ORIGINAL ARTICLES. SPORT

Integral testing indicators individual features of various playing roles volleyball players at the specialized basic training stage

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection
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DOI: https://doi.org/10.58962/HT.2023.1.2.6-21

How to Cite
Kozina Z, Polishchuk D, Polishchuk S. Integral testing indicators individual features of various playing roles volleyball players at the specialized basic training stage. *Health Technologies*. 2023;1(2)6-21. https://doi.org/10.58962/HT.2023.1.2.6-21

Abstract

Rationale and purpose	Volleyball has a unique feature of combining both tall attackers and small, fast liberos in one team. The purpose of the study was to develop individual programs of the educational and training process of volleyball players at the stage of specialized basic training based on factor models of their readiness.
Material and Methods	The women's volleyball team of the Children's League of Ukraine of sports boarding school No. 1 in the city of Kharkiv took part in the study, in the number of 12 players aged 15-16 years. The testing was carried out on 10 tests of physical fitness. From the methods of statistical analysis, the method of descriptive statistics, factor analysis by the method of principal components with the determination of the individual manifestation of each factor in female athletes, and cluster analysis were used.
Results	On the basis of the factor analysis, the structure of the preparedness of volleyball players at the stage of specialized basic training was determined, in which four pronounced factors were revealed. The model of the existing or possible belonging of the players to the role according to the determined factor structure is determined: in the forwards of the first tempo, the factors "speed-power readiness" and "power endurance" come to the fore, in the attackers of the second pace - "speed-power readiness" and "speed endurance", in "communication" - "speed endurance" and "special (aerobic-anaerobic) endurance", in libero - "power endurance" and "special (aerobic-anaerobic) endurance". Using this scheme, you can determine the individual potential opportunities of different players to play in different roles.
Conclusions	As a result of the cluster analysis, the functions of volleyball players were clarified and the players most similar to each other in terms of their preparation structure were identified, which sometimes causes some difficulties for coaches when working with athletes with implicitly expressed game functions. Individual profiles of players were compiled and individual recommendations for training volleyball players were developed based on the individual values of readiness factors and the results of cluster analysis.
Keywords	volleyball, preparedness, game roles, factor structure

https://doi.org/10.58962/HT.2023.1.2.6-21

Анотація

Жаннета Козіна. Дмитро Поліщук, Станіслав Поліщук. Індивідуальні особливості показників інтегрального тестування волейболісток різного ігрового амплуа на етапі спеціалізованої базової підготовки

Обгрунтування і мета	Волейбол відрізняється унікальною особливістю поєднувати в одній команді як високорослих нападників, так і маленьких швидких ліберо. Мета дослідження полягала у розробці індивідуальних програм навчально-тренувального процесу волейболісток на етапі спеціалізованої базової підготовки на основі факторних моделей їх підготовленості.
Матеріал і методи	У дослідженні взяли участь жіноча волейбольна команда дитячої ліги України спортивного інтернату № 1 міста Харкова у кількості 12 гравців віком 15-16 років Тестування проводилося по 10 тестам з фізичної підготовленості. З методів статистичного аналізу застосовувались метод описової статистики, факторний аналіз методом головних компонет з визначенням індивідуального прояву кожного фактора у спортсменок та кластерний аналіз.
Результати	На підставі факторного аналізу була визначена структура підготовленості волейболісток на етапі спеціалізованої базової підготовки, у якій виявилося чотири виражених фактори. Визначено модель наявної чи можливої належності гравців до амплуа згідно до визначеної факторної структури: у нападників першого темпу на перший план виступають фактори «швидкісно-силова підготовленість» та «силова витривалість», у нападників другого темпу – «швидкісно-силова підготовленість» та «швидкісна витривалість», у «зв'язок» – «швидкісна витривалість» та «спеціальна (аеробно-анаеробна) витривалість», у ліберо – «силова витривалість» та «спеціальна (аеробно-анаеробна) витривалість». Користуючись даною схемою, можна визначити індивідуальні потенціальні можливості різних гравців до гри в різних амплуа.
Висновки	У результаті кластерного аналізу уточнено функції волейболісток та виявлені найбільш схожі між собою гравці за своєю структурою підготовленості, що викликає іноді деякі труднощі в тренерів при роботі зі спортсменами з неявно вираженими ігровими функціями. Складено індивідуальні профілі гравців та розроблено індивідуальні рекомендації щодо тренування волейболісток на основі індивідуальних значень факторів підготовленості і результатів кластерного аналізу.
Ключові слова	волейбол, підготовленість, ігрові амплуа, факторна структура

Introduction

The individualization of the training process is key to the future of sports competitions, including volleyball [1, 2, 3]. One distinctive aspect of volleyball is the combination of tall attackers and short, quick liberos on the same team [2, 3]. Although the necessity to research and implement a unique method to each team member considerably complicates the educational and training process, this is the primary requirement of contemporary sports.

Players in the same game functions as well as those in separate roles both require an individual strategy. It is now feasible to precisely describe an athlete's unique traits and create so-called "ideal" models of athletes thanks to modern scientific approaches [4, 5]. But these techniques are rarely used. However,

such methods are rarely used, which significantly reduces the effectiveness of the educational and training process.

At all levels of sports training, particularly for players on professional teams, an individualized approach to athletes is required [6]. This time period is crucial in the development of a high-class athlete since it is when athletes in volleyball are more rigorously separated into roles and have their unique game profiles established.

Theoretical generalization of literary sources [7–11] revealed that the variables that affect volleyball's sporting outcomes serve as the cornerstone of systematic methods to the process's individualization. Individualization of physical, psychological, and technical-tactical training are the three categories that they fall under [1, 12, 13]. At the same time, none of the authors [14, 15] suggests a particular approach where a fusion of all three aspects is feasible for volleyball players' individual training. The time is right to create an algorithm that combines all forms of training and, consequently, all systematic approaches to individualization in order to individually tailor the training process for volleyball players.

An algorithm for determining the individual complex structure of readiness was created in our earlier studies [1–5], which shown its efficacy for raising volleyball players' competence. Individual characteristics of difficult preparation for particular players are compiled on the basis of this algorithm. The stages of this algorithm are as follows:- conducting testing of female athletes, which includes a set of at least 10 tests;

- using factor analysis to determine the general structure of athletes' readiness. identifying the key variables and compiling their traits;

- doing a hierarchical cluster analysis on the testing indicators;

- based on cluster analysis of individual features and the determination of the individual factor values.

This algorithm has proven to be effective in identifying the unique qualities of players in a variety of game roles across a range of game sports [1–5]. But at the stage of specialized basic training, it was not used to identify the unique qualities of volleyball players. In the study, it was proposed that it would be effective to combine statistical modeling with data on volleyball players' unique characteristics at the stage of specialized basic training., it will be effective to apply statistical modeling to the combination of factorial and cluster analysis of testing indicators of female athletes.

In this regard, the purpose of the study was to develop individual programs of the educational and training process of volleyball players at the stage of specialized basic training based on factor models of their readiness.

Material and methods

Participants

The women's volleyball team of the Children's League of Ukraine of the sports boarding school No. 1 of the city of Kharkiv in the number of 12 players aged 15-16 years participated in the study.

Procedure

In this study, a ascertaining experiment was conducted in September 2021, in which the players of the team of sports boarding school No. 1 of the city of Kharkiv took part. On the basis of the obtained data, the structure of the readiness of volleyball players was determined and the individual features of the factor structure of the readiness of volleyball players of various playing roles were determined.

Testing methods

Testing was conducted on 10 physical fitness tests [16–20]. When performing each test, 3 attempts were given, and the best result was recorded. The tests were conducted during 2-3 training sessions.

Description of tests

1. Running to 4 points (Fig. 1). The execution time was fixed.

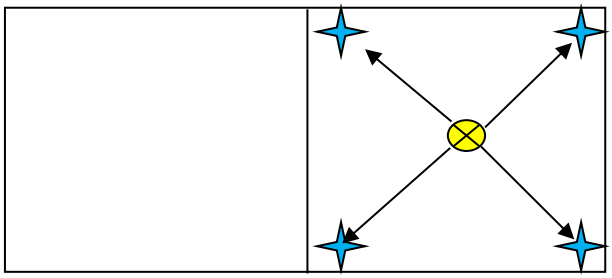


Fig. 1. The "run to 4 points" test on half of the volleyball court

2. Running to determine the speed of movement on the volleyball court for a distance of 30 m (9-3-6-3-9 m). The starting point was the serving line of the volleyball court. From the starting position of the high start on the command "March" the player ran 9 m to the middle line and touched the ball No. 1; after that he returned to 3m and touched ball No. 2; after that he ran to the other side of the court (6 m) and touched ball No. 3; then returned to the 3 m line to ball No. 1 and, after touching it, finished on the serving line of the second half of the court. The test execution time was fixed.

3. Jump up from a place. Height was measured with a raised hand, after which a jump was performed with fixation of reaching the highest point on the shield or stand. The difference between these values in cm was calculated.

4. Jump up from acceleration. The testing was carried out using the same method as measuring the height of the standing jump.

5. Throwing a stuffed ball from a sitting position.

6. Throwing a stuffed ball from a lying position.

7. Lifts of the trunk from the position of lying on the back in 20 seconds (number of times).

8. Lifts of the trunk from the position lying on the stomach in 20 seconds (number of times).

9. Bending-extending the arms in a lying position in 20 seconds (number of times)

10. The standing long jump was performed from the initial position standing in front of the starting line. Simultaneously with the withdrawal of the arms back, the player's legs were bent at the knee joints, and then with the active extension of the arms forward, a jump forward and up was performed. Players were given two attempts, the best result was recorded.

Statistical analysis

The results obtained in this study were processed using appropriate well-known mathematical and statistical methods. The following methods were used for mathematical processing of test data:

1. Calculation of "simple statistics".

2. Factor analysis 2. reducing the number of test signs and figuring out how volleyball players' specific preparation is structured utilizing the principal components technique. It was first necessary to ascertain the general structure of athletes' preparedness in order to ascertain the individual structure of preparedness, on the basis of which it is feasible to individualize the educational and training process. In order to achieve these goals, a factor analysis was used in this study. Through this method, a significant number of variables—11 in this case—that are connected to the studied cases—athletes—were condensed into a manageable number of independent values known as factors.In this way, complex factors of female athletes' preparedness were found, which explain as fully as possible the relationships observed between variables (that is, testing indicators).

At the first step of the factor analysis procedure, the given values of the variables

were standardized using the z-transformation; then, using the standardized values of the variables, Pearson correlation coefficients were calculated between the considered variables.

Based on the correlation matrix, the relative variances of simple components (factors) or the eigenvalues of factors, the number of which coincides with the number of indicators, were determined.

The eigenvalues of the components (factors) were sorted in descending order, after which the main factors with eigenvalues greater than one were selected. To obtain unambiguous solutions, orthogonal rotation was carried out using the varimax method.

3. Cluster analysis to determine the most similar players according to testing indicators for planning a differentiated approach to the training process.

Processing of indicators was carried out with the help of modern computer programs - "EXEL" and "SPSS".

In order to develop individual programs for volleyball players at the stage of specialized basic training, a comprehensive analysis of their testing indicators was carried out.

In order to obtain a general characteristic of the group of examinees, the average indicators for all tests were first calculated (Table 1). It should be noted that in the team that was surveyed, the majority of players are declared as second-rate strikers with a clear shortage of players of other functions. Therefore, in order to draw up individual training programs, it was necessary, first of all, to establish the extent to which the players differ from each other in terms of testing indicators.

To develop individual training models, it is necessary to rely on mathematically identified features of players, and therefore we applied the algorithm developed in this study to determine the team and individual structure of players' training.

Results

Table 1. Indicators of testing volleyball players at the stage of specialized basic training

№	1	2	3	4	5	6	7	8	9	10	11
1	14.9	9.1	230	50	55	5.5	6	19	24	23	200
2	15	8.9	235	35	40	5.5	5.7	20	28	20	190
3	15	9	239	41	51	5.5	5.8	18	25	20	215
4	15	9	225	45	53	5.5	6.5	16	22	21	208
5	14.9	8.8	207	43	67	5.5	6.1	25	30	24	210
6	14.9	9.2	235	40	45	5.5	5.9	18	22	23	200
7	15	10.3	238	37	42	6.2	6.1	18	30	20	170
8	15	9	238	40	42	6	6.1	15	28	20	208
9	17	9.8	238	41	44	5.2	6.1	19	32	27	200
10	14.9	8.7	235	45	55	6.4	6.5	16	26	20	215
11	14.5	9.2	228	32	47	4.3	5	19	30	20	180
12	16.5	9	225	38	53	4	4.5	20	24	20	180
$\overline{X}$	15.22	9.17	231.08	40.58	49.50	5.43	5.86	18.58	26.75	21.50	198.00
σ	0.74	0.45	9.13	4.85	7.70	0.69	0.58	2.57	3.39	2.28	14.86
Minimum	14.5	8.7	207	32	40	4	4.5	15	22	20	170
Maximum	17	10.3	239	50	67	6.4	6.5	25	32	27	215

Notes: 1 - Run to 4 dots (s), 2 - Run "93639" (s), 3 - Body length with raised arm 9 (cm), 4 - Jump up from a place (cm), 5 - Jump up from the run (cm),. 6 - Throwing a stuffed ball while sitting (m), 7 - Throwing a stuffed ball lying down (m), 8 - "Press" 20 s (number of times), 9 - "Back" 20 s (number of times), 10 - "Push-ups" 20 s (number of times), 11 - long jump (cm)

In this study, the number of factors whose eigenvalue exceeds one turned out to be four (Table 2). Thus, four factors were identified in the general structure of the preparedness of volleyball players at the stage of specialized basic training.

At the next stage of the study, the characteristics of the main factors were determined, for which the correlation coefficients between these factors and the test indicators were calculated. The resulting returned component matrix is presented in Table 3.

Table 2. Explained total variance of testing indicators of volleyball players at the stage of specialized basic training

Components	Primary eigenvalues			The sum of squares of the loads is returned		
	Sum	% dispersion	Cumulative %	Sum	% dispersion	Cumulative %
1	3.37	30.64	30.64	2.89	26.30	26.30
2	2.87	26.12	56.76	2.73	24.81	51.11
3	1.98	18.03	74.80	2.14	19.44	70.55
4	1.25	11.39	86.19	1.72	15.64	86.19
5	0.65	5.93	92.12			
6	0.34	3.07	95.19			
7	0.21	1.90	97.09			
8	0.17	1.53	98.61			
9	0.11	0.96	99.57			
10	0.03	0.25	99.83			
11	0.02	0.17	100.00			

To explain the main factors for each test indicator (variables), the largest factor loadings, that is, the largest correlation coefficients between the variables and the main factors, were determined.

The full characteristics of the factors are presented in Table 3. The first factor included the following test indicators: throwing a stuffed ball while lying down, throwing a stuffed ball while sitting, long jump from a standing position, high jump from a standing position. It is not difficult to notice that throwing a stuffed ball while lying down and sitting are naturally interdependent: it is natural that with an increase in the speed and power capabilities of the muscles of the hands, the performance of such tests as throwing a stuffed ball from different starting positions increases. In the same way, the results of the standing jump and long jump tests, which were also included in the first factor (Table 3), are related.

Table 3. Returned correlation matrix of the main components (factors)

Indexes	Factors			
	1	2	3	4
Throwing a stuffed ball lying down (m)	0.97			
Throwing a stuffed ball while sitting (m)	0.89			
Long jump (cm)	0.67		-0.54	
Jump up from a place (cm)	0.66		-0.53	
Body length with raised arm (cm)		-0.94		
"Press" 20 s (number of times)		0.84		

Jump up from acceleration (cm)		0.84		
"Back" 20 s (number of times)			0.87	
Run "93639" (c)		-0.41	0.72	
Run to 4 dots (s)				0.87
"Push-ups" 20s (number of times)				0.81

Notes: 1 – factor “Speed-Strength Fitness”, 2 – factor “Strength Endurance”, 3 – factor “Special (aerobic-anaerobic) Endurance”, 4 – factor “Speed Endurance”

Analyzing the common cause that unites the indicators included in the first factor, it can be noted that all these indicators (throwing a stuffed ball from different starting positions, jumping up from a place, long jump from a place) reflect the development of speed-power abilities , because all these motor actions are performed within a short time (several seconds) and require the manifestation of both strength and speed for the maximum implementation of test tasks. Since, according to the basic provisions of the physiology of muscle activity, strength and speed are interconnected by feedback, and exercises that require the manifestation of both strength and speed, that is, the manifestation of maximum power, are called speed-power exercises. In the practice of sports, there are a large number of such exercises, and the indicators included in the first factor in our study are "purely" speed-power actions. Therefore, the first factor was named "speed-power readiness".

The second factor included such indicators as the length of the body with an outstretched arm (with feedback), "Abs" and jump up from acceleration.

Since the "Press" exercise, performed for 20 seconds, can be attributed to the manifestation of strength abilities, in particular, strength endurance, and growth with an outstretched arm is a reflection of body length, it can be argued that the fact of a drop in results in the "Press" exercise with increasing growth indicators, is a manifestation of the biomechanical regularity of a drop in relative strength with increasing body length. Since this factor included the indicator of a jump up from acceleration, which is also partly a reflection of strength capabilities, the second factor was named "strength endurance" (Table 3).

The third factor included such indicators as shuttle running "9-3-6-3-9" and raising the body from the position of lying on the stomach for 20 seconds. Since these indicators reflect different types of endurance required in volleyball, the third factor was called "special endurance" (Table 3). The fourth factor included performance indicators of the tests "running to the 4th point" and flexion-extension of the arms in a lying position. The "weightier" indicator of the fourth factor is the result of the "run to 4 dots" test. According to the indicators included in the fourth factor, it was called "speed endurance" (Table 3).

Analyzing the percentage contribution of various factors to the total variance, we note that it is practically the same for all four factors (26.30%, 24.81%, 19.44% and 15.64%, respectively (Table 2)). This testifies to the almost equal importance of the identified factors in the structure of the preparedness of volleyball players at the stage of specialized basic training, although the first and second factors - "speed-power preparedness" and "power endurance" - are mainly expressed. This coincides with data from the literature [16, 18] regarding the advantage of speed-power qualities of fitness in volleyball.

To determine the individual structure of volleyball players' readiness, individual factor values were calculated, which are presented in Table 4. Each individual factor value can vary from -3 to +3, and expressed as a percentage - from 0 to 100%. In our study, the first factor (speed-power preparedness) was most pronounced in female athletes Nos. 4, 5, and 10 (Table 4). The second factor (strength endurance) is most evident in sportswomen Nos. 1, 5 and 11. The third factor (Special Endurance) is most evident in sportswomen Nos. 7, 9 and 11, the fourth factor (Speed

Endurance) is most evident in sportswomen No. No. 1, 9 and 12.

According to a certain individual factor structure of volleyball players, graphic models were built for each player and leading and underdeveloped qualities were determined. In accordance with the team test indicators, a scale for evaluating test results was also developed (Table 5).

At the next stage of the research, model characteristics were determined for players of various game roles. For this purpose, the most characteristic players for each role were selected (libero, 1-pace attacker, 2nd-pace attacker, "link"). Having analyzed the individual factor models of these players, we created a model of existing or possible affiliation of players to the role according to the factor structure. This model is presented in fig. 2. According to the obtained experimental data, the attackers of the first pace should differ in the most developed first and second factors. In addition, there is also a tendency for first pace hitters to develop a fourth factor. In hitters of second pace, the most developed factors are the first and fourth, and there is a tendency to develop the first factor more. In connecting players, the most developed factors are the third, fourth, and also the first. In libero, the most developed factors are the second and third. Thus, in forwards of the first pace, such factors as speed-strength fitness and strength endurance come to the fore, in forwards of the second pace - speed-strength fitness and speed endurance, in link players - speed endurance and special endurance , the libero has power endurance and special endurance. The resulting patterns of prevalence of different qualities in players of different roles are schematically depicted in fig. 2. By substituting the schemes of individual factor structures of preparedness (Fig. 4) on the scheme in Fig. 2, it is possible to determine individual tendencies towards one or another role. In addition, after testing "new" players on the leading tests of each factor, it is possible to determine an approximate score for each factor according to the rating scale presented in Table 5, and determine the individual features of the readiness structure of "new" players. In addition, using this scheme (Fig. 2), it is possible to determine individual potential opportunities of different players to play in different roles.

The actual and potential game roles of female volleyball players were also clarified, as well as the players with the most similar structure in terms of preparedness, using a hierarchical cluster analysis of test indicators. Each unique case in hierarchical cluster analysis initially creates a distinct cluster of its own. Two distinct clusters that are closest to one another in terms of structure are joined into a single cluster at each step. The stages of cluster unification are shown in the dendogram (Fig. 2), where it can be seen that players #3 and 6 were first merged into one cluster, followed by #2 and 11 and 1 and 4.

Table 4 shows the individual values of the criteria for the primary team's athletes

№	Speed and strength training	Power endurance	Special (aerobic-anaerobic) endurance	Speed Endurance
	1	2	3	4
1	75	91.67	25	83.33
2	25	50	66.67	16.67
3	41.67	41.67	41.67	50
4	83.33	66.67	8.33	58.33
5	91.67	100	75	66.67
6	33.33	25	50	75
7	50	16.67	100	33.33

8	66.67	8.33	58.33	41.67
9	58.33	33.33	91.67	100
10	100	58.33	33.33	25
11	16.67	83.33	83.33	8.33
12	8.33	75	16.67	91.67

From this it follows that these players are the closest in terms of their preparedness structure, which must be taken into account when conducting training sessions and games. The similarity of these players is illustrated by their individual factor structure of preparedness in fig. 4.

Table 5. Rating scale of testing indicators of volleyball players at the stage of specialized basic training

Rating	Calculation	1	2	3	4	5	6	7	8	9	10	11
5	$\bar{x}$ +2S	14.5	8.7	239	50	67	6.4	6.5	25	32	27	215
4	$\bar{x}$ +S	15.12	9.1	231	45.5	60.25	5.8	6	22.5	29.5	25.25	203.7
3	$\bar{x}$	15.75	9.5	223	41	53.5	5.2	5.5	20	27	23.5	192.5
2	$\bar{x}$ -S	16.38	9.9	215	36.5	46.75	4.6	5	17.5	24.5	21.75	181.2
1	$\bar{x}$ -2S	17	10.3	207	32	40	4	4.5	15	22	20	170

Notes: 1 - Run to 4 dots (s), 2 - Run "93639" (s), 3 - Body length with raised arm 9 (cm), 4 - Jump up from a place (cm), 5 - Jump up from the run (cm),. 6 - Throwing a stuffed ball while sitting (m), 7 - Throwing a stuffed ball lying down (m), 8 - "Press" 20 s (number of times), 9 - "Back" 20 s (number of times), 10 - "Push-ups" 20 s (number of times), 11 - long jump (cm)

Players who are most similar in their factorial structure can be paired in training, can replace each other in games or, on the contrary, depending on the tasks of training or the features of the game, the coach can make other decisions using this information .

Let's consider the mathematical method of dividing players into groups. First, the optimal number of clusters is determined. It is equal to the difference between the number of players who appeared in the cluster analysis and the step number at which the cluster coefficients begin to grow non-linearly. In our case, the number of the step at which the cluster coefficients begin to grow non-linearly is the eighth (Fig. 3). Thus, in our case, the optimal number of clusters is equal to:

12 (number of players) - 8 (step number) = 4 (clusters). In volleyball, this corresponds to four playing roles.

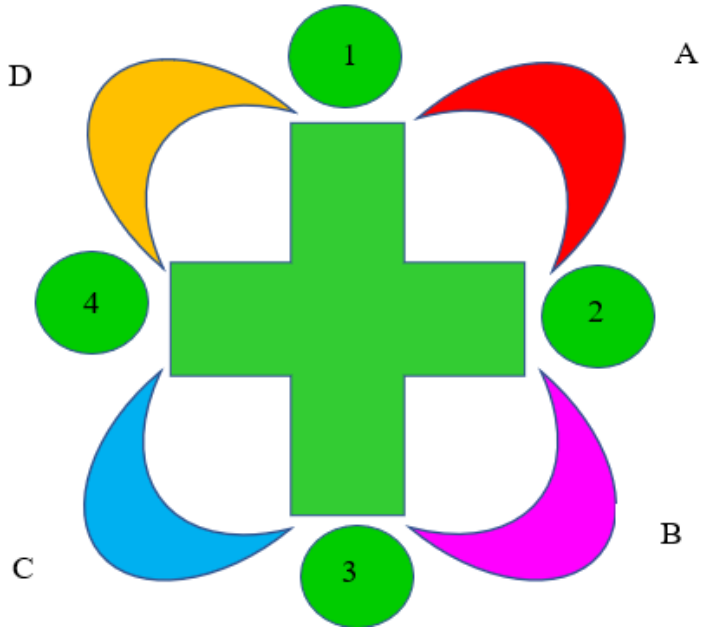


Fig. 2. The scheme for determining the playing roles of volleyball players based on indicators of special physical fitness:
1 – factor “speed-strength preparedness”, 2 – factor “relative strength”, 3 – factor “special (aerobic-anaerobic) endurance”, 4 – factor “speed endurance”;
A - players with a combination of factors 1 and 2 - attackers of the first pace; B - players with a combination of factors 2 and 3 - libero; C - players with a combination of factors 3 and 4 - "connections"; D - players with a combination of factors 4 and 1 - attackers of the second pace.

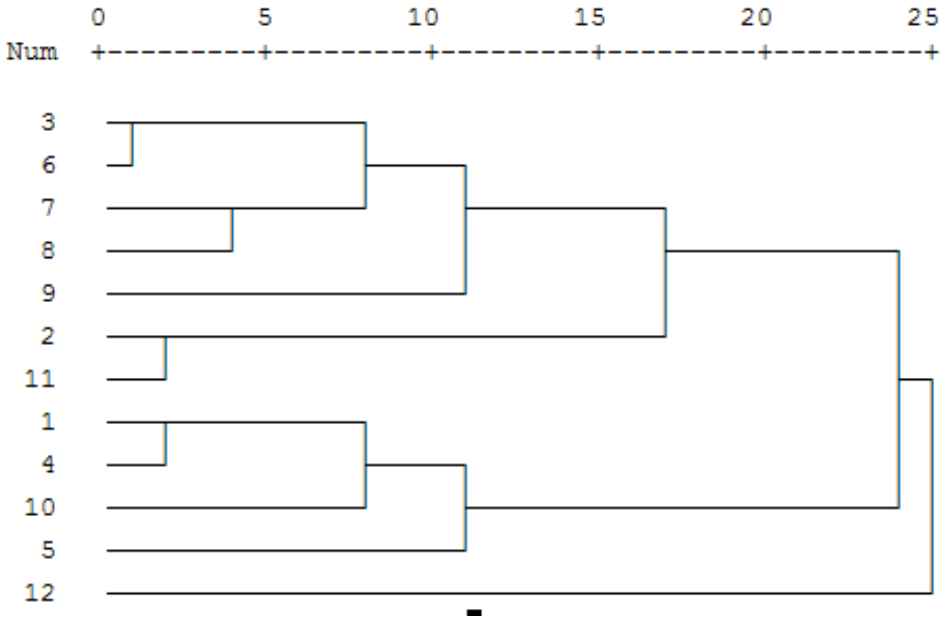


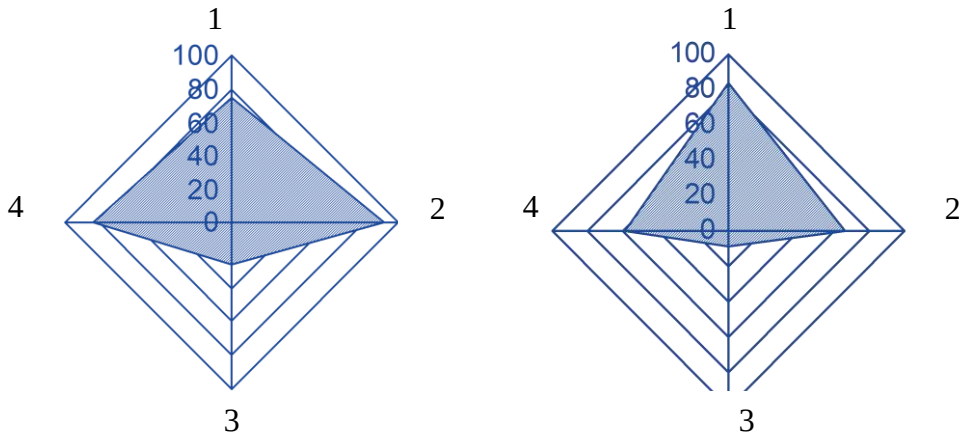
Fig. 3. Dendogram of players' clustering

According to the dendogram (Fig. 3) and from calculations based on the total number of clusters (Table 6), we determine the obtained groups of players.
Cluster 1 - numbers 3, 6, 7, 8, 9.
Cluster 2 - Nos. 2, 11.
Cluster 3 - numbers 1, 4, 10.
Cluster 4 - No. 5, a player who occupies a central position and can be assigned to different groups, and player No. 12, who, on the contrary, differs from the others in terms of his preparation structure (Fig. 3).

Table 6. Membership of the clusters of players of the women's volleyball team at the stage of specialized basic training

Player number	Cluster number
1	3
2	2
3	1
4	3
5	4
6	1
7	1
8	1
9	1
10	3
11	2
12	4

Thus, as a result of the cluster analysis, the functions of volleyball players were clarified and the players most similar to each other in terms of their preparation structure were identified, which sometimes causes some difficulties for coaches when working with athletes with implicitly expressed game functions.



a b

Fig. 4. Examples of similar players by factor structure according to cluster analysis data:
a - Player 1 – attacker of the 2nd pace, b – Player 2 – attacker of the 1st and 2nd pace; 1 – the “speed-strength preparedness” factor, 2 – the “relative strength” factor, 3 – the “special (aerobic-anaerobic) endurance” factor, 4 – the “speed endurance” factor

The conducted research made it possible, based on the individual values of readiness factors and the results of the cluster analysis, to draw up individual profiles of players and develop individual recommendations for the training of volleyball players. We give examples of individual profiles of volleyball players and individual recommendations regarding the training process.

Individual characteristics of the studied athletes

Athlete No. 1

Function - striker of the first pace.

The most manifested factors 1, 2 and 4 are speed-strength preparedness, strength endurance, speed endurance. The manifestation of the "speed endurance" factor makes it possible to conclude that this player can also perform the function of an attacking second pace. When building an individual educational and training process for this player, it is necessary to rely on the most strongly developed qualities, that is, on speed and strength, to develop those that are lagging behind, that is, special endurance. In the game, this athlete needs to focus on attacking attacks. Developing your strengths and building on them, it is worth working on "lagging" qualities, such as the ability to work for a long time in the glycolytic mode of energy supply. To increase the third factor, it is worth using iron-containing drugs and working on the development of endurance and speed, for example, playing in defense. The most similar player is Oh. These players can be paired in training for mutual reinforcement of strengths, or, on the contrary, separated to develop lagging qualities.

Athlete No. 8

Function is a second-pace hitter and, as shown by the study of the individual factor structure of preparedness, can be a connecting player.

The most manifested factor 1 is speed-power preparedness, at the average level the manifested factors No. 3 and 4 are "special endurance" and "speed endurance", which makes it possible to draw a conclusion about the ability of this player to play as a link. The least manifested factor 2 is strength endurance. When building an individual educational and training process for this player, it is necessary to rely on the most strongly developed qualities, that is, on speed, to develop those that are lagging behind, that is, strength endurance. In the game, this athlete needs to focus on quick attacks, on actions that require quick decision-making, non-standard thinking. While developing your strengths and building on them, it is worth working on "lagging" qualities, such as strength abilities. The most similar player in terms of individual factor structure is P-k, whose function is a second-tempo striker, but well-developed qualities of speed and special endurance make it possible to play well in defense.

Athlete No. 2

The function is libero.

The most manifested factors 2 and 3 are power endurance and special endurance, the least manifested factors 1 and 4 are speed-power preparedness and speed endurance. When building an individual educational and training process for this player, it is necessary to develop those that are lagging behind, relying on the most strongly developed qualities, that is, strength endurance and special endurance. In the game, this athlete needs to focus on movements that allow her to perform ball techniques for a long time without reducing intensity and efficiency. While developing your strengths and building on them, it is worth working on "lagging" qualities, such as speed-strength fitness and speed endurance. The most similar player is I-a, who is a second-tempo forward, but as a result of her individual fitness factor structure can also serve as a libero.

Athlete No. 5, the function is a libero, but the well-developed first and second factors make it possible to conclude that this player has the skills of a striker, and if necessary, could perform this function.

This player has well-developed forward factors and, combined with libero factors, gives the opportunity to perform versatile actions in the game. This player can work with each member of the team, adapting to their individual characteristics.

Based on factor models and certain game functions, individual training programs

were developed for each player of the "HOVUFKS" volleyball team, according to which they trained for four months. When organizing individual work at each training session, time was set aside for individual tasks, and the players thus improved their individual skills.

An example of an individual training program for a volleyball player – libero, No. 5 is given.

This player has the least developed factor 1 - speed-power qualities. Therefore, an individual program was planned for this player, which consisted of the following exercises:

1. Exercises using external resistance:

a) resistance is used as an object (exercises with stuffed balls, dumbbells, a barbell, etc.);

b) resistance is provided by the partner (squatting, leaning, walking, with the partner on the shoulders);

c) the resistance of the external environment is used (jumping, running on soft sand, soil, snow, in water). These exercises are more often used in off-season meetings.

2. Exercises burdened with the weight of one's own body, for example, climbing a rope, pulling up, jumping.

3. Exercises using various simulators, blocks, mechanisms.

All these exercises are aimed at the general development of strength and musculoskeletal system. Volleyball includes general physical training with special. The specific work of a volleyball player is the execution of game techniques, the effectiveness of which is determined by the level of strength development and speed endurance.

Discussion

On the basis of the algorithm developed in our previous studies [1–5], a hypothesis was put forward: to determine the individual characteristics of volleyball players at the stage of specialized basic training, it will be effective to use statistical modeling based on a combination of factor and cluster analysis of testing indicators of female athletes. This hypothesis was fully confirmed as a result of the conducted research. Statistical modeling of the individual characteristics of female athletes based on factor analysis with the determination of the individual factor structure of the preparedness of female athletes in combination with the results of cluster analysis showed high efficiency for determining a differentiated approach to the training process.

The conducted study is one of the first to determine the individual factor structure of volleyball players' readiness at the stage of specialized basic training. The results of other authors [13, 14], who investigated the problem of individual characteristics of volleyball players, testify to the predominance of the psychological approach to the individualization of the training process. Our approach involves the use of statistical modeling of individual characteristics of female athletes based on factor and cluster analysis.

The cited authors [13, 14] only take into account psychological differences when addressing the issue of individual differences; they do not address the issue of individualization when addressing it from the perspective of viewing a person as a system that integrates a complex of different indicators. Therefore, our study exhibits some uniqueness when seen from this perspective. However, it should be emphasized that some authors [16, 17] attempt to provide a comprehensive assessment of individuality by taking into consideration a wide range of markers. Such signs include the development of specific physical traits and psychophysiological skills, as well as the characteristics of the nervous system combined with the dominance of one cognitive type. The characteristics of individual differences are provided separately for each category of indicators in this instance, rather than being integrated. When individual preparation or competitive activity schemes are created for each group of indicators separately [11, 12], and such a structure consists of individual indicators, not factors, each of which includes a complex of interrelated indicators as suggested in our study, this is how the assessment of individual differences in sports takes place. We provide an algorithm for constructing individual models of complicated

readiness in this regard. This algorithm enables evaluation of individual differences by individual indicators as well as holistic systemic integration of all measured indicators. Individual differences are categorized in sports physiology and sports medicine based on the ways in which the circulatory and neurological systems respond to stress. It is now possible to combine physiological, psychological, and psychophysiological markers into a single integral assessment of the athlete's personal characteristics thanks to our concept and the associated methodologies and algorithms for developing individual programs.

Athletes are typically categorized in sporting events according to function, or game role [1, 3, 11, 15]. The issues of individual differences regarding other individual characteristics (psychological, physiological, and psychophysiological) of athletes-players are practically not covered in the recommendations for the training of players of various game roles. As a result, our suggested statistical models for identifying the key variables, which take into account a variety of examined indicators in the organization of athletes' training, provide a novel approach to the issue of individualized volleyball player training.

Conclusions

1. Based on the factor analysis, the structure of volleyball players' readiness at the stage of specialized basic training was identified. Four standout factors were identified: The first factor to consider is speed-power readiness, followed by strength endurance, special (aerobic-anaerobic) endurance, and speed endurance.

2. Based on the given factor structure, a model of the participants' potential or actual role-playing affiliations is established: Speed-power readiness and power endurance are prominent in the first tempo's forwards; speed-power readiness and speed endurance are prominent in the second tempo's attackers; speed endurance and special endurance are prominent in the "connection"; strength endurance and special (aerobic-anaerobic) endurance are prominent in the libero. The individual potential capacities of various players to play in various positions can be ascertained using this method, individual factor models of players, and the proposed scale of evaluations of test indicators.

3. The cluster analysis clarified volleyball players' game functions and identified the athletes who were most similar to one another in terms of their preparation structure, which can occasionally present challenges for coaches when dealing with athletes who have implicitly expressed game functions. Based on the unique values of the readiness criteria and the findings of the cluster analysis, personalized player profiles and training recommendations for volleyball players were created.

Conflict of interest

The author declares no conflict of interest**.**

Sources of funding

This article did not receive financial support from a governmental, public, or commercial organization.

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Received: 2023-02-20 Accepted: 2023-03-16 Published: 2023-04-25