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DISCRIMINATORY POWER OF FINAL GAME ACTIONS VOLLEYBALL IN FORMATIVE STAGES

PODER DISCRIMINATORIO DE LAS ACCIONES FINALES DE VOLEIBOL EN ETAPAS DE FORMACIÓN

Dávila-Romero, C.¹; García-Hermoso, A.² & Saavedra, J.M.²

1 Degree in Sciences for Physical Activity and Sports. University of Extremadura. racdavila@hotmail.com

2 PhD in Sciences for Physical Activity and Sports. FPI granted (PRE08060) in the Department of Didactics of the Musical, Plastic and Corporal Expression at University of Extremadura. AFIDES research group. University of Extremadura. antoniogh@unex.es

3 PhD in Sciences for Physical Activity and Sports. Senior Lecturer at Faculty of Sports Sciences. AFIDES research group. University of Extremadura. jsaavdra@unex.es

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ABSTRACT

The aims of this study were (i) to compare final actions in game which differentiate winning and losing teams and (ii) to identify game actions which predict victory in female volleyball training categories. A total of 139 matches were analyzed in infantile category and 155 matches in cadet category in the national volleyball scholar age championship (12-16). The results showed that the winning teams in both categories had significantly a better performance in final game actions, mainly in positive serve and attack that predict victory in some matches. Results point out that the lack of continuity in the game favors that service was a decisive action on the final outcome in training categories, thus conditioning posterior actions.

KEY WORDS: Volleyball, notational analysis, victory-defeat, training categories.

RESUMEN

Los objetivos de este estudio fueron: (i) comparar las acciones finales de juego que diferencian a los equipos ganadores de los perdedores y (ii) identificar las acciones de juego que predicen la victoria en categorías de formación de voleibol femenino. Se analizaron un total de 139 partidos en categoría infantil y 155 partidos en categoría cadete de los Campeonatos de España de Voleibol en edad escolar (12-16 años). Los resultados mostraron que los equipos ganadores en ambas categorías tuvieron un mejor rendimiento en las acciones finales (ataque positivo, ataque negativo, saque positivo, saque negativo, bloqueo positivo y error). Por otro lado, el saque y ataque positivo, prediciendo la victoria en los partidos. Los resultados sugieren que la falta de continuidad en el juego favorece que el saque sea una acción decisiva en el resultado final en categorías de formación, condicionando por lo tanto las acciones posteriores.

PALABRAS CLAVE: Voleibol, análisis notacional, victoria-derrota, edad escolar.

1. INTRODUCTION

The analysis of game actions is a research line belonging to notational analysis. It is used in different sports and it is a relevant analysis which allows researchers to place at coaches' disposal objective, reliable and valid information (Sampaio, Ibáñez, & Feu, 2004). This analysis has been applied to different team sports (Escalante, Saavedra, Mansilla, & Tella, 2011; Gruić, Vuleta, & Milanović, 2006; Hughes & Franks, 2005).

Unlike other team sports, volleyball has technical actions that are developed in a sequential order (serve, reception, set, spike, block and field defense). As a result of that, each of them affects the following action and, therefore, the final performance (Eom, 1989). This feature makes players look for answers for a variable adaptation in a short period of time; due to this feature and its noticeable difficulty, volleyball technique gets extraordinary importance (Ureña, 2007).

In volleyball, the final performance is complex and depends on multiple causes. Research workers have studied the relations among these causes by means of the analysis of the game, players' motor skills and kinanthropometric and psychological characteristics among others (Stamm et al., 2003). One of the most noteworthy aspects in literature is the necessary efficiency to solve technical and tactical situations in different parts of the game (Zadražnik, Marelič, & Rešetar, 2009). In this sense, several studies made in the last years have analyzed volleyball teams' efficiency through the analysis of the game actions (Asterios, Kostantinos, Athanasios, & Dimitrios, 2009; João, Leite,

Mesquita, & Sampaio, 2010; Rodríguez-Ruiz, Quiroga, Miralles, Sarmiento, de Saá, & García-Manso, 2011; Zetou, Moustakidis, Tsigilis, & Komninakidou, 2007), although it is worth mentioning these analysis took place among professional sportsmen.

These studies in training categories deal with different subject matters identifying who is gifted and the analysis of technical game actions. These two, which take place among many others, are the ones that should be highlighted. The first one is based on establishing which kinanthropometric variables or physical capacities decide performance in competitive environment (Grgantov, Katić, & Janković, 2006; Katić, Grgantov, & Jurko, 2006; Stamm et al., 2003). Respecting the second one, the study of service in volleyball stands out due to its evolution in the last years. The tasks focus on the analysis of its efficiency at play time (García-Tormo, Redondo, Valladares, & Morante, 2006) or its effect in the way the opposite team builds its attack (Ureña, Vavassori, Rodríguez, & González, 2011). These studies state the importance of service beyond team's production in stage K2.

Therefore, there are not studies analyzing game in training categories because most of them take part in male categories of high rank. Thus, the aims of this study were: (i) to compare final actions in game which differentiate winning and losing teams and (ii) to identify game actions which predict victory in female volleyball training categories.

2. METHOD

The sample consisted of the results and statistics of 294 matches played (139 in child category and 155 in cadet category), 1021 sets (478 in infantile category and 543 in cadet category) and 888 players (432 in infantile category and 456 in cadet category). The sample consisted of the results and statistics of games played in the Championships of Spain Volleyball in infantile (12-14 years) and cadet (14-16 years) category by region, held in Valladolid (2008) and Huelva (2009) (Spain). Archival data were obtained from the Official Website of the Championships. These statistics were collected by Royal Spanish Volleyball technical game experts specifically trained in the software game "*Infoball*" (RFEVB). In this regard, other studies using similar software, such as *Volleyball Information System* of the International Volleyball Federation (Joao et al., 2010) or the *Data Volley System* (Rodriguez-Ruiz et al., 2011).

The variables analysed were the following (game actions within regulatory constraints that involves winning or losing a point): The six actions included: (i) Positive attack, an offensive action that involves winning a point; (ii) Negative attack, a defensive action that involves losing a point; (iii) Positive service. a service action that involves winning a point; (iv) Negative service; a service action that involves losing a point; (v) Positive block; a blocking action that involves winning a point; (vi) Error; regulation fault during an intermediate action

(service reception, setting, or field defense) that involves losing a point (FIVB, 2009).

Basic statistical descriptors (mean and standard deviation) were calculated for context (winning and losing the set) and for set number (total, initial, and last set). All the variables satisfied the tests of normality (Kolmogorov-Smirnov test) and homoskedasticity (Levene homogeneity test) of their distributions. A one-way ANOVA was used to compare the means of the set winners and losers. The effect sizes (ES) and 95% confidence intervals (CI) were calculated by means of t-scores, number of participants, and standard deviations. Cohen's categories were used to evaluate the magnitude of the effect size: (i) small if $0 \leq |d| \leq 0.2$; (ii) medium if $0.2 < |d| \leq 0.5$; and (iii) large if $|d| > 0.5$ (Cohen, 1998). All data gathered were converted to z-scores based on the average of the championships in different categories and final actions.

This was followed by a discriminant analysis including all the independent variables together in the model. This model identifies the game statistics that have the greatest predictive power for the final result of the set. For each function, we calculated the percentage correctly classified, Wilks's lambda, the canonical correlation index, chi-squared, and the level of significance. The criteria of relevance for the interpretation of the linear model were structural coefficients $\geq |0.300|$ (Tabachnick & Fidell, 2007) and p-values ≤ 0.05 . The statistical analysis was performed with the software package SPSS version 15.0 (SPSS Inc., Chicago, IL, USA).

3. RESULTS

Table 1 presents the basic descriptive statistics (mean and standard deviation) for the two contexts (won and lost) and category (infantile and cadet), the one-way ANOVA of the game-related statistics, the effect size (ES), and the confidence intervals (CI). It was observed that winning teams have higher values in the positive attack, positive service, positive block and minor in negative attack and error in infantile category. For his part, in cadet category were differences between winners and losers in all variables analyzed less in the negative service.

Table 1. Means and standard deviations of final actions according to the results (win or loss), effect size, and 95% CI.

	Win		Loss		<i>p</i>	ES	CI (95%)
	Mean	SD	Mean	SD			
Infantile							
Positive attack (n)	9.07	3.06	5.44	3.32	0.001	1.14	1.00 to 1.27
Negative attack (n)	2.73	1.86	3.01	1.97	0.026	-0.15	-0.27 to -0.02
Positive service (n)	5.41	3.15	2.35	2.07	0.001	1.15	1.01 to 1.29
Negative service (n)	2.71	1.66	2.40	1.58	0.003	0.19	0.06 to 0.32
Positive block (n)	1.15	1.15	0.78	1.09	0.001	0.33	0.20 to 0.46
Error (n)	2.22	1.84	2.94	1.87	0.001	-0.39	-0.52 to -0.26
Cadet							
Positive attack (n)	9.81	3.02	6.45	4.03	0.001	0.94	0.81 to 1.08
Negative attack (n)	2.88	2.07	3.43	2.06	0.001	-0.27	-0.40 to -0.13
Positive service (n)	4.59	3.17	2.01	1.73	0.001	1.01	0.87 to 1.15
Negative service (n)	2.65	1.78	2.52	1.59	0.267	0.08	-0.05 to 0.21
Positive block (n)	1.46	1.33	1.04	1.18	0.001	0.33	0.20 to 0.47
Error (n)	1.52	1.31	2.22	1.65	0.001	-0.47	-0.60 to -0.34

SD: standard deviation; ES: effect size; CI: confidence interval.

Table 2 presents the results of the discriminant analysis: percentage correctly classified, Wilks's lambda, canonical correlation index, chi-squared value, and level of significance. In infantile category the predictive model classified 80% of the total matches correctly using two variables (positive service and positive attack). For its parts, in cadet category were classified 78% of the total matches correctly, identifying positive service and attack again as predictors of final outcome.

Table 2. Discriminant analysis models for the different phases, giving the percentage correctly classified, Wilks's λ , canonical correlation index, and variables included in the model

	Infantile	Cadet
Percentage correctly classified	80.0	78.2
Wilks's lambda	0.582	0.615
Canonical correlation index	0.646	0.621
<i>p</i>	0.001	0.001
Variables selected	Positive service (SC=0.699) Positive attack (SC=0.687)	Positive service (SC=0.679) Positive attack (SC=0.667)

SC = structure coefficients

4. DISCUSSION

This paper offers, for the first time, statistical data about which are the final actions which differentiate and predict performance in female training categories.

Winning teams in children categories were differentiated from losing teams in all the final actions which were analyzed. These differences become accentuated

in positive attack and service in both categories (Table 1). In the same way, in junior categories, these differences were also observed but in negative service. The fact that in these categories differences in service error don't exist, seems to corroborate the current tendency to identify service as an offensive technique as age raises so, the risk which is assumed in service seems not to influence in the final result (García-Tormo et al., 2006).

Through a discriminatory analysis of the final actions, a series of functions were looked for in order to predict the victory or defeat according to the official statistic study. The analysis in infantile category showed a function ($p < 0.001$) that discriminates against both the winning and losing teams. In this category, the canonical correlation was 0.65 and the final actions that predict the victory in this category were the positive service and attack. In the same way, in the cadet category we observed a function ($p < 0.001$) with a canonical correlation of 0.62 where the final actions that predicted the victory were the positive service and attack.

These results seem to point out the service as one of the most relevant functions in formation categories. These pieces of information coincide with the studies carried out in the matter at these same ages (Grgantov et al., 2006). In such studies, the service is shaped as a predictor of feminine category performance (ages 12-14 and 14-15). Thus, this must be due to the fact that the service is the only closed regulated technical action which is not related in any ways to a previous one. Therefore, carrying it out does not depend on immediate temporal determinants. It is not even closely related to other motor skills which are so important at these ages, such as strength and agility (Katic et al., 2006). In this same way, the learning rhythm of volleyball specific techniques seems to be positively observed. Such techniques are closely related to their technical difficulty, being the service one of the fastest techniques to learn and acquire (age 12-13). It somehow leads to a positive learning of some other techniques that are considered to be more difficult for players and which are learned bit by bit as time goes by. Among them we can mention spikes or blocks. This piece of work establishes that the better the technical quality, the better the results during the competition (Grgantov et al., 2006). On the other hand, another study states that the service, as it is an action where players have a full control and possession of the ball, should be working at a full capacity (Martines & Abreu, 2003). For this reason, the service could be understood as a technical action that discriminates victory or defeat during early ages.

In the same line, the positive attack, which is present in some other studies in different ways, has also been chosen for our discriminating analysis. Actually, some other studies show the importance the positive attack has in feminine volleyball (Grgantov et al., 2006). If we take his study into account, we infer that for professional players the positive attack is a good performance predictor, mainly during K1 phase, where the attack is one of the variables that predicts victory (Rodriguez-Ruiz et al., 2011), and K2 phase, the attack after defending (Hayrinen et al., 2004). Hence, the attack is one of the most important final

actions when talking about scoring a point as well as performance prediction in these categories.

If we analysed both variables (service and attack) it is obvious to state that the team which is able to positively defend the rival attack will have a reduced error when attacking (Ureña, Santos, Martínez, Calvo, Hernández, & Oña, 2001). The reception systems are the structures that are used in order to neutralise the service, sending it to the setter in the best way possible. Therefore we can highlight the importance of his/her performance in the final results of the game (Ureña, Calvo, & Lozano, 2002). Bearing all said in mind, a recent study about male formation category confirms that services somehow make it difficult for players to prepare the consequent attack, affecting in some way the development of the game as well as the effect of the attack on the final result (Ureña et al., 2011). This same fact has also been verified for professional categories, observing both a successful positive increase in the attack and a decreasing percentage when receiving (Hayrinen, 2004).

By means of the positive attack it is not possible for us to extract any more details, since it obviates the context where it is carried out (touch of fingers, attack, and so on). On the other hand, as the players develop their motor skills, the final attack actions which are near to the net will become important bearing in mind the final performance (Stamm et al., 2003). The impossibility of obtaining a series details during intermediate actions makes us be careful when interpreting such results, since actions directly have a bearing on the final actions that have been analysed (Eom, 1989). For this reason, the big connection between the different actions, where the success of some depends on the quality of the previous ones, it is hard for us to determine which element is more relevant in the final result (Martinez & Abreu, 2003).

5. CONCLUSION

Generally speaking, we come to the following conclusions: (i) There exist game differences between the winning and losing teams in all final actions in infantile categories, observing in the meantime similar differences in cadet categories except for negative attack; and (ii) Game differences between the winning and losing teams are emphasized during the positive service and attack, these being the actions that predict victory in both categories. It is evident that such results show the service offensive evolution, which is of great importance on predicting the final result in feminine formation categories. Thus, we should highlight the importance of positive attacks as a relevant technical action in order to be really successful. It has been proved both in professional and formation categories. Thus, predicting performance variables are quite useful when trying to analyse both positive service and attack in formation categories, helping, in the meantime, coaches and sport managers to carry out their job successfully. This fact is even more helpful in subsequent categories.

Future lines of investigation

The data obtained in this championship only stick to game final actions, so we are not allowed to analyse the importance that intermediate actions bestow during the match. Therefore, it would be interesting to carry out a series of studies in these categories by means of more specific and detailed statistics along with some other programs related to volleyball (for instance, Data volley). These statistics would help to distinguish in a more precise way the different intermediate technical actions during the game performance. That would let coaches successfully plan their trainings and formations.

Practical Application

The results obtained in this study highlight how important the service is in feminine formative categories. It seems to be clear that relating it to the training field makes us stress other technical variables which offset such a big impact. Here, we can include reception techniques or adaptable tactical systems in K1, always considering the corporal development of players. Nevertheless, the main application would be the fact of optimizing services, as an initial action which will lead to control the different phases of the game. Another important application we should include when training is making it more difficult for the rival team to control the ball by means of successful service training.

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