

ANALYSIS OF ASSOCIATIONS AND FACTORS PREDICTING THE EFFECTIVENESS OF FINALIZATION IN THE FEMALE HANDBALL OF HIGH LEVEL

ANÁLISE DAS ASSOCIAÇÕES E DOS FATORES PREDITIVOS DA EFICÁCIA DO LANÇAMENTO NO HANDEBOL FEMININO DE ALTO NÍVEL

Gustavo De Conti Teixeira Costa¹, Nilva Pessoa de Souza¹, Auro Barreiros Freire², José Cícero Moraes³, Fabiano de Souza Fonseca⁴, Flórence Rosana Faganello Gemente¹, Juracy da Silva Guimarães¹ and Henrique de Oliveira Castro^{5,6}

¹Goiás Federal University, Goiânia-GO, Brazil.

²Union Business and Administration University Center, Belo Horizonte-MG, Brazil.

³Rio Grande do Sul, Federal University Porto Alegre-RS, Brazil.

⁴Pernambuco Federal Rural University, Recife-PE, Brazil.

⁵Brasília University Center of Superior Education, Brasília-DF, Brazil.

⁶Anhanguera College, Brasília-DF, Brazil.

RESUMO

O estudo objetivou analisar a associação entre a posição da atacante, o local do lançamento e a direção do lançamento com o efeito do lançamento, bem como os fatores preditivos deste. Foram analisadas 6146 ações de ataque de 66 jogos realizados pelas 24 equipes participantes do Campeonato Mundial de Handebol Feminino de 2015. Para a associação entre as variáveis estudadas recorreu-se ao teste do Qui-Quadrado e para análise preditiva utilizou-se a regressão logística multinomial. Adotou-se o valor de significância de $p \leq 0,05$ e utilizou-se o *software* SPSS versão 20.0 para Windows. Os resultados apontaram associação entre o efeito do lançamento e a posição da atacante ($\chi^2 = 107,39$; $p = 0,0001$; $\phi = 0,13$), entre o efeito do lançamento e o local do lançamento ($\chi^2 = 715,01$; $p = 0,0001$; $\phi = 0,34$), entre o efeito do lançamento e a direção do lançamento ($\chi^2 = 587,25$; $p = 0,0001$; $\phi = 0,34$) e que o local do lançamento e a direção do lançamento foram fatores preditivos do efeito do lançamento ($\chi^2 = 854,666$; $p < 0,0001$). Assim, a partir dos resultados, pode-se concluir que o efeito do lançamento é predito pelo local do lançamento e pela direção do lançamento, sugerindo que a posição da jogadora não influencia na obtenção do gol.

Palavras-chave: Análise de jogo. Efeito do lançamento. Fatores preditivos.

ABSTRACT

The study aimed to analyze the association between the position of the attacker, the place of the finish and the direction of the finalization with the effectiveness of the finalization, as well as the predictive factors of this. A total of 6146 attack actions of 66 matches were analyzed by the 24 teams participating in the 2015 Women's World Handball Championship. For the association between the variables studied, we used the Chi-Square test and for predictive analysis of the data, we used the multinomial regression. The significance level of $p \leq 0.05$ was adopted and the software SPSS version 20.0 for Windows was used. The results showed an association between the finalization effect and the attacker's position ($\chi^2 = 107.39$, $p = 0.0001$, $\phi = 0.13$), association between the finishing effect and the finishing direction ($\chi^2 = 715$, ($X^2 = 587.25$, $p = 0.0001$, $\phi = 0.34$), and that the predictive factors of the finalization effect was statistically significant ($\chi^2 = 854.666$; $p < 0.0001$). Thus, from the results, it is possible to concluded that the effect of the finalization and the direction of the finalization, suggesting that the position of the player does not influence in obtaining the goal.

Keywords: Game analysis. Effectiveness of finalization. Predictive factors.

Introduction

Game analysis is an important tool to assess the performance of individuals and sport teams, since it provides information for training and competitions^{1,2}. Information originated by the analysis of the game has helped to identify the actions and situations that significantly influence the final result in handball matches^{2,3}. In this sense, it is seen that the game context, that is, the quality of the opponent and the location of the game do not interfere in the result of the match³. However, indicators of the effect of finalization, such as the number of goals scored and throws defended or lost interfere in the final result of the match^{2,4}, the fast attacks and counterattacks and the pivot's location of finalization are predictive factors regarding a

successful finalization^{5,6}. Therefore, since the effect of finalization is related to the position of the attackers in court, understanding the configurations and the basic implications of the attack lines is essential. In general, the formation of two lines exists: the first is constituted by the backcourts, whose purpose is to organize the attacks based on the uncertainties generated in the opponents' defensive system either through their own actions or the pivot's actions. A second line comprises the pivot and wings, which is organized closer to the goal with the aim of having a greater attack depth and effective finalizations⁷.

In this regard, the studies that investigated the European and world championships pointed out that in women's handball the first offensive line makes more long-distance finalizations, besides assisting, making technical fouls and losing more possession of the ball⁴, whereas the second line, regardless of sex, scores faster counterattack goals^{5,6} possibly due to an unstructured opponent's defensive system. Therefore, the game played in depth proves to be an effective strategy to score a goal⁸, as well as the use of the pivot⁸. On the other hand, the game played by the backcourts and wings are less effective in finalizations when compared to the pivot^{9,10} because of the long distance from the goal or the small finalization angle.

According to this bias, it is seen that the investigations on handball games seek to understand the effectiveness of collective tactical actions and the correlation between the attack lines. The emphasis is given to the effective finalization with regard to the 1st and 2nd lines as a differentiating aspect in the offensive quality of women's high level teams^{11,12}, which influences the final result of the match^{6,13,14}. In addition, the 1st line attacks are positively associated with victory when confrontation between the teams is balanced^{13,14}. Similarly, the high performance regarding finalization, the goalkeeper's defenses, the stolen balls and the reduced number of technical fouls explain the final result of the high level games in more than 80%¹⁵. Thus, the effective finalizations executed by the wings, as well as the finalizations of the first offensive line and the number of counterattacks significantly determine the success of the match^{16,17}.

In short, research involving game analysis on high-level men and women's international handball reveals that the number of finalizations, especially the ineffective ones, and the number of successful assists are differentiators of the teams' performance in the match^{2,16,18}. In spite of the fact that the effective finalizations on goal are associated with the performance of winning teams, studies on high-level women's handball that have associated the results with the location and direction of the finalizations were not found in the literature. Such analysis has significant practical implications, since these variables can be decisive for the outcome of the match. In addition, this information can support coaches in the sense of structuring specific training aimed at improving the competitive level both, in attack situations by strengthening technical-tactical actions that enhance the chance of a goal, and in defense situations by consolidating the technical-tactical actions that can neutralize the finalization actions of the opponent's attack.

Therefore, having high level women's handball as subject, the present study aimed at analyzing the associations of the effect of finalization with the attacker's position, the location of finalization and the direction of finalization, as well as showing them as predictive factors of an effective finalization.

Methods

Sample

A total of 6146 attack actions of 66 games played by the 24 teams participating in the 2015 World Women's Handball Championship were assessed.

Variables

Attacker's position: the position of the attackers on court is determined according to specific demands of the tactical system, as well as to the players' tactical, technical and physical qualities. In this sense, the classification proposed by Schorer et al.¹⁹ was adopted. Thus, the following lineup was used: left wing, right wing, pivot, left back, right back, center back and goalkeeper (Figure 1).

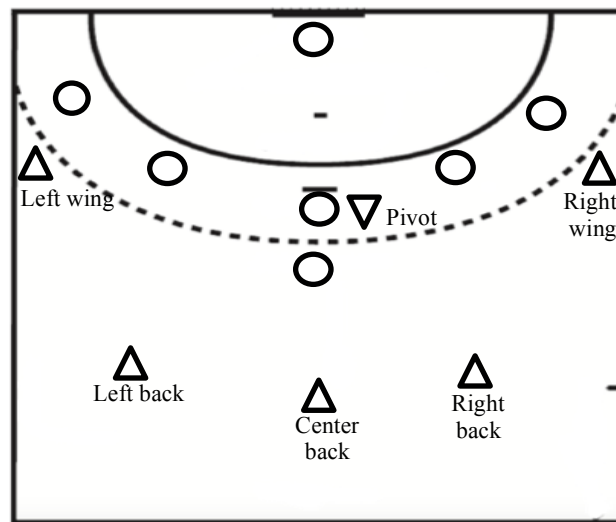


Figure 1. The attackers' position

Source: Schorer et al.¹⁹

The location of finalization: the instrument proposed by Lago-Penas et al.²⁰, Oliveira, Gomes and Sampaio²¹ and the International Handball Federation (IHF)²² was used to assess the location of finalization. Therefore, the categories shown in Table 1 were adopted.

Table 1. Location of finalization

2 nd offensive center line (6C)	Finalization occurred in front of the goal at a lateral distance of 3 meters, and between the goal and the free-throw line, that is, between 6 meters and 9 meters from the goal (Figure 2-A)
2 nd offensive right line (6D)	Finalization occurred on the attack right side, bounded by a quarter circle with a 6-9 m radius measured from the inside angle of the right goalpost (Figure 2-B).
2 nd offensive left line (6E)	Finalization occurred on the attack left side, bounded by a quarter circle with a 6-9 m radius from the inside angle of the left goalpost (Figure 2-C).
1 st offensive center line (9C)	Finalization occurred behind the free-throw line and in front of the goal. Thus, this area is bounded by a 3 m line directly in front of the goal (Figure 2-D)
1 st offensive right line (9D)	Finalization occurred behind the free-throw line and to the right of the center area of the 1 st offensive line (Figure 2-E).
1 st offensive left line (9E)	Finalization occurred behind the free-throw line and to the left of the center area of the 1 st offensive line (Figure 2-F).
7-m throw (7M)	Finalization executed with a 7-meter throw (Figure 2-G).

Source: The authors

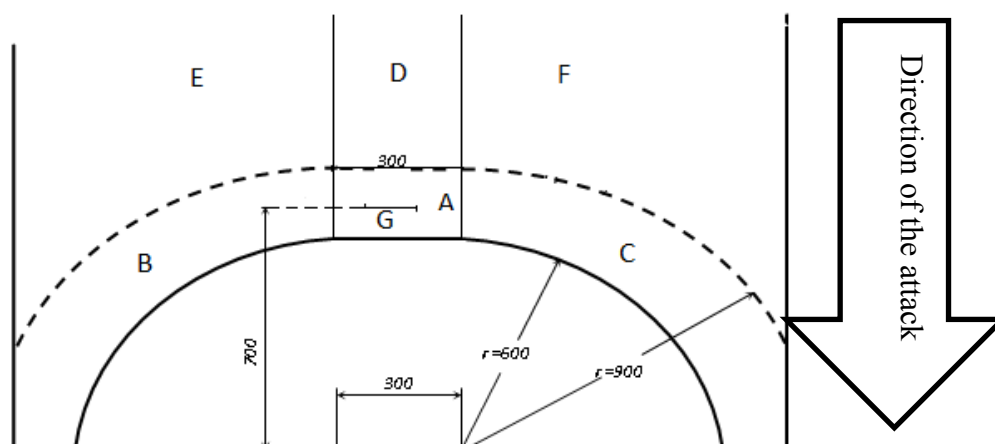


Figure 2. Location of finalization

Source: The authors

Direction of finalization: the same criteria used in the statistical analysis by the IHF²² were adopted. Thus, the location of the ball when thrown towards the goal at the time of finalization was considered, configuring quadrants with similar areas (Figure 3). The following categories were obtained: upper left (Figure 3-A), upper center (Figure 3-B), upper right (Figure 3-C), intermediary left (Figure 3-D), intermediary center (Figure 3-E), intermediary right (Figure 3-F), lower left (Figure 3-G), lower center (Figure 3-H), lower right (Figure 3-I), ball on the post and throw off.

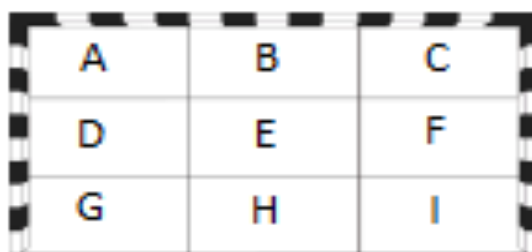


Figure 3. Quadrants of the goal

Source: The authors

Effect of finalization: the instrument proposed by Costa et al.⁴ was used, and the following categories were obtained:

- 1 - Goal: scored when the ball completely crossed the goal line provided that no break of the rules had been committed by the thrower or any other player, before or during finalization.
- 2 - The Goalkeeper's defense: it occurred when the finalization was defended by the goalkeeper, thus, preventing the goal from being scored.
- 3 - Error: it occurred when the finalization resulted in the ball off or on the post, without the goalkeeper touching the ball.

Data collection procedure

The games were analyzed based on a film recording made available by the International Handball Federation. The data reliability was verified by two independent

observers (graduated in Physical Education and with more than 5 years of experience in game analysis) through the re-analysis of the video recordings of ten random games, which included 950 attack actions (15% of the total), exceeding the reference value of 10%²³. Cohen's Kappa values for inter and intra-observer reliability were greater than 0.90, and the agreement with the IHF scores was greater than 95%, a number above the reference value, that is, 0.75²⁴.

Statistical analysis

The descriptive statistics was used for exploratory analysis by obtaining the frequencies and respective percentages for each category of the variables under study. The Chi-Square test with the Monte Carlo correction was used to obtain the associations between the variables, whenever less than 20% of the cells had a value below 5. In addition, the adjusted residuals were calculated in order to identify the cells that had statistical significance to explain the association between two variables.

Based on the variables that pointed to a correlation, a logistic regression model was built in order to identify the predictive factors of the effect of finalization. Considering the data predictive analysis, a multinomial regression was used to investigate the associations of the independent variables, that is, the attacker's position, the location of finalization and direction of finalization with the dependent variable, the effect of finalization, one by one. In order to correct the inconsistencies of the predictive model, only the effects of finalization on goal and the goalkeeper's defense were considered. The significance value of 5% ($p \leq 0.05$) was adopted for the statistical treatment of data, and the SPSS software (Statistical Package for the Social Sciences) version 20.0 for Windows was used.

Results

Table 2 shows that the pivot had a higher percentage of goals scored (70.20%) in relation to the attempts made, followed by the left wing (63.00%) and the right wing (59.20%). When analyzing the occurrence of goals, in general, it is seen that the backcourts executed more finalizations towards the goal and, thus, showed a higher percentage of goals scored; the left back had the best effect of finalization (23.50%), followed by the central back (21.00%) and the right back (16.60%). Moreover, an association between the result of the finalizations and the attackers' position was seen ($\chi^2 = 107.39$; $p = 0.0001$; $\phi = 0.13$). The positions of the right and left backcourts were more associated with the finalization errors (adjusted residuals = 3.9 in both positions), whereas the positions of the left wing and pivot were more associated with the effective results of the finalizations regarding goals scored (adjusted residuals = 3.6 and 6.9, respectively).

Table 2. Association between the effect of finalization and the attacker's position

Attacker's position		Effect of finalization			Total
		Goals	Goalkeeper's defense	Error	
Center back	Occurrence	733	339	272	1344
	% The athlete's position	54.50%	25.20%	20.20%	100.00%
	% Effect of finalization	21.00%	22.30%	23.80%	21.90%
	Adjusted residuals	-1.8	0.4	1.8	
Right back	Occurrence	579	273	250	1102
	% The athlete's position	52.50%	24.80%	22.70%	100.00%
	% Effect of finalization	16.60%	17.90%	21.90%	17.90%
	Adjusted residuals	-3.1*	0	3.9*	
Left back	Occurrence	817	404	342	1563
	% The athlete's position	52.30%	25.80%	21.90%	100.00%
	% Effect of finalization	23.50%	26.50%	30.00%	25.40%
	Adjusted residuals	-4.1*	1.1	3.9*	
Right wing	Occurrence	495	216	125	836
	% The athlete's position	59,20%	25,80%	15,00%	100,00%
	% Effect of finalization	14,20%	14,20%	11,00%	13,60%
	Adjusted residuals	1,6	0,8	-2,9*	
Left wing	Occurrence	448	167	96	711
	% The athlete's position	63,00%	23,50%	13,50%	100,00%
	% Effect of finalization	12,90%	11,00%	8,40%	11,60%
	Adjusted residuals	3,6*	-0,8	-3,7*	
Pivot	Occurrence	408	120	53	581
	% The athlete's position	70,20%	20,70%	9,10%	100,00%
	% Effect of finalization	11,70%	7,90%	4,60%	9,50%
	Adjusted residuals	6,9*	-2,4*	-6,2*	
Goalkeeper	Occurrence	3	3	3	9
	% The athlete's position	33,30%	33,30%	33,30%	100,00%
	% Effect of finalization	0,10%	0,20%	0,30%	0,10%
	Adjusted residuals	-1,4	0,6	1,1	
Total	Occurrence	3483	1522	1141	6146
	% Effect of finalization	56.70%	24.80%	18.60%	100.00%

Note: *difference found for $p < 0,05$

Source: The authors

Table 3 shows that finalization occurred in most of the center areas; area 6C was the most used one (44.6%), followed by 9C (19.5%). When assessing the effect of finalization, it was seen that the closer to the goal the finalization occurred, the greater the number of goals scored. The finalizations made in the 7-meter throw relatively showed the greatest amount of goals scored (70.20%), followed by areas 6C (69.20%), 6E (53.4%) and 6D (52.40%). In addition, a correlation between the effect of finalization and the location of finalization was found ($\chi^2 = 715.01$; $p = 0.0001$; $\phi = 0.34$). Areas 6C and 7M were positively associated with the effect of finalization on goal (adjusted residuals = 17.8 and 9.0, respectively), and negatively associated with the finalization error (adjusted residuals = -14.9 and -5.8, respectively). On the other hand, areas 9C, 9E and 9D were positively associated with the finalization error (adjusted residuals = 14.0, 9.8 and 7.5, respectively) and negatively with the effect of finalization on goal (adjusted residuals = -16.3, -8.9 and -8.2, respectively).

Table 3. Association between the effect of finalization and the location of finalization

Location of finalization		Effect of Finalization			Total
		Goal	Goalkeeper's defense	Error	
6C	Counting	1897	561	283	2741
	% Location of finalization	69.2%	20.5%	10.3%	100.0%
	% Effect of Finalization	54.5%	36.9%	24.8%	44.6%
	Adjusted residuals	17.8*	-7.0*	-14.9*	
6D	Counting	236	145	69	450
	% Location of finalization	52.4%	32.2%	15.3%	100.0%
	% Effect of Finalization	6.8%	9,5%	6.0%	7.3%
	Adjusted residuals	-1.9	3,8*	-1.8	
6E	Counting	238	130	78	446
	% Location of finalization	53.4%	29.1%	17.5%	100.0%
	% Effect of Finalization	6.8%	8.5%	6.8%	7.3%
	Adjusted residuals	-1.5	2.2*	-0.6	
9C	Counting	428	379	391	1198
	% Location of finalization	35,7%	31,6%	32,6%	100,0%
	% Effect of Finalization	12,3%	24,9%	34,3%	19,5%
	Adjusted residuals	-16,3	6,1*	14,0*	
9E	Counting	145	113	150	408
	% Location of finalization	35.5%	27.7%	36.8%	100.0%
	% Effect of Finalization	4.2%	7.4%	13.1%	6.6%
	Adjusted residuals	-8.9*	1.4	9.8*	
9D	Counting	123	106	117	346
	% Location of finalization	35.5%	30.6%	33.8%	100.0%
	% Effect of Finalization	3.5%	7.0%	10.3%	5.6%
	Adjusted residuals	-8.2*	2.6*	7.5*	
7M	Counting	416	88	53	557
	% Location of finalization	74.7%	15.8%	9.5%	100.0%
	% Effect of Finalization	11.9%	5.8%	4.6%	9.1%
	Adjusted residuals	9.0*	-5.1*	-5.8*	
Total	Counting	3483	1522	1141	6146
	% Effect of Finalization	56.7%	24.8%	18.6%	100.0%

Note: *difference found for $p < 0,05$

Source: The authors

Table 4 shows that most finalizations occurred towards the lower left (18.8%) and right (17.9%) corners. When analyzing the effect of finalization, a higher occurrence of goals was seen in the lower right (85.60%), upper right (83.60%), lower left (79.40%) and upper left (77.50%) corners. In addition, an association between the effect of finalization and the direction of finalization was found ($\chi^2 = 587.25$; $p = 0.0001$; $\phi = 0.34$); the upper left and right corners, as well as the lower left and right corners were positively associated with the effect of finalization on goal (adjusted residuals = 4.1, 7.7, 6.7 and 10.9, respectively), whereas the other categories were negatively associated.

Table 4. Association between the effect of finalization and the direction of finalization

Direction of finalization		Effect of finalization		Total
		Goal	Goalkeeper's defense	
Upper left	Occurrence	459	133	592
	% Direction of finalization	77.5%	22.5%	100.0%
	% Effect of finalization	13.2%	9.1%	12.0%
	Adjusted residuals	4.1*	-4.1*	
Upper center	Occurrence	151	87	238
	% Direction of finalization	63.4%	36.6%	100.0%
	% Effect of finalization	4.3%	5.9%	4.8%
	Adjusted residuals	-2.4*	2.4*	
Upper right	Occurrence	514	101	615
	% Direction of finalization	83.6%	16.4%	100.0%
	% Effect of finalization	14.8%	6.9%	12.4%
	Adjusted residuals	7.7*	-7.7*	
Intermediate left	Occurrence	307	291	598
	% Direction of finalization	51.3%	48.7%	100.0%
	% Effect of finalization	8.8%	19.8%	12.1%
	Adjusted residuals	-10.9*	10.9*	
Intermediate center	Occurrence	49	126	175
	% Direction of finalization	28.0%	72.0%	100.0%
	% Effect of finalization	1.4%	8.6%	3.5%
	Adjusted residuals	-12.5*	12.5*	
Intermediate right	Occurrence	282	290	572
	% Direction of finalization	49.3%	50.7%	100.0%
	% Effect of finalization	8.1%	19.8%	11.6%
	Adjusted residuals	-11.7*	11.7*	
Lower left	Occurred	738	191	929
	% Direction of finalization	79.4%	20.6%	100.0%
	% Effect of finalization	21.2%	13.0%	18.8%
	Adjusted residuals	6.7*	-6.7*	
Lower center	Occurrence	224	120	344
	% Direction of finalization	65.1%	34.9%	100.0%
	% Effect of finalization	6.4%	8.2%	6.9%
	Adjusted residuals	-2.2*	2.2*	
Lower right	Occurrence	759	128	887
	% Direction of finalization	85.6%	14.4%	100.0%
	% Effect of finalization	21.8%	8.7%	17.9%
	Adjusted residuals	10.9*	-10.9*	
Total	Occurrence	3483	1467	4950
	% Effect of finalization	70.4%	29.6%	100.0%

Note: *difference found for $p < 0,05$

Source: The authors

The analysis of the predictive factors of the effect of finalization proved to be statistically significant ($\chi^2 = 854.666$; $p < 0.0001$), as shown in Table 5. Thus, it is seen that the areas of finalization 6C, 6D and 7m increase the chances of a goal to be scored in relation to the goalkeeper's defense effect. This is also seen in all categories of the direction of finalization.

Table 5. Predictive factors of the effect of finalization

Effect of finalization ^a	crude p	crude OR	adjusted p	adjusted OR	CI	
					Lower limit	Upper limit
Center back	0.0010	0.658	0.2514	0.851	0.646	1.121
Right back	0.0001	0.634	0.2362	0.840	0.630	1.121
Left back	0.0001	0.600	0.1936	0.834	0.635	1.096
Right wing	0.0090	0.705	0.8996	0.979	0.708	1.355
Left wing	0.0980	0.795	0.5429	1.111	0.791	1.562
Pivot ^b						
6C	0.0001	2.920	0.0001	3.154*	2.593	3.836
6D	0.0070	1.417	0.0243	1.471*	1.051	2.058
6E	0.0010	1.576	0.1073	1.336	0.939	1.901
9E	0.5180	1.098	0.8370	1.033	0.759	1.405
9D	0.7750	0.045	0.8616	1.030	0.742	1.429
7M	0.0001	4.255	0.0001	4.245*	3.157	5.708
9C ^b						
Upper left	0.0001	9.179	0.0001	10.808*	7.239	16.137
Center left	0.0001	4.616	0.0001	4.541*	2.924	7.054
Upper right	0.0001	13.535	0.0001	16.075*	10.653	24.257
Intermediary left	0.0001	2.797	0.0001	3.009*	2.050	4.418
Intermediary right	0.0001	2.595	0.0001	2.762*	1.878	4.061
Lower left	0.0001	10.276	0.0001	11.908*	8.104	17.498
Lower center	0.0001	5.006	0.0001	5.414*	3.573	8.206
Lower right	0.0001	15.770	0.0001	17.706*	11.904	26.334
Intermediary center ^b						

Note: ^aThe reference category for the dependent variable: the goalkeeper's defense; OR: odds ratio; CI: confidence interval; ^bThe reference category for the independent variable; *difference found for p <0.05

Source: The authors

Discussion

The analysis of the 2015 World Women's Handball Championship showed that most finalizations during the competition were converted into goals, especially considering the pivot's position. Such finalizations occurred more frequently in the center areas of the court and towards the lower and upper corners of the goal. These results corroborate the literature, according to which the pivot, because of her proximity to the goal, can obtain high effective finalizations²⁵ and choose the direction of the finalization in face of the situational constraints, such as the prior positioning of the goalkeeper in relation to both, the attacker and the type of finalization executed^{26,27}.

The association between the effect of finalization and the attacker's position showed that only the left wing and the pivots were positively associated with the goals scored. These results partially corroborate with the literature, since an association of the effect of finalization with both offensive lines is reported, thus, the 1st line is more important in balanced confrontations¹³. On the other hand, it is seen that winning teams are more effective with regard to finalizations that occur at the 2nd offensive line¹⁸. In this sense, the results found in the present study suggest that the pivots increase the offensive effectiveness, supposedly because they are closer to the opponent's goal. Moreover, Menezes, Morato and Reis²⁵ pointed out that the female pivot's position and the movement of the ball executed by her and the wings is a significant offensive strategy, which might explain the association found in the present study concerning the goals scored by the left wing and the pivot.

In addition to the results with regard to the association between the attacker's position and the effect of finalization, it was seen that the areas of finalization 6C and 7M were positively associated with the goal. This reinforces the literature findings that showed, in general, a correlation between the attacks on the 2nd offensive line and the goal^{13,15,18,26}. In this context, it is suggested that attacking on the 2nd line results in a better effective finalization, however, there is a difference related to the location of finalization. This implies stating that the center region provides better conditions for finalization due to its proximity to the goal and the attack angle.

The association between the effect of finalization and the direction of finalization revealed that the goal was positively correlated with the corners of the goal, whereas the goalkeeper's defense was positively associated with the center and intermediary areas. Although no research with a similar design was found, it is worth mentioning that the goalkeeper's defensive posture changes according to the attacker's position and type of finalization²⁷, and the greater the predictability, the faster the goalkeeper anticipates²⁸. Therefore, once the goalkeeper adapts to situational constraints²⁹, it is possible to infer, based on the results of the present study, that the differences found regarding the association between the effect of finalization and its direction are due to the anticipations of the goalkeeper who, preferably, makes the direction difficult in the most predictable locations and ends up leaving the corners of the goal unprotected.

The analysis of the predictive factors of the effect of finalization showed that the attacker's position does not interfere with the effect of finalization. On the other hand, the areas of finalization 6C, 6D and 7M increased the chances of having a goal scored; likewise the corners of the goal increased the chances of having a goal scored by more than 10 times. These results partially corroborate with the literature that reports the location of finalization as being a predictive factor of the goal^{4,18}, although this is mostly determined according to the attacker's position. On the other hand, teams that have a varied repertoire of finalizations and good offensive organization through the positional play have a greater chance of being successful in the game³⁰, and the finalizations made by the wings contribute to victory⁵. Thus, it is clear that the success of the attack is likely to be related to some situational constraints, specifically with regard to the location and direction of finalization, which suggests the need to use tactical team actions in order to enable the finalization from the center area. In this sense, group tactics involving the two offensive lines must be encouraged, considering that this type of offensive organization may promote unpredictability to the opponent's defensive system.

Conclusions

Based on the results found in the present study, it can be concluded that in spite of the association of the effect of finalization with the attacker's position, the location of finalization and direction of finalization, only the location and the direction of the finalization proved to be predictive factors for having a goal scored. Such findings point to the importance of attackers to look for areas that provide the best position to overlap the opponent's defensive system to the detriment of the original positions.

A comprehensive analysis of the game is a limitation of this study, since the variables were not characterized according to different periods (e.g.: 1st and 2nd halves or periods of 10 minutes), neither the defensive and offensive tactical systems used by the teams were considered. As a result, it is suggested that further research investigates how the game-specifying variables (location of finalization, direction of finalization, type of finalization, etc.) change according to the different offensive and defensive systems, as well as considering the team tactics used. This suggestion is based on the possible implications that shall be made

available with regard to the broadening of knowledge, considering the tactical structures and their changes according to situational constraints. Finally, it is suggested that these investigations are carried out on men's and women's handball, thus, allowing that the type of game played are characterized and differentiated.

References

1. Bilge M. Game analysis of Olympic, World and European Championships in men's handball. *J Hum Kinet* 2012;35:109-118. Doi:10.2478/v10078-012-0084-7.
2. Daza G, Andrés A, Tarragó R. Match statistics as predictors of team's performance in elite competitive handball. *Rev Int Ciên Dep* 2017;13(48):149-161. Doi: 10.5232/recyde.
3. Pietro J, Gomez MA, Sampaio J. Game-scoring coordination in handball according to situational variables using time series analysis methods. *Int J Perf Anal Sport* 2016;16(1):40-52. Doi: <https://doi.org/10.1080/24748668.2016.11868869>.
4. Costa GDCT, Pedrosa GF, Souza NP, Gemente FRF, Freire AB, Castro HO. Type of game practiced in handball according to the positions of the attackers: Analysis of the Women's World Handball Championship 2015. *Int J Perf Anal Sport* 2017;17(3):360-373. Doi: <https://doi.org/10.1080/24748668.2017.1345197>.
5. Ohnjec K, Vuleta D, Dizdar D, Milanovic D. Structural analysis of counter-attacks performed at the 2010 European handball championship for women. *Sport Sci* 2015;8(2):69-75.
6. Gomez MA, Lago-Penas C, Viaño J, Gonzáles-García I. Effects of game location, team quality and final outcome on game-related statistics in professional handball close games. *Kinesiol* 2014;46(2):249-257.
7. Moncef C, Dagbaji G, Abdallah A, Mohamed S. The offensive efficiency of the highlevel handball players of the front and the rear lines. *Asian J Sports Med* 2011;2:241-248. Doi: 10.5812/asjms.34746
8. Roulj N, Vuleta D, Milanović D, Čavala M, Foretić N. The efficiency of elements of collective attack tactics in handball. *Kinesiol Slovenica* 2011;17:5-14.
9. Ohnjec K, Vuleta D, Milanović D, Gruić I. Performance indicators of teams at the 2003 world handball championship for women in Croatia. *Kinesiol* 2008;40:69-79.
10. Srhoj V, Rogulj N, Katić R. Influence of the Attack end conduction on match result in handball. *Collegium Antropol* 2001;25:611-617.
11. Karastergios A, Skandalis V, Zapartidis I, Hatzimanouil D. Determination of technical actions that differentiate winning from losing teams in woman's handball. *J Phys Educ Sport* 2017;17(3):1966-1969.
12. Valentin LF. Women's handball world championship 2017 case study: European teams versus rest of the participating teams' efficiency. *Acta Kinesiol* 2018;12(1):19-23.
13. Teles N, Volossovitch A. The influence of contextual variables on the team's performance in the last 10 minutes of the handball match. *Rev Bras Educ Fís Esporte* 2015;29(2):177-187. Doi: 10.1590/1807-55092015000200177
14. Ferrari WR, Santos JV, Vaz VPS. Offensive process analysis in handball: Identification of game actions that differentiate winning from losing teams. *Am J Sports Sci* 2014;2(4):92-96. Doi: 10.11648/j.ajss.20140204.14
15. Saavedra JM, Porgeirsson S, Chang M, Kristjánssdóttir H, Garcia-Hermoso A. Discriminatory power of women's handball game-related statistics at the olympic games (2004-2016). *J Hum Kinetics* 2018;62(1):221-229. Doi: 10.1515/hukin-2017-0172
16. Valentin LF, Gheorghe P. Longitudinal study on the effectiveness of the game action in woman's handball top competition (2004-2016). *J Phys Educ Sport* 2017;17(5):2255-2260.
17. Bajgoric S, Rogulj N, Cavala M, Burger A. Difference in attack situational activity indicators between successful and less successful teams in elite men's handball. *Sport Sci Health* 2017;13(3):515-519. Doi: <https://doi.org/10.1007/s11332-017-0348-7>.
18. Lozano D, Camerino O, Hilenro R. Analysis of the offensive tactical behavior in critical moments of game in the high performance in handball: A study Mixed Methods. *Cuad Psicol Dep* 2016;16(1):151-160.
19. Schorer J, Copley S, Busch D, Brautigam H, Baker J. Influences of competition level, gender, player nationality, career stage and playing position on relative age effects. *Scand J Med Sci Sports* 2009;19(5):720-730. Doi:10.1111/j.1600-0838.2008.00838.x
20. Lago-Peñas C, Gomez MA, Viano J, González-García I, Fernández-Villarino M. Home advantage in elite handball: The impact of the quality of opposition on team performance. *Int J Perf Anal Sport* 2013;13(3):724-733. Doi:10.1080/24748668.2013.11868684
21. Oliveira T, Gomez M, Sampaio J. Effects of game location, period, and quality of opposition in elite handball performances. *Percep Mot Skills* 2012;114(3):783-794. Doi:10.2466/30.06.PMS.114.3.783-794.
22. International Handball Federation [Internet]. Statistics. [acesso em 5 junho 2020]. Disponível em: <http://www.ihf.info>.
23. Tabachnick B, Fidell L. Using multivariate statistics. 6th ed. Boston, MA: Allyn & Bacon; 2013.

24. Fleiss J. Statistical methods for rates and proportions. 3rd ed. Hoboken, NJ: Wiley-Interscience; 2003.
25. Menezes RP, Morato MP, Reis HHB. Análise do jogo de handebol na perspectiva de treinadores experientes: categorias de análise ofensivas. *Rev Educ Fis* 2015;26(1):11-20. Doi:10.4025/reveducfis.v26i1.24306
26. García J, Ibáñez S, Feu S, Cañadas M, Parejo I. Study of the differences y play between winning and losing teams in formative stages of team handball. *Cult Cienc Deporte* 2008;3(9):195-200.
27. Vignais N, Bideau B, Craig C, Brault S, Multon F, Delamarche P, Kulpa R. Does the level of graphical detail of a virtual handball thrower influence a goalkeeper's motor response? *J Sports Sci Med* 2009;8(4):501–508.
28. Gutierrez-Davila M, Rojas FJ, Ortega M, Campos J, Parraga J. Anticipatory strategies of team-handball goalkeepers. *J Sports Sci* 2011;29(12):1321–1328. Doi: 10.1080/02640414.2011.591421
29. Rivilla-Garcia J, Sampedro-Molinuevo J. Influence of the opposition in throwing accuracy in elite and amateur handball players. *Br J Sports Med* 2010;44(14):534–539. Doi:10.1136/bjism.2010.078972.47.
30. Vuleta D, Sporis G, Vuleta D, Purgar B, Herceg Z, Milanovic Z. Influence of attacking efficiency on the outcome of handball matches in the preliminary round of men's Olympic Games 2008. *Sport Sci* 2012;5(2):7–12.

Author's ORCID:

Gustavo De Conti Teixeira Costa: <https://orcid.org/0000-0003-0911-8753>

Nilva Pessoa de Souza: <https://orcid.org/0000-0002-8614-0295>

Auro Barreiros Freire: <https://orcid.org/0000-0001-5198-9363>

José Cícero Moraes: <https://orcid.org/0000-0002-5415-9653>

Fabiano de Souza Fonseca: <https://orcid.org/0000-0002-9461-8797>

Flórence Rosana Faganello Gemente: <https://orcid.org/0000-0003-1063-4958>

Juracy da Silva Guimarães: <https://orcid.org/0000-0002-9928-3869>

Henrique de Oliveira Castro: <https://orcid.org/0000-0002-0545-164X>

Received on Mar, 21, 2019.

Reviewed on Nov, 30, 2019.

Accepted on Feb, 22, 2020.

Author address: Gustavo De Conti Teixeira Costa: Endereço: Faculdade de Educação Física e Dança na Avenida Esperança s/n, Câmpus Samambaia. E-mail: conti02@ufg.br