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THE EFFICIENCY OF ELEMENTS OF COLLECTIVE ATTACK TACTICS IN HANDBALL

UČINKOVITOST ELEMENTOV KOLEKTIVNE TAKTIKE NAPADA V ROKOMETU

ABSTRACT

On a sample of 90 matches of the First Croatian Handball League for men we determined the performance efficiency of 19 elements of collective tactics describing the duration, continuity, systems, organisation and spatial direction of attacks in competitive circumstances. We used an analysis of variance and discriminant analysis with appropriate parameters. The results of the research show the insufficient presence of what are otherwise the most efficient attacks on an unorganised defence and the frequent realisation of short position attacks on a set defence. No significant differences were established in efficiency between the game systems involving one as opposed to two pivots, while the system with no pivots was the least efficient. Attacks based on the group co-operation of a smaller number of players and on the collective combinatory activity are more frequent but less efficient than attacks based on individual actions. Attacks directed at depth with an attempt to finish from line positions are significantly more efficient than attacks directed at width. The research results can improve the tactical performance of a team and training practice so that in their tactical preparation more attention is paid to the most efficient tactical actions.

Key words: handball, attack, collective tactics, efficiency

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IZVLEČEK

Na vzorcu 90-ih tekem 1.HRL (Hrvaške rokometne lige) za moške so ugotavljali učinkovitost izvedbe 19 elementov kolektivne taktike, s katerimi opisujejo: trajanje, kontinuiteta, sistemi, organizacija in prostorska usmerjenost napada v tekmovalnih pogojih. Uporabili smo analizo variance in diskriminativno analizo z ustreznimi parametri. Rezultati raziskave kažejo na nezadostno zastopanost sicer najučinkovitejših napadov na neorganizirano obrambo ter običajno izvedbo kratkih pozicijskih napadov na postavljeno obrambo, ki so hkrati tudi učinkovitejši od prekinjenih dolgih napadov. V raziskavi niso bile ugotovljene značilne razlike v učinkovitosti med sistemom z enim, v primerjavi s sistemom z dvema krožnima napadalca, medtem ko je sistem brez krožnega napadalca najmanj učinkovit. Napadi, zasnovani na skupnem sodelovanju manjšega števila igralcev in na kolektivni kombinirani aktivnosti, so pogostejši, vendar tudi manj učinkoviti od napadov, ki temeljijo na individualnih akcijah. Globinsko usmerjen napad, ki teži k zaključku z linijskih pozicij, je znatno učinkovitejši od napada, usmerjenega v širino. Rezultati raziskave lahko pospešijo taktično delovanje ekipe in vadbeno prakso tako, da se v taktični pripravi posveti večjo pozornost najučinkovitejšim taktičnim elementom.

Ključne besede: roket, napad, kolektivna taktika, učinkovitost.

INTRODUCTION

Handball is a sport game characterised by a clearly defined goal: scoring as many goals and conceding as few as possible. The achievement of this aim is determined by technical and tactical knowledge (Vuleta, 1997; Šimenc et al. 1998), the physical potential, morphological features and intellectual/emotional characteristics of a player, the opponent's performance and external influences of the environment. Scoring or, alternatively, preventing the opposition from scoring, not only depends on the activity and abilities of the player immediately engaged in finalisation, but is also largely the result of the cumulative actions of other players and their co-ordinated group and collective actions. Therefore, the results in a handball game are determined by numerous factors, where the performance efficiency of tactical actions assumes an important role. Tactical activity is an essential characteristic of sport games, manifested in situation-related competitive circumstances, and it can also be defined as the planned and premeditated managing of all system dimensions to achieve the aim, i.e. to win in the framework of the current conditions and confronting opponent's activity. Tactical performance is used to purposefully apply all of the available potential in a way least suitable for players from the opposing team in terms of time and space. This assumes the optimal use of the specific qualities of every individual by assigning tasks compatible with their abilities and in appropriate time and space terms, depending on the confronting activities of players in the opposing team.

Previous researches in this area were mostly based on the basic detection of individual technical/tactical indicators, most frequently elements of the final attack, without any serious intention to try to establish their efficiency in relation to certain situation-related criteria.

A certain number of previous researches were based on an analysis of the presence of technical/tactical elements in relation to players' positions (Ignjatova, 1984; Znoj, 1990; Šimenc et al. 1996; Gruić et al. 2006; Ohnjec et al. 2008). Technical/tactical elements were equally analysed with regard to time span (Brzić, 1990), but also with regard to the efficiency of their implementation in competitive circumstances (Vuleta & Šimenc, 1989; Taborsky, 1996; Czerwinski, 1998). A few researches analysed differences in technical/tactical elements in relation to the classification of teams in qualitative groups at competitions (Brčić et al. 1997; Rogulj, 2001; Apitzs et al. 1997; Taborsky 2008) or to the influence of technical/tactical elements on the match outcome (Czerwinski, 1995; Günter, 1998; Srhoj et al. 2001, Vuleta et al. 2003), while far fewer researches focused on analyses of the latent structure of technical/tactical elements (Rogulj, 1990; Vuleta, 1997; Rogulj et al. 2004, Rogulj et al. 2009).

By summarising researches in the technical/tactical area, we can gain an insight into previous development of the handball game since it is evident that contemporary handball is characterised by the emphasised tactical variability and variety of game elements, abundance of technical elements, intensification and dynamicity of the game and the dominance of players' physical potential. This is directly reflected in the reduction of technical mistakes with the ball in the attack phase, an increase in the number of shots from longer distances, the more significant influence of defence elements in the structuring of the match outcome, a rise in the number of fast attacks and, generally, the performance efficiency of the attack finalisation.

However, not enough researches analyse the efficiency of implementing individual and particularly group and collective tactical performances in competitive circumstances (Seco, 1998; Rogulj, 2003; Foretić et al. 2010). Starting with the importance of establishing tactical efficiency

for everyday training competitive practice, the subject of this research is an analysis of the realisation efficiency of collective tactical elements in attack, as the dominant factor of good results in handball.

MATERIALS AND METHODS

Sample of entities

The research was conducted on a sample of 90 matches of the First Croatian Handball League for men in the 1998-1999 season, which represents a total number of 180 mutually opposed periods of tactical activity.

Sample of variables

The sample of variables consisted of 19 elements of collective attack tactics describing the duration, continuity, systems, structure and spatial direction of an attack. As a starting point for defining the prediction variables system, we used qualitative analyses of the structure of tactical activities in a handball game where tactical elements were systemised on a theoretical and empirical basis (Tomljanović and Malić, 1982; Müller et al. 1992; Šimenc et al. 1998).

ATTACK DURATION	
1	CATT NUMBER OF COUNTERATTACKS
a type of attack against an unorganised defence satisfying the following conditions:	
– a maximum of four passes, including the goalkeeper	
– the longest duration is 5 seconds from the moment of recovering the ball	
– at the moment of shooting at the goal, none of the defence players is in front of the attacker	
2	PCATT NUMBER OF PROLONGED COUNTERATTACKS
a type of attack against a partially organised defence satisfying the following conditions:	
– the attack lasts a maximum of 10 seconds	
– all players from the opposing defence have not formed the defence activity within the applied system	
3	SPA NUMBER OF SHORT POSITION ATTACKS
an attack against an organised defence lasting up to 25 seconds	
4	MPA NUMBER OF MEDIUM POSITION ATTACKS
an attack against an organised defence lasting up to 50 seconds	
5	LPA NUMBER OF LONG POSITION ATTACKS
an attack against an organised defence lasting more than seconds	
ATTACK CONTINUITY	
6	UIA NUMBER OF UNINTERRUPTED ATTACKS
a continuous aspect of an attack that ends in the first wave by scoring a goal or losing the ball	
7	SIA NUMBER OF SINGLE INTERRUPTION ATTACKS
a discontinuous aspect of an attack interrupted on a single occasion by the opposing team or the attacker's error, thus ending in the second wave	
8	MIA NUMBER OF MULTIPLY INTERRUPTED ATTACKS
a discontinuous aspect of an attack interrupted on several occasions by the opposing team or the attacker's error	

ATTACK SYSTEMS		
9	NO-PIV	NUMBER OF ATTACKS IN A GAME SYSTEM WITHOUT A LINE PLAYER/PIVOT
a game system comprising two wing and four back players		
10	ONE-PIV	NUMBER OF ATTACKS IN A GAME SYSTEM WITH ONE LINE PLAYER/PIVOT
a game system comprising three back, two wing and one pivot players		
11	TWP-PIV	NUMBER OF ATTACKS IN A GAME SYSTEM WITH TWO LINE PLAYERS/PIVOTS
a game system comprising two wing, two back and two pivot players		
ATTACK ORGANISATION		
12	GCOOP	NUMBER OF GROUP-CO-OPERATION-BASED ATTACKS
a partially organised attack based on the group co-operation of a few players, where the position and activity of the remaining players have no direct influence on the engaged group activity		
13	BP	NUMBER OF BASIC-PRINCIPLES-BASED ATTACKS
an organised attack performed by all or almost all players based on elementary tactical principles of width, depth, ball speed and successive gaining the spatial-temporal advantage		
14	COMB	NUMBER OF COMBINATION-BASED ATTACKS
an attack organised on the basis of combinations in which players change their positions within predetermined actions		
15	GMAN	NUMBER OF GROUP-MANOEUVRING-BASED ATTACKS
an attack based on the group co-operation of a few players on the principle of combinations, i.e. defined actions with the obligatory exchange of playing positions		
16	IA	NUMBER OF INDIVIDUAL-ACTION-BASED ATTACKS
an attack based on an individual action, i.e. an individual's effort to finish the attack		
ATTACK DIRECTION		
17	RIGHT	NUMBER OF RIGHTWARD ATTACKS
the course of an attack, i.e. the ball trajectory is directed from players positioned left to right		
18	LEFT	NUMBER OF LEFTWARD ATTACKS
the course of an attack, i.e. the ball trajectory is directed from players positioned right to left		
19	DEPTH	NUMBER OF IN-DEPTH DIRECTED ATTACKS
the course of an attack, i.e. the ball trajectory is directed in depth, from players positioned at the back to the line		

Registering the tactical elements in the handball matches was carried out through the observation of video recordings of the matches. Among the position attacks that were interrupted by the opposing defence, each segment was analysed separately. The data in the form of corresponding abbreviations and symbols was manually entered into specially designed forms suitable for computer entry.

Data processing methods

We determined standard descriptive and distribution statistic parameters. To establish the significance of the differences inside the criterion groups, we employed multivariate variance

analysis (MANOVA) and a canonical discrimination analysis with appropriate parameters. Entities were classified in two qualitative groups with regard to the realisation efficiency criterion in competitive circumstances: elements which resulted in a scored goal or a forced 7m penalty shot (efficient) and elements which resulted in a missed goal and the loss of the ball (inefficient).

RESULTS

The basic description parameters of the variables are presented in Table 1. All variables showed a normal distribution, with a mild positive asymmetry being more pronounced in the variables *number of attacks in the game system without a pivot player* (NO-PIV) and *number of individual-action-based attacks* (IA). The coefficients of variation were satisfactory, with the exception of the already mentioned variables that showed a high level of dispersion.

Table 1: Basic description and distribution parameters of the prediction variables

	VAR	XA	min	max	sig	V%	a_3	a_4	md	Z1%	Z2%	m
VARIABLES OF COLLECTIVE ATTACK TACTICS												
1	CATT	6.78	0	19	3.68	54.28	0.73	0.47	0.11	6.93	11.55	*
2	PCATT	8.91	1	18	3.93	44.11	0.24	-0.58	0.09	9.11	15.18	*
3	SPA	20.57	7	39	5.29	25.72	0.06	0.14	0.06	21.02	35.04	*
4	MPA	16.24	6	26	3.65	22.48	0.04	0.15	0.06	16.60	27.67	*
5	LPA	6.02	0	16	3.05	50.66	0.51	-0.18	0.11	6.15	10.26	*
6	UIA	26.84	9	46	7.69	28.65	0.23	-0.58	0.07	27.43	52.82	*
7	SIA	11.84	0	20	3.82	32.26	-0.36	0.83	0.10	12.10	23.30	*
8	MIA	12.13	1	28	4.87	40.15	0.38	0.10	0.08	12.40	23.87	*
9	NO-PIV	6.51	0	30	4.79	73.58	1.59	3.78	0.15	6.65	8.29	*
10	ONE-PIV	54.24	14	105	16.19	29.85	0.20	0.13	0.06	55.43	69.06	*
11	TWP-PIV	17.79	2	52	8.86	49.80	0.88	0.92	0.10	18.18	22.65	*
12	GCOOP	17.96	4	37	7.63	42.48	0.51	-0.47	0.08	18.35	19.57	*
13	BP	40.60	20	81	10.92	26.90	0.90	1.23	0.07	41.49	44.25	*
14	COMB	19.30	4	38	6.30	32.64	0.14	-0.11	0.07	19.72	21.04	*
15	GMAN	5.94	0	29	4.11	69.19	1.75	5.39	0.17	6.07	6.47	*
16	IA	7.95	0	21	4.70	59.12	0.58	-0.31	0.12	8.12	8.66	*
17	RIGHT	29.83	15	56	8.19	27.46	0.39	-0.12	0.06	30.49	38.55	*
18	LEFT	27.96	10	52	7.82	27.97	0.30	0.04	0.65	28.57	36.13	*
19	DEPTH	19.59	7	41	5.73	29.25	0.76	1.90	0.08	20.02	25.32	*

Legend: Arithmetic mean (XA), value of the minimal and maximal result (MIN, MAX), standard deviation (SIG), variability coefficient (V%) – $SIG/XA \cdot 100$ (V%), asymmetry coefficient (a_3), distortion coefficient (a_4), maximum deviation of the relative cumulative empirical frequency from the relative cumulative theoretical frequency (md), variable percentage in relation to the total number of match segments (Z1%), variable percentage within a related group of variables (Z2%) and a mark for multivariate processing suitable variables (m).

Table 2 presents the results of the variance and canonical discrimination analysis of differences in the performance efficiency of collective attack tactics.

Table 2: Results of an analysis of variance and canonical discrimination analysis of differences in the performance efficiency of collective attack tactics

Wilks' λ	Df	λ	Can R	χ^2	p
0.52	19	0.93	0.69	228.86	0.00

VAR	XA ₁	XA ₂	F	p	effect%	STRUC
CATT	2.46	3.56	22.88	0.00	59.14	0.26
PCATT	3.03	3.13	0.21	0.65	50.81	0.03
SPA	10.41	10.16	0.39	0.53	49.39	-0.03
MPA	8.52	7.72	6.90	0.01	47.53	-0.14
LPA	3.46	2.56	15.97	0.00	42.58	-0.22
UIA	14.01	12.83	5.21	0.02	47.79	-0.13
SIA	6.02	5.82	0.51	0.48	49.15	-0.04
MIA	6.47	5.66	6.34	0.01	46.63	-0.14
NO-PIV	1.89	1.16	22.29	0.00	38.03	-0.26
ONE-PIV	14.00	13.34	2.01	0.16	48.79	-0.08
TWP-PIV	5.03	4.53	2.90	0.09	47.39	-0.09
GCOOP	4.77	5.34	4.30	0.04	52.82	0.11
BP	11.86	10.99	4.25	0.04	48.10	-0.11
COMB	5.66	4.90	8.00	0.00	46.40	-0.16
GMAN	1.33	1.74	8.72	0.00	56.68	0.16
IA	2.14	1.94	1.26	0.26	47.55	-0.06
RIGHT	8.38	7.44	8.50	0.00	47.03	-0.16
LEFT	7.71	6.91	6.27	0.01	47.26	-0.14
DEPTH	5.38	7.07	31.68	0.00	56.79	0.31

Legend: Wilks' λ - Wilks' lambda value, df - respective values of the degree of freedom λ - eigenvalues of discriminant function, Can R - coefficient of canonical discrimination, χ^2 - value of the chi-square test, p - significance level, AM₁ - arithmetic means first group (unsuccessful), AM₂ - arithmetic means second group (successful), F - F values of statistical significance testing, effect% - variable percentages of effective implementation of the elements, STRUC - correlations of variables with a discriminative function.

DISCUSSION

All the variables showed a normal distribution with a mild positive asymmetry being more pronounced in the variables number of attacks in the game system without a pivot player (NO-PIV) and number of individual-action-based attacks (IA). That was probably due to the low frequency of these variables. The realisation of an attack finalisation through an individual action is not frequent in the game, and neither is an attack in the system without a pivot. The implementation of an individual action is determined by the specific circumstances of a game, when a defence

player is alone in a large space and is far enough from the goalkeeper's line and neighbouring defence players, while the game system without the pivot is mostly applied when there are fewer players in an attack compared to the full formation of defence players.

When analysing the attack duration, the frequency of the counterattack is lower than in the sample of World Championship matches where there were 7.81 counterattacks on average (Rogulj, 2001). This may be the result of greater equality, i.e. smaller differences among the teams' qualities in the First Croatian Handball League than among national teams at the World Championship. The emphasised polarisation of teams' values is present among the teams that participate in big international competitions where other national teams with an inadequately developed handball game also take part, and the number of realised counterattacks is the most reliable indicator of differences in the teams' qualities.

The attack continuity analysis shows the dominant frequency of non-interrupted attacks, i.e. in more than half of the cases the attack actions finish in the first wave. On one hand, this is the result of insufficient engagement and defence efficiency, i.e. the attempt of the attacking players to materialise an advantage over an unprepared defence as soon as possible.

The game system with one pivot is the most frequently used in attack. This system enables the completion of all three elementary game principles in attack: width (widely set wings), density (equally set outer players), and depth (co-operation with the pivot), it also enables optimal the usage of space and can be used against almost all defences. The implementation of other game systems in an attack is determined by the type of the opponent's defence. Hence, the game system with two pivots is most frequently used against deep defence formations when playing needs to be enhanced on the goalkeeper's line where such defences are the most fragile, while the game system without a pivot, as stated, is the most frequently used when a team is playing in the attack with a smaller number of players with regard to the full formation of the defence players.

The dominant frequency of an attack based on group co-operation proves the fragmentation and isolation as well as the insufficient balance and fluidity of attack actions, unlike the tactical concept of the game in the world's top national teams based on collective performance and basic principles of the game. The lower frequency of individual attacks on a set defence is the result of its rare implementation determined by specific situation-related circumstances and is, in most cases, a reflection of the inferiority quality and tactical insufficiency of the attacking team compared to the defence.

Rightward attacks are somewhat more common than leftward ones since they are technically/tactically more suitable for performing considering that teams have more right-handed than left-handed players. For right-handed players, keeping and distributing balls during fake shooting at the goal is far more convenient on the right side due to them shielding the ball from the opponents with their bodies.

Following the difference analyses results, we determined that the efficiency of an attack decreases the longer it goes on. This is understandable since the opposing defence is the weakest at the beginning and cannot show its maximum potential, most often is not formed in an organised system or is incomplete with regard to the number of defence players engaged and thus the attacking players most easily create a favourable opportunity. In a prolonged attack, the defence activity of opponents is stabilised and adapted to attack actions, especially if they are repetitive and stereotyped. Counterattack efficiency is particularly emphasised as it is the aspect of

attack actions where the opposing defence nearly does not confront at all, and finalisation is performed from a close range, most frequently without any defence players being present. We had even expected greater than the just over 50% higher counterattack efficiency compared to the efficiency determined for the sample of World Championship matches (Rogulj, 2001). We can assume these differences are the result of the physical and technical/tactical inferiority of players in the First Croatian Handball League compared to the players who took part in the World Championship. The idea of the greater efficiency of shorter attacks on an unorganised defence compared to other prolonged position attacks on a set defence is somewhat proven by the attack continuity variables, where discontinuous attacks, multiply interrupted by opposing defence actions, show the lowest efficiency.

As far as the attack system is concerned, the emphasised inefficiency of the system without a pivot, compared to the systems with one or two pivots, is primarily the result of the fact that the attack in the system without a pivot is mostly used when a team plays with one player less compared to the full formation of defence players, and this is when the attack efficiency is generally lower due to the lack of players. In a game with the same and the full number of players, a system without a pivot is almost never used, which only proves that in practice they recognise the importance of depth-directed attacks, which is achieved through the co-operation of the outer players and pivots.

With regard to organisational aspects, an attack based on individual action stands out most for its efficiency. However, this variable includes attacks on an unorganised defence, i.e. counterattacks with the highest percentage of efficiency. An attack based on individual actions, in terms of the breaking through, is particularly efficient when low quality teams intentionally, with tactically justified reasons, engage in a prolonged and non-dynamic attack against a higher quality team and then suddenly apply an individual action as somewhat of a surprising element against a passive defence. We should also take into consideration that in an individual action an attacking player possesses remarkable inertial potential that enables him to efficiently finish from a close range.

An attack based on basic principles of the game in attack also displays a high level of efficiency. Basic attack activity founded on the principles of width and depth of the attack, fast movement of the ball and successive creation of spatial advantage by engaging the defence players shows good efficiency and is a reliable indicator of a quality attack organisation. This basic simple activity is a characteristic of quality teams which manage to spatially/temporally optimise themselves, i.e. purposefully balance the movement of an attacking player and the ball in relation to the defence players. A combinatory activity in an attack in which a certain group of players or all of them take part, although more complex from the kinesiological point of view, is less efficient than a simple basic attack. The implementation of combinations in terms of the frequent changing of players' positions and stereotyped moving is the primary and dominant form of tactical action in less quality teams, being a result of the inability to perform an attack based on elementary principles. In quality teams, combinatory activity only comes as an addition to the basic attack, most frequently when played with a bigger or smaller number of attacking players in relation to the defence players.

The depth component of an attack activity showing dominant efficiency in relation to a width-directed attack is most frequent in an attack on an unorganised defence, i.e. a counterattack and a prolonged attack. During a position attack on a set defence, the depth of the attack is achieved

by vertical movements of the outer attacking players in terms of a run-up to the goal and by co-operation between the outer and line players, primarily pivots. In both cases, the player who performs the finalisation of the attack is most frequently in a favourable situation, possesses an emphasised inertial potential and shoots from a close range, which enables a high level of efficiency in the realisation.

By summarising the results of the research, we can conclude the performance of collective tactics in an attack recognised as efficient in competitive conditions should be based on the performance of as many as possible fast attacks on an unprepared defence and on short position attacks, emphasising a deep orientation towards the line players, primarily the pivot, and the organisation of simple attacks based on primary principles and individual actions.

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