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The efficiency of executing technical actions in volleyball and the teams' gender and sports level

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Abstract

Introduction. Modern statistical methods related to team games can be very helpful in improving the quality of analysis. Aim of Study. The aim of the paper was to identify differences in the efficiency of executing technical actions by teams participating in the Men's and Women's European Volleyball Championship in 2013-2017, with consideration for the gender and the place taken in the final classification. Material and Methods. The research material consisted of teams (n = 96) divided into five groups: 1 – places 1-4, 2 – places 5-8, 3 – places 9-12, 4 – places 13--16, 5 – all teams. The results of efficiency in the serve, reception, setting the reception, the attack and the block were analysed. Results. Female teams were more efficient than the male ones in reception by 4.45% ($p < 0.05$) and in the block by 0.32 point ($p < 0.05$), while the male teams were better than the female ones in setting by 10.24% ($p < 0.001$) and in the attack by 7.46% ($p < 0.001$). Female teams from places 1-4 were more efficient in the serve by 0.44 point ($p < 0.01$), in setting by 13.93% ($p < 0.001$), in the attack by 9.00% ($p < 0.001$) and in the block by 1.00 point ($p < 0.01$) in comparison with teams from places 13-16. Similar results were obtained by men: in the serve by 0.44 point ($p < 0.01$), in setting by 13.93% ($p < 0.001$), in the attack by 9.00% ($p < 0.001$) and in the block by 1.00 point ($p < 0.01$). Conclusions. The obtained results indicate differences between male and female volleyball players. This necessitates using different methods of training. The efficiency of performing technical actions differentiates between teams from places 1-4 and 13-16. Therefore, in training control, coaches should primarily focus on tools that allow an assessment of the efficiency of male and female players in individual technical elements.

KEYWORDS: volleyball, team sport, gender, efficiency, skills, statistics.

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Introduction

Victory in volleyball depends on a number of factors [11, 16, 21]. The objective of a training process relies on modifying them in order to succeed. The coach's observation, which can become important in constructing the training and in sports competition [2], is an important factor in monitoring the training process. However, from a scientific point of view, the observation method is subjective; therefore, it loses its validity and credibility. Due to this fact, modern statistical methods related to team games can be very helpful in improving the quality of analysis [20].

The issue of monitoring efficiency of volleyball has been addressed in a number of publications [7, 8, 12, 13, 14]. Those studies mainly focused on the importance of the effectiveness of performing technical actions with regard to victory and defeat [8], positions occupied on court [7], differences between levels of competition [12] and genders [13, 14].

Analyses of the efficiency of performing technical actions with a view to gender are justified due to the different characteristics of the male and female phenotypes in terms of strength, acceleration and speed caused by greater muscle mass in men [19]. In most sports, women's and men's rivalry is subject to the

same rules and regulations of the game. In volleyball, the height of the net suspended at 224 cm for women and at 243 cm for men [10] makes a special difference. A study by Palao et al. has shown that women are more efficient in the serve than men, while men are characterized by higher efficiency in receiving the serve and in setting in comparison with women. The efficiency in attack and in defence does not differ between the genders [14]. A study from 2010 proved that the course of the game in male volleyball is more related to closing actions (mistakes in the serve), while the game in female volleyball is characterized by continuous actions (in defence and in attack). The differences may be associated with anthropometric and physiological differences between men and women, which can influence the efficiency profile [13].

Authors have also undertaken the issue of the impact of performing technical actions on the teams' sports level [15, 17]. For example, Palao et al. studied the influence of the teams' levels on the efficiency of executing technical actions in volleyball matches at the Olympic Games in Sydney in 2000. The analysis was conducted separately for men and women, and the teams' levels were defined on the basis of the final classification of the competition (level 1: 1-4; level 2: 5-8 and level 3: 9-12). The study showed significant differences between the teams' levels in the efficiency of attack and block among male teams. Female teams (level 1) were more efficient at attack than teams ranking lower in the competition [15]. Research by Pena et al. proves, among others, that errors in reception and the efficiency in the block were the distinctive factors for teams occupying different positions in competitions [17].

Aim of Study

The aim of the present study was to determine differences in the efficiency of performing technical actions by teams participating in the Men's and Women's European Volleyball Championship in 2013-2017, with consideration for gender and the position taken in the final classification. The study allowed finding answers to the following research questions:

1. Do the female and male teams participating in the European Volleyball Championship in 2013--2017 differ in terms of the efficiency of executing the serve, receiving the serve, setting, attack and block?
2. Does the efficiency of executing technical actions differentiate between the teams which took different positions in the final classification of the Men's and Women's European Volleyball Championship in 2013-2017?

Material and Test Method

The research material consisted of teams (n = 96) participating in the Men's and Women's European Volleyball Championship in 2013-2017 (Table 1).

Results of the technical actions of the teams divided into five groups among men and women were subject to analysis. The first research group was made of teams classified in places 1-4; the second one, teams classified in places 5-8; the next one, teams classified in places 9-12, then teams from places 13-16, and the last all one was made of all teams participating in the Men's and Women's European Volleyball Championship in 2013--2017. The following technical actions were analysed: serve, reception, setting, attack, and block.

Table 1. Final classification of the Men's and Women's European Volleyball Championship in 2013-2017 (n = 96)

Final classification of the competition	Women's European Volleyball Championship			Men's European Volleyball Championship		
	2013	2015	2017	2013	2015	2017
1	2	3	4	5	6	7
	Russia	Russia	Serbia	Russia	France	Russia
	Germany	Netherlands	Netherlands	Italy	Slovenia	Germany
	Belgium	Serbia	Turkey	Serbia	Italy	Serbia
	Serbia	Turkey	Azerbaijan	Bulgaria	Bulgaria	Belgium
	Croatia	Germany	Italy	France	Poland	Italy
	Italy	Belgium	Russia	Germany	Russia	Bulgaria
	Turkey	Italy	Belarus	Belgium	Serbia	Czech Rep.
	France	Poland	Germany	Poland	Germany	Slovenia

1	2	3	4	5	6	7
	Netherlands	Belarus	Bulgaria	Finland	Netherlands	France
	Czech Rep.	Croatia	Poland	Netherlands	Belgium	Poland
	Poland	Czech Rep.	Croatia	Slovakia	Estonia	Turkey
	Belarus	Hungary	Czech Rep.	Dania	Finland	Finland
	Bulgaria	Bulgaria	Ukraine	Slovenia	Czech Rep.	Estonia
	Switzerland	Azerbaijan	Belgium	Turkey	Slovakia	Netherlands
	Azerbaijan	Romania	Hungary	Belarus	Croatia	Slovakia
	Spain	Slovenia	Georgia	Czech Rep.	Belarus	Spain

Data on the efficiency of performing technical actions by the teams (serve, reception, setting, attack, block) were obtained from the official website of the European Volleyball Confederation (CEV) [6]. The efficiency of the serve was expressed as the mean value of points scored per set. The efficiency of reception was calculated by dividing the number of received serves allowing a fast attack from all zones by the number of all attempts to receive. The obtained result was multiplied by 100%. The efficiency in setting was determined as the percentage of scoring attacks after setting. The examined teams' efficiency in attack was expressed as percentage. The percentage of attack efficiency was calculated by dividing the number of scoring attacks by the number of all attempts in attack, and then multiplying the result by 100%. The efficiency in block was expressed as the mean value of the points scored per set.

Statistical analysis allowed determining mean values and standard deviations of the results obtained in technical actions by particular groups. The Shapiro–Wilk test was used to check the normality of distributions in the examined groups. ANOVA test used as to analyse of variance. In order to examine whether the obtained results differed, statistical tests were used. The t-test was used to identify differences in the efficiency of technical actions between female and male teams participating in the European Volleyball Championship in 2013-2017. The Scheffe test used to determine the differences in the efficiency of technical actions between the teams grouped in the tournament according to the taken place. The analysis was conducted in statistical software STATISTICA 10.

Results

The first part of the analysis was to determine of the volume of differences in the efficiency of performing technical actions between female and male teams participating in the European Volleyball Championship in 2013-2017 (Table 2).

Table 2. Efficiency of performing technical actions by the teams participating in the Men's and Women's European Volleyball Championship in 2013-2017, broken down by gender (n = 96)

Efficiency of performing technical actions	Teams participating in the Women's European Volleyball Championship in 2013-2017 (n = 48)	Teams participating in the Men's European Volleyball Championship in 2013-2017 (n = 48)
	Mean ± SD	Mean ± SD
Serve (points scored per set)	1.43 ± 0.43	1.29 ± 0.48
Reception (% of perfect receptions)	33.85 ± 7.26*	29.40 ± 10.63
Setting (% scoring attacks after setting)	30.85 ± 8.84	41.09 ± 8.49**
Attack (% of scoring balls)	39.50 ± 4.96	46.96 ± 4.55**
Block (points scored per set)	2.63 ± 0.73*	2.31 ± 0.61

Differences statistically significant between groups for * $p \leq 0.05$, ** $p \leq 0.001$

The study showed that the female teams participating in the European Volleyball Championship in 2013-2017 were more efficient at receiving the serve by 4.45% ($p < 0.05$) and in the block by 0.32 point ($p < 0.05$) when compared with the male teams. The men's teams were more efficient than the women's ones at setting by

10.24% ($p < 0.001$) and in attack by 7.46% ($p < 0.001$). oth female and male teams participating in the European Volleyball Championship in 2013-2017 did not differ in terms of the efficiency of the serve.

In the next phase of the study, differences in the efficiency of performing technical actions by the teams participating in the Women's European Volleyball Championship in 2013-2017 were determined with a breakdown by groups: places 1-4, places 5-8, places 9-12, places 13--16 (Table 3).

Teams from places 1-4 were more efficient in the serve by 0.44 point ($p < 0.01$), in setting by 13.93% ($p < 0.001$), in attack by 9.00% ($p < 0.001$) and in block by 1.00 point ($p < 0.01$) when compared with teams from places 13--16. In addition, the best teams (1-4) were more efficient in attack than the teams from places 9-12 by 5.66% ($p < 0.01$), and the teams from places 5-8 by 5.34% ($p < 0.05$) when compared with the teams from places 13-16. The groups did not differ in terms of the efficiency of receiving the serve.

In the final stage, differences in the efficiency of performing technical efficiency by the teams participating in the Men's European Volleyball Championship in 2013-2017 were examined with regard to a breakdown by groups (Table 4).

Teams from places 1-4 were more efficient in the serve by 0.54 point ($p < 0.05$), in setting by 10.73% ($p < 0.01$), in attack by 4.83% ($p < 0.05$), and in block by 0.92 point ($p < 0.001$) when compared with teams from places 13-16. Teams from places 5-8 were more efficient at

Table 3. The efficiency of performing technical actions by the teams participating in the Women's European Volleyball Championship in 2013-2017, broken down by groups (n = 48)

Groups	Places 1-4 (n = 12)	Places 5-8 (n = 12)	Places 9-12 (n = 12)	Places 13-16 (n = 12)
Efficiency of performing technical actions	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Serve (points scored per set)	1.75 ± 0,37[a]	1.48 ± 0.53	1.30 ± 0.32	1.17 ± 0.29
Reception (% of perfect receptions)	33.33 ± 5.91	37.17 ± 6.53	32.83 ± 6.64	32.08 ± 9.30
Setting (% scoring attacks after setting)	37.83 ± 5.11[a]	31.30 ± 7.21	30.34 ± 7.88	23.90 ± 9.33
Attack (% of scoring balls)	44.08 ± 3.50[ab]	40.42 ± 3.15[a]	38.42 ± 3.23	35.08 ± 5.12
Block (points scored per set)	2.99 ± 0.63[a]	2.84 ± 0.65	2.66 ± 0.61	1.99 ± 0.68

Data are presented as mean ± SD, where a, $p < 0.05$ compared with the places 13-16 and b, $p < 0.05$ compared with places 9-12

Table 4. The efficiency of performing technical actions by the teams participating in the Men's European Volleyball Championship in 2013-2017, broken down by groups (n = 48)

Groups	Places 1-4 (n = 12)	Places 5-8 (n = 12)	Places 9-12 (n = 12)	Places 13-16 (n = 12)
Efficiency of performing technical actions	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Serve (points scored per set)	1.43 ± 0.29[a]	1.54 ± 0.58[a]	1.32 ± 0.45	0.89 ± 0.34
Reception (% of perfect receptions)	30.58 ± 9.34	29.08 ± 11.98	31.5 ± 10.30	26.42 ± 11.40
Setting (% scoring attacks after setting)	44.95 ± 4.99[a]	45.42 ± 5.32[a]	39.80 ± 7.31	34.22 ± 10.35
Attack (% of scoring balls)	48.50 ± 2.68[a]	50.25 ± 3.36[ab]	45.42 ± 4.19	43.67 ± 4.85
Block (points scored per set)	2.68 ± 0.36[a]	2.60 ± 0.40[a]	2.20 ± 0.63	1.76 ± 0.56

Data are presented as mean ± SD, where a, $p < 0.05$ compared with the places 13-16 and b, $p < 0.05$ compared with places 9-12

the serve by 0.65 point ($p < 0.01$), in setting by 11.20% ($p < 0.01$), in attack by 6.58% ($p < 0.01$), and in block by 0.84 points ($p < 0.05$) than the teams from places 13-16, and they were more efficient in attack by 4.83% ($p < 0.05$) than the teams from places 9-12. The groups did not differ in terms of the efficiency of receiving the serve.

Discussion

The efficiency of performing technical actions in volleyball has been described in many studies [1, 3, 5]. This study broadens previous analyses and answers the question: do gender and the position taken in the final ranking differentiate between teams in terms of the efficiency of performing technical actions?

On average, teams score 7.3% of all points in a match from the serve [3]. Own research shows that the female and male teams participating in the European Volleyball Championship in 2013-2017 did not differ in terms of the efficiency of the serve, while the teams (both female and male) occupying places 1-4 and 13-16 in the competition differ in terms of the efficiency of executing the serve. The obtained results do not confirm previous reports in which women were more efficient in the serve than men, and the men's and women's teams occupying the highest and the lowest positions in competitions of a championship rank do not differ in terms of the efficiency of performing the serve [14, 15].

Receiving the serve directly affects the efficiency of setting the ball and executing the attack [4, 9]. The obtained results showed that the female teams participating in the European Volleyball Championship in 2013-2017 were more efficient at reception when compared to the male teams. In both men and women no differences in the efficiency of reception were observed when it comes to teams from the highest and the lowest places in the final classification of tournaments. In earlier studies, men were characterised by higher efficiency in receiving the serve than women, and there were no differences in the efficiency of receiving the serve between teams from different positions [14, 15].

Setting the ball efficiently influences increased efficiency of attack [1]. The study showed that the male teams were more efficient at setting the ball than the female ones. Teams from places 1-4 were more efficient at setting in comparison with teams from places 13-16 both among men and women. In addition, the men's teams from places 5–8 were more efficient at setting than teams from places 9-12. A study by Palao et al. [14] confirms that men are characterised by higher efficiency in setting than women. In the previous analyses, differences in the efficiency of setting the game between the highest and the lowest classified teams in competitions of the championship rank were not investigated.

Attack in volleyball is a technical action that gives teams approximately 81% of points [3]. In the presented study, the attack efficiency of the male teams was higher than of the female teams participating in the European Volleyball Championship in 2013-2017. In addition, female teams from places 1-4 were more efficient in attack when compared with the teams from places 9-12 and 13-16, and the teams from 5-8 places in comparison with the teams from places 13-16. Among men, the teams from places 1-4 were more efficient in attack when compared with the teams from places 13-16, and the teams from places 5-8 more efficient than the teams from places 9-12 and 13-16. Earlier reports mention a lack of differences in the efficiency of attack between the genders, and both female and male teams from places 1-4 were more efficient at attack than teams from places 9-12 [14, 15].

The block is an action that yields 14.5-15.6% of points scored in a match [18]. This analysis showed that the female teams participating in the European Volleyball Championship in 2013-2017 were more efficient in the block when compared to the male teams. The female teams from places 1-4 were more efficient in the block than teams from places 13-16. Analogous results were obtained among the male teams. In literature analysis no studies comparing the efficiency in the block between the sexes were found. Research by Palao et al. indicates significant differences between teams' levels (level 1 – – places 1-4, level 2 – places 5-8, level 3 – places 9-12) in the block efficiency among male teams, but there were no differences in the block performance efficiency between the different levels among women [15].

An analysis of the efficiency of particular technical actions of the teams taking into account different variables is an issue raised by authors in the last two decades [1, 14, 15]. Own research provides new and different results from the previous reports. The female teams participating in the European Volleyball Championship in 2013-2017 were more efficient at receiving the serve and in the block as compared to the male teams. The male teams were more efficient than the female teams in setting and in attack. Both female and male teams from places 1-4 were more efficient in the serve, in setting, in attack and in block than the teams from places 13-16.

Changes in the somatic composition of both male and female players participating in competitions of the championship rank and changes in the rules of the game render the presented study up-to-date and useful.

Conclusions

Female teams are more efficient at receiving the serve and in the block than male teams. Differences in the efficiency of reception may result from the use of different techniques in executing the serve [14]. Differences in the efficiency of performing the block leave space for conducting further analyses.

Male teams were more efficient than the female ones in setting the ball and in attack. The differences in setting and in attack may be due to the diversity of male and female phenotypes in terms of strength, acceleration and speed [19]. Men are faster, which enables them to set a larger number of balls with both hands up, which is more precise [14]. Simultaneously, they jump higher than women, which increases their efficiency in attack.

Both female and male teams from places 1-4 were more efficient in the serve, setting, attack and block in comparison to teams from places 13-16. It can be, therefore, concluded that the efficiency of performing each of the abovementioned technical actions affects the victory or failure in the competition. Better performing teams occupy higher positions in the final classification. Teams from different groups did not differ in terms of the efficiency of receiving the serve. The lack of differences is difficult to explain, and further analysis of the problem is needed.

The presented results of the study on the efficiency of technical actions taking into consideration the gender and the sports level of teams provide new information necessary for properly conducting the training process. They indicate differences between male and female volleyball players, which necessitates using different training methods. In addition, the study proved that the highest classified teams at the Women's and Men's European Volleyball Championship in 2013-2017 are characterised by higher efficiency in performing technical actions as compared to the lowest ranked teams. In training control, coaches should primarily focus on tools allowing an assessment of the male and female players' efficiency in particular technical elements.

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