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Determinants of attack tactics in Youth male elite volleyball

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Abstract

The aim of this study was to identify determinants of the attack tactics' effectiveness in Elite Youth Men's Volleyball. Eleven matches of the 2007 World Youth Championship were analyzed, totalling 863 actions of reception, 1191 actions of attack and 435 actions of defence. Multinomial logistic regression was applied in order to analyze the association of reception effect, defence effect, attack tempo and attack type, with the attack effectiveness. The reliability of the observation was calculated through Cohen's Kappa, with values being above 0.81. This study showed that the powerful attack increased the chances of scoring in both side-out and transition. Regarding the timing of the attack, 1st tempo increased the chances of scoring in transition. These results show that the Elite Youth male's game claims a more offensive game through powerful and quick attacks.

Keywords: attack effectiveness, side-out, transition.

1. Introduction

In volleyball, the attack is assumed to be the most decisive procedure for the competitive success of the teams (Marelic *et al*., 1998; Palao *et al*., 2004; Eom & Schutz, 1992a,b; Marcelino *et al*., 2008; Drikos *et al*., 2009), and is associated with the reception effect (João *et al*., 2006; Patsiaouras *et al*., 2009; Bergeles *et al*., 2009), defence effect (Monteiro *et al*., 2009), attack tempo (César & Mesquita, 2006; Rocha & Barbanti, 2004, Palao *et al*., 2007) and attack type (Palao *et al*., 2009; Castro & Mesquita, 2008, Mesquita & Cesar, 2007). This complexity implies the attack will vary according to the game complexes, due to their different features, suggesting the necessity to study these characteristics divided according to the different game complexes.

In volleyball, two major complexes may be distinguished: complex I or side-out (reception, setting and attack), and complex II or transition (service, block, defence and counterattack) (Frohner & Zimmermann, 1996; Palao *et al*., 2004). The occurrence of

powerful attacks is significantly higher in side-out (Castro & Mesquita, 2008; Palao *et al.*, 2005; Mesquita *et al.*, 2007), in addition to favoring a faster game (Afonso *et al.* 2005). In opposition, complex II or transition exhibit slower attack tempos, thus providing an increased number of players blocking and reduced chances of scoring (Afonso *et al.*, 2005, Mesquita et. al., 2007, Cesar & Mesquita, 2006).

The offensive actions present different characteristics in the two major game complexes, specifically in function of the characteristics of setting, attack tempo, defensive systems adopted by the opponent, and attack zone (Palao *et al.*, 2007). However, few studies have resorted to bivariate statistical procedures, which do not provide insights regarding the interactions between a set of variables, consequently impairing the understanding of the internal dynamics of the game. Recently, some studies in volleyball have been using more complex, nonlinear statistical procedures (Eom & Schutz, 1992a,b; Patsiaouras *et al.*, 2009; Afonso, Mesquita, Marcelino & Silva, 2010; Rocha & Barbanti, 2004; Rocha & Barbanti, 2006). Such research has been conducted in adult teams, thus limiting the drawing of conclusions for the younger teams.

This study aims to examine possible determinants of the attack tactics' effectiveness in side-out and transition, with reference to the effect of reception and defence, attack tempo, and attack type in elite Youth Male Volleyball Teams.

2. Methods

2.1. Sample
The sample consisted in a set of 11 national teams that participated in the 2007 World Youth Male Championship (Brazil - 1st place, Russia - 2nd place, Iran - 3rd place, Italy - 4th place, Argentina - 5th place, Bulgaria - 6th place, USA - 7th place, Cuba - 8th place, Slovenia - 9th place, Egypt - 10th place and Japan - 11th place). Eleven matches were observed, gathering a total of 1034 actions of serve, 863 actions of reception, 1191 actions of attack and 435 actions of defence. Sequences comprising attacks made by the setter in the 2nd touch where disregarded.

2.2. Variables and instrument
For the *effect of reception and defence*, an adaptation of the instrument applied by Eom and Schutz (1992a) was used, considering a scale of five items, ranging from zero to four. Since the purpose of this study was to analyze the attack effectiveness, only the reception and defence actions that promoted continuity were analyzed. The criterion for the categorization of the actions was based on the effect that the reception or the defence caused in the level of offensive organization, including the number of attack options. As such, the utilized categories were:

1. *Reception or defence that does not allow organized attack:* there is no possibility of offensive organization, with only one or two attackers available for the attack. Hence, there isn't the possibility of quick and combined attacks to occur.
2. *Reception or defence that allows organized attack:* there is the possibility of offensive organization, with three or more attackers available for the attack.

The observation instrument used for evaluating the effect of the attack was the one proposed by Mesquita and César (2007). Thus, the analysis categories adopted were: *error* – attacker fails (net, out or fault), or blocking opponent scores; *continuity:* attack action that does not result in a terminal action, with continuity of the rally, after being defended or returned by the opponent's block; *point:* ball attacked directly to the opponent's floor / ball attacked, then tapping the block or defence without success / the block fails.

Regarding *attack tempo*, the categories of Afonso and Mesquita (in press) were used with small adjustments: tempo 1 (the attacker jumps during or slightly after the set, possibly giving one step after the set), 2 (the attacker gives two or three steps after the set), and 3 (the attacker starts a three-step approach after the set, when the ball is reaching its peak in height).

Regarding *attack type*, strong and soft attacks were considered, following the definition used by Castro and Mesquita (2008). In the strong attack, there is a powerful hit on the ball, imprinting it a downward trajectory, whilst the soft attack corresponds to the attacks where the ball is contacted with controlled application of strength.

2.3. Data Collection and Analysis
All matches were filmed from the top, allowing visualizing the field longitudinally. Recorded images were previously tested, to verify if the images recorded in different locations would made it difficult to observe any variable of the study. Hence, the images were recorded in locations that guaranteed the quality of images collected.

2.4. Data analysis
Descriptive statistics were used to determine the frequencies and percentages of occurrence of each variable. In order to investigate possible determinants of the effect of the attack, multinomial logistic regression was performed. It was intended to measure the predictive power of explanatory variables (reception effect, effect of defence, attack tempo and attack type) in relation to a response variable (attack effectiveness). Initially, each chosen explanatory variables were tested individually, in order to identify the existence of a significant association with the response variable (*odds ratio raw*); if this assumption was found, the respective variable would be incorporated in the adjusted model (*odds ratio adjusted*). For data analysis, SPPS 17.0 for windows was used.

2.5. Reliability
For reliability calculation, 35% of the actions were analyzed, a value substantially higher than the reference of 10% pointed by the literature (Tabachnick & Fidell, 2000). Cohen's Kappa was applied, since this statistic detects the existence of agreements by chance. Inter- and intra-observer reliability exhibited Cohen's Kappa values ranging from 0.89 to 0.96 for the effect of reception, 0.96 and 0.94 for the effect of defence, 0, 85 and 0.82 for the attack tempo, 0.83 and 0.87 for the attack type, and 0.96 and 0.96 for the effect of the attack. All variables have presented values substantially higher than the minimum acceptable suggested by the literature (0.75) (Fleiss, 2003).

3. Results

Foremost, the descriptive statistics for each game variable are presented in table 1.

Table 1 – Descriptive statistics per game variable

Game Variables	Categories	Frequency	Percentage
Reception	Reception does not allow organized attack	208	25.8%
	Reception allows organized attack	599	74.2%
Attack tempo	1st tempo	247	21.3%
	2nd tempo	515	44.4%
	3rd tempo	399	34.4%
Defence	Defence does not allow organized attack	195	47.1%
	Defence allows organized attack	219	52.9%
Attack type	Potent Attack	785	80.0%
	Placed Attack	196	20.0%
Effect of the attack	Error	235	19.8%
	Continuity	416	34.9%
	Point	540	45.3%

Table 2 – Predicting the effect of the attack on the side-out

Game Variables	Cont.[a] (%)	Error (%)	Raw OR	Adjusted OR	p	Point (%)	Raw OR	Adjusted OR	p
Reception									
Reception does not allow organized attack	50.6%	9.9%	0.62 (0.34-1.15)c	0.95 (0.34-2.94)c	0.93	39.5%	0.51 (0.35-0.73)c	0.77 (0.37-1.63)c	0.50
Reception allows organized attack [b]	35.0%	10.9%				54.1%			
Attack tempo									
1st tempo	38.5%	9.5%	1.32 (0.62-2.77)c	0.87 (0.27-2.81)c	0.83	52.0%	1.80 (1.15-2.81)c	1.42 (0.63-3.20)c	0.40
2nd tempo	32.3%	12.0%	1.99 (1.03-3.84)c	1.48 (0.51-4.34)c	0.47	55.7%	2.30 (1.53-3.47)c	1.70 (0.79-3.66)c	0.18
3rd tempo [b]	51.6%	9.7%				38.7%			
Attack type									
Potent Attack	36.7%	12.9%	2.24 (1.12-4.50)c	2.37 (1.14-4.93)c	0.02	50.4%	3.70 (2.27-6.04)c	4.27 (2.48-7.34)c	<0.001
Placed Attack [b]	65.4%	10.3%				24.3%			

a Category of reference of the dependent variable

b Category of reference of the independent variable

c Lower and upper 95% confidence interval

Table 2 presents the results of the associations between the reception effect, attack tempo, and attack type, and the effect of the attack in the side-out, as well as the frequencies and their percentages of occurrence. The analysis of table 2 shows that, in side-out, the only variable that determined the effect of the attack in the adjusted model was attack type. Regarding the association between *attack type* and *attack effectiveness*, it was observed that the odds ratio was 2.37 for the potent attack, meaning that the error/continuity ratio was higher for this attack type than for the placed attack (reference category). Therefore, the possibility of a potent attack resulting in error was approximately two times greater than for the placed attack. Moreover, concerning the point/continuity ratio, the value of adjusted odds ratio was 4.27, meaning that the possibility of scoring through a potent attack was approximately four times greater than with a placed attack.

Table 3 presents the results regarding the tactical determinants of the attack effectiveness in transition.

Table 3 – Predicting the effect of the attack in transition

Game Variables	Cont.[a] (%)	Error (%)	Raw OR	Adjusted OR	P	Point (%)	Raw OR	Adjusted OR	p
Defence									
Defence does not allow organized attack	47.6%	15.9%	1.24 (0.62-2.48)c	2.00 (0.33-5.46)c	0.18	36.6%	0.42 (0.27-0.67)c	0.87 (0.40-1.88)c	0.72
Defence allows organized attack [b]	32.3%	8.7%				59.0%			
Attack tempo									
1st tempo	20.6%	8.8%	1.35 (0.33-5.56)c	1.81 (0.33-9.85)c	0.49	70.6%	3.68 (1.51-9.00)c	3.60 (1.01-11.9)c	0.04
2nd tempo	36.1%	9.8%	0.86 (0.40-1.85)c	0.66 (0.23-1.87)c	0.44	54.1%	1.61 (0.99-2.62)c	0.88 (0.41-1.87)c	0.73
3rd tempo [b]	44.4%	14.2%				41.4%			
Attack type									
Potent Attack	29.3%	18.7%	3.83 (1.69-8.67)c	4.31 (1.82-10.2)c	0.001	52.0%	5.99 (3.15-11.4)c	6.40 (3.20-12.8)c	<0.001
Placed Attack [b]	68.3%	11.4%				20.3%			

a Category of reference of the dependent variable

b Category of reference of the independent variable

c Lower and upper 95% confidence interval

It is evident that, in *transition,* both the *attack tempo* and attack type have determined the *effect of the attack*. The association of attack tempo with the effect of the attack in transition showed an adjusted odds ratio of 3.60 for the 1st tempo attack, meaning that the point/continuity ratio was greater for this attack tempo than for the 3rd tempo attack (reference). Thus, the possibility of conquering a point after a 1st tempo attack was approximately four times superior than after a 3rd tempo attack.

The association between attack type and its effect on the transition exhibited an adjusted odds ratio of 4.31 for the potent attack; therefore, the error/continuity ratio was greater for this attack type than for the placed attack (reference). Thus, the possibility of making an error with a potent attack was approximately four times greater than when using a placed attack. Moreover, it was found that the point/continuity ratio presented an adjusted odds ratio of 6.40, meaning that the possibility of scoring with a potent attack was approximately six times greater than when using a placed attack.

4. Discussion

The present study aimed to analyze possible determinants of the attack effectiveness in side-out and transition, with reference to the effect of reception and defence, the speed of the attack (attack tempo) and attack type, under the youth male elite category.

Regarding the possible determinants of the attack effectiveness, different trends emerged for *side-out* and transition. While in the side-out only the attack type has shown predictive power, in transition the *attack tempo* has also emerged as a determinant of the effect of the attack. The fact that the attack tempo has been determinant only in the transition is enlightening of the dissimilarities in the characteristics of the offensive game structures between the two complexes, showing that the fastest tempo (1st attack tempo) has increased the chances of making the point. Patsiaouras *et al*. (2009), having analyzed fifteen games of the 2006 World League through the stepwise regression method, have noticed that setting fastballs was a predictor factor to win the match and having showed that a faster game created advantages to the offensive system.

In the volleyball game complex analysis, it is observed that the *side-out* possesses more stable initial organization conditions, as the ball is recovered from the most predictable action of the game, the serve, thus creating favorable conditions to the offensive organization (Mesquita 2005). Hence, it is plausible that in this complex the effect of the attack will not depend on its speed, because this is common. In opposition, according to the same author (idem), the transition has more unstable initial organization conditions, caused by the action of the opponent's attack, thus promoting slower attacks. Consequently, the increase of the attack tempo in this complex optimizes the effect of attack, since it is not so common.

Conversely, the predictive effect of the *attack type* on the *attack effectiveness* was verified in both *side-out* and transition, showing that the strong attack assists in conquering the point. The study by Rocha and Barbanti (2004), using the multinomial logistic regression, has showed that the chance to occur an attack that allowed the continuity of the game was lower when the ball was struck straight to the floor, which was regularly achieved by using the strong attack; on the contrary, the prevalence of the effect of continuity increased when the attack was placed.

In order to recover the ball in both *side-out* and transition, the present study showed that the quality of the reception and defence did not determine the effect of the attack. These findings contrast with the study of Rocha and Barbanti (2004), referring to the *side-out*,

in which 20 matches of the Brazilian Adult Championship were observed. The authors found that perfect reception created advantages in obtaining the point of attack. Similarly, Eom and Schutz (1992b), using the *log-linear* model, observed that the quality of the first touch provided better conditions for setting and, consequently, favorable conditions of finalization. These divergences may find explanation in the difference of the game level between the teams of these studies (male adult, high competitive level) and the present study (youth male elite) since the increased match flow on the top level creates conditions of greater functional dependence between the defensive organization (on the reception of the service) and offensive organization.

5. Conclusion

It is concluded that, in younger categories of male volleyball, the use of the strong attack in both *side-out* and transition is crucial to achieve high effectiveness in the attack. However, playing with speed proved to be decisive only in transition, in order to create favorable conditions of finalization capable of delaying the blocking action of the opponent. The actions of reception and defence were not determinant for the attack effectiveness, probably due to the fact that the game, in this level of practice is not yet well integrated, suggesting that the subsequent actions do not have high functional dependence relatively to the precedent ones. These aspects indicate that the training process requires a more interconnected work between the different moments of the game in order to optimize the conditions of the attack's finalization. The results of this study suggest the necessity of increasing the offensive "aggressiveness" of the teams through an increase of the game velocity.

It would be important, in future studies, to analyze situational variables, such as the *match status* and the quality of the opposition, which may influence the strategies used by the teams and their performance, considering the dynamic interaction between the two teams in each moment of the game.

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