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Impact of ball possession time and number of passes on the efficiency of scoring in men's water polo

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THEODOROS PLATANOU[1], EVDOKIA VARAMENTI[2]

[1] Division of Aquatic Sports, School of Physical Education and Sports Science, National and Kapodistrian University of Athens, Athens, Greece
[2] Sports Science Department, Aspire Academy, Doha, Qatar

ABSTRACT

Purpose. This study aimed to explore whether a meaningful relationship existed between scoring in men's water polo and ball possession time and the number of passes in even and extra player offence conditions.

Methods. Overall, 24 close matches played during international competitions were analysed twice, for the winning and losing teams separately. This allowed to collect a sample consisting of 1588 offences when teams played in equal conditions and 492 with an extra player.

Results. For effective scoring in even conditions, the results demonstrated significant relationships between the exchanging of many passes (7.78 ± 1.09 passes) and short-duration attacks lasting for 1–10 s (7.87 ± 2.29 s) (p = 0.05). In the extra player condition, a considerable relationship was noted between short to average ball possession time and scoring (p = 0.05). However, the effect size for these differences ranged from moderate to low.

Conclusions. Knowledge of this study results could help coaches design specific workouts during routine practices and make decisions during matches.

Key words: performance analysis, even conditions, extra player, team sports

Introduction

The analysis of players' activities during games constitutes a reliable method of collecting information in diverse sports [1–7]. In team sports, by possession, we mean controlling the game's ball by a team, which usually allows that team to score. Generally, when in an attack, the team holds the ball while the other team is in defence. Also, each team sport has different rules governing how possession remains or is lost, which affects the game strategy.

In water polo, a team can hold the ball for 30 s in an actual game; after the end of this time, the possession changes, and the ball is passed to the opposing team. In addition, the ball possession can change after an offensive foul, a shoot-out or block by the goalkeeper, and after a claim, where the opponent loses the ball [8]. The number of ball possessions, the duration of the ball control of each attack, or the total possession time throughout the game are often helpful in team statistics. Another informative factor is the number of passes (NOP) exchanged by players during the period in which they hold the ball. Players exchange numerous passes with one another in the game or play at a slower pace, transferring a few passes and keeping the ball in their hands for a long time. Literature states that an athlete usually displays an average of 38.75 ± 14.49 passes during a water polo game and 7.88 ± 3.14 shots [1].

The most distinct game condition in water polo is when competing teams play with the same number of players in attack and defence (i.e., even condition: 6 players in the field and 1 goalkeeper, 6 on 6). When the ball enters the defending team's possession, the team has 30 s clock time to exhibit an attack. However, depending on the athletes' defensive actions, the number of players in the field might vary during the game, in accordance with the Fédération Internationale de Natation (FINA) rules [8]. Thus, another important con-

Correspondence address: Theodoros Platanou, Division of Aquatic Sports, School of Physical Education and Sports Science, National and Kapodistrian University of Athens, 41, Ethnikis Antistassis, 172 37, Daphne, Athens, Greece, e-mail: tplatan@phed.uoa.gr, https://orcid.org/0000-0002-3821-9572

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dition of the match, in which many goals are accomplished, occurs when 1 team plays with an extra player because of an opposing team player having been dismissed after a severe (heavy) foul (i.e., extra player condition; 6 on 5) [5]. When a team gains the advantage of playing with an extra player, the attacking players can hold the ball for 20 s clock time. When this period of actual play has elapsed, the excluded player returns to the game, and the teams continue playing with the same number of players. However, the dismissed player can return to the game earlier once the opposing team has lost possession of the ball [8].

Each team aims to outscore the opponent's number of goals and win during the water polo game. Therefore, the notion that arises is whether the ball possession time (BPT) and the total NOP in each offence play a significant role in achieving a goal during the game, with a matched number of players and 1 player more. Are BPT and NOP valuable measures for predicting a water polo game winner? Little research has been conducted on the effect of the mentioned factors on water polo results.

In football, the research results regarding the relationship between BPT and competitive success are controversial. Data collected during the Euro 2000 [9], among Spanish League First Division teams during the 2008–2009 season [10], and in the English Premier League [11] revealed that successful teams employed longer possessions than unsuccessful ones. These outcomes contradict the earlier conclusion from the 1994 World Cup [12], where maintaining the ball was not linked to success. However, the match result and the difference between close and balance games are important in team sports, water polo included [13]. In elite English soccer competitions, the percentages of ball possession and shots on goal were lower for the teams with a 1 goal up game status than those with 1 goal down condition [14]. Most studies have focused on performance-related characteristics, such as the athletes' physiological and swimming profiles in water polo. Recently, different authors have started to examine water polo game statistics, looking for factors that can discriminate between winning and losing teams [5, 6, 12, 15, 16].

However, reviewing examination of factors falling under the spectrum of holding the ball has offered minor consideration to its components. Therefore, this study aimed to determine whether a substantial relationship prevailed between scoring in water polo and BPT and NOP in offence in 2 typical situations, in even and extra player conditions.

Material and methods

Experimental approach to the problem

An experimental research design was used to examine the effect of BPT and NOP on scoring in men's water polo. The analysis incorporated 24 close score matches played by 11 men's national water polo teams during international competitions, exhibiting a mean score difference of 2.17 ± 1.43 (range: 1–4) goals. Close games illustrate the level and competence of competing teams. The examined national teams were Hungary (8 matches), Croatia (7 matches), Spain (7 matches), Serbia (6 matches), Italy (6 matches), Greece (5 matches), Montenegro (5 matches), and Romania, Australia, Germany, and Russia (1 recorded game each).

Matches

The games selected for the notational analysis consisted of official matches from video recordings collected during the World Water Polo Championships, European Championships, and Olympic Games in years 2012–2020. In particular, each chosen game was analysed at least twice, for the winning and losing teams separately, which resulted in the evaluation of 48 teams. Video footage was selected from international events: 1 match was retrieved from the London 2012 Olympic Games and 1 match from Rio 2016 Olympic Games; from the World Water Polo Championships, 6 matches from Gwangju 2019 and 2 matches from Budapest 2017; and from the European Championships, 6 matches from Budapest 2020, 1 match from Barcelona 2018, 2 matches from Belgrade 2016, and 5 matches from Budapest 2014, for a total of 24 matches.

Procedures

The selected games were randomly chosen from those available on public television. As the present survey is a notational analysis of public access data, no informed consent was required. During the game, BPT and NOP of the 2 opposing teams were measured for each attack, with participants in even conditions and extra player conditions, subsequently allocated in cases where the ball ended up in a scored goal or not.

In both conditions, BPT was calculated by monitoring and recording the time from the official time and score table of the match as it appeared during the game projection on the television screen. In the even condition, the time of possession was determined by subtracting the indication when the team lost the ball

possession from the indication of time when the ball was acquired. In the extra player condition, the clock time was measured by subtracting the signal of the time when the team lost possession of the ball from the sign of the dismissal time. NOP for each offence was reported by counting NOP during distinct attacks. During the even condition, the time counting started with the ball's first transfer by the goalkeeper or any other player after its retention. Likewise, the time count-up began with the ball's first transfer after the opposing team's player exclusion in the extra player condition.

For the even condition, the BPT of 30 s was further split into periods of 10 s, creating 3 qualitative levels. The BPT from 1 to 10 s was considered short, from 11 to 20 s average, and from 21 to 30 s long possession time. For the extra player condition, the analogous period of 20 s was further subdivided into 5-s intervals, which produced 4 qualitative levels. The BPT from 1 to 5 s was considered short, from 6 to 10 s short to average, from 11 to 15 s average to long, and from 16 to 20 s long possession time. For the total NOP in both conditions, the transfer of 1–3 passes was considered as few, 4–6 as average, and 7–10 as many passes. The derived sample consisted of 1588 offences when teams played in equal conditions and 492 when with an extra player.

In line with preceding notational analyses on water polo, a particular observer (T.P.) with extensive experience in the field remarked on all included matches. To provide a single reliable analysis, the intra- and inter-observer reliabilities were established. Before starting the study, the mentioned observer analysed the same sample of a winner and a losing team in a game twice in an observational period of 5 days to enable test-retest reliability assessment. In addition, 3 observers (i.e., the research observer and 2 additional water polo coaches) were engaged in scoring a random sample of a winner and a losing team in a game. The calculated intraclass correlation coefficient (ICC) between the analyses of the same observer (ICC = 0.99) and among all 3 observers (ICC: 0.97–0.98) was high.

Statistical analyses

The statistical analysis was performed by using the IBM SPSS Statistics software for Windows, version 22.0 (SPSS Inc., Chicago, IL, USA). Since the variables were not normally distributed (the Shapiro-Wilk test), data were analysed with the non-parametric chi-square (χ^2) test. Besides, data were examined as a mean and standard deviation with the Kruskal-Wallis test. If there was a statistically significant difference, a post-hoc test was further performed. The phi coefficient was calculated, which is a non-parametric measure of effect size (*ES*), and its magnitude can be characterized as 0.10 – small, 0.30 – moderate, and 0.50 – large [17]. All descriptive statistics are presented as mean ± standard deviation. Statistical significance of the results was accepted at $p < 0.05$.

Ethical approval

The conducted research is not related to either human or animal use.

Results

The total number of scored goals, corresponding to BPT and NOP, when both teams played with a matched number of players is presented in Table 1. The mean ± standard deviation of passes and attack time in each subcategory based on whether athletes achieved a goal or not, along with the overall number of shots, were also recorded. These results indicate that the number of attacks played in even conditions with few passes was higher than the number of attacks with average and many passes. Regarding BPT, longer possession time attacks were reported more frequently than short- or average-duration attacks.

In the even condition, between BPT and the scored goals with teams, a statistically significant relationship ($\chi^2_{(2)} = 7.292$, $p = 0.05$) was observed. Those significant differences in scoring were identified between short and average BPT ($\chi^2_{(2)} = 7.1$, $p = 0.0083$) and short and long BPT ($\chi^2_{(2)} = 5.83$, $p = 0.0083$). Scoring after short BPT was more effective than for the average (19.15 vs. 9.73%) and long possession time attacks (19.15 vs. 0.82%). However, the *ES* values for those differences were minimal and of little value, as the phi coefficient equalled 0.11 and 0.074, respectively.

Between NOP and scored goals, a statistically significant relationship ($\chi^2_{(2)} = 10.8$, $p = 0.05$) was observed. The significant differences were detected between the exchange of many and few passes ($\chi^2_{(2)} = 8.67$, $p = 0.0083$) and many and an average number of passes ($\chi^2_{(2)} = 9.13$, $p = 0.0083$). Scoring after exchanging many passes was more effective than scoring after few passes (18% vs. 10.52%) and average NOP (18% vs. 10.10%). However, the *ES* values of those differences were trivial and of little value, as the phi coefficient equalled 0.096 and 0.11, respectively.

The total number of scored goals, corresponding to BPT and NOP, for each categorical variable when 1 team played with an extra player is presented in Table 2.

Table 1. The number of scored and non-scored goals per short, average, and long ball possession time (BPT) (n = 1588) and per the number of passes (NOP) of few, average, and many (n = 1506) in the even condition, as well as mean ± *SD* of BPT and NOP when goals were scored or not

	Even condition					
BPT	BPT and scored goals		BPT and non-scored goals		BPT and total shots	
	Goals	BPT (s)	Non-goals	BPT (s)	Shots	BPT (s)
Short (1–10 s)	18	7.89 ± 1.41	76	7.87 ± 2.47	94	7.87 ± 2.30
Average (11–20 s)	50	15.84 ± 3.15*	464	16.57 ± 2.57	514	16.50 ± 2.64
Long (21–30 s)	106	25.94 ± 2.82*	874	25.99 ± 2.81	980	25.98 ± 2.81
Total	174	21.17 ± 6.95	1414	21.93 ± 6.13	1588	21.84 ± 6.23
NOP	NOP and scored goals		NOP and non-scored goals		NOP and total shots	
	Goals	NOP	Non-goals	NOP	Shots	NOP
Few (1–3 passes)	76	1.92 ± 0.81#	646	2.13 ± 0.78	722	2.10 ± 0.79
Average (4–6 passes)	58	5.41 ± 0.72#	516	4.88 ± 0.82	574	4.93 ± 0.83
Many (7–10 passes)	38	8.05 ± 1.11	172	7.72 ± 1.08	210	7.78 ± 1.09
Total	172	4.45 ± 2.60	1334	3.91 ± 2.12	1506	3.97 ± 2.18

* significantly different from short BPT, # significantly different from many passes; $p < 0.05$

Table 2. The number of scored and non-scored goals per short, short to average, average to long, and long duration of attacks (n = 488) and per the number of passes (NOP) of few, average, and many (n = 492) in the extra player condition, as well as mean ± *SD* of BPT and NOP when goals were scored or not

	Even condition					
BPT	BPT and scored goals		BPT and non-scored goals		BPT and total shots	
	Goals	BPT (s)	Non-goals	BPT (s)	Shots	BPT (s)
Short (1–5 s)	12	2.50 ± 0.52	6	3.00 ± 0.89	18	2.67 ± 0.68
Short to average (6–10 s)	26	6.85 ± 1.32	12	8.17 ± 1.64	38	7.26 ± 1.53
Average to long (11–15 s)	32	12.87 ± 1.18*	44	13.68 ± 1.27	76	13.34 ± 1.29
Long (16–20 s)	156	19.47 ± 2.34*	200	20.13 ± 2.63	356	19.85 ± 2.52
Total	226	16.74 ± 6.40	262	18.47 ± 5.13	488	17.67 ± 5.81
NOP	NOP and scored goals		NOP and non-scored goals		NOP and total shots	
	Goals	NOP	Non-goals	NOP	Shots	NOP
Few (1–3 passes)	36	2.11 ± 0.95	26	2.08 ± 0.74	62	2.10 ± 0.86
Average (4–6 passes)	54	4.89 ± 0.84	64	5.09 ± 0.85	118	5.00 ± 0.85
Many (7–10 passes)	140	8.90 ± 1.49	172	8.73 ± 1.89	312	8.80 ± 1.72
Total	230	6.89 ± 2.94	262	7.18 ± 2.80	492	7.05 ± 2.87

* significantly different from short to average BPT, $p < 0.05$

In contrast to the even condition, during the extra player, the number of attacks played with many passes (7–10) and the lengthy possession time (16–20 s) in all games was more evident than in the other examined conditions.

In the extra player condition, no significant relationship was noted between NOP and scoring. However, a statistically significant relationship was found between BPT and scoring ($\chi^2_{(2)} = 11.91$, $p = 0.05$). Particularly, the significant differences were detected between short to average and average to long BPT ($\chi^2_{(3)} = 7.02$, $p = 0.0062$), and short to average with the long duration of attack ($\chi^2_{(3)} = 8.36$, $p = 0.0062$). Scoring after short to average BPT was more effective than after average to long (68.42% vs. 42.10%) and long BPT (68.42% vs. 43.8%). The *ES* values for those differences ranged from moderate to low, as the phi coefficient was 0.25 and 0.15, respectively.

Discussion

This study aimed to classify ball possessions depending on BPT and NOP in 2 specific conditions and examine whether BPT and NOP that the players of a team exchanged in each offence played a decisive role in scoring a goal. For this purpose, the winning and losing teams in 24 close games were analysed, and the current study suggests that the effect of BPT and NOP during each attack on scoring is small. Specifically, for effective scoring in even conditions, the results demonstrated significant relationships between exchanging many passes and short-duration attacks, lasting 1–10 s. A considerable relationship was noted between short to average BPT and scoring in the extra player condition. However, the *ES* for these differences ranged from moderate to low. During a water polo game, it is widespread among coaches to ask their players not to rush to complete their attack, either with an equal number of players or with an additional player. Nevertheless, they advise them to run out the attack time expecting that the opponents will get tired and the attacking players will find the appropriate moment to shoot towards the opposing goalkeeper or pass the ball to their centre-forward and gain a dismissal. This perception is confirmed by the present research since most of the attacks in all included games, regardless of whether teams played in even or extra man conditions, displayed a long possession time (21–30 and 16–20 s, respectively) (Tables 1 and 2).

Long BPT and exertion of shooting at the end of the attack are generally considered desirable and efficient by coaches. However, it is not certain that this perception and implementation can guarantee victory. In the present study, the BPT and NOP performed by the players of all teams during their attacks had little contribution to achieving a goal during the even condition. Specifically, 2 different strategies are found related to the effectiveness of the offence. The first one concerned NOP, as it was observed that the exchange of many passes (7.78 ± 1.09) was more effective than fewer passes. The second strategy was about BPT: short attacks, lasting for 1–10 s (7.87 ± 2.29 s), were more effective. On the basis of these results, we can assume that a high rate of exchanging many passes in a short time may be more effective for scoring in even conditions. But as this outcome could have appeared owing to the characteristics of the counterattacks (where a temporary numerical advantage takes place in favour of the attackers), prospective investigations could focus on further explaining the finding mentioned above. According to earlier articles, counterattacks are characterized by shorter periods than even conditions for youth [17] and top-level [18] games. Moreover, during the extra player condition, NOP did not affect the scoring, while BPT had a small effect. The short to average BPT, lasting for 6–10 s (7.26 ± 1.53 s), displayed a higher success rate than the short BPT, lasting for 1–5 s (2.67 ± 0.68 s), and the longer BPT of 11–15 s and 16–20 s (13.34 ± 1.29 s and 19.85 ± 2.52 s, respectively). It seems that the coaches' prevailing view that the players should run out all the attack time in the extra player condition cannot be verified here. In general, BPT and NOP do not seem to be causal variables in a team's scoring. Instead, it is a consequence of an interaction process determined by several factors, such as the available space, the opponent's quality (strong or weak), the tactics configuration, and the current result.

The research results on the relationship between game success and BPT are inconclusive in football. Few studies have reported no association [12, 19], while several other authors have revealed a significant and positive relationship [9–11]. A recent study, including matches from the English Premier League, implies that possession duration is indeed related to successful performance; however, this is likely to be connected to the players' skill levels and not necessarily indicative of the applied tactic schemes [11]. Hence, a more analytic exploration of the features of ball possession is required. Further investigation is also needed to demonstrate how ball possession develops from the exchange of passes aspect. In football again, few studies have aimed to explore the short or long pass type used to succeed. Results from the English and Italian premier leagues showed that the higher the classification teams, the greater the number of short passes than in those listed at the bottom of the ranking [20, 21].

Similarly, in basketball, many studies have explored how ball possession leads to scoring achievement. The existing investigation has determined NOP, participants, and the possession duration as applicable variables to analyse attacks and ball possessions [22–24]. However, several articles have pointed out the extra worth of group tactical offensive and defensive activities [25, 26]. Nevertheless, when 1450 ball possessions from 8 close games of the Spanish basketball play-off series were analysed, the results showed, among others, that the winning teams made more passes and had longer BPT vs. different defensive systems than the losing teams [22]. In a subsequent study, where data from 40 basketball games were explored, men's teams increased the effectiveness of offences over the last crucial 5 minutes, using only 1 pass or no passes during a specific period [27].

In the present study, it was found that there were minimal to negligible differences regarding BPT and NOP in water polo while in attack in even or extra player conditions to achieve a goal. In even situations, the attacking team's short actual attack time and the closed (pressing) defence of the opponent team can partially explain this outcome [6]. Platanou and Geladas [6] estimated that although a water polo team could hold the ball for 30 s, the actual offence time lasted 15 s. There is minimal potential for free kicks and shots towards the opponent's goalkeeper; thus, players are shooting when the right opportunity is detected, regardless of BPT and exchanged NOP. The same limitations apply to the extra player condition, where the actual time of the offence is 20 s.

Knowledge of these trends, which emerged from this study results, could motivate coaches to use this information to design specific workouts during routine practices and to make decisions during matches. For example, during even condition training, players can practise in front of 1 goal at a high pace (a quick rotation of the ball in a short time) and will either pass the ball to the centre forward or try a direct shot from the perimeter. In the extra player condition training, in turn, it will focus athletes on scoring fast.

During matches, coaches could propose their players to shoot at the opponent's goal regardless of BPT and NOP performed if they have identified the proper circumstances and are free. Beyond these conclusions, water polo is a popular dynamic sport; therefore, prospective analysis projects must be designed to hand over tools and scientific resources for coaches and players.

Conclusions

The current outcomes imply that a higher rate of exchanging passes is more efficient under even conditions. In the extra player condition, players could try a shot when they can avoid the opponents' blocks and are free, regardless of whether the attack time is near to elapse. Viewing these findings from a practical perspective could motivate coaches to use this information to construct specific workouts during routine practice and to make decisions during the games.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

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