

Laterality and technical-tactical shot indicators in elite Water Polo

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Abstract: The aims of this study were to compare the effectiveness of left-handed vs. right-handed players in goal-related actions and positive technical-tactical outcomes during play and evaluate shot efficacy across field positions in elite Water Polo. A total of 5422 shots (2724 male - 2698 female) from the XXXIV Male European Water Polo Championships and XVIII Female European Water Polo Championships were analysed using a nomothetic, multidimensional observational design. Inter-observer reliability ($\kappa > 0.90$) was confirmed. Statistical analyses were performed using SPSS 28.0, employing Mann-Whitney U or chi-square tests to compare categorical outcomes. Results revealed left-handed players demonstrated superior efficacy in zones 1 and 2 (45.5% vs. 22.2% in zone 1; 48.8% vs. 36.3% in zone 2, $p < 0.05$) and generated more positive actions (23.9% vs. 13.8%). Shots from zones 1 and 2 showed lower efficacy compared to central positions ($p < 0.01$). These findings suggest that coaches should strategically exploit the positional advantages of left-handed—particularly in lateral attacking zones—by designing offensive structures and training tasks. Moreover, understanding the reduced efficacy of peripheral shooting zones can help refine defensive planning and guide players toward higher-probability shooting positions.

Keywords: Team sports, match analysis, functional asymmetry, hand dominance, situational frameworks.

1. Introduction

Laterality refers to the preferential use of one side of the body for precision tasks and is considered a key neuro-motor behaviour linked to nervous system maturation (Picq & Vayer, 1977). Although the lateralization process develops gradually throughout childhood (Castejón et al., 1997), its relevance extends into sports, where the dominant side may influence coordination, strength, accuracy, and tactical decision-making, that plays a critical role in sports performance.

This study investigates whether laterality influences throwing efficiency in

water polo and whether left-handed players have tactical advantages over right-handed players and for these reasons we ask ourselves if the left-handed players have higher shot efficiency than right-handed players in elite water polo?

In sport science literature, laterality has been classified in various ways (Ortega & Blázquez, 1982; Ruiz-Pérez et al., 2001). Despite these differences, most frameworks converge on the idea that laterality encompasses a cognitive domain, particularly regarding the relationship between handedness and cognitive skills (Nogueira et al., 2019). Additionally,



functional asymmetries derived from laterality may influence both athletic performance and injury risk (Arden et al., 2011; Atkins et al., 2016; Impellizzeri et al., 2007; Newton et al., 2006; Rouissi et al., 2016).

For example, Evershed et al. (2014) found in swimmers, that ~85% have asymmetries greater than 10-15% and this was corrected in ~50% due to altered kinematic movement pattern, and symmetrical manual force generation.

Research from different sport contexts—such as cycling, swimming, or kicking sports—has shown that inter-limb strength or coordination asymmetries can impair technical execution in cycling, swimmers, kicking accuracy in Australian football or penalty kicks in professional indoor soccer (Bini & Hume, 2015; Dos Santos et al., 2015; Hart et al., 2014; Liu & Jensen, 2012; Vieira et al., 2016), and has been used as a measure of return to play (Davies et al., 2020).

These findings highlight the relevance of examining laterality in complex sports that require high coordination and spatial precision, such as water polo.

Although left-handed athletes represent approximately 10% of the general population, their prevalence is disproportionately higher—reaching up to 30%—in certain sports (Grouios et al., 2000). This overrepresentation has contributed to the belief among some coaches that left-handed players possess competitive advantages over right-handed players, potentially due to greater tactical unpredictability or perceptual benefits, particularly in invasion sports (Annett, 1985; Azemar et al., 1983; Yang et al., 2017). However, despite these assumptions, empirical evidence supporting a consistent performance advantage for left-handed athletes remains inconclusive (Loffing et al., 2016; Breznik, 2013; Yeo & Gangestad, 1993).

For example, if we turn to the literature review conducted by Bishop et al. (2018), we found in the main databases 16274 references (2621 in sports journals) of which only 18 had a relationship between asymmetry and sports performance and

were therefore included in their review. To our knowledge, this is the first study to compare players' shots taking into account their laterality in official competition.

In water polo, previous notational studies have primarily focused on shot performance, identifying shot efficacy—defined by coordination, strength, speed, and precision—as a decisive factor for success (Smith, 1998; Stevens et al., 2010; Van der Wende, 2005). In addition, researchers have analysed other shot-related variables such as velocity, accuracy, shooting location, game context, and pre-shot actions (e.g., De Conti et al., 2017; García-Cervantes et al., 2017; Sabio et al., 2020; van den Tilliar & Ettema, 2009).

Despite this body of research, very few studies have directly examined the role of handedness in water polo, and the existing evidence remains contradictory or incomplete. For instance, Sabio et al. (2020), reported a higher number of positive actions for left-handed players in peripheral positions; however, their analyses did not fully explore technical-tactical efficiency across different field zones, nor did they account for shot outcomes by handedness in both male and female elite players.

These gaps highlight two key limitations in the existing literature: first, the absence of systematic, competition-based analyses examining how handedness influences shot efficacy and technical-tactical outcomes in water polo; and second, the limited consideration of positional differences, despite the strong tactical relevance of lateral shooting angles. To address these gaps, the present study provides a comprehensive, match-based analysis of shot performance according to handedness across playing positions, allowing for a clearer understanding of whether left-handed players possess a genuine tactical advantage. By integrating shot outcomes, field zones, and positional roles, this study offers novel evidence to inform both performance analysis and training strategies in elite water polo.

Consequently, the aim of this study is to compare the performance efficiency of

right-handed and left-handed elite water polo players, as well as to analyse if shot efficacy varies across field positions across the game.

2. Materials and Methods

Design - An observational study (Anguera, 2003) that analysed all shots (5422) performed in male and female matches from the European Championships held in Hungary.

Subjects — The total sample comprised 2724 male and 2698 female shots.

Methodology — The matches of the analysed championship were obtained through the online broadcasts of LEN TV, LEN Video and Spanish Radio Television. The combination of the three media made it possible to perfectly observe all shots, the thrower, and the goalkeeper. The field format for match analysis was designed by the software LINCÉ (Gabin et al., 2012), following the previous studies structure (Argudo et al., 2021). Subsequently, six observers, with more than 300h of experience in observational studies of water polo consensually and have received training in observational categorization, analysed all shots with high inter-rater reliability ($\kappa > 0.90$). In addition, the variables considered in this study were:

(0) Laterality: left-handed or right-handed throwers.

(1) Team: winner or loser at the end of a match.

(2). Team level: position at the end of the tournament, considering medallists and others. As well as segmenting the sample according to the level reached (first four classified, from 5th to 8th classified, from 9th to 12th and from 13th to 16th classified).

(3) Momentary score: considering whether the result was a draw, with a difference of one, two, three or more goals.

(4) Situational framework:

- Equality: both teams have the same number of players, and they play on one of the two sides of the field.

- Counter-attack: numerical advantage of the attacking team originated by a change in ball possession and swimming to the other field.

- Inequality: numerical advantage of the attacking team originated by one or more defender's being temporarily removed for a serious foul.

- Penalty: shot from 5 m against the goalie due to a serious foul by a defender.

(5) Shot position: field zone from which the shot comes (Figure 1): LE: Left, C: Center or RI: Right

(6) Feint: presence or absence in the shot:

- WF: shot with feint
- OUTF: shot without feint

(7) Technique:

- Tense shot: the ball follows a trajectory parallel to the water.

- Tense shot with bounce: the ball follows a descending trajectory and then ascends after bouncing off the water.

- Vaseline shot: the ball follows a parabolic trajectory, first ascending and then descending.

- Backhand shot: the player with their back to the goal performs a turn in place and releases the ball at the same time.

- Others: gestural forms distinct from those previously described and that appear with lower frequency in the game.

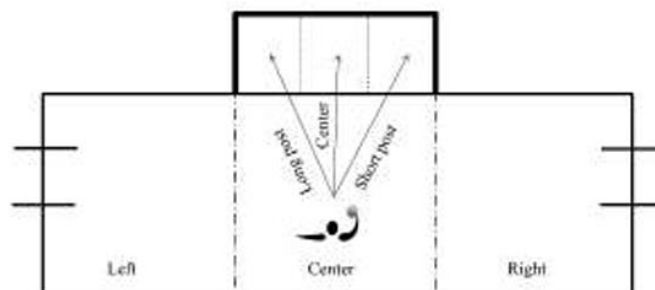
(8) Fault: shot from behind the 5 m line because of an ordinary foul by a defender:

- AF: after fault
- WFA: without fault

(9) 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) (Figure 1): short post, center or long post.

(10) Result: Goal or no goal.

Figure 1. Field format and shot positions, goal zones and shot directions.



Statistical analysis - The inferential analysis began by studying the normality of the variables using the Shapiro-Wilk test and inspection of Q-Q plots and verifying using Levene's test the homogeneity of variances, observing a non-normal distribution of the data, so non-parametric techniques were applied to check the differences between two independent groups such as the results of efficiency of the shots made by left-handed and right-handed throwers, the shots present in the men's and women's competition, the existence of a previous feint or not, as well as whether the shot was made directly after receiving a foul, as during the previous phase of the competition or the final phase, the result of the shot, goal or no goal, as well as the condition of winner or loser of the match (using the Mann-Whitney U test). Similarly, and due to the reduction in sample size when segmenting and categorising the sample, the ANOVA test with Welch's correction and Games-Howell, contingency tables and the chi-squared was used to establish differences between the shots made according to the laterality of the thrower and the period of play (1st, 2nd, 3rd, 4th and penalties), the situational framework (1- Equality, 2- Counterattack, 3- Inequality and 4- Penalty); the position from which the shot is taken (Left, Center or Right); the type of shot (Tense, 2- With bounce, 3- Vaseline, 4- Backhand and Others), the direction (Short post, Center or

Large post), as well as the level reached (first four classified, from 5th to 8th classified, from 9th to 12th and from 13th to 16th classified). Likewise, regression formulas were used to establish possible explanatory formulas for the level. The SPSS 28.0 (IBM Corp., Armonk, NY, USA, 2021), statistical package was used to carry out the analyses, establishing a confidence level of 95% ($p < 0.05$). A description of the design, subject information (including a statement that institutional review board approval was granted, in the spirit of the Helsinki Declaration), interventions, outcome measures, and statistical analyses.

3. Results

The 5422 shots taken in the championship were analysed, of which 1926 resulted in a goal (35.5% efficiency). The data (Table 1) are broken down according to sex (men: $n=984$ goals; women: $n = 942$ goals), sporting success (medallists: $n = 978$ goals; non-medallists: $n = 1176$ goals), throwing zone (left: $n = 513$; center: $n = 978$; right: $n = 435$), type of shot and laterality of the thrower. We found that 765 shots were made by left-handed players, of which 274 (35.82%) ended in a goal, compared to 4657 shots made by right-handed players, who obtained a scoring efficiency of 35.47%. If we look at these data according to sex: men (left-handed) showed an efficiency of 38.06% in the 465 shots thrown, while women reached an efficiency of 32.33% (300 shots).

Table 1. Descriptive data of the shots and the efficiency observed in the championship.

	Total				Men competition				Women competition				Medallist				Non Medallist				Right Zone				Left Zone			
Shot	LH	%	RH	%	LH	%	RH	%	LH	%	RH	%	LH	%	RH	%	LH	%	RH	%	LH	%	RH	%	LH	%	RH	%
Total	765	35,8	4657	35,5	465	38,1	2259	35,7	300	32,3	2398	35,2	216	43,5	1524	43	549	32,8	3133	31,8	31	32,3	1531	32,9	233	39,1	2254	39,4
Win	423	42,6	2531	45,6	256	42,2	1216	42,5	167	43,1	1315	48,5	153	49	1152	47,7	270	38,9	1379	43,9	16	43,8	796	41,8	129	47,3	1312	49,1
Loose	342	27,5	2126	23,4	209	33	1043	27,8	133	18,8	1083	19,1	63	30,2	372	28,8	279	26,9	1754	22,2	15	20	735	23,1	104	28,8	942	25,8
Equality	391	23,5	2436	24,9	223	23,3	1107	25,7	168	23,8	1329	24,2	87	29,9	701	29,7	304	21,7	1735	23	15	20	754	22,8	133	23,3	1167	27
Counter	98	50	691	49,1	52	53,8	313	41,9	46	45,7	378	55	30	53,3	293	57	68	48,5	398	43,2	4	50	261	45,6	24	50	277	53,1
Inequality	246	43,9	1356	43,1	166	45,8	759	44,3	80	40	597	41,7	86	46,5	466	50,2	160	42,5	890	39,4	12	41,7	516	41,1	46	50	639	47,7
Direct	496	30,6	2954	31,9	308	33,8	1448	31,7	188	25,5	1506	32,1	141	39,7	972	39,5	355	27	1982	28,2	18	33,3	1036	30,6	126	31	1372	34,8
Rebound	159	54,7	959	47,8	107	55,1	496	47	52	53,8	463	48,6	56	62,5	301	53,5	103	50,5	658	45,1	11	36,4	349	43,6	49	59,2	398	54,8
Other	110	31,8	744	33,7	50	28	315	36,5	60	35	429	31,7	19	15,8	251	44,2	91	35,2	493	28,4	2	0	146	23,3	58	39,7	484	39,7

Legend: RH: right-handed; LH: left-handed; %: Percentage of shot efficiency

Table 2. Descriptive data of the championship goals and average comparisons made according to laterality (left-handed vs. right-handed) as a function of the variables considered in the study.

	Group		Period 2		Period 4		Actual score ±1		Actual score ±2		Actual score ±4		Counter		Right Zone		Without Feint		Rebound Shot		Lob Shot		Large Post	
	LH	RH	LH	RH	LH	RH	LH	RH	LH	RH	LH	RH	LH	RH	LH	RH	LH	RH	LH	RH	LH	RH	LH	RH
Tourn	165	977	76	412	61	403	63	319	40	206	103	721	49	339	173	262	190	1262	87	458	6	67	114	654
Group			50	240	38	252	24	146	24	102	84	538	35	229	104	151	109	740	49	255	4	45	68	390
Final			26	172	23	151	39	173	16	104	19*	183*	14	110	69	111	81	522	38	203	2	22	46	264
Men	94	395	47*	210*	41	197	44	181	33	119	49	275	28	131	110	126	119	602	59	233	3	19	70	324
Women	71	582	29	202	20	206	19	138	7	87	54*	446*	21	208	63	136	71	660	28	225	3	48	44	330
Left Zone	9	285	1	119	3	129	0	94	3	70	5	211	2	119	0	0	5	362	4	152	0	26	5	177
Right Zone	104	151	48	71	41	63	45	44	25	32	61	121	35	73	173	262	109	197	54	88	5	17	63	96
Equality	52	371	24	161	18	145	21	115	10	70	34	262			58	120	68	448	31	147	1	28	29	243
Counter	35	229	19	83	13	86	10	33	2	41	28	209	49	339	35	73	30	246	16	103	3	35	21	146
Inequality	67	310	28	150	26	146	26	141	24*	80*	36	205			80	68	67	447	27	138	2	4	44	200
Non Medallist	118*	566*	51	249	42	239	41	199	27	137	67	416	33	172	108	159	124	768	52	297	5	28	80*	393*
5º - 8º	64	287	30	123	24	118	27	98	21*	65*	29	203	16	82	62	86	69	391	29	140	3	18	46	195
-1	24	146	20	86	7	34	63	319					10*	33*	45*	44*	48*	242*	23*	72*	1	11	23	126
-3	11	84	6	55	8	31							4	27	14	31	17	122	8	51	0*	5*	7	68
Short Post	89	505	44	211	27	213	37	164	17	106	52*	394*	25	154	96	148	100	685	48	258	0*	9*		
Without Feint	109	740	54	308	40*	304*	48*	242*	24	162	69*	550*	30	246	109	197	190	1262	61	360	2	44	78	470

Legend: Tourn: Tournament; Group: group phase; RH: right-handed; LH: left-handed; * p-value <0.05.

On the other hand, if we consider the differences between left-handed and right-handed players in those variables that are not dichotomous. For the total sample, significant differences were found according to laterality and throwing zone through the ANOVA test carried out in this respect ($F=471.1$; $\eta^2=0.15$; $p < 0.001$), the type of shot ($F=2.026$; $\eta^2=0.02$; $p < 0.05$), the direction ($F=0.32$; $\eta^2=0.01$; $p < 0.05$) and the level reached ($F=0.35$; $\eta^2=0.02$; $p < 0.05$). When considering the male sample, significant differences were observed as a function of laterality and partial score ($F=0.35$; $\eta^2=0.04$; $p < 0.05$), throwing zone ($F=32.84$; $\eta^2=0.17$; $p < 0.001$), shot type ($F=3.85$; $\eta^2=0.01$; $p < 0.05$), shot direction ($F=0.32$; $\eta^2=0.04$; $p < 0.05$) and level reached ($F=0.39$; $\eta^2=0.0041$; $p < 0.05$). While the female sample, significant differences were found as a function of laterality and partial score ($F=0.42$; $\eta^2=0.006$; $p < 0.05$), throwing zone ($F=4.29$; $\eta^2=0.128$; $p < 0.001$), shot type ($F=2.197$; $\eta^2=0.003$; $p < 0.05$) and level reached ($F=2.57$; $\eta^2=0.004$; $p < 0.05$).

Similarly, through the chi-square test, significant differences were found for the total sample between laterality and throwing zone ($\chi^2 = 803.08$; $gl = 2$; $p < 0.001$) and between laterality and level reached ($\chi^2 = 11.704$; $gl = 4$; $p < 0.02$). Whereas, in the male sample, significant differences were observed between laterality and partial score ($\chi^2 = 9.9948$; $gl = 4$; $p < 0.05$), throwing zone ($\chi^2 = 463.9$; $gl = 2$; $p < 0.001$), the type of throw ($\chi^2 = 15.358$; $gl = 4$; $p < 0.004$), shot direction ($\chi^2 = 12.17$; $gl = 2$; $p < 0.003$) and the level reached ($\chi^2 = 11.147$; $gl = 4$; $p < 0.03$). And in the female sample, significant differences were found between laterality and partial score ($\chi^2 = 17.112$; $gl = 4$; $p < 0.002$), throwing zone ($\chi^2 = 346.08$; $gl = 2$; $p < 0.001$) and level reached ($\chi^2 = 10.25$; $gl = 4$; $p < 0.04$).

Finally, regression models were developed to predict the classification in the Championship according to the variables analysed as a function of the laterality of their performer, finding:

Ranking Left-Handed = $5.35 - 0.84 * \text{phase} - 0.75 * \text{period 1} - 0.97 * \text{period 4} - 0.95 * \text{score } (\pm 1) + 2.99 * \text{winner of the match}$

Ranking Right-Handed = $3.06 - 0.41 * \text{period 1} - 0.49 * \text{period 3} - 0.51 * \text{period 4} + 0.4 * \text{score } (\pm 1) + 1.17 * \text{score } (\pm 2) + 1.54 * \text{score } (\pm 3) + 1.28 * \text{score } (\pm 4) + 3.09 * \text{winner} - 0.37 * \text{feint} - 0.68 * \text{backhand shot} - 0.62 * \text{foul} + 0.48 * \text{center} + 0.51 * \text{shot stopped} + 0.46 * \text{shot blocked} + 0.49 * \text{out}$

Ranking Left-Handed Men = $6.48 - 1 * \text{phase} - 1.5 * \text{period 4} + 3.25 * \text{winner} - 0.88 * \text{feint}$

Ranking Right-Handed Men = $4.20 - 0.56 * \text{phase} - 0.58 * \text{period 2} - 0.84 * \text{Period 3} - 0.83 * \text{Period 4} - 6 * \text{Penalty} + 1.36 * \text{score } (\pm 1) + 1.38 * \text{score } (\pm 2) + 2.0 * \text{score } (\pm 3) + 3.44 * \text{winner} + 0.6 * \text{blocked shot} + 0.76 * \text{shot out}$

Ranking Left-Handed Women = $2.68 * \text{winner} + 1.09 * \text{feint} + 0.78 * \text{large post} + 1.11 * \text{post shot}$

Ranking Right-handed Women = $- 0.32 * \text{phase} - 0.40 * \text{period 2} - 0.44 * \text{period 3} - 0.50 * \text{period 4} + 2.5 * \text{penalty} + 0.83 * \text{score } (\pm 2) + 1.33 * \text{score } (\pm 3) + 1.18 * \text{score } (\pm 4) + 2.71 * \text{winner} - 0.51 * \text{counterattack} - 0.62 * \text{inequality} - 0.37 * \text{center} - 0.46 * \text{goal} + 0.40 * \text{shot stopped} + 0.62 * \text{shot out}$

4. Discussion

The results of this study confirm that laterality significantly influences the effectiveness of some shots in water polo, particularly in peripheral positions such as zones 1 and 2 (which are on the right side of the field and therefore considered as the strong side for left-handed players), especially highlighting the differences found when the outcome of the match is ± 1 . This implied that, in this part of the field, left-handed players obtained a tactical advantage by achieving 45.5% scoring efficiency in zone 1 and 48.8% in zone 2, surpassing right-handed players who obtained 22.2% and 36.3% respectively in this zone. These results suggest that, under conditions of competitive balance, left-handed players may gain a tactical advantage in peripheral positions.

One possible explanation is that, in evenly matched games, teams tend to circulate the ball more rapidly to exploit defensive imbalances, often finishing offensive sequences on the strong side of left-handed players. This reduces the time required for ball control and shot execution, thereby increasing performance efficiency, as previously observed in numerical superiority situations (Argudo et al., 2021). In line with this interpretation, and although not a

primary objective of this study, left-handed players in zones 1 and 2 also generated a greater number of positive actions (e.g., exclusions, penalties, corners), supporting the hypothesis that their relative rarity in the sport population (Grouios et al., 2000) poses perceptual and tactical challenges for defenders and goalkeepers (Yang et al., 2017).

However, if we take into consideration the gender differences in the advantage observed on the part of left-handed players, when reviewing the results obtained, and even though on average we can say that the efficiency of left-handed players is higher than that of right-handed players, although these differences do not seem to be significant. It is worth noting that left-handed players have a lower efficiency than right-handed players ($n=391$, 23.5%; $n=2436$, 24.9%) and in Tense shot ($n=496$, 30.6%; $n=2954$, 31.9%). In male competition, the better efficacy of left-handers is observed in all the variables considered, except in Equality situation shots ($n=223$, 23.3%; $n=1107$, 25.7%). However, this does not occur in the case of the female, where lower efficacy rates are observed when comparing left-handed and right-handed throwers except for rebound shot ($n=52$, 53.8%; $n=463$, 48.6%). In this sense, it is found that the advantage of left-handers was more pronounced in men (38.06%) than in women (32.33%).

These gender-specific patterns may be explained by several factors. Previous research has reported an overrepresentation of left-handed players in male competitions (Laxdal et al., 2024), which may reinforce their tactical integration and exploitation. In contrast, the lower frequency of left-handed players in female categories may result in fewer game situations that systematically exploit lateral advantages, as well as differences in defensive strategies and levels of exposure to left-handed opponents (Loffing et al., 2016). These findings reinforce the importance of conducting gender-specific analyses, as tactical dynamics, defensive behaviors, and performance determinants may differ substantially between male and female competitions (Breznik, 2013).

Interestingly, certain results appear to contradict previous findings in water polo (Sabio et al., 2020, 2021) and handball (De Conti et al., 2017), where left-handed players typically demonstrate superior efficiency from lateral positions due to less predictable shooting angles and increased goalkeeper anticipation difficulty (Bideau et al., 2004). However, similar to the findings of Laxdal et al. (2024), our results did not consistently show a left-handed advantage in specific shot types, such as penalty or rebound situations. These discrepancies highlight the need for more detailed analyses incorporating contextual and technical variables to better understand performance differences between left- and right-handed players, particularly given the relatively low proportion of shots taken by left-handed players in this study (approximately 14%).

From a spatial perspective, the lower effectiveness of shots from zones 1 and 2 compared with central areas suggests that, despite their strategic importance for generating exclusions, these zones present greater technical and tactical challenges, such as reduced shooting angles and increased defensive pressure (Argudo et al., 2016). Nevertheless, the superior performance of left-handed players in these areas underscores their tactical value in destabilizing organized defenses, especially during situations of numerical equality (Sabio-Lago et al., 2021).

Similarly, according to Sabio et al. (2021), it is necessary to emphasize and teach right-handed players the importance of technique and body position in the water. As well as taking care of the technique of displacements, especially in those athletes with asymmetries in the extremities greater than 10% (Dos Santos et al., 2013), since in addition to being an indicator of injury it seems to be a reason for a reduction in scoring efficiency, although more detailed and specific studies need to be done in this regard.

In addition to the inherent limitations of observational design, several methodological factors should be considered when interpreting

these findings. First, differences in team level and competitive strength were not controlled for, which may have influenced shot selection and effectiveness. Similarly, opponent quality and defensive organization could have affected performance outcomes, particularly in close matches. Moreover, contextual variables such as fatigue were not included in the analysis and may interact with laterality effects. Finally, the relatively lower number of actions performed by left-handed players limits the generalizability of certain comparisons and highlights the need for future studies with larger and more balanced samples. However, this study seems to open the door to future work that investigates the kinematic differences between shots performed by right-handed and left-handed players, determining velocity, angle, etc., and analysing how fatigue affects efficiency by laterality in the final phases.

5. Practical Applications.

From a practical standpoint, the findings of this study highlight the strategic importance of exploiting laterality in offensive play, particularly in peripheral positions such as zones 1 and 2, which represent the weak side for right-handed players and the strong side for left-handed players. Coaches and performance analysts should deliberately design offensive structures that maximise ball circulation toward these zones, especially in situations of numerical equality or closely matches, where laterality-related advantages appear to be most pronounced.

Given the defensive attention typically directed toward left-handed players in these positions, it is essential that they are systematically exposed to training tasks involving high-frequency shooting and assisting actions under defensive pressure. Specifically, training drills should encourage attacking the defender's outside arm, as well as exploiting inside and over-the-top shooting trajectories to overcome various types of zone defenses. Developing a broad technical repertoire in these players—including quick-release shots, body orientation adjustments,

and deceptive passing options—may enhance their ability to maintain effectiveness despite increased defensive focus.

In addition, right-handed players occupying these same zones should receive targeted technical training to mitigate their positional disadvantage. Emphasis should be placed on improving body positioning, shooting mechanics, and decision-making to compensate for less favorable shooting angles. Finally, these findings support the inclusion of laterality-based criteria in talent identification, player positioning, and match preparation, enabling coaches to tailor tactical plans and training loads according to the lateral characteristics and positional demands of their athletes.

6. Conclusions

This study provides evidence on the importance of considering laterality in the analysis of water polo performance. Thus, from the findings described here it is inferred that laterality is a critical factor in offensive water polo performance, with clear implications for player selection and tactical design. The left-handed advantage not only reflects their population rarity, but also adaptive technical skills that challenge conventional defensive structures. Which can and should have implications for coaching through technical development of left-handers in zones 1 and 2 to exploit their angular advantage and generate defensive asymmetries. On the other hand, right-handers should improve their versatility in lateral positions through crosses and feints, techniques that neutralize zone defenses from this zone. This has repercussions on the preparation of goalkeepers who require specific training against left- or right-handed shots, since their kinematics differ in arm rotation and release point.

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