Amatria, M.; Lapresa, D.; Martín Santos, C.; Pérez Túrpin, J.A. (2020) Offensive Effectiveness in the Female Elite Handball in Numerical Superiority Situations. Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte vol. 20 (78) pp. 227-242 Http://cdeporte.rediris.es/revista/revista78/artanalisis1161.htm
DOI: http://doi.org/10.15366/rimcafd2020.78.003

ORIGINAL

OFFENSIVE EFFECTIVENESS IN FEMALE ELITE HANDBALL IN NUMERICAL SUPERIORITY SITUATIONS

EFICACIA OFENSIVA EN EL BALONMANO FEMENINO DE ÉLITE EN SITUACIONES DE SUPERIORIDAD NUMÉRICA

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ACKNOWLEDGEMENTS

The authors are grateful for the support of the subproject *Enfoque de método mixto en el análisis de rendimiento (en entrenamiento y competición) en el deporte de élite y academia [Mixed method approach in performance analysis (in training and competition) in elite sport and academy*] [PGC2018-098742-B-C33] in the triennial 2019-2021 (Ministry of Science, Innovation and Universities, State Programme for the Generation of Knowledge and Scientific and Technological Strengthening of the R+D+I System), which is part of the coordinated project *New approach of research in physical activity and sport from mixed methods perspective* (NARPAS_MM) [SPGC201800X098742CV0].

UNESCO code: 5899 Otras especialidades pedagógicas (Educación Física y Deporte) / Other pedagogical specialties (Physical Education and Sport)
Council of Europe classification: 4. Educación Física y deporte comparado / Comparative physical Education and sport

Recibido 27 de julio de 2018 **Received** July 27, 2018
Aceptado 16 de agosto de 2019 **Accepted** August 16, 2019

ABSTRACT

Despite being one of the most practiced sports in Europe, handball does not generate great interest on the part of the scientific community in its female modality. Given the relevance of situations of numerical superiority during the matches, the present work aims to analyze, in greater detail, the effective and ineffective offensive superiority sequences that occurred during the Women Handball World Championship (Sweden 2016). The observational methodology and the sequential analysis of delays have been used for this investigation. The results obtained reveal a successful offensive game pattern (ending in goal). This pattern uses an unstructured tactical system, regardless of its starting form, using the first wave counterattack as the main offensive play, to finish the actions with situations of 1vs0.

KEY WORDS: female handball, handball, observational methodology, attack.

RESUMEN

El balonmano, a pesar de ser uno de los deportes más practicados en Europa, no despierta gran interés por parte de la comunidad científica en su modalidad femenina. Dada la relevancia que tienen en los partidos las situaciones de superioridad numérica, el presente trabajo tiene como objetivo analizar las secuencias ofensivas, eficaces e ineficaces, que se producen en el balonmano femenino de élite en situaciones de superioridad numérica ofensiva, durante el Campeonato Mundial celebrado en Suecia en 2016. Para ello se ha hecho uso de la metodología observacional y del análisis secuencial de retardos. Los resultados obtenidos revelan como patrón de juego ofensivo exitoso, es decir, que la secuencia ofensiva concluye en gol, un patrón de juego que utiliza un sistema táctico no estructurado, con independencia de su forma de inicio, que emplea como principal medio ofensivo el contraataque de primera oleada, para finalizar las acciones con situaciones de 1vs0.

PALABRAS CLAVE: balonmano femenino, balonmano, metodología observacional, ataque.

INTRODUCTION

Handball practice has evolved in recent years: players and coaching staff have reached a higher level of professionalisation; types of training have evolved in the pursuit of performance; and competitions have become championships with a higher level of the game (Prudente, Sousa, Sequeira, López-López and Hernández-Mendo, 2017).

The performance of the different teams competing in the most relevant international tournaments (World and European Championships) has currently reached very similar levels; depending the victory in these matches on small details that mark the development of the matches (Ferrari, dos Santos and Vaz, 2014). In this regard, the regulations have undergone several modifications with the intention of making this sport more spectacular and favouring the existence

of those small details that unbalance the match and make handball a more unpredictable and exciting spectacle.

Handball is one of the most practiced sports in Europe (Prieto, Gómez and Sampaio, 2015) and, consequently, it is a source of interest for the scientific community from different perspectives: biomedical (Asker, Waldén, Källberg, Holm and Skillgate, 2017; Fieseler, Hermassi, Hoffmeyer, Schulze, Irlenbusch, Bartels, Delank, Laudner and Schwesig, 2017; Grabara, 2018; Lubiatowski, Kaczmarek, Cisowski, Breborowicz, Grygorowicz, Dzianach, Krupecki, Laver and Romanowski, 2018; Pueo Jimdodo, 2018; Pueo Jimdodo, 2018-Pueo Jimdodo, 2018 Penichet-Tomas, Ortega and Espina, 2017), psychological (Mayer and Thiel, 2018), in terms of game analysis or match analysis (Cardinale, Whiteley, Hosny, Popovic, 2017; Gutiérrez, Fisette, García-López and Contreras, 2014; Navarro, Morillo, Reigal and Hernández-Mendo, 2018) and in terms of physical preparation and training (Debanne, Laffaye and Trouilloud, 2018; Dello Iacono, Martone, zagatto, Meckel, Sindiani, Milic and Padulo, 2018; Forthomme, Croisier , Delvaux, Kaux, Crielaard and Gleizes-Cervera, 2018 ; Hermassi, Chelly, Fieseler, Bartels, Schulze, Delank, Shepard and Schwesig, 2017; Menezes, two Reis and Tourinho, 2015; Sabido, Hernández-Davo, Botella, Navarro and Tous-Fajardo, 2017; Srhoj, Rogulj, Padovan, and Katić, 2001; Wagner, Gierlinger, Adzamija, Ajayi, Bacharach, and von Duvillard, 2017).

Female handball does not arouse as much interest as male handball, which is a reflection of the very long way that the female sport has still to go in order to achieve equal consideration (Lopiano, 2000). Therefore, the production in these dimensions is lower: biomedical aspects (Ntai, Zahou, Paradisis, Smirnitou & Tsolakis, 2017; Steffen, Nilstad, Krosshaug, Pasanen, Killingmo & Bahr, 2017), physical preparation and training (Mhenni, Michalsik, Mejri, Yousfi, Chaouachi, Souissi & Chamari, 2017; Ohnjec, Vuleta, Milanović and Gruić, 2008), sports initiation (Ingebrigtsen, Jeffreys & Rodahl ,, 2013), and game analysis or match analysis (Michalsik, Aagaard and Madsen, 2013; Morillo-Baro, Reigal and Hernández-Mendo, 2015).

The study of numerical asymmetry during the development of the game is included within the match analysis. A situation resulting from the breach of the rules of the game, where one of the teams has a numerical advantage - both defensive and offensive - with respect to its adversary (Espina, Pérez and Cejuela, 2011; Gutiérrez, Fernández and Borrás, 2010). These situations of favourable numerical asymmetry foster the achievement of success in the game sequence (Wagner, Finkenzeller, Würth and von Duvillard, 2014). Bearing in mind the relevance of the goal in this sport, the study and knowledge of the situations prior to its achievement acquires a clear importance for coaches and players because of its high impact on the playing performance (Hristovki, Aceski, Balague, Seifert, Tufeckcievski and Cecilia, 2017).

Thus, and according to the above information, this research pursues the objective of analysing, in the elite female handball, the construction of the offensive, effective and ineffective sequences in situations of favourable numerical superiority.

METHOD

This study is carried out within the observational methodology (Anguera, 1979), which has found in sports - due to the quantity and variety of behaviours that can be observed -, an appropriate environment for its methodological development (Anguera and Hernández-Mendo , 2015). Additionally, handball researchers have resorted to the observational methodology for the possibilities that it offers to the match analysis (González, 2015; Morillo and Hernández-Mendo, 2015; Prudente et al., 2017; Ribeiro, Oliveira, Freitas, Leitao, Anguera and Campaniço, 2009).

The observational design followed is, according to Anguera, Blanco-Villaseñor and Losada 2011: a) Intersessional follow-up -23 matches- and intrasessional -frame to frame- in each sequence analysed; b) nomothetic -the 12 participating teams- and c) multidimensional -as reflected in the five dimensions that will support later the observation instrument-.

Participants

All teams classified for the development of the second phase -main round- and qualifying for the following rounds of the World Women's Handball Championship held in Sweden, 2016, which are a total of 12 teams, are included in this research. The observational sampling - offensive sequences in superiority by exclusion of players from the rival team - has been obtained from all the matches played in the main round and in the subsequent qualifiers of the championship -23 matches-. The women's handball world championships are held during the last months of the year, usually December. Consequently, all the videos necessary to develop the research were already collected in 2017. This videos collection is conditioned by the lack of public emissions of this sport modality "free-to-view". Once the videos are available, the data registration, the analyses and the elaboration of the article are then carried out. Finally, the document was prepared and sent to the magazine on 27 July 2018 (only the 2017 World Cup had been held, which was subsequent to the analysed one), but the assessment processes lead us up to this date.

Despite this, there are currently no similar studies or with similar contributions, being a strong starting point for future research both longitudinal (already being carried out by this research group) with the following championships and transversal.

Likewise, the match knowledge by this generation is essential to understand the game itself and improve their performance and practice.

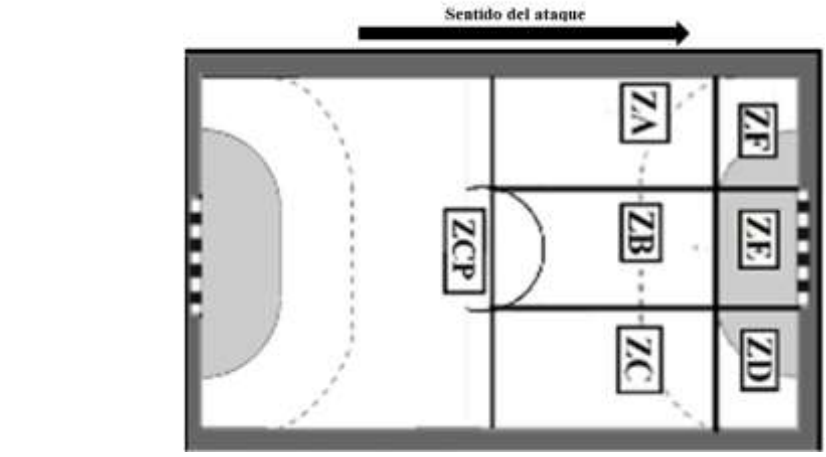
Last but not least, research and scientific progress in the female modality acquires a capital relevance today, since it is becoming increasingly popular in our society.

Observation instrument

An ad hoc observation instrument has been developed (table 1) for the data registration, making use of the Lozano proposal (2014) for the "construction" dimension. The observation instrument is a combination of the field format and category systems (Anguera, Magnusson and Jonsson, 2007). All field format dimensions are deployed in category systems by meeting the requirements of thoroughness and mutual exclusivity (Anguera and Hernández-Mendo, 2013).

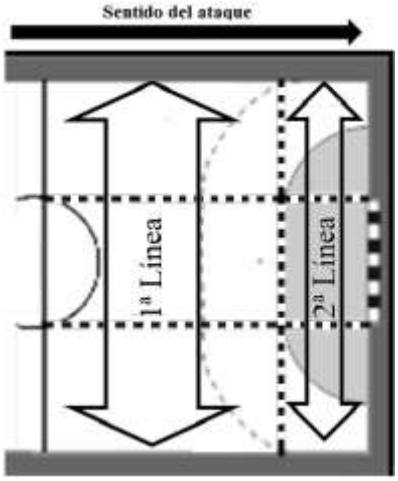
Table 1. Observation instrument.

No.	Dimension	Category Systems: codes and brief description
1	Ball possession	PO) Possession per team observed; PC) Possession by opposing team; Inob) Unobservability.
2	Beginning of the offensive phase	RO) Stealing the Ball in situations of 1x1 o 1x2; IN) Ball interception; SP) Goal-Throw; SC) Throw-off; ER) Regulatory violation by the rival team; PB) Ball turnover by opposing team.
3	Attack typology	CA) Counterattack; 65) positional attack on superiority 6x5; 76) positional attack on superiority 7x6; GF) Free-Throw; SE) special situations in numerical superiority of two or more players.
4	Formation	STE) structured tactical system; STNE) unstructured tactical system.
5	Zone of the beginning of the move	ZIA, ZIB, ZIC -first line sector-, ZID, ZIE, ZIF -second line sector-; ZICP - Own field - (see figure 1).
6	Creation	CR) crossing; CRP) pivot crossing; PER) changing positions; PEX) external switch; Trns24) changing to offensive system 2-4; BLO) blockages; PAN) screening; COR) curtain; PV) "give and go"; PS) subsequent penetrations; JA) fly; X11) action of 1x1; X22) action of 2x2; CA1O) first wave counterattack; CA2O) second wave counterattack.
7	Second creation	CR2) crossing; CRP2) Pivot crossing; PER2) changing positions; PEX2) external switch; Trns242) changing to offensive system 2-4; BLO2) blockages; PAN2) screening; DES2) Slippage; PV2) "give and go"; PS2) subsequent penetrations; JA2) fly; X112) action of 1x1; X222) action of 2x2; NING) No second creation is produced.
8	Pre-completion	VS43) situation 4 vs. 3; VS32) situation 3 vs. 2; VS21) situation 2 vs. 1; VS10) situation 1 vs. handball, without defenders.
9	Completion	GOL) throw and goal; ML) throw not ending up in goal; 7M) 7-metre penalty in favour of the team observed; FGF) Free-Throw in favour of the team observed; PBL) Ball turnover by the team observed; ERR) regulatory error made by the team observed.
10	End zone	ZFA, ZFB, ZFC -first line sector-, ZFD, ZFE, ZFF -second line sector-. See figure 1.



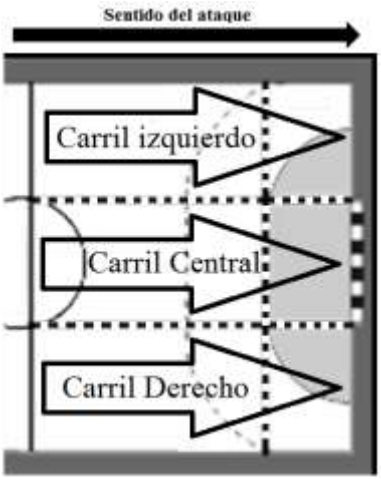
Zone Distribution Area

Legend: Attack direction



Spatial Distribution by Sectors

Legend: Attack direction. 1st line. 2nd line



Spatial Distribution by Areas

Legend: Attack direction. Left wing, Central Area, Right Wing

Figure 1. Spatial distribution in the court based on zones, sectors and areas of the court.

Registration and coding

The data was recorded using the version 1.2.1 Lince software (Gabin, Camerino, Anguera and Castañer, 2012). Each of the offensive sequences which occurred in situations of numerical superiority have been registered, by exclusion of a player of the rival team, in the second phase and in the following qualifying rounds of the 2016 Women's Handball World Championship. The registration of each sequence was carried out in three phases: the start of the offensive sequence; the development of the sequence, composed at least of a creation action; and finally, the end of the sequence - see figure 2-. A total of 262 offensive sequences have been registered in superiority by exclusion of players of the rival team. According to Bakeman and Quera (1995), the data obtained are from different events.

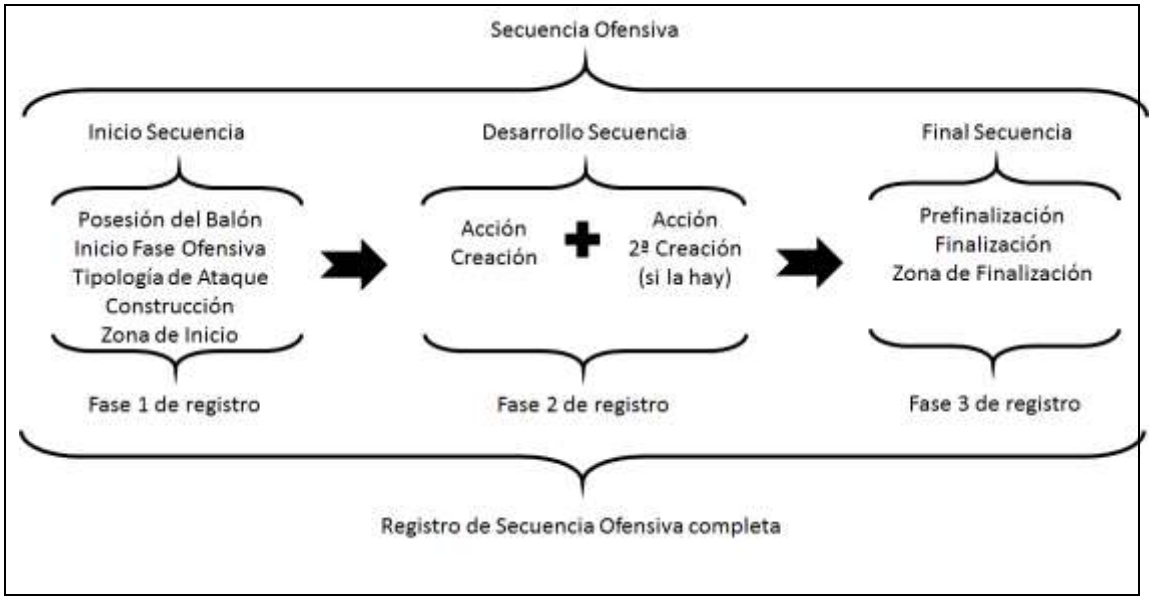


Figure 2. Registration of the structure of each offensive sequence: phases and dimensions to be registered.

Legend: ***Offensive sequence****.* *Start of Sequence (Ball possession; Beginning of the Offensive Phase, Attack Typology; Formation, Zone of the beginning of the move) – Registration Phase 1. Sequence Development (Creation Action + 2nd Creation Action – if any-) – Registration Phase 2. Final Sequence. (Pre-completion. Completion. End Zone) – Registration Phase 3.* ***Registration of the Complete Offensive Sequence***

Data reliability

The data were recorded by two observers, both with a Bachelor's degree in Physical Activity and Sports Sciences, with experience in handball and observational methodology. They had previously conducted a training process based on Anguera (2003). One of the observers recorded all the sequences of the observational sampling; while the second observer recorded 10% of the total.

In order to specify the reliability – in terms of consistency - of the data obtained from the observation instrument, the Cohen's kappa (1960) has been used, with the version 5.1 GSEQ programme (Bakeman and Quera, 2011). The Cohen's kappa values corresponding to the data packages recorded by both observers have been calculated by means of dimensions or criteria of the observation instrument; obtaining a minimum value of $\kappa = 0.91$ (table 2), which guarantees the reliability of the data supporting this research (Fleiss, Levin and Paik, 2003).

Table 2. Consistency between observations: Cohen's kappa by means of the observation instrument dimensions.

Dimension	Cohen's kappa
Ball possession	1
Beginning of the offensive phase	1
Attack typology	1
Formation	0.91
Zone of the beginning of the move	0.93
Creation	0.94
Second creation	0.91
Pre-completion	0.95
Completion	0.93
End zone	0.95

Data analysis

A data diachronic analysis has been carried out to respond to the aim of the present study. Specifically, a sequential delay analysis has been conducted using the v 5.1 GSEQ software (Bakeman and Quera, 2011).

The calculation of the adjusted residuals between the criteria behaviours -provided in GSEQ terminology- corresponding to the completion dimension -GOL, ML, 7M, FGF, PBL and ERR- and the conditioned behaviours -target- corresponding to the instrument dimensions has been conducted: beginning of the offensive phase, attack typology, formation, zone of the beginning of the move, completion zone, creation, second creation, and pre-completion. The retrospective conditioned behaviours related to the established criteria categories have been analysed, from delay -3 to delay 0 or co-occurrence.

Pursuant to Bakeman, and Gottman (1986), those transitions greater than 1.96 show a statistically significant correlation ($p < 0.05$) of activation between the given behaviour and the target behaviour; while those transitions lower than -1.96, indicate a statistically significant correlation of inhibition between the criterion behaviour and the conditioned behaviour.

RESULTS

Taking advantage of the possibilities offered by the observational methodology to capture the behaviour displayed in terms of order and length parameters, a sequential analysis of delays has been carried out to respond to the established objective, obtaining the results shown in Table 2.

As criterion behaviours or behaviours given, those corresponding to the dimension of the offensive action completion have been established - GOL, ML, 7M, FGF, PBL and ERR. As conditioned behaviours - or target -, the categories corresponding to the dimensions have been specified: beginning of the offensive phase, attack typology, start and end areas of the offensive action, type of creation and second creation; and pre-completion situation. Depending on the objective to be analysed, in the elite female handball, the formation of the

offensive, effective and ineffective sequences, in situations of favourable numerical superiority, the sequential analysis of adjusted residuals has been carried out from the retrospective point of view (delays -3, -2, -1) and, as data obtained from different events, in the co-occurrence.

Table 2. Significant adjusted residuals which constitute sequential patterns (activation higher than 1.96- or inhibition lower than -1.96-) of completion of offensive sequences, in situations of favourable numerical superiority.

Lag -3	Lag -2	Lag -1	Lag 0	Criterion behaviour
STE (-2.04) - Structured Tactical System - SNTE (2.04) - UnStructured Tactical System -	CA1O (3,47) - First wave counterattack -		VS10 (2.83) -Situation 1 vs 0-	GOL
SC (2.77) -Throw-off- STE (2.03) - Structured Tactical System - SNTE (-2.03) - UnStructured Tactical System -	CR (2,42) -Crossing-		ZFA (1.99) -Final Zone A- ZFB (-2.08) - Final Zone B-	ML -Throw not ending in goal-
	PS (3.20) -Subsequent Penetrations-	BLO2 (3.08) -Blockage in second creation-	ZFE (2.82) -Final Zone E-	7M - 7-meter throw-
ZID (3,41) -Start Zone D-				FGF -Free-throw in favour -
			VS43 (2,37) -Situation 4 vs 3- VS10 (-2,27) - Situation 1 vs 0-	PBL (Ball turnover)
			ZFE (2,12) - Final Zone E-	ERR - Regulatory Error -

DISCUSSION

In the sequential analysis of delays, they have been considered criterion behaviours those related to the “completion” dimension (GOL, ML, 7M, GF, PBL, ERR). Conditioned behaviours were deemed those corresponding to the other dimensions that make up the instrument of observation (beginning of the offensive phase, attack typology, formation, zone of the beginning of the move, completion zone, creation, second creation, and pre-completion). Successful offensive sequences were those whose completion of the offensive action concludes in goal (GOL) or with a 7-meter (7M) throw. Offensive sequences will be considered “unsuccessful” when they end with a bad throw (ML), a free

throw in favour (FGF), a ball turnout (PBL) or with a regulatory error made during the offensive action by the team observed (ERR).

The results obtained corresponding to those offensive sequences of favourable offensive numerical superiority ending with a goal (GOL) reflect a pattern of behaviour made of an unstructured tactical system (STNE). They use the first wave counterattack as a creative element in its development (CA1O), and conclude with pre-completion situations of 1vs0 (VS10) - that is, the attacking thrower against the opposing goalkeeper-. This behaviour pattern follows the internal logic of a counterattack and is in line with the results obtained by Hernández et al. (2010). These results concluded that the counterattack has a greater effectiveness in terms of goal achievement compared to the positional game. Likewise, they coincide with those results obtained by Ribeiro et al. (2009), in their comparative study between counterattacks and rapid attacks in male handball. They detected temporal patterns in the sequences of direct counterattack, but not in those of rapid attack-. In addition, Lozano and Camerino (2012), in their analysis of the effectiveness of offensive handball systems conclude that counterattack is the most effective type of offensive action regardless of the type of defence developed by the opposing team. This statement differ with this study, since this research concludes that the most effective tactical system is structured (STE).

The results obtained concerning those offensive sequences which, while occurring in a situation of favourable offensive numerical superiority, end with a 7-meter throw in favour (7M), show the presence of the PS category (subsequent penetrations) in first creation and of BLO2 (blocking in second creation) as second creation action, with positive values in lag -2 and -1 respectively. These actions end in ZFF (completion zone F), corresponding to the space occupied by the left wing -figure one-. Sousa, Prudente, Sequeira, López-López and Hernández-Mendo (2015) in their study of 2x2 game situations in the 2012 European men's handball championship, claimed that the crossing, as a technical-tactical element, significantly triggers the 7-metre throw; while the technical-tactical blocking action activates the goal achievement.

The 2x2 is a technical-tactical element, part of the basic tactical means (Foretić, Rogulj and Trninic, 2010; García, Aníz, Arellano, Domínguez, and García, 2004; Montoya, Moras and Anguera, 2013; Rogulj, Srhoj, and Srhoj, 2004; Román, 2005). Therefore, it is relevant to highlight the absence of a significant correlation between the “successful” criterion behaviours - GOL (goal achievement) and 7M (7-metre throw in favour) - and the 2x2 (X22) category - creation dimension - in the development of the offensive sequence. These results differ from those obtained by Prudente et al. (2017), in male handball, which concluded that 2x2 situations have great tactical importance throughout the development of a match. Passos, Milho, Fonseca, Borges, Araújo and Davids (2011) in their study on team sports also affirm that grouping tendencies in the collective offensive game, are reduced to subunits of two individuals, being sensitive to different task delimitations, such as, in this case, game actions that occur in situations of favourable numerical asymmetry.

The results obtained in terms of offensive actions leading to a throw which does not end with a goal (ML) show a statistically significant correlation with the start of the sequence as a throw-off (SC), and through structured tactical systems (STE). These results are different from those already mentioned by Lozano and Camerino (2012). In the development and completion of the offensive sequence, a statistically significant correlation has been detected between the throwing criterion which does not end with a goal (ML) and the conditioned behaviours of crossing (CR) and the completion zone A (see figure 1) in lag -2 and the co-occurrence, respectively. These results match those obtained by Sousa et al. (2015), who concluded in their study of the 2x2 game situations, in the 2012 European men's handball championship, that the "crossing and continuity" activates the throw to the post or crossbar.

As for the offensive sequences ending with a ball turnover by the team observed (PBL), it should be highlighted the statistically significant activation relationship in lag 0 or co-occurrence with the tactical situation of pre-completion 4vs3 (VS43). There is also a statistically significant correlation of inhibition in the co-occurrence of the 1vs0 situation (VS01). It is also underlined that the sequences where complex tactical situations are carried out or where more than two or three players are grouped together, have a greater difficulty of ending successfully (Sousa et al. 2015).

CONCLUSION

In the light of the results obtained in this research, it can be concluded that the success of the offensive sequences in situations of favourable numerical superiority, during the 2016 women's handball world championship, responds to an offensive game pattern. This pattern uses an unstructured tactical system, without being relevant how it starts (stealing the ball in situations of 1x1 or 1x2, interception of the ball, goal-throw, throw-off, regulatory infringement by the rival team or ball turnover by the rival team). This pattern uses the first wave counterattack as the main offensive means, to end the actions with situations of 1vs0.

The present study aims to help the coaches of female handball to deepen their knowledge of offensive sequences with numerical superiority resulting from a disciplinary penalty of exclusion (two minutes of the match in numerical inferiority) in the women's elite handball. Consequently, this research is seeking to be a support point for the design of tasks, aimed at simulating counterattack situations with 2x2 situations to reach a throw; or, to allow the application of tactical means of less execution complexity for the achievement of goal.

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