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ORIGINAL

The efficiency of executing technical actions by female volleyball players depending on their positions on the court

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Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

abstract

Background The aim of the study was to determine differences in the efficiency of executing technical actions by female volleyball players taking into account their positions on the court.

Material/Methods The research material comprised results of the efficiency of female volleyball players' technical actions (n = 98) participating in the 2015 Women's European Volleyball Championship. The subjects were divided into five groups: receivers, middle blockers, spikers, setters, and liberoes. The following technical actions were analysed: attack, block, serve, and receiving a serve. In order to determine the differences between the studied groups, statistical tests were used. The Scheffe test was used to compare the efficiency in attack, block, and serve. Student's T-test was used to compare receiving the serve.

Results Middle blockers are more efficient in attack than spikers by 6.82% ($p < 0.05$) and receivers by 9.61% ($p < 0.001$). Middle blockers also gain more points in the block per set than receivers ($\Delta x = 0.39$, $p < 0.001$), setters ($\Delta x = 0.49$, $p < 0.001$) and spikers ($\Delta x = 0.35$, $p < 0.01$). Liberoes present the efficiency in receiving the serve higher by 6.07% ($p < 0.05$) than receivers.

Conclusions Efficiency in attack, block and receiving a serve significantly diversifies players at different positions. Their positions on the court do not affect the efficiency of the serve. These differences may arise from the game tactics of the teams and may be related to different tasks realised at particular positions.

Key words statistical analysis, technique, performance, team sport, female, volleyball

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INTRODUCTION

Victory in sport depends on a combination of many factors: technical and tactical actions as well as physiological, psychological and anthropometric parameters [1, 2, 3, 4]. Technical actions, construed as the necessary motor habits characteristic of a given sport discipline, have a significant influence on the sports result achieved by a team [5].

In volleyball there are many individual technical actions: attack, serve, block, receiving a serve, defence, or setting. Individual technical actions make up a number of complex technical-tactical actions [6].

Among the team games, volleyball has a very deterministic structure. Technical actions executed during the game as first significantly affect the subsequent ones [7, 8]. Technical actions which produce the highest score include: attack (76.8–80%), block (14.5–15.6%) and serve (4.4–8.1%) [9]. For this reason, analysis of the efficiency of particular technical actions enables determining which ones, and to what extent, decide about victory at the level of sports championship. The efficiency of players' motor actions, with consideration for age, gender and the court zone, has been a subject of numerous studies in the last decade [10, 11, 12, 13, 14]. Still analysis of literature did not show research defining how the position on the court differentiates players in terms of efficiency of executing technical actions.

In volleyball there are five positions: the receiver, the middle blocker, the spiker, the setter and the libero [15, 16, 17]. Each position is associated with different roles realised by players on the court. The receiver's task is to receive the ball after the opponent's serve and defensive game combined with attacks from the wings or backcourt (attack from the sixth zone). The main task of the middle blocker is to block the opponent's attacks and to attack in the first pace (attack from the third zone). The spiker has the task to finish the action with attack after setting the ball up by the setter. He/she also takes part in the team's defensive game (block, defence). The setter's task is the set the ballup for the players participating in attack (spiker, middle blocker, receiver) following its reception by the receiver or the libero. The libero is responsible for the team's defensive game and for receiving a serve.

Different tasks performed on the court by players on particular positions are also associated with differences in their somatic composition, age or jumping potential. Palao et al. [15] showed significant differences in body height, one-handed and both-handed reach in attack and in block and the players' age depending on their position on the court. Middle blockers, in contrast to receivers, present a higher level of features conducive to blocking and attacking (they are younger and taller, and have a lower BMI and greater reach in attack and block). Setters and liberoes are shorter, lighter and older, which may promote better efficiency in setting the ball, receiving a serve or defence [15].

The aim of the study was to determine the differences in the efficiency of executing technical actions by female volleyball players taking into account their positions on the court. The following technical actions were analysed: attack, block, serve, receiving a serve. The study allowed answering the following research questions:

- Does the position on the court differentiate female players in terms of efficiency in attack, block, and serve?
- Are female libero players characterised by greater efficiency in receiving a serve than female receivers?

MATERIAL AND METHODS

The research material comprised results of the efficiency of technical actions of female volleyball players (n = 98) participating in Women's European Volleyball Championship in 2015 in the Netherlands and Belgium. Players who played a small number of sets in the tournament (< 12) were excluded from the analysis. The subjects were assigned to five groups depending on their positions on the court, i.e. receivers, middle blockers, spikers, setters, and liberoes (Table 1).

Table 1. Characteristics of age, body height and body weight of female players participating in the 2015 Women's European Volleyball Championships with regard to their position on the court (n = 98)

Subjects	Receivers (n = 26)		Middle blockers (n = 29)		Spikers (n = 15)		Setters (n = 15)		Liberoes (n = 13)	
Feature	x̄	SD	x̄	SD	x̄	SD	x̄	SD	x̄	SD
Age	27.08	3.46	25.34	3.86	26.00	5.18	26.93	4.06	27.62	3.18
Body height (cm)	184.92	4.76	189.31	4.71	190.20	4.38	181.47	5.34	174.54	5.01
Body weight (kg)	71.73	5.17	76.28	5.52	77.00	9.56	69.87	5.45	62.85	4.02

x̄ – mean, SD – standard deviation

Data on age, anthropometric parameters (body height and weight) and the efficiency of executing technical actions by female volleyball players (attack, block, serve, and receiving a serve) were obtained from the official website of the European Volleyball Confederation (CEV) [18]. The examined players' efficiency in attack was expressed in percentage points. The percentage of efficiency in attack was obtained by dividing the number of attacks that ended with scoring a point by the number of all attempts at attack, and then by multiplying the obtained result by 100%. Efficiency in block and in serve was expressed as the mean values of obtained points per set in a given technical action. Efficiency in receiving a serve was calculated by dividing the number of received serves enabling a fast pace of attack from all zones by the number of all attempts of receiving a serve. The obtained result was multiplied by 100%.

Statistical analysis allowed determining the mean values and standard deviations of the obtained results in motor activities in particular groups.

In order to check the normality of distribution in the examined groups, the Shapiro-Wilk test was used. Levene's test was used to analyse the homogeneity of variance. Analysis of the sampling distribution in groups was made with a use of the chi-squared test.

In order to examine whether the obtained results vary, statistical tests was applied. The Scheffe test was used to compare the efficiency in attack, block, and serve in each group. Student's T-test was used to compare receiving a serve in the analysed groups. Analysis was performed with a use of STATISTICA 10 software.

RESULTS

The first stage of the analysis was to determine the efficiency of executing technical actions in the tested groups (Table 2).

Table 2. Qualitative characteristics of technical actions of female players participating in the 2015 Women's European Volleyball Championship with regard to their positions on the court (n = 98)

Position on the court	Receivers (n = 26)		Middle blockers (n = 29)		Spikers (n = 15)		Setters (n = 15)		Liberoes (n = 13)	
Technical actions	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Attack (% of finished balls)	37.17	8.24	46.78	9.36	39.96	6.28	-	-	-	-
Block (points scored per set)	0.29	0.18	0.68	0.37	0.33	0.20	0.19	0.15	-	-
Serve (points scored per set)	0.25	0.17	0.18	0.14	0.21	0.14	0.19	0.09	-	-
Perfect reception (%)	32.18	7.68	-	-	-	-	-	-	38.25	7.92

$\bar{x}$ – mean, SD – standard deviation

The tested volleyball players' efficiency in attack ranged from 37.17% (SD = 8.24) for receivers to 46.78% (SD = 9.36) for middle blockers. Spikers were characterised by efficiency in attack at 39.96% (SD = 6.28).

Efficiency in serve expressed in points scored per set was in the range from 0.19 (SD = 0.15) for setters to 0.68 (SD = 0.37) for middle blockers. Receivers were characterised by efficiency in block at the level of 0.29 points/set (SD = 0.18) and spikers at 0.33 points/set (SD = 0.20).

The mean number of points scored in the serve per set ranged from 0.18 (SD = 0.14) for middle blockers to 0.25 (SD = 0.17) for receivers. Setters, on average, scored 0.19 points/set (SD = 0.09) in the serve, while spikers 0.21 points/set (SD = 0.14).

Receivers reached 32.18% (SD = 7.68) of the perfect reception and libero players 38.25% (SD = 7.92).

At the next stage of analysis, values of differences in the efficiency of executing technical actions between the tested groups. The research has shown that middle blockers are more efficient in attack than spikers by 6.82% ($p < 0.05$) and receiversby 9.61% ($p < 0.001$) (Fig. 1).

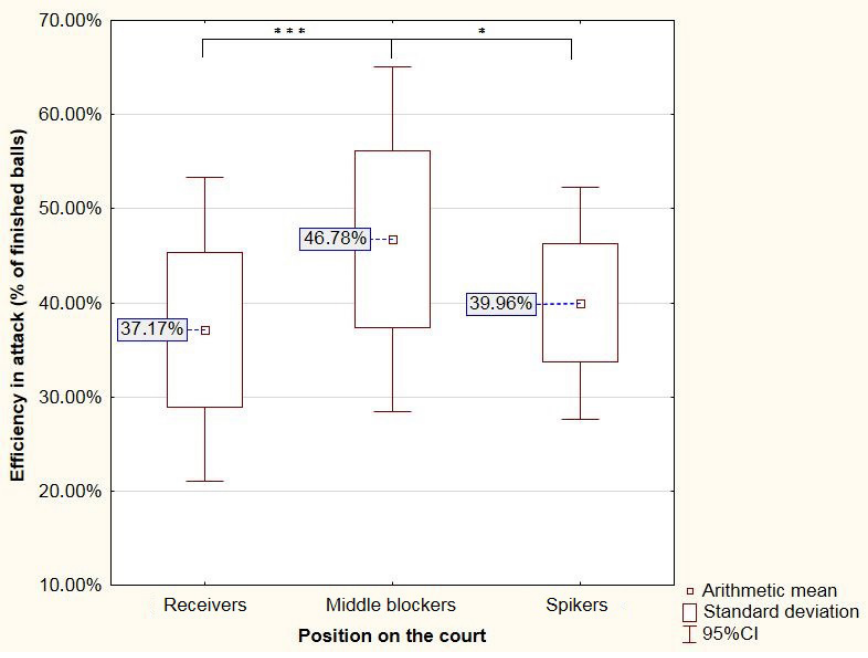

Fig. 1. Efficiency in attack (% of balls finished) among female players participating in the 2015 Women's European Volleyball Championship (n = 98) taking into account their positions on the court
Statistically significant differences for *p ≤ 0.05, *** p ≤ 0.001

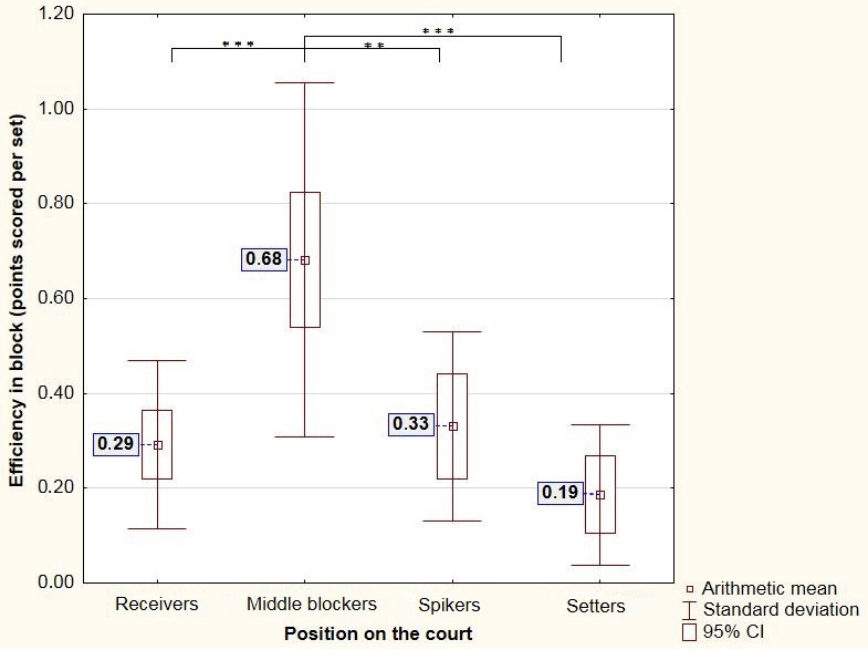

Fig. 2. Efficiency in block (points scored per set) among female players participating in the 2015 Women's European Volleyball Championship (n = 98) taking into account their positions on the court
Statistically significant differences for **p ≤ 0.01, *** p ≤ 0.001

Middle blockers also score more points per set in the block in comparison to receivers ($\Delta x = 0.39$, $p < 0.001$), setters ($\Delta x = 0.49$, $p < 0.001$) and spikers ($\Delta x = 0.35$, $p < 0.01$) (Fig. 2).

The studied groups did not differ in terms of points scored in the serve per set (Fig. 3).

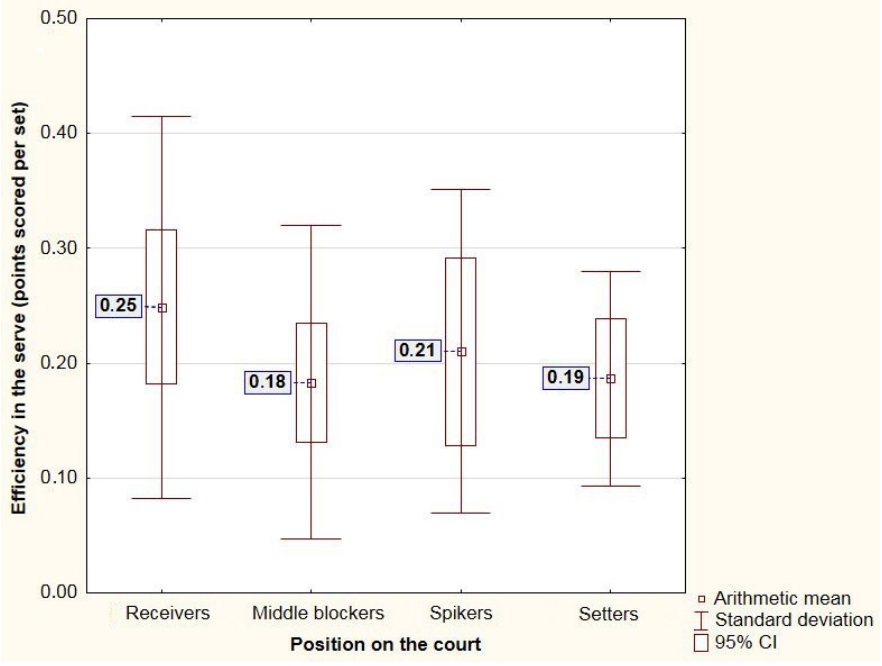

Fig. 3. Efficiency in the serve (points scored per set) among female players participating in the 2015 Women's European Volleyball Championship (n = 98) taking into account their positions on the court

Finally, it was examined how the efficiency of receiving the serve differentiates liberoes and receivers. Libero players represent the perfect reception higher by 6.07% ($p < 0.05$) than receivers (Fig. 4).

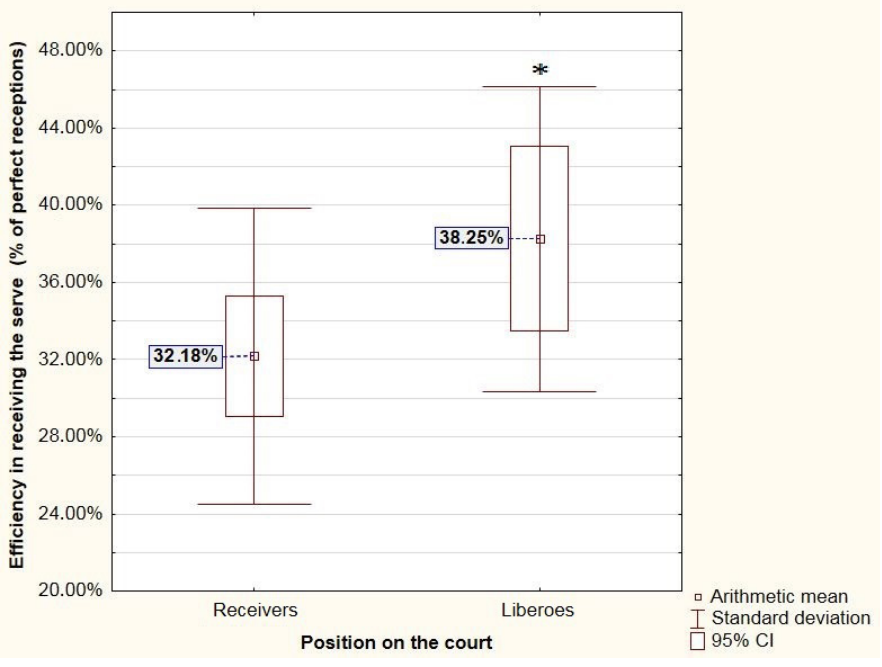

Fig. 4. Efficiency in receiving the serve (% of perfect receptions) among libero players (n = 13) and receivers (n = 26) participating in the 2015 Women's European Volleyball Championship. Statistically significant differences for *p ≤ 0.05

DISCUSSION

Sports rivalry in volleyball is based on the players' consecutively performing appropriate technical actions (serve, receiving the serve, setting the ball, spike, block, defence). The efficiency of their execution is dependent on the level of the players' tactical skills and their physiological and anthropometric characteristics [10]. The efficiency of executing technical actions affects the sports result. Volleyball teams taking higher ranking positions have better efficiency in attack and block compared with teams that take lower places in tournaments [19].

Efficiency of motor actions in volleyball has been extensively described in research [10, 11, 12, 13, 14]. The authors' own research significantly broadens earlier analyses and provides an answer to the question: how does the position occupied on the court affect the efficiency of executing technical actions?

In volleyball each position is associated with different tasks performed by players on the court. For this reason, in this study only key technical actions characterizing the game at a specific position were analysed.

Attack in volleyball is the technical action giving a team the biggest point score [9]. A feature that defines players' potential in attack is their one-handed reach. One-handed reach affects the efficiency of a volleyball game and the achieved sports result [2]. Winning teams usually have better efficiency in attack [10]. In this study the efficiency in attack of middle blockers (46.78%) was higher than of spikers (39.96%) and receivers (37.17%). Analysis of literature did not reveal research on the efficiency in attack with regard to the position on the court. The obtained results can be compared with papers in which the efficiency in attack was analysed with regard to the players' gender or age. Studies have shown that the efficiency of attack among female volleyball players after setting up the ball well falls within the range of 36.8–43% [10, 12, 13]. The results of own analysis, in which the efficiency of female players' attack disregarding their position was at 41.75%, only confirm the earlier scientific reports.

Block, according to Quiroga et al. [9], is an action that generates 14.5–15.6% of points scored in a match [9]. Its efficiente xecution increases the team's chances of winning the match. The present analysis showed that female middle blockers (they gained 0.68 points/set) were more efficient in block than spikers ($\Delta x = 0.35$, $p < 0.01$), receivers ($\Delta x = 0.39$, $p < 0.001$) and setters ($\Delta x = 0.49$, $p < 0.001$). It is impossible to refer the presented results to earlier papers. Earlier studies determined the number of points scored in the block per set by female senior (2.3 points/set) and junior teams (2.8 points /set). Yet, they did not analyse the number of scored points in the block by female players at particular positions [10].

Serve is in third place when it comes to technical actions bringing the largest point score for the team [7]. Research shows that receivers are the most efficient in the serve (0.25 point/set), then there are spikers (0.21 point/set), setters (0.19 point/set) and middle blockers (0.18 point/set). However, no differences have been demonstrated between the studied groups. According to previous reports, the efficiency of serve for female volleyball players amounts to 5–6% [10, 12]. The presented results cannot be compared with earlier research, because a different unit of measurement was applied here.

Receiving the serve directly affects the success of subsequent technical actions such as setting the ball up and attack [7, 8]. Liberoes and receivers were analysed in terms of the efficiency of receiving the serve. The obtained results show that liberoes (x = 38.25%) manifest better efficiency in receiving the serve (by 6.07%, $p < 0.05$) than receivers (x = 32.18%). In previous studies the influence of the player's position on the court on the efficiency of receiving the serve had not been analysed. However, it is worth adding that Inkinen et al. [10] and Palao et al. [12] defined the perfect reception of a serve in female volleyball in the range 53.2–56.4% at the senior level and at 45.9% at the juniorlevel. In the presented analysis the players' perfect reception was lower than in the cited works.

Analysis of the efficiency of players' executing individual technical actions taking into account different variables is a subject discussed by authors in the last decade [10, 11, 12, 13, 14]. Yet, own studies have provided new information in this area and helped determine how the position on the court affects the efficiency of executing technical actions. Participants of the 2015 Women's European Volleyball Championship playing on the position of the middle blocker were more efficient in attack and block compared with spikers, receivers and setters. Liberoes manifested higher efficiency in receiving the serve in comparison with receivers, and the efficiency in the serve was not dependent on the position on the court.

It is worth noting that volleyball has a very deterministic structure. For this reason, the efficiency of subsequent technical actions is dependent on the previously performed actions. This constitutes a premise for further research which should focus on the efficiency of executing technical actions completing an action (attack), depending on the efficiency of the preceding steps (receiving the serve and setting up the ball).

CONCLUSIONS

Efficiency in attack, block, and receiving the serve differentiates players at different positions. These differences may arise from the tactics of the team or be related to various tasks realised at particular positions. Female middle blockers were more efficient in attack than spikers and receivers. This is due to the fact that middle blockers attack the ball in the first pace at which blockers from the opposite team have the least time to execute an efficient block. Middle blockers were also more efficient in the block than receivers, setters and spikers. The main reason for these differences is the specific specialization of middle blockers in a technical action, such as the block.

Liberoes are characterised by more efficient reception of the serve in comparison with receivers. The reasons for the differences can be traced in the different tasks realised by liberoes and receivers. Liberoes mainly specialise in receiving the serve and in defence, while receivers are also responsible for executing the attack and the block. Therefore, the structure of training for both positions is different. The position on the court does not affect the efficiency of executing serves.

The results of the study on the influence of female volleyball players' position on the court on the efficiency of executing technical actions presented in the

paper give premises for conducting many analyses. Volleyball coaches can use the results of research to improve individual and team tactics (in attack, block, serve and receiving the serve). The presented results also provide new information needed for the selection of players at specific positions in terms of the efficiency of executing technical actions.

Test results of the research presented here should be taken into account by coaches in the process of constructing the team and individual tactics. However, it is worth keeping in mind that the results apply to female volleyball players and may not be reflected in men's volleyball.

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