PROPOSAL FOR THE USE OF MEASURES OF ACTION SKILLS IN BALL SETTING AND ATTACK IN BEACH VOLLEYBALL

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- player activity,
- assessment of actions,
- tools for assessment of actions

Abstract:

Importance of evaluation of players' actions has been emphasized by numerous authors. The number of scientific studies and practical solutions is substantial, but there is a field where original solutions are needed. This area concerns assessment of action skills, which is especially important among young athletes, where the use of assessment focused exclusively on playing effectiveness may be very misleading. The present study discusses the proposal of the assessment of action skills in beach volleyball which involves correctness of actions, flexibility, diversity and surprising by actions. The actions the proposal concerns are setting the ball for attack and the attack.

The aim of the study is to present proposals for specific assessment criteria for action skills during setting the ball and attack performed by beach volleyball players.

The study presents proposals for assessment tools, verified in previous studies based on observation of playing of male and female teams at a high sport skill level. Another step in the study was to modify the previously selected tools and to present them in a form of a comprehensive set.

The set of tools uses various assessment criteria and indices that allow for formulation of quantified assessment of selected aspects of actions performed by a player.

It seems that the indices proposed in the study might substantially improve the set of tools used for assessment of actions performed by beach volleyball players and be effectively transferred to indoor volleyball.

Further research on the indices of other actions performed by players during international beach volleyball competitions should be continued, especially in the context of defensive actions, team actions and the higher number of study participants.

In order to ensure that the proposed indices demonstrate differences between players with high and poor action skills, the research should also be focused on players from young categories and those that play at regional and national levels.

INTRODUCTION

Professionalization of beach volleyball is a phenomenon which has been observed for a long time [4] and is manifested in, for example, organization of competition, tasks assigned to coaches, methods to analyze games and, obviously, in training. An important part of this system is assessment of players' activities. It allows, among other things, for evaluation of the effectiveness of activities on the field, choice of adequate training methodologies and resources or formulation of tasks based on actual effects of activities. Assessment of the actions of players and teams has attracted interest of both sport scientists and practitioners for

many years [9, 13, 24, 25]. Nowadays, the assessment is substantially supported by advanced IT and electronic solutions [11, 26, 27] but performance-based assessment that takes into consideration effectiveness, activity and reliability remains to be the most popular [9, 16, 18, 20]. This approach is connected with the goals pursued by well-trained professional athletes which focus on achievement of best performance in action. Therefore, at the highest level of competitiveness, where beach volleyball is becoming a professional sport [4], the performance-based approach seems to be entirely illegitimate. However, development of players is a process distributed over a relatively long time and reaching the top performance might take even 10 years. For this reason, methods to assess players who learn perform effective actions, and, consequently, make mistakes that affect playing effectiveness, should be taken into consideration and developed. Furthermore, the use of performance-based measures might become an obstacle to a comprehensive development of players which is essential in beach volleyball.

Consequently, new methods for assessment which take into consideration other values of players' action are needed. It seems that a helpful solution is offered by the concept of assessment of abilities to perform actions developed by R. Panfil [16], who proposed a generic assessment of correctness, flexibility, variety, speed of action, speed of cooperation and surprising by action. The attempts have been made to develop sport-specific assessment criteria to evaluate the abilities to perform actions based on this concept [12, 14, 19, 23].

AIM OF THE STUDY

The aim of the study is to present proposals for specific evaluation criteria for action skills during setting the ball and attack performed by beach volleyball players. Part of tools presented in the study was verified based on observation and assessment of actions performed by male and female players at high skill level. The verification helped modify selected tools. With tools that do not require correction, they represent a new proposal that concerns selected assessment criteria for abilities to perform actions in beach volleyball.

MATERIAL AND METHODS

Based on practical experience and examinations we developed and initially verified selected measures of abilities to perform actions that included correctness, flexibility, diversity and surprising by actions. Based on a study by R. Panfil [16], the paper adopted the following definitions of abilities to perform actions.

Proper performance with respect to the action of a player means an action where correction is not needed, i.e. follows a specific pattern. The pattern can be provided by a model action or a view consistent with the description of technique;

Flexibility in sport games means an ability to adjust actions to changing situations. Flexibility is understood to mean an ability to adjust player's actions to changing conditions so that despite the changes in situations the actions remain to be effective;

Diverse actions can be observed if a player is able to use many solutions for the specific situation.

Surprising by actions means that a player causes a situation the opponents did not expect or did not take into consideration during performing their actions in attack or defense.

The measures include only the criteria which, according to authors, can be effectively used in actions. Other criteria from the proposal by R. Panfil are of little importance here due to the specific nature of the activities analyzed or the assessment methodology that focuses on individual decisions of a player concerning the most effective actions. Therefore, these other criteria will be neglected. The verification was based on the material collected during elite-level FIVB tournaments. Actions analyzed by means of the measures are setting the ball for

attack and the attack. As demonstrated in the related literature [5, 6, 21], these actions are essential to the score, both in beach volleyball and indoor volleyball.

The study discusses the tools for assessment of selected aspects of correctness, flexibility and diversity of setting the ball for attack and criteria for assessment of correctness, flexibility, diversity and surprise by actions performed in attack.

RESULTS

Setting the ball

Assessment of correctness of actions

Correctness of the actions performed by players was assessed separately for setting the ball by an overhand set with fingertips of both hands or a bump set. The assessment will be conducted for the sets that met preconditions for an overhand set with fingertips (WG_1 to WG_4) and a bump set (WD_1 to WD_5) presented by Superlak [21]. In overhand set with fingertips the preconditions include:

- balanced body posture before the set (WG_1),
- simultaneous contact of the palms of the hand with fingers adjusted to the shape of the ball and in front of the face (WG_2),
- contact of the player with the ball in the second phase of the extension (WG_3),
- adopting proper body position with relation to the ball and direction of hitting (WG_4).

In setting with a bump set, the preconditions [25] are:

- with balanced body posture, forming the greatest hitting surface area possible attained through proper shape of the palms and forearms (WD_1) ,
- the choice of optimum angle between arms and the long axis of the body, (WD_2)
- contact of the player with the ball in the second phase of the extension (WD_3),
- performing the hit in the space between the knees (WD_4) ,
- adopting proper body position with relation to the ball and direction of hitting (WD_5).

Assessment of the correctness of each action depends on meeting individual preconditions (assessed in a "binary" system) by a player. Therefore, if a precondition is met, the action yields a point for the setting action. Not meeting the precondition yields no point. This means that any setting the ball using an overhand set with fingertips could be scored 0 to 4 points, whereas setting the ball with a bump set could be scored 0 to 5 points. The holistic assessment of the correctness of setting the ball with an overhand and bump sets will represent the mean of partial assessment scores obtained for each setting using a particular technique. For an overhand set with fingertips, correctness (P_G) will be calculated according to the equation:

P_G = WG1 + WG2 + WG3 + WG4 / 4, where

WG1 to WG4 are points scored during the assessment of individual preconditions.

The correctness of player's actions for an overhand setting the ball with fingertips during a single game (PM_G) is computed from the formula:

$PM_G = P_{G1} + P_{G2} + \ldots + P_{Gn} / n$, where

P_{G1} to P_{Gn} are partial correctness scores for individual overhand sets with fingertips,

n denotes the number of overhand sets with fingertips.

Analogous computation is performed for setting the ball with a bump set over a single game (PM_D).

$PM_D = P_{D1} + P_{D2} + \ldots + P_{Dn} / n$, where

P_{D1} to P_{Dn} are partial correctness scores for individual bump sets,

n denotes the number of bump sets

Assessment of setting flexibility

Flexibility is a criterion examined in this study based on the reliability of player's actions during setting the ball in various situations. Computation of the reliability should be based on the quotient of effectiveness and activity level for a situation. Effective setting the ball means passing the ball before an attack with a trajectory that allows a partner to perform a jump attack [19], while the activity level means the number of actions over a specific period of time. The criterion that distinguished between situations was the zone from which the ball was hit (Fig. 1). Based on a study published by Seweryniak and Szuliński [19], we determined the place and dimensions of the optimum pass zone, which are illustrated in Fig. 1. Other zones were denoted as A1, A2, B1, B2, D, C1, C2, E. Setting the ball from outside the field is regarded as setting the ball from the adjacent zone in the court. Two indices of flexibility are proposed: relative flexibility (EW) and absolute flexibility (EB). Evaluation of the relative flexibility takes into consideration the actions performed by the player who sets the ball from at least three zones with activity level in the zone greater or equal to 4. The absolute flexibility is evaluated with respect to reliability for all the zones, regardless of their number and activity level.

$N_{EW} = \frac{S_{A1}}{A_{A1}} + \frac{S_{SOP}}{A_{SOP}} + \frac{S_{A2}}{A_{A2}} + \frac{S_{B1}}{A_{B1}} + \frac{S_D}{A_D} + \frac{S_{B2}}{A_{B2}} + \frac{S_{C1}}{A_{C1}} + \frac{S_E}{A_E} + \frac{S_{C2}}{A_{C2}}$,

for $A_{A1}, A_{SOP}, A_{A2}, A_{B1}, A_D, A_{B2}, A_{C1}, A_E, A_{C2} \geq 4$,

where $A_{A1}, A_{SOP}, A_{A2}, A_{B1}, A_D, A_{B2}, A_{C1}, A_E, A_{C2}$ are activity levels measured with the number of actions in a zone.

L_{EW} – number of zones with the activity level greater or equal to 4.

$N_{EB} = \frac{S_{A1}}{A_{A1}} + \frac{S_{SOP}}{A_{SOP}} + \frac{S_{A2}}{A_{A2}} + \frac{S_{B1}}{A_{B1}} + \frac{S_D}{A_D} + \frac{S_{B2}}{A_{B2}} + \frac{S_{C1}}{A_{C1}} + \frac{S_E}{A_E} + \frac{S_{C2}}{A_{C2}}$,

L_{EB} – number of all the zones from which the ball was set by the player.

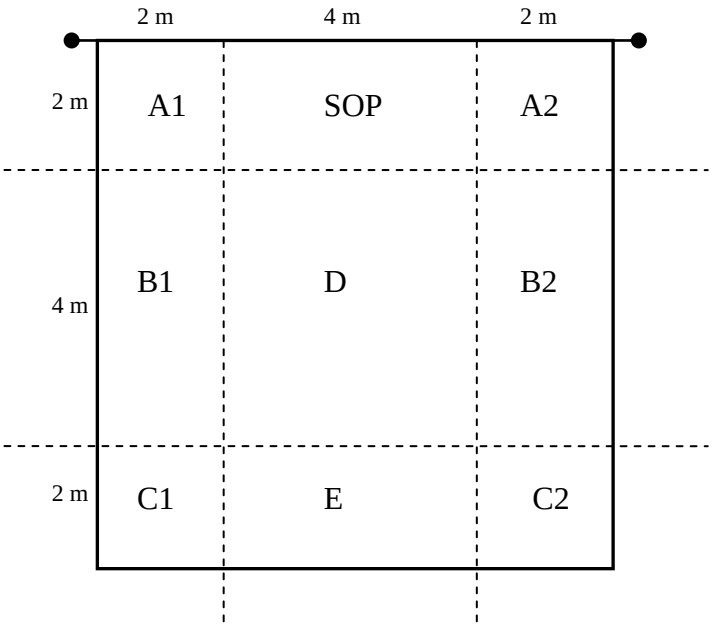

Fig. 1. Zones determined on the court for evaluation of selected criteria for ability to perform actions in beach volleyball

Source: author's own elaboration based on a study by Seweryniak and Szuliński [19]

Assessment of diversity of actions in setting the ball for an attack

Evaluation of diversity takes into consideration setting in the situation of total freedom of activity. The situation of total freedom of activity is considered as passing the ball to the optimum reception zone (SOP) by a receiver with the trajectory that offers a time comfort for a setter.

The setting techniques are categorized with respect to the method to hit the ball, zone on the net where the ball was oriented and the tempo (height) of the set. By assigning each criterion one number, the type of setting the ball is determined by three numbers. Based on previous observations, we considered six the most frequent methods to hit the ball, two setting tempos connected with the height of a set and eight zones (each with width of 1m) where sets were directed (see Tab. 1). The zone numbers on the nets and numbering of setting zones was the same for each team. Zone A1 for determination of the place from which the ball was set is located in both team courts near the net on the left (Fig. 1), while zone 1, used for assessment of the place to which the ball was directed was near the left net antenna.

Method of hitting	Code numeral	Setting tempo	Code numeral	Place where the ball is directed	Code numeral
Overhand set with fingertips (forward)	1	second tempo (up to around 2 m)	2	zone 1	1
Overhand set with fingertips (backward)	2	third tempo (over 2 m)	3	zone 2	2
bump set (forward)	3			zone 3	3
bump set (backward)	4			zone 4	4
Jump overhand set with fingertips (forward)	5			zone 5	5
Jump overhand set with fingertips (backward)	6			zone 6	6
				zone 7	7
				zone 8	8

Fig. 2. Criteria for assessment of diversity and numbers used for coding the setting
Source: Author's own elaboration based on [19]

A measure of diversity is provided by the number of variants of setting the ball for the attack used by a player in the matches.

Attack

Assessment of attack correctness

The proposal or assessment of attack correctness is based on observation of the three key components: approach run, getting low with arm swing (WA_1), jump with arm swing and body work to prepare the spike (WA_2), hitting the ball in the optimal point completed with proper work of the palm of the hand (WA_3). In effect, each individual attack can be assessed on a scale of 0 to 3, with 0 denoting that none of key elements were observed in the attack and 3 denoting that all of them were performed. The assessment concerning a game or a series of games was based on the means of assessments for attacks performed during the games. Correctness (P_A) for an attack is calculated according to the formula:

$P_A = WA_1 + WA_2 + WA_3 / 3$, where

WA_1 to WA_3 are points scored during the assessment of individual preconditions.

The correctness of player's actions in attack during a single game (PM_A) is calculated from the formula:

$PM_A = P_{A1} + P_{A2} + \ldots + P_{An} / n$, where

P_{A1} do P_{An} denote partial attack correctness obtained during a match, n is the number of attacks.

Assessment of attack flexibility

Similar to setting flexibility, assessment of attack flexibility is based on absolute flexibility and relative flexibility. Furthermore, assessment of flexibility is proposed to be made based on reliability with respect to two groups of situations. The first group is situations determined by the locations from which the attack is performed. The second group of situations results from the solution used by the opponent in defense.

Flexibility in attack from different sectors of the court (E1)

Nine sectors were determined for the court of the attacking team (Fig. 2). Sectors L1, L2 and L3 with width of 3 m and length of 1 m near the net in the left part of the court, with the sector L1 located the nearest to the net. Sectors R1, R2 and R3, with analogous shape and location, placed near the right part of the court and sectors M1, M2, M3 with width of 2m and length of 1m near the central part of the court, with the sector M1 located the nearest to the net. The attacks performed from outside the sectors used for assessment of attack flexibility are sporadic. Therefore, we neglected these types of attacks.

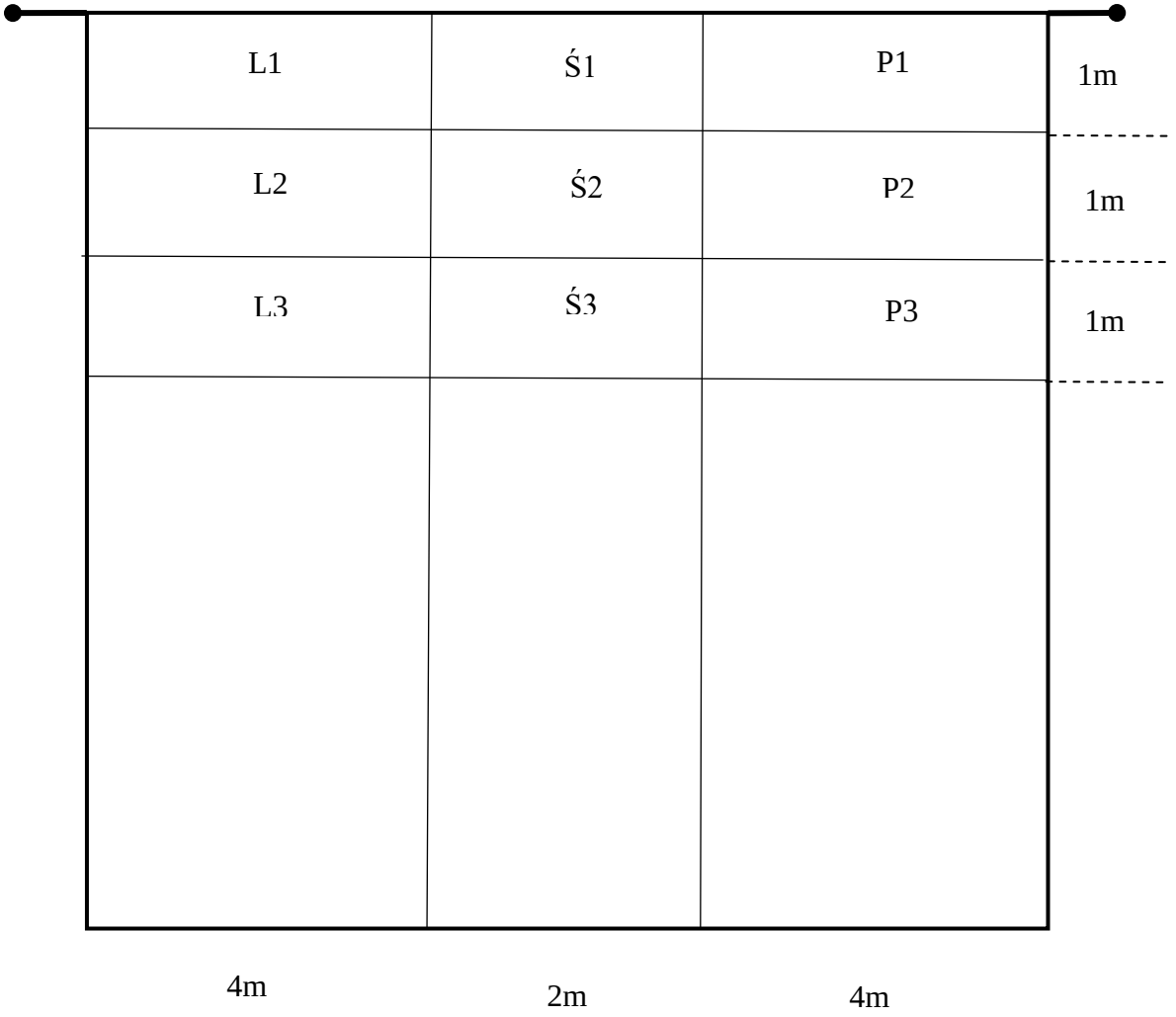

Fig. 3. Layout of zones in the court proposed for assessment of attack flexibility for the attacks from different court zones (E1) **Source:** author's own elaboration.

Similar to setting, attack flexibility were assessed using the reliability achieved for individual sectors.

Absolute flexibility (E1B) is calculated from the formula:

E1B = (SL1/AL1 + SL2/AL2 + SL3/AL3 + SM1/AM1 + SM2/AM2 + SM3/AM3 + SR1/AR1 + SR2/AR2 + SR3/AR3) / n,

where:

SL1, SL2, SL3, SM1, SM2, SM3, SR1, SR2, SR3 is effectiveness of actions in attack in individual sectors;

AL1, AL2, AL3, AM1, AM2, AM3, AR1, AR2, AR3 are activity level in attack for individual sectors; n is the number of sectors from which the attack was performed.

Relative flexibility (E1W) is calculated from the equation for minimum two zones:

E1W = (SL1/AL1 + SL2/AL2 + SL3/AL3 + SM1/AM1 + SM2/AM2 + SM3/AM3 + SR1/AR1 + SR2/AR2 + SR3/AR3) / nw;

for AL1, AL2, AL3, AM1, AM2, AM3, AR1, AR2, AR3 $\geq$ 4;

where:

SL1, SL2, SL3, SM1, SM2, SM3, SR1, SR2, SR3 represent effectiveness of actions in attack in individual sectors;

AL1, AL2, AL3, AM1, AM2, AM3, AR1, AR2, AR3 are activity levels for the specific sectors; nw n is the number of sectors from which the attack was performed by a player for nw≥2

Attack flexibility against various types of defensive actions (E2)

Ten most frequent techniques were assessed in the defensive playing that determine situation of activity in attack.

1. BLL – defense with "straight" covering block against the attacks from sector L1 to L3
2. BLA – defense with "diagonal" covering block against the attacks from sector L1 to L3
3. 0LL – defense without block with the retreat of the blocking player along the straight line against the attacks from sectors L1 to L3
4. 0LA – defense without block with the retreat of the blocking player along the diagonal line against the attacks from sectors L1 to L3
5. BML – defense with block against the attacks from sectors M1 and M2 with defender on the left side
6. BMR – defense with block against the attacks from sectors M1 and M2 with defender on the right side
7. BRL – defense with "straight" covering block against the attacks from sectors R1 to R3
8. BRA – defense with "diagonal" covering block against the attacks from sectors R1 to R3
9. 0RL – defense without block with the retreat of the blocking player along the straight line against the attacks from sectors R1 to R3
10. 0RA – defense without block with the retreat of the blocking player along the diagonal line against the attacks from sectors R1 to R3

Absolute flexibility (E2W) is calculated from the formula:

E2B = (SBLL/ABLL + SBLA/ABLA + S0LL/A0LL + S0LA/A0LA + SBML/ABML + SBMR/ABMR + SBRL/ABRL + SBRA/ABRA + S0RL/A0RL + S0RA/A0RA) / n, where

SBLL is the effectiveness of the attack against the defense of BLL type
SBLA is the effectiveness of the attack against the defense of BLA type
S0LL is the effectiveness of the attack against the defense of 0LL type
S0LA is the effectiveness of the attack against the defense of 0LA type
SBML is the effectiveness of the attack against the defense of BML type
SBMR is the effectiveness of the attack against the defense of BMR type
SBRL is the effectiveness of the attack against the defense of BRL type
SBRA is the effectiveness of the attack against the defense of BRA type
S0RL is the effectiveness of the attack against the defense of 0RL type
S0RA is the effectiveness of the attack against the defense of 0RA type

ABLL is the activity level in the attack against the defense of BLL type
ABLA is the activity level in the attack against the defense of BLA type
A0LL is the activity level in the attack against the defense of 0LL type
A0LA is the activity level in the attack against the defense of 0LA type
ABML is the activity level in the attack against the defense of BML type
ABMR is the activity level in the attack against the defense of BMR type
ABRL is the activity level in the attack against the defense of BRL type
ABRA is the activity level in the attack against the defense of BRA type
A0RL is the activity level in the attack against the defense of 0RL type

A0RA is the activity level in the attack against the defense of 0RA type

Relative flexibility (E2W) at minimum two techniques in defense is calculated from the formula:
E2W = (SBLL/ABLL + SBLA/ABLA + S0LL/A0LL + S0LA/A0LA + SBML/ABML + SBMR/ABMR + SBRL/ABRL + SBRA/ABRA + S0RL/A0RL + S0RA/A0RA) / nw
for activity ≥4, with nw≥2

Assessment of attack diversity

Diversity is proposed to be evaluated due to the number of attack techniques used and the number of selected directions of attack. Studies have shown [17] that in female beach volleyball for example, three techniques to perform the attack are the most popular: spike (40.67%), off-speed spike (42.24%) and open hand tip (13.34%). Assessment of diversity according to the attack techniques is based on the frequency of each attack technique in all actions performed. Prevalence of these three attack techniques represents the basis for evaluation of the level of attack diversity according to the attack technique (Tab. 2). In order to evaluate diversity in terms of the number of directions chosen, we defined 6 zones on the court with respect to the positions of defenders and attack topography (Fig. 3) and, additionally, the attacks directed towards the block, which yields 7 directions of attack: far left (LD), far center (SD), far right (PD), close left (LB), close center (SB), close right (PB) and attack after the block (BL). Zones are not related to the places from which the attack is performed but rather with the court layout, attack topography and the most frequent positions taken by defenders. Assessment of diversity according to the direction of the attack was based on the assumption that the greater number of the directions of the attack reflects the greater diversity. In order to eliminate random situations, a minimal threshold was adopted (10% of all the attacks). Over the threshold directing the ball to a particular area was considered as a well-grounded technique.

Assessment of the attack diversity requires adoption of another assumption that only attacks in the situation of freedom of actions (after accurate setting the ball) can be assessed. An essential component is also identification of the directions of attack from the standpoint of the attacking player, which means, for example, that the "far right" zone is located in the right part of the court, near the final line, where the attacking player is standing facing the net.

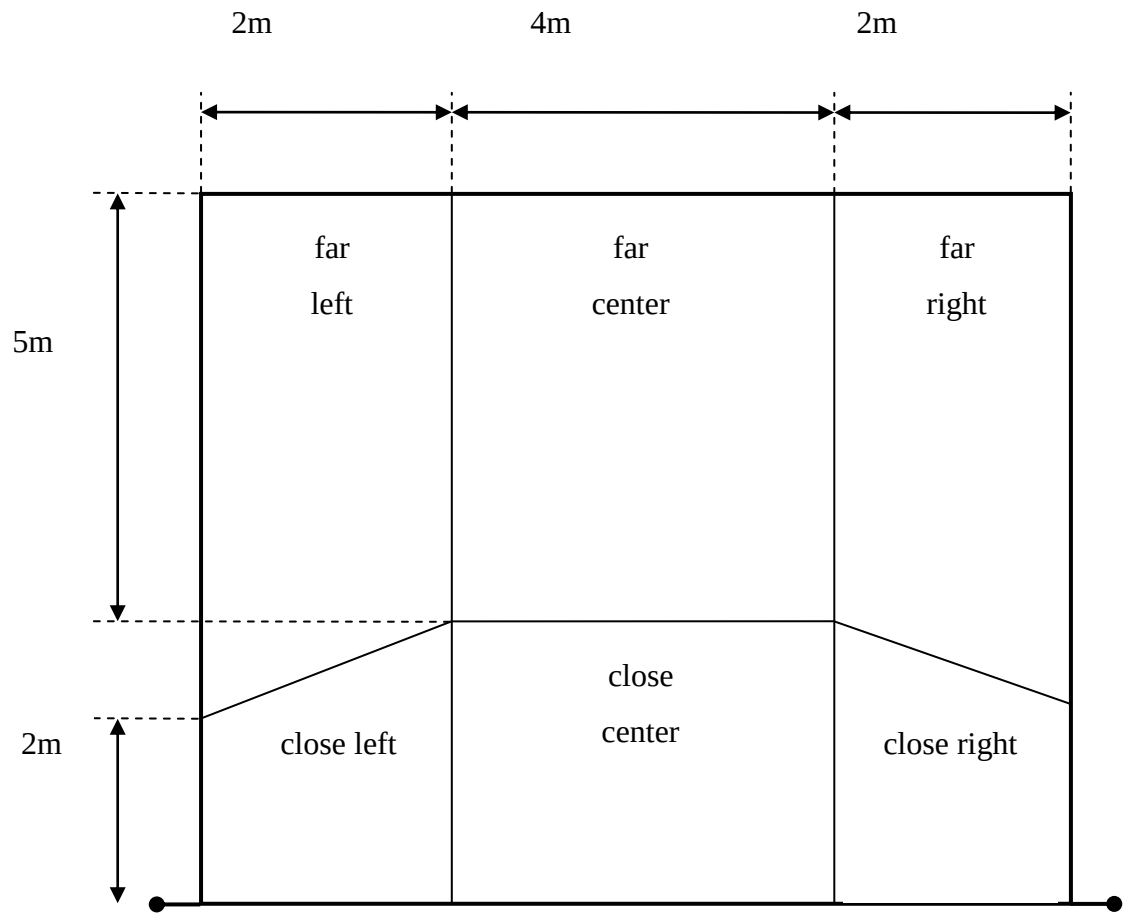

Fig. 4. Court topography used for assessment of diversity of attack directions
Source: author's own elaboration based on [17].

Criterion of abilities to perform actions / Level of ability to perform actions		ability		
		High	Medium	Low
Diversity (attack techniques)	Spike	over 35%	25 – 35%	below 25%
	Off-speed spike	over 35%	25 – 35%	below 25%
	Open hand tip	over 10%	6 – 10 %	below 6%
Diversity (place)		5-7 directions	4 or 3 directions	2 or 1 direction
Correctness		over 90%	between 90 and 80%	below 80%
Surprise		over 45%	between 45 and 30%	below 30%

Fig. 5. Proposal of standards concerning selected criteria for abilities to perform actions in setting the ball for the attack developed based on the studies on selected players included in the FIVB ranking. Table based on [17]

Assessment of the surprise in attack

Assessment of the abilities to use surprise in attack was based only on the reaction of the defender since the situation of surprising a blocking player who chose wrong place and wrong timing for a jump occurs rarely in beach volleyball. It was adopted that a surprise occurs when the defender, after the direct attack or hitting the ball after the block, does not move to the ball or decides not to continue the movement. Ineffective activities (attack completed outside the court, successfully blocked attack) of the attacker were classified as unsurprising activities. Skill levels in using the surprise are proposed to be assessed with consideration for the percentage share of actions where a defender was surprised compared to all attacks performed.

DISCUSSION

The tool proposed in the study for assessment of selected aspects of players' activities in beach volleyball was designed based on an original concept of R. Panfil [16], which authors attempted to apply in beach volleyball, being a dynamically developing Olympic sport.

The essence of this problem can be illustrated by other scientific studies that have discussed the assessment of abilities to perform actions by players in tennis [12], indoor volleyball [22] and beach volleyball [17, 19]. The most important studies have been conducted in the field of indoor volleyball [15, 21, 22]. The authors of these studies have also examined abilities to perform actions, but the major focus was on cooperation skills, assuming high skill level for individual actions, which seems to be a justified assumption since the research material was the group of athletes from national teams in their countries, playing in the top-priority indoor volleyball tournaments. However, cooperation skills which were the focus of interest of these researchers were based on and determined by individual skills of individual players. Previous assessment of individual action skills seems to be required in order to exclude their negative effect on cooperation. This study presents the tools which are useful in this assessment. We believe that studies aimed at assessment of cooperation skills should also be conducted in the field of beach volleyball after making sure that players have high individual action skills.

Previous studies [17, 19] have presented the assessment tools for action skills and results of the assessment for elite players that demonstrated high skills of the study participants, which was unsurprising due to the sample selection. However, these studies had some deficiencies which we attempted to eliminate from the present study. On the other hand, numerous publications on assessment of player's actions based on research material in the field of beach volleyball have focused on the effective actions [1, 2, 8, 11] or quantitative analyses [3, 7, 10], limiting complex actions to technical elements used during the game. These studies have neglected the essential aspect of making decisions and the choice of activity due to the situation on the court, resources or opportunities for surprising the opponent. An additional argument for the need for more focus in beach volleyball on individual action skills is limited possibilities to improve team action efficiency through cooperation, which resulted from the fact that a "team" is reduced during an action to two players.

CONCLUSIONS

1. It seems that the indices proposed in the study might substantially improve the set of tools used for assessment of actions performed by beach volleyball players and be effectively transferred to indoor volleyball.
2. Further research on the indices of other actions performed by players during international beach volleyball competitions should be continued, especially in the context of defensive actions, team actions and the higher number of study participants.

3. In order to ensure that the proposed indices demonstrate differences between players with high and poor action skills, the research should also be focused on players from young categories and those that play at regional and national levels.

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