ORIGINAL SCIENTIFIC ARTICLE

MODERN APPROACHES TO ANALYSIS OF TECHNICAL AND TACTICAL ACTIONS OF SKILLED VOLLEYBALL PLAYERS

Iryna Oliinyk[1ABCD], Eduard Doroshenko[2ABCD], Mykhaylo Melnyk[3ABCD], Ruslana Sushko[4ABCD], Valeria Tyshchenko[5CDE], Valerij Shamardin[6CDE]

[1]Prydniprovsk State Academy of Physical Culture and Sports
[2]Zaporizhzhia State Medical University
[3]Ukrainian Volleyball Federation
[4]Borys Grinchenko Kyiv University
[5]Zaporizhzhia National University
[6]Ukrainian Football Association Licensing Center

Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Corresponding Author: Eduard Doroshenko, E-mail: doroe@ukr.net

Abstract

Purpose. To develop an algorithm of special analysis for improving the training process, based on the identification of indicators of technical and tactical actions in the competitive activity of skilled volleyball players.

Material and Methods. The study analyzed 2,688 technical and tactical indicators of the competitive activity of 56 players of national volleyball teams which played 6 games in the 2019 CEV Volleyball European Championship, taking into account the athletes' playing roles, based on the methods of analysis of the competitive activity, analysis of generalization of practical experience, and theoretical modeling.

Results. The study interpreted the total performance indicators of the competitive activity of skilled volleyball players, the indicators of technical and tactical activity in the competitive process, the ratio of performance indicators in skilled volleyball players in position zones.

Conclusions. The modified algorithm of special analysis of indicators of technical and tactical actions has the following structure: analysis of quantitative characteristics of team, group and individual actions in attack and defense; chronological analysis of the competitive activity development in sets; analysis of playing actions in various zones of the court; comparative analysis of quantitative indicators of technical and tactical actions of volleyball players who directly counteract in the match; analysis of critical moments of the game, which is directly related to organizing and holding a particular match; interpretation and qualitative analysis of indicators of technical and tactical actions in a particular match.

Based on the analysis of success and performance indicators of the competitive activity of Ukraine's national volleyball team in the qualifying tournament of the 2019 European Championship (group F), it can be said that the modified algorithm of special analysis of indicators of technical and tactical actions showed high efficiency.

Keywords: volleyball, technical and tactical actions, competitions, analysis, algorithm.

Introduction

Modern requirements for training skilled volleyball players are conditioned by strong competition in official international competitions – the Olympic Games, World and European Championships, World League and Euroleague. In the structure of factors that ensure the achievement of high sports results, the leading role belongs to the effectiveness of technical and tactical actions of skilled volleyball players in the competitive activity (Afonso et al., 2010; Marcelino et al., 2010). For the procedures of analyzing the effectiveness of technical and tactical actions in the competitive activity in volleyball, quantitative and qualitative indicators of the effectiveness of technical and tactical actions; taking into account the

playing specialization (role) of athletes; choosing a tactical orientation in the game against a particular opponent are of critical importance (Bergeles et al., 2009; Doroshenko et al., 2019). Based on the combined use of these components of the competitive activity, prerequisites are created for developing a procedure of special analysis of technical and tactical actions of skilled volleyball players. This will make it possible to identify the leading components of technical and tactical actions and promptly use the most effective means for correction of technical and tactical training, which indicates the relevance and timeliness of experimental studies on this issue.

Experts note that the procedure of special analysis requires a differentiated accounting of indicators of technical and tactical actions (individual, group, and team characteristics) (Cojocaru et al., 2018; Millán-Sánchez et al., 2018), variants of the competitive activity development in sets (dominant, recessive, variable, and combined) (Silva et al., 2016; Paulo et al., 2016), differentiation of attacking technical and tactical actions from the front or back line, and the direction of attacking technical and tactical actions, taking into account the tactical variants of players' positioning in the front line zones ("2", "3", "4") (Palao et al., 2004; Sotiris et al., 2009). Additionally, it is important to develop an algorithm of special analysis – a certain sequence of procedures that ensures a logical and rational interpretation of the results of special analysis of technical and tactical actions in the competitive activity of skilled volleyball players (Doroshenko, 2013).

Considering the complexity of analysis and interpretation of indicators of technical and tactical actions in the competitive activity of skilled volleyball players, specialists are naturally interested in the problem of special physical training, which is a factor that also determines the efficiency and effectiveness of competitive actions. A wide range of experimental studies is presented in this research area. In addition to attacking technical and tactical actions, it is important to use a group block with a certain number of blockers (2-3 athletes) and the effectiveness of this playing action. (Afonso et al., 2005; Millán-Sánchez et al., 2019). It was shown that a group block consisting of two athletes is the most effective. The study of isokinetic strength characteristics of the muscles of the lower limbs and their manifestations in training and competitive processes in female volleyball players gives grounds for creating specialized plyometric programs in order to make the most of female athletes' technical and tactical potential (Gjinovci et al., 2017; Jackson et al., 2017; Kabaciński et al., 2017). Additionally, experimental studies revealed the relationship between acoustic disorders and indicators of aerobic endurance of female volleyball players (Sienkiewicz-Dianzenza et al., 2015) and showed the mechanisms of possible correction, which helps optimize the training process. The assessment of the impact of physical development parameters on the level of motor coordination in female volleyball players at the stage of specialized basic training gave reason to believe that in the process of long-term training there is a need for targeted individual correction of motor abilities development, taking into account the sensitive periods of motor abilities development (Boichuk et al., 2018, 2021). Similar processes were recorded in experimental studies of the team of authors (Kumar et al., 2021; Zerf et al., 2019), which show that special exercises are an effective means of developing coordination abilities and contribute to the

formation of specialized psychophysiological functions that ensure the effectiveness of the competitive activity in volleyball. Based on the study of special literature and the results of their own studies, researchers summarized the ways of improving the special physical training of highly-skilled volleyball players in the preparatory (Trajkovic et al., 2012) and competitive periods (Malikova et al., 2018) of the annual macrocycle and showed their role in achieving a steady effect for maximum fulfilment of female athletes' technical and tactical potential in the competitive process.

Studies showed a steady effect when using special training devices for developing technical skills in female volleyball players (Kovalchuk et al., 2019).

The study by Nikolaidis et al., 2015 examines the differences in anthropometry, somatotype, body composition, and physiological characteristics of female volleyball players according to the levels of competitive practice (regional, national and international). It was shown that female volleyball players with different qualifications have pronounced anthropometric and somatotypical differences. Taking into account these factors helps reduce sport traumatism and contributes to maximum integration of fitness indicators into the highest possible sports result (Migliorini et al., 2019; Natali et al., 2019).

Also of importance for effective implementation is the psychological aspect – experimental studies show the relationship between volleyball players' psychomotor abilities and the selected level of tactical tasks in the competitive activity, which indicates the dependence between the athlete's psychological characteristics and the implementation of his/her skills in the competitive activity (Singh et al., 2016). The study (Afrouzeh et al., 2013) determined the optimal time for learning the skills of basic technical and tactical actions in volleyball. Based on the generalization of data from special literature, we state that the problem of analysis of technical and tactical actions in the competitive activity of skilled volleyball players is complex. The most relevant directions for its solution are the selection of the most important indicators for analyzing the competitive activity effectiveness, as well as the development of an algorithm of special analysis and interpretation of indicators of technical and tactical actions. Despite the sufficient degree of development of the problematic issues that determine the efficiency and effectiveness of the competitive activity of skilled volleyball players, these scientific areas remain under discussion.

Hypothesis. Substantiation, development and testing of the procedure of special analysis of indicators of technical and tactical actions in the competitive activity of skilled volleyball players will help optimize the training process and competitive activity.

The purpose of the study: To develop an algorithm of special analysis for improving the training process, based on the identification of indicators of technical and tactical actions in the competitive activity of skilled volleyball players.

Material and methods

Study Participants

The study participants were 56 skilled volleyball players, members of national teams of Switzerland, Macedonia, Hungary, and Ukraine, which played 6 games in the

qualifying tournament of the 2019 CEV Volleyball European Championship – Men – Pool F. The study analyzed and interpreted 2,688 technical and tactical indicators of the competitive activity of highly-skilled volleyball players, taking into account the playing role of athletes.

Study Organization

According to the regulations of the 2019 CEV Volleyball European Championship – Men, the national volleyball team of Ukraine played 6 games with rivals in the Pool F group. The date, venue, rivals, and results of the competition are presented below: 1) Ukraine – Switzerland – 3:0 (15.08.2018, Zaporizhzhia, Ukraine); 2) Macedonia – Ukraine – 2:3 (18.08.2018, Skopje, Macedonia); 3) Ukraine – Hungary – 3:0 (22.08.2018, Zaporizhzhia, Ukraine); 4) Hungary – Ukraine – 1:3 (25.08.2018, Budapest, Hungary); 5) Ukraine – Macedonia – 3:1 (05.01.2019, Zaporizhzhia, Ukraine); 6) Switzerland – Ukraine – 2:3 (09.01.2019, Schönenwerd, Switzerland).

The indicators of technical and tactical actions in the competitive activity of volleyball players of the national team of Ukraine were obtained by specialists of the complex scientific group of the Volleyball Federation of Ukraine, using the "DataVolley 4 Professional" computer program. When preparing for the official games of the qualifying tournament "2019 CEV Volleyball European Championship, Men, Pool F", the algorithm of special analysis of indicators of technical and tactical actions proposed in the studies (Doroshenko, 2013) was used. It contains the following components:

- analysis of team schemes of the game: in attack, in defense;
- analysis of group interactions in attack, in defense;
- analysis of individual actions in attack, in defense;
- chronological analysis of the competitive activity development in sets (up to 8 points up to 16 points up to 25 points or until the end of the set);
- analysis of playing actions in various zones of the court: defense zone or back row, attack zone or front row;
- analysis of critical moments of the game, which is directly related to:
  a) a mindset for the game, a tactical plan of the game, individual tactical tasks for the game;
  b) the coach's personal qualities, professional knowledge, professional experience, and pedagogical skills;
  c) the current team composition, taking into account the level of technical and tactical skills and special physical fitness of players.

In addition, the structure of the algorithm of special analysis uses a differentiated accounting of individual, group, and team indicators of technical and tactical actions, the peculiarities of the formation of dynamic models of the competitive activity effectiveness in sets (dominant, recessive, variable, and combined), differentiation of attacking technical and tactical actions (front or back line of attack) and their direction, taking into account the tactical variants of players' positioning in zones "2", "3", "4".

Methods of research. Analysis of scientific-methodological and special literature, Internet data, analysis and generalization of practical experience of coaches of Ukraine's national volleyball team, analysis and interpretation of indicators of technical and tactical actions in the competitive activity of skilled volleyball players, theoretical modeling.

Statistical Analysis

Experimental studies used the following methods of mathematical processing of the obtained results: calculation of the arithmetic mean, error of the arithmetic mean, standard deviation, confidence interval, coefficient of variation, modes and medians.

Statistical processing of indicators of technical and tactical actions in the competitive activity of skilled volleyball players was carried out by specialists of the Department of Physical Rehabilitation, Sports Medicine, Physical Education and Health of Zaporozhzhia State Medical University, using the "SPSS-12" computer program.

The general efficiency of indicators of technical and tactical actions of skilled volleyball players in the competitive activity was determined by the formula (1):

$$E = \frac{Ne}{N} \cdot 100, \%$$ (1),

where E is the effectiveness of technical and tactical actions of skilled volleyball players in the competitive activity, %; N is the total indicator of technical and tactical actions, n; Ne is the indicator of technical and tactical actions, as a result of which the team won a point.

With the help of methods of analysis of the competitive activity, analysis of generalization of practical experience, and theoretical modeling, 2,688 technical and tactical indicators of the competitive activity of highly-skilled volleyball players were analyzed and interpreted, taking into account the playing role of athletes. To process the obtained results of the competitive activity, the authors of the study conducted a special analysis of the effectiveness of technical and tactical indicators of the competitive activity of highly-skilled volleyball players. To interpret the results obtained, the study applied the method of theoretical modeling, which provided the basis for the formation of an algorithm for preparing national volleyball teams.

Results

Table 1 shows the total performance indicators of the competitive activity of skilled volleyball players, which were recorded by specialists of the complex scientific group of the national team of Ukraine in the qualifying games of the 2019 European Volleyball Championship.

Table 2 shows the indicators of team technical and tactical actions in the competitive activity of volleyball players in the qualifying tournament of the 2019 European Championship (group F). The indicators of the national team of Ukraine in the games with the national teams of Macedonia, Switzerland, and Hungary were taken as a basis. The quantitative indicators of technical and tactical actions and their ratio in the competitive activity were determined: "kill on reception" and "attack on dig" by the ratio of errors, blocks, efficiency, and the total points scored.

The ratio of performance indicators in skilled volleyball players in position zones in the qualifying tournament of the 2019 European Championship (group F) is given in Table 3. In the structure of special analysis of the effectiveness of

Table 1. Performance indicators of volleyball players' competitive activity in the qualifying tournament of the 2019 European Championship (group F), n=12

Team, place	Performance indicators								
	games			sets			points in sets		
	"W"	"L"	points	"W"	"L"	"W : L"	"W"	"L"	"W : L"
1. Ukraine	6 (2)	0 (0)	16	18	6	3.000	572	512	1.117
2. Macedonia	3 (2)	3 (2)	9	14	13	1.077	595	594	1.002
3. Switzerland	2 (2)	4 (3)	7	12	16	0.750	581	600	0.968
4. Hungary	1 (1)	5 (2)	4	8	17	0.471	534	576	0.927

Note. "W" – won; "L" – lost; "W : L" – "won-lost" ratio; n – number of games

Table 2. Indicators of team technical and tactical actions in the competitive activity of volleyball players in the qualifying tournament of the 2019 European Championship (group F), n=12

Game, result	Indicators of team technical and tactical actions							
	kill on reception							
	1st attack after positive reception				1st attack after negative reception			
UA - SUI 3 : 0	err, n_1	blo, n_1	pts, %	tot, n_1	err, n_1	blo, n_1	pts, %	tot, n_1
	2 : 4	0 : 4	74 : 52	19 : 29	2 : 2	1 : 3	63 : 17	19 : 23
	attack on dig							
	err, n_1		blo, n_1		pts, %		tot, n_1	
	2 : 0		2 : 2		53 : 39		30 : 23	
	kill on reception							
	1st attack after positive reception				1st attack after negative reception			
MAC - UA 2 : 3	err, n_1	blo, n_1	pts, %	tot, n_1	err, n_1	blo, n_1	pts, %	tot, n_1
	2 : 5	5 : 5	53 : 53	34 : 47	5 : 6	2 : 4	29 : 43	41 : 30
	attack on dig							
	err, n_1		blo, n_1		pts, %		tot, n_1	
	1 : 4		7 : 1		39 : 57		38 : 49	
	kill on reception							
	1st attack after positive reception				1st attack after negative reception			
UA - HUN 3 : 0	err, n_1	blo, n_1	pts, %	tot, n_1	err, n	blo, n_1	pts, %	tot, n_1
	1 : 2	0 : 3	73 : 55	22 : 20	0 : 3	0 : 1	52 : 61	21 : 28
	attack on dig							
	err, n		blo, n		pts, %		tot, n	
	2 : 1		1 : 3		61 : 42		31 : 26	
	kill on reception							
	1st attack after positive reception				1st attack after negative reception			
HUN - UA 1 : 3	err, n_1	blo, n_1	pts, %	tot, n_1	err, n	blo, n_1	pts, %	tot, n_1
	0 : 4	3 : 1	61 : 56	28 : 34	5 : 6	3 : 1	38 : 45	34 : 33
	attack on dig							
	err, n_1		blo, n_1		pts, %		tot, n_1	
	5 : 1		3 : 2		56 : 50		39 : 32	
	kill on reception							
	1st attack after positive reception				1st attack after negative reception			
UA - MAC 3 : 1	err, n_1	blo, n_1	pts, %	tot, n_1	err, n_1	blo, n_1	pts, %	tot, n_1
	1 : 2	2 : 5	58 : 57	38 : 30	4 : 4	3 : 2	43 : 50	28 : 32
	attack on dig							
	err, n_1		blo, n_1		pts, %		tot, n_1	
	4 : 2		2 : 5		51 : 37		37 : 35	
	kill on reception							
	1st attack after positive reception				1st attack after negative reception			
SUI - UA 2 : 3	err, n_1	blo, n_1	pts, %	tot, n_1	err, n_1	blo, n_1	pts, %	tot, n_1
	3 : 3	5 : 4	47 : 58	45 : 40	3 : 5	1 : 7	52 : 28	31 : 32
	attack on dig							
	err, n_1		blo, n_1		pts, %		tot, n_1	
	6 : 1		5 : 2		38 : 62		39 : 29	

Note. n – number of games; n_1– number of technical and tactical actions; err– errors; blo – block; pts– points; tot– total

Table 3. Performance ratio in skilled volleyball players in position zones in the qualifying tournament of the 2019 European Championship (group F), n=12

Game, result	Indicators of team technical and tactical actions in players' position zones, n_1					
	"1"	"2"	"3"	"4"	"5"	"6"
UA - SUI 3 : 0	+14 : -2	+5 : -4	0 : -1	+5 : -10	0 : -1	0 : -3
	ratio of performance indicators, n_1					
	reception	points SO	R / P SO	serve	points BP	S / P BP
	43 : 63	28 : 23	1.54 : 2.74	74 : 53	28 : 9	2.64 : 5.89
	"1"	"2"	"3"	"4"	"5"	"6"
MAC - UA 2 : 3	-8 : -9	+4 : +8	+1 : +4	+1 : +3	+2 : +3	-5 : +4
	ratio of performance indicators, n_1					
	reception	points SO	R / P SO	serve	points BP	S / P BP
	91 : 94	37 : 47	2.46 : 2	106 : 112	27 : 41	3.93 : 2.73
	"1"	"2"	"3"	"4"	"5"	"6"
UA - HUN 3 : 0	+6 : -4	+2 : -5	+5 : -3	+3 : -1	0 : -2	+2 : -3
	ratio of performance indicators, n_1					
	reception	points SO	R / P SO	serve	points BP	S / P BP
	51 : 63	38 : 33	1.34 : 1.91	75 : 61	22 : 9	3.41 : 6.78
	"1"	"2"	"3"	"4"	"5"	"6"
HUN - UA 1 : 3	+4 : +3	-2 : +4	-8 : 0	+7 : 0	-3 : -1	0 : -2
	ratio of performance indicators, n_1					
	reception	points SO	R / P SO	serve	points BP	S / P BP
	79 : 81	36 : 40	2.19 : 2.02	96 : 97	25 : 32	3.84 : 3.03
	"1"	"2"	"3"	"4"	"5"	"6"
UA - MAC 3 : 1	-2 : -5	+5 : -4	+7 : +3	+1 : -1	+5 : -4	-3 : +3
	ratio of performance indicators, n_1					
	reception	points SO	R / P SO	serve	points BP	S / P BP
	78 : 80	44 : 38	1.77 : 2.11	100 : 94	33 : 21	3.03 : 4.48
	"1"	"2"	"3"	"4"	"5"	"6"
SUI – UA 2 : 3	+7 : -2	-6 : +1	-2 : -1	+7 : +4	-1 : +2	-3 : -2
	ratio of performance indicators, n_1					
	reception	points SO	R / P SO	serve	points BP	S / P BP
	86 : 83	44 : 41	1.95 : 2.02	108 : 107	28 : 27	3.86 : 3.96

Note. n – number of games; n_1 – number of technical and tactical actions; points SO – points scored on the opponent's serve; points BP – points scored on the serve

technical and tactical actions of skilled volleyball players, the ratio of indicators of technical and tactical actions in different zones of the court is the dominant factor. This is due to the peculiarities of the competitive activity in volleyball and the official rules of competitions – "positioning and transitions of players".

Table 4 shows the indicators of attacking technical and tactical actions in the competitive activity of skilled volleyball players in the qualifying tournament of the 2019 European Championship (group F). The data are given taking into account the playing specialization (role) of athletes who perform more than 80% of the team's attacking technical and tactical actions – "opposite", "outside-spiker" and "middle-blocker".

Discussion

In our opinion, the indicators of technical and tactical actions in the competitive activity of skilled volleyball players, given in Tables 2-4, have a significant difference from similar studies (Afonso et al., 2010; Bergeles et al., 2009; Kovalchuk A. al., 2019) – analytical approaches are based not on the quantitative and qualitative indicators of technical and tactical actions of skilled volleyball players, but on their ratio in a particular match. This makes it possible to form the foundations of an algorithm of special analysis of indicators of skilled volleyball players' technical and tactical actions in a particular match, taking into account a comparative analysis of characteristics of athletes with a certain role ("opposite", "outside-spiker", and "middle-blocker"), certain positions of players (zones "1" – "6"). Also of importance is the selection of indicators of technical and tactical actions, which are used in the procedures of special analysis. For most modern researchers, a complex use of quantitative and qualitative indicators of the effectiveness of technical and tactical actions of skilled volleyball players is a common practice (Cojocaru et al., 2018; Sotiris et al., 2009) – quantitative characteristics of technical and tactical actions in attack, in defense, when blocking, serving are complemented by qualitative characteristics of

Table 4. Indicators of attacking technical and tactical actions in the competitive activity of skilled volleyball players in the qualifying tournament of the 2019 European Championship (group F), n=12

Match	Indicators of attacking TTA		
UA – SUI – 3:0	total, n_1	pts, n_1	%
opposite	12 : 15	7 : 5	58.33 : 33.33
outside-spiker	40 : 47	23 : 18	57.5 : 38.30
middle-blocker	15 : 11	11 : 4	73.33 : 36.36
MAC – UA – 2:3	total, n_1	pts, n_1	%
opposite	49 : 42	23 : 24	46.94 : 57.14
outside-spiker	51 : 55	18 : 27	35.29 : 49.09
middle-blocker	9 : 27	4 : 15	44.44 : 55.55
UA – HUN – 3:0	total, n_1	pts, n_1	%
opposite	24 : 22	14 : 10	58.33 : 45.45
outside-spiker	32 : 36	17 : 18	53.13 : 50
middle-blocker	17 : 9	14 : 5	82.35 : 55.55
HUN – UA – 1:3	total, n_1	pts, n_1	%
opposite	33 : 32	17 : 17	51.51 : 53.13
outside-spiker	41 : 43	18 : 22	43.90 : 51.16
middle-blocker	24 : 22	16 : 11	66.67 : 50
UA – MAC – 3:1	total, n_1	pts, n_1	%
opposite	34 : 53	19 : 25	55.88 : 47.17
outside-spiker	50 : 37	21 : 17	42 : 45.95
middle-blocker	19 : 7	11 : 4	57.89 : 57.14
SUI – UA – 2:3	total, n_1	pts, n_1	%
opposite	21 : 28	9 : 16	42.86 : 57.14
outside-spiker	71 : 45	20 : 18	28.17 : 40.00
middle-blocker	21 : 16	12 : 9	57.14 : 56.25

Note. n – number of games; n_1 – number of technical and tactical actions.

their effectiveness. In studies on the analysis of technical and tactical actions of skilled athletes, the authors use this approach in the structure of one of the research methods – analysis of competitive activity (Afrouzeh et al., 2013; Millán-Sánchez et al., 2019). However, in our opinion, the analysis of competitive activity, in this case, is an integral component of the long-term training management system. Its structure also includes such components as planning, programming, modeling, forecasting, control, and correction of the training process indicators. One of the main provisions of the theory of athletes' training management is the statement that when modeling the training and competitive processes, it is inappropriate to use calculated indicators (in this case, qualitative characteristics of volleyball players' technical and tactical actions). A complex use of quantitative and qualitative indicators of the competitive activity in the procedures of special analysis of indicators of technical and tactical actions of skilled volleyball players can lead to serious distortions of results. Naturally, subsequent procedures of interpreting the indicators of technical and tactical actions can also have significant distortions. This provision should be taken into account by researchers of this issue. In our opinion, this statement is true not only for volleyball, but also for other team sports – basketball, handball, football, etc.

The next aspect of optimal analysis of indicators of technical and tactical actions in the competitive activity of skilled volleyball players is the problem of standardization when using quantitative indicators. We are talking about the use of various forms in the structure of special analysis,

namely, maximal indicators, minimal sufficient indicators, average indicators, data ranges (min-max). In modern research, when analyzing the indicators of technical and tactical actions in the competitive activity, it is also common to use the principle of determining leading indicators. For example, in the process of special analysis and interpretation of indicators of technical and tactical actions of a volleyball player with the "opposite" role, the most important are the indicators of attacking technical and tactical actions during attacks from zones "2" and "1". Other indicators of technical and tactical actions in the competitive activity of volleyball players with the "opposite" role may be close to minimal sufficient values. This example characterizes the relationships between individual, group, and team aspects of athletic fitness of skilled volleyball players based on the playing role and tactical variants of the competitive activity.

This approach to algorithmization of the procedures of special analysis of indicators of skilled volleyball players' technical and tactical actions also enables the use of comparative characteristics during athletes' direct opposition in the competitive activity. For example, the effectiveness of attacking technical and tactical actions of the player of team "A" (zone "4", role "outside-spiker") and the effectiveness of blocking of the player of team "B" (zone "2", role "opposite").

In addition, in the process of experimental research, we identified four main models of the competitive activity chronological development in sets: dominant, recessive, and variable. Certain combinations of the chronological models in a particular set allow us to single out the fourth model of the competitive activity chronological development – a combined one.

The dominant model of the competitive activity chronological development in the set is characterized by a constant 3-point or more advantage over the opponent.

The recessive model of the competitive activity chronological development, on the contrary, is characterized by a constant lag behind the opposing team in terms of the number of points scored (3 points or more).

The variable model of the competitive activity chronological development is characterized by frequent changes in the leadership of teams in terms of the number of points scored with approximately equal values: + 1 or +2.

Conclusions

Based on the results of experimental studies and analysis of scientific and methodological literature, we state the following:

1. The modified algorithm of special analysis of indicators of technical and tactical actions has the following structure:

- analysis of quantitative characteristics of team, group and individual actions in attack and defense;
- chronological analysis of the competitive activity development in sets;
- analysis of playing actions in various zones of the court;
- comparative analysis of quantitative indicators of technical and tactical actions of volleyball players who directly counteract in the game;
- analysis of critical moments of the game, which is directly related to organizing and holding a particular match;
- interpretation and qualitative analysis of indicators of technical and tactical actions in a particular match.

2. Based on the analysis of success and performance indicators of the competitive activity of Ukraine's national volleyball team in the qualifying tournament of the 2019 European Championship (group F), it can be said that the modified algorithm of special analysis of indicators of technical and tactical actions showed high efficiency.

Disclosure statement

Conflict of interest

Acknowledgements

References

Afonso, J., Mesquita, I., Marcelino, R., & Silva, J. (2010). Analysis of the setter'stactical action in high-performance women's volleyball. *Kinesiology,* 82-89. https://www.semanticscholar.org/paper/analysis-of-the-setter's-tactical-action-in-women's-AfonsoMesquita/5f3907052a1f1057e4973a31cef165d56ac4b67f

Marcelino, R., Mesquita, I., Sampaio, J., & Moraes, J. (2010). Study of performance indicators in male volleyball according to the set results. *Revista Brasileira de EducaçãoFísica e Esporte, 24*(1), 69-78. https://doi.org/10.1590/S1807-55092010000100007

Bergeles, N., Barzouka, K., & Nikolaidou, M.E. (2009). Performance of male and female setters and attackers on Olympic-level volleyball teams. *International Journal of Volleyball Research, 9*(1), 141-148. https://doi.org/10.1080/24748668.2009.11868470

Doroshenko, E., Sushko, R., Koryahin, V., Pityn, M., Tkalich, I., & Blavt, O. (2019). The competitive activity structure of highly skilled basketball players on the basis of factor analysis methods. *HumanMovement, 20*(4), 33-40. https://doi.org/10.5114/hm.2019.85091

Cojocaru, A.-M., & Cojocaru, M. (2018). Study on the efficiency of attack in the first division senior male in volleyball. *Journal of Physical Education and Sport,18*(5), Art 292, 1976-1979. https://doi.org/10.7752/jpes.2018.s5292

Millán-Sánchez, A., Morante, J.C., & Ureña, A. (2019). The middle blocker in volleyball: A systematic review. *Journal of Human Sport and Exercise, 14*(1), 29-38. https://doi.org/10.14198/jhse.2019.141.03

Silva, M., Marcelino, R., Lacerda, D., & Vicente, J.P. (2016). Match analysis in volleyball: a systematic review. *Montenegrin Journal of Sports Science and Medicine, 5*(1), 35-46. http://www.mjssm.me/clanci/MJSSM_March_2016_Silva.pdf

Paulo, A., Zaal, F. T. J. M., Fonseca, S., & Araújo, D. (2016). Predicting Volleyball Serve-Reception. *Frontiers in Psychology, 7*, 1694. https://doi.org/10.3389/fpsyg.2016.01694

Palao, J.M., Santos, J.A., & Ureña, A. (2004). Effect of team level on skill performance in volleyball. *Journal International Journal of Performance Analysis in Sport, 4*(2), 50-60. https://doi.org/10.1080/24748668.2004.11868304

Sotiris, D., Panagiotis, K., Laios, A., & Laios, Y. (2009). Correlates of team performance in volleyball. *International Journal of Performance Analysis in Sport, 9*(2), 149-156. https://doi.org/10.1080/24748668.2009.11868472

Doroshenko, E. (2013). Model parameters of technical and tactical actions in the competitive activities of volleyball players. *Physical education of students,* 41-45. https://doi.org/10.6084/m9.figshare.771020

Doroshenko, E. (2013). Rating assessment of the effectiveness of technical and tactical actions of highly qualified volleyball players (on the materials of the 2012 Summer Olympic Games tournament. *Scientific Notes of the Belarusian State University of Physical Culture,* 16, 155-162. https://www.sportedu.by/wp-content/uploads/2014/11/161.pdf

Afonso, J., Mesquita, I., & Palao, J. (2005). Relationship between the use of commit-block and the numbers of blockers and the block effectiveness. *International Journal Performance Analysis in Sport, 5*(2), 36-45. https://doi.org/10.1080/24748668.2005.11868326

Gjinovci, B., Idrizovic, K., Uljevic, O., & Sekulic, D. (2017). Plyometric training improves sprinting, jumping and throwing capacities of high level female volleyball players better than skill-based conditioning. *Journal of Sports Science and Medicine, 16*(4), 527-535. https://pubmed.ncbi.nlm.nih.gov/29238253/

Jackson, K.M., Beach, T., & Andrews, D.M. (2017). The effect of an isometric hip muscle strength training protocol on valgus angle during a drop vertical jump in competitive female volleyball players. *International Journal of Kinesiology and Sports Science, 5*(4), 1-9. http://doi.org/10.7575/aiac.ijkss.v.5n.4p.1

Kabaciński, J., Murawa, M., Fryzowicz, A., & Dworak, L.B. (2017). Acomparison of isokinetic knee strength and power output ratios between female basketball and volleyball players. *Human Movement, 18*(3), 40-45. https://doi.org/10.1515/humo-2017-0022

Sienkiewicz-Dianzenza, E., Baranowska, M.B., & Stupnicki, R. (2015). The effects of acoustic disturbance on anaerobic endurance in female volleyball players. *Human Movement, 16*(1), 33-35. https://doi.org/10.1515/humo-2015-0024

Boichuk, R., Iermakov, S., Kovtsun, V., Pasichnyk, V., Melnyk, V., Lazarenko, M., Troyanovska, M., & Kovtsun V. (2018). Effect of physical development parameters and conditioning abilities on the level of motor coordination in female volleyball players in the phase of specialized basic training. *Journal of Physical Education and Sport, 18*(4), Art 288, 1950-1957. https://doi.org/10.7752/jpes.2018.s4288

Boichuk, R., Iermakov, S., Vintoniak, O., & Yermakova, T. (2021). Combined impact method in the preparatory period of the annual macrocycle of female volleyball players aged 18–19 years old. *Pedagogy of Physical Culture and Sports, 25*(4), 234-243. https://doi.org/10.15561/26649837.2021.0405

Kumar, G., Shukla, A., Chhoker, A., & Thapa, R. (2021). Identification of Factors Determining Winning in Men's and Women's Beach Volleyball: a Logistical Regression Approach. *Teorìâ ta Metodika Fìzìčnogo Vihovannâ, 21*(1), 26-35. https://doi.org/10.17309/tmfv.2021.1.04

Zerf, M., Hadjar Kherfane, M., Kohli, K., & Louglaib, L. (2019). Relationship Between Maximum Aerobic Speed Performance and Volleyball Game Motor Power-Explosive Abilities. *Teorìâ ta Metodika Fìzìčnogo Vihovannâ, 19*(4), 179-185. https://doi.org/10.17309/tmfv.2019.4.03

Trajkovic, N., Milanovic, Z., Sporis, G., Milic, V., & Stankovic, R. (2012). The effects of 6 weeks of preseason skill-based conditioning on physical performance in male volleyball players. *Journal of Strength & Conditioning Research, 26*(6), 1475-1480. https://doi.org/10.1519/JSC.0b013e318231a704

Malikova, A.N., Doroshenko, E.Y., Symonik, A.V., Tsarenko, E.V., & Veritov, A.I. (2018). The ways of improvement special physical training of high-qualified women volleyball players in competitive period of annual macrocycle. *Physical educationof students, 22*(1), 38-44. https://doi.org/10.15561/20755279.2018.0106

Kovalchuk, A., Shvets, O., Bohuslavska, V., Hlukhov, I., Pityn, M., & Hnatchuk, Y. (2019). Efficiency of special training devices for forming technical skills in female student volleyball players. *Journal of Physical Education and Sport, 19*(1), Art 90, 619-626. https://doi.org/10.7752/jpes.2019.01090

Nikolaidis, P.T., Afonso, J., & Busko, K. (2015). Differences in anthropometry, somatotype, body composition and physiological characteristics of female volleyball players by competition level. *Sport Sciences for Health, 11*(1), 29-35. https://doi.org/10.1007/s11332-014-0196-7

Migliorini, F., Rath, B., Tingart, M., Niewiera, M., Colarossi, G., Baroncini, A., & Eschweiler, J. (2019). Injuries among volleyball players: a comprehensive survey of the literature. *Sport Science and Health*, 15, 281-293. https://doi.org/10.1007/s11332-019-00549-x

Natali, S., Ferioli, D., La Torre, A., & Bonato, M. (2019). Physical and technical demands of elite beach volleyball according to playing position and gender. *Journal of Sports Medicine and Physical Fitness, 59*(1), 6-9. https://doi.org/10.23736/S0022-4707.17.07972-5

Singh B., & Singh J. (2016). Relationship of psychomotor abilities in relation to selected sports skill in volleyball. *Science Journal of Education, 4*(2), 27-31. https://doi.org/10.11648/j.sjedu.20160402.12

Afrouzeh, M., Sohrabi, M., Taheri, H.R., & Afroozeh, A. (2013). Optimal timing of mental practice on learning the volleyball service skill. *Annals of Applied Sport Science, 1*(3), 29-38. https://pdfs.semanticscholar.org/e0bb/e1ee9b0832ae139e7b1d49bfee8ca7527517.pdf

СУЧАСНІ ПІДХОДИ ДО АНАЛІЗУ ТЕХНІКО-ТАКТИЧНИХ ДІЙ КВАЛІФІКОВАНИХ ВОЛЕЙБОЛІСТІВ

Ірина Олійник[1ABCD], **Едуард Дорошенко**[2ABCD], **Михайло Мельник**[3ABCD], **Руслана Сушко**[4ABCD], **Валерія Тищенко**[5CDE], **Валерій Шамардін**[6CDE]

[1]Придніпровська державна академія фізичної культури і спорту
[2]Запорізький державний медичний університет
[3]Федерація волейболу України
[4]Київський університет імені Бориса Грінченка
[5]Запорізький національний університет
[6]Центр ліцензування Української асоціації футболу

Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Мета дослідження – на основі визначення показників техніко-тактичних дій в змагальному процесі кваліфікованих волейболістів розробити алгоритм спеціального аналізу для вдосконалення тренувального процесу.

Матеріал і методи. Проаналізовані з урахуванням ігрового амплуа спортсменів на підставі методів аналізу змагальної діяльності, аналізу узагальнення практичного досвіду і теоретичного моделювання 2688 техніко-тактичних показників змагальної діяльності 56 гравців національних збірних команд з волейболу, які провели 6 ігор в рамках чемпіонату Європи з волейболу 2019.

Результати. Інтерпретовані підсумкові показники результативності змагальної діяльності кваліфікованих волейболістів, показники техніко-тактичної діяльності

в змагальному процесі, співвідношення показників результативності у кваліфікованих волейболістів в зонах розміщення.

Висновки. Модифікований алгоритм спеціального аналізу показників техніко-тактичних дій має наступну структуру: аналіз кількісних характеристик виконання командних, групових та індивідуальних дій в атаці і захисті; хронологічний аналіз розвитку змагального процесу в сетах; аналіз ігрових дій в різних зонах майданчика; порівняльний аналіз кількісних показників техніко-тактичних дій волейболістів, які безпосередньо протидіють в матчі; аналіз критичних моментів гри, який безпосередньо

пов'язаний з організацією та проведенням конкретного матчу; інтерпретація і якісний аналіз показників техніко-тактичних дій в конкретному матчі.

На підставі аналізу показників успішності і результативності змагального процесу національної збірної команди України з волейболу у відбірковому турнірі чемпіонату Європи 2019 року (група F), можна констатувати, що модифікований алгоритм спеціального аналізу показників техніко-тактичних дій показав високу ефективність.

Ключові слова: волейбол, техніко-тактичні дії, змагання, аналіз, алгоритм.

Information about the authors:

Oliinyk Iryna: oleynikmikel.1991@ukr.net; https://orcid.org/0000-0003-1888-1187; Prydniprovsk State Academy of Physical Culture and Sports, Naberezhna Peremohy St, 10, Dnipro, 49094, Ukraine.

Doroshenko Eduard: doroe@ukr.net; https://orcid.org/0000-0001-7624-531X; Department of Physical Rehabilitation, Sports Medicine, Physical Education and Health, Zaporizhzhia State Medical University, Mayakovsky St, 26, Zaporizhzhia, 69035, Ukraine.

Melnyk Mykhaylo: directorate.fvu@gmail.com; https://orcid.org/0000-0003-4769-7397; Ukrainian Volleyball Federation, p/b B-17, Kyiv, 01001, Ukraine.

Ruslana Sushko: r.sushko@kubg.edu.ua; https://orcid.org/0000-0003-3256-4444; The Faculty of Health, Physical Training and Sports, Borys Grinchenko Kyiv University, Marshala Tymoshenko St, 13-B, Kyiv, 04212, Ukraine.

Tyshchenko Valeria: valeritysh@ukr.net; https://orcid.org/0000-0002-9540-9612; Department of Theory and Methods of Physical Training and Sports, Zaporizhzhia National University, Dniprovska St, 33-A, Zaporizhzhia, 69600, Ukraine.

Shamardin Valerij: clffu2017@gmail.com; https://orcid.org/0000-0003-4615-4972; Ukrainian Football Association Licensing Center, Laboratory lane, 7A, р/в 55, Football House, office 218, Kyiv, 01133, Ukraine.