Prihvaćeno: 28. lipnja 2019.

izr. prof. dr. Jera Gregorc
University of Ljubljana, Faculty of Education
jera.gregorc@pef.uni-lj.si

Alenka Humar
University of Ljubljana, Faculty of Education
alenka.humar@pef.uni-lj.si

THE ANALYSIS OF THE DIFFERENCES BETWEEN 4- AND 6-YEAR-OLD CHILDREN'S MOTOR EFFICIENCY AFTER SIX MONTHS OF SYSTEMATICALLY ORGANISED PHYSICAL ACTIVITY

Summary: *The aim of the research was to establish whether organised physical activity (OPA)have the same effect on the physical efficiency for4- and 6-year-old children. A total of149 intentionally selected children (39 4-and 1106-year-olds) were enrolled in research during the year 2016-2017. The children were divided into control group (no additional OPA) and experimental group (attend additional OPA). MOT 4–6 test was used for measuring physical efficiency. Children were tested twice (before and after six months). The results indicated that all children showed progress within six months, regardless of their age or type of OPA. The physical efficiency progress in4-year-old children was statistically significantly higher than in 6-year-old children. No statistically significant differences were identified among 4-year-old children, who participated in additional OPA, and those who did not. Yet, in6-year-old children there were statistically significant differences in progress between the control group and the experimental group. According to our results, organised physical activity makes more sense for 6-year-old children than for 4-year-old children. The results also show that 6-year-old children should attend OPA twice a week, regardless of the type.*

Keywords: *motor development, organised physical activities, preschool children*

INTRODUCTION

In the following article, we follow the three aspects of OPA, such as its importance, frequency and type of implementation for 4- and 6-year-old children for their progress in motor development. Therefore, the first part of introduction is divided into those three sections and in the second part we introduce some aspects of measuring the motor efficiency.

THE IMPORTANCE OF OPA FOR 4- AND 6-YEAR-OLD CHILDREN

Due to the speed of changes within holistic development, the measurement instruments are often standardised for every six months (Logan, Barnett, Goodway & Stod-

den, 2017). On average, 4- to 6-year-old children grow approximately 5–6 cm per year (Natale & Rajagopalan, 2014) and gain about 2 kg each year (Pem, 2015). The growth intensity and mass increase are in close connection with the necessary modification of the existing motor programmes; therefore, the adjustments to newly formed body proportions are required (Malina, 2014). Moreover, the differences between children are also affected by their integrated development. The social, emotional, cognitive, physical and motor aspects are mutually connected and influencing one another. This implies that the changes in one of them also affect the remaining aspects (Pišot & Planinšec, 2010). In addition, preschool children are characterized by individual development (Moser, Reikerås & Tønnessen, 2018). After they turn six, the intensity of growth and the gain on weight is moderate (WHO, 2006). Most children in the European Union countries are included in primary school programmes at that age (Eurostat, 2018). With the beginning of primary education, systematically organised and guided physical activities (OPA) start. These activities are less structured in the preschool period due to systemic differences in teaching methods in preschool and school periods (Van Laere & Vandenbroeck 2018). The first research question of our research therefore deals with the importance of highly structured OPA for both 4- and 6-year-old children. We would like to find out whether the effect (motor efficiency) of the same exercise is the same for both age groups.

THE IMPORTANCE OF THE FREQUENCY OF OPA ON MOTOR DEVELOPMENT

Kabiri, Mitchell, Brewer and Ortiz (2017) found out that children should not only take part in OPA, they should also do it regularly. They discovered that there were significant differences regarding physical efficiency between children who participated in an OPA for less than three hours per week and children who participated in OPA at least three hours per week. Finnish researchers Iivonen, Sääkslahti and Nissinen (2011) concluded that the desired results could not be achieved with only one additional hour of OPA per week. They found out that two hours of physical education were enough to improve locomotive skills, but not to improve balance or manipulative movements. Iranian researchers Sheikh, Safaniab and Afshari (2011) used a sample of twenty5- or 6-year-old children and the Lincoln-Oseretsky test to examine the differences in progress in particular motoric abilities and motoric development after OPA (three times per week) that lasted for three months. They compared it to children not attending any OPA during that period. They found out that statistically significant improvement was evident within the experimental group –both in motor abilities (balance, speed and strength) and in motor development in general. That is way the second research question of this research is how often children should perform OPA.

THE IMPORTANCE OF THE TYPE OF OPA ON MOTOR DEVELOPMENT

Each teacher, educator or trainer wants to provide a good foundation to the children's later engagement in sport (Moser, Reikerås & Tønnessen, 2018). Many new motor/sports programmes, such as NTC (Nikola Tesla Center) Learning(Rajović,

Berić, Bratić, Živković & Stojiljković, 2016), GMD (Game - Movement - Development) concept (Gregorc & Meško, 2016), Sportball (Jahagirdar, Venditti, Duncan, Reed& Fleming, 2017), and various existing sports categories (such as mini volleyball, mini basketball, dancing, rhythmic gymnastics, etc.) are always offered to preschool children. In doing so, various connections are sought between the type of PAor motor/sports programmes and its effectiveness or its impact on motor development (Jahagirdar et al., 2017; Rajović et al., 2016; Giagazoglou et al., 2011). Rajović et al. (2016) measured the performance effects of the NTC programme with a longitudinal study in state kindergartens with two parallel groups, one of which applied the NTC programme for a period of six months, while the second group applied the usual exercise program. The sample consisted of two groups of children aged 4 to 6. The children's motor abilities were estimated by a battery of tests, BOT 2, comprising 14 subtests. On the basis of the applied statistical analyses, it was determined that children in the experimental group achieved significantly improvement on the motor skills test. Karachle, Dania and Venetsanou (2017) verified the differences in motor development between preschool children who participated in additional OPA (recreational gymnastics) twice a week for six months and children who had not participated in such activities. They found statistically significant differences in favour of the group that attended the OPA. Jahagirdar et al. (2017) came to similar results, but they were looking at the effects of Sportball's practice. Salaj, Krmpotić and Stamenković (2016) used 78 preschool children to determine the differences in motor skills between preschool children who took part in OPA (multilateral exercise programmes, football, rhythmic gymnastics) and children who were not included in any OPA. These researchers concluded that the most appropriate OPA for improving motor skills are general exercises. Giagazoglou et al. (2011) also detected differences in motor development between the children who participate in OPA and those who do not. Therefore, our third research question is whether one type of organised exercises had a different influence on the motor efficiency than the other.

SELECTED ASPECTS OF MEASURING MOTOR EFFICIENCY

Measuring the motor efficiency always includes numerous influences that are hard to measure. That is why different measuring instruments have been developed, especially for quantitative and qualitative measurements. Quantitative measurements provide maybe more realistic results (e.g. number of jumps, balls caught, time of running etc. and are expressed by units of measurement). Researchers can compare them among themselves during the research, as well as with other researchers. Qualitative measurements (that are evaluated on the criteria scale) are focused on the movement sample. They are more subjective and depend on the knowledge and experience of the person who administers the measurements/testing. Therefore, Kroes et. al. (2004) consider that this type of measurements is more suitable to determine or predict the progress of developmental shortcomings in children. Both motoric and other dimensions of human's psychosomatic status are not directly expressed, not visible and cannot be directly measured. We can therefore only conclude about them based on measured

specific reactions of an individual. There are latent dimensions (factors), which are based on special statistical methods (factor analysis, component analysis, regression analysis…). These statistical methods, based on the highest number of manifest variables (tests results), define a lower number of statistical dimensions (factors) that should be logically interpreted (Cemič, 1997).

Although it is important to define a child's motoric status – specially to detect retardation and acceleration development phenomena (Cemič, 1997), there are numerous difficulties when it comes to the measurement of preschool children's motor skills. The reasons for this are the following: there is no suitable battery of tests for preschool children at different development stages; the same tests define different motoric dimensions; we should apply more tests in order to determine the development of motor skills; the time when a child is able to concentrate and willing to cooperate during tests is short; for better reliability, a particular test should be repeated several times, and this affects a child's fatigue and motivation to repeat the same tasks (Pišot and Planinšec, 2010).

In recent decades, different tests were designed for the evaluation of motoric development, i.e. motor skills are only some of the motoric tests that should be suitable to test preschool children, according to authors. Cools, De Martelaer, Samaey and Andries (2009) compared the tests and concluded that all tests are suitable. Yet, each of them has its advantages and weaknesses, and the measuring instrument to be used depends on what will be measured.

Given all abovementioned difficulties, we decided to choose MOT 4–6 for the purposes of our research. MOT 4–6 was developed by Renata Zimmer and Meinhart Volkamer, while Cemič standardised it in 1993 for Slovenian children.

METHODS

PARTICIPANTS

The research participants were intentionally selected regarding their age and inclusion or exclusion in OPA. Other activities outside that context were not controlled. The sample selection inclusion criteria were: signed informed consent by parents, child's healthiness on the day of testing and presence and cooperation at both tests. The research included 149 children from Slovenian kindergartens and sports clubs (cities: Brezovica, Kranj and Ljubljana); 39 of them were 4-year-olds (53.8% boys and 46.2% girls), and 110 children were 6-year-olds (61.8% boys and 38.2% girls).We divided 4-year-old children (39 children) in two groups: 48.7% of them represented the control group (no additional OPA), and the rest (51.3%)represented the experimental group (they were include in general OPA twice a week). We used the term "general OPA" to describe the type of OPA, which does not specialize in a single sport. This type of OPA involves elementary games with the aim of integrating as many different natural forms of movement (jumping, walking, climbing, running, crawling, etc.) as possible. The 6-year-old children (110) were divided into five groups; 22.7% of the children represented the control group (they did not participate in OPA), the experimental group

was divided into four subgroups (22.7% of the children did climbing activities twice a week, 17.3% attended judo with the same frequency, 19.1% of the children participated in a general OPA twice a week, while 18.2% participated in general OPA three times per week).The research was approved by the Ethical Committee of the Faculty of Education, University of Ljubljana.

PROCEDURES

We used two types of variables for the purpose of our research. The first one was the measuring instrument (MOT 4-6) designed for measuring physical efficiency. MOT 4-6 consists of the following 18 items: Forward jump in a hoop (this item is introductive and thus it is not assessed), Walking forward, Making dots on a sheet, Grasping a tissue with toes, Jumping sideways, Catching a dropped stick, Carrying balls from box to box, Walking in backward direction, Throwing a ball to a target, Collecting matches, Passing through a hoop, Jumping in a hoop on one foot standing on one leg, Catching a ring, Jumping Jacks, Jumping over a cord, Rolling around, Standing up holding a ball on the head, Jumping and turning in a hoop. The administration of the battery takes approximately 15–20 min. The performance in each task was scored and converted into a three-level ranking scale. Child's item score ranges from 0 (skill not mastered), 1 (skill medium mastered) to 2 (skill mastered). The scores of all seventeen tasks are then added together and their sum constitutes the child's total score between 0 and 34. We applied the test twice. First, we applied it prior to attending OPA and then again after six months. We observed "individual progress" in physical efficiency.

The second type involved different types and frequencies of OPA. Both control groups did not perform in any OPA. The five experimental groups performed in different types (climbing or judo or general OPA) or frequencies of OPA (two or three times per week). The duration of one exercise was 45 min.

We collected the data in the school year 2016/2017.The assessments of control groups were conducted during the daily program from 9.00 to 12.00 o'clock from Monday to Friday. The assessments of experimental groups were conducted during their programme in sports clubs (climbing, judo and general OPA) from 15.00 to 19.00 o'clock from Monday to Friday. Each child was barefooted and individually tested according to the test guidelines (Zimmer &Volkamer,1987).

Prior to research conduct, we informed the parents about our testing goals and the course, and they provided written consent for their children to participate in the research.

STATISTICAL ANALYSIS

We used statistical programme IBM SPSS (version 22.0 for Windows, IBM Corp., Armonk, NY, USA) for the statistical processing of our data. Besides descriptive statistics, we applied comparative statistics, paired-samples T-test, T-tests for independent samples (effect size was tested with Cohen's coefficient), one-way analysis of variance (Welch) and Games-Howell post hoc, with the measurement of

effect η^2 (Eta squared).The normality of distribution was established by using graphical technique (q-q plot). The significance level was set at $p<0.05$.

RESULTS

Table 1. Descriptive characteristics of control and experimental groups of children and results of repeated testing

		first testing$_1$		second testing$_2$		Paired t-test			
	N	M	SD	M	SD	t	df	p	Cohen`s d
4-year-old children –control group	19	17.16	3.17	22.68	4.10	5.893	18	<0.001	1.35
4-year-old children – experimental group	20	14.75	4.92	21.55	4.97	7.490	19	<0.001	1.67
4-year-old children – total	**39**	**15.92**	**4.28**	**22.10**	**4.54**	**9.480**	**38**	**<0.001**	**1.52**
6-year-old children – control group	25	18.96	3.85	20.12	4.26	7.774	24	<0.001	1.55
6-year-old children – experimental group	85	22.09	4.83	26.38	4.11	14.857	84	<0.001	1.61
6-year-old children –total	**110**	**21.38**	**4.80**	**24.95**	**4.90**	**13.875**	**109**	**<0.001**	**1.32**

Legend: N = numerous; M = mean; SD = standard deviation; t = value of t-test; df = degree of freedom; p = statistical significance.

Table 1 shows that all groups of tested children, regardless the type (experimental and control groups) achieved higher results in MOT 4–6 after 6-month period. According to the results of paired t-test (p-value is less than 0.05), it can be concluded that there is a statistically significant difference between the first and the second measurement within each group. However, the progress is not the same for both age groups (4-year- and 6-year-old children). The physical efficiency progress can be calculated from the results, obtained in table 1. The physical efficiency progress for all 4-year-old children is 6,18 ($M_{testing2}$ (22,10) - $M_{testing1}$(15,92) = 6,18) and for all 6-year-old children is 3,57 ($M_{testing2}$ (24,95) - $M_{testing1}$ (21,38) = 3,57). We use approximate t-test for independent samples, which showed that the physical efficiency progress for all 4-year-old children is statistically significantly higher than for all 6-year-old children($t(50.36) = 3.719$, $p = 0.001$, $d = 0.84$).Therefore, the motor development is in general faster for 4- versus for 6-year-old children during six-month period.

For further analysis, we calculated a progress in physical efficiency for each participant. We deducted the result of the first testing (MOT 4-6 (1) = r_{n1}) from the result of the second testing (MOT 4-6 (2) = r_{n2}) and calculated the progress (progress = r_{n2}-r_{n1}). This eliminated the differences in the initial stage.

Table 2. Descriptive characteristics of progress in physical efficiency according to experimental and control groups of 4- and 6-year-old children and the results of t-test

	N	progress ($r_{n2} - r_{n1}$)		t-test for independent samples			Cohen`s d
		M	SD	t	df	p	
4-year-old children – control group	19	5.53	4.09	-0.976	37	0.335	0.32
4-year-old children – experimental group	20	6.80	4.06				
				approximate t-test for independent samples			
6-year-old children – control group	25	1.16	0.75	-9.620	107.93	<0,001	1.59
6-year-old children – experimental group	85	4.28	2.66				

Legend: N = numerous; r_{n1} = result of first testing; r_{n2} = result of second testing; M= mean of progress, SD = standard deviation; t = value of t-test; df = degree of freedom; p = statistical significance.

Table 2 shows the progress in physical efficiency separately according to the age of the control and experimental groups separately. It can be seen that the progress in control groups is lower than in experimental groups for both 4- and 6-year-old children. On average, 4-year-old children in the control group (no additional OPA) progress for 5.53 points, while 6-year-old children in the same group progress for 1.16 point. The difference is thus 4.37 points, which represents 12.9% on a 34-point scale. The difference in progress between the experimental groups (4- and 6-year-old children) is 2.52 points (7.4%). The t-test result determines no statistically significant differences between the control and experimental group of 4-year-old children ($t(37) = -0.976$, $p = 0.335$, $d = 0.32$). However, there are statistically significant differences between the control group and experimental group of 6-year-old children ($t(107.93) = -9.62$, $p < 0.001$, $d = 1.59$). The speed of changes in motor development between 6-year-old children who attended OPA and those who did not are therefore statistically significant in favour of experimental group.

The first question of our research was whether the effect (the progress in physical efficiency) of the same OPA (two times per week) is the same for both age groups (4- and6-year-old children).

Table 3. Descriptive characteristics and progress in physical efficiency of 4- and 6-year-old children in general OPA and the results of independent t-test

		first testing$_1$		second testing$_2$		progress ($r_{n2} - r_{n1}$)		t-test for independent samples			Cohen`s d
	N	M	SD	M	SD	M	SD	t	df	p	
4-year-old children – (general OPA)	20	14.75	4.92	21.55	4.97	6.80	4.06	2.367	39	0.023	0.73
6-year-old children – (general OPA)	21	24.00	2.86	28.14	3.69	4.14	3.09				

Legend: N = numerous; M = mean; SD = standard deviation; t = value of t-test; df = degree of freedom; p = statistical significance

The t-test for independent samples indicated statistically significant differences ($t(39) = 2.367$, $p = 0.023$, $d = 0.73$) in progress(the changes in physical efficiency)between younger and older children within a six-month period of general OPA in favour of younger children. It can be also seen that the younger children had lower total results in MOT 4-6 compared to older children (both at the start of the exercise and six months later). Yet, six months later, the changes/the progress in motor development in younger children was on average2.66 points higher (on a 0-34 points' scale) than in older children (Table 3), but not statistically significantly different between the control and experimental group of 4-year-old children (Table 2).

In further analysis, we included only 6-year-old children, as we wanted to know whether children who more frequently attend OPA advanced faster in their motor development.

Table 4. Descriptive characteristics of progress in physical efficiency between 6-year-old children who attend OPA with different frequency and Welch's test val*ue*

		progress ($r_{n2} - r_{n1}$)		Levene's test for homogeneity of variance		Welch's test				*Games-Howell post hoc test*
	N	M	SD	F	p	F	df	p	η^2	p
6-year-old children – no additional OPA	25	1.16	0.75	13.54	<0.001	47.82	43.23	<0.001	0.237	0.000 (no OPA vs 2 times per week)
6-year-old children – OPA 2 times per week	65	4.31	2.44							0.002 (no OPA vs 3 times per week)
6-year-old children – OPA 3 times per week	20	4.20	3.33							0.990 (2 times per week vs 3 times per week)

Legend: N = numerous; M = mean; SD = standard deviation; F = F-value; df = degree of freedom; p = statistical significance.

We used Welch's test to verify the statistically significant differences in the physical efficiency between progresses of 6-year-old children with different frequency of participation in OPA. This test indicated statistically significant differences between the groups in motor development($F(43.23) = 47.824$, $p < 0.001$, $\eta^2 = 0.237$).We applied Games-Howell post hoc comparisons to verify between which groups the differences appeared. The Games-Howell post hoc test indicated statistically significant differences in the frequency of exercise of the children who did not attend additional OPA (M = 1.16; SD = 0.75), compared to the children who attended the exercise twice a week (M = 4.31; SD = 2.44) ($p < 0.001$), and the children who had no additional OPA, compared to the ones who attended it three times per week (M = 4.20; SD = 3.33) ($p = 0.002$). Yet, no statistically significant differences were detected between the children who attended the exercise two or three times per week ($p = 0.99$).

To find out whether different types of OPA had different influence on the motor efficiency, we used Welch's test and Games-Howell post hoc test.

Table 5. Descriptive characteristics of progress in physical efficiency between 6-year-old children who attend different types of OPA two times per week and Welch's test value to determine the differences

		progress ($r_{n2} - r_{n1}$)		Levene's test for homogeneity of variance		Welch's test	
	N	M	SD	F	p	F	p
6-year-old children – general OPA	21	4.14	3.09	8.239	<0.001	1.600	0.218
6-year-old children – (climbing)	25	4.00	1.25				
6-year-old children – (judo)	19	4.89	2.83				

Legend: N = numerous; M = mean; SD = standard deviation; F = F-value; p = statistical significance.

According to Table 5, Welch's test ($F(31.12) = 1.600$, $p = 0.218$, $\eta^2 = 0.025$) shows no statistically significant differences in the physical efficiency progresses of 6-year-old children between different types of OPA. Games-Howell post hoc test also shows no statistically significant differences between the types of OPA.

DISCUSSION

In our research, we tried to verify the importance of age, frequency and type of the inclusion of children in OPA. We identified three important aspects which are confirmed in the theory of children's motor development, even though they are hardly acceptable in practice.

The first question is whether the same structured OPA has the same effect on motor development of 4- and 6-year-old children. Butterfield, Lehnhard and Coladarci (2002) and Palmer, Matsuyama and Robinson (2017) verified that all preschool children progress in motor development –regardless of their inclusion into additional exercises. We verified and confirmed the same in our research, as it can be seen from Table 1.The paired sample t-test showed statistically significant differences between first and second testing in all groups of children. However, we also found out that 4-year-old children in total progressed averagely for 6.18 points in a 6-month period, while 6-year-old children in total progressed on average for 3.57. Based on Table 2, which shows the results of progress in MOT 4-6 during a 6-month period, we can see that in control groups4-year-old children achieved 4.37 points (12.9%) higher results in progress compared to 6-year-old children. The progress of 4-year-old children was also higher (for 2.52 points or for 7.4%) in comparison with 6-year-old children within the experimental groups. However, all of these differences in favour of younger children could mislead us. We should have observed the progress in physical efficiency within the same age to determine the importance of OPA. When we obser-

ved the progress between the control (M = 5.53, SD = 4.09) and experimental group (M = 6.8, SD = 4.06) of 4-year-old children no statistically significant differences were detected. It means that 4-year-old children's progress was approximately equal regardless of the inclusion into OPA. Although, 4-year-old children progressed statistically significantly higher than 6-year-old children (Table 3), the results cannot be attributed to OPA. According to this data, motor development of 4-year-old children is much more dynamic that of 6-year-old children. Clearly numerous factors influence children's development. Yet, it is difficult to include all the factors into the research completely (King, Law, King, Rosenbaum, Kertoy & Young, 2003). Zeng, Ayyub, Sun, Wen, Xiang and Gao (2017) researched the influence of PA on the development of motor skills (in a cross-sectional study)and discovered that the scientists in 2017 confirmed the importance of PA for the progress in the development of both motor and cognitive functions in eight out of ten studies .Dodge, Bai, Ladd and Muschkin (2017) also emphasise the importance of structured programmes (not necessarily motor programmes) and prove their strong influence on educational purposes. However, we were mostly interested in OPA and its influence on physical efficiency. We also wanted to know when the systematic OPA comes to effect. As we can see from the results, 4-year- old children have higher progress in motor efficiency than 6-year-old children. However, statistically significant difference in the progress between the experimental and control group was found only in 6-year-old children. This finding convinced us that systematic OPA makes more sense for 6-year-old children.

The second important aspect is the frequency of attending OPA per week. In the previous section we investigated the most appropriate time for starting with OPA in preschool period. In this section, we will try to answer the question about the appropriate frequency of attending OPA per week. Both, parents and researchers, often wonder how often preschool children should be weekly involved in OPA. If the goal is progress in physical efficiency, our research might help to answer the question about the appropriate weekly inclusion in OPA. The analysis of our results shows that the systematically OPA was statistically significantly important for the progress in physical efficiency for 6- but not for 4-year-old children. It was also confirmed that the higher number of exercises per week did not necessarily mean a significant progress in motor efficiency.

The third important aspect is the type of systematic OPA. We found out that the type of systematic OPA has no influence on physical efficiency (Table 5). Salaj et al. (2016) came to similar results, but they were looking to determine the differences in motor skills between children who were attending multilateral exercise programmes, football and rhythmic gymnastics. They concluded that the most appropriate OPA are general exercises. It is important that 6- year-old children attend a systematic OPA, but it does not matter which type. However, this statement is not so evident for 4-year-old children.

The synthesis (an analytical and synthetic overview of all results) of our research conclusions indicates that it makes sense to perceive OPA in the preschool period

in a different way than in the school period. It makes sense to perform OPA in a different way, and not only with reduced duration in minutes, shorter distances and lowered or adapted equipment.

LIMITATIONS

As a limitation of our study, the results are based on a relatively small sample which cannot be considered as representative. Another limitation of this study was a lack of information about the body mass index. However, from this research, we can conclude the effect of OPA on motor efficiency of preschool children but for a better understanding, further research is needed.

CONCLUSION

We found out that 4-year-old children progress higher in physical efficiency during 6-month period than 6-year-old children, regardless the OPA. However, only 6-year-old children statistically significant progress in physical efficiency, if they are included in OPA in comparison to when they are not. If 6-year-old children do not attend OPA, the progress is almost negligible. We have also found out that 6-year-old children should attend OPA twice a week, and that there were no differences between progress in physical efficiency, by attending different types of OPA. In this research, we may have indirectly additionally substantiated that the so-called sports tuition makes more sense for6-than for 4-year-old children. For 4-year-old children it is better to consider connecting all areas through the methods of work that include movement.

REFERENCES

1. Butterfield, S. A., Lehnhard, R. A., & Coladarci, T. (2002). Age, sex, and body mass index in performance of selected locomotor and fitness tasks by children in grades K-2. Perceptual and Motor Skills, 94(1), 80–86. doi:10.2466/pms.2002.94.1.80.
2. Cemič, A. (1993). Standardization of test MOT 4–6. Defektologica slovenica, 1(1), 29–38.
3. Cools, W., De Martelaer, K., Vandaele, B., Samaey, C., &Andrie, C. (2010). Assessment of movement skill performance in preschool children: Convergent validity between MOT 4-6 and M-ABC. Journal of Sports Science and Medicine, 9, 597–604.
4. Dodge, K. A., Bai, Y., Ladd, H. F., &Muschkin, C. G. (2017). Impact of North Carolina's Early Childhood Programs and Policies on Educational Outcomes in Elementary School. Child Development, 88(3), 996–1014. doi:10.1111/cdev.12645.
5. Eurostat (2018). Early childhood and primary education statistics. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php/Early_childhood_and_primary_education_statistics.
6. Giagazoglou, P., Kabitsis, N., Kokaridas, D., Zaragas, C., Katartzi, E., &Kabitsis, C. (2011). The movement assessment battery in Greek preschoolers: The impact of age, gender, birth order, and physical activity on motor outcome. Research in Developmental Disabilities, 32(6), 2577–2582.doi:10.1016/j.ridd.2011.06.020.
7. Gregorc, J., &Meško, M. (2016). The concept "play- physical activity - development"

as a response to the contemporary teaching methods in preschool education. Research in kinesiology: International journal of kinesiology and other related sciences, 44(1), 19–25.
8. Iivonen, S., Sääkslahti, A., &Nissinen, K. (2011). The development of fundamental motor skills of four- to five-year-old preschool children and the effects of a preschool physical education curriculum. Early Child Development and Care, 181(3), 335–343. doi: 10.1080/03004430903387461.
9. Jahagirdar, I., Venditti, L. A., Duncan, A., Reed, N., & Fleming, S. (2017). Exploring the relationship between participation in a structured sports program and development of gross motor skills in children ages 3 to 6 years. Journal of Occupational Therapy, Schools, & Early Intervention, 10(3), 203–212.doi: 10.1080/19411243.2017.1325816.
10. Kabiri, L. S., Mitchell, K., Brewer, W., & Ortiz, A. (2017). Motor Skill Proficiency Among Homeschool Children. Journal of Motor Learning and Development, 5(2), 336–345. doi: 10.1123/jmld.2016-0085.
11. Karachle, N., Dania, A., &Venetsanou, F. (2017). Effects of Recreational Gymnastics Program on the Motor Proficiency of Young Children. Science of Gymnastics Journal, 9(1), 17–25.
12. King, G., Law, M., King, S., Rosenbaum, P., Kertoy, M. K., & Young, N. L. (2003). A conceptual model of the factors affecting the recreation and leisure participation of children with disabilities. Physical & Occupational Therapy in Geriatrics,23(1), 63–90. doi: 10.1300/J006v23n01_05.
13. Kroes, M. et al. (2004). Reliability and validity of a qualitative and quantitative motor test for 5- to 6-year-old children. European Journal of Paediatric Neurology, 8(3), 135–143.
14. Logan, S.W., Barnett, L. M., Goodway, J. D., &Stodden, D. F. (2017). Comparison of performance on process- and product-oriented assessments of fundamental motor skills across childhood. Journal of Sports Science, 35(7), 634–41. doi:10.1080/02640414.2016.1183803.
15. Malina, R. M. (2014). Top 10 research questions related to growth and maturation of relevance to physical activity, performance, and fitness. Research Quarterlyfor Exercise and Sport, 85(2), 157–73. doi:10.1080/02701367.2014.897592.
16. Moser, T., Reikerås, E., & Tønnessen, F. E. (2018). Development of motor-life-skills: variations in children at risk for motor difficulties from the toddler age to preschool age. European Journal of Special Needs Education, 33(1), 118-133. doi: 10.1080/08856257.2017.1306964.
17. Natale, V., & Rajagopalan, A. (2014). Worldwide variation in human growth and the World Health Organization growth standards: a systematic review. BMJ Open, 4(1). doi: 10.1136/bmjopen-2013-003735.
18. Palmer, K. K., Matsuyama, A. L., & Robinson, L. E. (2017). Impact of Structured Movement Time on Preschoolers' Physical Activity Engagement. Early Childhood Education Journal, 45(2), 201–206.
19. Pem, D. (2015). Factors Affecting Early Childhood Growth and Development: Golden 1000 Days. Advanced Practicesin Nursing, 1(1). doi:10.4172/2573-0347.1000101
20. Pišot, R., & Planinšec, J. (2010). Motor structure and basic movement competences in early child development. Annales Kinesiologiae, 1(2), 145–165.
21. Rajović, R., Berić, D., Bratić, M., Živković, M., &Stojiljković, N. (2016). Effects Of An "Ntc" Exercise Program On The Development Of Motor Skills In Preschool Children. Physical Education and Sport, 14(3), 315–329. doi: 10.22190/FUPES1603315R.
22. Salaj, S., Krmpotić, M., &Stamenković, I. (2016). Are specific programs a threat to

overall motor development of preschool children? KinesiologiaSlovenica, 22(1), 47–55.
23. Sheikh, M., Safaniab, A. M. & Afshari, J. (2011). Effect of selected motor skills on motor development of both genders aged 5 and 6 years old. Procedia Social and Behavioral Sciences, 15, 1723–1725.
24. Van Laere, K. & Vandenbroeck, M. (2018). The (in)convenience of care in preschool education: examining staff views on educare. Early Years, 38(1), 4–18. doi: 10.1080/09575146.2016.1252727.
25. WHO (2006). Child Growth Standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age. Retrieved from http://www.who.int/childgrowth/standards/Technical_report.pdf?ua=1.
26. Zeng, N., Ayyub, M., Sun, H., Wen, X., Xiang, P. & Gao, Z. (2017). Effects of Physical Activity on Motor Skills and Cognitive Development in Early Childhood: A Systematic Review. BioMed Research International,2017, 1–13. doi:10.1155/2017/2760716.
27. Zimmer, R. &Volkamer, M. (1987). MOT 4-6. Motoriktest fur vier- bis sechsjährige Kinder [MOT 4-6. Motoric test for four- to six-year-old children].(2nd ed.).Weinham, Germany: Beltz.

ANALIZA RAZLIKA MOTORIČKE EFIKASNOSTI NAKON ŠESTOMJESEČNE SUSTAVNO ORGANIZIRANE TJELESNE AKTIVNOSTI IZMEĐU ČETVEROGODIŠNJE I ŠESTOGODIŠNJE DJECE

Sažetak: *Cilj istraživanja bio je utvrditi ima li organizirana tjelesna aktivnost (OPA) jednak učinak na tjelesnu učinkovitost kod četverogodišnjaka i kod šestogodišnjaka. U istraživanje je tijekom 2016. i 2017. godine uključeno ukupno 149 ciljano odabrane djece (39 četverogodišnjaka i 110 šestogodišnjaka). Djeca su bila podijeljena u kontrolnu skupinu (koja nije bila uključena u dodatnu organiziranu tjelesnu aktivnost) i pokusnu skupinu (koja je uključena u dodatnu organiziranu tjelesnu aktivnost). Tjelesna učinkovitost mjerena je testom MOT 4–6 . Djeca su testirana dvaput (drugo testiranje provedeno je šest mjeseci poslije prvoga). Rezultati pokazuju da se nakon šest mjeseci kod sve djece opaža napredak, bez obzira na njihovu dob i na tip organizirane tjelesne aktivnosti. Napredak u tjelesnoj aktivnosti kod četverogodišnjaka je statistički značajno viši nego kod šestogodišnjaka. Nisu ustanovljene statistički značajne razlike između četverogodišnjaka koji su uključeni u dodatnu organiziranu tjelesnu aktivnost i njihovih vršnjaka koji u njoj nisu sudjelovali. Međutim, postoje statistički značajne razlike u napretku između šestogodišnjaka koji su pripadali kontrolnoj skupini i njihovih vršnjaka koji su pripadali pokusnoj skupini. Prema rezultatima naših istraživanja, organiziranu tjelesnu aktivnost smislenije je provoditi među šestogodišnjom djecom nego među četverogodišnjacima. Rezultati također pokazuju da bi se šestogodišnjaci organiziranom tjelesnom aktivnošću trebali baviti dvaput tjedno, bez obzira na tip te aktivnosti.*

Ključne riječi: *motorički razvoj, organizirane tjelesne aktivnosti, djeca predškolske dobi*