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CHANGES IN SOME OF THE MOTOR ABILITIES OF PRESCHOOL CHILDREN (AGE FOUR)

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Abstract. *On a sample of 96 children (57 children in the experimental group and 39 children in the control group), all at the age of four, initial and final measurements were carried out with the aim out of determining their motor abilities.*
On the basis of the participation of the experimental group in the realization of the sport program assigned to the preschool children, at a rate of four days per week for 50 - 60 minutes, all of the possible differences in motor abilities between the experimental and control group during the initial and final check-up over a period of nine months were observed.
The tests used to check the motor abilities were: the "shuttle run" (agility test), walking backwards, "school-hops", sit-ups, long jump, holding pull-ups, V-sit and reach, the lateral split and lying extension. All the tests used to check motor abilities were evaluated for discrimination, reliability and validity. The obtained results pointed to valid metric test characteristics.
Changes in the area of motor abilities were evaluated by a T-test for independent samples between the experimental and control group as part of an initial and final check. The obtained results show that there is no difference between the groups in the initial check, while in the final check there was a statistically significant difference showing the advantage of the experimental group, which points out that the children who participated in the sport program improved their motor abilities.

Key words: *sports program, preschool children, motor abilities*

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1. INTRODUCTION

Since movement is the biological necessity of every human being, especially of a child, it is necessary, particularly in urban areas, to satisfy this necessity by means of organized physical activities (Findak, 2001).

The influence of motor development is of critical importance to the development of preschool children in general. Children grow and develop intensively and therefore the necessity for their motor activity increases. Therefore, a lack of playing, experience and the opportunity to take part in different physical activities can slow down their regular process of development (Brown et al., 2006, Finn, Johannson & Specker 2002). Until the age of seven, children learn the basic types of motor activity, which stimulates the process of development of their basic motor abilities, among them coordination, speed, strength, flexibility, balance, and precision, and it is difficult to make up for the lack of these abilities later on. Therefore, one should bear in mind that preschool children are at the best age for the stimulation of motor abilities and thereby of intellectual potential, both of which will be built up during their entire lifetime (Graham, Holt/Hale & Parker, 1998).

In recent years there has been more and more scientific research and thereby more and more theories have appeared regarding the necessity for the physical exercise of preschool children (Jackson et al., 2003., Melody, Schofield & Kolt, 2007., Sanders, 1993., Pate et al., 2004., Kostić, Miletić, Jocić and Uzunović, 2003). The motor development of children is of crucial importance and has crucial influence on their development in general, especially in the case of the youngest children, and for that reason it influences their intellectual, social and emotional characteristics. If children are not able to allow proper motor development and make progress in their motor abilities and skills, it is more likely that they will have less self-confidence, and more difficulties when communicating with their environment, as well as in handling everyday situations. In most cases, these children will not do the minimum physical activities necessary for a healthy and productive life once they are grown-ups (Strauss at al., 2001).

For this reason, the number of kinesiology programs ensuring the appropriate growth, development and health of preschool children is increasing (Avery, 1994, Council on Physical Education for Children 1992, Graham et al. 1998, National Association for Sport and Physical Education, 2002, Sanders, 1992, Werner, 1997). Well organized programs for physical activities are useful in several respects; through the development of motor activities, children's cognitive, social and emotional skills will be developed. The quality of these kinesiology programs will greatly depend on the feedback concerning the development of motor abilities, as well as on the healthy growth and development of the children (Dowda, 2004).

Because of the basic necessity for the healthy growth and development of children, and in order to allow a positive influence on their psychomotor abilities, a special sports program for preschool children was developed (Hraski and Živčić, 1996). The program was successfully carried out in kindergartens, where it was combined with other daily activities. Continuous work and the realization of the sports program made it possible to observe every individual child and to learn more about the effects of this kind of program. Therefore, the purpose of this paper was to determine the changes in some of the motor abilities of preschool children (age four) that took place as a consequence of a nine-month experimental kinesiology program.

2. METHODS

2.1. The sample of subjects

The sample consisted of four-year-old children:

On a sample of 96 children (57 children in the experimental group and 39 children in the control group), all age four, initial and final measurings were carried out with the aim out of determining their motor abilities.

The experimental group consisted of 57 children at the age of four, who attended kindergartens in two different cities (Rijeka and Zagreb). They all took part in the nine-month sports program for preschool children, which was carried out four times per week over 50 - 60 minute sessions.

The control group consisted of 39 children at the age of four, who attended two kindergartens in the same cities (Rijeka and Zagreb), and who had a regular kindergarten program.

2.2. Measuring instruments

The estimation of the motor efficiency of the four-year-olds (the experimental and control group) was carried out by a battery of 9 tests (Trajkovski – Višić, 2004), (Table 1).

Table 1. Measuring instruments

Name of Test	Variable	Motor ability
Shuttle run	STRUN	Agility
Walking backwards on all fours	BWALK	Coordination
"School-hops"	SCHHOP	Coordination
Sit-ups	SITUP	Strength of the trunk
Long jump	LGJUMP	Explosive strength – lower extremities
Holding pull-ups	HPULL	Strength of the upper extremities
V-sit and reach	VSIT	Flexibility
Lateral split	LSPLIT	Flexibility
Lying extension	ARMEXT	Flexibility

2.3. Characteristics of the experimental sports program

The sports program for preschool children was created to include dissimilar subjects which were then divided into three groups:

1. Basic kinesiological movements appropriate for the development of basic motor abilities.
2. Fundamental techniques in some sports: track and field, artistic gymnastics, rhythmic gymnastics, dance, aerobics, basketball, volleyball, football, handball, badminton, tennis, wrestling and others combat sports.
3. Elementary games in various types of organization, with or without requisites aimed at the development of motor abilities.

The experimental sports programs were realized over a nine-month period (September – June), four times per week, over 50 - 60 minute sessions. During that period, the children had 168 hours of planned and organized sports training. By learning and performing basic kinesiological movements and the fundamental techniques in different sports and

by playing different elementary games, the children were under continual influence to develop their basic motor abilities.

2.4. Experimental procedure

The experiment was conducted in kindergartens in Rijeka and Zagreb. Both the experimental and control group were tested by means of the aforementioned motor tests at the beginning and at the end of the experimental program.

The experimental group took part in a nine-month sports program for preschool children four times per week, over 50 - 60 minute sessions. At the same time, the control group took part in a regular kindergarten program.

The first measurements were made in September, the last were made in June, with the same battery of motor tests over the same period of time.

2.5. Statistical methods

The collected data was processed as follows:

1) Basic statistical data (descriptive statistics) were calculated for every item.
2) The statistically significant difference between the first and second measuring of the control group and experimental group was calculated by means of the T-test for dependent samples.
3) The results of the initial and final measuring of the experimental and control group were compared using a T-test for independent samples (Student's T-test).
4) The comparison of the progress of the experimental and control group in each test was calculated on an individual level for each sample and for each test by subtracting the result of the initial measuring from the result of the final measuring (Student's T-test).
5) The discriminant analysis (backward stepwise) illustrated which tests showed the most significant difference between the experimental and control group.

3. RESULTS AND DISCUSSION

The statistically significant difference in the results from the first and second measuring of the experimental and control group was calculated using a T-test for dependent samples. On the basis of the results, the effects of the program were monitored. What was also monitored was whether there was any statistically significant progress between the first and second measuring of the experimental and control group.

The results shown in Table 2 and 3 refer to: the arithmetic mean from the initial and final measuring (M1 and M2), standard deviation (SD1 and SD2) from the initial and final measuring, the T-test for dependent samples (t), and statistical significance (p).

By comparing the results from the initial and final measurings (Table 2), a conclusion can be made that the control group achieved a statistically more significant difference in improving their results from the final measuring, compared to the initial measuring for the following variables: STRUN, BWALK, SCHHOP, SITUP, and HPULL. There was no statistically significant difference found for the following variables: LGJUMP, VSIT, LSPLIT, and ARMEXT.

Table 2. Results of the initial and final measuring of the control group

Variable	M	SD	N	t	df	p
STRUN	16,64 15,94	1,53 1,58	38	3,14	37	0,003
BWALK	9,45 8,15	2,46 1,98	39	5,52	38	0,000
SCHHOP	2,09 1,91	0,63 0,54	39	3,23	39	0,002
SITUP	7,89 10,44	5,94 5,88	38	-6,16	37	0,000
LGJUMP	75,29 76,70	17,75 18,67	24	-0,33	23	0,741
HPULL	3,96 5,74	4,00 4,80	39	-4,04	38	0,000
VSIT	4,61 5,26	5,08 5,28	23	-1,87	22	0,074
LSPLIT	90,04 88,13	11,66 20,32	23	0,45	22	0,653
ARMEXT	21,48 22,26	3,26 3,15	23	-1,80	22	0,085

Children at the age of four made progress in all of the coordination tests, so a conclusion can be made that there was an improvement in coordination skills during the process of development. At the same time, there was an improvement in the tests for the control of motor abilities such as strength (except the LGJUMP test), although the children did not take part in systematic exercise, so this can be seen as part of the regular process in the growth and development of children.

The reason why they did not show improvement in all of the flexibility tests is mainly because the coefficient of heredity for this ability is very small, and if this ability is not systematically developed there can be no improvement.

There was no statistically significant improvement in the LGJUMP test (the long jump) in the final measuring, when compared to initial one. One of the reasons is the fact that the successful performance of this test requires certain skills and knowledge of technique. Children in the control group did not have the opportunity to learn such specific motor activities, just like the children in the experimental group. But considering the fact that the jump with both legs requires a burst of strength in a short period of time, along with the requirements of technique, it is possible that the test was too demanding and not appropriate for their age.

The comparison of the initial and final measurings (Table 3) makes it obvious that the experimental group made a statistically significant improvement in their results in all of the motor tests at the end of the nine-month program.

Table 3. Results of the initial and final measuring of the experimental group

Variable	M	SD	t	P
STRUN	M1=16,44 M2=13,60	SD1= 1,86 SD2= 1,10	14,74	0,000
BWALK	M1= 9,50 M2= 6,87	SD1= 2,68 SD2= 2,02	12,62	0,000
SCHHOP	M1= 1,98 M2= 1,72	SD1= 0,54 SD2= 0,28	3,89	0,001
SITUP	M1= 9,09 M2=19,68	SD1= 6,41 SD2= 6,39	15,76	0,000
LGJUMP	M1=73,72 M2=95,79	SD1=18,51 SD2=15,32	12,11	0,000
HPULL	M1= 5,15 M2=12,68	SD1= 5,03 SD2= 7,02	10,40	0,000
VSIT	M1= 4,79 M2= 8,03	SD1= 5,06 SD2= 5,70	7,04	0,000
LSPLIT	M1=91,05 M2=98,52	SD1=10,60 SD2= 9,04	12,27	0,000
ARMEXT	M1=21,60 M2=23,80	SD1= 4,41 SD2= 3,14	5,11	0,000

In the test "shuttle run", the children improved their result by 3 seconds and made a statistically significant progress over the nine-month period. Since the program involved a great number of activities including coordination – agility, a conclusion can be made that it enabled faster and better skill development of running fast with a change in direction. In the test of walking backwards for 5 meters the children improved their result by 2.6 seconds and made a statistically significant improvement over the nine-month period. The children repeated the test three times and their results improved each time. The conclusion is that learning is an important factor in this exercise and the children learned by repeating it. The improvement was expected because this type of activity belongs to the subgroup of activities used to develop coordination, which includes the reorganization of stereotypes and which was stimulated in this program. It must be mentioned that the results of this test depend on the strength of the upper extremities and shoulders because of the type of exercise, and the age of the preschool children must be considered. Since the children who took part in the experimental sports program improved their results in the test which was used to measure this motor ability, a conclusion can be made that the contents of the program meet all the basic requirements for a successful performance of the "walking backwards on all fours" test.

The children showed a 0.96 second improvement in the "school-hops" test. There was a statistically significant improvement in the results, but it must be emphasized that there was no important difference between the initial and final measuring. The results of this test were already high at the initial measuring. Most probably the children had the opportunity to do this kind of exercises often while playing, so it was not unknown to them.

In the "sit-ups" test, which measures the repetitive strength of the trunk, great progress was noticed. The results improved from 9 repeats in the initial measuring to 20 repeats in the final one. A significant improvement in this test is expected because repetitive strength is influenced by regular exercise and by doing specific exercises.

The "holding pull-ups" tested the static strength of the upper extremities and shoulders. There was a statistically significant improvement in the results, from an average of 5 seconds to 12 seconds. The applied sports program included a large number of exercises for the upper body and arms and in this way influenced the development of strength of the upper extremities and shoulders. The exercises included activities from the basic movement type to exercises with different kinds of hangs and support movements performed on a specially constructed jungle gym for preschool children. It is necessary that the strength of the children's muscles increases with their growth, especially that of the arm and shoulders muscles, particularly because the modern way and speed of life, as well as the accompanying urbanization and modernization relevantly influence and reduce the movement of children and at the same time have a negative impact on the development of this motor ability. This was an important part of the sports program so it had a great impact on the development of this segment of motor ability.

The results of the long jump improved on average by 21 cm in the final measuring, which is a significant improvement. It was noticed that there was an improvement within the measuring process, so a conclusion can be made that this was an effect of the learning process. Since the control group did not achieve any statistically significant improvement, it is obvious that for children of this young age, the long jump test is a motor ability that requires learning correct technique. The V-sit and reach is an exercise dominated by the flexibility of the back side of the legs. It was already mentioned that flexibility is a motor ability which is determined by heredity and can be strongly influenced, especially in the case of children of a very young age. But inappropriate exercises and their inappropriate performance can lead to negative effects and injuries. That is why the way of exercising should be planned, as was the case in this experimental sports program, which mainly includes combined exercises of the dynamic type which influence the improvement of flexibility. The children who took part in the sports program four times a week and carried out the basic warm-up exercises at the beginning of the lesson every day, improved their results from an average of 5 cm to 8 cm.

In the lateral split test, the children's results improved from an average of 91 cm to 98.5 cm. Since the test was measured in a different way (the length from the floor to the os pubis was not measured, but instead, the distance between the feet in the lateral split), a conclusion can be made that the improvement in these results did not depend only on the development of flexibility, but also on the change in anthropological relations, because the children were in a phase of intensive growth during that period of time.

The results of the lying extension test improved from 21.60 cm to 23.80 cm. The statistical items of this test indicate improvement, but it is not as significant as in the other motor tests. The reason for this is that the sports program did not plan the development of shoulder flexibility because the flexibility of this part of the body is specific only to certain conventional esthetic sports, which require this because of their creative structure and esthetic performance (artistic and rhythmical gymnastics, swimming, diving and others).

The results of the initial and final measuring of both groups for the purpose of a precise comparison (the Student's T-test) are shown in Tables 4 and 5.

It can be seen from the results of the initial measuring (Table 4), that there is no other statistically significant difference of variables among the samples within a group, except in the holding pull-ups test. This is due to different conditions of measurement. The experimental group had better conditions for the performance of this test (low bar, made of plastic, not slippery, prevents blisters).

Table 4. Results of the initial measuring between the experimental (X1) and control group (X2)

Variable	X1	X2	t-value *(z-value)	df	P	N1	N2	SD1	SD2
STRUN	16,54	16,43	0,31	88	**0,75**	53	37	1,83	1,55
BWALK	9,50	9,65	-0,295	105	**0,768**	55	52	2,682	2,526
SCHHOP*	1,955	2,072	-0,469*		**0,639***	48	51	0,44	0,61
SITUP	9,089	7,64	1,226	105	**0,22**	56	51	6,411	5,680
LGJUMP	73,76	76,34	-0,75	103	**0,45**	55	50	18,35	16,45
HPULL*	5,06	3,12	2,262*		**0,023***	57	52	5,03	3,79
VSIT	4,78	5,50	-0,757	107	**0,450**	57	52	5,06	4,69
LSPLIT	91,05	88,09	1,451	107	**0,149**	57	52	10,60	10,64
ARMEXT*	21,66	21,23	0,584*		**0,559***	57	51	4,40	3,17

A comparison of the results of the final measuring (Table 5) makes it obvious that the experimental group achieved significantly better results for all of the variables.

Table 5. Results of the final measuring between the experimental (X1) and control group (X2)

Variable	X1	X2	t-value *(z-value)	df	p	N1	N2	SD1	SD2
STRUN*	13,645	15,941	-6,592*		**0,000***	57	38	1,095	1,581
BWALK	6,984	8,150	-2,678	93	**0,008**	56	39	2,154	1,983
SCHHOP*	1,649	1,923	-3,045*		**0,002***	53	39	0,294	0,488
SITUP	19,333	10,666	6,406	94	**0,000**	57	39	6,851	5,970
LGJUMP	95,600	76,708	4,723	77	**0,000**	55	24	15,248	18,676
HPULL*	12,678	5,747	4,951*		**0,000***	56	39	7,026	4,801
VSIT	8,035	5,260	2,010	78	**0,047**	57	23	5,703	5,276
LSPLIT	98,526	91,173	3,166	78	**0,002**	57	23	9,047	10,245
ARMEXT*	23,80	22,260	2,163*		**0,03***	56	23	3,141	3,151

Table 6 illustrates a comparison of the progress between the experimental and control group for every test. The progress was calculated on an individual level for every sample and for each test by subtracting the result of the initial measuring from result of the final measuring. Because of these results, a conclusion can be made that the experimental program had an impact on the improvement in the results for the coordination, strength and flexibility tests.

Table 6. Differences between the initial and final measuring (the experimental (X1) and control group (X2))

Variable	X1	X2	t-value *(z-value)	df	P	N1	N2	SD1	SD2
STRUN	-2,89	-0,21	-8,890	85	**0,000**	52	35	1,45	1,25
BWALK	-2,63	-1,31	-4,157	92	**0,000**	55	39	1,54	1,48
SCHHOP*	-0,30	-0,01	-3,887*	84	**0,000**	47	39	0,39	0,29
SITUP*	10,59	2,55	7,181*		**0,000***	56	38	5,03	2,55
LGJUMP*	22,07	1,42	4,861*		**0,000***	54	24	13,39	20,79
HPULL*	7,52	1,78	5,651*		**0,000***	56	39	5,41	2,76
VSIT*	3,25	0,65	3,662*		**0,000***	57	23	3,48	1,67
LSPLIT	7,47	1,74	5,494	78	**0,000**	57	23	4,60	3,08
ARMEXT*	2,20	0,78	2,207*		**0,027***	56	23	3,22	2,09

To identify the test that most significantly distinguishes the experimental group from the control group, with respect to the achieved improvement as a result of the sports program, a stepwise discriminant function analysis (backward stewards) was carried out for the experimental group (Table 7).

Table 7. Discriminant analysis

Variable	Wilks' Lambda	Partial Lambda	F-remove	P-level	Toler.	1-Toler. (R-Sqr.)
STRUN	0,261	0,795	13,635	0,000	0,964	0,037
SITUP	0,273	0,761	16,615	0,000	0,964	0,036
HPULL	0,250	0,833	10,615	0,000	0,914	0,086
LGJUMP	0,276	0,753	17,417	0,000	0,941	0,060
LSPLIT	0,271	0,768	16,052	0,000	0,921	0,079

The classification of the groups according to the results from measurings and screenings of the five motor tests shows almost 100% sensibility, and their peculiarity in the determination of the success of the sports program for four-year-old children. This indicates that planned and controlled exercise at this age is one of the ways to support the development of the motor abilities of children.

4. CONCLUSION

The analysis of the results of the initial and final measurings indicates that, unlike the control group, the experimental group showed significant differences in all of the tests used to estimate basic motor abilities. The obtained results indicate that the experimental program achieved the set objectives and tasks, aimed primarily at the development and improvement of the motor abilities of preschool children at the age of four.

This paper proves that changes in the motor abilities of preschool children at the age of four, who attended a special sports program, did take place. In comparison with the other sports program (Council on Physical Education for Children, 1992, Mitchell, Davis & Lopez 2002), it has to be emphasized that every planned and well aimed exercise program has a positive impact on the development of primary motor abilities of children at a very young age. For this reason, it can be recommended as one of the components of the daily creative planning of leisure time of children at a very young age, as part of an organized educational and learning program.

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PROMENE U NEKIM MOTORIČKIM SPOSOBNOSTIMA DECE PREDŠKOLSKE DOBI

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Na uzorku od 96 ispitanika (57 ispitanika sačinjavalo je eksperimentalnu grupu i 39 ispitanika kontrolnu grupu) starosne dobi četiri godine, sprovedeno je inicijalno i finalno merenje s ciljem procene motoričkih sposobnosti ispitanika.

Na temelju sudelovanja eksperimentalne grupe u realizaciji sportskog programa namenjenog deci predškolskog uzrasta, u trajanju od četiri dana, nedeljno po 50 – 60 minuta, utvrđivane su moguće razlike u motoričkim sposobnostima između eksperimentalne i kontrolne grupe na inicijalnom i finalnom merenju u periodu devetomesečnog sudelovanja u sportskom programu.

Testovi za proveru motoričkih sposobnosti bili su: "prenošenje kockica", hodanje četvoronoške u nazad, školica, podizanje trupa, skok u dalj, izdržaj u zgibu, pretklon u sedu, čeona špaga i zaručenje u ležanju. Svi testovi za procenu motoričkih sposobnosti podvrgnuti su procenama diskriminativnosti, pouzdanosti i valjanosti. Dobijeni rezultati pokazali su dobre metrijske karakteristike testova.

Promene u prostoru motoričkih sposobnosti procenjene su t – testom za nezavisne uzorke između eksperimentalne i kontrolne grupe na inicijalnom i finalnom merenju. Dobijeni rezultati ukazuju da nema razlika između grupa na inicijalnom merenju dok je na finalnom merenju došlo do statistički značajne razlike u korist eksperimentalne grupe, što ukazuje da su deca, polaznici sportskog programa, poboljšali svoje motoričke sposobnosti.

Ključne reči: *sportski program, predškolska deca, motoričke sposobnosti*