

NATIONAL SPORTS ACADEMY

“Vassil Levski”

“Basketball, Volleyball, Handball” Department

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**Development of coordination abilities and their influence on
individual tactics of 13 year old girl volleyball players**

ABSTRACT BOOK

of dissertation for awarding of educational
and scientific degree “Doctor”

Under the doctoral program “Theory and methodology of sports science”, field of
higher education 7. Health and sports, professional field 7.6 Sport

Phd program: Theory and methodology of sport science

Scientific supervisor:

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Sofia, 2024

The dissertation is developed over 227 pages, which include: an introduction, four chapters, a bibliography with 98 literary sources, and two appendices.

The dissertation was discussed and approved for defense at an extended meeting of the Department of “Basketball, Volleyball, Handball” at the National Sports Academy "Vasil Levski", held on June 25, 2024.

The defense of the dissertation will take place on September 17, 2024, at 3:30 PM in Hall A3 of the National Sports Academy "Vasil Levski" in an open session of the scientific jury, composed of:

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Introduction

Volleyball is one of the most popular, entertaining, and exciting sports worldwide. It is characterized by speed, explosive athletic and acrobatic actions. Its uniqueness lies in the presence of various elements that overlap and complement each other as they are in constant interaction. Volleyball enjoys great interest among young girls. The large number of those wishing to train volleyball at the initial stage of preparation creates significant competition between different clubs. Volleyball training is characterized by varied intensity and a complex manifestation of physical qualities.

Volleyball belongs to the category of ball sports played over a net. This implies that good coordination skills can assist in the development of the players, both in the initial learning of technical elements and in improving tactical preparation. Girls enter puberty between the ages of 10-13, which is marked by the negative impact of morphological changes on coordination levels. This necessitates greater attention to agility during the training process.

At this stage of preparation, more attention is given to individual tactical actions. Tactical skills are defined as "the choices and actions of players in the competition, aimed at gaining an advantage over the opposing team or player." The more extensive a player's set of tactical options, the more beneficial they can be to their team. This is especially true when the level of technical preparedness is not perfect, as is the case with young players.

In recent years, there has been an increasing trend towards early specialization in positions among players, which limits their knowledge and skills regarding the tasks of their teammates playing in different positions. When situations arise that necessitate a change of position, either due to compulsion or a coach's decision, it leads to panic and stress for the unprepared players.

At the initial stage of training, the players who often stand out are those with better pre-existing coordination skills, acquired both within and outside the training process. Those who lag in anthropometric characteristics or lifestyle can catch up with their teammates in skills if they manage to further develop their technical and tactical abilities. Complementary and necessary speed-strength training will help them comprehensively develop into leading volleyball players in their clubs and competitions.

In youth championships, players who excel in powerful spikes and strong serves often dominate, as these elements lead to winning points. However, over the course of many years of sports preparation, the focus of these players does not change, and in most cases, they are caught up by their peers who have advanced in technical and physical aspects. When this happens, players with better tactical preparation have an advantage because they handle complex game situations on the court better.

At the highest level in volleyball, there is exceptional parity among teams in the technical-tactical aspects of the game. It often happens that the outcome of individual sets is decided after the 25th point or with a very close score difference. This focuses our attention on the rallies at the end of the sets, where all players are extremely concentrated and motivated to win. In these cases, the best performers stand out, as they have solutions for every complex situation they encounter.

Having a wide range of tactical skills makes good players a great asset to their coaches. Every coach would feel at ease knowing that their players can execute any tactical task assigned to them. They can quickly and successfully translate coaching instructions onto the court, which can be crucial for winning a set or match. This gives coaches more options to successfully manage their teams, surprise opponents, and often win the tactical battle against the opposing team's coach.

Motivated by this idea, we focused on this problem in the game, aiming to address it at an earlier stage of sports training and improvement in the tactical aspect.

I. FORMULATION OF THE PROBLEM

In training practice, it is fundamental to develop the coordination abilities of players for effective performance in complex game situations. These abilities, in turn, contribute to improving the technical skills of volleyball players and mastering new technical techniques. The application of these skills in a game requires setting various tasks for the players, aimed at achieving rational execution. This provokes the use of specific tactical actions necessary for success.

The process of developing tactical habits is long and highly variable, depending on the player's ability to apply learned technical-tactical actions according to the demands of the game situation. Based on the established methodology for learning specific tactical actions in defense and attack, significant progress is achieved in mastering and applying these actions on the court. By developing the necessary motor qualities and coordination abilities, this process is shortened, which is an advantage in achieving game skills. On the other hand, certain complex motor prerequisites are inherent in tactical actions, which are essential for successful play. These prerequisites include acquired or innate skills that enable players to handle complex technical-tactical actions. These prerequisites also involve the complex coordination movements fundamental to the game of volleyball.

Based on our review of the literature on the development of coordination abilities and their impact on athlete performance, as well as the acquisition of tactical skills by volleyball players, we formulated our **WORKING HYPOTHESIS:**

We assume that by increasing the levels of their coordination abilities, young volleyball players will show better success in mastering and applying individual tactical actions in both offense and defense.

II. PURPOSE, TASKS AND METHODOLOGY OF THE RESEARCH

The aim of this study is to improve the individual tactical actions of 13-year-old volleyball players by implementing a specialized training program designed to develop their coordination abilities.

To achieve this aim, we set the following *objectives*:

1. To conduct an informational survey of literature sources related to the coordination abilities and tactical skills of young volleyball players.
2. To determine the level and variability of coordination abilities and technical-tactical skills of 13-year-old volleyball players.
3. To establish the relationships between coordination abilities and individual tactical actions of the volleyball players.
4. To develop and test a specialized training program aimed at improving coordination abilities and mastering individual tactical actions of the players.
5. To determine the reliability of the results obtained after the implementation of the specialized program in terms of indicators assessing coordination abilities and individual tactical preparedness of the players.

Methodology and Organization of the research

Organization of the research

The current study spans from October 2019 to June 2024:

First Stage – October 2019 to February 2021 includes the following activities:

- Review of literature sources on the research problem;
- Formulation of working hypothesis, aim, and objectives of the study;
- Development of the study plan-methodology and test battery;
- Creation of a training program to develop coordination abilities and improve individual tactical actions of 13-year-old volleyball players;

Second Stage – March 2021 to June 2021 includes the following activities:

- Preparation and conduct of the first testing of the participants;
- Implementation of the sport-pedagogical experiment;
- Preparation and conduct of the first testing of the participants.

Third Stage – July 2021 to December 2021:

- Preparation of tables, figures, and illustrations applicable to the dissertation work;
- Detailed description and analysis of the results obtained from the two rounds of testing.

Fourth Stage – January 2022 to June 2024:

- Compilation of the dissertation and initiation of procedures for official defense.

The subject of the study is the training process of 13-year-old female volleyball players.

The object of the study is the coordination abilities and technical-tactical actions of the volleyball players.

The participants in the study are 27 athletes aged 13 from VC Akademik and VC Zvezdi 94.

For the purposes of the study, the athletes were tested during the competitive season 2020-2021, with testing conducted in March and June 2021. During this period, a pedagogical experiment was conducted.

The experimental group consists of 14 athletes from VC Zvezdi 94 who will undergo a specialized training program aimed at improving their technical-tactical actions and developing their coordination abilities.

The control group consists of 13 athletes from VC Akademik who will undergo competition-focused training based on gameplay methods in tactical training.

Methodology of the research

The comprehensive methodology of the research includes:

1. **Analysis of Information Sources:** In relation to the research questions, we conducted an information search on Bulgarian and

foreign authors. After conducting theoretical analysis and summarizing the gathered information, we formulated our own concepts regarding the research problem.

2. Sport-Pedagogical Testing: To determine the level of coordination abilities and technical-tactical skills of the athletes, 25 indicators were examined.

3. Pedagogical Observation and Recording of Game Actions:

4. Sport-Pedagogical Experiment:

Indicators of Coordination Abilities

Table 1. Coordination Indicators (Indicators from № 1 to № 6)

№	Indicators	Measurement units	Measurement accuracy	Direction of increase
1	Throwing and catching a tennis ball for 30 seconds	number	1,0	+
2	Throwing a tennis ball at a target for 30 seconds	number	1,0	+
3	Bounces in 12 squares – Time 1st variant	Sec.	0,01	-
4	Bounces in 12 squares – Time 2nd variant	Sec.	0,01	-
5	"Eight"	Sec.	0,01	-
6	Balance on a platform	Sec.	0,01	-

Indicators of Technical Skills

Table 2 Technical Indicators (Indicators from No. 7 to No. 11)

№	Indicators	Measurement units	Measurement accuracy	Direction of increase
7	Passing with two hands overhead to a target	number	1,0	+
8	Passing with two hands overhead to a target after moving	number	1,0	+
9	Passing with two hands underhand to a target	number	1,0	+
10	Passing with two hands underhand to a target after moving	number	1,0	+
11	Spiking in the direction of the approach	number	1,0	+

Indicators of Technical-Tactical Preparation

Table 3 Tactical Indicators (Indicators from No. 12 to No. 25)

12	Positive play when spiking the ball from deep positions	number	1	+
13	Passive play when spiking the ball from deep positions	number	1	+
14	Negative play when spiking the ball from deep positions	number	1	+
15	Tactical positive plays when not participating in block during test 12	number	1	+
16	Tactical negative plays when not participating in block during test 12	number	1	+
17	Technical positive plays when not participating in block during test 12	number	1	+
18	Technical negative plays when not participating in block during test 12	number	1	+
19	Tactical positive plays in defense during test 13	number	1	+
20	Tactical negative plays in defense during test 13	number	1	+
21	Technical positive plays in defense during test 13	number	1	+
22	Technical negative plays in defense during test 13	number	1	+
23	Positive play when overcoming a double block	number	1	+

24	Passive play when overcoming a double block	number	1	+
25	Negative play when overcoming a double block	number	1	+

Mathematical-Statistical Methods for Processing the Research Results

The results of the research are subjected to mathematical-statistical processing through:

1. **Variation Analysis** – for determining the average levels and variability of the studied indicators in each of the observed groups.
2. **Student's t-test** – for proving or rejecting the null hypothesis regarding the significance of differences between the average levels of the studied indicators in normally distributed independent samples.
3. **Student's t-test** – for proving or rejecting the null hypothesis regarding the significance of differences between the average levels of the studied indicators in normally distributed dependent samples. The critical value of the t-test for all studied groups, with a high level of confidence $P_t \geq 95\%$, is determined according to Y. Brogli et al. (1992).
4. **Mann-Whitney U-test** – for proving or rejecting the null hypothesis regarding the significance of differences between the average levels of the studied indicators in non-normally distributed independent samples.
5. **Wilcoxon T-test** – for proving or rejecting the null hypothesis regarding the significance of differences between the average levels

of the studied indicators in non-normally distributed dependent samples.

6. **Correlation Analysis** – for determining the strength of dependence between the studied indicators in each observed group. Pearson's r-coefficients are calculated using the "each against each" method.

When constructing so-called Correlation-Structural models and interpreting the relationships, only those dependencies are considered whose numerical analysis exceeds certain boundaries of significance set for each population, with an accepted high level of statistical significance $P_t \geq 95\%$ (N. Masalagin, 1974).

III. ANALYSIS OF RESULTS

III.1. Determination of variability degrees and mean values of the studied indicators

III.1.1. Study of coordination abilities of EG

Table 4 presents the data from the statistical analysis with variance analysis of EG from the first coordination abilities test.

The indicators "Throwing - Catching" ($V=20.24$) and the second variant of the "Hopping" test ($V=22.07$) are approximately homogeneous. In the "Octagon" test ($V=4.65$), the group shows a strongly homogeneous result. The high variation coefficient in the "Platform Balance" indicator is due to competitors who do not have a well-developed ability to balance, possibly influenced by their social environment and the lack of complex coordination movements outside the training process.

The "Throwing at Target" indicator shows an average of 3.79 successful attempts, with competitors successfully throwing the ball towards the wall and catching it 17 times on average in the second "Throwing - Catching" test. In the "Hopping" test, the average successful completion times are 17.73 seconds for the first variant and

24.15 seconds for the second variant. Competitors maintained balance on the platform for an average of 12.65 seconds. For the "Octagon" indicator, the average result is 18.92 seconds.

Table 4: Mean level and dispersion of coordination ability indicators of EG from the 1st study

	N	R	Xmin	Xmax	Mean	Std. Deviation	V	As	Ex
Throwing at Target	14	5.00	2.00	7.00	3.79	1.58	41.69	0.68	-0.49
Throwing - Catching	14	11.00	10.00	21.00	17.00	3.44	20.24	-1.19	0.81
Hopping 1	14	22.18	11.22	33.40	17.73	6.46	36.44	1.57	2.03
Hopping 2	14	16.60	16.90	33.50	24.15	5.33	22.07	0.33	-1.25
Balance	14	27.95	2.05	30.00	12.65	10.06	79.52	0.98	-0.45
"eight"	14	2.67	17.51	20.18	18.92	0.88	4.65	0.02	-1.11

Table 5 presents the data from the statistical analysis with variance analysis of EG from the second coordination abilities test.

The group shows similar results compared to the first test, with the indicator "Hopping 1" ($V=29.28$) now also showing moderate dispersion ($30 > V > 10$), similar to "Throwing - Catching" ($V=11.52$) and "Hopping 2" (22.51). Once again, the "Octagon" indicator ($V=2.78$) shows strong homogeneity ($V < 10$).

For the "Throwing at Target" indicator, the average result is 3.86 attempts. "Throwing - Catching" shows an average of 19.43 successful attempts. In the "Hopping 1" test, the average time is 15.23 seconds, and in "Hopping 2" it is 23.67 seconds. The "Balance" indicator has an average result of 19.23 seconds. The "Octagon" test was completed in an average of 19.02 seconds during testing.

Table 5: Mean level and dispersion of coordination ability indicators of EG from the 2nd study

	N	R	Xmin	Xmax	Mean	Std. Deviation	V	As	Ex
Throwing at Target	14	6.00	2.00	8.00	3.86	1.75	45.34	1.16	1.07
Throwing - Catching	14	7.00	16.00	23.00	19.43	2.24	11.53	0.18	-1.33
Hopping 1	14	18.66	9.75	28.41	15.23	4.64	29.28	1.77	4.62
Hopping 2	14	19.87	17.20	37.07	23.67	5.33	22.52	1.40	1.77
Balance	14	25.30	4.70	30.00	19.23	10.51	54.65	-0.10	-1.95
“eight”	14	1.87	18.01	19.88	19.02	0.53	2.79	-0.26	-0.52

III.1.2. Study of coordination abilities of CG

Table 6 presents the data from the statistical analysis with variance analysis of CG from the first coordination abilities test.

Results are approximately homogeneous ($30 > V > 10$) for the "Throwing - Catching" indicator ($V=22.30$) and "Hopping in" ($V=17.37$), while the "Octagon" indicator ($V=5.62$) shows strong homogeneity ($V < 10$).

The result for the "Throwing at Target" test is 5.05 successful attempts. The "Throwing - Catching" test has an average result of 23 successful attempts. In the "Hopping" test, results are 15.78 seconds for the first variant and 21.42 seconds for the second. Balance on the platform test results in an average of 17.70 seconds. The average completion time of the "Octagon" test is 19.91 seconds.

Table 6: Mean level and dispersion of coordination ability indicators of CG from the 1st study

	N	R	Xmin	Xmax	Mean	Std. Deviation	V	As	Ex
Throwing at Target	19	8.00	1.00	9.00	5.05	2.84	56.24	0.04	-1.31
Throwing - Catching	19	21.00	18.00	39.00	23.00	5.13	22.3	1.99	4.60
Hopping 1	19	19.64	9.09	28.73	15.78	5.73	36.31	0.98	0.28
Hopping 2	19	15.25	14.70	29.95	21.42	3.72	17.37	0.38	0.09
Balance	19	26.45	4.13	30.00	17.70	10.24	57.85	0.15	-1.75
“eight”	19	3.56	18.18	21.74	19.91	1.12	5.62	-0.04	-0.87

Table 7 presents the data from the statistical analysis with variance analysis of CG from the second coordination abilities test.

The results show moderate dispersion ($30 > V > 10$) for the indicators "Throwing - Catching" ($V=12.88$) and "Hopping 2" (13.12). Once again, the "Octagon" indicator ($V=6.36$) shows strong homogeneity ($V < 10$).

The results with moderate dispersion for the tests "Throwing - Catching" and the second variant of the "Hopping" test show average results of 21.58 successful attempts for "Throwing - Catching" and 21.41 seconds for the execution of "Hopping." The test with strongly homogeneous results, "Octagon," has an average result of 19.63 seconds. The "Throwing at Target" test has an average result of 6.74 successful attempts. The first variant of the "Hopping" test has an average result of 15.53 seconds. The tested participants managed to maintain balance on the platform for an average of 17.47 seconds.

Table 7: Mean level and dispersion of coordination ability indicators of CG from the 2nd study

	N	R	Xmin	Xmax	Mean	Std. Deviation	V	As	Ex
Throwing at Target	19	10.00	1.00	11.00	6.74	3.41	50.59	-0.27	-1.34
Throwing - Catching	19	10.00	17.00	27.00	21.58	2.78	12.88	0.26	-0.54
Hopping 1	19	20.18	8.92	29.10	15.53	4.89	31.49	1.13	1.83
Hopping 2	19	9.93	16.61	26.54	21.41	2.81	13.12	0.12	0-.47
Balance	19	26.09	3.91	30.00	17.47	9.75	55.75	0.26	-1.69
“eight”	19	4.65	17.62	22.27	19.63	1.25	6.36	0.20	-0.09

III.1.3. Study of Tactical Abilities of EG

Table 12 presents the data from the statistical analysis with variance analysis of EG from the first tactical skills test.

The sample is approximately homogeneous ($30 > V > 10$) for the indicators of correct ($V=24.59$) and incorrect ($V=19.55$) technical actions in the tests for defense near the net and in the backcourt ($V=26.1$ and $V=22.7$), in passive plays against a double block during spiking ($V=22.34$), and for incorrect tactical actions in the tests for defense near the net ($V=13.28$) and in the backcourt ($V=14.39$).

In the test for spiking from zone 4 against a double block, EG has results for passive actions (-) 51.43%, successful actions (+) 28.57%, and incorrect actions (=) 20.00%. In the test for spiking from zone 4 after a deep-set ball, successful actions (+) are 29.29%, passive actions (-) are 46.43%, and incorrect actions (=) are 23.57%. In the test for defense near the net, the average results are 44.29% correct and 55.71% incorrect technical execution, and 28.57% correct and 71.43% incorrect tactical execution. In the test for defense in the backcourt, the results are 53.57% correct compared to 46.43% incorrect actions in terms of technique, and 30.71% correct compared to 69.29% incorrect actions in terms of tactics (Figure 32).

Table 12: Mean level and dispersion of tactical skill indicators of EG from the 1st study

	N	R	Xmin	Xmax	Mean	Std. Deviation	V	As	Ex
Spiking 4 double block -	14	40.00	30.00	70.00	51.43	14.06	27.34	-0.10	-1.19
Spiking 4 double block +	14	30.00	10.00	40.00	28.57	9.49	33.22	-0.31	-0.69
Spiking 4 double block =	14	30.00	0.00	30.00	20.00	8.77	43.9	-0.80	0.71
Spiking depth -	14	60.00	10.00	70.00	46.43	15.50	33.38	-0.89	1.09
Spiking depth +	14	40.00	10.00	50.00	29.29	14.39	49.13	0.32	-1.30
Spiking depth =	14	30.00	10.00	40.00	23.57	10.82	45.91	0.43	-0.94
Defense near the net technique -	14	40.00	30.00	70.00	55.71	10.89	19.55	-1.05	1.26
Defense near the net technique +	14	40.00	30.00	70.00	44.29	10.89	24.59	1.05	1.26
Defense near the net tactics -	14	30.00	60.00	90.00	71.43	9.49	13.28	0.31	-0.69
Defense near the net tactics +	14	30.00	10.00	40.00	28.57	9.49	33.22	-0.31	-0.69
Defense in the backcourt technique -	14	40.00	30.00	70.00	46.43	12.16	26.19	0.21	-0.47
Defense in the backcourt technique +	14	40.00	30.00	70.00	53.57	12.16	22.7	-0.21	-0.47
Defense in the backcourt tactics -	14	40.00	50.00	90.00	69.29	9.97	14.39	0.16	0.75
Defense in the backcourt tactics +	14	40.00	10.00	50.00	30.71	9.97	32.46	-0.16	0.75

Table 13 presents the data from the statistical analysis with variance analysis of EG from the second tactical skills test.

Moderate dispersion ($30 > V > 10$) is present for indicators of errors in technical ($V=21.07$) and tactical ($V=17.19$) actions in both defense tests, correct technical execution in backcourt defense ($V=26.42$), passive plays against a double block from zone 4 ($V=22.66$), and spiking with a deep-set ball ($V=20.4$).

In the second test of tactical skills, EG has average results of 57.86% for neutral (-) actions, 22.14% for positive (+) actions, and 22.00% for negative actions (=) after spiking from zone 4 against a double block. For spiking from zone 4 after a deep-set ball, positive actions are 26.43%, neutral actions are 56.43%, and errors are 16.43%. In the test for defense near the net, the technical execution results are 62.86% errors and 37.14% correct actions, while tactical errors are 77.86%, and correct actions are 22.14%. In the backcourt defense test, technical actions are 43.57% positive and 56.43% negative, while tactical actions are 21.43% correct and 78.57% incorrect.

Table 13: Mean level and dispersion of tactical skill indicators of EG from the 2nd study

	N	R	Xmin	Xmax	Mean	Std. Deviation	V	As	Ex
Spiking 4 double block -	14	40.00	40.00	80.00	57.86	13.11	22.66	0.46	-0.75
Spiking 4 double block +	14	50.00	0.00	50.00	22.14	14.77	66.71	0.07	-0.58
Spiking 4 double block =	14	40.00	0.00	40.00	20.00	13.01	65.05	-0.49	-0.85
Spiking depth -	14	40.00	30.00	70.00	56.43	11.51	20.4	-0.94	0.83
Spiking depth +	14	40.00	10.00	50.00	26.43	10.08	38.14	0.86	1.21

**Table 13 Continued*

	N	R	Xmin	Xmax	Mean	Std. Dev.	V	As	Ex
Defense near the net technique +	14	40.00	10.00	50.00	37.14	12.04	32.42	-0.90	0.50
Defense near the net tactics -	14	40.00	60.00	100.00	77.86	11.88	15.26	0.16	- 0.62
Defense near the net tactics +	14	40.00	0.00	40.00	22.14	11.88	53.66	-0.16	- 0.62
Defense in the backcourt technique -	14	50.00	30.00	80.00	56.43	12.04	21.07	-0.28	1.30
Defense in the backcourt technique +	14	50.00	20.00	70.00	43.57	11.51	26.42	0.23	2.02
Defense in the backcourt tactics -	14	50.00	50.00	100.00	78.57	13.51	17.19	-0.58	0.13
Defense in the backcourt tactics +	14	50.00	0.00	50.00	21.43	13.51	63.04	0.58	0.13

III.1.4. Research of Tactical Abilities of CG

Table 14 presents the data from the statistical analysis with variance analysis of CG from the first tactical skills test.

Results with approximately homogeneous samples ($30 > V > 10$) are seen in backcourt defense with good technical action (25.02) and incorrect tactical action (25.76).

The average results of CG in the tests determining tactical skills in the first assessment are 26.92% for successful (+), 49.23% for passive (-), and 23.85% for incorrect (=) execution in the test for spiking from zone 4 against a double block. In the test for spiking from zone 4 after a deep-set ball, correct execution (+) is 29.23%, passive (-) is 36.15%, and incorrect (=) is 35.38%. In the tests for defense near the net from a technical perspective, the results are 60.00% to 40.00% with errors predominating, while in tactics, the ratio is 76.92% to 23.08% again favoring errors. In the test for defense in the backcourt, technical plays result in 58% for correct (+) and 41.54% for incorrect (-) plays,

whereas tactical plays result in 46.15% for correct (+) and 53.85% for incorrect (-) actions.

Table 8: Mean level and dispersion of tactical skill indicators of CG from the 1st study

	N	R	Xmin	Xmax	Mean	Std. Dev.	V	As	Ex
Spiking 4 double block -	13	70.00	10.00	80.00	49.23	22.53	45.76	-0.09	-1.19
Spiking 4 double block +	13	70.00	0.00	70.00	26.92	18.43	68.46	1.01	1.39
Spiking 4 double block =	13	50.00	0.00	50.00	23.85	16.09	67.46	-0.04	-1.06
Spiking depth -	13	50.00	10.00	60.00	36.15	16.60	45.92	-0.17	-0.79
Spiking depth +	13	50.00	10.00	60.00	29.23	16.05	54.91	0.72	-0.62
Spiking depth =	13	50.00	10.00	60.00	35.38	18.08	51.1	0.13	-1.85
Defense near the net technique -	13	60.00	40.00	100.00	60.00	17.80	29.67	0.84	0.56
Defense near the net technique +	13	60.00	0.00	60.00	40.00	17.80	44.5	-0.84	0.56
Defense near the net tactics -	13	50.00	50.00	100.00	76.92	15.48	20.12	-0.03	-0.76
Defense near the net tactics +	13	50.00	0.00	50.00	23.08	15.48	67.07	0.03	-0.76
Defense in the backcourt technique -	13	75.00	5.00	80.00	41.54	17.50	45.95	0.61	2.60
Defense in the backcourt technique +	13	60.00	20.00	80.00	58.46	14.63	25.02	-1.39	3.51
Defense in the backcourt tactics -	13	50.00	30.00	80.00	53.85	13.87	25.76	0.06	-0.28
Defense in the backcourt tactics +	13	50.00	20.00	70.00	46.15	13.87	30.05	-0.06	-0.28

Table 15 presents the data from the statistical analysis of CG from the second testing for tactical skills.

Errors in technical ($V=29.36$) and tactical ($V=22.83$) actions in defense in the backcourt show approximately homogeneous ($30 > V > 10$) dispersion, as well as errors in tactical actions in defense near the net ($V=19.6$).

The spike from zone 4 against a double block test resulted in 50.77% for neutral actions, 29.23% for correct actions, and 20.00% for errors. In the spike after receiving a deep ball test, correct actions (+) were 22.31%, neutral actions (-) were 43.85%, and errors (-) were 33.08%. In the defense near the net test, technical actions resulted in 37.69% positive and 62.31% negative outcomes, while tactical actions showed 20.77% correct and 79.23% incorrect outcomes.

In the defense in the backcourt test, positive technical actions were 47.69% and negative were 52.31%. Tactical actions were 38.46% positive and 61.54% negative. (Figure 28)

Table 15: Mean level and dispersion of tactical skill indicators of CG from the 2nd study

	N	R	Xmin	Xmax	Mean	Std. Deviation	V	As	Ex
Spike against double block -	13	70.00	10.00	80.00	50.77	26.60	52.39	-0.13	-1.73
Spike against double block +	13	40.00	20.00	60.00	29.23	13.82	47.28	1.28	0.48
Spike against double block =	13	40.00	0.00	40.00	20.00	17.32	86.6	0.00	-1.91
Spike from depth -	13	70.00	10.00	80.00	43.85	20.22	46.11	-0.41	0.03
Spike from depth +	13	40.00	0.00	40.00	22.31	13.63	61.09	0.21	-1.10

**Table 15 Continued*

	N	R	Xmin	Xmax	Mean	Std. Deviation	V	As	Ex
Net defense technique +	13	50.00	0.00	50.00	37.69	14.23	37.75	-1.78	3.51
Net defense tactic -	13	50.00	50.00	100.00	79.23	15.53	19.6	-0.17	-0.46
Net defense tactic +	13	50.00	0.00	50.00	20.77	15.53	74.77	0.17	-0.46
Field defense technique -	13	60.00	30.00	90.00	52.31	15.36	29.36	1.18	2.12
Field defense technique +	13	60.00	10.00	70.00	47.69	15.36	32.21	-1.18	2.12
Field defense tactic -	13	50.00	40.00	90.00	61.54	14.05	22.83	0.53	-0.13
Field defense tactic +	13	50.00	10.00	60.00	38.46	14.05	36.53	-0.53	-0.13

III.2 Correlation Analysis of the Studied Test Indicators

III.2.1 Establishing the Strength of Dependence between Indicators of Coordination Abilities and Tactical Skills of EG

In Figure 39, we observe significant correlations of moderate or greater significance between coordination abilities and tactical skills in EG (young volleyball players). Some of these correlation links confirm our hypothesis that with increasing levels of coordination abilities, young volleyball players demonstrate better proficiency in learning and applying individual tactical actions in both offense and defense.

The indicator "target throwing" has a large (-0.712) correlation with the indicator "faulty attack from zone 4 after receiving a deep pass," and a

moderate correlation with "passive attack from zone 4 after receiving a deep pass," demonstrating that by improving "target throwing," EG will reduce errors in attacking from zone 4 after receiving a deep pass. In most cases, they will play the ball so that it is not lost, allowing the play to continue, and subsequently giving the team another opportunity to win the rally. This can be attributed to the fact that accuracy in throwing assists athletes in making the correct choice of play.

The indicator "throwing and catching" moderately correlates (0.375) with the indicators "passive attack from zone 4 against double block" and (-0.446) "faulty attack from zone 4 against double block" in EG, indicating that by improving quick ball handling skills, EG indirectly reduces errors and increases passive attacks in attacking from zone 4 against double block. This may be due to the speed of execution in both actions and the short reaction time, which require precision.

The indicator "first try hopping 1" significantly correlates with (-0.525) "passive play from zone 4 against double block" and (0.514) "faulty play from zone 4 against double block" in EG, showing that by reducing the "first step" indicator, they have reduced erroneous plays in attacking from zone 4 against double block and increased passive plays, which leads to longer rallies and enhances their chances of winning points.

The indicator "platform balance" moderately correlates (0.416) with "passive attack from zone 4 against double block" in EG, indicating that by improving their balance, EG will be able to execute more passive attacks in attacking from zone 4 against double block and effectively continue rallies, thereby gaining another opportunity to win points. This can be attributed to the stable body posture required during attacks, which demands body balance to execute the correct action to overcome the opponent's block.

The indicator "eight" correlates significantly (-0.587) with the indicator for tactically correct play in defense in the backcourt. This demonstrates that quicker completion of the "eight-shaped running" test will lead to EG athletes swiftly and accurately occupying the correct defensive

position in the backcourt. This may be due to the demands of both indicators for rapid movement to the required location with the correct body positioning.

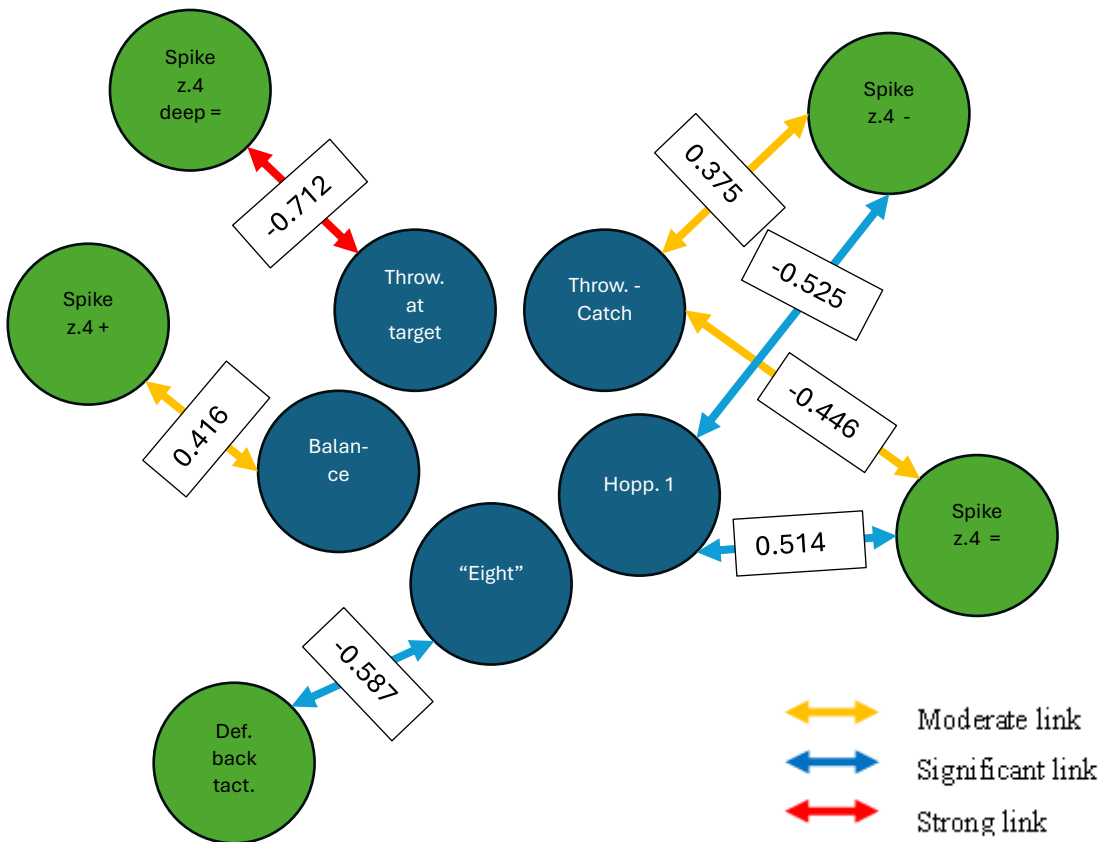


Figure 39: Correlation Relationships Between Coordination Abilities and Tactical Skills of EG

III.2.2. Determining the Strength of Dependency Between Coordination Abilities and Tactical Skills of CG

In Figure 40, we observe significant correlations of moderate or greater importance between coordination abilities and tactical skills of CG. Some of these correlations demonstrate and confirm the aforementioned reasoning.

The indicator "accurate throwing" correlates moderately (0.396) with passive spiking from zone 4 against a double block. This explains that improving accurate throws assists CG in increasing passive spikes in zone 4 against a double block. Such a tactical decision does not score a point immediately but rather prolongs the rally. It is understandable that for these athletes, accurate throwing helps them avoid mistakes during gameplay on the court, but it does not necessarily guarantee success.

The indicator "Hopping 2" moderately correlates with the indicators (-0.343) "defense play near the net - technique" and (-0.398) "defense play near the net - tactics." This shows us that by reducing their reaction time in overcoming the set in the second variant of the "second hopping" test, CG will enhance their success in defensive play from both technical and tactical perspectives. This may be attributed to the similarity in execution of both complex tasks and the ability to orient oneself in a dynamic environment within a very short period.

The indicator "platform balance" correlates moderately (0.377) with successful play in attacking from zone 4 against a double block, and significantly (-0.512) with erroneous play in attacking from zone 4 against a double block. This indicates that improving the ability of CG athletes to maintain balance on the platform for longer periods reflects in successful attacks from zone 4 against a double block, while simultaneously reducing errors in the same situation. During the uncontested phase of the attack and with good balance in the air, athletes are aided in reacting more appropriately to specific situations.

The indicator "platform balance" correlates significantly (0.501) with successful attacking from zone 4 after receiving a deep pass, moderately (0.358) with passive attacking from zone 4 after receiving a deep pass, and (-0.427) with erroneous attacking from zone 4 against a double block. This shows that increasing the time CG athletes maintain their balance on the platform will improve their attacking from zone 4 against a double block. It will enhance successful and transferring hits while reducing their errors.

The same indicator "platform balance" shows a strong correlation (0.736) with tactically correct defensive play near the net, as well as with tactically correct defensive play in the backcourt. Similarly, this demonstrates that platform balance has a positive impact on defensive play both near the net and at the backcourt, where quick adoption of a stable position to meet the ball is required.

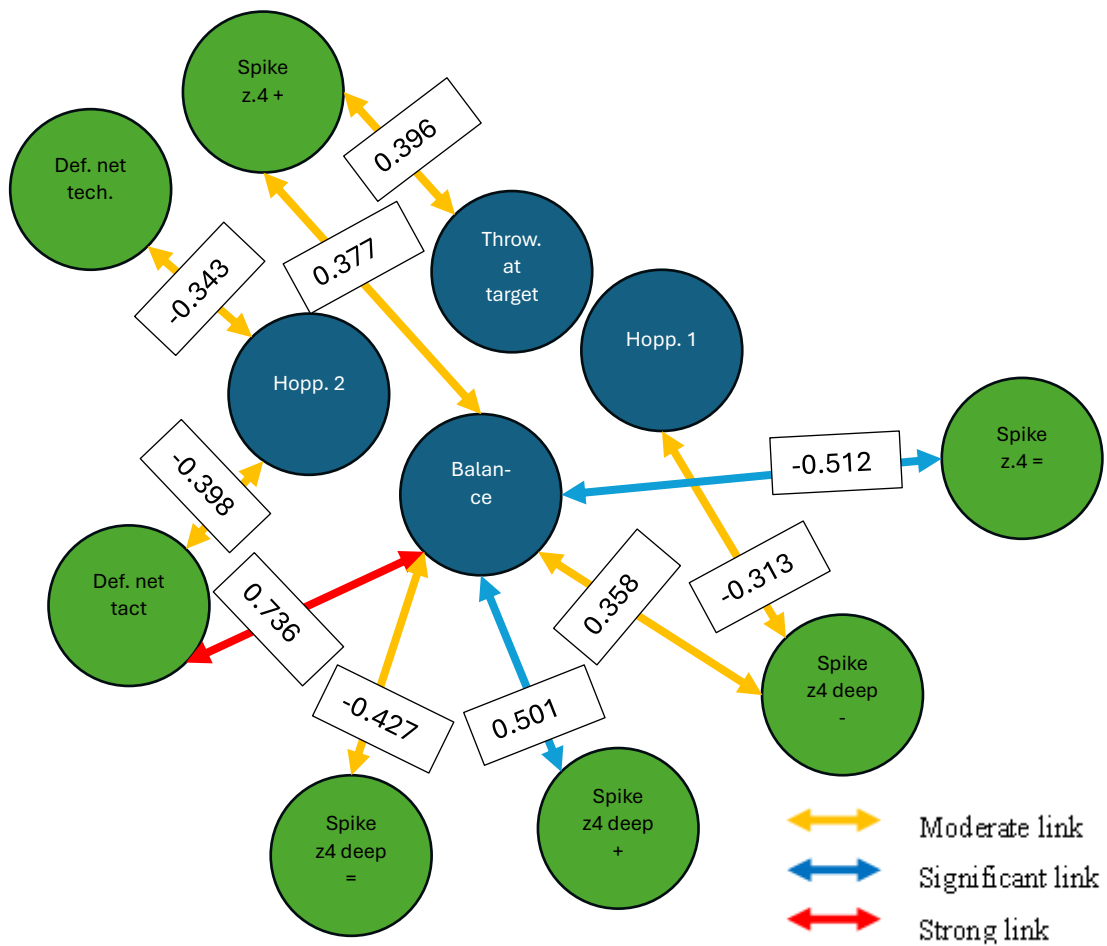


Figure 40 Correlation links between the indicators for coordination abilities and tactical skills of CG

III.3. Establishing the impact and effectiveness of the experimental training program

III.3.1. Development of the coordination abilities of the EG during the experiment

The indicators "throwing-catching" with $\alpha=0.04$ and "balance on platform" with $\alpha=0.01$ show statistically significant improvement, confirming the alternative hypothesis at $\alpha \leq 0.05$. These indicators, as well as "throwing to target" and "eight", were processed using Student's t-test for dependent samples with normal distribution. The indicators "hopping 1" and "hopping 2" were processed using Wilcoxon's t-test for dependent samples with non-normal distribution. Among these, only "hopping 1" has $\alpha \leq 0.05$, making it statistically significant in terms of improvement.

On Figure 43, the increases in individual indicators for coordination abilities in EG are displayed. Our proposed methodology positively impacts the indicators: "throwing-catching" with an increase of 2.43 successful executions, "balance on platform" with an improvement of 6.58 seconds, and "hopping 1" with 2.49 seconds. For the other indicators, we observe minimal increases that are not statistically significant.

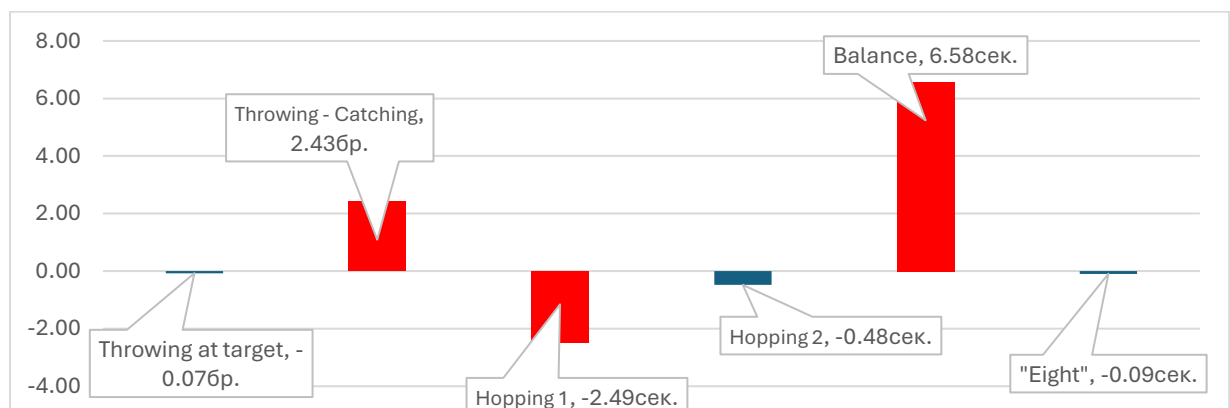


Figure 43: Increases in EG's Coordination Performance Indicators

III.3.2. Development of Coordination Abilities in CG During the Experiment

The indicator "throwing - catching" was analyzed using the Wilcoxon signed-rank test for dependent samples due to its non-normal distribution. Its growth was not statistically significant because $\alpha > 0.05$, confirming the null hypothesis.

All other indicators were processed using the Student's t-test (Table 18) for dependent samples with normal distribution. Among them, the indicators "target throwing" and "eight" showed statistically significant growth, with $\alpha \leq 0.05$, confirming the alternative hypothesis.

When processing the results of coordination tests for CG, we found that their training process significantly improved the indicators "target throwing" with 1.68 successful executions and "eight" by 0.28 seconds (Figure 44).

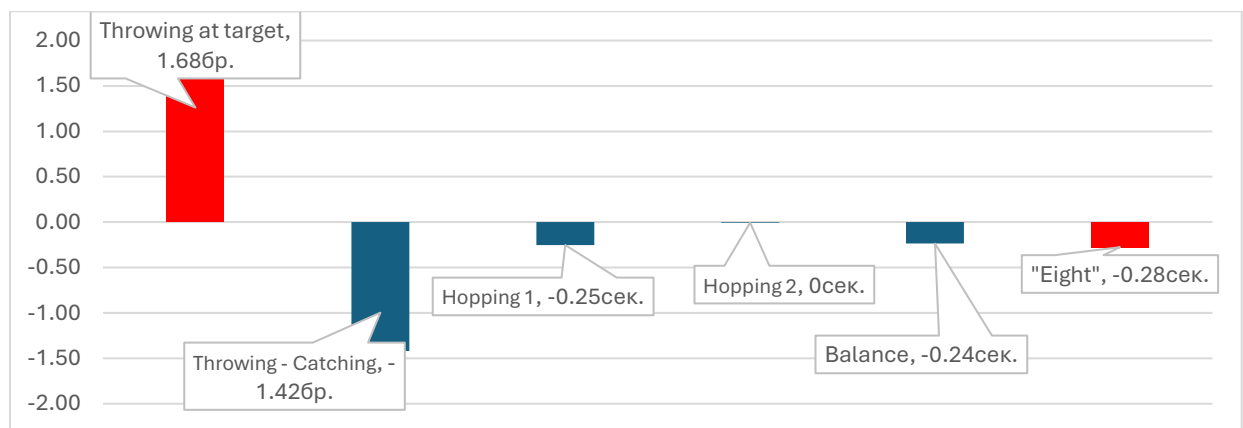


Figure 41 Improvements of CG in coordination indicators

III.3.3. Development of tactical skills of EG during the experiment.

All indicators were processed using the Student's t-test for dependent samples, showing statistically significant improvements in

successful spiking against double block, successful and unsuccessful spiking from zone 4 after deep pass, and all indicators derived from tactic tests. We prove the alternative hypothesis by comparing their achieved level of significance with $\alpha \leq 0.05$.

The applied experimental methodology statistically improves the following indicators: successful spiking against double block by 6.43%, successful spiking from zone 4 after a deep pass by 10%, reduces errors in spiking from zone 4 after a deep pass by 7.14%, improves defensive play near the net by 7.14% technically and 6.43% tactically, and enhances defensive play in the backcourt by 10% technically and 9.29% tactically. There was no change in errors in spiking against double block after the second testing session. Passive plays and spiking against double block after a deep pass decreased by 6.43% and 2.86% respectively, but these changes were statistically insignificant.

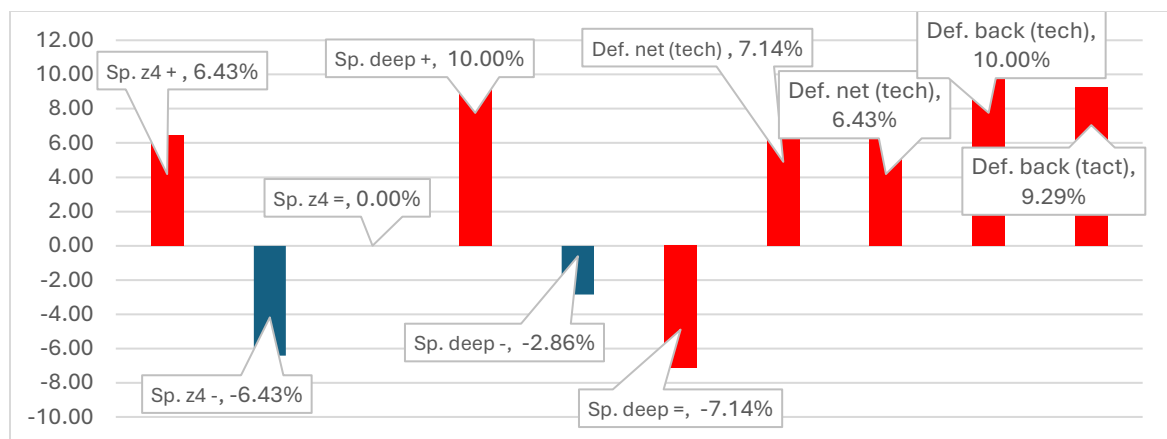


Figure 47 Improvements of EG in terms of tactical skills

III.3.4. Development of tactical skills of CG during the experiment

The analysis was conducted using Student's t-test for dependent samples with a normal distribution. The indicators that have $\alpha \leq 0.05$

confirming the alternative hypothesis are successful spikes from zone 4 after deep passing, defense in the backcourt from both technical and tactical perspectives. Table 26 presents data from the statistical analysis conducted using Wilcoxon's t-test for dependent samples with non-normal distribution, where with $\alpha = 0.002$, incorrect execution in defense in the backcourt from a tactical perspective shows a significant improvement ($\alpha \leq 0.05$).

The tactical skills of CG show a statistically significant difference with a 7.60% increase in successful spikes from zone 4 after deep passing and a 10.77% increase in technical aspects of defense in the backcourt, along with a 7.69% increase in tactical aspects (Fig. 43). This indicates that CG also effectively trains in terms of defense in the backcourt, but lags behind EG in tactics both in attack and defense near the net.

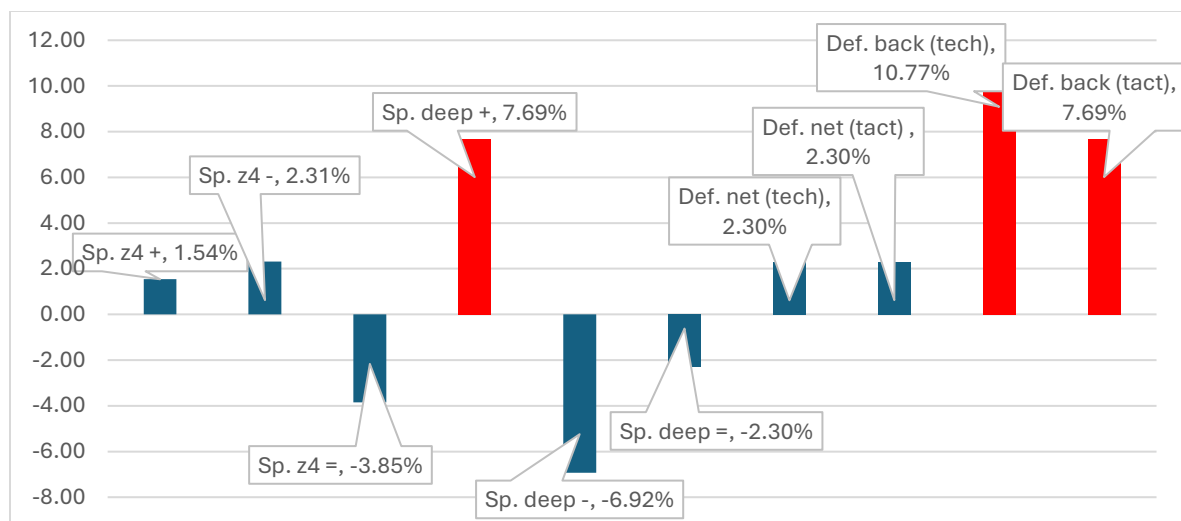


Figure 48 Improvements of CG in terms of tactical skills

III.4. Comparative Analysis of Results Between the Two Groups

III.4.1. Establishing the Significance of Differences in Coordination Capabilities Between EG and CG

To compare the results of coordination capabilities between the two teams, we used the Student's t-test for independent samples with normal distribution and the Mann-Whitney U test for independent samples with non-normal distribution. In the first testing phase, significant differences were observed between the two groups in the "vertical jump" and "subtests 1" indicators. Their values of U and T exceeded the critical values, with $U=105$ for the subtests, which is greater than 78, and $T=2.73$ for the "vertical jump", which is higher than 2.14. For the remaining indicators, the null hypothesis was confirmed, indicating that there was no statistically significant difference between the two groups in the first testing phase. Therefore, we will only compare the two groups for these indicators after conducting the experiment, as they provide a baseline comparison point.

When comparing the indicators between the two groups after conducting the experiment, we found statistically significant differences in the indicators "target throwing", "throw and catch", and "subtests 2". The indicators "target throwing" and "throw and catch" were analyzed using the Student's t-test for independent samples with normal distribution. Their t-values exceeded the critical value of 2.14, specifically $t=2.88$ for target throwing and $t=2.38$ for throw and catch.

The comparison for the "subtests 2" indicator was conducted using the Mann-Whitney U test for independent samples with non-normal distribution. The U-value obtained was 107, which is greater than the critical value for U (78). This indicates that the experiment we conducted had a statistically significant impact on these indicators,

which showed no significant difference in the first testing phase but demonstrated statistical significance in the second testing phase.

In the indicators where the experiment statistically demonstrated improvement, the EG enhanced its performance in "throw and catch" by 2.43 successful attempts per 30 seconds, whereas the CG experienced a negative change of 1.42 fewer successful attempts. During the execution of the second version of "hopping", the CG showed minimal change in their athletes' performance, while the EG improved their results by 0.48 seconds. The only area where the CG had an advantage in development was in the "target throwing" indicator.

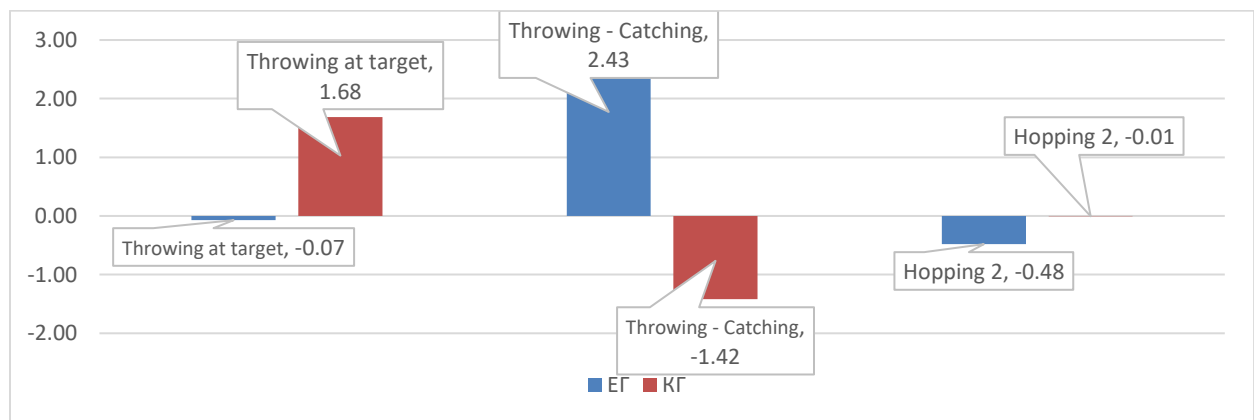


Figure 58 Comparison of growth rates between the two groups in terms of coordination indicators

III.4.3. Establishing the significance of differences in tactical skills between EG and CG.

The comparison of results between the two groups was conducted using the Student's t-test for independent samples with a critical t-value of 2.14. In the initial testing, a statistically significant difference was

found in the tactical performance indicator for defense in the backcourt. For all other indicators, the null hypothesis was confirmed, indicating that there is no statistically significant difference between the two teams, as their t-values were smaller than the critical value.

At the second testing, again, the comparison between the tactical indicators of the two teams was conducted using the Student's t-test for independent samples with a normal distribution. The indicator "faulty spike from zone 4 after deep pass" showed a change compared to the first testing, with a t-value greater than the critical value, confirming the alternative hypothesis. This gives us reason to assert that our proposed methodology statistically influences the reduction of errors in spiking from zone 4 after a deep pass.

The increases in performance for EG in the indicators of successful spiking from zone 4 against a double block and after a deep pass are greater than those for CG, but they are not statistically significant. The same pattern holds for the correct technical and tactical aspects in defense near the net. The only indicator where we can say that our proposed methodology statistically outperforms CG's methodology is "faulty spike from zone 4 after a deep pass." EG reduced their errors in this situation by 7.14%, whereas CG reduced theirs by 2.30%.

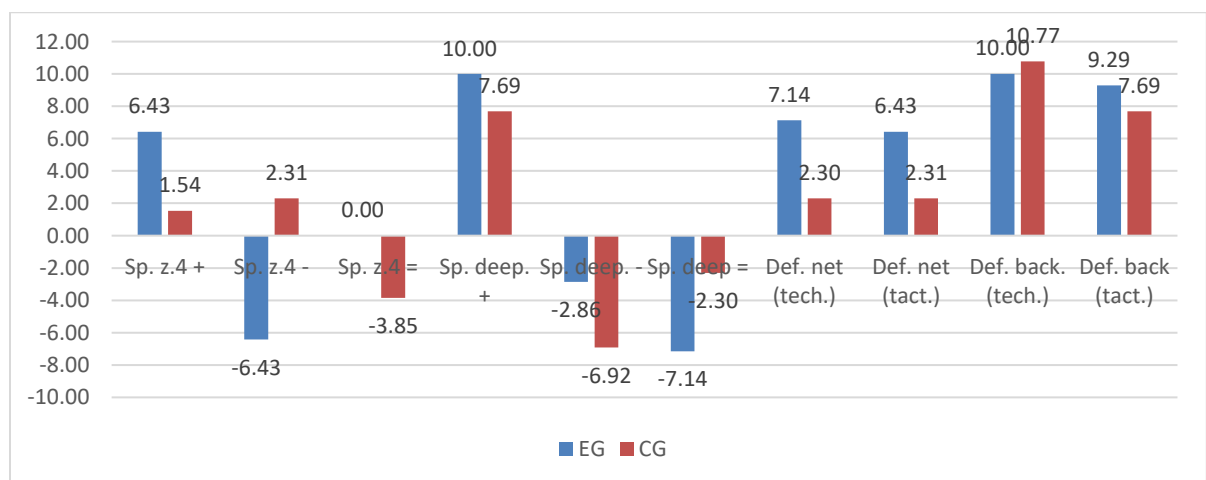


Figure 61 Comparison of growth in both groups for tactical skills

IV. CONCLUSIONS AND RECOMMENDATIONS

IV.1 Conclusions

The analysis conducted on literary sources and the pedagogical experiment provide us with grounds to draw the following conclusions regarding sports-pedagogical practice :

1. The indicators of the two groups are heterogeneous because some children in this age group in Sofia change their club affiliation due to various reasons or have started training later than their peers. Additionally, the study was conducted in the post-COVID period, which also had an impact.

2. Coordination abilities have a positive influence on tactical skills, such as:

- The "balance" indicator affects performance in spiking from zone 4 against a double block and after receiving a deep pass.

- Improving the time to complete the second variation of the "side-stepping" test influences performance in defense near the net, both technically and tactically.

- Better results in throwing indicators like "aimed throw" and "throw and catch" reduce direct errors in spiking from zone 4 against a double block and after receiving a deep pass.

3. Our experimental methodology positively impacts with statistical significance on coordination indicators such as "throw and catch," "side-stepping 1," and "balance," as well as on technical indicators like "two-handed overhand pass" and "spiking." The influence is also noticeable on tactical indicators such as "successful spiking from zone 4 against a double block," "successful spiking from zone 4 after receiving a deep pass," and all indicators derived from tests on defense near the net and in the backcourt.

4. In comparing the technical and tactical indicators between EG and CG after the experiment, we did not find significant differences. It can be concluded that the use of gameplay methods, to a certain extent, also positively influences these elements of the game. The results of EG compared to CG show significant statistical influence in coordination indicators such as "throw and catch" and "hopping 2."

IV.2 Recommendations

1. Based on the conclusions drawn, we recommend that the training process should concurrently focus on developing the coordination abilities and tactical skills of the athletes in an integrated manner.

2. We recommend a training program for sports coaches that would improve:

- Tactical skills for playing defense near the net and in the backfield.

- Success rates in executing attacks from zone 4 against a double block and after deep serves.

3. Introduce more complex exercises to develop the coordination abilities of the athletes, aimed at facilitating the acquisition of individual tactical actions relevant to their age group's training.

4. Conversely, in every exercise designed to master tactical actions on the field, vary the degree of game situation complexity by applying coordination-intensive elements in the drills.

5. Develop the coordination skill of "balance" among volleyball players, which will support successful play in defense in the backcourt.

6. Prepare a scientific manual with the training program created by us for developing coordination abilities and tactical skills.

CONTRIBUTIONS OF THE DISSERTATION WORK

1. The dissertation is in a thematic area that is insufficiently explored, and the doctoral work can serve as a basis for subsequent scientific research.

2. The developed training program for improving coordination abilities and tactical skills will contribute to a quicker mastery of individual tactical actions in both attack and defense among young volleyball players.

3. The influence of coordination abilities on the training of individual tactical actions has been established in 13-year-old volleyball players.

PUBLICATIONS RELATED TO THE TOPIC OF THE DISERTATION WORK

1. Birbochukov, G. Tests for individual tactical actions in volleyball. SC „Optimization of the pedagogical process in basketball, volleyball, handball“. 27 may 2021 year, Annual of National Sport Academy „Vasil Levski“: Vol. 1, Sofia: NSA PRES, 2021, pg. 145-152