

Motor abilities: methods of strength and strength endurance development in middle-school-aged boys in a 4-week physical training cycle

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Abstract

Purpose: The study purpose was to develop a technology of programming for strength and strength endurance development in middle-school-aged boys in a 4-week physical training cycle.

Material: The study participants were boys of 6th grade (n=35), 7th grade (n=36), 8th grade (n=36). The study materials were processed by the IBM SPSS 23 statistical analysis software. The following parameters were calculated: arithmetic mean (X); standard deviation (s). The probability of difference in statistical indicators was estimated using the *Student's t*-test.

Results: The analysis of the study results demonstrated that after using a combined method of strength development (1-6 classes), the experimental group boys showed a statistically significant improvement in results in the set of tests ($p < 0.05$). After using a combined method of strength development, the 6th-8th grade boys had the largest increase in the results of strength and strength endurance of shoulder muscles, strength and strength endurance of abdominal muscles, strength and static strength endurance of leg muscles ($p < 0.05$). After using a circuit training method (7-12 classes), the experimental group boys also showed a statistically significant improvement in results in the set of tests ($p < 0.05$). The 6th-8th grade boys had the largest increase in the results of dynamic and static strength endurance of shoulder muscles, abdominal and back muscles, leg muscles ($p < 0.05$). According to the Eurofit motor fitness tests, after using the combined method of strength development (1-6 classes) and the circuit training method (7-12 classes) in a 4-week training cycle, the experimental group boys showed a statistically significant improvement in results in the set of tests ($p < 0.05$). During the experiment, the 6th-8th grade boys of the control group showed no statistically significant improvement in test results for most parameters ($p > 0.05$). A comparison between the levels of strength fitness of the control group boys and experimental group boys after the experiment showed that the experimental group boys had statistically significantly better results of strength and strength endurance of shoulder muscles, abdominal and back muscles, leg muscles ($p < 0.05$).

Conclusions: After using the combined method of strength development (1-6 classes) and the circuit training method (7-12 classes) in a 4-week physical training cycle, the middle-school-aged boys showed positive dynamics of strength and strength endurance development of shoulder muscles, abdominal and back muscles, leg muscles. The dynamics of strength and static endurance of the local muscle group is strongly influenced by the combined method of strength development. The circuit training method is effective to develop dynamic and static strength endurance of the local muscle group. For overall development of strength and general endurance, it is effective to use a combination of the combined method of strength development and circuit training method in a 4-week physical training cycle.

Keywords: boys, circuit training method, combined method, mischool age.

Introduction

Studying motor fitness of schoolchildren is one of the most important issues in school physical education [1, 2, 3]. A solution to this issue is related to the following perspectives:

- optimization of motor activity, health promotion and protection of children and adolescents [1, 4];
- planning and control of motor abilities development [5, 6];
- improvement in teaching physical exercises [7, 8].

The papers by Liakh [9], Ivaschenko [5] focus on the search for means and methods aimed at developing motor abilities in children and adolescents. The researchers determined the principles of strength development methods, revealed regularities, means and methods, as well as pedagogical control over motor abilities development

in schoolchildren [9, 5], identified the influence of various forms of lessons on improving motor fitness of middle-school-aged boys, found that boys of this age undergo an overall development of motor abilities [10, 11].

The analysis of scientific literature showed that:

- strength fitness can be regarded as a basis for speed and endurance development [12, 11];
- circuit training method is effective for developing general and local strength endurance [12, 13];
- combined method of strength development is preferable for overall development of muscle groups [14].

Thus, additional research is needed to study the impact of a series of physical training classes using the combined method of strength development and the circuit training method on the dynamics of strength abilities and strength endurance development in middle-school-aged boys.

The study purpose was to develop methods for strength and strength endurance development in middle-school-aged boys in a 4-week physical training cycle.

The study object was the process of physical education of 6th-8th grade boys.

Materials and methods

Participants. The study participants were boys of 6th grade (n=35), 7th grade (n=36), 8th grade (n=36). The children and their parents were fully informed about all the features of the study and gave their consent to participate in the experiment.

Research Design. The study was conducted in a 4-week physical training cycle. For experimental groups, lessons in developing strength and strength endurance of shoulder muscles, abdominal and back muscles, leg muscles were conducted according to the following scheme: combined method of strength development, 1–6 classes; mode of exercising: dynamic effort method, 5 repetitions with a 45-second rest interval between sets; maximum effort method, 3 repetitions with a 45-second rest interval between sets; isometric effort method, 3 repetitions with a 45-second rest interval; repetition effort method, 10-12 repetitions with a 45-second rest interval; circuit training method, 7-12 classes.

The circuit training included two classes aimed at developing shoulder muscle endurance (first – maximum, second – 50% of maximum), two classes developing abdominal and back muscle endurance (first – maximum, second – 50% of maximum), two classes developing leg muscle endurance (first – maximum, second – 50% of maximum).

For control groups, an overall development of motor abilities was carried out according to the curriculum during physical training classes.

To solve the tasks set, the following research methods were used: analysis of scientific and methodological literature, pedagogical testing, and methods of mathematical statistics for processing research results.

The experimental group was tested before the experiment, after six classes of combined strength development and after six circuit training classes. The control group was tested before the experiment and after a 4-week cycle according to the school curriculum.

Testing procedure. The testing procedure included commonly known tests [9, 5, 16].

Test 1. Pull-Up / Chin Up Test (low crossbar), quantity of times;

Test 2. Bent Arm Hang Test (two hands), sec.;

Test 3. Pull-Up / Chin Up Test (Rope Climbing), quantity of times;

Test 4. Cadence Push-Up Test, quantity of times;

Test 5. The subject lies in prone position, arms bent at the elbow 90 degrees - hold position in seconds;

Test 6. Pull Up Bar - Straight Leg Hanging Leg Raises, quantity of times;

Test 7. Hanging Leg Raises, sec.;

Test 8. Decline Reverse Crunch on Bench, quantity of times;

Test 9. Trunk Lift Test, quantity of times;

Test 10. Squats Test (two legs), quantity of times;

Test 11. Single Leg Squat (SLS) Test - right leg, quantity of times;

Test 12. Single Leg Squat (SLS) Test - left leg, quantity of times;

Test 13. Single Leg Squat (Pistol) - right leg;

Test 14. Single Leg Squat (Pistol) - left leg;

Test 15. Handgrip Strength Test, kg;

Test 16. Standing Long Jump Test (Broad Jump), cm;

Test 17. Eurofit Sit Up Test (for 30 sec.), quantity of times;

Test 18. 4x9 m Shuttle Run Test, sec.;

Test 19. Hand Tapping Test, sec.;

Test 20. Seated Forward Bend, cm;

Test 21. Flamingo Balance Test - single leg balance test;

Test 22. Harvard Step Test.

During shoulder muscle testing, the following parameters were measured: Pull-Up / Chin Up Test (shoulder flexion strength), Bent Arm Hang Test (shoulder flexion static endurance), Pull-Up / Chin Up Test (Rope Climbing) (shoulder flexion strength endurance), Cadence Push-Up Test and The subject lies in prone position, arms bent at the elbow 90 degrees - hold position in seconds (shoulder extension strength).

During abdominal and back muscle testing, the following parameters were measured: Pull Up Bar - Straight Leg Hanging Leg Raises (abdominal muscle strength), Hanging Leg Raises (abdominal muscle static endurance), Decline Reverse Crunch on Bench (abdominal muscle strength endurance), Trunk Lift Test (back muscle endurance).

During leg muscle testing, the following parameters were measured: Squats Test (two legs) (leg muscle strength endurance), Single Leg Squat Test - right leg, Single Leg Squat Test - left leg (leg muscle strength), Single Leg Squat (Pistol) - right leg, Single Leg Squat (Pistol) - left leg (leg muscle static endurance).

The study also measured motor abilities parameters using the Eurofit tests: Handgrip Strength Test (hand flexion strength), Standing Long Jump Test (speed and strength), Eurofit Sit Up Test (for 30 sec.) (abdominal muscle strength endurance), 4x9 m Shuttle Run Test (dexterity), Hand Tapping Test (speed), Seated Forward Bend (flexibility), Flamingo Balance Test (static balance of the body).

Statistical analysis. The study used the IBM SPSS 23 software. For each variable, the following statistics were calculated: mean values, standard deviations, Student's t-test for paired samples and Student's t-test for independent samples.

The study protocol was approved by the Ethical Committee of H. S. Skovoroda Kharkiv National Pedagogical University. In addition, the children and their parents or legal guardians were fully informed about all the features of the study, and a signed informed-consent document was obtained from all the parents.

Results

Tables 1-6 present the test results of strength fitness of the control and experimental group boys.

After the combined method of strength development

(see Table 1), the experimental group boys showed a statistically significant improvement in results in the set of tests ($p < 0.05$).

The test results of shoulder muscle strength of the 6th

Table 1. Test results of strength fitness of 6th -8th grade boys (experimental group). Combined method of strength development

No.	Test	Grade	Before experiment		After experiment		Increase %	t	P	
			x	s	x	s				
1	Pull-Up / Chin Up Test (low crossbar), quantity of times	6	3.368	1.257	4.053	1.026	-0.684	20.3	-4.444	0.000
		7	4.790	1.932	5.316	1.701	-0.526	11.0	-3.750	0.001
		8	5.895	2.558	6.316	2.311	-0.421	7.1	-3.618	0.002
2	Bent Arm Hang Test (two hands), sec.	6	4.226	1.276	4.700	0.946	-0.474	11.2	-3.911	0.001
		7	5.758	1.987	6.337	1.817	-0.579	10.0	-9.977	0.000
		8	6.626	1.918	7.000	1.842	-0.374	5.6	-8.400	0.000
3	Pull-Up / Chin Up Test (Rope Climbing), quantity of times	6	9.579	2.775	10.526	2.480	-0.947	9.9	-5.295	0.000
		7	10.737	2.705	11.895	2.664	-1.158	10.8	-8.382	0.000
		8	13.368	2.910	14.474	2.776	-1.105	8.3	-10.500	0.000
4	Cadence Push-Up Test, quantity of times	6	17.895	3.213	19.263	3.494	-1.368	7.6	-6.245	0.000
		7	18.842	4.598	20.158	4.259	-1.316	7.0	-6.994	0.000
		8	21.684	3.575	22.632	3.113	-0.947	4.4	-4.025	0.001
5	The subject lies in prone position, arms bent at the elbow 90 degrees - hold position in seconds	6	13.016	2.661	13.321	2.637	-0.305	2.3	-8.420	0.000
		7	14.116	2.904	14.542	2.926	-0.426	3.0	-9.583	0.000
		8	17.168	2.077	17.411	2.064	-0.242	1.4	-7.608	0.000
6	Pull Up Bar- Straight Leg Hanging Leg Raises, quantity of times	6	4.316	0.820	4.842	0.834	-0.526	12.2	-4.472	0.000
		7	5.526	1.073	6.158	0.958	-0.632	11.4	-5.555	0.000
		8	6.263	0.991	6.842	0.765	-0.579	9.2	-4.158	0.001
7	Hanging Leg Raises, sec.	6	5.247	0.646	5.689	0.624	-0.442	8.4	-8.232	0.000
		7	6.179	0.991	6.574	0.982	-0.395	6.4	-8.791	0.000
		8	7.321	0.961	7.637	0.941	-0.316	4.3	-9.409	0.000
8	Decline Reverse Crunch on Bench, quantity of times	6	9.947	1.870	10.684	1.827	-0.737	7.4	-4.916	0.000
		7	9.632	1.892	10.737	2.104	-1.105	11.5	-6.533	0.000
		8	14.105	2.706	15.105	2.331	-1.000	7.1	-7.550	0.000
9	Trunk Lift Test, quantity of times	6	24.737	2.257	26.158	1.979	-1.421	5.7	-5.092	0.000
		7	26.316	2.382	26.895	2.052	-0.579	2.2	-3.012	0.007
		8	29.947	3.045	30.474	2.855	-0.526	1.8	-3.750	0.001
10	Squats Test (two legs), quantity of times	6	27.263	3.445	29.263	3.142	-2.000	7.3	-7.886	0.000
		7	28.263	4.331	29.789	3.489	-1.526	5.4	-5.459	0.000
		8	33.632	3.004	34.842	2.363	-1.211	3.6	-5.750	0.000
11	Single Leg Squat (SLS) Test - right leg, quantity of times	6	2.211	0.855	2.368	0.761	-0.158	7.1	-1.837	0.083
		7	2.842	1.167	3.000	1.000	-0.158	5.6	-1.837	0.083
		8	3.105	0.936	3.211	0.855	-0.105	3.4	-1.455	0.163
12	Single Leg Squat (SLS) Test - left leg, quantity of times	6	1.842	0.834	1.895	0.809	-0.053	2.9	-1.000	0.331
		7	2.158	1.068	2.263	0.991	-0.105	4.9	-1.455	0.163
		8	2.579	0.961	2.684	0.885	-0.105	4.1	-1.455	0.163
13	Single Leg Squat (Pistol) - right leg	6	4.684	0.825	5.279	0.766	-0.595	12.7	-9.012	0.000
		7	5.005	1.315	5.474	1.232	-0.468	9.4	-9.930	0.000
		8	5.705	1.083	6.295	0.977	-0.589	10.3	-14.098	0.000
14	Single Leg Squat (Pistol) - left leg	6	4.211	0.836	4.732	0.827	-0.521	12.4	-9.984	0.000
		7	4.311	1.176	4.826	1.218	-0.516	12.0	-11.875	0.000
		8	5.232	0.972	5.595	1.031	-0.363	6.9	-6.986	0.000

Table 2. Test results of strength fitness of 6th -8th grade boys (experimental group). Circuit training method

No.	Test	Grade	Before experiment		After experiment		Increase %	t	P	
			x	s	x	s				
1	Pull-Up / Chin Up Test (low crossbar), quantity of times	6	4.053	1.026	4.368	0.895	-0.316	7.8	-2.882	0.010
		7	5.316	1.701	5.684	1.416	-0.368	6.9	-2.348	0.031
		8	6.316	2.311	6.789	1.988	-0.474	7.5	-4.025	0.001
2	Bent Arm Hang Test (two hands), sec.	6	4.700	0.946	5.032	0.952	-0.332	7.0	-7.221	0.000
		7	6.337	1.817	6.595	1.645	-0.258	4.1	-4.534	0.000
		8	7.000	1.841	7.453	1.746	-0.453	6.5	-10.246	0.000
3	Pull-Up / Chin Up Test (Rope Climbing), quantity of times	6	10.526	2.480	11.263	2.207	-0.737	7.0	-4.379	0.000
		7	11.895	2.664	12.474	2.366	-0.579	4.9	-4.158	0.001
		8	14.474	2.776	15.263	2.156	-0.789	5.5	-3.174	0.005
4	Cadence Push-Up Test, quantity of times	6	19.263	3.494	19.947	3.027	-0.684	3.5	-4.444	0.000
		7	20.158	4.259	20.947	3.865	-0.789	3.9	-4.371	0.000
		8	22.632	3.113	23.421	2.950	-0.789	3.5	-4.371	0.000
5	The subject lies in prone position, arms bent at the elbow 90 degrees - hold position in seconds	6	13.321	2.637	13.568	2.598	-0.247	1.9	-7.762	0.000
		7	14.542	2.926	15.037	2.804	-0.495	3.4	-8.534	0.000
		8	15.105	2.331	15.842	1.803	-0.737	4.9	-4.379	0.000
6	Pull Up Bar- Straight Leg Hanging Leg Raises, quantity of times	6	4.842	0.834	5.053	0.780	-0.211	4.4	-2.191	0.042
		7	6.158	0.958	6.632	1.116	-0.474	7.7	-3.375	0.003
		8	6.842	0.765	7.579	1.017	-0.737	10.8	-4.379	0.000
7	Hanging Leg Raises, sec.	6	5.689	0.624	5.926	0.550	-0.237	4.2	-5.077	0.000
		7	6.574	0.982	7.026	0.902	-0.453	6.9	-7.618	0.000
		8	7.637	0.941	8.105	0.874	-0.468	6.1	-8.836	0.000
8	Decline Reverse Crunch on Bench, quantity of times	6	10.684	1.827	11.789	1.813	-1.105	10.3	-5.144	0.000
		7	10.737	2.104	11.474	2.038	-0.737	6.9	-4.379	0.000
		8	15.105	2.331	15.842	1.803	-0.737	4.9	-4.379	0.000
9	Trunk Lift Test, quantity of times	6	26.158	1.979	26.737	1.759	-0.579	2.2	-3.644	0.002
		7	26.895	2.052	27.579	1.924	-0.684	2.5	-3.980	0.001
		8	30.474	2.855	31.211	2.417	-0.737	2.4	-3.986	0.001
10	Squats Test (two legs), quantity of times	6	29.263	3.142	30.105	2.846	-0.842	2.9	-4.086	0.001
		7	29.789	3.489	30.684	3.233	-0.895	3.0	-4.819	0.000
		8	34.842	2.363	36.211	1.686	-1.368	3.9	-4.083	0.001
11	Single Leg Squat (SLS) Test - right leg, quantity of times	6	2.368	0.761	2.421	0.692	-0.053	2.2	-1.000	0.331
		7	3.000	1.000	3.105	0.936	-0.105	3.5	-1.455	0.163
		8	3.211	0.855	3.316	0.749	-0.105	3.3	-1.455	0.163
12	Single Leg Squat (SLS) Test - left leg, quantity of times	6	1.895	0.809	1.947	0.705	-0.053	2.8	-1.000	0.331
		7	2.263	0.991	2.316	0.946	-0.053	2.3	-1.000	0.331
		8	2.684	0.885	2.789	0.787	-0.105	3.9	-1.455	0.163
13	Single Leg Squat (Pistol) - right leg	6	5.279	0.766	5.668	0.745	-0.389	7.4	-7.869	0.000
		7	5.474	1.232	6.105	1.166	-0.632	11.5	-8.298	0.000
		8	6.295	0.977	6.784	0.828	-0.489	7.8	10.398	0.000
14	Single Leg Squat (Pistol) - left leg	6	4.732	0.827	5.158	0.726	-0.426	9.0	-6.162	0.000
		7	4.826	1.218	5.274	1.228	-0.447	9.3	-8.591	0.000
		8	5.595	1.031	6.105	0.890	-0.511	9.1	-8.224	0.000

grade boys statistically significantly increased in test 1 (shoulder flexion strength) by 20.3%; in test 2 (shoulder flexion static endurance) by 11.2%; in test 3 (shoulder flexion strength endurance) by 9.9%; in test 4 (shoulder extension strength) by 7.6%. The test results of abdominal and back muscle strength statistically significantly

increased in test 6 (abdominal muscle strength) by 12.2%; in test 7 (abdominal muscle static endurance) by 8.4%; in test 8 (abdominal muscle strength endurance) by 7.4%. The test results of leg muscle strength statistically significantly increased in test 10 (leg muscle strength endurance) by 7.3%; in tests 13 and 14 (leg muscle static

Table 3. Test results of strength fitness of 6th-8th grade boys (control group). Circuit training method

No.	Test	Grade	n	Before experiment		After experiment		Increase %	t	P	
				x	s	x	s				
1	Pull-Up / Chin Up Test (low crossbar), quantity of times	6	16	3.375	1.310	3.563	1.153	-0.188	5.6	-1.861	0.083
		7	17	4.706	2.469	4.824	2.351	-0.118	2.5	-1.461	0.163
		8	17	5.941	2.657	6.059	2.633	-0.118	2.0	-1.461	0.163
2	Bent Arm Hang Test (two hands), sec.	6	16	4.225	1.205	4.319	1.228	-0.094	2.2	-1.996	0.064
		7	17	4.965	1.879	5.059	1.771	-0.094	1.9	-1.793	0.092
		8	17	5.976	1.816	6.018	1.797	-0.041	0.7	-1.692	0.110
3	Pull-Up / Chin Up Test (Rope Climbing), quantity of times	6	16	10.063	3.193	10.250	3.109	-0.188	1.9	-1.861	0.083
		7	17	9.235	2.927	9.353	2.871	-0.118	1.3	-1.461	0.163
		8	17	13.000	2.718	13.235	2.562	-0.235	1.8	-2.219	0.041
4	Cadence Push-Up Test, quantity of times	6	16	18.625	3.344	18.750	3.256	-0.125	0.7	-1.464	0.164
		7	17	18.176	4.640	18.294	4.469	-0.118	0.6	-1.461	0.163
		8	17	20.941	3.363	21.118	3.219	-0.176	0.8	-1.852	0.083
5	The subject lies in prone position, arms bent at the elbow 90 degrees - hold position in seconds	6	16	13.587	2.273	13.700	2.192	-0.113	0.8	-1.840	0.086
		7	17	14.329	2.665	14.447	2.688	-0.118	0.8	-2.311	0.034
		8	17	16.618	2.282	16.612	2.252	0.006	0.0	0.120	0.906
6	Pull Up Bar- Straight Leg Hanging Leg Raises, quantity of times	6	16	4.063	1.124	4.188	1.047	-0.125	3.0	-1.464	0.164
		7	17	5.471	1.375	5.588	1.326	-0.117	2.1	-1.461	0.163
		8	17	7.000	1.275	7.118	1.111	-0.118	1.7	-1.461	0.163
7	Hanging Leg Raises, sec.	6	16	4.856	0.904	4.900	0.878	-0.044	0.9	-1.282	0.219
		7	17	5.994	0.957	6.018	0.927	-0.023	0.4	-0.746	0.466
		8	17	7.141	0.879	7.118	0.821	0.023	0.3	0.523	0.608
8	Decline Reverse Crunch on Bench, quantity of times	6	16	10.125	2.579	10.250	2.569	-0.125	1.2	-1.464	0.164
		7	17	9.882	2.088	10.059	2.045	-0.176	1.8	-1.852	0.083
		8	17	13.353	2.805	13.471	2.672	-0.118	0.9	-1.461	0.163
9	Trunk Lift Test, quantity of times	6	16	23.563	2.632	23.687	2.469	-0.125	0.5	-1.464	0.164
		7	17	23.765	3.052	23.941	2.839	-0.176	0.7	-1.852	0.083
		8	17	27.471	3.281	27.647	3.121	-0.176	0.6	-1.852	0.083
10	Squats Test (two legs), quantity of times	6	16	27.937	3.193	28.063	3.065	-0.125	0.4	-1.464	0.164
		7	17	28.294	4.606	28.647	4.242	-0.353	1.2	-2.073	0.055
		8	17	31.823	2.481	32.000	2.424	-0.176	0.5	-1.376	0.188
11	Single Leg Squat (SLS) Test - right leg, quantity of times	6	16	1.813	0.911	1.813	0.911	-	-	-	-
		7	17	2.353	1.057	2.353	1.057	-	-	-	-
		8	17	2.647	1.057	2.647	1.057	-	-	-	-
12	Single Leg Squat (SLS) Test - left leg, quantity of times	6	16	1.563	0.727	1.563	0.727	-	-	-	-
		7	17	1.941	0.899	1.941	0.899	-	-	-	-
		8	17	2.471	0.874	2.471	0.874	-	-	-	-
13	Single Leg Squat (Pistol) - right leg	6	16	4.431	0.973	4.469	0.982	-0.038	0.8	-1.861	0.083
		7	17	4.188	1.252	4.318	1.155	-0.129	3.0	-2.637	0.018
		8	17	4.918	1.172	4.988	1.118	-0.070	1.4	-1.509	0.151
14	Single Leg Squat (Pistol) - left leg	6	16	3.950	0.848	3.994	0.854	-0.044	1.1	-1.447	0.168
		7	17	3.735	1.127	3.806	1.057	-0.071	1.9	-1.900	0.076
		8	17	4.782	1.197	4.818	1.199	-0.035	0.7	-1.144	0.269

endurance) by 12.7% and 12.4%, respectively.

The test results of shoulder muscle strength of the 7th grade experimental group boys statistically significantly increased in test 1 (shoulder flexion strength) by 11.0%; in test 2 (shoulder flexion static endurance) by 10.0% and in test 3 (shoulder flexion strength endurance) by 10.8%.

The test results of abdominal and back muscle strength statistically significantly increased in test 6 (abdominal muscle strength) by 11.4% and in test 8 (abdominal muscle strength endurance) by 11.5% ($p < 0.05$). The test results of leg muscle strength statistically significantly increased in test 10 (leg muscle strength endurance) by

Table 4. Test results of strength fitness of 6th -8th grade boys after a one-month physical training cycle using the combined method of strength development and the circuit training method (experimental group).

No.	Test	Grade	n	Before experiment		After experiment		Increase %	t	P	
				x	s	x	s				
15	Handgrip Strength Test, kg	6	19	16.305	1.407	16.421	1.387	-0.116	0.7	-3.450	0.003
		7	19	17.579	1.458	17.868	1.416	-0.289	1.6	-8.090	0.000
		8	19	18.147	1.916	18.374	1.855	-0.226	1.2	-5.712	0.000
16	Standing Long Jump Test (Broad Jump), cm	6	19	1.542	0.133	1.546	0.127	-0.004	0.3	-1.455	0.163
		7	19	1.589	0.210	1.611	0.199	-0.022	1.4	-4.686	0.000
		8	19	1.671	0.213	1.685	0.205	-0.015	0.9	-3.441	0.003
17	Eurofit Sit Up Test (for 30 sec.), quantity of times	6	19	23.947	3.613	24.579	3.024	-0.632	2.6	-2.721	0.014
		7	19	26.684	4.888	27.789	4.144	-1.105	4.1	-4.025	0.001
		8	19	26.263	3.413	27.158	2.814	-0.895	3.4	-3.923	0.001
18	4x9 m Shuttle Run Test, sec.	6	19	11.616	0.462	11.463	0.469	0.153	1.3	4.422	0.000
		7	19	11.374	0.605	11.263	0.576	0.111	1.0	3.625	0.002
		8	19	11.037	0.680	10.926	0.689	0.111	1.0	3.745	0.001
19	Hand Tapping Test, sec.	6	19	13.937	0.779	13.779	0.755	0.158	1.1	5.276	0.000
		7	19	13.632	0.987	13.484	0.944	0.147	1.0	4.169	0.001
		8	19	12.263	0.617	12.168	0.576	0.095	0.8	3.375	0.003
20	Seated Forward Bend, cm	6	19	5.895	1.100	5.947	0.911	-0.053	0.9	-0.438	0.667
		7	19	5.474	1.172	5.368	0.895	0.105	2.7	1.000	0.331
		8	19	4.526	1.429	4.474	1.219	0.053	1.2	0.567	0.578
21	Flamingo Balance test - single leg balance test	6	19	9.000	1.856	8.789	1.475	0.211	2.3	1.455	0.163
		7	19	7.895	1.449	7.895	1.243	0.000	0.0	0.000	1.000
		8	19	8.105	1.595	8.158	1.259	-0.053	0.7	-0.325	0.749
22	Harvard Step Test	6	19	63.421	4.046	65.000	3.756	-1.579	2.5	-4.962	0.000
		7	19	65.684	5.508	67.632	6.112	-1.947	3.0	-4.401	0.000
		8	19	67.421	5.337	68.737	5.636	-1.316	2.0	-3.664	0.002

Table 5. Test results of motor fitness of the control group boys after a 4-week physical training cycle according to the school curriculum

No.	Test	Grade	n	Before experiment		After experiment		Increase %	t	P	
				x	s	x	s				
15	Handgrip Strength Test, kg	6	16	16.419	1.313	16.456	1.327	-0.038	0.2	-1.695	0.111
		7	17	16.012	1.796	16.059	1.784	-0.047	0.3	-2.057	0.056
		8	17	16.900	1.569	16.923	1.534	-0.024	0.1	-0.497	0.626
16	Standing Long Jump Test (Broad Jump), cm	6	16	1.540	0.125	1.541	0.125	-0.001	0.1	-1.000	0.333
		7	17	1.574	0.173	1.574	0.170	-0.000	0.0	-0.270	0.791
		8	17	1.705	0.143	1.705	0.143	0.000	0.0	0.270	0.791
17	Eurofit Sit Up Test (for 30 sec.), quantity of times	6	16	24.625	3.202	24.813	2.949	-0.187	0.7	-1.379	0.188
		7	17	26.412	4.287	26.706	3.949	-0.294	1.1	-2.063	0.056
		8	17	25.294	3.653	25.412	3.572	-0.118	0.5	-1.461	0.163
18	4x9 m Shuttle Run Test, sec.	6	16	11.469	0.535	11.469	0.545	0.000	0.0	0.000	1.000
		7	17	11.247	0.565	11.247	0.540	0.000	0.0	0.000	1.000
		8	17	10.935	0.625	10.994	0.678	-0.059	0.5	-1.429	0.172
19	Hand Tapping Test, sec.	6	16	14.344	0.697	14.325	0.736	0.019	0.1	0.426	0.676
		7	17	14.106	1.112	14.112	1.159	-0.006	0.1	-0.148	0.884
		8	17	12.929	1.236	12.912	1.265	0.018	0.1	0.337	0.740
20	Seated Forward Bend, cm	6	16	5.813	1.109	5.875	1.088	-0.063	1.0	-1.000	0.333
		7	17	5.353	1.835	5.353	1.835	-	-	-	-
		8	17	4.941	1.435	4.941	1.435	-	-	-	-
21	Flamingo Balance test - single leg balance test	6	16	9.500	1.592	9.250	1.390	0.250	2.6	1.732	0.104
		7	17	8.176	1.629	8.118	1.536	0.059	0.7	0.566	0.579
		8	17	7.941	1.819	7.882	1.576	0.059	0.7	0.566	0.579
22	Harvard Step Test	6	16	66.563	3.915	66.687	3.516	-0.125	0.2	-0.620	0.544
		7	17	71.588	5.917	71.529	5.680	0.059	0.1	0.324	0.750
		8	17	68.412	4.691	68.353	5.049	0.059	0.1	0.324	0.750

Table 6. Comparative analysis between the levels of strength fitness of the 6th -8th grade boys of the experimental and control groups after the experiment

No	Test	Grade	n	Experimental group		n	Control group		p
				x	s		x	s	
1	Pull-Up / Chin Up Test (low crossbar), quantity of times	6	19	4.368	0.895	16	3.563	1.153	0.026
		7	19	5.684	1.416	17	4.824	2.351	0.187
		8	19	6.789	1.988	17	6.059	2.633	0.351
2	Bent Arm Hang Test (two hands), sec.	6	19	5.032	0.952	16	4.319	1.228	0.062
		7	19	6.595	1.645	17	5.059	1.771	0.011
		8	19	7.453	1.746	17	6.018	1.797	0.021
3	Pull-Up / Chin Up Test (Rope Climbing), quantity of times	6	19	11.263	2.207	16	10.250	3.109	0.269
		7	19	12.474	2.366	17	9.353	2.871	0.001
		8	19	15.263	2.156	17	13.235	2.562	0.014
4	Cadence Push-Up Test, quantity of times	6	19	19.947	3.027	16	18.750	3.256	0.268
		7	19	20.947	3.865	17	18.294	4.469	0.065
		8	19	23.421	2.950	17	21.118	3.219	0.032
5	The subject lies in prone position, arms bent at the elbow 90 degrees - hold position in seconds	6	19	13.568	2.598	16	13.700	2.192	0.874
		7	19	15.037	2.804	17	14.447	2.688	0.525
		8	19	17.758	2.051	17	16.612	2.252	0.119
6	Pull Up Bar- Straight Leg Hanging Leg Raises, quantity of times	6	19	5.053	0.780	16	4.188	1.047	0.008
		7	19	6.632	1.116	17	5.588	1.326	0.015
		8	19	7.579	1.017	17	7.118	1.111	0.202
7	Hanging Leg Raises, sec.	6	19	5.926	0.550	16	4.900	0.878	0.000
		7	19	7.026	0.902	17	6.018	0.927	0.002
		8	19	8.105	0.874	17	7.118	0.821	0.001
8	Decline Reverse Crunch on Bench, quantity of times	6	19	11.789	1.813	16	10.250	2.569	0.046
		7	19	11.474	2.038	17	10.059	2.045	0.046
		8	19	15.842	1.803	17	13.471	2.672	0.003
9	Trunk Lift Test, quantity of times	6	19	26.737	1.759	16	23.687	2.469	0.000
		7	19	27.579	1.924	17	23.941	2.839	0.000
		8	19	31.211	2.417	17	27.647	3.121	0.000
10	Squats Test (two legs), quantity of times	6	19	30.105	2.846	16	28.063	3.065	0.049
		7	19	30.684	3.233	17	28.647	4.242	0.112
		8	19	36.211	1.686	17	32.000	2.424	0.000
11	Single Leg Squat (SLS) Test - right leg, quantity of times	6	19	2.421	0.692	16	1.813	0.911	0.032
		7	19	3.105	0.936	17	2.353	1.057	0.030
		8	19	3.316	0.749	17	2.647	1.057	0.034
12	Single Leg Squat (SLS) Test - left leg, quantity of times	6	19	1.947	0.705	16	1.563	0.727	0.122
		7	19	2.316	0.946	17	1.941	0.899	0.233
		8	19	2.789	0.787	17	2.471	0.874	0.258
13	Single Leg Squat (Pistol) - right leg	6	19	5.668	0.745	16	4.469	0.982	0.000
		7	19	6.105	1.166	17	4.318	1.155	0.000
		8	19	6.784	0.828	17	4.988	1.118	0.000
14	Single Leg Squat (Pistol) - left leg	6	19	5.158	0.726	16	3.994	0.854	0.000
		7	19	5.274	1.228	17	3.806	1.057	0.001
		8	19	6.105	0.890	17	4.818	1.199	0.001
15	Handgrip Strength Test, kg	6	19	16.421	1.387	16	16.456	1.327	0.940
		7	19	17.868	1.416	17	16.059	1.784	0.002
		8	19	18.374	1.855	17	16.923	1.534	0.016
16	Standing Long Jump Test (Broad Jump), cm	6	19	1.546	0.127	16	1.541	0.125	0.905
		7	19	1.611	0.199	17	1.574	0.170	0.562
		8	19	1.685	0.205	17	1.705	0.143	0.746
17	Eurofit Sit Up Test (for 30 sec.), quantity of times	6	19	1.546	0.127	16	1.541	0.125	0.905
		7	19	27.789	4.144	17	26.706	3.949	0.429
		8	19	27.158	2.814	17	25.412	3.572	0.111
18	4x9 m Shuttle Run Test, sec.	6	19	11.463	0.469	16	11.469	0.545	0.974
		7	19	11.263	0.576	17	11.247	0.540	0.932
		8	19	10.926	0.689	17	10.994	0.678	0.768
19	Hand Tapping Test, sec.	6	19	13.779	0.755	16	14.325	0.736	0.038
		7	19	13.484	0.944	17	14.112	1.159	0.083
		8	19	12.168	0.576	17	12.912	1.265	0.027
20	Seated Forward Bend, cm	6	19	5.947	0.911	16	5.875	1.088	0.832
		7	19	5.368	0.895	17	5.353	1.835	0.974
		8	19	4.474	1.219	17	4.941	1.435	0.298
21	Flamingo Balance test - single leg balance test	6	19	8.789	1.475	16	9.250	1.390	0.352
		7	19	7.895	1.243	17	8.118	1.536	0.634
		8	19	8.158	1.259	17	7.882	1.576	0.564
22	Harvard Step Test	6	19	65.000	3.756	16	66.687	3.516	0.182
		7	19	67.632	6.112	17	71.529	5.680	0.056
		8	19	68.737	5.636	17	68.353	5.049	0.832

5.4% and in tests 13 and 14 (leg muscle static endurance) by 9.4% and 12.0%, respectively ($p < 0.001$).

The test results of shoulder muscle strength of the 8th grade experimental group boys statistically significantly increased in test 1 (shoulder flexion strength) by 7.1%, test 2 (shoulder flexion static endurance) and test 3 (shoulder flexion strength endurance) by 5.6% and 8.3%, respectively. The test results of abdominal and back muscle strength statistically significantly increased in test 6 (abdominal muscle strength) by 9.2% and in test 8 (abdominal muscle strength endurance) by 7.1% ($p < 0.001$). The test results of leg muscle strength statistically significantly increased in tests 13 and 14 (leg muscle static endurance) by 10.3% and 6.9%, respectively.

After the circuit training method (see Table 2), the experimental group boys showed a statistically significant improvement in results in the set of tests ($p < 0.05$).

The test results of shoulder muscle strength of the 6th grade experimental group boys statistically significantly increased in test 1 (shoulder flexion strength) by 7.8%; in test 2 (shoulder flexion static endurance) and test 3 (shoulder flexion strength endurance) by 7.0% and 7.0%, respectively ($p < 0.001$). The test results of abdominal and back muscle strength statistically significantly increased in test 8 (abdominal muscle strength endurance) by 10.3% ($p < 0.001$). The test results of leg muscle strength statistically significantly increased in tests 13 and 14 (leg muscle static endurance) by 7.4% and 9.0%, respectively ($p < 0.001$).

The test results of shoulder muscle strength of the 7th grade experimental group boys statistically significantly increased in test 1 (shoulder flexion strength) by 6.9% and in test 3 (shoulder flexion strength endurance) by 4.9% ($p < 0.001$). The test results of abdominal and back muscle strength statistically significantly increased in test 6 (abdominal muscle strength) by 7.7%, in test 7 (abdominal muscle static endurance) and 8 (abdominal muscle strength endurance) by 6.9% and 6.9%, respectively. The test results of leg muscle strength statistically significantly increased in tests 13 and 14 (leg muscle static endurance) by 11.5% and 9.3%, respectively ($p < 0.001$).

The test results of shoulder muscle strength of the 8th grade experimental group boys statistically significantly increased in test 1 (shoulder flexion strength) by 7.5%, in test 2 (shoulder flexion static endurance) by 6.5% and test 3 (shoulder flexion strength endurance) by 5.5%, respectively.

The test results of abdominal and back muscle strength statistically significantly increased in test 6 (abdominal muscle strength) by 10.8% and in test 7 (abdominal muscle static endurance) by 6.1%. The test results of leg muscle strength statistically significantly increased in tests 13 and 14 (leg muscle static endurance) by 7.8% and 9.1%, respectively.

During the experiment, the control group boys (see Table 3) showed no statistically significant improvement in the test results for most parameters ($p > 0.05$). The 7th grade control group boys showed a tendency to improve the results in test 5 (shoulder extension strength)

($p < 0.05$), the 8th grade boys – in test 3 (shoulder flexion strength endurance) ($p < 0.05$). In other tests, there were no statistically significant differences between the 6th-8th grade boys ($p > 0.05$).

According to the Eurofit motor fitness tests, after a 4-week training cycle, the experimental group boys (see Table 4) showed a statistically significant improvement in results in the set of tests ($p < 0.05$).

The results of the 6th grade experimental group boys statistically significantly increased in test 17 (abdominal muscle strength endurance) by 2.6% and in test 22 (Harvard Step Test) by 2.5% ($p < 0.001$).

The results of the 7th grade boys statistically significantly increased in test 17 (abdominal muscle strength endurance) by 4.1% and in test 22 (general endurance) by 3.0% ($p < 0.001$).

The results of the 8th grade experimental group boys statistically significantly increased in test 17 (abdominal muscle strength endurance) by 3.4% and in test 22 (general endurance) by 2.0% ($p < 0.05$).

In other tests, the 6th-8th grade boys showed a tendency to improve the test results ($p > 0.05$).

During the experiment, the control group boys (see Table 5) showed no statistically significant improvement in the test results for most parameters ($p > 0.05$).

A comparison between the levels of strength fitness of the control group boys and experimental group boys after the experiment (see Table 6) showed that the 6th grade boys of the experimental group had statistically significantly better test results of strength and strength endurance of shoulder muscles, abdominal and back muscles in tests 1, 6, 7, 8, 9 ($p < 0.05$), and statistically significantly better test results of leg muscle strength in tests 10, 11, 13, 14 ($p < 0.05$).

A comparison between the levels of strength fitness of the control group boys and experimental group boys after the experiment (see Table 7) showed that the 7th grade boys of the experimental group had statistically significantly better test results of strength and strength endurance of shoulder muscles, abdominal and back muscles in tests 2, 3, 6, 7, 8, 9 ($p < 0.05$), and statistically significantly better test results of leg muscle strength in tests 13, 14 ($p < 0.05$).

A comparison between the levels of strength fitness of the control group boys and experimental group boys after the experiment (see Table 8) showed that the 8th grade boys of the experimental group had statistically significantly better test results of strength and strength endurance of shoulder muscles, abdominal and back muscles in tests 2, 3, 4, 5, 7, 8, 9 ($p < 0.05$), and statistically significantly better test results of leg muscle strength in tests 10, 11, 13, 14 ($p < 0.05$).

Discussion

The study assumed that the use of the combined method of strength development and the circuit training method in a 4-week physical training cycle would positively affect the dynamics of strength and strength endurance development in 6th-8th grade boys.

After six classes (1–6) using the combined method of strength development, the 6th-8th grade boys showed a statistically significant positive dynamics in the results of strength fitness and endurance. The largest increase (by 20.3 %) was observed in shoulder flexion strength in the 6th grade boys. These data supplement the findings of Cieślicka et al. [10], Ivashchenko et al. [15] on the effectiveness of the combined method of strength development during school physical training classes.

After six classes (7-12) using the circuit training method, the 6th-8th grade boys showed a statistically significant positive dynamics in the results of strength fitness and endurance. The test results increased by 2-11%. These data confirm the findings of Poperekov et al. [13] on the effectiveness of the circuit training method during physical training of children and adolescents.

The study ascertained that the use of the combined method of strength development and the circuit training method in a one-month physical training cycle positively affected the overall development of motor abilities in the 6th-8th grade boys. The obtained results of the study characterize the peculiarities of the dynamics of middle schoolers' motor fitness and supplement the data of Ivashchenko et al. [17], James et al. [18] on the holistic character of motor abilities development in children and adolescents; the data of Blagrove et al. [19], Prykhodko [20] on the regularities of motor abilities development in children and adolescents.

Consequently, the study results indicate that the combined method of strength development and the circuit training method in a 4-week physical training cycle have

a statistically significant effect on the dynamics of motor fitness of middle-school-aged boys.

Further research is required to study the regularities of development and relationship between muscle strength and endurance of middle-school-aged boys.

Conclusions

After using the combined method of strength development (1-6 classes) and the circuit training method (7-12 classes) in a 4-week physical training cycle, the middle-school-aged boys showed positive dynamics of strength and strength endurance development of shoulder muscles, abdominal and back muscles, leg muscles. The dynamics of strength and static endurance of the local muscle group is strongly influenced by the combined method of strength development. The circuit training method is effective to develop dynamic and static strength endurance of the local muscle group. For overall development of strength and general endurance, it is effective to use a combination of the combined method of strength development and circuit training method in a 4-week physical training cycle.

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Conflict of interest

The authors state that there is no conflict of interest.

References

1. Bădicu G. Physical Activity and Health-Related Quality of Life in Adults from Braşov, Romania. *Education Sciences*, 2018; 8(2). <https://doi.org/10.3390/educsci8020052>
2. Balsevich VK. *Ontokinesiology of man*. Moscow: Theory and practice of physical culture; 2000. (in Russian)
3. Novak D, Podnar H, Emeljanovas A, Marttinen R. Comparison of Fitness Levels between Croatian and Lithuanian Students. *Montenegrin Journal of Sports Science and Medicine*, 2015; 4(1): 5–11.
4. Krutsevych TYu, Bezverkhnia HV. *Recreation in the physical culture of different population groups: teaching. manual*. Kiev: Olympic Literature; 2010. (in Ukrainian)
5. Ivashchenko OV. *Modelling of physical education students*. Kharkiv: OVS; 2016. (in Ukrainian)
6. Emeljanovas A, Mieziene B, Putriute V. The Relationship Between Physical Activity and Content of the Physical Education Classes in 11-12 Years Old Lithuanian Schoolchildren. The Pilot Study. *Croatian Journal of Education-Hrvatski Casopis Za Odgoj I Obrazovanje*, 2015; 17(1): 93–120.
7. Ivashchenko O, Abdulkhalikova T, Cieślicka M. Effectiveness of Motor Skills Development in 5th-7th Grade Girls at Different Modes of Physical Exercises. *Teoriâ Ta Metodika Fizičnogo Vihovannâ*, 2017; 17(4): 201-7. <https://doi.org/10.17309/tmfv.2017.4.1205>
8. Ivashchenko O, Khudolii O, Iermakov S, Harkusha S. Physical exercises' mastering level in classification of motor preparedness of 11-13 years old boys. *Journal of Physical Education and Sport*, 2017; 17(3): 1031-6. <https://doi.org/10.7752/jpes.2017.03158>
9. Liakh VI. *Driving abilities of schoolchildren: Fundamentals of theory and methods of development*. Moscow: Terra-Sport; 2000. (in Russian)
10. Cieślicka M, Ivashchenko O. Discriminant analysis method to determine the power of the boys 11-12 year. *Journal of Education, Health and Sport*, 2016; 6(10): 721-9. <https://doi.org/10.5281/zenodo.229911>
11. Khudolii OM, Ivashchenko OV. *Simulation of the learning process and development of motor abilities in children and adolescents*. Kharkiv: OVS; 2014. (in Ukrainian)
12. Khudolii OM. *General Fundamentals of Theory and Methodology of Physical Education*. Kharkiv: OVS; 2008. (in Ukrainian)
13. Poperekov VS, Buldakova N, Bandakov MP, Zhilina NO, Solgalov VS. Focused Development of Jumping Ability in Young Basketball Players By Means of Circuit Training. *Human Sport Medicine*, 2018; 18(4): 103–9. <https://doi.org/10.14529/hsm180415>
14. Liu C, Chen CS, Ho WH, Fule RJ, Chung PH, Shiang TY. The Effects of Passive Leg Press Training on Jumping Performance, Speed, and Muscle Power. *Journal of Strength and Conditioning Research*, 2013; 27(6): 1479–86.
15. Ivashchenko O, Cieślicka M. Discriminant analysis in the classification of the preparation strength girls 11-12 year. *Journal of Education, Health and Sport*, 2016; 6(8): 888-97. <https://doi.org/10.5281/zenodo.229884>
16. Khudolii OM, Ivashchenko OV. *Simulation of the learning*

- process and development of motor abilities in children and adolescents*. Kharkiv: OVS; 2014. (in Ukrainian)
17. Ivashchenko O, Khudolii O, Iermakov S, Lochbaum M, Cieślicka M, Zukow W, Nosko M, Yermakova T. Methodological approaches to pedagogical control of the functional and motor fitness of the girls from 7-9 grades. *Journal of Physical Education and Sport*, 2017; 17(1): 254-261. <https://doi.org/10.7752/jpes.2017.01038>
18. James LP, Haff GG., Kelly VG, Connick MJ, Hoffman BW, Beckman EM. The impact of strength level on adaptations to combined weightlifting, plyometric, and ballistic training. *Scandinavian Journal of Medicine & Science in Sports*, 2018; 28(5): 1494-1505. <https://doi.org/10.1111/sms.13045>
19. Blagrove RC, Howe LP, Cushion EJ, Spence A, Howatson G, Pedlar CR, Hayes PR. Effects of Strength Training on Postpubertal Adolescent Distance Runners. *Medicine and Science in Sports and Exercise*, 2018; 50(6): 1224-1232. <https://doi.org/10.1249/mss.0000000000001543>
20. Prykhodko VV. The Factor Structure of Coordination Abilities Development in 5th-7th Grade Boys. *Teoriâ Ta Metodika Fizičnogo Vihovannâ*, 2017; 17(4): 191-200. (in Ukrainian) <https://doi.org/10.17309/tmfv.2017.4.1204>

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