



STATE AND DYNAMICS OF THE STRENGTH ABILITIES OF PRESCHOOL CHILDREN

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ABSTRACT

The period of pre-school age is characterized by an intensive growth and development of the human organism. In that connection, we set the **aim of our study**: to investigate the development of the strength abilities of children from a preparatory group for school (5-7 years old) as a result of the application of physical culture enriched educational program (for the period of one school year). The investigated subjects were 208 children from two kindergartens and one school in the city of Sofia.

The following **methods** were used: Theoretical analysis, pedagogical experiment, pedagogical testing, and statistical methods.

The following motor fitness tests were used: hand grip (left and right hand), standing broad jump, throwing 1 kg medicine ball with two hands above head, throwing 1 kg medicine ball with two hands underneath, throwing a small dense ball as far as possible, and maximum number of squats for 20 sec. From the results obtained, it was found that the greatest increase in strength abilities was found in the children of the experimental test groups as follows: ‘Throwing a small dense ball’, ‘left hand grip’, ‘throwing 1 kg medicine ball with two hands above head’.

Results: As a result of the training methodology applied, an increase in the strength abilities of the children of both sexes was established.

Key words: Strength abilities, preparatory group for school, sports-pedagogical testing

INTRODUCTION

The role of physical education for the proper physical and mental development of adolescents is scientifically proven (1). Preschool age includes the period from 3 to 6 years, and preschool education is compulsory for 5 – 7 years old children (2, 3). We decided to examine the state and development of the strength abilities of that age group. A number of authors underline that the main task during that age period is the strengthening of the muscles and skeleton system of the children instead of developing their strength. So the exercises used must have predominantly speed-strength character (4, 5).

The aim of our study was to investigate the development of the strength abilities of children from a preparatory group for school (5 – 7 years old) as a result of applying physical culture enriched educational program (for the period of one school year).

METHODOLOGY

The object of the study was the strength abilities of the children. We investigated 5-7-year olds - totally 208 boys and girls, divided into two experimental groups (62 boys and 43 girls) and two control ones (51 boys and 52 girls). They represented the so-called III-rd and IV-th preparatory groups in the kindergarten. The children of the experimental groups (EG) followed an enriched educational program in physical culture - three times a week – totally of 93 pedagogical situations, while the control groups (CG) followed the content approved by the Ministry of Education for the same period of time (6, 7). The following motor fitness tests

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were used in the survey: hand grip of the right and the left hand, standing broad jump, throwing a medicine ball 1 kg with two hands above the head, throwing a medicine ball 1 kg with two hands underneath, throwing a small dense ball as far as possible, maximum number of squats for 20 seconds (8, 9)

The following methods were used: Theoretical analysis, pedagogical experiment, pedagogical testing, and statistical methods.

The statistical processing of data is carried out using a specialized software PRODUCT IBM SPSS 19.0. The data were subjected to:

- Variation analysis
- Comparative analysis-as the statistical significance was selected at the level of $p \geq 0.05$
- Graphical analysis

RESULTS AND ANALYSIS

The statistical parameters of the variation and the comparative analysis are presented in **Figure 1** and **Figure 2**, **Table 1** and **Table 2**.

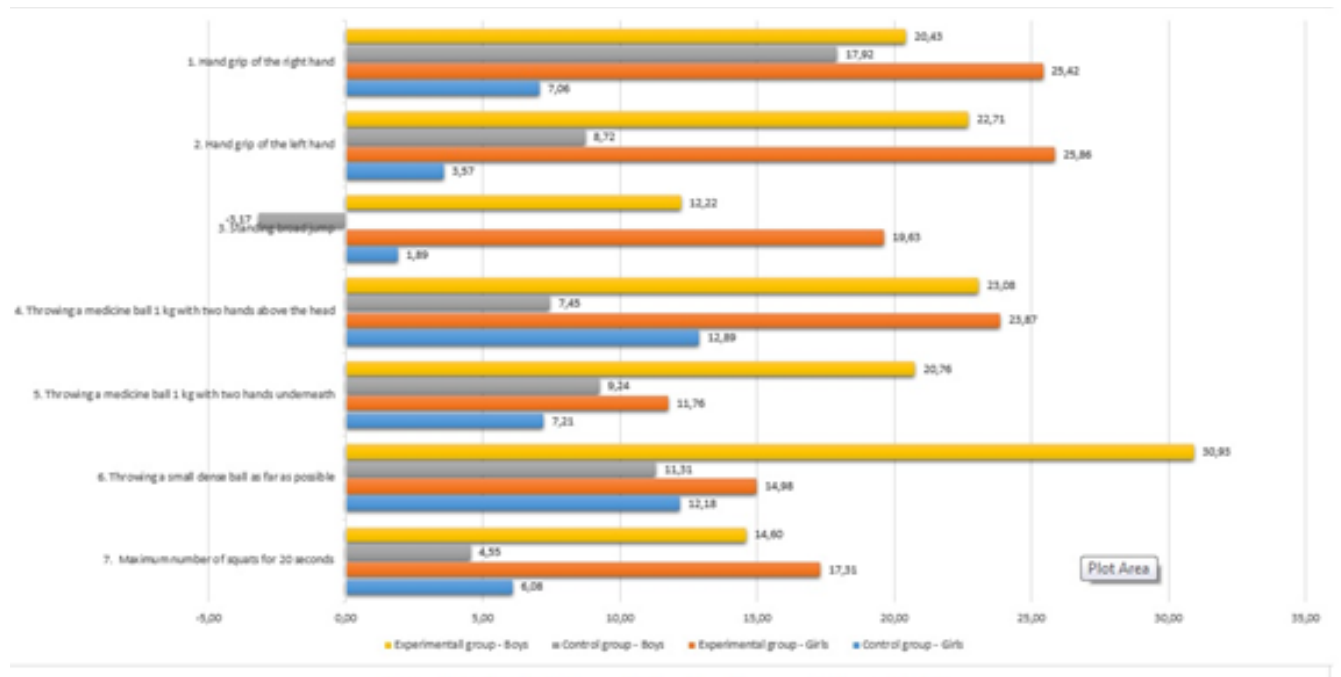


Figure 1. Gain in test results for III-rd Group children (in %)

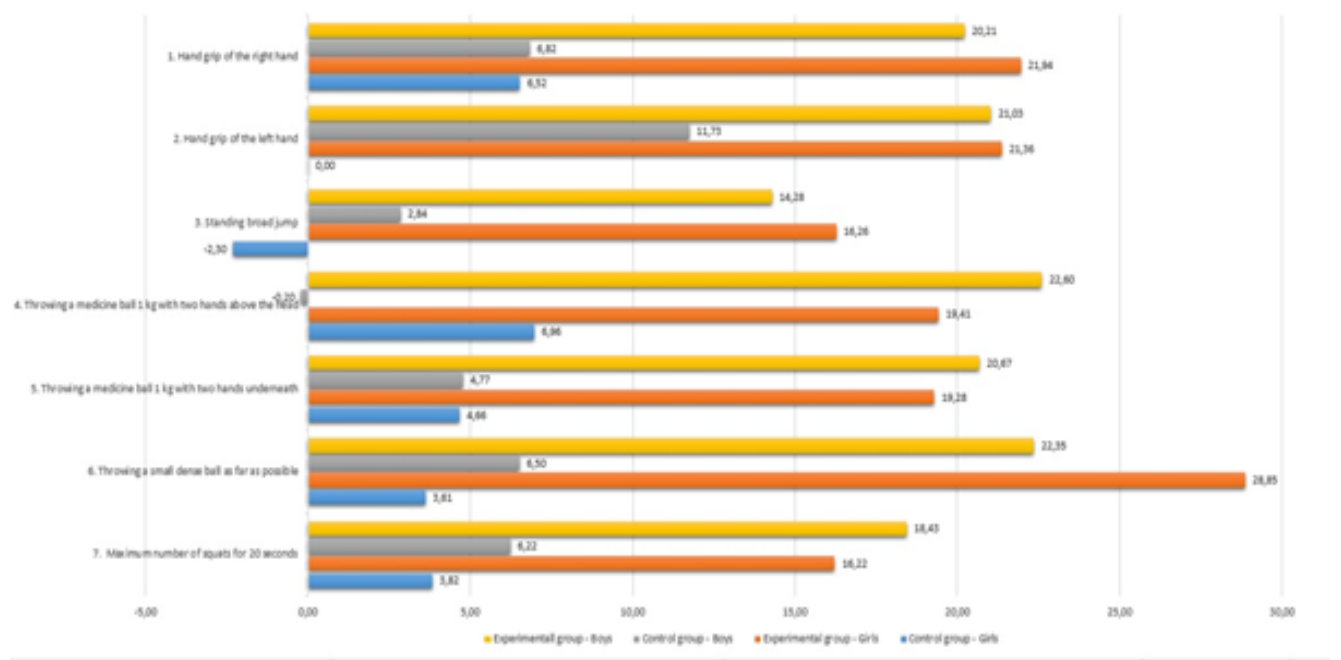


Figure 2. Gain in test results for IV-th Group children (in %)

Table 1. Dynamics of strength abilities –preschool groups – boys

AGE	TESTS	EXPERIMENTAL GROUP											CONTROL GROUP										
		n	Ist Investigation			IInd Investigation			Gain		Statistical significance		n	Ist Investigation			IInd Investigation			Gain		Statistical significance	
			\bar{X}	S	V	\bar{X}	S	V	d	d%	t	α		\bar{X}	S	V	\bar{X}	S	V	d	d%	t	α
III-rd Group	1. Hand grip of the right hand	30	7,67	1,77	23,05	9,23	1,77	19,23	1,57	20,43	8,53	0,00	16	6,63	2,13	32,13	7,81	2,01	25,70	1,19	17,92	3,72	0,00
	2 Hand grip of the left hand	30	7,63	1,87	24,51	9,37	1,96	20,88	1,73	22,71	10,93	0,00	16	6,81	2,17	31,86	7,41	1,82	24,55	0,59	8,72	1,64	0,12
	3. Standing broad jump	30	89,23	15,84	17,75	100,13	12,23	12,21	10,90	12,22	7,02	0,00	16	82,81	21,18	25,58	79,69	15,89	19,94	-3,13	-3,77	0,80	0,44
	4. Throwing a medicine ball 1 kg with two hands above the head	30	231,83	49,59	21,39	285,33	67,95	23,81	53,50	23,08	6,61	0,00	16	205,63	55,25	26,87	220,94	65,93	29,84	15,31	7,45	1,37	0,19
	5. Throwing a medicine ball 1 kg with two hands underneath	30	271,07	55,67	20,54	327,33	57,65	17,61	56,27	20,76	4,73	0,00	16	263,75	63,76	24,17	288,13	56,48	19,60	24,38	9,24	2,67	0,02
	6. Throwing a small dense ball as far as possible	30	542,97	175,15	32,26	710,93	179,16	25,20	167,97	30,93	6,57	0,00	15	431,67	113,02	26,18	480,47	105,43	21,94	48,80	11,31	4,02	0,00
	7. Maximum number of squats for 20 seconds	30	16,67	1,94	11,64	19,10	2,35	12,32	2,43	14,60	5,83	0,00	15	16,13	3,09	19,16	16,87	3,25	19,25	0,73	4,55	0,86	0,40

IV-th Group	1. Hand grip of the right hand	32	8,81	2,07	23,50	10,59	2,31	21,83	1,78	20,21	10,33	0,00	35	9,63	2,03	21,08	10,29	1,71	16,60	0,66	6,82	4,64	0,00
	2 Hand grip of the left hand	32	9,06	2,24	24,72	10,97	2,26	20,65	1,91	21,03	8,60	0,00	35	9,26	1,72	18,57	10,34	1,80	17,39	1,09	11,73	6,18	0,00
	3. Standing broad jump	32	103.50	15.95	15.41	118.28	13.15	11.12	14.78	14.28	7.93	0.00	35	97.66	21.55	22.06	100.43	20.75	20.66	2.77	2.84	1.18	0.25
	4. Throwing a medicine ball 1 kg with two hands above the head	32	253.75	68.33	26.93	311.09	72.95	23.45	57.34	22.60	7.74	0.00	35	291.43	83.60	28.69	290.86	83.29	28.64	-0.57	-0.20	0.06	0.95
	5. Throwing a medicine ball 1 kg with two hands underneath	32	352.19	83.10	23.60	425.00	85.42	20.10	72.81	20.67	6.71	0.00	35	365.14	85.76	23.49	382.57	81.76	21.37	17.43	4.77	1.79	0.08
	6. Throwing a small dense ball as far as possible	32	694,44	193,58	27,88	849,66	193,67	22,79	155,22	22,35	7,29	0,00	35	658,49	176,53	26,81	701,29	183,70	26,19	42,80	6,50	3,04	0,00
	7. Maximum number of squats for 20 seconds	32	17,47	2,77	15,86	2,48	2,35	11,99	3,22	18,43	7,53	0,00	35	17,00	2,91	17,12	18,06	3,06	16,93	1,06	6,22	3,00	0,01

Table 2. Dynamics of strength abilities –preschool groups – girls

AGE	TESTS	EXPERIMENTAL GROUP											CONTROL GROUP										
		n	Ist Investigation			IInd Investigation			Gain		Statistical significance		n	Ist Investigation			IInd Investigation			Gain		Statistical significance	
			\bar{X}	S	V	\bar{X}	S	V	d	d%	t	α		\bar{X}	S	V	\bar{X}	S	V	d	d%	t	α
III-rd Group	1. Hand grip of the right hand	17	6,94	1,52	21,20	8,71	1,40	16,12	1,76	25,42	5,40	0,00	23	7,39	1,85	25,02	7,91	1,76	22,20	0,52	7,06	1,91	0,07
	2 Hand grip of the left hand	17	6,82	1,42	20,82	8,59	1,54	17,96	1,76	25,86	6,67	0,00	23	7,30	1,49	20,41	7,57	1,65	21,76	0,26	3,57	1,37	0,19
	3. Standing broad jump	17	70,7 1	11,7 2	17,75	84,59	13,12	15,50	13,88	19,63	6,18	0,00	23	87,52	19,43	25,58	89,17	20,34	22,81	1,65	1,89	0,97	0,35
	4. Throwing a medicine ball 1 kg with two hands above the head	17	188,53	28,93	15,34	233,53	39,83	17,06	45,00	23,87	7,61	0,00	22	209,77	52,11	24,84	236,82	59,47	25,11	27,05	12,89	3,63	0,00
	5. Throwing a medicine ball 1 kg with two hands underneath	17	252,65	62,13	24,59	282,35	58,45	20,70	29,71	11,76	3,81	0,00	22	280,68	70,01	24,17	300,91	77,50	25,76	20,23	7,21	2,68	0,01
	6. Throwing a small dense ball as far as possible	17	380,41	121,79	32,02	437,41	88,50	20,23	57,00	14,98	4,37	0,00	19	414,26	119,09	26,18	464,74	160,63	34,56	50,47	12,18	3,47	0,00
	7. Maximum number of squats for 20 seconds	17	15,29	2,47	16,15	17,94	2,28	12,69	2,65	17,31	4,66	0,00	23	17,87	2,16	12,09	18,96	1,97	10,36	1,09	6,08	2,77	0,01

IV-th Group	1. Hand grip of the right hand	26	7,54	1,61	21,35	9,19	1,70	18,48	1,65	21,94	9,46	0,00	28	8,21	2,36	28,78	8,75	2,10	24,02	0,54	6,52	2,65	0,01
	2 Hand grip of the left hand	26	7,92	1,79	22,60	9,62	2,21	22,97	1,69	21,36	8,54	0,00	28	8,46	2,20	26	8,46	1,73	20,47	0,00	0,00	0,00	1,00
	3. Standing broad jump	26	93.6 9	11.7 2	12.51	108.92	9.83	9.02	15.23	16.26	11.5 0	0.00	28	87.14	16.16	18.55	85.14	15.32	18.00	-2.00	-2.30	0.65	0.52
	4. Throwing a medicine ball 1 kg with two hands above the head	26	243. 19	50.8 1	20.89	290.38	49.44	17.02	47.19	19.41	13.7 3	0.00	28	246.4 3	50.49	20.49	263.57	59.08	22.42	17.14	6.96	2.70	0.01
	5. Throwing a medicine ball 1 kg with two hands underneath	26	297. 31	66.1 9	22.26	354.62	65.68	18.52	57.31	19.28	6.86	0.00	28	306.4 3	60.63	19.78	320.71	60.12	18.75	14.29	4.66	1.69	0.10
	6. Throwing a small dense ball as far as possible	25	506. 56	125. 40	24.76	652.72	130.19	19.95	146.16	28.85	8.82	0.00	28	532.1 8	161.4 4	30.34	551.39	150.7 9	27.35	19.21	3.61	1.15	0.26
	7. Maximum number of squats for 20 seconds	26	17.3 1	2.02	11.64	20.12	2.07	10.26	2.81	16.22	8.81	0.00	28	16.82	2.74	16.27	17.46	1.84	10.51	0.64	3.82	1.23	0.23

The results were analyzed grouped according to the basic forms of the strength abilities of the children. Due to the fact that the children took part in the survey were randomly selected we will not comment the initial data for the different strength indicators and will pay attention to their dynamics within the experimental period. Another important reason for that decision is the fact that the coefficient of variability in most of the parameters is higher enough to consider the experimental and control groups heterogynous in any of the studied strength forms.

Static strength

The static strength of hands is determined by various tests, but the hand dynamometry is the most often used (9). It reveals the strength of the hands flexors.

From the tables it is seen that the mean values of this indicator increased significantly in all the studied groups with exception of third control group – boys – left hand, third control group – girls (both hands) and fourth control group – girls – left hand. It is interesting to mention that the differences between the right and left hand are insignificant in all age-sex groups, which gives us the reason to believe that there are no functional asymmetry in the hands strength at this age.

We have determined significantly greater improvement in static strength of older children (IV-th EG) which is due probably to the natural physiological processes of the organism during that age period. Hands grip strength, right and left, was significantly higher in boys in comparison with girls. The difference between the first and second measurement expressed in percentage are illustrated in **Figure 1** and **Figure 2**. As it is seen in the experimental groups, greater differences between the two measurements are found – as they range from 20.21% to 25.86% and from 6.52% to 17.92% in the control one.

Explosive strength

The explosive strength was measured with the following tests: standing broad jump, throwing 1 kg medicine ball with two hands above the head and underneath.

The standing broad jump test is characterized by high objectivity in determining the explosive strength of the lower extremities (8, 9, etc.). From **Tables 1** and **2**, it appears that the experimental groups marked a significant statistically and reliable increase in the mean values in comparison with the control ones.

The highest results at the end of the experimental period are registered for the boys from forth group – 118.28 cm and 108.92 cm for the girls from the same age. The changes in the explosive strength of the all control groups varies in very narrow limits and are statistically insignificant. The increase in the control group of girls is 1.89% and in their peers of 5 years, a decrease of (-3.77%) was detected while 6 old boys increase their strength with 2.64 % and the girls decrease it with (-2.30%). The same trends as in the previous test are observed – older children have better results and boys are better than girls.

A big difference between the first and the second measurement of the explosive strength of upper extremities and torso is observed in the test “throwing 1 kg medicine ball with two hand above head”. (**Table 1** and **2** and **Figure 1** and **2**). In the experimental groups, the 6 years old boys increase their results with 57.34 cm while the girls of the same age - with 47.2 cm as the differences are statistically significant. As a whole the gain in the results ranges from 19.41% to 23.87%, due both to the increased muscle mass and strength on one hand and to the positive impact of the physical exercises used by us on the other. The test results in the control groups also increased but to a smaller degree as they are statistically insignificant both in the third and fourth groups of the boys while the girls increased their results significantly.

In the test "Throwing 1 kg medicine ball with two hands underneath", similar results are observed. The increase of the explosive strength of upper extremities has the biggest values in the experimental fourth preparatory groups – 20.67% for boys and 19.28% for girls. In the control groups, the highest values were found for the boys from third preparatory group - 9.24%, while the girls of the same age improved their results by 7.21%. Older boys showed an improvement of 4.77% while the girls increased their results by 4.66%. It is interesting to mention that the results of this test are higher in comparison with the results from the previous one.

Dynamic strength

The test “Throwing a small dense ball (150 g) as far as possible” measures the dynamic strength (or explosive one according to some authors) of the upper extremities. From **Table 1** as well as **Figure 1**, we detect the highest increase of the results in the experimental

groups. The initial values were higher but the gain at the end of the experiment was higher too. This was observed in the third experimental group -boys – 30.93%. The increase in experimental groups in younger girls and boys ranged from 14.98% to 30.93% and was statistically significant. In the older boys and girls the gain is also significant and ranges from 22.35 % to 28.85 %. In the control groups boys and girls show significantly smaller increase which is respectively 11.31% (boys third group) and 3.61% (girls - fourth group). The bigger increase of the dynamic strength of upper extremities in the experimental groups is an important indicator for the positive influence of our program on that form of strength.

Muscular endurance

In order to reveal the changes in that strength form we used the test “maximum number of squats in 20 seconds”. Some authors are of the opinion that with this test we can also measure a dynamic force (.5.) The results are presented in **Tables 1** and **2**. Again, it is seen a statistically significant increase in the mean values in the experimental groups, ranging between 14.60% and 18.43% in the boys and from 17.31 to 16.22% in the girls. The control groups also show an increase of that indicator but the values are lower and varies from 3.82% to 6.22% as at the same time the differences are insignificant.

It is well known that in this age it is better to develop the aerobic endurance instead of muscular endurance.

CONCLUSION

From the analysis of the results we can make the following conclusions:

1. An increase in the mean values of the tested strength abilities for all experimental and

control groups are recorded with some exceptions as the highest increase is in the experimental groups. That proves the positive effect of the applied enriched physical culture program.

2. The values of the strength parameters increase with age but this process has an uniform character.
3. The boys have higher values of strength abilities in comparison with girls.

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