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Original Article

Short-term influence of rule changes on match characteristics in water polo

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Abstract
The Fédération Internationale de Natation implemented rule changes in 2013 to promote more dynamic movement, creativity, explosive speeds and reduce static situations in water polo. This study aimed to determine if the intents of the rule changes were met. The characteristics of 16 international matches played by the same team under both the old (n = 8) and new (n = 8) rules were compared. Under the new rules, there was a decrease in the average total number of shots from the offensive 2-m area (72%), impediments (70%) in most field of play except the center, and ordinary fouls in the offensive 5 m and beyond area (57%), thereby suggesting more dynamic play. Conversely, there was an increase in average total static time (25%) arising from an increase in the average total number of exclusion fouls (110%) albeit an increase in the number of passes prior to the offence (86%). The intents of the rule changes were partially achieved.
Keywords*:* performance analysis, water polo, tactics, team sport, location-based analysis, rule change

Introduction

Rule changes in invasion sports have previously been introduced with various aims ranging from increasing safety to making the game more attractive and entertaining (Arias, Argudo Iturriaga, & Alonso Roque, 2011; Williams, 2007). In football, the offside law was implemented in the 1930s. The intent was to prevent 'football-tennis', and encourage the game to be played using the entire playing area (Kew, 1987) and re-emphasize the uniqueness of football (i.e, display of ball control skills and 'taking men on'). Rule changes have also been implemented to reduce technical offences such as fouls and/or dangerous play (Williams, 2007) that are prevalent in sports such as water polo whereby there are approximately three times more fouls that occur in a game than in football (Hraste, Bebic, & Rudic, 2013).

The first water polo game was characterized by uncontrolled play that involved a lot of diving underwater and sinking of opponents, without attention paid to technique or rules (Hraste et al., 2013). Since time is stopped when a foul occurs in water polo, stoppage time can be equivalent to the time players spend swimming (Platanou, 2004). Water polo has since evolved through numerous periods of rule changes (Donev & Aleksandrović, 2008; Hraste et al., 2013). Modern water polo is a high tempo game played with six field players and one goalkeeper per team with rolling substitutions. There are four periods, each lasting for eight minutes. The offensive team can possess the ball for 30 seconds that restarts in the event of a turnover foul, an exclusion foul, or a shot on goal. Ordinary and exclusion fouls can happen anywhere in the field of play. A penalty foul is awarded if a defending player commits a foul within five meters of the defensive goal post. This normally results in a goal being conceded. Nonetheless, modern water polo is still plagued with excessive physical contact and static offensive play (Hraste et al., 2013).

The intents of the 2013 rule changes by the Fédération Internationale de Natation (FINA) was to bring out more movement, creativity and explosive speed, to remove static situations, and to provide more clarity to the correct application of rules. One major rule change is for referees to award an exclusion foul instead of an ordinary foul to players who impede any opponent not holding the ball, regardless of possession, to slow the game down throughout the entire playing area (FINA., 2013). Traditionally, a defensive player could impede an offensive player by swimming across his/her legs or shoulders, and/or by restricting his/her movements with two hands without getting excluded. Any foul to stop the flow of the game especially during counter attack must result in an exclusion. Referees are also instructed to play advantage at all times, with the discretion to award (or not award) any fouls, in favor of the attacking team. Other rule changes include but are not limited to: increasing timeouts from two per match to one per quarter; replacing extra time with a penalty shootout; restarting the shot clock during simultaneous exclusions of players from opposing teams and awarding an ordinary foul to the opposing team for simulation of being fouled to waste time. These rule changes will likely influence the proceedings of the game, with implications on match characteristics, performance demands on the players and coaching strategies.

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Notational analysis has been used to quantify technical and tactical aspects of various team sports such as Water Polo as an indication of a team's performance. Some examples include the differences in game-related statistics between winning and losing water polo teams (Argudo Iturriaga, F. M., Roque, Marín, & Lara, 2007; Argudo Iturriaga, Ruiz Lara, & Alonso Roque, 2009; Escalante et al., 2012; Escalante, Saavedra, Mansilla, & Tella, 2011; Lupo, Condello, & Tessitore, 2012; Lupo, Tessitore, Minganti, & Capranica, 2010; Vila, Abraldes, Alcaraz, Rodríguez, & Ferragut, 2011), the effects of competition level on the offensive center forward's role (Lupo et al., 2012), analyses of shots according to player's position (Özkol, Turunç, & Dopsaj, 2013), and differences between elite and sub-elite water polo matches (Lupo et al., 2010). Notational analyses would also be useful in quantifying the potential change in the technical and tactical aspects of water polo after the implementation of rule changes.

This study aims to quantify and understand the immediate influences of the 2013 rule changes on match characteristics. This will be accomplished by comparing international water polo matches played according to the new rules (between 2 to 12 months from implementation) versus the old rules by a competitive water polo men's team using notational analysis of video footages. Water polo coaches and athletes are likely to have ideas or assumptions of the implications of the rule changes on game play, both in the short and long-term, this study will provide coaches and players with objective data. The findings will potentially allow for more informed programming of training sessions and strategizing by coaches and players to meet the new performance requirements.

Materials and Methods

Samples

Sixteen international water polo matches played by the Singapore water polo men's team from 2012 to 2014 were analyzed; eight games before and eight games after the implementation of the rule changes in 2013. The competitions before the rule changes consisted of the 2012 Asian Championships (Dubai) and the 2013 Asian Cup (Singapore), and the competitions after the rule changes consisted of the 2013 Southeast Asian Games (Myanmar) and the 2014 Asian Games (Korea). These 16 selected matches were considered to have similar team dynamics as the team was largely unchanged and spread of competition levels (based on the professional opinions of national coaches and sports scientists) in the eight matches before and after the rule changes. Ethics approval was obtained by the institutional review boards of the Singapore Sports Institute and the Nanyang Technological University.

Variables

The independent variable was the type of rule (new or old) the matches were played in while match-related dependent variables are listed in Table 1 below.

Table 1. Match-related dependent variables and its operational definitions.

Variable	Operational Definition
Goals	Number of goals scored
Shots on goal*	Number of shots on goal attempted
Ball fed to offensive center forward*	Number of times the ball is being fed to the offensive center forward (with reference from where the ball is fed from)
Ordinary fouls*	Number of ordinary fouls committed whereby a free throw is awarded to the opponent
Exclusion fouls*	Number of exclusion fouls committed whereby a free throw is awarded to the opponent and the offending player is out of the game for 20 seconds
Penalty fouls*	Number of penalty fouls committed whereby a penalty throw is awarded to the opponent
Total fouls	Total number of ordinary, exclusion and penalty fouls.
Players held down or impeded*	Number of times a foul committed involves the opponent being held down or impeded
Counter fouls by offensive center forward*	Number of times the offensive center forward commits a foul leading to a turnover
Substitutions	Number of players substituted in a game
Timeouts	Number of timeouts used during a game

Passes per offence	Number of times the ball is passed from the start of possession to a shot on goal
Time to set up offence	Time taken to take a shot on goal from the start of possession
Stoppages (min)	Ineffective playing time in the game due to fouls/restarts. Does not include time during timeouts
Static time (min)	Total playing time (min) – Stoppages (min) – Total time taken for timeouts for both teams.

*Note: * Indicates location based analysis was performed; Static time (min) = [total playing time - 32 - total time taken to restart after a goal by both teams - total time taken for timeouts by both teams]*

Notational analysis

A notational analysis software, Sports Code Elite (version 8.4.1, Warriewood, NSW, Australia), was used to analyze the matches. Each match was analyzed individually to identify and quantify the match-related variables in Table I for the team. These variables that include frequency counts and temporal information were then extracted from the software for compilation and further analysis.

The water polo field of play was divided into left, center and right with reference to the offensive goal post, and each half of the court was divided into the offensive and defensive 2 m, 5 m and 5 m and beyond areas (Figure 1). Location based analyses according to this division of the field of play was performed for the relevant variables indicated in Table 1.

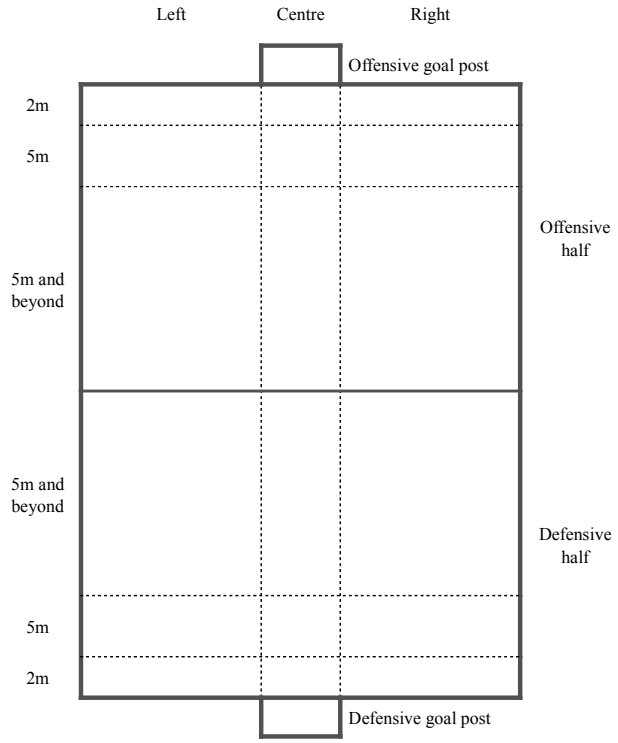

Figure 1. Division of water polo court for match analysis.

Rater reliability

Intra- and inter-rater reliability was assessed to determine the reliability of the coding process (Table 2). To determine intra-rater reliability, five matches were coded twice by the same coder, separated by two weeks for the variables listed in Table 1. To ensure validity of the event selection and reliability of the location that it occurred, inter-rater reliability was performed to ensure (location and variable agreement) was established through the comparison of 2 matches between two coders, while passes per offence (counts) was based on a set of common events between the two coders. The coders are versed in notational analysis and proficient in the use of Sports Code Elite. Intra- and inter-rater reliability were assessed with either the Cohen's Kappa or the intraclass correlation coefficient (ICC), two-way random effects, single measures model for absolute agreement. Cohen's Kappa was used for location agreement of variables where location based analysis was performed as indicated in Table 1. ICC was used for time to set up offence, passes per offence and frequency counts of the remaining variables in Table 1. There was high intra- and inter-rater reliability as listed in Table 2.

Table 2. Intra- and inter-rater reliability

	Intra-rater		Inter-rater	
	Test statistic	95% confidence intervals	Test statistic	95% confidence intervals
Location agreement	Kappa = 0.996	N/A	Kappa = 0.967	N/A
Variable counts#	ICC = 0.989	(0.979, 0.994)	ICC = 0.981	(0.950, 0.993)
Time variables*	ICC = 0.999	(0.999, 0.999)	ICC = N/A	N/A
Passes per offence	ICC = 0.989	(0.984, 0.992)	ICC = 0.996	(0.944, 0.999)

*# Variable count was performed for each individual variable listed in Table 1. * Time Variables was measured using the time displayed on SportsCode Elite*

Statistical analysis

Differences in match characteristics between the new and old rules were assessed using the Wilcoxon signed rank test and effect size *r* due to violations in normality. Magnitudes of effect size are interpreted by r: 0.1-0.3 = small, r > 0.3-0.5 = medium and r > 0.5 = large.. was set at $P < 0.05$. Statistical significance was set at $P < 0.05$. Statistical analyses for intra- and inter-rater reliability was determined using R (version 3.2.5), while all others were performed with SPSS (version 22.0).

Results

Frequency of occurrence and duration of match-related variables

There was an increase in the number of passes per offence, exclusion fouls, static time, and decreased instances of players held down or impeded (Table 3). All other variables had no statistically significant differences.

Table 3. Frequency of occurrence and duration of match-related variables in new and old rules, mean ± *s* (median) with exact *P*-value, *Z* score and absolute effect size, *r*. *$P < 0.05$.

	New rules	Old rules	*P*	*Z*	*r*
Goals	9.8 ± 3.7 (8.5)	8.8 ± 6.6 (8.0)	0.462	-0.736	0.184
Shots on goal	26.9 ± 5.1 (25.0)	30.0 ± 4.7 (28.0)	0.362	-0.911	0.228
Ball fed to offensive center forward	18.4 ± 6.0 (18.0)	19.5 ± 8.9 (18.0)	1.000	0	0
Ordinary fouls	35.5 ± 18.2 (32.5)	39.3 ± 16.1 (43.0)	0.400	-0.842	0.211
Exclusion fouls	7.1 ± 3.9 (8.0)	3.8 ± 1.5 (3.5)	*0.034	-2.117	0.529
Penalty fouls	1.0 ± 0.9 (1.0)	0.4 ± 0.5 (0)	0.157	-1.414	0.354
Total fouls	43.6 ± 19.5 (40)	43.4 ± 15.9 (47)	0.933	-0.085	0.021
Players held down or impeded	7.5 ± 3.5 (8.0)	24.8 ± 10.5 (23.0)	*0.012	-2.521	0.630
Counter fouls by offensive center forward	3.3 ± 2.5 (2.5)	3.6 ± 2.6 (5.0)	0.609	-0.512	0.128
Timeouts	1.4 ± 1.2 (1.0)	1.3 ± 0.9 (1.5)	0.739	-0.333	0.083
Substitutions	26.0 ± 6.5 (25.0)	18.8 ± 7.8 (15.5)	0.069	-1.820	0.455
Passes per offence	4.3 ± 0.4 (4.2)	3.3 ± 0.5 (3.5)	*0.012	-2.521	0.630

Stoppages (min)	7.0 ± 1.6 (6.8)	5.6 ± 1.1 (5.2)	*0.017	-	0.595
Time to set up offence (s)	18.7 ± 2.1 (18.3)	18.9 ± 2.7 (19.2)	0.779	-0.280	0.070

Location-based analysis

Table 4 shows the results of the location-based analysis for the frequency of occurrence of match-related variables in the left, center and right sides of the pool. Tables 5 to 7 show the results of the frequency of occurrence of match-related variables in the offensive and defensive 2 m, 5 m, and 5 m and beyond areas respectively.

There were more exclusions in the center, and ordinary fouls in the offensive 2 m and defensive 2-m areas. Conversely, there were less players held down or impeded in the offensive 5 m, offensive 5 m and beyond, defensive 5 m and beyond areas, and the left and right sides of the pool. There were also less ordinary fouls in the offensive 5 m and beyond area, and shots on goal from the offensive 2-m area and right side of the pool.

Table 4. Location based (left/ center/ right) frequency of occurrence of match-related variables in the new and old rules, mean ± *s* (median) with exact *P*-value, *Z* score and absolute effect size, *r*.*$P < 0.05$.

	Left					*Center*					*Right*				
	New rules	Old rules	*P*	*Z*	*r*	New rules	Old rules	*P*	*Z*	*r*	New rules	Old rules	*P*	*Z*	*r*
Goals	2.8 ± 1.8 (2.0)	2.0 ± 1.5 (2.0)	0.180	-1.342	0.336	4.6 ± 2.2 (4.0)	4.6 ± 4.5 (3.0)	0.621	-0.494	0.124	2.4 ± 1.2 (2.0)	2.3 ± 1.8 (2.0)	1.000	0	0
Shots on goal	8.0 ± 2.4 (7.5)	8.0 ± 2.8 (8.5)	0.916	-0.105	0.026	11.8 ± 4.1 (12.5)	13.0 ± 4.4 (12.0)	0.889	-0.140	0.035	7.1 ± 1.7 (7.5)	9.0 ± 2.5 (9.0)	*0.017	-2.392	0.598
Ball fed to OCF	5.6 ± 2.9 (5.0)	8.4 ± 5.1 (7.5)	0.205	-1.266	0.317	4.4 ± 2.1 (4.5)	4.1 ± 2.2 (4.5)	0.994	-0.071	0.018	8.4 ± 2.4 (9.0)	7.0 ± 4.3 (6.5)	0.481	-0.705	0.176
Ordinary fouls	17.1 ± 13.0 (13.0)	17.0 ± 8.7 (19.5)	0.889	-0.140	0.035	8.8 ± 5.9 (7.5)	9.8 ± 5.7 (10.5)	0.336	-0.962	0.241	9.6 ± 2.9 (9.5)	12.5 ± 7.0 (10.5)	0.261	-1.123	0.281
Exclusion fouls	1.6 ± 1.6 (1.0)	0.9 ± 0.8 (1.0)	0.236	-1.186	0.297	4.0 ± 2.1 (4.0)	1.9 ± 1.1 (1.5)	*0.041	-2.043	0.511	1.5 ± 1.5 (1.5)	1.0 ± 0.8 (1.0)	0.546	-0.604	0.151
Penalty fouls	0 (0)	0 (0)	1.000	0	0	0.8 ± 1.0 (0.5)	0.3 ± 0.5 (0)	0.180	-1.342	0.336	0.3 ± 0.5 (0)	0.1 ± 0.4 (0)	0.564	-0.577	0.144
Players held down or impeded	1.8 ± 1.8 (1.0)	9.6 ± 5.2 (9.0)	*0.018	-2.366	0.592	4.3 ± 1.8 (4.0)	6.3 ± 2.5 (5.5)	0.127	-1.527	0.382	1.4 ± 1.6 (1.0)	8.9 ± 5.8 (6.5)	*0.012	-2.527	0.632
Counter fouls by OCF	0.1 ± 0.4 (0)	0 (0)	0.317	-1.000	0.250	3.0 ± 2.4 (2.0)	3.1 ± 2.4 (4.5)	0.495	-0.682	0.171	0.1 ± 0.4 (0)	0.5 ± 0.8 (0)	0.180	-1.342	0.336

Note: OCF = offensive center forward.

Table 5. Location based (2 m) frequency of occurrence of match-related variables in the new and old rules, mean ± s (median) with exact P-value, Z score and absolute effect size, r. *$P < 0.05$.

	Offensive 2 m					Defensive 2 m				
	New rules	Old rules	P	Z	r	New rules	Old rules	P	Z	r
Goals	0.5 ± 0.8 (0)	1.8 ± 2.3 (1.0)	0.059	-1.890	0.473	-	-	-	-	-
Shots on goal	0.8 ± 1.0 (0.5)	2.6 ± 2.6 (2.0)	*0.016	-2.414	0.604	-	-	-	-	-
Ball fed to OCF	0.5 ± 0.8 (0)	0.8 ± 1.0 (0.5)	0.705	-0.378	0.095	-	-	-	-	-
Ordinary fouls	1.1 ± 0.8 (1.0)	0.1 ± 0.4 (0)	*0.046	-1.994	0.499	0.6 ± 0.5 (1.0)	0 (0)	*0.025	-2.236	0.559
Exclusion fouls	0 (0)	0 (0)	1.000	0	0	0.3 ± 0.5 (0)	0.3 ± 0.5 (0)	1.000	0	0
Penalty fouls	-	-	-	-	-	0 (0)	0 (0)	1.000	0	0
Players held down or impeded	0 (0)	0.1 ± 0.4 (0)	0.317	-1.000	0.250	0.3 ± 0.5 (0)	0.3 ± 0.5 (0)	1.000	0	0
Counter fouls by OCF	0.1 ± 0.4 (0)	0 (0)	0.317	-1.000	0.250	-	-	-	-	-

Note: OCF = offensive center forward. Due to the nature of these variables (Goals, Shots on goal, Ball fed to OCF, Counter fouls by OCF and Penalty Fouls), these events were not available/calculated for both offensive and defensive 2m.

Table 6. Location based (5 m) frequency of occurrence of match-related variables in the new and old rules, mean ± s (median) with exact P-value, Z score and absolute effect size, r. *P < 0.05.

	Offensive 5 m					Defensive 5 m				
	New rules	Old rules	P	Z	r	New rules	Old rules	P	Z	r
Goals	6.1 ± 2.7 (5.5)	4.5 ± 4.0 (3.0)	0.206	-1.265	0.316	-	-	-	-	-
Shots on goal	12.4 ± 3.6 (12.0)	11.5 ± 6.3 (11.5)	0.400	-0.841	0.210	-	-	-	-	-
Ball fed to OCF	5.1 ± 2.5 (5.0)	2.6 ± 2.3 (2.0)	0.051	-1.947	0.487	-	-	-	-	-
Ordinary fouls	3.6 ± 2.2 (3.5)	4.3 ± 3.4 (5.0)	0.435	-0.781	0.195	4.6 ± 3.0 (4.5)	4.9 ± 3.1 (4.0)	0.778	-0.281	0.070
Exclusion fouls	0.3 ± 0.5 (0)	0.3 ± 0.5 (0)	1.000	0	0	3.5 ± 2.6 (3.5)	1.9 ± 1.5 (2.0)	0.084	-1.725	0.431
Penalty fouls	-	-	-	-	-	1.0 ± 0.9 (1.0)	0.4 ± 0.5 (0)	0.157	-1.414	0.354
Players held down or impeded	0 (0)	2.5 ± 2.2 (2.5)	*0.027	-2.207	0.552	4.3 ± 2.7 (4.0)	5.4 ± 2.3 (5.5)	0.319	-0.997	0.249
Counter fouls by OCF	2.8 ± 2.5 (2.0)	3.3 ± 2.5 (4.5)	0.610	-0.511	0.128	-	-	-	-	-

Note: OCF = offensive center forward. Due to the nature of these variables (Goals, Shots on goal, Ball fed to OCF, Counter fouls by OCF and Penalty Fouls), these events were not available/calculated for both offensive and defensive 5m.

Table 7. Location based (5 m and beyond) frequency of occurrence of match-related variables in the new and old rules, mean ± s (median) with exact P-value, Z score and absolute effect size, r. *P < 0.05.

	Offensive 5 m and beyond	Defensive 5m and beyond

	New rules	Old rules	P	Z	r	New rules	Old rules	P	Z	r
Goalsa	3.1 ± 2.2 (3.0)	2.6 ± 1.4 (2.5)	0.546	-0.604	0.151	-	-	-	-	-
Shots on goala	13.8 ± 3.5 (13.5)	15.9 ± 7.0 (14.0)	0.396	-0.848	0.212	-	-	-	-	-
Ball fed to OCFa	12.8 ± 4.2 (13.5)	16.1 ± 7.6 (16.0)	0.175	-1.357	0.339	-	-	-	-	-
Ordinary fouls	2.9 ± 2.2 (2.0)	6.1 ± 3.8 (5.5)	*0.034	-2.120	0.530	22.6 ± 14.8 (19.0)	23.9 ± 12.3 (26.5)	0.398	-0.844	0.211
Exclusion fouls	0.8 ± 0.9 (0.5)	0.5 ± 0.8 (0)	0.589	-0.541	0.135	2.4 ± 1.6 (2.0)	0.9 ± 1.1 (0.5)	0.104	-1.625	0.406
Players held down or impeded	0.6 ± 0.7 (0.5)	2.1 ± 0.6 (2.0)	*0.016	-2.401	0.600	2.3 ± 1.7 (2.0)	14.4 ± 8.4 (14.5)	*0.012	-2.521	0.630
Counter fouls by OCF	0.4 ± 0.7 (0)	0.4 ± 0.5 (0)	1.000	0	0	-	-	-	-	-

Note: aIncludes whole area in the defensive half in addition to the mentioned area. OCF = offensive center forward. Due to the nature of these variables (Goals, Shots on goal, Ball fed to OCF, Counter fouls by OCF), these events were not available/calculated for Defensive 5m and beyond).

Discussion

A major intention of the 2013 rule change in water polo is to minimize static situations that occur due to instances of impediments and fouls. The current investigation observed that there was a reduction in the total instances of impediments by approximately 70%, especially in the left, right, offensive 5 m, 5 m and beyond, and defensive 5 m and beyond areas (Tables 4, 6 and 7) when the game was played in accordance with the new versus old rules. These decreases in instances of impediments were, however, met with an increase in the number of exclusion fouls.

While the total numbers of impediments and ordinary fouls decreased under the new rules, the number of exclusion fouls increased by approximately 87% under the new rules. The increase in the number of exclusions could possibly lead to more time spent in static situations in the game. This proposition is supported by the longer static duration present in matches played under the new rules (approximately 25%). Compared with an ordinary foul that involves a momentary pause of the game, an exclusion foul involves a longer pause due to the need for the referee to signal to the offending player and officials, and ensure that the offending player moves out of the playing area before resuming play. Consequently, while the instances of static situations may have decreased, the overall time spent in static situations increased. It remains inconclusive whether the 2013 rule change was effective in achieving its intent of "reducing static situations" and requires further clarification.

Location-based analyses revealed that there was a 110% increase in the number of exclusion fouls committed in the center but not in the left and right sides of the pool under the new rules. This suggests that teams may have strategized to earn exclusion fouls from the opposing teams in the center forward or center back positions. This finding is substantiated by a decrease in the number of players held down or impeded at the left (approximately 47%) and right (approximately 433%) but not at the center. Interestingly, passes to the offensive center forward at the offensive 5m almost doubled to 5.1 (± 2.5) passes from 2.6 (± 2.3) under the new rules. This doubling in the number of passes (Table 6) that approached significance ($p = 0.051$) and with a relatively significant effect size ($r = 0.487$) is worth noting and may provide further support for the postulation that teams may have strategized to earn exclusion fouls from the opposing teams in the center forward or center back positions. Furthermore, a 110% decrease in ordinary fouls committed in the offensive 5 m and beyond area and 1000% more ordinary fouls committed in the offensive 2-m area could mean that players were driving up closer toward the offensive goal post and more offensive and defensive play was occurring in that area.

Collectively, the games played under the new rules seem to be characterized by less static situations on the left and right of the pool but more concentrated play in the offensive 2-m area, especially where the offensive center forward is. This suggests more fluid play going down both sides of the pool, and potentially more dynamic movements and activity in the offensive 2-m area. The increase in the number of exclusion fouls in the center of the pool is usually characterized by the offensive center forward fighting for position against the defensive center back before the foul is committed. This duel often encompasses "explosive speed and dynamic movements" before the occurrence of a foul and therefore partially satisfies the intents of the rule change.

Exclusion fouls also mean that the offensive team has a one man advantage over the defensive team in a "six versus five" situation. The offensive team usually takes advantage of this and attempts to score by passing the ball around very quickly to their extra man for an open shot. This was reinforced by the 30% increase in the

number of passes per offence. Offensive players also often drive into the defensive zone to once again, exploit the advantage of having an extra player, and get into positions whereby they can receive a pass and subsequently shoot while unmarked. Both these scenarios did support the intents of the 2013 rule change; to promote more dynamic movements and reduce static situations; but only partially. There was an increase in static time that accompanied the increase in exclusion fouls as reported previously. As such, further clarification from FINA might be required to distinguish whether the rule change is meant to reduce static situations, static time, or both. Coaches/Teams may also want to place more emphasis on the offence and defense strategies related to "six versus five" situations in their training programs.

Despite more passes made per offence and exclusion fouls drawn by the offensive team from the defensive team under the new rules compared with the old rules, there was no increase in goals scored per game. An increase in six versus five situations generally result in more goals being scored/conceded. The 1000% increase in ordinary fouls committed in the offensive 2-m area would have resulted in increased turnovers and could have contributed to the approximate 69% decrease in shots at goal. This increase in ordinary fouls committed in the offensive 2-m area also contravenes an intent of the rule change which was for referees to "play advantage at all times, with the discretion to award (or not award) any fouls, in favor of the attacking team." Perhaps, the attacking teams could have tried to exploit this intent of the rule and committed fouls more freely on the defensive teams while the referees may not have fully embraced this intent in their umpiring. Future research could investigate the time lapse between rule changes and modifications in umpiring styles so that coaches and players can adjust their game play at the right time to avoid getting penalized for presumably fulfilling the intents of any rule changes.

An important point of consideration for this study is that the timeframe from the implementation of the rule changes to the matches played and analyzed in this study was short (2 to 12 months). The true extent of the impact of the 2013 rule changes on umpiring and coaching strategies, and thereby match characteristics, would require follow up studies of a similar nature to be performed. Furthermore, a limitation to this study is that activity profiles such as frequency and duration of movement characteristics (e.g. tread, cruise, sprint etc) and distance swum of all the players could not be analyzed due to the nature of the video recordings which does not cover every single player at every single time point as in the studies conducted by Platanou & Geladan, Polglazs, 2006 and Tae, & Dawson, 2009. The opponent teams analyzed were also not the exact same team, although they were matched as best as possible.

Conclusion

The 2013 rule changes in water polo had intentions to bring out more movement, creativity and explosive speed from the players during the game. These intents were reflected, in part, from an increase in the number of passes before a shot was taken and six versus five man-up situations. There were also more instances of players driving closer towards both the defensive and offensive goal post to prevent and attempt to score a goal respectively. The aforementioned can be inferred from the increased number of ordinary fouls in both the offensive and defensive 2-m areas and less shots taken from the offensive 2-m area due to turnovers before a shot could be taken.

Although the rule changes reduced instances of players being held down or impeded, it also increased the number of exclusions particularly in the center. This resulted in increased static time and thus more static situations instead of removing it as intended by the rule changes. It is possible that as more international competitions are being held in accordance to the new rules, coaches and players may adjust their strategies to minimize the exclusions. Therefore it is a bit too early to determine if the 2013 rule changes will have any long term effects on the tactical doctrine of water polo. It is suggested that this investigation be repeated to observe the longer term effects of the rule changes. A repeat of this investigation would also provide insight regarding the timeframes required for rule changes to effect changes in refereeing style and thereby, effect changes in the performance of the athletes. Other future studies could investigate the changes in specific positions such as the center forward, center back, and/ or perimeter players.

The statistics of the effects of the rule changes on match characteristics would provide the water polo community with a quantifiable basis for their next course of action. Water polo administrators are able to analyse and utilise this information for future rule changes while coaches are able to better strategise training programs and game tactics.

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

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