

ORIGINAL RESEARCH

Effect of using the additional field player on attack efficiency during 2017 Women's Handball World Championship

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Abstract

Background: Rule changes such as the use of the additional field player in the attack to replace the goalkeeper can significantly change the tactical strategies of the handball game. **Objective:** The aim of this study was to analyze the effectiveness of the use of the additional field player in offensive situations during the positional attack and counterattack suffered by the teams participating in the 2017 Women's Handball World Championship. **Methods:** The sample consisted of 15 matches in the knockout stage. In total, 1638 attack actions (positioned and counterattack) were identified and analyzed. For the exploratory analysis, we used descriptive statistics, obtaining the frequencies and respective percentages for each category of study variables for both situations: when the additional player was used and when not. **Results:** Our data showed that teams tend to use goalkeeper substitution by a field player to maintain numerical equality (54.9%), followed by the use to obtain numerical offensive advantage (41.3%). There were no differences in the throwing position (left wing, left back, center, pivot, right back and right wing) between situations with and without the additional field player. There was a significant increase in the number of errors when using the additional field player to gain numerical superiority in attack. In numerical equality and inferiority situations, no difference was found. The analyses also showed more counterattacks with goals and 9-m throws when using the additional field player. **Conclusions:** The use of the additional player did not bring advantages to the team, as more counterattacks were suffered.

Keywords: match analysis, seventh player, notational analysis

Introduction

Game analysis is an important procedure that provides athletes and teams with information, guides training and performance in competitions (Bilge, 2012; Daza et al., 2017) provides data on tactical organization, technical performance and helps to develop teaching methods by improving the quality of coaches interventions and influencing the strategic-tactical performance of the teams (Bilge, 2012; Karastergios et al., 2017; Prieto et al., 2015b).

Specifically, in handball, studies indicate that the effectiveness of group tactical actions is associated with a game played with greater depth of the playing space (Prieto et al., 2015b; Rogulj et al., 2011) and that fast counterattacks and the throw area are predictive factors of success in the attack (Gómez et al., 2014). Thus, it was observed that the players of the first offensive line have more throws of 9-m line, more assists, technical failures and loss the ball (Costa et al., 2017), while the wings and pivots score more points of fast counterattacks in 6-m line (Gómez et al., 2014).

While there are several game analysis studies that point to predictive performance factors in attack, these results predate the rule changes the Rio 2016 Olympic Games, allow teams to use seven players in the attack without the

goalkeeper (International Handball Federation, 2016), in other words, any field player may replace the goalkeeper in attack actions, and it is not necessary to maintain a goalkeeper when the team is attacking.

In this context, it is known that this change in the rule interferes directly in the strategic-tactical structures of the game (Sevim & Bilge, 2007), allowing new individual and group actions such as the organization of offensive and defensive systems. It is essential to analyze performance from the constraints and new situational possibilities (Taylor et al., 2008). Thus, the aim of this study is to analyze the effectiveness of the use of the additional field player in the attack and the counterattacks suffered in the 2017 Women's Handball World Championship.

Methods

Sample and data collection

The sample consisted of 15 matches in the knockout stage of the 2017 Women's Handball World Championship in Germany. This championship phase was chosen due to the need to win the match, which makes the teams take more risks in the strategies.

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One match was not included in the sample due to video failures (scoreboard with no time and scoring), rendering the analysis unfeasible. All attack actions were collected and analyzed, with a total of 1638 attack actions.

The games were analyzed using the official IHF images of public domain, and were performed by two independent observers, graduated in Physical Education and with more than five years of experience as teachers or handball coaches. Data collection took approximately two hours in each game.

Independent variables

Independent variables were selected for the study, such as positioning attack, counterattack, attack asymmetries and throwing place in both game situations, with and without the additional field player, which will be explained as follows.

The offensive situation is the time interval from the recovery of ball possession until a register action in which there is a situation of a total loss of possession, either by finalization or foul.

Counterattack is defined as the phase of the game in which the defending team switches over to the attack when they regain the ball possession, and comes to the finishing goal without organizing the opposing defense (Călin, 2010). In the same way, we considered in our analysis that the counterattack occurs in the following situations: a) the first movement to regain ball possession is the throw directly into the goal, without a pass, from where it was; b) when there is a goalkeeper's throw or a throw from the player with the ball to a player in displacement, who receives and throw, before the defense organization; c) fast attack, with more passing and collaboration between offensive players, however, the finalization of the goal still occurs with the unstructured defense.

For game situation analyses, we considered the relation between the number of attackers and defenders, disregarding the goalkeeper (when the goalkeeper is in the goal area). Thus, the following categories were established: a) numerical equality – both teams had the same number of field players, which is the same number of players on offense and defense not mentioning the goalkeeper; b) numerical inferiority – the attack had fewer players than the defense; c) numerical superiority – the attack had more players than the defense.

These asymmetrical situations were considered when there was a player's exclusion in the match, in other words, when a defensive player suffered exclusion and the attack had numerical superiority, but also in situations in which there was a substitution of the goalkeeper by an additional field player.

The position of the throw was considered. Therefore, we have seven possible throw positions, being left wing (LW), left back (LB), center (CE), pivot (PV), right back (RB), right wing (RW) and goalkeeper (GL).

Dependent variable

The efficiency of the attack was considered from the categories: a) goal (yes) – occurred when the ball passed the goal line completely, without any rule infraction by the attacker

or by any team member before or during the throw; and b) goal (no) – goalkeeper's defense or loss of possession of a ball due to foul or error: occurred when the goal was defended by the goalkeeper and prevented the goal from being scored or when the attack lost the ball without the goal, due to technical error or irregular action by the attacking player.

Statistical procedures

For the exploratory analysis, we used descriptive statistics, obtaining the frequencies and the respective percentages. To associate the studied variables we used the chi-square test (χ^2), with the Monte Carlo correction when less than 20% of the cells had a value under 5. The residual adjustments were calculated to identify which cells had significance in the statistical explanation from the relation between two variables.

We also analyzed the situations of the use of the additional player or not with: the percentage of use of the additional player by national teams, the percentage of throwing by position and the percentage by symmetry/asymmetry of the attack, and the comparison of the time of the attack using the Student *t*-test.

The value $p < .05$ was considered as significant. For the analysis, we used IBM SPSS (Version 20.0 for Windows; IBM, Armonk, NY, USA).

Results

Table 1 shows the total number of attacks analyzed in this study, separated by the teams that participated in the knockout stage of the Handball World Championship with their respective percentage of attacks with and without the use of the additional field player.

Figure 1 shows the percentages of throws per position, comparing descriptively their frequency with the use of the additional field player or not, in positional attack. There was no statistically significant difference between the throwing positions ($\chi^2(6) = 3.85$, $p = .69$), showing a tendency of the throws in the central position, in both situations.

The analysis of the effectiveness of the attacks in Table 2 showed that there is no difference in scoring goal when teams used the additional field player ($\chi^2(1) = 3.01$, $p = .08$). This analysis did not take into account the situations of asymmetry of the game.

When analyzing the attacks asymmetries (inferiority, superiority and equality), no statistically significant difference was found (Table 3) in scoring goal when the additional field player was used in equality ($\chi^2(2) = 0.61$, $p = .43$) or inferiority situations ($\chi^2(2) = 0.06$, $p = .93$). However, in superiority, the analyses showed that when the additional field player was used, the attack is less effective ($\chi^2(2) = 4.34$, $p = .03$). It is important to note that in this analysis, only positioned attacks were considered.

It is observed that the teams used the additional player mainly in situations to maintain the numerical equality (54.9%), followed by the use to obtain numerical offensive advantage (41.3%).

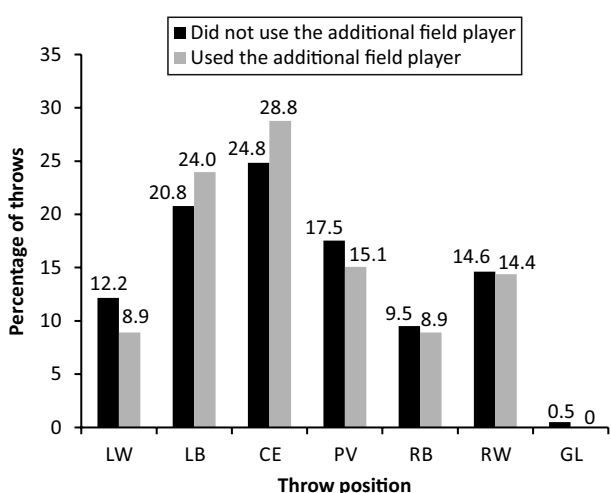
Table 1 Team description of the total number of attacks analyzed in the study, and the percentage referring to the total number of attacks analyzed, with and without the use of the additional field player

Team	Did not use the additional field player	Used the additional field player	Total
Netherlands (3rd)	196 (13.7%)	31 (15.0%)	227 (13.85%)
Japan (16th)	40 (2.8%)	21 (10.2%)	61 (3.72%)
France (1st)	185 (12.9%)	20 (9.7%)	205 (12.51%)
Denmark (6th)	77 (5.4%)	20 (9.7%)	97 (5.92%)
Sweden (4th)	200 (14%)	18 (8.7%)	218 (13.3%)
Norway (2nd)	136 (9.5%)	17 (8.3%)	153 (9.43%)
Romania (10th)	37 (2.6%)	14 (6.8%)	51 (3.11%)
Spain (11th)	43 (3.0%)	12 (5.8%)	55 (3.35%)
Hungary (14th)	42 (2.9%)	12 (5.8%)	54 (3.29%)
Slovenia (15th)	48 (3.4%)	11 (5.3%)	59 (3.6%)
Montenegro (7th)	104 (7.3%)	9 (4.4%)	103 (6.28%)
Serbia (9th)	51 (3.6%)	7 (3.4%)	58 (3.54%)
Czechia (8th)	104 (7.3%)	5 (2.4%)	109 (6.65%)
Germany (12th)	45 (3.1%)	5 (2.4%)	50 (3.05%)
South Korea (13th)	60 (4.2%)	4 (1.9%)	64 (3.9%)
Russia (5th)	64 (4.5%)	0 (0%)	64 (3.9%)
Total	1432 (100%)	206 (100%)	1638 (100%)

Table 2 Attack effectiveness: Total number and percentages, comparing the situations in which the additional field player was used and not used (without considering the asymmetries of the attack)

Attack situation	Goal		Total
	Yes	No	
Did not use the additional field player			
Count	613	364	977
Relative (%)	62.7	37.3	100
Used the additional field player			
Count	69	57	126
Relative (%)	54.8	45.2	100

Figure 1 Percentage of throws in game analysis by attack position, when using and not using additional field player in positional attack



Note. LW = left wing; LB = left back; CE = center; PV = pivot; RB = right back; RW = right wing; GL = goalkeeper.

Significantly more goals were scored in counterattacks when using the additional field player ($\chi^2(1) = 12.56$, $p < .001$), see Table 4.

Average attack time for attacks without the additional field player ($n = 1169$) was significantly lower than for attacks with the additional player ($n = 140$), 26.47 ± 17.75 s vs. 38.26 ± 15.41 s, $p < .001$.

No statistically significant difference was found when comparing occurrences of 7-m situations, ($\chi^2(2) = 2.96$, $p = .22$), see Table 5.

Table 6 shows that when the additional field player was not used, there were more throws of 6 m, while when the additional field player was used, there were more throws of 9 m ($\chi^2(1) = 7.22$, $p < .001$) considering positional attacks.

Discussion

This study aimed to assess the effectiveness of the attack at the 2017 Women's Handball World Championship

Table 3 Attack effectiveness: Total number and percentages, comparing the situations in which the additional field player was used or not, considering the asymmetries of the attack

Attack situation	Goal		Total
	Yes	No	
Equality			
Did not use the additional player			
Count	509	306	815
Relative (%)	62.5	37.5	100
Used the additional player			
Count	41	31	72
Relative (%)	44.1	26.9	100
Superiority			
Did not use the additional player			
Count	85	41	126
Relative (%)	67.5	32.5	100
Used the additional player			
Count	27	26	53
Relative (%)	50.9	49.1	100
Inferiority			
Did not use the additional player			
Count	19	17	36
Relative (%)	52.8	47.2	100
Used the additional player			
Count	1	1	2
Relative (%)	50.0	50.0	100

Table 4 Suffered counterattack with a goal comparing the situations in which the attack used the additional field player or not

Attack situation	Goal scored in the counterattack		Total
	No	Yes	
Did not use de additional field player			
Count	1332	90	1422
Relative (%)	93.7	6.3	100
Used the additional field player			
Count	178	27	205
Relative (%)	86.8	13.2	100

Table 5 Frequency of the occurrence of 7 m with and without goal converted in situations of use and not use of the additional field player

Attack situation	Suffered 7 m			Total
	Yes, with goal	Yes, no goal	No	
Did not use the additional field player				
Count	76	24	1332	1432
Relative (%)	5.3	1.7	93.0	100
Used the additional field player				
Count	15	6	185	206
Relative (%)	7.3	2.9	89.8	100

Table 6 Frequency of throws according to the distance in relation to the use or not of the additional field player in positional attack

	Throw line		
Attack situation	6 m	9 m	Total
Did not use the additional field player			
Count	573	495	1068
Relative (%)	53.7	46.3	100
Used the additional field player			
Count	54	77	131
Relative (%)	41.2	58.8	100

related to goalkeeper replacement by an additional field player, according to the possibility attributed by the recent rule change (International Handball Federation, 2016). This change allows teams to attack with up to seven players, increasing the frequency of asymmetric situations but allowing the risk of the goal being unprotected in handball matches.

The analysis showed that the throws occurred mainly from the central and right back position, with no difference whether the attack was using the additional field player or not, showing the tendency of the women teams in this championship to privilege the throws from these regions of the court. As in the results presented by Srhoj et al. (2001) in which they observed a greater frequency of throws from the central position, not having a significant influence on the results of the matches.

In addition, our data showed that teams often use the substitution of the goalkeeper by a field player to maintain numerical equality. The descriptive analysis showed that this feature was used although it did not increase offensive effectiveness, since whether or not to use the additional field player does not interfere with the attack effect. Garcia and Lorenzo (2010) suggest that the use of the “false goalkeeper”, strategy to replace the goalkeeper with a court player before the new rule, is a strategy to be explored to balance the attacking team in cases of exclusion since the positional game in numerical equality can be a decisive aspect to define the winner or loser of the game (Gutiérrez-Aguilar et al., 2010).

In our study, we observed that the teams used the additional field player to maintain equality and not allow the opposing team to increase the score in situations of

numerical inferiority of the attack (Figure 1). Players' exclusions are critical moments and the instability arising from these situations of inequality changes the nature of cooperation and opposition of the teams and may affect the final outcome of the match (Ferreira, 2013). Teams that defend in superiority have obtained advantages in the result of the game (Matéfi, 2013), and having a player excluded allows disadvantages in the score for the team in numerical inferiority (Prieto et al., 2015a).

Furthermore, our findings showed that there were fewer goals scored with the use of the additional field player in superiority situations. Thus, it highlights the fact the use of the additional player was not effective for the attack in this championship. Musa et al. (2017) found that the use of an additional player in the attack is ineffective for offensive efficacy in accordance with the findings of our study, demonstrating that, in cases of exclusion, goalkeeper replacement is a strategy that does not result in differences in score in matches of elite handball. On the other hand, the use of the additional player in the attack may be a way to prevent the opposing team from advancing on the scoreboard during periods of a player's exclusion, since studies have shown that defense in numerical superiority has a decisive effect on the final results of the games (Matéfi, 2013; Prieto et al., 2015a).

However, a possible disadvantage of using the additional field player is the risk of leaving the goal unprotected when there is a danger of losing possession of the ball and suffering a counterattack. In this study, we have observed that when there is the use of the additional player to replace the goalkeeper, the frequency of the counterattack with a goal being scored are statistically significant. The counterattack is one of the most significant actions for success in handball matches (Srhoj et al., 2001), elite teams having a structured form of play, the success of the match is determined by counterattacks (Daza et al., 2017; Lozano Jarque & Camerino Foguet, 2012; Saavedra et al., 2017), and leaving the goal unprotected shows a significant difference in our study.

Another point to be considered, shown by other studies (Gutiérrez-Aguilar et al., 2010; Trejo Silva & Planas Anzano, 2018), is that winning teams are more effective in attack when compared to losing teams regardless of numerical superiority or inferiority, suggesting that winning the game depends on the combination of tactical, technical, physical and psychological aspects of teams and players, as well as the ability to adapt to the situation of numerical asymmetry.

Our study noted that when using the additional field player, there are more 9-m throws. This demonstrates that there is a tendency of these teams to use the finalization from the back line positions when using the additional field player. This tactical behavior is in agreement with other studies that show that there are more throws from the back-line positions (Hatzimanouil et al., 2017; Ohnjec et al., 2008). Another possible explanation may be related to the fact that the teams that defend in numerical inferiority increase the protection of the area (either by the change in the defensive system or by the rules of action of the defenders), providing larger spaces for throwing from long distances.

The results showed that there was no association between the effectiveness of the attack and the use of an additional field player, in other words, the numerical superiority imposed by an additional attack player did not bring score benefits. In this context, there are no studies that can support the results of the present research due to the recent rule change. In addition, other studies on game analysis in handball do not consider the symmetries or asymmetries in the attack (Debanne, 2018; Oliveira et al., 2012; Vuleta et al., 2012), making it necessary to evaluate the effectiveness of offensive actions in a restrictive condition (Gutiérrez-Aguilar et al., 2010; Sierra-Guzmán et al., 2015).

Some limitations of the study should be mentioned, such as not describing in detail which errors caused the attacks do not result in goals. Also, this is a study carried out with data from 2017, just one year after the official change of the goalkeeper substitution rule, which must be monitored for future evolutions in the way of playing with this new regulation.

Conclusions

It was shown that the additional player was used more often to maintain the numerical equality of the attack – when in a situation of exclusion – followed by situations of superiority (to have the extra player). However, there is a lower score in these situations of numerical superiority using the additional player.

There was a greater frequency of counter-attacks suffered, more time spent on the attack and a greater number of throws from 9 m when using the additional player.

Our data show that there was no clear advantage in the use of the additional field player, possibly due to the time proximity between the change the rule and the implementation of the championship analyzed in this study and the limited use in situations of sanctions, there is still a wide field for the development of offensive tactical options with this “additional” player. Therefore, over time, further studies are required to know whether the addition of the seventh player has really expanded the tactical offensive possibilities.

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Conflict of interest

The authors report no conflict of interest.

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