

Coordination training of 16–17-year-old volleyball players (girls)

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Abstract.

To develop and experimentally test the effectiveness of the program aimed at coordination training of volleyball players (girls) aged 16-17. The study involved volleyball players (girls) aged 16–17 years ($n = 24$, training experience - 7 years), who were divided into two groups: experimental ($n = 12$) and control ($n = 12$). Significant improvement in the experimental group was found in 9 of 12 indicators ($p < 0.05$). In the control group, a significant improvement in results was observed for 3 indicators out of 12 ($p < 0.05$). The volleyball players (girls) of the experimental group showed a significant improvement in the indicators that characterized the ability to: kinesthetic differentiation; coherence and restructuring of motor actions; spatial orientation; static equilibrium. In the control group, the indicators of abilities for spatial orientation and static equilibrium significantly increased ($p < 0.05$). The results of tests for dynamic balance and speed of response did not show a significant improvement in the volleyball players (girls) of any of the groups. In all the main indicators of technical and tactical skills (ball reception, attack, defensive play, blocking, delivery), the volleyball players (girls) of the experimental group significantly improved their results ($p < 0.05 - 0.001$). At the same time, only the indicator of attack actions ($p < 0.05$) underwent significant changes in the volleyball players (girls) of the control group. In other indicators, the changes were not significant ($p > 0.05$). Coordination training should be conducted systematically at all stages and periods of training of volleyball players (girls). The systematic use of coordination exercises, which are aimed at developing important types of coordination skills for volleyball, is an important requirement.

Key words: volleyball players, girls, coordination, program, skills, training.

Introduction

Technical training is one of the main sections of training athletes in sports and volleyball in particular. Effective implementation of techniques in the process of competitive activity requires a high level of development of general and special motor skills. Increased requirements are placed on the visual-motor coordination of the volleyball player (Zerf, Hadjar Kherfane, Kohli, & Louglaib, 2019; Rogowska, 2020).

Lyakh, Sadowski, and Witkowski (2011) state that the technical and tactical skills of even the best athletes often reach their limits. These boundaries are difficult to expand due to the stabilization of erroneous techniques and underdeveloped sports coordination base. The authors link the sportsmanship reserves with the “technique-coordination” factor. In this sense, there is a purposeful and continuous development of significant coordination skills. Platonov (2017) confirms that high sports results can only be achieved with a high level of development of abilities to assess and accurately regulate the dynamic, temporal, and spatial parameters of movements. Ljach and Witkowski (2010) point to the existence of a crisis situation in the theory and methods of sports training. It is caused by “the achieved limit of the volume and intensity of training loads in high-achievement sports.” The authors see ways to overcome this situation in improving the training process structure. In particular, coordination and technical training systems shall be improved (Boichuk et al., 2018a; Wong et al., 2019).

Boichuk et al. (2019a), Nagovitsyn et al. (2020) report that a high level of development of coordination abilities of volleyball players (girls) is a necessary condition for achieving high sports results. The school period is characterized by a special sensitivity, “sensitivity” to improve coordination of movements. Accordingly, the

lost opportunities for the development of coordination skills in adolescents are unlikely to be made up later. All this can have a negative impact on the success of athletes. After all, in modern volleyball, the main volume of competitive activity is carried out in probabilistic and unexpected situations. This, in turn, requires athletes to show intelligence, quickness of reaction, ability to concentrate and switch attention.

Ljach and Witkowski (2010) understand coordination abilities as psychomotor features of an individual that determine the readiness for optimal control and regulation of motor actions. The authors point out the need to distinguish between the concepts of "coordination of movements" and "coordination abilities". The first one is the organization of the controllability of movements, or the process of their management and regulation. The second one includes the properties necessary for the normal course of this process. Bernstein (1967) notes that coordination skills are a prerequisite for adequate adaptation to external conditions, as well as speed, stability, and accuracy of movement training. Platonov (2017) believes that the main components of coordination abilities are the ability to orient, balance, react, coordination of movements, ability to rhythm, restructuring of motor actions, differentiation of movement parameters. Accordingly, other studies (Lyakh, Sadowski, & Witkowski, 2011) show that responsiveness, differentiation of movement parameters, spatial orientation and coordination of motor actions are important for volleyball. For volleyball players (girls) of the first training years, the authors recommend focusing on the development of all the above coordination skills. It is recommended to take into account the fact that there is a possibility of compensating for the insufficient level of development of some types of coordination skills due to a higher level of other ones (Bandakov & Sannikova, 2020).

Coordination training in sports games is divided into general and special. Thus, general coordination training is a difficult coordination exercise. Such training requires increased requirements for the coordination skills of athletes. However, these exercises do not include elements of special volleyball technique (ball delivery, attacking kicks, receiving and passing the ball, etc.). Therefore, special coordination training is the performance of acquired technical skills and abilities in specially created conditions that are difficult to coordinate (Polevoy & Strelnikova, 2020). The authors also emphasize the need for increased requirements for the coordination skills of athletes. Malikova Doroshenko, Symonik, Tsarenko, and Veritov (2018) recommend that the process of improving the technical skills and abilities of experienced athletes be carried out in close connection with the in-depth development of various coordination skills. This indicates that much more time shall be spent for special coordination training of volleyball players (girls) than for general one in practical sports activities.

Bernstein (1967) and Platonov (2017) state that a great amount of motor memory is the main prerequisite for the efficiency and adequacy of motor actions in complex and unexpected situations. The high level of motor memory allows to quickly and adequately display motor situations and promotes rapid motor response. If the amount of motor memory is insufficient, then the appropriate action requires prior awareness and analysis. Then the motor response can be delayed. This dramatically reduces the effectiveness of technical and tactical actions. The authors point out that the effectiveness of the motor memory use for dexterity is associated with the following characteristics: readiness, dynamism, resistance to obstacles. Memory readiness is the ability to update the information needed to solve a specific task in a timely manner. Memory dynamics is a property of memory processes, which is manifested in the functional variability of mnemonic actions. Memory interference is the ability to withstand external (external stimuli) and internal (memory limitations, information loss, competition between short-term and long-term memory, etc.) interference. Kozina, Chebanu, Repko, Kozin, and Osipov (2018) emphasize that the volume and quality of motor memory is associated with anticipation (the athlete's ability to anticipate the actual actions of the opponent before performing them). The basis for successful anticipation is the past experience of the player, the type and level of intelligence, the amount of motor memory, the type of attention, the level of emotional arousal. Therefore, it is necessary to develop more advanced programs of coordination training of volleyball players (girls) aged 16-17.

Hypothesis. It is assumed that the development of a coordination training program for volleyball players (girls) aged 16-17 will allow to more successfully improve their technical and tactical skills. This will make it easier to cope with motor tasks that require a high level of psychophysiological functions development. The study purpose is to develop and experimentally test the effectiveness of the coordination training program for volleyball players (girls) aged 16-17.

Material and Methods.

Participants. Volleyball players (girls) aged 16–17 took part in the experiment (n = 24, training experience - 7 years). Volleyball players (girls) were divided into control (n = 12) and experimental groups (n = 12). The created groups were identical in the level of coordination training and technical and tactical skills. The study protocol was approved by the Ethics Committee of Ivano-Frankivsk National Technical University of Oil and Gas (Ukraine).

Procedure. The pedagogical experiment lasted 9 months. Well-known motor and computer tests were used to determine the coordination level of volleyball players (girls) (Kozina et al., 2011; Serhiienko, 2013; Boichuk et al., 2018b). Testing was performed at the experiment beginning and end. In the course of study, the level of abilities to kinesthetic differentiations, spatial orientation, reaction, adjustment and coordination of movements, balance was determined:

Test 1: Throwing a ball directed at a target standing with one's back to it (number of times);
 Test 2: Ten eight figures (s);
 Test 3: Stepping over a gymnastics stick (s);
 Test 4: Shuttle run (3×10 m) (s);
 Test 5: Shuttle run with back forward (3×10 m) (s);
 Test 6: Shuttle run (3×10 m) (s);
 Test 7: Running to numbered balls(s);
 Test 8: Static equilibrium evaluation by E. Ya. Bondarevsky's method (s);
 Test 9: Rotations on gymnastic bench (number of times);
 Test 10-12: measurement of the simple and complex visual-motor reaction (ms).
 To determine the level of technical and tactical readiness, the volleyball players (girls) played three control games before and after the experiment. In the process of analyzing the game activity, the following indicators were recorded:

1. Number of ball receptions after their delivery;
3. Number of goals missed;
4. Effectiveness of ball receiving after spikes in the defensive zone;
6. Missed spike goals;
7. Successful court protection against fraudulent actions of the opponent;
8. Number of successful spikes;
9. Number of successful ball blocks from of the opponent's spikes;
10. Number of ball deliveries completed.

Control and experimental groups trained 6 times a week for 2-2.5 hours. The content of training loads was similar in both groups. The only exceptions were the peculiarities of training coordination skills. In the control group, the improvement of coordination skills was carried out in the traditional way with the help of appropriate “dexterity” exercises (Rycarev, 2015). A special program of coordination exercises was used in the experimental group. Emphasis was placed on the purposeful development of seven types of coordination skills in combination with elements of volleyball technique. Approximately the same amount of time was spent for training each type of coordination skills. One coordination training session used special coordination exercises lasting 8–12 minutes, and no more than 2-3 types of coordination abilities were subject to improvement. Separate training sessions were entirely devoted to the improvement of sports-significant coordination abilities of volleyball players (girls) (ability to react, spatial orientation, kinesthetic differentiation, coherence and restructuring of motor actions). According to the guidelines (Lyakh, Sadowski, & Witkowski, 2011), the approximate distribution of time for general and special coordination training among other types of training was as follows (Table 1).

Table 1. Approximate distribution of training types in the experimental training program (Lyakh, Sadowski & Witkowski, 2011)

Training type	Partial volumes, %
General coordination	5
Special coordination and technical	45
Conditioning	25
Tactical	25

A fundamental provision of the coordination training program of volleyball players (girls) aged 16-17 is the development of coordination skills in the process of technical and technical-tactical training and improvement. During the training and improvement of technical techniques of volleyball players (girls), two types were emphasized. In some attempts, the players' attention was focused on the correct execution of the necessary motor actions. In other attempts - on the development of appropriate coordination skills (ability to react quickly in difficult conditions, coordination of hand and foot movements, rapid transition from defense to attack and vice versa, change the rhythm of movements). In the process of implementing the coordination training program for volleyball players (girls), the method of combined influence was used. The optimal combination of coordination exercises with exercises that affect various fitness abilities (speed, strength, endurance, flexibility and their combinations) was used. During the training of volleyball players (girls) of the experimental group, time was provided for influencing psychophysiological functions, which are related to the development of coordination abilities (influence on perceptual, mnemonic, sensorimotor and intellectual components). These are the speed of information reception and processing, response speed and accuracy, anticipation, random access memory, speed and quality of operational thinking, sense of time, space and degree of muscular effort.

Statistical analysis. Statistical data processing was performed using programs aimed at processing the results of scientific research: Microsoft Excel “Data Analysis” and SPSS. For each parameter the following was determined: arithmetic mean (X), standard deviation (S), standard error (m), confidence interval (Δx), assessment of the differences significance by Student's t-test with the appropriate level of significance (p). Differences were considered significant at a significance level of $p < 0.05$.

Results

Prior to the pedagogical experiment, no statistically significant differences were found between the indicators studied in the experimental and control groups. It was found that the variant of coordination training that was used contributed to a higher growth rate of the development level of most coordination abilities in volleyball players (girls) of the experimental group in comparison with the control group. Significant improvement ($p < 0.05$) in the experimental group was found in 9 of 12 indicators. At the same time, in the control group, a significant improvement of the results ($p < 0.05$) was achieved only in 3 cases out of 12 (table 2).

Table 2. Change in the parameters of coordination preparedness of volleyball players (girls) of the experimental group (n = 12) in the process of pedagogical experiment

N	Parameter	Before the experiment		After the experiment		Δx	t	p
		X	s	X	s			
1	Throwing a ball directed at a target	12.4	1.9	14.5	1.9	1.47	3.2	0.02
2	Ten eight figures, s	9.72	0.6	8.85	0.5	0.65	3.4	0.01
3	Stepping over a gymnastics stick, s	14.0	2.6	11.9	2	1.88	3.2	0.02
4	Running to numbered balls, s	12.6	0.6	11.7	0.6	0.63	5.7	0.001
5	Difference between 5x3m running and running to numbered balls, s	2.28	0.6	1.95	0.5	0.51	3.3	0.02
6	Static equilibrium, s	31	9.1	59.2	21.1	10.9	3.5	0.01
7	Rotations on gymnastic bench (number of times)	7.28	0.67	7.64	0.8	0.98	1.2	0.28
8	Shuttle run with back forward, s	10.6	0.42	10.2	0.38	0.51	3.5	0.01
9	Difference between 3x10m and 3x10 m shuttle run with back forward, s	2.61	0.31	2.34	0.43	0.39	3.5	0.01
10	RCh 1-3, ms	490	35.2	470	40.2	34.3	2.9	0.03
11	RCh 2-3, ms	522	60.5	509	48.2	44.9	1.06	0.33
12	SVMR, ms	325	56.6	302	29.8	41.9	0.95	0.38

Note: SVMR – simple visually quick reaction, RCh1-3 – choice reaction of one signal from three, RCh2-3 – choice reaction of two signals from three.

Training for 9 months (12-14 hours per week) improved kinesthetic differentiation (ball feel) by 16.9% ($p < 0.05$) in the experimental group and 7.8% ($p > 0.05$) in the control (table 3). Indicators that characterized the ability of players to coordinate motor actions in the experimental group improved by 9.8% (“Ten eight figures” test) and 17.6% (“Stepping over a gymnastics stick” test). In the control group, these indicators improved by 11.7% and 15.1%, respectively. At the end of the experiment, a significant increase in this ability at the level ($p < 0.05$) was found in both groups. The indicator “running to the numbered balls” test, which characterized the level of manifestation of the ability to spatial orientation, increased in the volleyball players (girls) of the experimental group by 7.7%.

However, the improvement of this indicator in the control group was 3.9%. Significant improvement of this ability ($p < 0.05$) was found only in volleyball players (girls) of the experimental group. Another indicator that characterized the level of development of the ability to spatial orientation in volleyball players (girls) was the difference between the time of the 5x3 shuttle run, m, and running to the numbered balls.

In the experimental group, this figure improved by 16.9%. Similarly, the improvement in the control group was 3.3% ($p > 0.05$). In the study course, a significant increase in the ability to static equilibrium at the level ($p < 0.05$) was found in both the experimental and control groups. Indicators of the ability to restructure and adapt motor actions in volleyball players (girls) of the experimental group during the experiment increased significantly ($p < 0.05$). While in the control group no significant changes were detected ($p > 0.05$).

As it can be seen, the improvement of the results in the experimental group is significantly higher than that of the control group. At the same time, it was found that neither in the experimental group, nor in the control group there was a significant improvement ($p > 0.05$) in indicators of response and dynamic equilibrium.

Table 3. Change of coordination readiness indicators of volleyball players (girls) in the control group (n = 12) in the course of pedagogical experiment

N	Parameter	Before the experiment		After the experiment		Δx	t	p
		X	s	X	s			
1	Throwing a ball directed at a target	10.2	3.9	11	3.7	2.88	1.3	0.25
2	Ten eight figures, s	8.5	2.6	9.5	0.9	1.96	1	0.35
3	Stepping over a gymnastics stick, s	14.5	1.7	12.6	1.8	1.31	2.95	0.025
4	Running to numbered balls, s	13.4	1.4	12.9	1.3	1.06	3.9	0.007
5	Difference between 5x3m running and running to numbered balls, s	2.51	0.7	2.43	0.9	0.51	0.3	0.77
6	Static equilibrium, s	10.9	8.1	17.9	12.7	6.06	2.6	0.04
7	Rotations on gymnastic bench (number of times)	7.14	0.9	7.5	0.58	0.67	1.05	0.33
8	Shuttle run with back forward, s	11.1	0.6	10.8	0.48	0.45	1.96	0.09
9	Difference between 3x10m and 3x10 m shuttle run with back forward, s	2.56	0.67	2.45	0.51	0.49	0.68	0.52
10	RCh 1-3, ms	462	35.2	453	32.7	26.1	0.63	0.54
11	RCh 2-3, ms	558	85.2	549	48.9	63.1	0.27	0.80
12	SVMR, ms	308	35.7	299	20.6	26.5	0.70	0.50

Note: SVMR – simple visually quick reaction, RCh1-3 – choice reaction of one signal from three, RCh2-3 – choice reaction of two signals from three.

The results analysis showed that the special program of coordination exercises resulted in a more significant improvement of the indicators of basic technical and tactical techniques. For the five main indicators of technical and tactical skills (ball reception, attack, defensive play, blocking, delivery), the volleyball players (girls) of the experimental group significantly improved ($p < 0.05 - 0.001$) their results (Table 4).

Table 4. Change in indicators of technical and tactical readiness of volleyball players (girls) of the experimental group (n = 12) in the process of pedagogical experiment

N	Test	Before the experiment		After the experiment		Δx	t	p
		X	s	X	s			
1	Ball reception	59.7	9	69.6	6.2	7.88	5.44	0.006
2	Attack	41.7	11.1	54.5	11.3	8.91	5.91	0.002
3	Defensive game	52.7	15.3	58.3	14.9	9.47	4.95	0.001
4	Blocking	50.1	6.7	54.8	7.3	4.96	7.2	0.001
5	Delivery	43.7	7.2	49.4	8	4.68	4.67	0.002

During the pedagogical experiment, the volleyball players (girls) of the control group also improved their results in this type of training (Table 5). However, only the indicator of attack actions ($p < 0.05$) underwent significant changes. As for other indicators, the changes were not significant ($p > 0.05$).

Table 5. Change of indicators of technical and tactical readiness of volleyball players (girls) of the control group (n = 12) in the process of pedagogical experiment (%)

N	Test	Before the experiment		After the experiment		Δx	t	p
		X	s	X	s			
1	Ball reception	52.9	11.2	54.4	11.6	7.6	0.77	0.47
2	Attack	38	4.53	41.1	4.29	3.3	5.25	0.002
3	Defensive game	39.7	10.9	41.4	10.3	7.4	1.79	0.12
4	Blocking	34.2	6.62	35.2	8.3	4.9	0.84	0.43
5	Delivery	45.7	16.5	48.5	15.6	11.4	1.77	0.12

Discussion

In recent years, experts have drawn attention to the factor of “technique-coordination” as one of the main reserves for improving the technical and tactical skills and efficiency of players’ competitive activities. This factor is considered as one of the main criteria that should be taken into account when selecting children for

sports. Nevertheless, many aspects of coordination training remain understudied (Boichuk et al., 2019b; Polevoy & Strelnikowa, 2020). The system of coordination exercises in volleyball and the method of their use also require more detailed substantiation. Accordingly, there is a need to conduct experiments, which would study the impact of special coordination tools on the level of certain types of coordination skills, technical skills and fitness abilities of volleyball players (girls). But such study is of great importance for practice. Because they dispel doubts about the usefulness and effectiveness of coordination training to improve the players' athletic skills.

The study results (Tables 2–5) confirmed the opinion and experimental data of other authors (Lyakh, Sadowski & Witkowski, 2011) on the greater effectiveness of the coordination exercises system, which are aimed at developing certain types of coordination skills of players compared to traditional “dexterity” exercises. Researchers have shown that this version of coordination training contributes to a more significant increase in the level of coordination training, technical skills and other motor skills. The inclusion of coordination exercises in training programs that affect the specific coordination abilities of volleyball players (girls) will improve the process of technique economizing and diversify the training process.

We found that the results of the dynamic equilibrium and response speed tests did not improve significantly. This can be explained by the fact that the level of these abilities at the age of 16-17 is approaching the peak of the maximum capabilities of volleyball players (girls). Also, according to Ljach and Witkowski (2010), the speed of response is a fairly genetically determined indicator and is difficult to improve. In our opinion, this encourages the search for the compensatory mechanisms and their development.

After the pedagogical experiment, the assumption of a positive effect of special coordination exercises on the growth of technical and tactical preparedness was confirmed. Previously, similar results were obtained by Wong et al. (2019) who worked with young athletes. Nagovitsyn et al. (2020) conducted the study with school-age children. The authors came to similar conclusions. The results obtained by us showed that the exercises of combined development of different coordination abilities improve the technical and tactical actions of volleyball players (girls). After all, high achievements in modern volleyball largely depend on them. Lyakh, Sadowski, and Witkowski (2011) consider this fact as a result of positive interference (transfer) of one more integral factor (abilities) to another - less integral (game technique).

The studies allowed us to conclude that the purposeful use of exercises with a gradual increase in their coordination complexity can significantly improve the level of development of various coordination abilities of volleyball players (girls) aged 16-17. Our data are fully consistent with studies by other authors who have studied the coordination of movements of young athletes (Wong et al., 2019; Nagovitsyn et al., 2020). Researchers have shown that the use of general and special exercises of increased coordination complexity for athletes of different ages and qualifications in training sessions gives a high training effect. The inclusion of such exercises in the training process in combination with a rational method of their application can significantly increase the level of motor coordination, technical and tactical skills, as well as fitness (speed, speed and strength skills, and endurance) of volleyball athletes.

An important theoretical and methodological provision of coordination training of volleyball players (girls) is the systematic use of special coordination exercises, which are aimed at developing important for this sport coordination skills. It is also important to determine the option of training the coordination abilities of volleyball players (girls) in macro- and mesocycles. Two variants were used in our study. This is a relatively even distribution and impact of training tools on all major types of coordination skills in the micro-, mesocycle and purposeful development of leading coordination skills in the preparatory, competitive and transitional periods. The choice of these ways of coordination training is fully consistent with the recommendations of other researchers (Lyakh, Sadowski, & Witkowski, 2011). Young athletes can simultaneously (in parallel) do tasks of coordination, conditioning and technical training. However, according to the authors, all options for coordination training require further experimental confirmation.

In addition, the use of special coordination exercises (loads) has a positive effect on the processes of activation of sensorimotor, intellectual, perceptual and kinesthetic functions of volleyball players (girls). Because the level of development of coordination abilities of volleyball players (girls) depends on these functions (Boichuk et al., 2019b; Genc, Cigerci, & Sever, 2019). Kozina, Iermakov, Bartik, Yermakova, and Michal (2018) consider the use of ideomotor training (means and methods of urgent information) to be effective approaches to improving motor coordination. The method of ideomotor exercise is to try to mentally reproduce the technique before performing it. Methods of urgent information are based on the use of technical devices that automatically register the movements parameters and urgently signal of the violation of some of them.

One of the most important conditions for successful training of coordination skills of volleyball players (girls) is the systematic and consistent mastery of general and special exercises (Bernstein, 1967; Lyakh, Sadowski, & Witkowski, 2011; Platonov, 2017). This allows them to create more complex forms of motor coordination. As one masters the motor actions, it is necessary to gradually increase the requirements for accuracy and speed, and later for efficiency and expediency of their use in changing conditions of motor activity. After mastering the preparatory and developmental coordination exercises in standard conditions, the athlete should proceed to their use in a variety of situations. This will avoid automation and coordination barriers to

performing various motor actions. The authors also emphasize that this provision should be observed not only in work with young but also with qualified athletes. In fact, the results of our study confirm the above mentioned. Thus, the results of our study indicate the feasibility of using coordination exercises in the training process of volleyball players (girls) aged 16-17. The application of the method of combined influence in the training of coordination skills and the improvement of volleyball technique elements will help to improve the players' competitive activity. In addition, further study is required to develop criteria for assessing the coordination complexity of exercises used in the training process of volleyball players (girls). It seems that it is time to pay more attention to the experimental justification of different options for volleyball coordination training.

Conclusions

It is expedient to improve the specific coordination abilities of volleyball players (girls) aged 16–17 with the help of guiding training means. The main thing is to emphasize the development of certain types of coordination skills in combination with the improvement of volleyball technique elements and the development of other motor skills (speed, strength, endurance, flexibility).

Coordination training should be conducted systematically at all stages and periods of volleyball players (girls) training. An important need is the systematic use of coordination exercises, which are aimed at developing important types of volleyball coordination skills. During training, time should be provided to influence the players' psychophysiological functions, which are associated with the coordination skills development.

It is required to conduct further study on the development and implementation of criteria for assessing the coordination complexity of exercises and testing the effectiveness of various options for coordination training of volleyball players (girls) at all stages of long-term sports development.

Conflict of interests

The authors declare that there is no conflict of interests.

References:

- Bandakov, M.P., & Sannikova, A.V. (2020). A Methodological Approach to Differentiating Means of Development of Coordination Abilities in Ski-Racers. *Human. Sport. Medicine*, 20 (1), 82–88. <https://doi.org/10.14529/hsm200110>
- Bernstein, N.A. (1967). *The coordination and regulation of movements*. Oxford: Pergamon Press.
- Boichuk, R., Iermakov, S., Kovtsun, V., Levkiv, V., Karatnyk, I., & Kovtsun, V. (2019a). Significance of typological features of the nervous system for the effective implementation of motor coordination processes in 16-18-year-old female volleyball players. *Journal of Physical Education and Sport*, 19(3), 1519–1525. <https://doi.org/10.7752/jpes.2019.03220>
- Boichuk, R., Iermakov, S., Kovtsun, V., Levkiv, V., Karatnyk, I., & Kovtsun, V. (2019b). Study of the correlation between the indicators of psychophysiological functions and coordination preparedness of volleyball players (girls) at the age of 15–17. *Journal of Physical Education and Sport*, 19(Supplement issue 2), 405–412. <https://doi.org/10.7752/jpes.2019.s2060>
- Boichuk, R., Iermakov, S., Kovtsun, V., Pasichnyk, V., Melnyk, V., Lazarenko, M., & Troyanovska, M. (2018a). Individualization of basketball players (girls) coordination preparation at the stage of preparation for the highest achievements. *Journal of Physical Education and Sport*, 18(3), 1722–1730. <https://doi.org/10.7752/jpes.2018.03251>
- Boichuk, R., Iermakov, S., Kovtsun, V., Pasichnyk, V., Melnyk, V., Lazarenko, M., Troyanovska, M., & Kovtsun, V. (2018b). 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), 1950–1957. <https://doi.org/10.7752/jpes.2018.s4288>
- Genc, H., Cigerci, A., & Sever, O. (2019). Effect of 8-week core training exercises on physical and physiological parameters of female handball players. *Physical Education of Students*, 23(6), 297–305. <https://doi.org/10.15561/20755279.2019.0604>
- Kozina, Z., Chebanu, O., Repko, O., Kozin, S., & Osiptsov, A. (2018). Influence of typological features of the nervous system on individual performance in running for short distances in athletes with visual impairment on the example of an elite athlete. *Physical Activity Review*, 6, 266–278. <https://doi.org/10.16926/par.2018.06.31>
- Kozina, Z., Iermakov, S., Bartík, P., Yermakova, T., & Michal, J. (2018). Influence of self-Regulation psychological and physical means on aged people's functional state. *Journal of Human Sport and Exercise*, 13(1), 99–115. <https://doi.org/10.14198/jhse.2018.131.10>
- Kozina, Zh.L., Baribina, L.M., Korobiejnikov, G.V., Mishchenko, D.I., Cikunov, O.A., & Kozin, O.V. (2011). *Computer program. "Psycho-diagnostic"*. Patent UA, No. 39679. (in Ukrainian)
- Ljach, W.I., & Witkowski, Z. (2010). Development and training of coordination skills in 11- to 19- year-old soccer players. *Human physiology*, 36(1), 64–71. <https://doi.org/10.1134/S0362119710010081>

- Lyakh, V.I, Sadowski, J., & Witkowski, Z. (2011). Development of coordination motor abilities (CMA) in the system of long-term preparation of athletes. *Polish Journal of Sport and Tourism*, 18(3), 187–197. <https://doi.org/10.2478/v10197-011-0014-6>
- Malikova, A.N., Doroshenko, E.Yu., 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 Education of Students*, 22(1): 38–44. <https://doi.org/10.15561/20755279.2018.0106>
- Nagovitsyn, R.S., Kudryavtsev, M.D., Osipov, A.Yu., Altuvaini, A.H., Markov, K.K., Doroshenko, S.A., ... Plotnikova, I.I. (2020). Needful-motivational tasks as an effective condition for the technical training of schoolchildren aged 11–12 during the training of the volleyball section. *Pedagogy of Physical Culture and Sports* 24(3), 129–136. <https://doi.org/10.15561/26649837.2020.0305>
- Platonov, V.N. (2017). *Motor qualities and physical training of athletes*. Kyiv: Olympic literature. (in Russian)
- Polevoy, G., & Strelnikova, I. (2020). Complex control of coordination and speed-power abilities in fire-applied sports. *Pedagogy of Physical Culture and Sports*, 24(6), 310-315. <https://doi.org/10.15561/26649837.2020.0606>
- Rogowska, A. (2020). Personality differences between academic team sport players and physical education undergraduate students. *Physical Education of Students*, 24(1), 55-62. <https://doi.org/10.15561/20755279.2020.0107>
- Rycarev, V.V. (2015). *Volleyball: theory and practice*. Moscow: Sport. (in Russian)
- Serhiienko, L.P. (2013). *Sports selection: theory and practice*. Moscow: Soviet sport. (in Russian)
- Wong, T. K. K., Ma, A. W. W., Liu, K. P. Y., Chung, L. M. Y., Bae, Y.-H., Fong, S. S. M., ... Wang, H.-K. (2019). Balance control, agility, eye–hand coordination, and sport performance of amateur badminton players: A cross-sectional study. *Medicine*, 98(2), e14134. <https://doi.org/10.1097/MD.00000000000014134>
- Zerf, M., Hadjar Kherfane, M., Kohli, K., & Louglaib, L. (2019). Relationship Between Maximum Aerobic Speed Performance and Volleyball Game Motor Power-Explosive Abilities. *Teoriã Ta Metodika Fizičnogo Vihovannã*, 19(4), 179–185. <https://doi.org/10.17309/tmfv.2019.4.03>