

Analysis of relation between team placing in tournament and selected indicators of playing performance in top-level volleyball

VLADIMÍR PŘIDAL, SILVIA PRIKLEROVÁ

Department of Sport Games, Faculty of Physical Education and Sport, Comenius University, SLOVAKIA

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Abstract:

The aim of our study is to find out which performance indicators predict a successful placing of a team in the tournament of top level in the category of men and women in volleyball. There were 16 teams of men and women like an object of investigation who took part in the final tournament of European Championship 2017. We have analysed all matches in both categories this was for 36 matches in every tournament. There were played-off 131 sets in category of men and 142 sets in category of women. We have registered 6079 serves, 6942 attack hits, 5002 serve receptions and 637 kill-blocks in our statistical analysis. In the category of women there were 6077 serves, 8814 attack hits, 5529 serve receptions and 708 kill-blocks. In the statistical analysis we correlated the overall team placing in the tournament with nine performance indicators which have been various qualitative characteristics of serve, attack hit, block and serve reception. We found out that the kill-blocks per set ($R = 0.846$, $p = 4E-05$) and the number of aces per set ($R = 0.608$, $p = 0.01232$) were the predictors of successful placing in the tournament at men. In the category of women the excellent attack ($R = 0.761$, $p = 0.00061$) and attack efficiency ($R = 0.688$, $p = 0.0032$) were these predictors. We were finding out the significantness of relations at 5 % of statistical significance. The study results enable to the coaches to attain a higher objectivity of their decision-making at searching for the most suitable strategies and procedures at team preparation and guiding in the competition in concrete match also at organizing the training process.

Key words: volleyball, performance analysis, performance indicators, competition.

Introduction

The searching for the reasons of team successfulness in a match and in the competition are problems, which were investigated by more authors (Eom & Schutz, 1992; Přidal 2001; Palao et al., 2004; Zetou et al., 2006; Zetou et al., 2007; Marcelino et al., 2008; Monteiro et al., 2009; Drikos & Vagenas, 2011; Marcelino et al. 2012 and further). One of the possibilities how to investigate these problems is a looking for relations between the team placing in the competition and performance indicators which are various qualitative characteristics of skills. By this direction more researches were come-after. Palao et al. (2004) analyzed the effect of a team's level on the performance of skills in high level volleyball. They divided the teams into three groups according to the final placement. The men found a significant difference between team's levels for the skills of spiking and blocking. In category of women there was identified a significant difference between team's levels for the skills of spiking. Marcelino et al (2008) investigated performance levels in scoring skills, and to relate the results to the team's final ranking in the tournament (World League 2005). They found that spike is the best indicator of success in high-level men's volleyball, but only when considering relative measures. The number of block points per game proved to be a good indicator of success in match. Drikos et al (2009) determined whether latent derivate parameters, can be better predictors than the original proportions of overall team's performance in volleyball expressed as the ratio of sets won to the total number of sets played by the team. The findings lead to clear-cut definitions of norms both for the serving and attack efficiency ratio. The leading teams had a serving efficiency ratio of around two and an attack efficiency ratio of around three. Drikos & Vagenas (2011) identified volleyball performance indicators that best discriminate between winning and losing teams in a set according to set final score differences. The analysis revealed significant multivariate differences in type of set, in type of results, and in their interaction. A follow-up Discriminant Analysis showed that effectiveness of attack is the most important performance indicator for all types of sets, far more for the ambivalent ones. The discriminant function correctly classified increasing % of cases with increase in score difference. Especially for ambivalent sets 67.3% were correctly classified, letting some space for further improving the critical performance indicators.

The aim our study was to find out which indicators predict the successful team placing in the tournament of top level in category of men and women in top-performance volleyball.

Methodology

There were teams of men and women like the object of our study who took part in the final tournament of the European Championship 2017. We have analysed all matches in both categories this was for 36 matches in every tournament. There were played-off 131 sets in category of men and 142 sets in category of women. We have registered 6079 serves, 6942 attack hits, 5002 serve receptions and 637 kill-blocks in our statistical analysis. In the category of women there were 6077 serves, 8814 attack hits, 5529 serve receptions and 708 kill-blocks. We have analysed the following indicators of playing performance:

- Number of service winners per set (aces per set)
- Relative number of illegal serves from the total serve number
- Efficiency of serve (ratio of service winners and illegal serves from the total serve number in percentage)
- Excellent attack (relative number of attacks after which the team gained a point from the total attack number)
- Relative number of errors attacks from the total attack number
- Attack efficiency (ratio of excellent attacks and errors attacks from the total attack number in percentage)
- Number of direct points from kill-block per set
- Excellent serve reception (relative number of precise, excellent serve receptions from the total number of serve receptions)
- Serve reception efficiency (ratio of excellent and errors serve receptions, after which the team gained a point, from the total number of serve receptions in percentage).

All data we obtained from the publicly available sources in CEV site (www.cev.lu) from the match reports that is one of statistical outputs of Data Volley software. The scouting in all matches was implemented by professional scouts who secure a high reliability of investigated data. We utilized the data with individual teams for our analysis from summary match report (the number of service winners and blocks per set, serve efficiency, efficiency of attack and serve reception, excellentness of attack and of serve reception) resp. we counted a relative representation of the indicated two skills from available absolute values of number of all errors serves and attacks and from knowledge of the total number of indicated activities.

We used Spearman's correlation coefficient (R) in evaluation of retrieved data at own relational analysis. We completed the relational analysis for a better image on notice value of the correlation coefficient by a calculation of determination coefficient (R²). We evaluated the results at 5 % level of the statistical significance. The size of the correlation coefficient was interpreted according to Chrásék (2007).

Results We indicate the qualitative parameters of investigated indicators of playing performance organized from the view of placing of particular teams in category of men and women in Table 1 and 2. From the factually logical point of view it is showed that there are no great differences in the level of investigated indicators between the two sexes except of measure of mistakes and of efficiency of the serve that is connected with a higher measure of errors at spiked/smashed serve which is preferred by men in contrast to floating serve which dominates in category of women. Also the relative frequency of excellent serve reception and its efficiency were on average at a higher level in category of women.

Tab 1 Ranking in the tournament and qualitative characteristics of individual indicators in category of men

Ranking	Team	Serve Ace per Set	Serve Error (%)	Serve Effic. (%)	Attack Exc. (%)	Attack Error (%)	Attack Effic. (%)	Block Point per Set	Rec. Exc. (%)	Rec. Effic. (%)
1.	RUS	1.7	13.7	-6	50	15.2	35	2.9	26	15
2.	GER	1.5	20.8	-14	46	15.6	31	2.7	25	18
3.	SRB	1.2	18.7	-13	50	19.2	30	2.4	18	11
4.	BEL	1.1	12.8	-8	44	14.3	30	3.3	30	23
5.	ITA	2.1	20.9	-12	49	16.4	33	2.1	24	17
6.	BUL	1.6	19.8	-13	54	14.5	40	3.0	5	7
7.	CZE	1.2	10.7	-6	46	14.2	32	2.5	24	15
8.	SLO	1.1	17.9	-13	47	19.0	28	2.3	19	9
9.	FRA	1.2	19.9	-15	49	15.8	34	1.5	39	35
10.	POL	1.8	22.0	-14	46	17.5	29	2.3	26	18
11.	TUR	0.9	18.8	-15	53	21.3	35	2.2	28	20
12.	FIN	1.7	16.9	-9	45	15.5	30	1.5	16	5
13.	EST	0.5	18.7	-16	50	13.4	36	2.1	13	3
14.	NED	0.4	15.8	-14	52	14.9	37	1.8	38	32
15.	SVK	1.1	27.5	-22	48	19.8	28	1.5	18	11
16.	ESP	1.1	9.6	-4	39	21.9	17	1.4	10	-4
Average		1.3	16.9	-13.1	48.1	16.4	31.6	2.2	23.6	14.7
Max		2.1	27.5	-4	53	21.9	40	3.0	39	35
Min		0.9	9.6	-22	39	13.4	17	1.4	10	-4

Tab 2 Ranking in the tournament and qualitative characteristics of individual indicators in category of women

Ranking	Team	Serve Ace per Set	Serve Error (%)	Serve Effic. (%)	Attack Exc. (%)	Attack Error (%)	Attack Effic. (%)	Block Point per Set	Rec. Exc. (%)	Rec. Effic. (%)
1.	SRB	2.2	14.9	-6	51	15.3	36	2.5	33	28
2.	NED	1.4	6.8	-1	45	11.4	33	2.3	33	25
3.	TUR	1.7	7.9	0	42	17.1	25	3.1	44	37
4.	AZE	1.5	9.2	-2	45	13.7	31	2.6	37	31
5.	ITA	2.3	14.7	-4	43	20.4	23	2.0	37	30
6.	RUS	0.8	4.5	-1	40	14.4	25	3.5	45	37
7.	BLR	1.3	6.5	1	37	17.8	19	2.6	34	28
8.	GER	1.3	10.6	-4	37	15.9	22	2.0	48	41
9.	BUL	1.6	6.5	1	40	15.4	25	2.5	47	41
10.	POL	1.4	4.8	1	37	14.5	23	3.2	43	36
11.	CRO	1.6	12.7	-5	44	14.7	29	2.7	27	16
12.	CZE	1.2	7.8	-3	38	15.8	23	2.5	34	27
13.	UKR	0.9	9.6	-5	37	18.1	19	2.1	51	45
14.	BEL	1.8	7.7	0	41	14.9	26	2.8	32	24
15.	HUN	1.5	8.9	-2	34	17.7	16	1.3	46	34
16.	GEO	1.1	20.7	-13	27	20.4	6	0.6	24	8
Average		1.5	9.9	-2.7	40.7	15.7	23.8	2.4	39	30.5
Max		2.3	20.7	1	51	20.4	36	3.5	51	45
Min		0.8	4.5	-13	27	11.4	6	0.6	24	8

In the category of men we found out a significant 5 % level of statistical significance only for kill-block per set ($R = 0.846$, $p = 4E-05$, $R^2 = 71.6\%$) and at a number of aces on serve per set ($R = 0.608$, $p = 0.01232$, $R^2 = 36.9\%$). In the first case we can speak on high dependence and in case of number of aces per set on the middle dependence. The determination coefficient shows that the placing in the tournament can be explained to 71.6% by the number of kill-blocks per set and by the number of aces per set to 36.9 %. In the other followed-up indicators we have not found out a significant relation. At errors attacks ($R = -0.2647$, $p \geq 0.05$) and serves ($R = -0.0029$, $p \geq 0.05$) the found-out results indicate an indirect linear dependence where we can surprisingly suppose a lower measure of errors in stated skills with worse placed teams (Tab 3).

Tab 3 Size of correlation coefficient and determination coefficient in investigated relations in category of men

Skills	Indicator	R	p	R ² (%)	Tightness of relation
Spike	Excellent attack	0.158	0.55186	2.5	Very weak dependence
	Attack efficiency	0.247	0.35591	6.1	Very weak dependence
	Errors attack	-0.2647	0.3218	10.4	Very weak dependence
Block	Kill-blocks per set	0.846	4E-05*	71.6	High dependence
Service	Service efficiency	0.394	0.13091	15.6	Very weak dependence
	Number of aces on serve per set	0.608	0.01232*	36.9	Middle dependence
	Number of error. serves per set	-0.0029	0.99138	0.009	Very weak dependence
Reception	Excellent serve reception	0.302	0.25407	9.1	Very weak dependence
	Serve reception efficiency	0.307	0.2465	9.4	Very weak dependence

* ($p \leq 0.05$)

In the category of women we found out a significant relation between a placing of team and excellent attack and its efficiency. We proved a high dependence at excellent attack ($R = 0.761$, $p = 0.00061$, $R^2 = 58\%$) and a middle dependence at the attack efficiency ($R = 0.688$, $p = 0.0032$, $R^2 = 47.3\%$). The found-out coefficients of determination show that we can explain the team placing to 58 % by the excellent attack and in case of effective attack to 47.3 %. The stronger tendencies to linear dependence have showed themselves in the indicator of serve efficiency ($R = 0.44118$, $p = 0.08715$) that in case of excellent serve reception leads to an

indirect linear dependence ($R = -0.097$, $p = 0.25407$) that from a factfully logical point of view we can interpret paradoxically by a lower relative representation of excellent reception with better placed teams.

Tab 4 Size of correlation coefficient and determination coefficient in investigated relations in category of women

Skills	Indicator	R	p	R ² (%)	Tightness of relation
Spike	Excellent attack	0.76176	0.00061*	58	High dependence
	Attack efficiency	0.68824	0.0032*	47.3	Middle dependence
	Errors attack	0.39706	0.12781	15.7	Very weak dependence
Block	Kill-blocks per set	0.347059	0.18783	12	Very weak dependence
Service	Service efficiency	0.44118	0.08715	19.5	Very weak dependence
	Number of aces on serve per set	0.402941	0.12175	1.4	Very weak dependence
	Number of erron. serves per set	0.079412	0.77002	0.6	Very weak dependence
Reception	Excellent reception	serve -0.09713	0.72045	0.9	Very weak dependence
	Serve efficiency	reception 0.16765	0.53486	2.8	Very weak dependence

*($p \leq 0.05$)

Discussion

In our study we have looked-into the fact, which performance indicators predict the team placing in the tournament of top level in category of men and women in volleyball. Significantly the higher numbers of kill-blocks and service winners per set were the predictors of successful placing at the European Championship 2017. In case of the kill-blocks per set we confirmed the results of study of Marcelino et al. (2009). In spite of a found-out high dependence at both indicators from factually logical point of view very small differences exist among teams that can in practice hardly influence the team placing in the tournament. In case of kill-block a difference of 1.5 blocks per set is in question, in case of number of aces per set approximately 1 ace between the highest and lowest value is in question. In contrast to the results of Drikos et al. (2009) we found out not with men a correlation between the placing in tournament and efficiency of serve and attack. Surprising results were brought by the results of tracking of relative number of errors in attack and on serve per set where the found-out tendencies to indirect linear dependence show that more successful teams in these two activities probably more risk, from which more errors result. Although, it has been a suitable strategy in the final effect. The data in further performance indicators of attack (Exc., Effic.) indicate only the tendencies to more successful implementation of these skills with higher placed teams. At this the qualitative characteristics of attack are in many studies the most frequent predictor of team successfulness (Zetou et al., 2006, Zetou et al., 2007, Marcelino et al., 2008, Monteiro et al, 2009, Přidal & Hančák, 2012, Marcelino et al, 2012, Přidal & Bartosova, 2013, Stutzig, Zimmermann, Büsch, & Siebert, 2015, Garcia-de-Alcaraz, & Marcelino, 2017 and further). The attack meaning has manifested in category of women where the excellent attack and attack efficiency are the predictors of successful placing. It is showed that with women the successful teams had a constantly quality attack without distinctive qualitative differences in particular matches. The winning team of Serbia is a good example, which had stabile highly efficient end attackers in team and altogether the best parameters in being indicated indicators. Tendencies to indirect linear dependence in case of excellent serve reception indicate a lower relative representation of excellent reception at higher placed teams. We suppose that the more successful teams managed to maintain a high excellentness and efficiency of attack also after more frequently implemented attack after negative serve reception, resp. they managed more effectively to utilize the positive serve reception for termination. The number of kill-blocks also aces on serve do not play such significant role for successful placing in the tournament at men but also with them, from the factually logical point of view, we can see a tendency to a higher successfulness in being stated indicators with higher placed teams than with more weak ones.

At factually logic analysis of retrieved results we assume that the performance indicators have a higher notice value at such analysis type, which express a relative value of concrete qualitative sign from the overall number of skills (e.g. efficiency and excellentness of attack and serve reception) than indicators where we evaluate the absolute frequency of kill blocks and number of aces on reception in our case. In volleyball the representation in both cases in category of men and women is very low that in the final effect brings the minimal differences among teams and they can hardly really influence the team placing in the tournament.

We realize that the results of statistical analysis could influence the performance failures in some sets or of whole matches of investigated teams and on contrary a very similar level in followed-up indicators of defeated

and winning teams in tight sets. The results could be influenced also by the playing system of tournament where some very successful teams in group (e.g. Turkey at men) have lost the key match in elimination phase and therefore they placed in the 9th – 12th place in overall valuation.

Conclusion

Our statistical analysis showed that the various investigated performance indicators were the predictors of successful placing at the European Championship 2017 from point of view of the two sexes. In category of men the number of kill-blocks and the number of service winners per set were these indicators. In category of women the excellentness and efficiency of attack were these ones. From a factually logic point of view we consider the indicators of excellentness and efficiency of attack for more relevant ones than absolute values of excellent serve and blocks per set. The results of competition can serve as bases for elaborating the structural models of playing performance of successful teams in category of men and women in top-level volleyball. For coach's practice the results can help to finding-out of strengths and weaknesses of their team that is a basic presumption for coaches in fixing the optimal focusing alternatively for correction of training process, an important aid at determination of suitable strategies and procedures in preparation and guiding of team in match. The knowledge verification on other performance category requires separate tracking.

This work is part of a research task VEGA 1/0529/16: Effectiveness of sports preparation of club and representative basketball teams, depending on age and gender.

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