| Centre | 16.00 ± 3.46 | 16.83 ± 2.44 | .276 | | 51.64 ± 19.61 | 26.23 ± 6.98 | <.001 | 1.22 |
| Left | 10.33 ± 2.87 | 10.33 ± 2.60 | 1.00 | | 58.38 ± 15.62 | 36.11 ± 25.16 | .057 | |
| Technique | | | | | | | | |
| Drive shot | 17.00 ± 2.41 | 20.00 ± 3.19 | <.001 | .75 | 48.64 ± 9.66 | 18.79 ± 6.77 | <.001 | 3.04 |
| Drive shot with rebound | 11.83 ± 3.32 | 10.50 ± 1.88 | .365 | | 76.85 ± 16.73 | 52.26 ± 14.42 | .011 | 1.13 |
| Lob shot | 2.67 ± .98 | 2.67 ± 1.77 | 1.00 | | 29.16 ± 23.43 | 13.88 ± 21.12 | .091 | |
| Others | 3.33 ± 2.60 | 3.33 ± 1.77 | 1.00 | | 19.04 ± 38.20 | 18.33 ± 17.49 | .922 | |
| Feint | | | | | | | | |
| Without | 23.67 ± 3.28 | 24.67 ± 2.60 | .463 | | 40.31 ± 9.41 | 25.18 ± 9.76 | <.001 | 1.12 |
| With 1 arm movement | 7.83 ± 1.26 | 7.67 ± 3.17 | .892 | | 81.52 ± 14.34 | 38.91 ± 7.63 | <.001 | 2.80 |
| With 2 or more arm movements | 3.33 ± 0.98 | 4.17 ± 2.85 | .372 | | 66.66 ± 34.81 | 44.57 ± 30.86 | .432 | |
| Direction | | | | | | | | |
| Short post | 17.33 ± 3.79 | 15.83 ± 3.09 | .349 | | 59.69 ± 10.99 | 38.86 ± 13.20 | <.001 | 1.31 |
| Centre | 5.33 ± 2.38 | 5.83 ± .71 | .559 | | 42.65 ± 29.02 | 5.15 ± 7.65 | .001 | 1.38 |
| Long post | 12.17 ± 1.11 | 14.83 ± 2.03 | .008 | 1.16 | 49.62 ± 10.50 | 25.84 ± 7.18 | <.001 | 2.73 |
| Result | | | | | | | | |
| Goal | 18.17 ± 3.68 | 10.33 ± 2.80 | <.001 | 1.97 | | | | |
| Post | 4.50 ± 1.97 | 2.67 ± 1.87 | .091 | | | | | |
| Stop | 10.50 ± 3.06 | 16.50 ± 2.23 | <.001 | 2.39 | | | | |
| Block | .83 ± .71 | 3.17 ± 1.26 | <.001 | 1.74 | | | | |
| Out | .83 ± .93 | 3.83 ± 1.11 | <.001 | 2.18 | | | | |

$p < .001$; ES = 3.04), with rebound (W = 76.85 ± 16.73; L = 52.26 ± 14.42; $p = .011$; ES = 1.13), without previous feint (W = 40.31 ± 9.41; L = 25.18 ± 9.76; $p < .001$; ES = 1.12), with feint of a movement (W = 81.52 ± 14.34; L = 38.91 ± 7.63; $p < .001$; ES = 2.80), aimed at the short post (W = 59.69 ± 10.99; L = 38.86 ± 13.20; $p < .001$; ES = 1.31), to the centre (W = 42.65 ± 29.02; L = 5.15 ± 7.65; $p = .001$; ES = 1.38) and to the long post (W = 49.62 ± 10.50; L = 25.84 ± 7.18; $p < .001$; ES = 2.73).

## 4. Discussion

Describing the actions and more specifically the shots in beach water polo makes sense, at an academic level, to understand the factors influencing performance in this new sport and to differentiate it from its "big brother". However, from a purely sporting and practical point of view, it provides technical managers with knowledge of the factors that determine success and therefore gives clues. Not only for the selection and preparation of specific teams in this sport (currently involving athletes from classic water polo) but can also serve as a guide for the programming and systematisation of the preparation of the athletes.

Because of this study and specifically, when comparing the frequency and effectiveness of the technical-tactical indicators of shooting in beach water polo, the comparisons carried out show that:

(1) The losing teams (5.00 ± 2.17) shot more without previous foul than the winners did (2.33 ± .98; $p$ = .004), data considerably smaller than those found by Argudo-Iturriaga et al. (2021), who found that the top-ranked women at the European Water Polo Championships shot 7.35 ± 5.27, while the medium ranked shot 8.87 ± 5.94, and lowest ranked shot without previous foul 8.21 ± 7.10 per match and from areas further away from the goalpost (15.17 ± 5.47) than the winners (5.50 ± 3.06; $p$ < .001). These differences may be due to the high intensity of the game, which involves short, fast swimming sprints, so players look for a foul to take a breath, rest and look for a clean shot on goalpost.
(2) Losing teams (20.00 ± 3.19) made more drive shots than winners did (17.00 ± 2.41; $p$ < .001), but fewer at the long post (12.17 ± 1.11 vs. 14.83 ± 2.03; $p$ = .008). In any case, these results are three times more than those found by Argudo-Iturriaga et al. (2021), in classic water polo European Championships, which may have occurred due to the different number of players in this sport and the existence of more space to shoot at the goalpost in search of easier shots, given the smaller size of the goalpost.
(3) Winning teams (29.00 ± 2.62) shot from closer to goalpost than losing teams (21.33 ± 5.80; $p$ = .004); scored more goals (18.17 ± 3.68 vs. 10.33 ± 2.80; $p$ < .001), and shots fewer times wide (.83 ± .93; vs. 3.83 ± 1.11; $p$ < .001), in the latter case, the results are similar to those found by Argudo-Iturriaga et al. (2021), at the European Classical Water Polo Championships in Budapest 2019. Likewise, losing teams (16.50 ± 2.23) received more saves than winners did (10.50 ± 3.06; p < .001) and blocks (3.17 ± 1.26 vs. .83 ± .71; $p$ < .001). Data very close to those found by Dol et al. (2020). These results are explained in this sport by the small size of the field (15 × 10 m) and the high intensity of the game, which means that on average each team shots 1.75 times per minute, double the number of shots that occur in classic water polo.

In this sense, if we compare the frequency of occurrence of shots with classic water polo (García & Argudo, 2017a), we can see that, although the duration of a match is shorter, a greater number of shots are observed (since the playing field and the duration of the possessions are much smaller). Likewise, the fact that the game is played in a fluid manner and without so many stoppages, produces more fun for the players, but at the same time more physical wear and tear. In this sense, it is also noted that, given the novelty of this modality, it has not been possible to develop a powerful tactic in this sport in which 1 vs. 1 technical situation currently prevail.

Regarding the observed efficacy, the values for the winners, are slightly lower as those observed in previous studies carried out in European Beach Handball Championships (Lara & Sánchez, 2018; Zapardiel, 2018). Appreciating for the winners an efficacy 15% lower than that observed in the winning teams, while for the losers an efficacy around 50% lower than that of the losing teams, found in Beach Handball World Championships by Dol et al. (2020).

Likewise, and in relation to defensive actions, it can be seen in this study that both blocks and saves show a lower efficiency than that found by Dol et al. (2020) in beach handball. However, if we compare this type of actions with those in classic water polo World Championships, we again find values much lower as those reported by García and Argudo (2017a). These differences are due to the novelty of the sport and the lack of specific experience of the athletes in this modality, as the same players combine the practice of classic water polo at the highest level with the specific preparation for this competition.

If, on the other hand, we look at the position on the field in which the shots are taken, we can see that in this study there is an abundance of shots from central positions, with greater efficiency being seen in shots from the left side of the field. The latter data being similar to those found in classic water polo by García and Argudo (2017a, 2017b), and in beach handball by Morillo-Baro et al. (2015).

As for the type of shot, unlike previous studies in classic water polo (García & Argudo, 2017a), it can be seen that the most abundant and most effective shots in beach water polo are those made after a previous foul, with a rebound, with a previous feint movement and aimed at the short post. Whereas in classic water polo, the most effective shots are the drive ones aimed at the long post and in a direct way in game situations without a previous foul. Possibly these differences are produced between these two modalities given the novelty in the appearance of this sport, the number of players and the time of possession, which determines that the game is fluid and at high speed.

Therefore, these results can be a contribution to the training of finishes, especially in the female field, but the main limitation of this study is that the results are framed in a specific competition, which is the first known study that has been carried out to date and therefore, these results cannot be generalisable.

Dol et al. (2020) found that approximately 67% of beach handball shots are spectacular, as well as observing that 91.30% of the goals scored were from shots with double value. Therefore, we wonder whether it might be relevant to consider giving a double value to this type of shot in beach water polo, or to shots taken in flight, as well as goals scored by the goalkeeper as in beach handball. Alternatively, if it would be relevant to consider double value for goals scored from the field of play itself.

## 5. Conclusions

From the analysis of associated variables with shooting performance in female Beach Water Polo Tournament in 2019, it is concluded that this is an emerging sport and there is still no scientific corpus to determine the determining factors of performance and even less to support the planning and programming of training. In addition, given its characteristics, it can be considered as a much more physically and mentally demanding sport than classic water polo, but much more fun for both the amateur (higher number of goals) and the athlete.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

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