



## **The impact of structured regular physical activity on the development of individual motor skills in school-aged children**

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### **ABSTRACT:**

The research was conducted on a suitable sample of school-aged children (experimental and control group) with the main aim to prove positive impact of the structured regular physical exercises on the development of the individual motor skills. The motor abilities that are specifically covered in this work are speed, strength, coordination and flexibility, which are among the seven basic motor abilities of every healthy individual.

In order to get an answer to the question, whether the experimental group differs in terms of the same anthropological characteristics from the control group of respondents at the final measurement compared to the initial measurement, appropriate means, methods and workloads were applied.

Applying the method of initial and final measurement, significant differences were found in the motor skills of children from the experimental group of subjects, which basically answered the question of the impact of the application of structured regular physical activity programs on the development of the mentioned motor skills.

**KEY WORDS** experimental and control group, motor skills, physical activity

### **INTRODUCTION**

Previous research unequivocally indicates that a high level of physical activity of children is closely related to a high level of motor skills (Fisher et al., 2005; Wrotniak et al., 2006), but also that insufficient physical activity of children has a negative impact on both motor skills and on the complete motor development of children (Lubans et al., 2010). Physical activity refers to any movement or movement of the body or parts of the body, which is the result of nervous support acting on the locomotor apparatus (bones, joints and muscles). Daily exercise of various forms of

physical activity has a positive effect on the growth and development of the organism (Eather et al., 2013; Hennessy et al., 2010).

Motor abilities are latent human abilities that are manifested through movement, and accordingly every person possesses them, but at a certain level. Motor abilities are the possibilities of a person, as a biopsychosocial and cultural being, to achieve success in a certain activity (Kukulj, 2006). The level of manifestation of motor skills depends on a number of factors such as: the general state of health of the organism, heredity, gender, age, training, etc. Physically active children have better results



in tests for the assessment of motor skills, a more favorable body mass index and a more positive self-perception of their abilities (Sollerhed, Apitzsch, Råstam, & Ejlerstsson, 2007)

In order to collect information about motor skills, and to define their existence, it is necessary to perform a series of measurements of the manifest area of motor skills. This is done by a special testing technique, where metrically tested tests are used as an instrument to obtain data.

Most authors agreed that seven motor abilities exist in the latent space, namely: strength, speed, coordination, flexibility, precision, balance and endurance.

In order to raise the level of certain or all motor skills to a higher level, it is necessary to be exposed to a certain process of exercising. Using a variety of shaping exercises, physical exercise as a basic means of working in physical culture not only has a positive effects on the general state of health of the individual, but also on increasing the level of motor skills, which was discussed in some of the earlier research according to which the child's development progresses as much and as quickly as in motor skills (Kamenov, 2008).

The subject of this paper is the development of motor skills of a certain number of school-age children, caused by the application of regular and additional physical activities.

The purpose of this paper is to prove that, even in short-time period, appropriate application of the structured physical activities can lead to improvement of the overall physical and motor abilities.

The problem of the research is to determine whether the applied means, methods and loads in the process of realizing regular physical activities during classes in the subject of physical education and extracurricular activities can significantly influence the development of motor skills at the end of the experimental period (in the final compared to the initial measurement).

Based on the subject and problem of the research, the basic and special research objectives were determined.

The main goal of the research is to determine the differences in the level of physical abilities in the final compared to the initial measurement in the experimental group of respondents, included in the regular teaching process of physical education and additional extracurricular activities (performing shaping exercises in free time according to the defined type and schedule).

The special goal of the research is to determine the effects (differences) in the level of motor skills between the experimental and control groups of respondents at the final measurement.

The impact of the special programs on motor skills has been the subject of some previous scientific research: Bavčević, T., J. Babin, I. Prskalo (2006); Hadžikadunić A. (2007); Hadžikadunić M. (2004); Luka M., I. Jukić, S. Šimek (2006); Malina, R. (1984); Stanković A. (2002); Skender N. (2004); Tabaković, M., N. Skender, S. Turković (2006); Tabaković, M., S. Turković, N. Skender (2005).

## METHODS

Taking into account the problem and goal of the research, a smaller group of measuring instruments was used to assess the level of motor skills.

In order to achieve certain results, bearing in mind the above mentioned, the following tasks were implemented:

- An initial measurement of the state of motor skills was performed in the test subjects of the experimental and control groups;
- Respondents from the experimental group were given previously defined tasks for performing training exercises in their free time;
- The final state of motor skills of the respondents of the experimental group was determined.

### 2.1. A sample of respondents

The sample of respondents included 43 school-age children from two classes of the 6th grade of the elementary school from the city Nevesinje (experimental and control group).

The sample includes children who, in addition to regular physical education classes, have additional activities in the form of training in various sports or other extracurricular activities (country dance, dance school, etc.), and who require additional physical activities (control group).

Respondents who, in addition to regular physical education classes, are not involved in sports clubs or sections, were given tasks to perform various shaping exercises in their free time, at least three times a week, for a minimum of 30 minutes, but no longer than 45 minutes with breaks, for a duration of one month with parental supervision (experimental group).

The basic condition for participation in this research was that all respondents were of the same age, in good general health, regularly attended physical education classes, and had parental consent for the purposes of the research.

### 2.2 Sample variables

The sample of variables included in this paper for the purposes of assessing the aforementioned motor abilities consists of:

- Long Jump (coordination and strength assessment- LJ)

- Hand Tapping (speed and coordination assessment- HT)
- Running 2x30m (strength and speed assessment- R2x30m)
- Bench Flexion (flexibility assessment- BF)
- Crunches (strength assessment- ABS)

### 2.3 Description of measuring instruments for assessing motor skills

#### Standing long jump

Instruments: 7cm thick leather mats, springboard of standard construction, steel measuring tape.

Task: The subject bounces off the end of an inverted springboard and jumps onto the mat as far as he can. A foot jump is mandatory.

Evaluation: Two jumps are performed, and the better result is recorded. The length of the jump is measured perpendicular to the reflection line, that is, from the beginning of the mat to the place where the back of the subject's body fell. The measurement accuracy is 1 cm.

#### Tapping by hand

Instruments: Taping board 80 cm long, marked in the middle and placed on the table, stopwatch.

Task: The subject sits at the table, places his weaker hand on the line marking the middle of the board, with his stronger hand at the moment of performing the task, passes over the hand placed in the middle of the board and touches the board on one and the other side of the placed hand.

Assessment: The examinee places the weaker hand in the middle of the plate, passes the stronger hand over the placed hand and reaches the surface, then returns the hand to the starting position. All this is performed in a time interval of 20 seconds, the measurement is performed twice and the number of correctly performed movements is recorded.

#### Running 2x30m

Instruments: Stands, stopwatch.

Task: Two racks are placed 30 meters apart. At the signal from the high start, the test taker runs from the rack marked "Start" to another rack placed at a distance of 30 m, going around it in a race, and returns running to the starting rack. Repeat the same task a second time after a 60-second break.

Assessment: The running time is measured in seconds, the result is measured with an accuracy of 0.05 sec. The better result of two attempts is entered.

#### Bench flexion

Instruments: Bar 60 cm long, marked with numbers from 0 to 30 cm and vice versa, attached to a wooden bench.

Task: The examinee stands on a wooden bench with his feet parallel, performs a forward bow with his arms extended forward. With the tips of the fingers of the hand, it goes down the vertically placed marked slat. The subject is instructed not to bend the knee joint, the task is performed twice with a break of 30 seconds.

Evaluation: The examinee does a forward bend from the bench twice, with outstretched arms without bending in the knee joint. The better result of two attempts is recorded.

#### Crunches

Instruments: 7cm thick leather mat, Swedish ladder, stopwatch.

Task: The subject lies on his back with his legs half-bent in the knee joint, with his feet resting on the slats of the Swedish ladder. The subject lifts the trunk off the ground holding the interlaced fingers of the hand behind the head with the elbows extended.

Evaluation: The number of trunk lifts is measured in two attempts at a time interval of 20 seconds, with a break between repetitions of 60 seconds. A better result is entered.

### 2.4 Program of the additional activities for the experimental group of respondents

The program of the additional activities for the experimental group was determined in such a way that in their free time, with the supervision and presence of their parents, at least three times a week, certain exercises were performed with the aim of increasing the level of motor skills in a period of one month (minimum 12 training sessions). The work plan for improving the motor skills of the tested respondents from the experimental group was designed so that shaping exercises were performed on days when there were no physical education classes in the school.

Shaping exercises were applied that were estimated to have a significant effect on increasing the level of motor skills measured by a suitable sample of variables. At the very beginning of the training, exercises for the general warm-up of the locomotor apparatus were applied according to the model of the warm-up that the respondents usually apply while attending classes of physical education, lasting no longer than 10 minutes (circular movements warming up the joints of the head and neck part of the spinal column, shoulder girdle, elbow joints, hips and pelvic girdle, knee joints, ankle and wrist). After the warm-up, exercises were applied in a standing position, alternately lifting one leg and the other, while simultaneously clapping the palms under the knee of the raised leg in series of 5x10 repetitions from the first to the fifth day of training with a break between series of up to 40 seconds. Then exercises to raise the trunk from a lying position on the back with semi-bent knees (preferably with the feet attached to a piece of furniture or with the assistance of a parent who firmly holds the feet of the legs resting on the entire surface on the surface) in series of 5x5-7 repetitions from the first to the fifth training with a break in between a series of up to 60 seconds. Next, lifting the trunk from a lying position on the stomach with fully extended legs (preferably with the feet attached to a piece of furniture or with the assistance of a parent who holds the feet firmly on the floor) in series of 5x5-7 repetitions from the first to the fifth training with a break between sets up to 60 seconds. Squats in sets of 5x5

repetitions from the first to the fifth training with a break between sets of up to 60 seconds. Running in place with a high knee lift (skipping) for 3x10 seconds with a break of 60 seconds from the first to the fifth training. Push-ups in series of 5x1-5 repetitions from the first to the fifth training (with the difference in the application of the exercise for boys and girls) with a break between series of up to 60 seconds. Then, in a sitting position on the floor with outstretched legs, alternately spread and cross the legs, without lifting them from the floor in series of 5x10 repetitions from the first to the fifth training with a break between series of 40 seconds, and from a standing position with the feet placed at the width of the hips with toes hand to reach the toes (without bending in the knee joint) in sets of 5x10 repetitions from the first to the fifth training with a break between sets of 40 seconds. The method of applying the assigned exercises from the sixth to the 12th training session was increased by one to a maximum of three series, and two to a maximum of four repetitions during the performance of one series, compared to the first five training sessions, all in accordance with the possibilities of the examinee.

In order to have the greatest possible impact of the applied exercises, it was recommended to the respondents and parents that the exercises should be performed outdoors if possible, with effective oxygen consumption, that is, that the space in which the exercises are performed should be maximally ventilated if the exercises are performed indoors.

#### 2.4 Data processing method

Table 1. Basic statistical parameters for the assessment of motor abilities of the experimental group at the initial measurement.

Variables	N	MIN	MAX	MEAN	ST.DEV.	CO.VAR.	SKEW	KURT
<b>R2X30m</b>	43	12.88	14.26	13	0.42	3%	0.5	-1.1
<b>HT</b>	43	46	60	55	4.46	8%	-0.8	-0.5
<b>BF</b>	43	8	-8	-3	2.77	-9%	0.6	0.4
<b>LJ</b>	43	125	159	142	8.62	6%	-0.1	-0.6
<b>ABS</b>	43	12	16	14	1.13	8%	0.1	-1

Analysis of the Table 2, shows the basic statistical parameters of the motor skills of the control group at the initial test, it can be concluded that by comparing the results (St. Dev) with the (Mean) arithmetic mean as well as with the range of minimum (Min) and maximum (Max) results, it is possible to conclude normal test sensitivity in most cases. By calculating the coefficient of variation (Co. Var) of the measured variables, the most significant variability (scattering) of the data was determined in the BF variable (bench flexion), as was the case with the experimental group.

The value of skewness (Skew) shows that almost all measured variables have a normal distribution, i.e. negligible asymmetry, because the values of the obtained results are around  $\pm 0.5$ . In the case of the variable ABS (crunches), a significant asymmetry of distribution was determined, as the values of the obtained results are around  $\pm 1.00$ .

Bearing in mind the number of respondents, the set goal and task of the work, the collected data were statistically processed in the Microsoft Office Excel 2016 program, standard deviation (St. Dev.), coefficient of variation (Co. Var.), skewness (Skew.) and kurtosis (Kurt.).

#### STATISTICAL RESULTS

Analysis of the Table 1, shows basic statistical parameters of the respondents motor skills of the experimental group at the initial measurement, it can be concluded that by comparing the results (St. Dev) with (Mean) the arithmetic mean as well as with the range of minimum (Min) and maximum (Max) the normal sensitivity of the tests, i.e. the expected values, can be concluded from the results. By calculating the coefficient of variation (Co. Var.) of the measured variables, the most significant variability (dispersion) of the data was determined in the case of the variable BF (bench flexion).

The value of skewness (Skew) shows that the measured variables have a normal distribution, i.e. negligible asymmetry, because the values of the obtained results are around  $\pm 0.5$ , except in the case of the variable HT (hand tapping) where slightly larger negative values were determined in relation to other variables.

The results of kurtosis (Kurt) for all measured variables range below the value of 3, which indicates a lower roundness (platykurtic) of the data than the normal value.

The values of kurtosis (Kurt) for most variables indicate less roundness (platykurtic) because the obtained values are below the value of 3, except for the variable BF (bench flexion) where a more pronounced roundness (leptokurtic) was determined because the values of the obtained results are above the value of 3.

Furthermore, by comparing the results obtained at the initial measurement in the experimental and control groups, obvious differences in the values of the results for all tested variables were noted.

Table 2. Basic statistical parameters for the assessment of motor abilities of the control group at the initial measurement.

Variables	N	MIN	MAX	MEAN	ST.DEV.	CO.VAR.	SKEW	KURT
<b>R2X30m</b>	43	11.09	12.7	12	0.51	4%	0	-1.3
<b>HT</b>	43	59	83	67	6.12	9%	1	1.3
<b>BF</b>	43	-10.0	-19.0	-12.0	2.5	-22%	-1.8	3.5
<b>LJ</b>	43	155	210	177	14	8%	0.7	-0.1
<b>ABS</b>	43	17	21	18	1.14	6%	0.6	-0.1

Analysis of the Table 3, shows the basic statistical parameters of the motor skills of the experimental group at the final measurement, it can be concluded that during the period of 30 days of the additional physical activities, the results of motor skills improved significantly.

By comparing the results (St. Dev) with the (Mean) arithmetic mean as well as with the range of minimum (Min) and maximum (Max) results, the normal sensitivity of the tests can be concluded in most cases as it was stated during the initial measurement. By calculating the coefficient of variation (Co. Var.) of the measured variables, the most significant variability (dispersion) of the data is still the most pronounced in the BF variable (bench flexion).

The skewness value (Skew) shows that all measured variables have a normal distribution, i.e. negligible asymmetry, because the values of the obtained results are around  $\pm 0.5$ .

The results of kurtosis (Kurt) for all measured variables are below the value of 3, which makes the distribution less rounded (platykurtic).

Table 3. Basic statistical parameters for the assessment of the motor skills of the experimental group at the final measurement.

Variables	N	MIN	MAX	MEAN	ST.DEV.	CO.VAR.	SKEW	KURT
<b>R2X30m</b>	43	12.22	14	13	0.43	3%	0.3	-0.3
<b>HT</b>	43	50	64	57	4.01	7%	-0.3	-1
<b>BF</b>	43	-1	-9	-6	2.19	-12%	0.2	-0.9
<b>LJ</b>	43	128	160	145	8.04	6%	-0.2	-0.5
<b>ABS</b>	43	13	18	15	1.32	9%	0.4	-0.2

## DISCUSSION

The results obtained by applying descriptive statistics in this research show (Tables 1 and 3) that in the final, in relation to the initial measurement, under the influence of the program of additional activities, certain changes occurred in terms of the manifestation of motor skills, regardless of the short period of conducting the research. The positive effects of the additional exercises program in addition to regular physical education classes are also indicated by the results of earlier researches (Batričević, 2008; Marković, 2016; Mitić, 2011; Nikolić, 2019; Pelemiš, Mitrović, Pelemiš, Lalić, Ujsasi, Bjelica, 2013; Požgaj, Belošević, Simić, 2010).

The results of a scientific research and experience from practice (Armstrong et al., 1994; Beets et al., 2005; Milanović, 2007) confirmed on a sample of elementary school students that a gradual increase in progressive load for the development of motor and functional abilities is particularly significant in order to the foundations have been built on which complex motor skills will be developed in all aspects, which will enable an easier transition to the specialization phase later on. A similar approach for the development of motor skills with a gradual increase in progressive load was achieved with the respondents in this research by applying a program of additional activities.

In support of the aforementioned is the fact that the respondents of the experimental group showed a certain degree of improvement in all measured variables at the final measurement, especially in the case of the BF variable (bench flexion), where the greatest improvement was noted, which is directly related to some of the earlier research, according to which flexibility is subject to changes through the application of a directed training process (Kurtz, 1994 according to Stojiljković, 2003) and is dependent on the training activity (Heimar et al. 1997).

Using a similar procedure, Stević et al. (2009) set the goal of determining the quantification of the transformations of motor skills in students caused by programmed extracurricular activities, where a statistically significant difference between the two groups of respondents was determined in the final measurement for all set variables. In this regard, it should be pointed out that the differences between the experimental and control groups at the initial and final measurements, viewed individually by variables, are evident and statistically improved.

The established differences show that variables measuring strength (ABS), speed and coordination (HT) and flexibility (BF) contributed to the greatest difference. Smaller differences between the studied samples were found in the variables for the assessment of coordination and strength (LJ), strength and speed (R2x30m), which is in accordance with earlier research that talks about quantitative changes in the area of the basic and situational-motor skills of students caused by additional training (Bajrić, Šmigalović, Bašinc, Bajrić, 2012; Korjenić, Jelićić, Bašinc, Begović, 2012; Lukić, 2015; Rađenović, 2015; Šmigalović, Bajrić, Lolić, 2012).

Respondents from the experimental group achieved better results of the measured variables compared to the initial measurement, which can be linked to the results of similar researches that showed that physically active children are superior to physically inactive children in almost all motor skills (Bojanić and et al., 2018; Lima et al., 2017; Matljan et al., 2015; Radanović, 2018). The effects of the application of the program of additional activities unequivocally led to the improvement of the results, some of which were also recorded in other researches (Bajrić et al., 2012; Lukić, 2015; Nešić et al., 2013).

Bearing in mind previous similar researches, it can be stated that in this research it was confirmed that there is a great impact of structured regular physical activity on the development of the children motor skills, although in this specific research it is a non-representative sample of respondents with a short time period of conducting the activity.

## ACKNOWLEDGEMENT

Observing the obtained results, on the basis of descriptive parameters, it was determined that there are statistically significant differences between the motor skills of the respondents of the experimental and control groups at the initial measurement.

Applying the appropriate means, methods and loads in the final measurement, the differences in the values of the results of the respondents of the experimental group in relation to the values of the results from the initial measurement were determined.

The main limitation for obtaining better results of motor skills tests that appeared during this short research is the general lack of knowledge of the elements of athletics and gymnastics among the majority of respondents. With regard to that, another conclusion is imposed, namely that it is necessary to introduce the teaching units of the athletics and gymnastics as a primary in the curricula for primary schools, especially for the lower grades, and only later to introduce the teaching units related to familiarization with the different ball sports.

With regard to all above mentioned, it can be unequivocally concluded that in addition to the noted increase in the level of motor skills, as a concrete result of the applied methods on a relatively small sample with a short period of time, structured physical activity programmes can significantly influence the formation of a positive attitude among parents about the importance of regular and continuous physical activities, and which can significantly affect the morphological characteristics of school-aged children, primarily the prevention of obesity and the occurrence of diabetes in the early stages of the body's development.

This is especially important for physical education teachers as the only educators who can influence the formation of positive attitudes through their work through the process of teaching physical education.

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