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DEVELOPMENT OF AN INSTRUMENT FOR THE OBSERVATION OF COLLECTIVE TACTICAL PROCEDURES OF POSITIONAL ATTACK IN BEACH HANDBALL

Elaboración de un instrumento para la observación de los procedimientos tácticos colectivos del ataque posicional en balonmano playa

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Abstract

The study of organized attack collective play in beach handball is a relatively under-researched area. Consequently, the main objective of this study is to design and validate an instrument for the observation of the collective tactical procedures of positional attack in beach handball. Another objective of this study was to gather the collective tactical procedures employed during the organized attack phase in beach handball matches at the highest level. The observational instrument was developed using the criterion of authority, with input from a panel of experts. To assess the quality of the data, Cohen's Kappa Index (intra-observer agreement) and Fleiss' Kappa Index (inter-observer agreement) were employed. Both indexes demonstrated almost perfect concordance values. It was concluded that the observation instrument, designed ad hoc, was valid for the purposes of the study. Furthermore, it was determined that women's teams performed more complex procedures than men's teams.

Keywords: Observational tool; planned play; directed play; strategy; tactical combinations.

Resumen

El balonmano playa es un deporte que ha sido poco estudiado en lo que se refiere al análisis del juego colectivo ofensivo organizado. Es por ello que el objetivo principal de este estudio es el de diseñar y validar un instrumento para la observación de los procedimientos tácticos colectivos del ataque posicional en el balonmano playa. Otro de los objetivos de este trabajo fue el de recoger los procedimientos tácticos colectivos de la fase de ataque organizada que se producen en partidos de balonmano playa del máximo nivel. Para la elaboración del instrumento observacional se utilizó el denominado criterio de autoridad mediante un panel de expertos y para la validación de la calidad del dato se estudiaron el Índice de Kappa de Cohen (concordancia intra-observador), y el índice de Kappa de Fleiss (concordancia inter-observador). Ambos índices mostraron valores de concordancia casi perfectos. Se concluyó que el instrumento de observación diseñado ad hoc era válido para el objetivo de estudio y que los equipos de mujeres realizan procedimientos más complejos si se comparan con los equipos de hombres.

Palabras clave: Herramienta observacional; juego prefabricado; juego dirigido, estrategia, combinaciones tácticas.

Introduction

Beach handball is a sport that originated in Italy in 1992 to achieve the same level of success that volleyball had achieved by moving from the court to the beach (Bebetsos, 2012). It is evident that beach handball shares numerous

characteristics with other sporting disciplines. However, it is distinguished by its primary focus on spectacle, which often supersedes the pursuit of victory. The rules of the game are designed with this objective in mind.

The aforementioned beach handball rules incite teams to play almost always in numerical inequality. Consequently, teams frequently implement defensive formations that are characterised by a paucity of depth and width, thereby leaving the peripheral areas of the defensive zone open and waiting for the attacking team to take the initiative (Zapardiel, 2020). In other instances, beach handball defenders, who are outnumbered, attempt to create uncertainty, which in turn encourage the attackers to attempt to resolve the uncertainty to generate potential goal actions (Zapardiel & Paramio, 2018). Therefore, to overcome these types of defences just mentioned, teams try different attack actions for scoring a goal. Identifying the attacking procedures used by the teams for scoring goals could be very useful for beach handball coaches.

In this context, and in relation to ball possession, the fundamental unit of observation can be defined as the temporal space that elapses between the moment players gain possession of the ball and the point at which they either pass it, throw it or lose possession (Martín et al., 2013). The Basic Attack Unit (BOU) is defined as the temporal span between the positioning of the attackers in specific positions and the occurrence of a break in play or change of possession (García Calvo et al., 2004). In terms of ball possession, the fundamental principles of the game are to retain possession of the ball, advance with it towards the opponent's goal and score a goal (Lasierra Aguilà, 2017).

To comply with the principles of the game, an organized decision-making framework must be defined. In this sense, the ‘strategic framework’ is a set of dynamic and changing decisions that occur during the competition that is divided into three categories, namely, game systems, collective procedures, and individual actions (Lasierra Aguilà, 2017).

The game in circulation, which is based on a structure, is an example of an "attack system" (such as 3:3 or 2:4) and the group-tactical actions are the combination that occur between two or more players (Lasierra Aguilà, 2017). These group-tactical actions can be classified into three categories, namely, elementary (asymmetry situations), simple (player and ball circulations), basic (crossing with ball, crossing without ball, cutting in, give and go, blocking, block, screen and piston movement) and complex (tactical procedures) (Antón García, 2014). Collective tactical procedures are the sum of group-tactical actions, which are those used, partially or totally, in the play system by a team (Lasierra Aguilà, 2017) during ball possession.

Three types of collective play can be distinguished: free play, in which players take the initiative from the outset of the BOU, depending on the responses of the opposing team; directed play, which begins with the planned play BOU; and finally planned play, which involves the development of the pre-established BOU (Antón García, 2006).

To avoid confusion, it is essential to clarify that free play does not entail each player acting in an autonomous manner regardless of the impact of their actions on others. It is imperative to withdraw this type of play from our teams as soon as possible (Ticó, 2002). Free play is defined as a situation in which the coach establishes the playing spaces and the players’ initial position along with the movement priorities and actions in relation to the player with the ball (Ticó, 2002).

In directed play, the coach organizes the initial position and the first movements of both the players and the ball. Subsequently, it is the player's responsibility to identify the best option for the continuation of play (Ticó, 2002).

Finally, the planned play game is that one in which the coach has foreseen all the specific movements of each player, the ball and all the different combinations, since the very beginning to the end of the BOU (Ticó, 2002).

At this stage, it would be beneficial to ascertain which of the collective tactical procedures could be more effective in resolving the issues posed by the defensive strategies employed in beach handball. However, before that, it is essential to have a clear understanding of the collective tactical procedures that are developed during a beach handball match.

To identify the types of attacking collective play that are developed in beach handball, observational methodology can be employed, a methodology that has already been utilized in a number of studies of this sport (Morillo Baro, 2016; Morillo et al., 2015; Vázquez Diz et al., 2019; Vázquez Diz, 2020). To gain a comprehensive understanding of team sports, it is necessary to combine quantitative analysis with qualitative analysis (Travassos et al., 2013). This observation system is designated as a mixed system and integrates both research paradigms, quantitative and qualitative, to conduct

a more comprehensive general analysis (Anguera et al., 2014). In the context of team sports, in which several variables can influence performance, the use of mixed methods is justified, as it allows the generation of properly contextualized results (Lozano Jarque, 2014). Recent research showing that contextual variables such as fatigue and perceived well-being can significantly influence performance and the quality of technical and tactical actions during competitions, especially in beach handball, reinforces the use of mixed methods (Lara-Cobos et al., 2024).

Morillo et al. (2015) provides a compelling illustration of the utilization of an observational methodology to assess the offensive capabilities of beach handball teams. Their findings indicate a tendency among women's teams to conclude on the left side within open defensive systems, and they further demonstrate that the goalkeeper's role is more pronounced than that of the other players during organized attacking play. In contrast, the study revealed that in men's teams, responsibilities were more evenly distributed during organized attacking play, with the completion of attacks directed towards the right wing when facing closed defensive systems. Furthermore, this study identified 360º shots as the most frequently executed shot.

To consider this observational method as rigorous, it is necessary to develop an instrument in which a record can be made (qualitative data), that must be subject to data quality controls and subsequent analysis (quantitative data) (Anguera et al., 2001). The considerable diversity of situations that can be observed during a match requires the use of an ad hoc instrument for each case. The instrument may be based on a system of categories, a field format, a combination of both, or ratio scales (Anguera & Hernández Mendo, 2013).

In the event that the selected system is that of categories, the following steps should be followed (Anguera & Hernández Mendo, 2013): 1) Compile a list of the observable reality. 2) Select the exhaustive categories. The number of previous observation sessions should ensure that no new categories emerge. At least three observation sessions should be conducted. 3) Formulate groupings of criteria based on specific behaviors according to their similarity. 4) Conduct observation sessions to ascertain the homogeneity of the groupings. In the event of non-homogeneity, the required modifications will be implemented until the exhaustive system of categories is well established.

Based upon the revised researches, this study attempts to reach the following aims: 1) To design an instrument to identify the attacking collective tactical procedures that take place/are implemented in beach handball competition. 2) Validate the instrument through the authority criterion by means of a panel of experts and study its reliability by performing/calculating intra-observer and inter-observer concordance indexes. 3) Record the collective attack tactical procedures and their relationship with other structural, spatial and temporal aspects of two top-level beach handball matches.

Method

Design

To design the observational instrument with the objective of understanding the types of beach handball collective play in this study, it was necessary to consider that the observed event would be synchronous, that the subjects would be in small groups that work as a unit, and that the observed behaviour would be hetero-contingent (Anguera et al., 2001).

Participants

A total of 10 beach handball experts participated in the assessment of the observational and recording instrument of this study (Calle et al., 2024). To be eligible for inclusion, experts were required to meet one of the following criteria (Santos et al., 2014):

a) 10 years of experience as a coach of the national category beach handball teams.

b) 5 years of experience as a researcher in this scientific area.

c) 5 years of experience as a coach of Spanish Beach Handball National teams.

In the initial phase of the validation process for the observational and recording instrument used in this study, three students from the Degree in Sports Science at University of Alcalá, who had completed the two following subjects, namely, Sport Basics: Basketball and Handball, and Sports Specialization in Handball, were selected to participate.

Observational instrument

The observation instrument was developed through a comprehensive review of the existing literature related to the observation and analysis of handball and beach handball (Anguera et al., 2001; Ávila, 2003; Lozano Jarque, 2014; Lozano & Camerino, 2012; Morillo et al., 2015; Prudente et al., 2010).

The initial approach to the design of the observational instrument created ad hoc was to develop a tool that did not show excessive rigidity (Anguera et al., 2007). This observational instrument is based on a system of categories that was constructed following the indications of Anguera & Mendo (Anguera & Hernández Mendo, 2013). Thirteen criteria and the respective categories related to the attacking actions of collective play in beach handball were created. The criteria were:

1. Team of the player performing the tactical procedure
2. Period of the match during which the tactical procedure is carried out
3. Minute of the set in which the tactical procedure is carried out
4. Attack structure when the tactical procedure is carried out
5. Attack tactical procedure carried out
6. Attack numerical situations of the players when the tactical procedure is carried out
7. Defence structure during the execution of the tactical procedure.
8. Finalization of the BOU
9. Orientation in the finalization of the BOU
10. Specific position BOU finalization
11. Area of the playing field from which the BOU is carried out
12. Type of finalization of the BOU action
13. Laterality of the BOU thrower

Table 1 shows all criteria used in the observational tool of this study. Each criterion is placed in the same column, followed by the criterion's name in the next column, and finally the corresponding categories and their identification code.

Table 1. List of criteria, records in the panel and corresponding categories.

CRITERION	PANEL REGISTRATION AND CODE	CATEGORIES AND CODE
1. Team of the player performing the tactical procedure	Team	- A (A) - B (B)
2. Period of the match in which the tactical procedure is carried out	Period of play (PEJU)	- First set (SET 1) - Golden goal first set (GO1) - Second set (SET 2) - Golden goal second set (GO2)
3. Minute of the set in which the tactical procedure is carried out	Playing time (TIJU)	- From M0 to M9 - Golden goal (GO)
4. Attack structure when the tactical procedure is carried out	Attack structure (ESOF)	- 3:1 goalkeeper on the substitution area side (3:1PB) - 3:1 goalkeeper on the opposite substitution area side (3:1PBC) - 3:1 central goalkeeper (3:1PC) - 3:1 goalkeeper at the pivot (3:1PP) - 4:0 goalkeeper on the substitution area side (4:0PB) - 4:0 goalkeeper on the opposite substitution area side (4:0PBC) - 4:0 goalkeeper on the substitution area side (4:0PLB) - 4:0 goalkeeper on back on the substitution area side (4:0PLBC) - 2:2 goalkeeper on the substitution area side (2:2PB) - 2:2 goalkeeper on the opposite the substitution area side (2:2PBC) - 2:2 goalkeeper on the substitution area side pivot (2:2PPB) - 2:2 goalkeeper on the opposite substitution area side (2:2PPBC) - Other attack structure (OTR-EO)
5. Attack tactical procedure carried out	Attack tactical procedure (METO)	- A - Other tactical combination (OTR-MT) - B - Piston movement (PS) - C - Fixed pivot (PF) - D - 360 and continuity (360C) - E - Flight and continuity (FYC) - F - Block (BLO) - G – Cutting in (COR) - H – Crossing with ball (CRU) - I - Screen (PAN) - J - Give and go (PYV) - K – Crossing without ball (PER) - L - Transformation (TRANS) - M - Jump and continuity (SALC) - N - None (NOHAY)
6. Attack numerical situation of the players when the tactical procedure is carried out	Attack numerical situation	- Numerical equality (IGU) - Attacking team one player less (INF1) - Attacking team two players less (INF2) - Attacking team one player more (SUP1) - Attacking team two players more (SUP2)
7. Defence formation during the execution of the tactical procedure	Defence formation	- 3 defenders lined up on the goal area line (3:0) - 2 defenders lined up on the goal area line and the central defender with more depth (2:1C) - 2 defenders on the goal area line and the wing left defender with more depth (21:L) - 2 defenders on the goal area line and the wing right with more depth (2:1R) - 1 defender on goal area line and both wing left and centre back with more depth (1:2LC) - 1 defender on the goal area line and both the wing right and centre back deepest (1:2RC) - Centre back lined up on the goal area line and the 2 wings with greater depth (1:2RL) - 3 defenders lined up with more defensive depth (0:3) - Individual defence (MtM) - Varying depth (VP) - Other defensive structure (OTR-ED)
8. Finalisation of the BOU	BOU finalisation (FINUBO)	- 6-metre throw (6M) - Goal (GOAL) - Save and possession defending team (SV+) - Save and possession attacking team (SV-) - Post-crossbar and possession defending team (POS+) - Post-crossbar and possession defending team (POS-) - The player drops the ball over the outer goal line (G-OUT) - Throw-in (TI) - Turnover (passing error or interception by defending team) (TOV) - Rule error (ERROR) - Passive play (PP) - Free throw (FT) - Blocking and possession defending team (including blocking on counter-spin) (BLOCK+) - Blocking and possession attacking team (including blocks on counter-spin) (BLOCK-) - Offensive foul (OF) - Technical-tactical error by the player in possession of the ball (MISTAKE). - BOU is developing (CONUBO-FI)
9. Orientation in the finalisation of the BOU	Finalisation orientation (ORUBO)	- Yes oriented (SIORE) - Not oriented (NOORE) - The BOU is developing (CONUBO-OR) - Other (OTR-OR)

10. Specific position BOU finalisation	Playing position (PE)	- Left Wing (ALIZ) - Right Wing (ALDE) - Pivot (PIV) - Left Back (LAIZ) - Right Back (LADE) - Centre (CEN) - Goalkeeper (POR) - Goalkeeper left wing (POR-AI) - Goalkeeper right wing (POR-AD) - Goalkeeper pivot (POR-P) - Goalkeeper left back (POR-LI) - Goalkeeper right back (POR-LD) - Central goalkeeper (POR-C) - BOU is developing (CONUBO-PE) - Other specific position (OTR-PE)
11. Area of the playing field from which the BOU is caried out	Zone play finalisation (ZOFI)	- From Z1 to Z16 (Z1 to Z16) - BOU is developing (CONUBO-ZO) - Other (OTR-ZO)
12. Type of finalisation of the BOU action	Type BOU finalisation (TIFACUBO)	- Stand shot without opposition (APOSIN) - Stand shot with opposition (APOCON) - Jumping shot in penetration (SALPEN) - Jump shot without opposition (SALSIN) - Jump shot with opposition (SALCON) - 360 vertical (both feet land first after the jump) (360VER) - 360 horizontal (both feet do NOT land on the sand first after the jump and the jump is in depth) (360HOR) - 360 fall-away shot (both feet do NOT land first after the jump and the jump is parallel to the 6-metre line) (360REC) - In-flight vertical shot (both feet land first after the jump) (FLYVER) - Horizontal in-flight shot (both feet do NOT land on the sand first after the jump and the jump is in depth) (FLYHOR) - In-flight fall-away shot (both feet do NOT land first after the jump and the jump is parallel to the 6-metre line) (FLYREC) - BOU is developing (CONUBO-TI) - Other (OTR-TI)
13. Laterality of the BOU thrower	Laterality BOU thrower (LAFI)	- Right-handed (DIES) - Left-handed (ZUR) - BOU is developing (CONUBO-LA) - Other (OTR-LA)

Note: Group-tactical actions adapted from Antón García (2006). Defence formation adapted from Gkagkanas et al. (2018). BOU action finalisation type adapted from Vázquez Diz et al. (2019).

The criterion "Player's team performing the tactical procedure" pertains to the identification of the home (A) or away (B) team at the time of the action under analysis. The criteria "Period of the match in which the tactical procedure is carried out" and "Minute of the set in which the tactical procedure is carried out" are related to the structure of a beach handball match. In accordance with the regulations set forth by the International Handball Federation (2021), a beach handball match is comprised of two distinct periods, each of which is scored separately. Each period lasts ten minutes. In the event that each team wins one period each, the result is a draw. As always there must be a winner, the "shootout" method of tie-breaking is implemented. In case of tie at the conclusion of the set, the winner must be determined by the "golden goal".

For the recording of the "group-tactical actions" used during the observed matches, the terminology of Antón (Antón García, 2006) has been adapted. In this context, the term "Block" is used to describe an action by an attacking player (X1) that obstructs the trajectory of a defending player (Z1), thereby creating space for another attacking player (X2); "Cutting in" is employed to describe a situation in which two players follow different trajectories, with one of them attempting to attract the attention of the defending player (X1), this enables X2 to take advantage of the available space; "Crossing with ball" denotes an attack manoeuvre involving two players, traversing opposing trajectories and converging at a single point, before passing the ball at a designated point along their respective trajectories; "Screen" when one or more attacking players obstruct the deep trajectory of the defending players, trying to prevent these defenders from avoiding a shot from distance; "Give and go" when a player with the ball (X1), makes a pass to an unmarked teammate (X2), subsequently X1 gets unmarked increasing the depth and returns to receive the ball from X2; "piston movement" when two or more players attack successively and staggered with and without the ball, towards the goal looking for fixation or free space with similar trajectories; "Crossing without ball" refers to a specific positional change involving two attacking players (X1 and X2) and a third player with the ball (X3), this positional change is made with a trajectory that incorporates depth, and the third player passes the ball to X1 or X2 after the positional change; "360 and continuity"

describes a trajectory towards the goal that ends with a jump with a turn, rather than a shot, instead, the third player passes the ball to another teammate; "In-flight and continuity" to the execution of a in-flight and instead of executing the throw-in, passing the ball to another teammate; and to the "fixed pivot" when passing to the pivot with fixation of this one. Passes prior to the first attack tactical procedure shall be recorded as "other". Data recorded when no tactical procedure is taking place shall be recorded as "not present" (e.g. when there is a throw-in, when there is a change of attacking structure, etc.).

To record the 'attack tactical procedure' during observation, the observer shall stop the video after each of these actions and indicate the type of action occurred. Once the entire BOU is completed, the final record shall be made.

The criterion "Attack numerical situation of players when performing the tactical procedure" is determined by the categories "Numerical equality", counting the total number of players on the playing court (goalkeeper included); "Attacking team one player less", meaning that the team of the observed player has one player less, counting the total number of players on the playing court (including the goalkeeper); "Attacking team two players down" means that the observed player's team has two players down, counting the total number of players on the playing court (goalkeeper included); "Attacking team one player up" means that the observed player's team has one player up, counting the total number of players on the playing court (including the goalkeeper); and "Attacking team two players up" means that the observed player's team has two players up, counting the total number of players on the playing court (including the goalkeeper).

To assess the criterion of defence formation during the realization of tactical procedure, an adaptation of the work of Gkagkanas et al. (2018) was undertaken. The defence formation that was identified during the annotated action are presented in Figure 1. The structure designated as "Varying Depth" (VP) is included in the analysis. Rather than representing a discrete structure, this defence system is characterized by a variation in depth, without the explicit delineation of concrete structures. It is necessary to indicate the most representative defence formation observed in the entire tactical environment.

The criteria "Completion of BOU" and "Specific position completion of BOU" have been explained in Table 1.

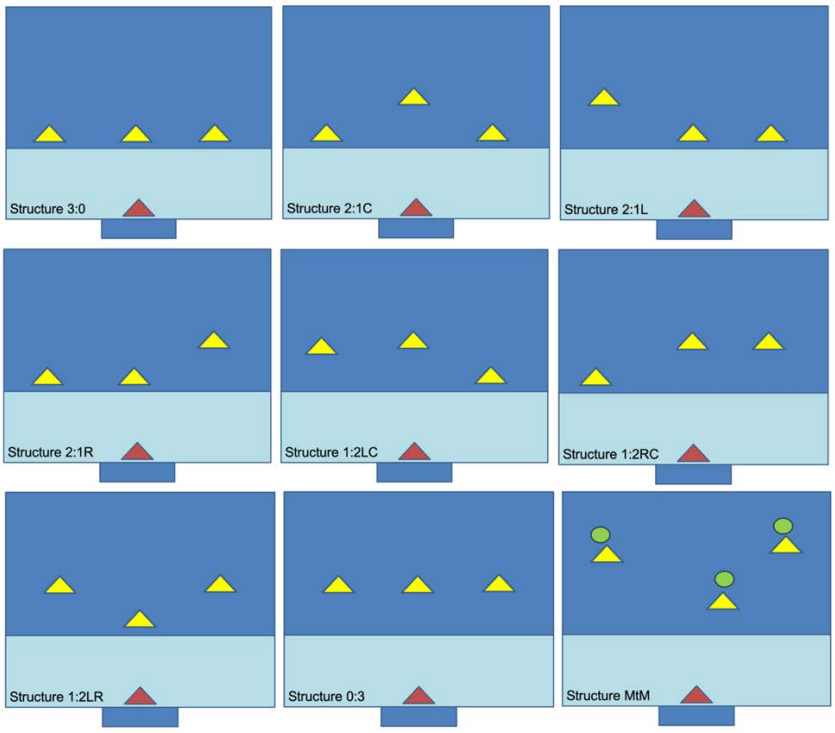

Figure 1: Defence formation in beach handball
Note: Adapted from Gkagkanas et al. (2018).

The "Orientation at the end of the BOU" criterion has two categories: firstly, "Yes Oriented", the player's hips are oriented towards the centre of the goal; secondly, "No Oriented", the player's hips are not oriented towards the centre of the goal. For the criterion "Zone of the court where the BOU ends", 16 zones have been considered instead of the 9 zones used previously, because we think it is better adapted to the 4:0 attack structures and because it also allows the shots to be taken from each zone of the beach handball court.

The criterion "Specific position BOU finalization" denotes the specific position from which the player propels the ball. In the case of the goalkeeper, in addition to his condition as a goalkeeper, it also specifies the position from which the ball.

Figure 2 shows how the zones of the playing court have been divided, taking into account the direction of attack when assigning the numerical value.

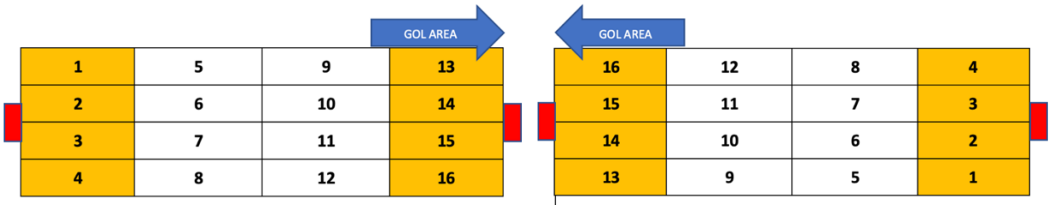

Figure 2: Division of BOU finalization zones

Note: Own elaboration.

The criterion "Type of finalization of the BOU action" (adapted from Vázquez Diz et al., 2019) is subdivided into the categories "Stand shot without opposition" which are all the throws that are performed with some foot set on the sand and without any player in front of the thrower; "In support with opposition" are all the throws that are performed with some foot set on the sand and with some player in front of the thrower; "Jumping shot in penetration " which are all the throws in which during the jump the player exceeds the 6-meter line and which are neither 360 nor flight; "In jump without opposition" which are all the throws made in jump behind the 6-meter line and without any player in front of the thrower; "Jumping shot in penetration " which are all the throws made in jump behind the 6-meter line and with some player in front of the thrower; "360" which are all throws that are made after making a complete turn in the air. The "360 vertical" is a throw in which after the throw, both feet land first. The "360 horizontal" is the throw in which after the throw, the two feet do not rest on the sand first and the jump is in depth. In the "360 fall-away shot" the two feet do not rest first after the jump and the jump is parallel to the 6-meter line. The "In-flight" throws are all throws that are made by receiving the ball in the air and throwing before falling; the "Vertical In-flight" when the two feet set first after the jump; the "Horizontal In-flight" when the two feet do not set in the sand first after the jump and the jump is in depth; and the " In-Flight" when the two feet do not set first after the jump and the jump is parallel to the 6-meter line.

The 'Other' category includes UBO completions for which no objective category can be identified.

All annotations must be made at the exact moment of finalization of each of the collected actions.

To avoid LINCE PLUS software (version 3.2.3.) malfunctions, a suffix was added to all equal codes. The suffix was related to the category in question.

Procedure

To confirm the validity of the observation and recording instrument, the so-called criterion of authority was employed by means of an expert panel. Ten beach handball experts were invited to evaluate the recording instrument. The experts were asked to indicate the relevance and appropriateness of each of the criteria and categories (Lozano Jarque, 2014). In the same way, the group of experts was able to make any contributions they deemed appropriate. Figure 3 illustrates an example of the questionnaires that were sent by email to the group of experts.

3.1.2. Period of play (PEJU)

Code	Descripción
SET1	First set
GO1	Golden goal first set
SET2	Second set
GO2	Golden goal second set

Code	Relevance: Does the category relate to the object of the study and its dimension?	Adequacy: Is the category definition understandable to the observer?	Amendments: What are the proposed amendments?
SET1			
GO1			
SET2			
GO2			

Figure 3: Example of one of the sections of the expert panel questionnaires
Note: Own elaboration.

Various experts provided their recommendations via email, and there were no instances of conflicting corrections. The modifications made following the expert panel's assessment were as follows:

- Inclusion of a clarification on the definition of the Basic Observation Unit (BOU). The BOU is defined as the space of time from the moment the attackers are positioned in the specific positions until there is a break in play or change of possession. In the observation, previous passes with no intention of attacking towards the goal at the start of the first attack tactical half shall be considered as “Other”.
- Correction of the wording of one of the instrument codes: UBOCO.
- Inclusion of a new category: Offensive Formation (ESOF).
- Inclusion of a new description in the category “Other” in the criterion “Attack Tactical Procedure”. Passes made prior to the first attack tactical procedure will be recorded in this category.
- A new category, "Not present" has been included in the criterion "Attack Tactical Procedure." This category will be used to record data when no tactical means are taking place. For example, data will be recorded as "Not present" when there is a throw, a change of attacking structure, or other similar instances.
- Introduction of a new category within the "BOU Finalization" criterion: "Offensive Foul".
- Inclusion of a new category in the criterion "Specific position of BOU finalization": "Central".
- Incorporation of a suffix to all repeated codes.
- The criterion "Specific position finalization of the BOU" on the specific position where the goalkeeper throws has been expanded to include new categories.
- Introduction of new categories to indicate the position of the goalkeeper in the criterion "Offensive Formation".
- Inclusion of a new category in the criterion "Defensive structure during the execution of the tactical procedure": "Varying Depth".
- Designation of the criterion "Attack Tactical Procedure" as a fixed variable in the LINCE PLUS software.

Once the observation tool had been validated by the panel of experts, the matches were visualized. The LINCE PLUS software (Soto et al., 2022), developed at the University of Lleida for the management and application of observational methodology, was used to record the observed actions. This software allows coding, recoding, image recording and the calculation of descriptive statistics. The PLUS version also allows working remotely among several users (García-González et al.). Figure 4 shows the interface of the recording instrument, created with the LINCE PLUS software.

This software enables both to watch the video of the event and the observational instrument simultaneously. Now of a collective tactical procedure, the video must be paused and the categories that are taken place in the procedure must be registered. If it was not possible to mark all categories during the initial viewing of the procedure, the video should be rewound to the beginning of the procedure (the software allows for a simple rewinding of only a few seconds).

The criterion "Tactical Procedure" is presented in capital letters in Table 1, as it has been identified as a fixed variable in the LINCE PLUS software. During the annotation process, the letter identifying the tactical means must be entered in chronological order in which the action is taking place. The annotations of tactical means are recorded by typing the capital letter corresponding to the tactical means followed by the + sign. Where appropriate, the capital letter of the tactical means is accompanied by a letter or letters (in lower case) identifying the specific post performing the action. When two specific positions are listed, they are separated by a hyphen. The specific positions are noted starting with the pivot first, followed from left to right by the specific position according to its position in the playing area. An example of a pivot fixation, followed by a cross between the centre and the right wing, would be annotated as follows: Cpi+Hc-ad. The letters identifying the specific positions are as follows: pivot = pi, left wing = ai, centre-back = c, right wing = ad and goalkeeper = p.

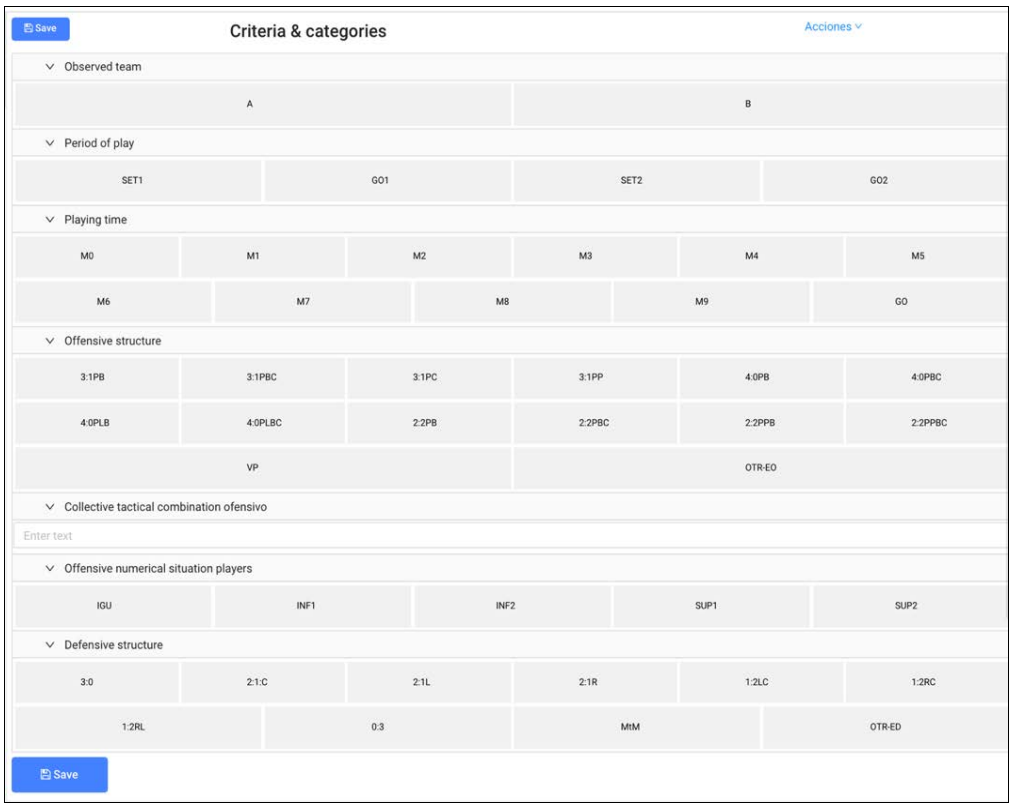

Figure 4: Observational instrument
Note: Own elaboration.

Once the recording instrument had been finalized with the LINCE PLUS software, the three observers underwent their training. The latter involved watching five beach handball matches from the European Championships and practicing data recording using the same observation criteria as the recording instrument of this study. The training phase lasted 7 days, with 60 minutes of practice three times a week. The matches watched in the observers' training were matches from the Beach Handball World Championship held in Heraklion, Greece. Croatia vs. Uruguay, Denmark vs. Norway, and Uruguay vs. Denmark, in the men's category; and Hungary vs. Spain and the Netherlands vs. Germany, in the women´s category.

Once the training of the observers was completed, the matches observed were visualized. The matches observed for validation were the finals of the Beach Handball World Championship, held in Heraklion, Greece, on 26 June 2022. The

matches were downloaded in MP4 format from the International Handball Federation's YouTube space. The men's final pitted the national teams of Denmark against Croatia. In the women's final, the national teams of Spain against Germany were pitted.

The data were downloaded directly from the LINCE PLUS software in a Microsoft Excel document and in a document with a LINCE PLUS software extension (.lince extension) for subsequent reliability analysis. This document was employed used to assess the reliability of the instrument by examining intra-observer and inter-observer agreement. This was achieved by performing a Cohen's Kappa index (Cohen, 1960). The reliability study was repeated on three separate occasions.

Statistical Analysis

Firstly, intra-observer and inter-observer agreement was checked. For this purpose, we used the software used to record the data (LINCE PLUS), which allows us to assess both Cohen's Kappa Index (Cohen, 1960) and Fleiss's k Index (Torres Gordillo & Perera Rodríguez, 2009). For the assessment of concordance, the interpretation of Landis and Koch (1977) was used, which called 'Poor' the value 0.00, 'Slight' the value included between 0.01 and 0.20, 'Acceptable' between 0.21 and 0.40, 'Moderate' between 0.41 and 0.60, 'Substantial' between 0.61 and 0.80, and 'Almost perfect' between 0.81 and 1.00.

Subsequently, a descriptive analysis of the study variables was carried out with SPSS software (version 29.0) using the cross-table test.

The values of Cohen's Kappa Index test (Cohen, 1960) with which intra-observer agreement was assessed (Table 2) and of Fleiss' k-index test (Torres Gordillo & Perera Rodríguez, 2009) with which inter-observer agreement was assessed (Table 3) are presented below.

Table 2. Cohen's Kappa Index test (Cohen, 1960)

CRITERION	VALOR
Team observed	1.00
Period of play	1.00
Playing time	1.00
Attack structure	0.98
Group tactical procedure	0.89
Attack numerical situation	1.00
Defensive structure	0.87
Finalization of the BOU	0.91
Orientation in finalization	1.00
Specific finalization position	1.00
Finalization zone	0.94
Type of BOU finalization	0.98
Finisher laterality	1.00
TOTAL	**0.96**

Note: Own elaboration. BOU: basic attack unit.

Table 3. Fleiss's k Index Test (Torres Gordillo & Perera Rodríguez, 2009)

CRITERION	AGREEMENT	EXPECTED DISAGREEMENT
Team observed	1.00	0.45
Period of play	1.00	0.62
Playing time	1.00	0.50
Attack structure	0.80	0.26
Group tactical procedure	0.89	-
Attack numerical situation	1.00	0.62
Defensive structure	0.73	0.22
Finalization of the BOU	0.87	0.23
Orientation in finalization	1.00	0.62
Specific finalization position	1.00	0.45
Finalization zone	0.87	0.23
Type of BOU finalization	0.95	0.22
Finisher laterality	1.00	0.45
TOTAL	**0.93**	**0.39**

Note: Own elaboration. BOU: basic attack unit.

Shows the evolution of the concordance of the observers who participated in this study (Table 4).

Table 4. Observer concordance assessed using the Fleiss's k Index test (Torres Gordillo & Perera Rodríguez, 2009)

K VALUE DAY 1	K VALUE DAY 2	K VALUE DAY 3	K VALUE DAY 4
0.38	0.54	0.44	0.93

Note: Own elaboration.

All the final values, both intra and inter-observer, are considered 'Almost perfect' following the interpretation of Landis and Koch (1977), except for the variable 'Defensive structure' which is the most difficult to assess in a beach handball match due to the continuous changes of depth made by the players.

Results

After watching the two final matches of the Beach Handball World Cup 2022, a total of 128 attack tactical procedures were collected with an average of 32 procedures per team. Figure 5 shows the number of procedures performed by each of the teams observed.

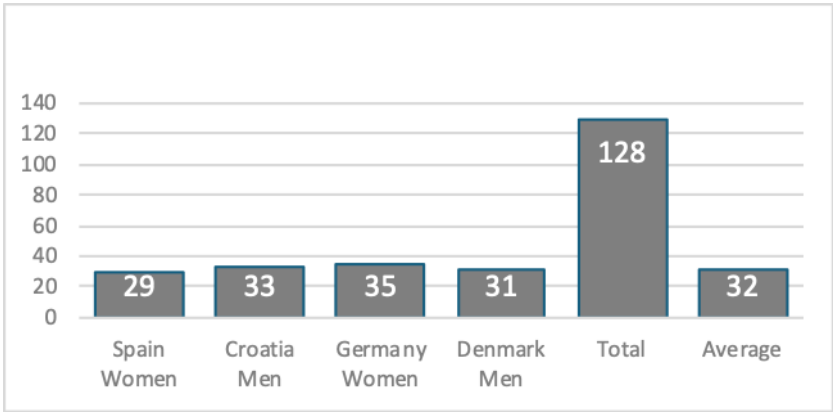

Figure 5: Number of attacking tactical procedures carried out by each national team
Note: Own elaboration.

These procedures are almost equally distributed between the two sets of each of the matches. For men, 24.2% of the procedures were performed in the first set and 25.8% in the second set. For women 24.9% were performed in the first set and 26.1% in the second set.

Figure 5 shows the percentage of attacking tactical procedures carried out in each minute of the game (from minute 0 to minute 9).

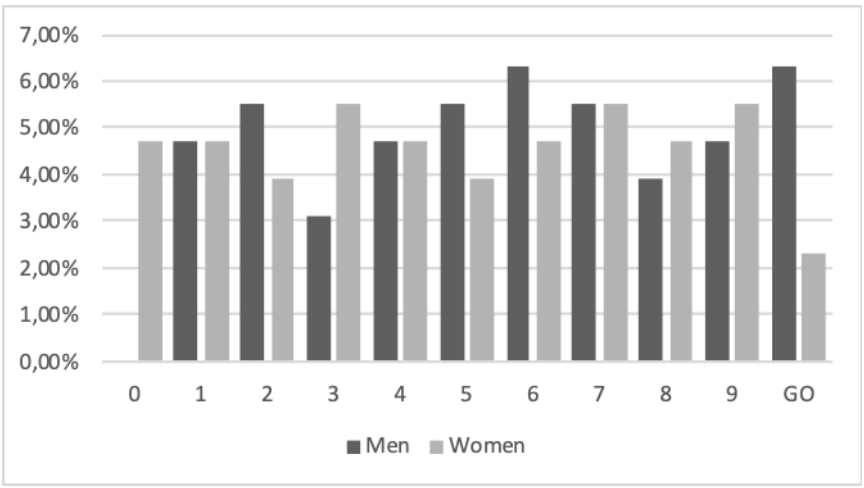

Figure 5: Percentage of attacking procedures carried out as a function of playing (minute)
Note: Own elaboration. GO: Golden goal.

In terms of the procedures and types of offensive formations used by the teams, the formation that showed the highest percentage of procedures for women was the 3:1 formation with the goalkeeper in the centre of the attacking (37.6%), followed by the 3:1 structure with the goalkeeper on the substitution side (26.6%) and, in third place, the 3:1 structure with the goalkeeper on the opposite substitution side. The 4:0 formation with the goalkeeper on the opposite substitution side reached 2.3% of the procedures, the 4:0 formation with the goalkeeper on the substitution side 1% and the 2:2 formation with the goalkeeper on the opposite substitution side also 1%.

For men, the most frequently used structure was 3:1 with the goalkeeper on the substitution side (46.8%), followed by 3:1 with the goalkeeper in the centre of the attacking (28.2%) and 3:1 with the goalkeeper on the opposite side of the substitution zone (25%).

Figure 6 presents the percentages of each of the attacking tactical procedures used during the matches. The men only use 3 different procedures and the women 13 different procedures.

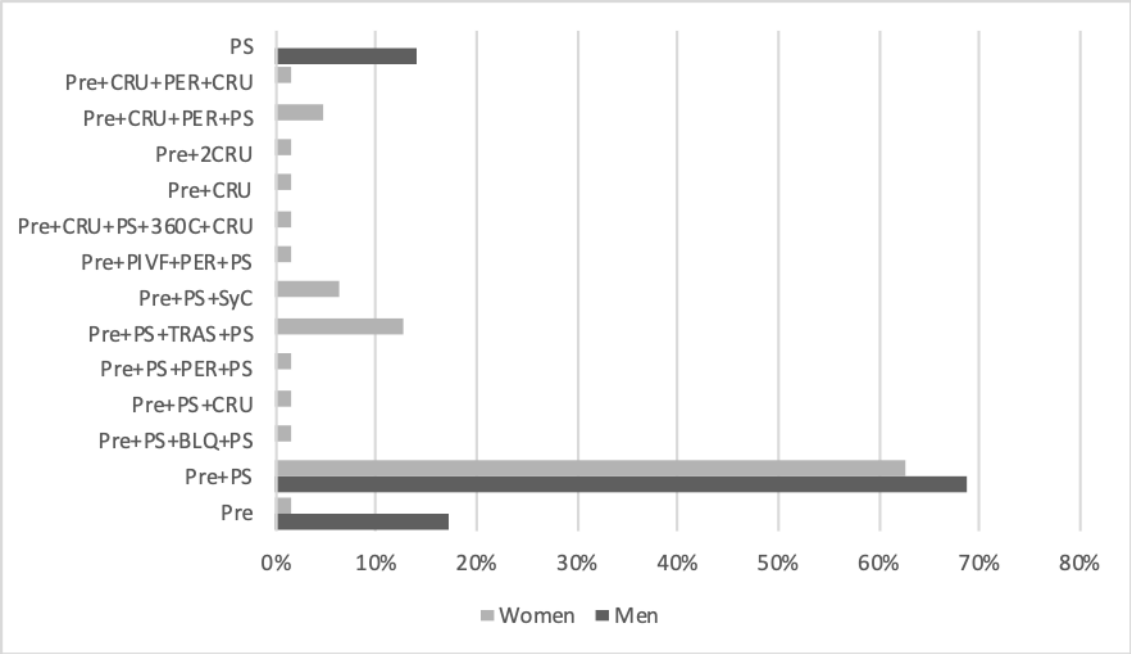

Figure 6: *Percentage of different types of attacking tactical procedures*

Note: Own elaboration. PS: Piston movement. Pre: Pre-passes of preparation. BLQ: Block. CRU: Crossing with ball. PER: Crossing without ball. TRAS: Transformation. SyC: Jump and continuation. PIVF: The pivot goes out to receive and performs a fixation. 360C: 360º turn and continuation.

In terms of the types of defensive structures and procedures used by the teams, the structure that received the highest percentage of procedures for women was the 2:1L structure (40.6%), followed by the 0:3 structure (18.8%), the 1:2RL structure in third place (15.6%) and the 3:0 structure in fourth place (11%). Other unidentified defensive structure types received 4.7% of the procedures and three defensive structures received 0.8% of the procedures (1:2LC, 2:1C and MtM).

For men, the defence formation with the highest percentage of procedures was the 3:0 formation which received 62.6% of the offensive tactical procedures, in second place, the defence formation that received the most procedures was the 1:2RL structure (18.8%), in third place, the 2:1C structure (7.8%) and in fourth place, the 1:2LC and 2:1L formation with 4.6% each. The 0:3 formation received only 0.8% of the procedures.

Figure 7 shows the types of completion of attacking tactical procedures in the observed matches.

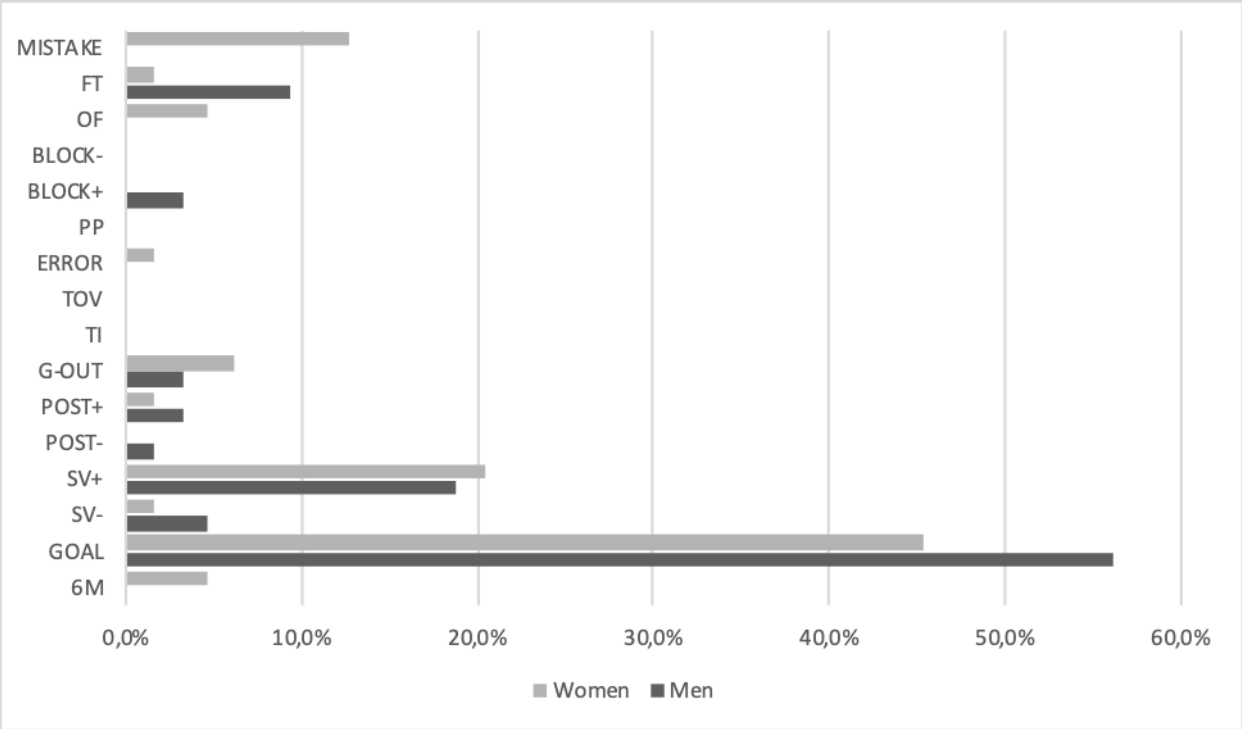

Figure 7: Types of completion of tactical attack procedures (in percentages)

Note: Own elaboration. MISTAKE: Technical-tactical error by the player in possession of the ball. FT: Free throw. OF: Offensive foul. BLOCK-: Block and turnover. BLOCK+: Block and ball possession. PP: Passive play. ERROR: Error in the rules of the game. TOV: Turnover (passing error or interception by defending team). TI: Throw-in. G-OUT: The player drops the ball over the outer goal line. POST-: Shot that hits the post or crossbar and remains in possession of the attacking team. POST+: Shot that hits the post or crossbar and remains in possession of the defending team. SV-: Save and possession of the ball for the attacking team. SV+: Save and possession of the ball for the defending team. 6M: 6-metre throw (penalty).

86.0% of the women's attacking tactical procedures ended with the hips aligned with the centre of the goal, 4.6% of the procedures did not end with an adequate hip alignment and in 9.4% of the procedures it was not possible to observe the hip alignment. In men, 75.0% of the attacking tactical procedures ended with the hips oriented towards the centre of the goal and in 25.0% of the procedures it was not possible to observe the orientation of the hips.

For women, 23.4% of the attacking tactical procedures ended with a shot from the Left Wing, 21.8% from the Right Wing, 18.8% from the Goalkeeper (9.4% from the centre of the goal area, 7.8% from the right outer zone of the goal area and 1.6% from the left outer zone of the goal area). 11.0% of the procedures ended with a throw-in from the pivot and 25.0% of the procedures did not end with a throw-in. For men, 39.0% of the attacking tactical procedures ended with a throw from the Right Wing, 20.4% from the Centre, 17.2% from the pivot, 12.4% from the Goalkeeper (7.8 from the centre of the goal area and 4.6% from the outside left of the goal area), 1.6 from the Left Wing, and 9.4% of the procedures did not end with a throw.

Figure 8 shows in percentages the type of throw that was made at the time of the completion of the attacking tactical procedures.

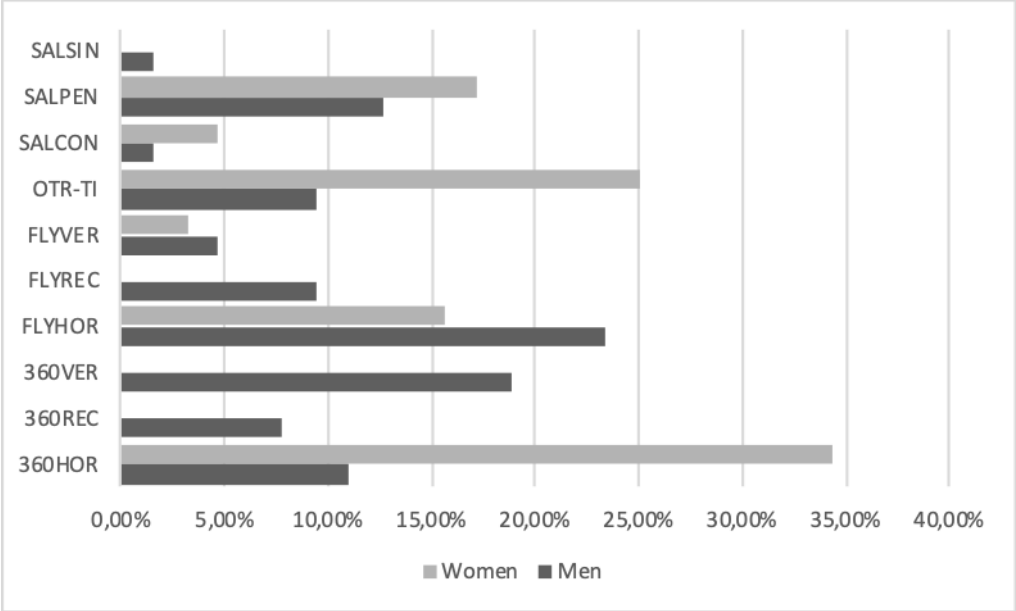

Figure 8: Percentages of the types of throws made at the end of attacking tactical procedures

Note: Own elaboration. SALSIN: No opposition jump throw. SALPEN: Jumping shot in penetration. SALCON: Opposition jump throw. OTR-TI: Procedures not ending in a throw. FLYVER: Vertical in-flight throw. FLYREC: Fall-away in-flight throw. FLYHOR: Horizontal in-flight throw. 360VER: Vertical 360º throw. 360REC: Fall-away 360º throw. 360HOR: Horizontal 360° throw.

Discussion

This study developed and validated an instrument to identify the collective attack tactical procedures that occur in beach handball competition. The validation of the instrument was carried out through the so-called authority criterion by means of a panel of experts, studying its reliability by assessing intra-observer and inter-observer agreement. Finally, the collective attack tactical procedures and their relationship with other structural, spatial and temporal aspects of two top-level beach handball matches were recorded.

The Kappa Index (Cohen, 1960) was employed to assess the reliability of the data analysis process. In this context, Landis and Koch (1977) propose a scale for interpreting the kappa value, with a value of 0.41 or above regarded as moderate and a value of 0.80 or above regarded as near-perfect (Figure 5). During this study, all observers demonstrated intra-observer agreement values above 0.60 following the second day of practice. The study concluded with an intra-observer mean of 0.96 after four days of practice. All observers in this study achieved an intra-observer index of greater than 0.90 by the conclusion of the study. In this context, the studies by Lozano (2014), Morillo et al. (2015), and Vázquez et al. (2019) also employed the Kappa index to assess the quality of their intra-observer concordance records. Lozano (2014) obtained a kappa index of 0.96 in his initial analysis and 0.95 in his second analysis. Morillo et al. (2015) obtained a mean of 0.98, whereas Vázquez et al. (2019) obtained an intra-observer mean of 0.97. The results of the studies analysed are comparable to the indices calculated in our work.

Kappa Statistic	*Strength of Agreement*
<0.00	Poor
0.00–0.20	Slight
0.21–0.40	Fair
0.41–0.60	Moderate
0.61–0.80	Substantial
0.81–1.00	Almost Perfect

Figure 9: *Kappa Index Rating*
Note: Taken from Landis and Koch (1977).

To assess the quality of the data through inter-observer agreement, an analysis of the Fleiss' Kappa index (Torres Gordillo & Perera Rodríguez, 2009) was conducted. The observers in our study required four days of training (Table 4) to achieve an index above 0.75, which could be considered an excellent concordance strength (Figure 5). This was the aim of this study. Finally, the mean Fleiss concordance index of our work was 0.93. The observational handball instruments studies by Lozano (2014) and beach handball studies by Morillo and Hernández (2015) and Vázquez et al. (2019) did not employ the Fleiss Index for inter-observer agreement assessment. In our study, the Fleiss Index was employed as it is indicated for the assessment of inter-observer agreement between more than two coders, both for nominal and ordinal scale data (Fleiss, 1988; cited in Torres Gordillo & Perera Rodríguez, 2009). In the research by Torres Gordillo and Perera Rodríguez (2009), six sessions were required to exceed the index of 0.75, with a maximum of 0.77. It should be noted, however, that this study is based on an analysis of the online teaching methodology. The initial observations, which did not exceed 0.50, are consistent with the findings of our study. In a study on football tactics (Sánchez López et al., 2023), a Fleiss Index of 0.88 was reached, although the previous values and the observers' practice days were not indicated.

Interpretación del índice Kappa de Fleiss (Fleiss, 1981)	
Valor de K	***Fuerza de concordancia***
0.40 – 0.60	Regular
0.61 – 0.75	Buena
> 0.75	Excelente

Figure 10: *Interpretation of the Fleiss Kappa Index*
Note: Figure taken from Torres Gordillo and Perera Rodríguez (2009).

Following an exhaustive examination of the existing literature on beach handball collective tactics, it can be concluded that no published document has yet documented the tactical procedures that occur in a beach handball match at the highest level. In our study, we were able to record 128 tactical procedures of positional attack (64 from two women's teams and 64 from two men's teams). Of these, 65 resulted in a goal. A notable contrast was observed between the tactical positional attacking procedures of the men's teams compared to those displayed by the women's teams. The attacking tactical procedures of the men's teams can be summarized as an initial of preparatory passing and the group-tactical actions of piston movements. A total of 11 actions were resolved following the initial preparation of ball passes and individual actions, 44 following initial preparation of ball passes and piston movements, and 9 following the execution of piston movements. However, the women's teams, although they also performed 40 initial preparation of ball passes and piston movements, employed 24 more complex procedures involving the group-tactical actions of piston movements, crosses with ball, crosses without ball, blocks, transformations, and so forth. It is worth noting that all 40 combinations ended with shots from the 6-meter line. This is in line set in the study by Trejo Silva et al., (2022). The procedures employed by the male teams were based on a consistent attack structure, with the goalkeeper positioned in the centre, on the substitution side, and on the opposite substitution side. The women's teams' procedures combined 3:1 and 4:0 attack structures. In most cases, the goalkeeper was initially positioned at centre or on the team's substitution side.

The consulted researchers studied the offensive structures of beach handball teams. At the 2017 European Beach Handball Championship, Hatzimanouil et al. (2020) studied the offensive structures of European national teams. They found that 54.0%, 15.5%, and 3.8% of the offensive structures were 3:1 with the goalkeeper positioned in the centre of the attack, 3:1 with the goalkeeper positioned on the substitution sideline, and 3:1 with the goalkeeper positioned on the opposite substitution sideline, respectively. In our study, these types of structures obtained the following percentages: 33.9%, 36.7% and 21.9%. These differences can be justified because the two studies were carried out 5 years and the

greater or lesser use of an attacking structure is marked by trends set by the best national teams. Other structures observed by Hatzimanouil et al. (2020) were 4:0 with the goalkeeper on the opposite substitution side (13.3%), 4:0 with the goalkeeper on the substitution side (3.6%), 4:0 with the goalkeeper on the left wing (5.0%) and 4:0 with the goalkeeper on the right wing (2.7%). In our study the 4:0 structure with the goalkeeper on the right back only occurred in 0.8% of the actions, with the goalkeeper on the substitution sideline 4.7% and with the goalkeeper on the opposite substitution sideline 2.3%.

Another aspect studied in beach handball research is the type of throw made when finishing an attacking tactical procedure. Navarro et al. (2018) observed that women “tended” to finish with in-flight throws and men “tended” to finish with 360º throws. These results are different from those obtained in our study as our own data show that the women's teams finished 34.0% of the procedures with 360° throws and the men finished 18.8%. However, the percentages of in-flight throws for men and women were both 18.7%. As in the case of attacking structures, the differences are marked by the year of publication of each of the studies, namely, 2015 and 2022, that is, seven years apart the two investigations (2015 and 2022) and the degree of professionalization of the women players. In the case of women, the greater professionalization of these in these years has led them to improve their jumping ability and to start using more the 360º throw, which is more demanding in this regard.

The offensive tactical procedures observed in our study were showed great variance in the women's teams, although they were much less varied in the men's teams. In Romarís Durán's (2016) study, which analysed the ACB League, and the Women's Basketball League, women and men used the same procedures with very similar percentages of use. The study by Romarís Durán (2016) divided them into movement without the ball, ball circulation, direct blocking, indirect blocking and individual actions. The respective percentages for men and women were as follows: 5.6 vs. 8.1, 2.5 vs. 3.7, 30.2 vs. 19.3, 29.3 vs. 31.5, and 27.4 vs. 31.7. Even women carried out more individual actions than men. The difference in relation to beach handball can be understood because in beach handball men have a higher percentage of effectiveness in the 360º throw (Zapardiel, 2020), which requires less collective play. Therefore, women's teams need to elaborate more collective tactical actions to achieve better throwing options. In this same study by Romarís Durán (2016), men's teams achieved a tactical procedure completion efficiency of 44.7% and women's teams 44.5%. The completion of attacking tactical procedures observed in our study had an efficiency of 56.2% in men and 50.0% in women. Romarís Durán (2016) compared the effectiveness of organized group play with the effectiveness of counterattacking. This could be a good topic of study for future beach handball research.

Conclusions

The main goals of the current study were threefold: firstly, to create an instrument to identify the attacking tactical procedures that occur in beach handball competition; secondly, to validate the instrument through the authority criterion by means of a panel of experts and to study its reliability by assessing intra-observer and inter-observer concordance; and thirdly, to record the attacking tactical procedures and to analyse their relationship with other structural, spatial and temporal aspects of two top-level beach handball matches.

In relation to the first objective, this research has created a tool for the observation of the attacking tactical procedures employed in high-level beach handball matches, with the capacity to collect all such procedures that occur on a beach handball field. Regarding the second objective, the tool created reflects the tactical procedures that occur in high-level beach handball matches, since it has been agreed by a panel of beach handball experts and has passed the necessary validations. In relation to the third objective, it can be concluded that, in the finals of the 2022 Beach Handball World Championship, women, compared to men, use a greater number of attacking tactical procedures to score goals and that these procedures were more complex. Observing these same matches, it can be concluded that women should train the finishing of in-flight and 360º shots to try to increase verticality, which would give them a better chance of observing the goalkeeper. This need to increase verticality and effectiveness in actions such as 360º shots seems to be in line with recent studies that highlight the importance of different manifestations of strength in handball performance

(Morenas-Aguilar et al., 2025). These abilities condition the optimal execution of certain types of finishes, which could influence the use and effectiveness of certain collective tactical procedures in beach handball.

It is recommended that future research endeavours seek to build upon the findings of this study. This would facilitate the development of a more comprehensive understanding of tactical procedures.

Practical applications

This study presents a validated observational instrument for the purpose of recording the procedures and their consequences that take place in a beach handball match. To utilise this instrument, the procedure to be followed has been meticulously described in this work, ensuring that it can be a reliable tool.

Author Contributions: All authors have contributed equally to this work: All authors have read and approved the published version of the manuscript.

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