THE INFLUENCE OF COORDINATION TRAINING ON THE INDEX LEVEL OF COORDINATION MOTOR ABILITIES IN GRECO-ROMAN WRESTLERS AGED 13—14

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ABSTRACT

Wrestling belongs to the group of sports disciplines with complex movement activities in which an essential role is played by coordination motor abilities (CMA). A high level of coordination improvement since the earliest years positively influences the process of learning new movements as well as enables to make a more effective use of technical and tactical skills during a sports fight. Therefore, the formation of coordination abilities since the earliest years is the condition of training young wrestlers effectively.

The aim of this study was to show the influence of coordination training on the changes in coordination motor abilities (CMA) in Greco-Roman wrestlers aged 13—14.

Boys practising Greco-Roman wrestling (n = 32) in the Student Sports Club UKS "Dwójka" in Radom took part in the research. They were divided into two groups that were at the same sports level: the experimental one (n = 16) and the control one (n = 16). As for those groups, no significant differences concerning somatic features (body mass, height and slenderness indices) were noticed at the beginning and at the end of the experiment, which excluded the influence of puberty on the obtained experiment results.

Seven CMA (kinesthetic differentiation, rhythmization, time-space orientation, movement combining, motor adjustment, speed of reaction, balance) were evaluated on the basis of 14 indices. For that reason sports-motor tests of various authors were applied. The tests were first checked in the context of reliability and accuracy.

The basic research method was a six-month pedagogical experiment. It involved implementing a larger number of means of different coordination complexity (low, medium, high) in the training of the experimental group. The control group took part only in the classical wrestling training. The experiment included 84 training sessions. The applied means equally influenced all examined coordination abilities. The total volume of such exercises in the whole experiment was 180 minutes per each examined ability. Moreover, special coordination exercises in the form of circuit training as well as coordination wrestling games and plays were applied once a week. The total work volume in both groups was the same.

It was observed that sportsmen undergoing coordination training obtained higher values of the examined indices of CMA than those from the control group ($p < 0.05$). The highest significant increase was noted in the case of rhythmization, maintaining body balance and motor adjustment. The increase ranged from 12.6% to 27.5%. The lowest increase was noticed in the case of movement combining, kinesthetic differentiation and time-space orientation. In this case the increase ranged between 4.7% and 7.3%. Statistically significant differences in CMA between the experimental and the control group were observed after the experiment ($p < 0.05$).

The obtained research results make it possible to draw the following conclusions:

1. The increase in the volume of varied complexity coordination exercises in the training of wrestlers contributed to a considerable improvement in the level of CMA, i. e. by 11.4% on average, whereas in the group performing traditional training the improvement was only by 3%.

2. The gain score of coordination abilities in wrestlers aged 13—14 was the biggest in the case of the following CMA: rhythmization (19.1%), body balance (17.3%), motor adjustment (15.1%) and speed of reaction (11.3%). The smallest gain score was noticed in movement combining (4.7%), kinesthetic differentiation (4.9%) and time-space orientation (7.1%).

3. After the experiment there occurred significant differences in the level of most indices of CMA in the experimental and control group, which shows that there may exist considerable reserves in the area of CMA. Autonomous coordination training ought to become an essential part of the process of training in wrestling.

Keywords: *Greco-Roman wrestling, coordination training, coordination motor abilities.*

INTRODUCTION

Coordination motor abilities (CMA) are particularly important at initial stages of the sports development of a competitor (Zimmermann, Nicklisch, 1981; Raczek, 1989; Ljach, 1995; Raczek et al., 2002). A high level of coordination improvement since the earliest years makes it possible to make use of technical and tactical skills during a sports competition in

an effective way (Szczepanik, 1993; Ljach, 1995; Sadovski, 2003; Starosta, 2003; Gierczuk, 2004). A well-formed basis of CMA in young sportsmen is maintained at a later age and is an important reason for faster and more accurate teaching of other, more difficult movement tasks (Raczek et al., 2002). A stressed formation of CMA since the earliest years in such a complex sports discipline as wrestling is an absolute must.

The aim of the study was to evaluate the influence of a 6-month coordination training of CMA in Greco-Roman wrestlers aged 13—14.

MATERIAL AND METHODS

The study was performed on 32 young boys practising Greco-Roman wrestling in the Student Sports Club UKS "Dwójka" in Radom, where they had been training on average for 6 hours per week for the past 1.5 years. They were 13—14 years old (M = 13.6; SD = 0.51).

The subjects were randomly assigned to one of the two groups: the experimental one (n = 16) and the control one (n = 16). In each group there were wrestlers at a similar level of sports advancement which was identified on the basis of two criteria: a rank evaluation of technical — coordination preparation made by the coach, and a total rank evaluation of coordination praparation of wrestlers obtained on the basis of sports-motor tests. The wrestlers were also assessed with regard to somatic features (body mass, height and slenderness indices). This assessment took place at the beginning and at the end of the experiment. The two groups were equal at the beginning of the study.

Seven CMA were assessed on the basis of 14 indices. It was done with the use of sports-motor tests elaborated by various authors (Mynarski, 2000; Raczek et al., 2002) and by the authors of this study (Sadowski et al., 2003). The tests had been checked with regard to reliability and accuracy (Sadowski et al., 2003).

Kinesthetic differentiation was evaluated on the basis of "long jump performed at 50% of maximal capabilities". Rhythmization was assessed with the help of performing and differentiating the rhythm of "the exercise of 5 cycles" as well as performing and differentiating the rhythm of "rhythmic jumps on Johnson—Matheny board". Time-space orientation was evaluated with "aimed jumps" and "the run towards colourful balls". Movement combining was assessed with "the movement of a gymnastic baton" and "standing long jump with and without swings". Body balance was measured with "standing with calves raised" and "turns on an inverted gymnastic bench". Speed of reaction was evaluated with "grabbing Ditrich's stick", whereas motor adjustment was assessed on the basis of "standing long jump forwards and backwards" as well as "the run forwards and backwards 3 × 10 m".

The basic research method was a pedagogical experiment (pre-test — post-test randomized groups design) which lasted for six months. A special coordination programme was an independent variable. This programme was carried out by the subjects from the experimental group, and not by those from the control group. In the first part of the experiment (three months) low complexity coordination exercises were applied. According to experts, the complexity of implemented exercises was equal to 1—2 points at a five-point scale. The exercises, the complexity of which was equal to 3—5 points at the scale were used during the second part of the experiment (the next three months). Both parts of experiments included 84 training sessions (3 sessions per week).

In the introductory part of a training session the wrestlers performed special coordination exercises. The total volume of such exercises in the whole experiment was 180 minutes per each examined ability. During the first training session the development of body balance and rhythmization were emphasized. During the second session an emphasis was laid on the speed of reaction and time-space orientation, whereas the third one involved kinesthetic differentiation, motor adjustment and movement combining. Moreover, once a week special coordination programme in the form of a circuit training as well as wrestling games and plays of coordination character were implemented. The circuit consisted of seven stages. Only special means that equally influenced all examined coordination abilities were applied. At every stage there were six stands designed to work on particular coordination abilities (12 minutes per each one). The coordination complexity of exercises in the circuit increased at the following stations. The duration of games and plays in training sessions was between 30 and 45 minutes. The volume of training work was equal in both groups.

The data obtained were processed applying basic statistical methods. Arithmetic means (M), standard deviation (SD) and variability index (V) were calculated. To describe the significance of differences between results before and after the ex-

periment, the t-Student test for dependent and independent groups was used. The level of $p < 0.05$ was considered significant.

RESULTS

Changes concerning the level of CMA in wrestlers of both experimental and control group are presented in Table 1.

Drawing on the data collected, it may be inferred that in the experimental group there occurred a differential and in most cases statistically significant increase in the level of CMA indices. Out of fourteen examined indices, the increase at the level of $p < 0.01$ was noticed in twelve cases and it was between 27.5% and 4.7%, whereas at the level of $p < 0.05$ it reached the value of 16.1% (Fig. 1).

The biggest improvement was observed in tests examining rhythmization, i.e. in the index "the exercise of five cycles' — imitating the rhythm (0.11 s), "rhythmic jumps on Johnson — Matheny board" — differentiating the rhythm (0.09 s), in the tests examining body balance, both static — "standing with calves raised" (2.2 s), and dynamic — "turns on an inverted gymnastic bench" (0.68 n) as well as in the indices evaluating motor adjustment, i. e. "standing long jump forwards and backwards" (8.8%) and "the run forwards and backwards 3 × 10 m" (9.8%).

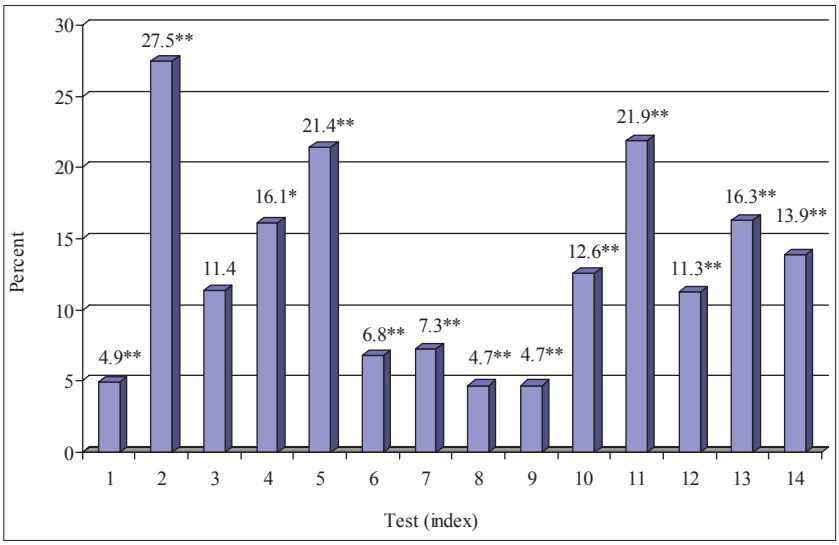
The lowest increase in the level of CMA was noted in the case of movement combining, in the test of "the movement of a gymnastic baton" (0.67 s) and "standing long jump with and without a swing" (3.6%). A low increase (3.5%) was also noticed in

Table 1. **Changes in the level of CMA in Greco-Roman wrestlers aged 13—14 after the pedagogical experiment**

COORDINATION ABILITY Test (index)	Measurement unit	Experimental group (n = 16)							Control group (n = 16)						
		Pre-test			Post-test			differences	Pre-test			Post-test			differences
		M	*SD*	*V*	*M*	*SD*	*V*		M	SD	V	M	SD	V	
Kinesthetic differentiation															
1. Standing long jump at 50% of maximal capabilities	%	69.8	1.76	2.5	73.3	1.69	2.3	**3.5****	70.4	2.2	3.1	71.8	2.37	3.3	**1.4****
Rhythmization															
2. Test of 5 cycles — rhythm imitation	s	0.4	0.14	35.0	0.29	0.11	37.9	**0.11****	0.43	0.19	44.2	0.39	0.15	38.5	0.04
3. Test of 5 cycles — rhythm differentiation	s	0.35	0.1	28.6	0.31	0.08	25.8	0.04	0.39	0.14	35.9	0.36	0.11	30.6	0.03
4. Rhythmic jumps on Johnson—Matheny board — rhythm imitation	s	0.31	0.07	22.6	0.26	0.1	38.5	**0.05***	0.46	0.15	32.6	0.44	0.17	38.6	0.02
5. Rhythmic jumps on Johnson—Matheny board — rhythm differentiation	s	0.42	0.11	26.2	0.33	0.11	33.3	**0.09****	0.44	0.14	31.8	0.41	0.15	36.6	0.03
Time-space orientation															
6. Aimed jumps	%	78.8	3.51	4.5	84.2	3.04	3.6	**5.4****	79.8	3.64	4.6	81.1	4.75	5.9	1.3
7. Run towards colorful balls	s	14.06	0.92	6.5	13.03	0.27	2.1	**1.03****	15.34	1.19	7.8	15.19	0.98	6.5	0.15
Movement combining															
8. Movement of a gymnastic baton	s	14.34	0.57	3.0	13.67	0.96	7.0	**0.67****	14.54	0.77	5.3	14.44	0.64	4.4	0.1
9. Standing long jump with and without a swing	%	76.0	1.9	2.5	79.6	2.12	2.7	**3.6****	77.1	2.55	3.3	77.9	2.03	2.6	0.8
Body balance															
10. Turns on an inverted gymnastic bench	n	5.38	0.7	13.0	6.06	0.83	13.7	**0.68****	5.19	0.85	16.4	5.22	0.63	12.1	0.03
11. Standing with calves raised	s	10.06	1.71	17.0	12.26	1.94	15.8	**2.2****	11.37	2.22	19.5	11.52	2.19	19.0	–0.15
Speed of reaction															
12. Grabbing Ditrich's stick Motor adjustment	cm	18.07	2.37	13.1	16.03	1.26	7.8	**2.04****	17.89	2.04	11.4	17.34	1.64	9.5	**0.55***
13. Standing long jump forwards and backwards	%	54.1	1.29	2.4	62.9	2.09	3.3	**8.8****	55.8	5.07	9.1	58.6	5.62	9.6	**2.8****
14. Run forwards and backwards 3 × 10 m	%	71.1	1.95	2.7	80.9	2.08	2.6	**9.8****	69.9	2.33	3.3	73.1	3.42	4.7	**3.2****

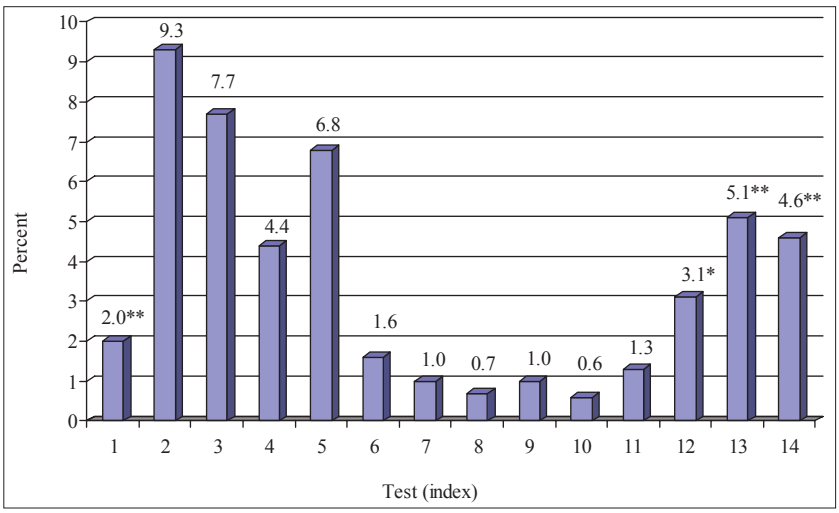
Note: * — statistically significant difference $p < 0.05$; ** — $p < 0.01$.

Fig. 1. **The increase in the level of CMA in the experimental group in Greco-Roman wrestlers after the experiment**



Note: * — statistically significant difference $p < 0.05$; ** — $p < 0.01$.

Fig. 2. **The increase in the level of CMA in the control group in Greco-Roman wrestlers after the experiment**



Note: * — statistically significant difference $p < 0.05$; ** — $p < 0.01$.

the index evaluating kinesthetic differentiation, i.e. in "long jump performed at 50% of maximal capabilities". A relatively low increase in relation to other CMA was also observed in the tests assessing time-space orientation, where in "aimed jumps" the improvement value reached 5.4%, and in "the run towards colorful balls" it was 1.03 s (Table 1).

In the case of "the exercise of 5 cycles" test — rhythm differentiation, the improvement (0.04 s) turned out to be statistically insignificant ($p > 0.05$).

In the control group four significant increases were observed. They were noticed in both tests for motor adjustment, i. e. "standing long jump forwards and backwards" (2.8%) and "the run forwards and backwards 3 × 10 m" (3.2%), as well as in the test assessing kinesthetic differentiation — "long jump performed at 50% of maximal capabilities" (1.4%) and in "grabbing Ditrich's stick" (0.55 cm) which measures speed of reaction. In the remaining tests the increase was not statistically significant ($p > 0.05$) (Table 1).

As for the tests, an average increase obtained in the following results was expressed by means of absolute values (%) in the experimental group: kinesthetic differentiation — 4.9%; rhythmization — 19.1%; time-space orientation — 7.1%; movement combining — 4.7%; body balance — 17.3%; speed of reaction — 11.3% and motor adjustment — 15.1% (fig. 1). In the control group the values reached the following levels: 2%; 7.1%; 1.3%; 0.8%; 1%; 3.1% and 4.9% (Fig. 2).

As we can see in Figure 1, an increased identical volume of exercises forming CMA led to a diversified growth. Rhythmization, balance and motor adjustment were most susceptible to a special coordination training, whereas movement combining, kinesthetic differentiation and time-space orientation were the least prone.

Average increase differences between the experimental group and the control groups after the experiment produced the following values: balance — 16.3%; rhythmization — 12.1%; motor adjustment — 10.3%; speed of reaction — 8.2%; time-space orientation — 5.8%; movement combining — 3.9%; kinesthetic differentiation — 2.9%.

Table 2. **Differences in the level of CMA between the experimental and control group in wrestlers aged 13—14 before and after the pedagogical experiment**

COORDINATION ABILITY Test (index)	Measurement unit	Wrestlers aged 13—14	
		Pre-test	Post-test
Kinesthetic differentiation			
1. Standing long jump at 50% of maximal capabilities	%	0.6	1.5
Rhythmization			
2. Test of 5 cycles — rhythm imitation	s	0.03	0.1*
3. Test of 5 cycles — rhythm differentiation	s	0.04	0.05
4. Rhythmic jumps on Johnson — Matheny board — rhythm imitation	s	0.15*	0.28**
5. Rhythmic jumps on Johnson — Matheny board — rhythm differentiation	s	0.02	0.08
Time-space orientation			
6. Aimed jumps	%	1	3.1*
7. Run towards colourful balls	s	1.28**	2.16**
Movement combining			
8. Movement of a gymnastic baton	s	0.2	0.77*
9. Standing long jump with and without a swing	%	1.1	1.7**
Body balance			
10. Turns on an inverted gymnastic bench	n	0.19	0.84*
11. Standing with calves raised	s	1.31*	0.74**
Speed of reaction			
12. Grabbing Ditrich's stick	cm	0.18	1.31*
Motor adjustment			
13. Standing long jump forwards and backwards	%	1.7	4.3**
14. Run forwards and backwards 3 × 10 m	%	1.2	7.8**

Note: * — statistically significant difference $p < 0.05$; ** — $p < 0.01$.

Summing up, it ought to be mentioned that in the experimental group the increase in CMA was 11.4% on average, whereas in the control group it was 3% ($p < 0.05$).

The data concerning group differences in wrestlers aged 13—14 before and after the pedagogical experiment were presented in Table 2.

The differences between the experimental group and the control group before introducing special coordination programme were in most cases statistically insignificant. The only exception occurred in "the run towards colorful balls", where the difference was 1.28 s ($p < 0.01$), in imitating the rhythm of "rhythmic jumps on Johnson — Matheny board", where the difference was 0.15 s ($p < 0.05$) and in "standing with calves raised", where the difference was 1.31 s ($p < 0.05$).

As for the differences concerning the increase in CMA between both groups of wrestlers, in most cases they turned out to be statistically significant for the benefit of those who took part in a special coordination programme. It led to the occurrence of significant differences between the means of both groups. After applying the special coordination programme, statistically significant differences appeared in ten indices, including four at the level of significance $p < 0.05$, i. e. in the rhythm imitation of "the test of 5 cycles" (0.1 s), in "aimed jumps" (3.1%), "the movement of a gymnastic baton" (0.77 s), "grabbing Ditrich's stick" (1.31 cm) and in six tests at the level of $p < 0.01$, i. e. "standing long jump forwards and backwards" (4.3%), "the run forwards and backwards 3 × 10 m" (7.8%), in rhythm imitation of "rhythmic jumps on Johnson — Matheny board" (0.28 s), "the run towards colourful balls" (2.16 s), "standing long jump with and without a swing" (1.7%) and in "standing with calves raised" (0.74 s).

DISCUSSION

The experiment and result analysis confirmed that special coordination training positively influenced the examined CMA. The results obtained are consistent with the data of many authors examining the effectiveness of special coordination preparation training (Starosta et al., 1983; Raczek, 1989; Szczepanik, 1993; Ljach, 1995; Raczek et al., 2002; Sadovski, 2003; Starosta, 2003). They point to the importance of oriented coordination training in the system of training wrestlers.

It was confirmed that coordination complexity of exercises influences the dynamics of an increase

in CMA. Wrestlers from the experimental group improved their CMA more than competitors from the control group. It was also noticed that more considerable complexity of coordination exercises led to a differentiated increase in CMA. The highest adaptability concerning oriented coordination stimulation was noticeable in rhythmization, balance and motor adjustment, whereas movement combining, kinesthetic differentiation and time-space orientation were less adaptable.

There may be many reasons for this difference. For instance, strong genetic conditioning of particular CMA could be one of the causes (Szopa et al., 1985; Mleczko, 1991; Raczek et al., 2002). Taking into consideration the importance of genetic factors in the susceptibility of CMA to training, the literature data are not unequivocal (Szopa et al., 1985; Mleczko, 1991; Raczek et al., 2002). Because of that, the results obtained may only be partly consistent with the data of other authors (Szopa et al., 1985; Mleczko, 1991).

Among wrestlers there also exists a considerable individual differentiation, which may be borne out by a high value of variability coefficient. Individual differentiation revealed in the research may probably be treated as potential reserves which could be used in the following stages of training.

The experiment results prove that special coordination training ought to be an integral part of a training process. Coordination preparation training, often called coordination training, should have its own autonomic aims and tasks that follow general training aims in many sports disciplines, particularly in those of a complex movement structure.

The obtained research results make it possible to draw the following conclusions:

1. The increase in the volume of varied complexity coordination exercises in the training of wrestlers contributed to a considerable improvement in the level of CMA, i. e. by 11.4% on average, whereas in the group performing traditional training the improvement was only by 3%.
2. The gain score of coordination abilities in wrestlers aged 13—14 was the biggest in the case of the following CMA: rhythmization (19.1%), body balance (17.3%), motor adjustment (15.1%) and speed of reaction (11.3%). The smallest gain score was noticed in movement combining (4.7%), kinesthetic differentiation (4.9%) and time-space orientation (7.1%).
3. After the experiment there occurred significant differences in the level of most indices of CMA in the experimental and control group, which shows there may exist considerable reserves in the area of CMA. Autonomous coordination training ought to become an essential part of the process of training in wrestling.

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KOORDINACIJOS LAVINIMO POVEIKIS 13—14 METŲ GRAIKŲ-ROMĖNŲ IMTYNININKŲ KOORDINACINIŲ MOTORINIŲ GEBĖJIMŲ RODIKLIAMS

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SANTRAUKA

Imtynės — sudėtingų judesių sporto šaka, ir čia labai svarbūs motoriniai gebėjimai (KMG). Ryškus koordinacijos pagerėjimas nuo pirmų treniruočių metų teigiamai veikia naujų judesių mokymąsi, leidžia geriau panaudoti techninius ir taktinius įgūdžius sportinėje kovoje. Dėl to koordinacinių gebėjimų ugdymas nuo pirmų treniruočių metų yra būtina jaunųjų imtynininkų treniravimosi sąlyga.

Tyrimo tikslas — parodyti, kaip koordinacijos lavinimas veikia 13—14 metų graikų-romėnų imtynininkų koordinacinių motorinių gebėjimų pokyčius.

Tiriamieji — atsitiktinai atrinkti 13—14 metų graikų-romėnų imtynininkai (n = 32), besitreniruojantys studentų sporto klube UKS „Dwoika“. Jie buvo padalyti į dvi tokio paties sportinio lygio grupes: eksperimentinę (n = 16) ir kontrolinę (n = 16). Berniukų somatiniai rodikliai (kūno masė, ūgis, lieknumas) šiose grupėse reikšmingai nesiskyrė nei eksperimento pradžioje, nei pabaigoje, dėl to galima buvo atmesti lytinės brandos poveikį eksperimento rezultatams.

14 rodiklių buvo vertinta 7 KMG (kinestetinė diferenciacija, orientacija laike ir erdvėje, judesių jungimas, motorinis prisiderinimas, reakcijos greitis ir pusiausvyra). Tuo tikslu buvo naudojami įvairių autorių parengti sportiniai motoriniai testai. Pirmiausia patikrinome šių testų patikimumą ir tikslumą.

Pagrindinis tyrimo metodas — šešių mėnesių trukmės pedagoginis eksperimentas. Jo metu eksperimentinėje grupėje buvo taikoma daug įvairaus sudėtingumo (mažo, vidutinio ir didelio) koordinacijos lavinimo priemonių. Kontrolinė grupė buvo treniruojama tik klasikiniais metodais. Eksperimentui skirtos 84 treniruotės. Taikomos priemonės vienodai lavino visas tiriamas koordinacijos savybes. Bendra tokių pratimų suma viso eksperimento metu — 180 minučių, skirtų kiekvienai tiriamai savybei lavinti. Be to, kartą per savaitę buvo taikomi grandininiai koordinacijos pratimai ir koordinaciniai imtynių žaidimai. Bendras darbo krūvis abiejose grupėse buvo vienodas.

Pastebėta, kad tiriami KMG rodikliai eksperimentinėje grupėje buvo didesni, lyginant su kontroline grupe ($p < 0,05$). Reikšmingiausias padidėjimas (nuo 12,6 iki 27,5%) pastebėtas tiriant ritmiškumą, pusiausvyros išlaikymą ir motorinį prisiderinimą. Mažiausiai pakito judesių jungimas, kinestetinė diferenciacija ir orientacija laike bei erdvėje (nuo 4,7 iki 7,3%). Po eksperimento eksperimentinės ir kontrolinės grupių KMG rodikliai skyrėsi statistiškai patikimai ($p < 0,05$).

Tyrimo rezultatai leidžia daryti šias išvadas:

1. Daugiau įvairaus sudėtingumo koordinacijos pratimų per treniruotes reikšmingai pagerino imtynininkų KMG rodiklius (vidutiniškai 11,4%), o per tradicines treniruotes šie rodikliai pagerėjo tik 3%.

2. Labiausiai pagerėjo šie 13—14 metų imtynininkų KMG rodikliai: ritmiškumas (19,1%), kūno pusiausvyra (17,3%), motorinis prisiderinimas (15,1%) ir reakcijos greitis (11,3%). Mažiausias pagerėjimas pastebėtas šių rodiklių: judesių jungimo (4,7%), kinestetinės diferenciacijos (4,9%) ir orientacijoje laike bei erdvėje (7,1%).

3. Reikšmingas eksperimentinės ir kontrolinės grupės KMG rodiklių skirtumas rodo, kad yra dar daug lavinimo koordinacijos rezervų. Autonominis koordinacijos ugdymas turėtų būti svarbiausia imtynių treniruočių dalimi.

Raktažodžiai: graikų-romėnų imtynės, koordinacijos lavinimas, koordinaciniai motoriniai gebėjimai.

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