Gustav Bala[1]*
Boris Popović[1]
Erne Sabo[2]

INFLUENCE OF THE KINDERGARTEN PERIOD ON THE DEVELOPMENT OF CHILDREN'S PSYCHOSOMATIC CHARACTERISTICS

UČINKI PREDŠOLSKEGA OBDOBJA NA RAZVOJ OTROKOVIH PSIHOSOMATSKIH ZNAČILNOSTI

Abstract

A battery of 11 anthropometric measures, 4 cardio-respiratory tests, 4 school-readiness tests, and 16 motor tests was administrated on a sample of 660 pre-school children (333 boys and 327 girls) just about to enrol in the first grade to analyse the influence of the kindergarten period on the development of the children's psychosomatic characteristics. The entire sample of children was divided into six groups by gender and the duration of kindergarten attendance (kindergarten period of 8-9 months 3 years and 5 years). The results showed that the entire education and motor activities in kindergarten contribute significantly to the development of children's psychosomatic characteristics, especially in terms of their school readiness and motor abilities. The greatest school readiness was found in those children who have attended kindergarten for a long period, and the worst in those children who have attended kindergarten for only one school year or less before enrolling in the first grade.

Key words: pre-school children, anthropometric characteristics, motor abilities, cardio-respiratory abilities, school readiness

Izvleček

Na vzorcu 660 predšolskih otrok (333 dečkov in 327 deklic), ki so bili tik pred vstopom v šolo, smo uporabili baterijo 11 antropometričnh meritev, 4 kardio-respiratornih testov, 4 testov pripravljenosti za šolo in 16 motoričnih testov, s katerimi smo analizirali učinke predšolskega obdobja na razvoj otrokovih psihosomatskih značilnosti. Celoten vzorec otrok smo razdelili v šest skupin po spolu in po trajanju obiskovanja vrtca (trajanje obiskovanja vrtca o d8 do 9 mesecev, 3 leta in 5 let). Rezultati raziskave so pokazali, da celotna vzgoja in motorične aktivnosti v vrtcu pomembno prispevajo k razvoju otrokovih psihosomatskih značilnosti, predvsem ko govorimo o njihovi pripravljenosti za vstop v šolo in motoričnih sposobnostih. Najvišja stopnja pripravljenosti za šolo je bila ugotovljena pri otrocih, ki so pred vstopom v šolo obiskovali vrtec daljše obdobje, manjša stopnja pa pri otrocih, ki so pred vstopom v šolo obiskovali vrtec eno leto ali manj.

Ključne besede: predšolski otroci, antropometrične značilnosti, motorične sposobnosti, kardio-respiratorne sposobnosti, pripravljenost za šolo

[1]Faculty of Physical Education, University of Novi Sad, Serbia
[2]Preschool Teacher' Training College, Novi Sad, Serbia

** Corresponding author:*
Faculty of Physical Education
University of Novi Sad
Lovćenska 16, 21000 Novi Sad, Serbia
Tel.: +38121 450 188
Fax: + 38121 450 199
E-mail: gustavbala@yahoo.com

INTRODUCTION

For most children in Eastern Europe the education process in a pre-school institution occurs very early on. Such children spend different amounts of time in pre-school institutions. In South-east Europe (the former republics of Yugoslavia), as well as in certain neighbouring countries (Hungary, Romania, Bulgaria, Greece etc), some children undergo this process when they are 18 months old, some at the age of 36 months to 4 years or later prior to enrolling in school. Some children stay in a pre-school institution from the age of 4 until they enrol in primary school, whereas others go through this process 9 months before enrolling in primary school. Given the varying ages of starting this process or the different times spent at pre-school institutions, we may say that different children groups are subjected to different forms of education. All groups practice morning and daytime physical activities (callisthenics, walking, running, crawling, climbing, passing through obstacles, pulling, jumping, throwing, balancing, ball games, various other games), strolling and outings. Models of activity, types of exercises along with the intensity, duration and frequency of exercises are, naturally, gradually increased in terms of quantity and complexity from baby age to older pre-school age.

The different times spent in pre-school institutions lead to the conclusion that it is impossible to realise a complete programme of pre-school education, which raises the question of the effects of education on the psychosomatic state of these groups at the time they enrol in primary school. By gaining insights into this situation, we can obtain information on those characteristics and abilities which are important for enrolling in the school system, i.e. the values of education in separate stages of pre-school institutions.

The main idea of this approach is seen in the findings of Bala, Sabo and Popović (2005) on a sample of 660 pre-school-children about to enrol in the first grade, where a battery of 16 motor tests was applied to analyse the relationship between motor abilities and the school readiness of children. The identified relationships showed that in both boys and girls general motor ability is positively correlated with general school readiness. The statistical significance and positive correlation between the set of motor variables and the set of school-readiness variables, i.e. cognitive abilities, pointed to the extreme importance of motor exercising at pre-school age.

The aim of this paper is to analyse the effects of the kindergarten period on the development of psychosomatic characteristics (anthropometric characteristics, motor and cognitive abilities) in pre-school children about to enrol in the first grade. More specifically, this research's purpose is to establish the effects of pre-school physical education and children's other activities in kindergarten on morphological characteristics, cardio-respiratory fitness, motor abilities and school readiness (cognitive abilities) of pre-school children when they start kindergarten at 1.5, 4, and 6 years of age.

METHOD

Participants

The sample was drawn from a population of children in the city of Novi Sad (Vojvodina, Serbia) immediately before enrolling in the first grade. The research was performed on a sample of 660 pre-school children, with an average age of 6.5 years (SD = 0.17 years), consisting of the following six sub-samples:

a) 116 boys and 110 girls who had been at kindergarten since they were 1.5 years old, i.e. they had spent 5 years at kindergarten – '5-year group',

b) 108 boys and 110 girls who had been at kindergarten since they were 3 years old, i.e. they had spent 3 years at kindergarten – '3-year group', and

c) 109 boys and 107 girls who had spent only 8-9 months at kindergarten, i.e., one year before enrolling in school – '1-year group'.

Instruments

An evaluation of the morphological characteristics of the pre-school children, based on the morphological model constructed by Bala (1981), was carried out by means of anthropometric measures according to the International Biological Programme (Lohman, Roche, & Martorell, 1988). The sample consisted of the following measures:

- evaluating body dimensionality: body height, arm length, leg length, biacromial breadth, biiliocristal breadth;
- evaluating body voluminosity and subcutaneous fat: body weight, chest girth, forearm girth, triceps skinfold, abdominal skinfold, and subscapular skinfold.

The evaluation of the pre-school children's cardio-respiratory fitness was carried out by applying the following physiological measures in standard conditions: heart rate, modified Lorenz test (Sabo, 2002), lung volume, and 300-metre run.

The school readiness of pre-school children was assessed by means of the POŠ test (Toličič, 1986), which consists of four sub-tests:

- speech comprehension: t.i., understanding messages, demands, orders, as well as identifying and understanding sentences, words and syntax,
- reasoning: t.i., the ability to conclude and use experience,
- graphomotor abilities: t.i., fine hand co-ordination, as well as the ability to copy different figures as a whole and their parts, and
- understanding amounts: t.i., perceptiveness.

The battery of 16 motor tests used in this research was selected on the basis of experience with adults and some of the tests were modified for small children (Bala, 1999a, 1999b). These tests estimate (for adults) the effectiveness of the following functional mechanisms: movement structuring, tonus and synergetic regulation, regulation of excitation intensity and regulation of excitation duration (Gredelj, Metikoš, Hošek, & Momirović, 1975; Kurelić, Momirović, Stojanović, Šturm, Radojević, & Viskić-Štalec, 1975). The motor abilities of the pre-school children were estimated according to this motor test battery:

a) Gross body co-ordination: co-ordination with a baton, obstacle course backwards, slalom with three balls,

b) Frequency of simple movements: arm plate tapping, foot tapping,

c) Flexibility: forward bend on a bench, straddle split,

d) Balance: standing on two legs on a narrow balance beam, across, eyes open, standing on one leg on a narrow balance beam, along, eyes open,

e) Explosive strength: standing broad jump, hand grip,

f) Static strength: bent-arm hang, holding legs on a box,

g) Dynamic strength: leg-lifting lying on the back, sit-ups, and

h) Sprint (dash): 15-metre dash.

A short description of the motor tests:

Co-ordination with a baton

The child stands in the middle of a mat holding a wooden stick in front of them. On the command their task is to turn around 180^0, sit, lie on their back, pull both legs through over the stick between their hands, and stand up in the starting position. The score is the length of time required to complete the task, measured in tenths of seconds.

Obstacle course backwards

The child has to walk backwards on all fours and cover a distance of 10 m, climb to the box top and go through one section of the box. The score is the length of time required to complete the task, measured in tenths of seconds.

Slalom with three balls

On the command the child rolls three balls between cones and covers a distance of 10 m. After they pass the last of the five cones, the child turns around it and continues rolling the balls around the cones towards the starting line. The task is completed when the child rolls all three balls over the starting line. The score is the length of time required to complete the task, measured in tenths of seconds.

Arm plate tapping

For fifteen seconds the child has to alternately tap, in a sitting position, two plates on a tapping board with their dominant hand, while holding the other hand between the two plates. The score is the number of alternate double hits completed in 15 seconds.

Foot tapping

For twenty seconds the child, sitting on a chair, has to lift their preferred foot over the perpendicular partition of the board for foot tapping and tap the board on the other side. The score is the number of cycles completed in 20 seconds.

Forward bend on a bench

The child stands on a bench and bows down as deep as possible. A straight-angle ruler which points down with a 40 cm mark at the child's feet, and 40 cm below it, is located next to them. The score is the depth of the reach measured in cm.

Straddle split

The child stands on a wooden plate, with one side to the wall, and with their foot touching the wall. The task is to move their other leg as far as possible to the other side over the wooden plate. The score is the horizontal distance from the wall to the outside distance of the subject's foot, measured in centimetres.

Standing on two legs on a narrow balance beam, across, eyes open

The child balances on a wooden balance rail standing with both legs with the long axis of the rail perpendicular to the long axis of their feet, with their hands on their hips. When the child feels they have their balance they say 'Go!', and the tester starts a stop watch. The time ends when the child touches the floor with any part of their body, or when they remove either hand from their hips. The score is the time they held their balance, measured in tenths of seconds.

Standing on one leg on a narrow balance beam, along, eyes open

This task is similar to the previous one, except that the child balances on a wooden balance rail standing with their preferred leg with the long axis of the rail parallel to the long axis of their feet, with their hands on their hips. The score is the time they held their balance, measured in tenths of seconds.

Standing broad jump

The child jumps with both feet from the reverse side of a Reuter bounce board onto a carpet which is marked in cm. The score is the length of the jump in cm. The task is performed three times without rest and the final result is the longest jump.

Hand grip

Using their stronger hand, on command the child squeezes the dynamometer once, sharply, as hard as they can. The score is the best of three squeezes repeated with a rest of at least thirty seconds between attempts.

Bent-arm hang

The child under-grips the bar and holds a pull-up as long as they can (with their chin above the bar). The score is the time of the hold, measured in tenths of seconds.

Holding legs on a box

The child lies flat on their stomach on a wooden box with their legs in a horizontal position over the floor. The task is to hold that position for as long as they can. The score is the time of the hold measured in tenths of seconds.

Leg-lifting, lying on the back

The child lies flat on their back, hands behind their neck, their partner holds their elbows down to the floor. After the signal the child raises their legs until they are vertical and then returns them to the floor. The score is the number of times the legs are elevated to a vertical position in twenty seconds.

Sit-ups

The child lies on their back with their knees bent and arms crossed over to the opposite shoulders. They rise into a sitting position and return to the starting position. The instructor's assistant holds the child's feet. The score is the number of correctly executed rises to the sitting position (no longer than 60 seconds).

15-metre dash

On the command the child who is standing behind the starting line has to run 15 m as fast as they can to the end of track (15 m). The score is the time of the run, measured in tenths of seconds.

Procedure

The measuring and testing of the performance of all children was carried out at the time of school enrolment (in the same school year). The children's parents were asked to give their permission for their child's participation in the research study and to provide necessary information about their children. School readiness was tested by psychologists whereas the anthropometric measurements, cardio-respiratory fitness and motor abilities were tested by senior students from the Faculty of Physical Education and the Pre-school Teachers' Training College in Novi Sad. All measurements and tests were performed in standard conditions, using standard apparatuses and under the supervision of the authors of this paper.

Two-factorial multivariate and univariate analyses of variance (MANOVA/ANOVA) were used to check the effects of interaction on the groups of children classified according to their kindergarten period and gender. The significance of differences between boys and girls at the time of enrolling in school was established by means of one-factorial multivariate (MANOVA) and univariate analyses of variance (ANOVA). The same statistical methods were used to establish the effects of the kindergarten period on the analysed psychosomatic characteristics of children at the time of enrolling in school.

RESULTS

The results of two-factorial multivariate and univariate analyses of variance show that there were no statistically significant differences in children in terms of the interaction of gender and kindergarten period (P = 0.59; the results are not shown for space reasons). This finding points out that these two factors did not produce effects which could hide the true effects of the kindergarten period or real differences between boys and girls. This situation is very convenient because it provides a good basis for a real analysis of differences between boys and girls, as well as for a real analysis of the effects of the kindergarten period on children's psychosomatic characteristics at the time of enrolling in school.

The values of means *(M)* and standard deviations *(SD)* of the analysed variables in boys and girls, as well the statistical tests for univariate *(f* and *p)* and multivariate *(F* and *P)* analyses of variance, are presented in Table 1.

As the whole system of variables was statistically significant in its discrimination between boys and girls (P = 0.00), it was generally determined that the longitudinal and transversal anthropometric characteristics and chest girth of boys had statistically higher values. The boys and girls had practically the same body weight and forearm girth, but the skinfolds were statistically more significant in girls.

Boys had lower but statistically significant better values cardio-respiratory variables (heart rate and lung volume) in comparison to girls. The analyses of the school-readiness variables reveals there were no statistically significant differences between the boys and girls.

Boys were significantly better with those motor tests which evaluated gross body co-ordination *(obstacle course backwards),* explosive strength *(standing broad jump and hand grip),* and static strength *(bent-arm hang).* Girls were more successful with those motor tests used for assessing the frequency of simple movements *(foot tapping),* flexibility *(forward bend on a bench),* and balance *(standing on one leg on a narrow balance beam, along, eyes open).*

Table 1: Results of the MANOVA and ANOVA of the psychosomatic variables of boys and girls

VARIABLES	BOYS		GIRLS			
	M	*SD*	*M*	*SD*	*f*	*p*
Anthropometric variables						
Body height (mm)	1238.9	55.0	1228.1	58.0	6.06	**0.01**
Arm length (mm)	539.5	30.4	527.7	31.2	24.15	**0.00**
Leg length (mm)	715.5	42.8	709.0	43.8	3.69	**0.05**
Biacromial breadth (mm)	267.7	16.6	263.8	15.6	9.83	**0.00**
Biiliocristal breadth (mm)	192.8	16.3	188.7	16.3	10.39	**0.00**
Body weight (mm)	264.2	48.7	257.8	47.3	2.93	0.08
Chest girth (mm)	603.3	43.3	587.7	46.0	19.86	**0.00**
Forearm girth (mm)	179.3	13.9	178.2	13.9	1.11	0.29
Triceps skinfold (mm)	10.2	3.8	11.3	3.7	13.91	**0.00**
Abdominal skinfold (mm)	5.7	3.4	6.4	3.9	6.42	**0.01**
Subscapular skinfold (mm)	6.8	3.3	7.7	3.6	9.17	**0.00**
Cardio-respiratory variables						
Heart rate (freq.)	96.3	8.6	97.9	8.6	5.58	**0.01**
Modified Lorenz test (s)	50.4	13.3	51.5	13.9	1.08	0.29
Lung volume (ccm)	1309.9	247.1	1227.7	226.6	19.77	**0.00**
300-m run (s)	91.4	39.6	92.3	12.6	0.15	0.69
School-readiness variables						
Speech comprehension (point)	11.7	2.6	12.0	2.4	1.40	0.23
Reasoning (point)	8.1	3.4	8.3	3.3	0.24	0.62
Graphomotor abilities (point)	12.1	5.5	11.9	5.4	0.08	0.77
Understanding the amounts (point)	7.7	2.6	7.4	2.9	2.46	0.11
Motor variables						
Co-ordination with a baton (0.1s)	50.9	30.7	51.5	28.9	.0729	0.78
Obstacle course backwards (0.1s)	311.9	94.7	356.7	119.7	28.40	**0.00**
Slalom with three balls (0.1s)	755.1	245.2	783.1	235.0	2.23	0.13
Arm plate tapping (freq.)	13.9	1.9	14.2	1.8	2.04	0.15
Foot tapping (freq.)	26.3	3.1	27.1	3.1	9.01	**0.00**
Forward bend on a bench (cm)	42.8	5.5	43.9	5.5	5.71	**0.01**
Straddle split (cm)	112.3	9.2	111.5	10.7	0.99	0.31
Standing on two legs on a narrow balance beam, across, eyes open (0.1s)	89.4	79.9	95.3	79.2	0.92	0.33
Standing on one leg on a narrow balance beam, along, eyes open (0.1s)	76.9	80.6	95.4	104.4	6.44	**0.01**
Standing broad jump (cm)	118.3	17.1	108.7	16.4	53.94	**0.00**
Hand grip (kp)	12.4	2.4	11.2	2.0	48.60	**0.00**
Bent-arm hang (0.1s)	77.5	65.7	65.3	58.1	6.35	**0.01**
Holding legs on a box (0,1s)	219.6	185.2	209.8	185.9	0.46	0.49
Leg-lifting, lying on the back (freq.)	17.4	10.1	16.2	8.4	2.79	0.09
Sit-ups (freq.)	9.4	8.8	9.1	8.4	0.17	0.68
15-m dash (0.1s)	41.2	4.9	41.7	3.7	2.73	0.09

$F = 8.10$ $P = 0.00$

Table 2: Results of the MANOVA and ANOVA of the psychosomatic variables of the three groups of children

VARIABLES	5-YEAR		3-YEAR		1-YEAR			
	M	*SD*	*M*	*SD*	*M*	*SD*	*f*	*p*
Anthropometric variables								
Body height (mm)	1241.2	50.8	1241.6	56.4	1233.8	58.0	0.69	0.50
Arm length (mm)	539.2	29.0	539.8	32.2	539.4	30.1	0.00	0.99
Leg length (mm)	717.5	37.5	717.2	43.0	711.3	47.7	0.65	0.52
Biacromial breadth (mm)	266.4	16.9	268.5	15.5	268.3	17.5	0.55	0.57
Biiliocristal breadth (mm)	194.0	16.9	192.3	15.2	192.0	16.7	0.48	0.61
Body weight (mm)	265.5	50.9	262.5	44.6	264.2	50.4	0.11	0.89
Chest girth (mm)	604.4	40.5	604.3	39.2	600.9	49.8	0.23	0.79
Forearm girth (mm)	178.8	14.3	179.3	12.9	179.7	14.5	0.11	0.89
Triceps skinfold (mm)	103.0	41.7	102.6	32.0	100.4	38.9	0.15	0.85
Abdominal skinfold (mm)	59.5	38.6	55.4	31.4	56.0	32.9	0.46	0.62
Subscapular skinfold (mm)	70.7	35.3	66.3	27.8	68.3	35.9	0.48	0.61
Cardio-respiratory variables								
Heart rate (freq.)	95.6	9.2	96.0	8.3	97.3	8.2	1.26	0.28
Modified Lorenz test (s)	51.1	13.8	50.4	12.9	49.6	13.0	0.32	0.72
Lung volume (ccm)	1287.1	238.3	1333.8	256.9	1310.5	246.2	1.00	0.36
300-m run (s)	89.2	14.0	88.6	15.1	96.6	65.9	1.40	0.24
School-readiness variables								
Speech comprehension (point)	12.7	2.0	12.3	1.9	10.1	3.0	37.19	**0.00**
Reasoning (point)	9.1	2.7	8.9	2.9	6.2	3.6	30.64	**0.00**
Graphomotor abilities (point)	14.3	4.4	13.0	4.8	8.7	5.6	38.20	**0.00**
Understanding the amounts (point)	8.5	1.7	8.2	1.9	6.4	3.3	23.78	**0.00**
Motor variables								
Co-ordination with a baton (0.1s)	49.3	30.3	49.1	27.4	54.4	33.8	1.03	0.35
Obstacle course backwards (0.1s)	297.0	80.6	296.1	74.1	343.3	117.2	9.39	**0.00**
Slalom with three medicine balls (0.1s)	723.7	223.1	736.4	255.0	806.8	251.5	3.75	**0.04**
Arm plate tapping (freq.)	14.1	1.8	14.1	2.0	13.5	1.9	4.26	**0.01**
Foot tapping (freq.)	26.7	2.9	26.4	3.1	25.7	3.3	2.99	**0.05**
Forward bend and touch on a bench (cm)	43.6	4.8	42.9	4.9	42.0	6.4	2.40	0.09
Straddle split (cm)	114.6	8.6	113.0	9.7	109.0	8.4	11.67	**0.00**
Standing on two legs on a narrow balance beam, across, eyes open (0.1s)	93.5	94.4	89.8	69.0	84.5	73.2	0.36	0.69
Standing on one leg on a narrow balance beam, along, eyes open (0.1s)	82.3	84.8	87.7	91.0	60.5	60.4	3.55	**0.02**
Standing broad jump (cm)	122.1	15.1	118.1	15.3	114.4	19.6	5.77	**0.00**
Hand grip (kp)	12.5	2.1	12.5	2.6	12.2	2.3	0.70	0.49
Bent-arm hang (0.1s)	78.6	63.4	84.1	68.4	69.6	65.2	1.33	0.26
Holding legs on a vaulting box (0.1s)	225.8	193.8	243.8	204.2	189.1	150.2	2.48	0.08
Leg-lifting, lying on the back (freq.)	18.4	7.9	18.7	11.2	15.1	10.7	4.50	**0.01**
Sit-ups (freq.)	8.4	5.6	8.9	7.5	10.8	12.0	2.30	0.10
15-m dash (0.1s)	40.6	3.4	40.1	3.8	42.7	6.7	8.46	**0.00**

$F = 5.53$, $P = 0.00$

The information needed to address the problem of this research is presented in Table 2. The system of applied variables was statistically significant in discriminating between three groups of children (P = 0.00).

It was easy to ascertain that the kindergarten period did not produce significant differences in the physical (morphological) growth and development of the subjects, as well as in their cardio-respiratory fitness (cardio-respiratory variables). However, analyses of all school-readiness and motor variables showed statistically significant better results in those subjects who had attended kindergarten for more years than the third group. This conclusion emerges from the ANOVA and the gradation of quantitative values in these variables within the groups, i.e. the best and similar results were recorded by children in the 5- and 3-year groups, while the poorest results were those of children in the 1-year group.

DISCUSSION

The results show that longitudinal and transversal anthropometric characteristics and chest girth are more developed in boys, while average body weight and forearm girth are same in both boys and girls. They also reveal that the amount of subcutaneous fat is statistically greater in the girls than the boys. These significant differences in the amount of subcutaneous fat can be explained by the specific female body structure and the influence of external factors (primarily the influence of physical exercising and nutrition). The nutrition of boys and girls in kindergartens, and even at home, is mostly the same in volume and quality terms. For the reason of the imbalance between nutrition and motor activity, this adequate nutrition is unlikely to be followed by adequate motor activity, however, with the same nutrition boys are more active. This situation holds a special value over a relatively long period of practicing activities beyond kindergarten.

The cardio-respiratory variables of the analysed children showed that the boys had a significantly lower heart rate and a bigger lung volume than the girls. This can probably be explained by the more intensive activation of those organs and organ functions which contribute to the better visceral development and better aerobic-anaerobic abilities of boys. Boys are more interested in activities which involve several types of motion (walking, running and jumping), while girls prefer less intensive and calmer activities. This difference in the activity of a child's organism during a longer period is reflected more on the development of boys' abilities.

As for the analysis of school-readiness variables, it was impossible to find statistically significant differences between the boys and girls. This finding demonstrates that mental development, i.e. cognitive functioning, is practically the same in the boys and girls.

The boys were significantly better in performing motor tests for the prediction of gross coordination and explosive strength, while the girls were better in the frequency of simple movements, flexibility and balance. This finding is in line with the results of Bala (2003) on a sample of 367 children (223 boys and 144 girls), 4-7 years of age, subjected to three anthropometric measures and seven motor tests. After the partialisation of the motor test variables according to the children's ages and body composition variables, the results point to the existence of 'motor potential capacity'. With such a motor factor the quantitative differences show that the boys have significantly better results in motor tests used for estimating explosive strength and

the gross body co-ordination of primary motor abilities, whereas the girls performed better in flexibility tests.

As the entire system of variables was statistically significant in discriminating three sample groups (P = 0.00), the ANOVA results show that the kindergarten period had no impact on differences in morphological growth and development, and cardio-respiratory abilities. But all the variables for predicting school readiness, and more than half of the applied motor variables, were significantly better in those children who had attended kindergarten for a longer period (the 5- and 3-year groups). As has been previously analysed, boys are generally better in performing motor tests whereas school-readiness tests are solved with equal success by boys and girls.

The performance of a pre-school child is associated with certain factors closely related to their overall motor, emotional, social and intellectual development (Ismail & Gruber, 1971). Bala, Sabo and Popović (2005) analysed the relationships between motor abilities and school readiness on a sample of 660 pre-school-children (333 boys and 327 girls) at the time of enrolling in the first grade by applying a 16 motor test battery. The obtained relationships showed that the general motor ability of boys and girls positively correlates with their general school readiness. Owing to the statistical significance and positive correlation between the set of motor variables and the set of school-readiness variables, it must be pointed out that motor exercising in pre-school age is of the utmost importance.

Within the structure of the general school-readiness factor in boys, the most important ones are graphomotor abilities and speech, while reasoning and understanding results were less important. In girls, this general factor was mostly manifested by understanding amounts and grapho-motor abilities, then by speech and reasoning. It is obvious that grapho-motor abilities in pre-school children are very important, as indicated by some other complex researches in this field (e.g., Del Giudice, Grossi, Angelini, Crisanti, Latte, Fragassi, & Trojano, 2000). The established relationship shows that general motor ability is in a positive correlation with general school readiness in boys and girls. This conclusion is in agreement with other researches (Dolenec, Pistotnik, & Pinter, 2002; Pistotnik, Dolenec, & Pinter, 2002; Planinšec, 2002), which pointed to the positive and significant associations of motor and cognitive abilities for boys and girls alike. According to the same results, the motor dimensions that are most strongly associated with cognitive abilities are co-ordination and the speed of movement. Of course, all of this points to the importance and need for the development of pre-school children. Children with better motor abilities can adapt better to different problem situations, activities and tasks at the beginning of and during their schooling.

Oja and Jurimae (2002) studied the relationships between physical activity, motor ability and school readiness in 294 healthy 6-year-old children from Tartu (161 boys and 133 girls). The physical activity of the children was reported by parents and teachers using Harro's questionnaire. The motor ability of children was evaluated using various tests from the Eurofit test battery as well as the 3-minute shuttle-run test. The Controlled Drawing Observation test was used as a predictor of school readiness and the development of mental abilities. Indoor physical activities predicted 19-25% of total variance in the motor scores of these pre-school children. Motor ability tests, which demand children's total attention and concentration, seem to be related to the particular school-readiness measures that are chosen.

Krombholz (1997) analysed the relationships between the physical performance of pre-school children and primary school pupils (N = 2309, age 61 to 108 months) and characteristics of physical growth and cognitive performance and ecological variables. Correlations between measures of physical growth and physical performance and between physical and cognitive performance were positive and significant. The results of the measurement of physical fitness and body co-ordination increased across ages. Significant differences were found between boys and girls; however, boys exceeded in some items, girls in others. Children of higher socio-economic status performed better than children of lower status, while those children who participated in sports outside school outperformed those who did not.

The results point to the conclusion that the entire education and motor activities in kindergartens contribute significantly to the development of the psychosomatic characteristics of children, especially school readiness and motor abilities. The degree of this development depends on how long children attend kindergartens. This means that the best school readiness is found in children who attend kindergartens for a long period, and the worst in children who attend kindergarten for only one school year (9 months) before they enrol in school.

REFERENCES

Bala, G. (1981). *Struktura i razvoj morfoloških i motoričkih dimenzija dece SAP Vojvodine* [The structure and development of morphological and motor dimensions of children in SAP Vojvodina]. Novi Sad: Faculty of Physical Education.

Bala, G. (1999a). Motor behavior evaluation of pre-school children on the basis of different result registration procedures of motor test performance. In V. Strojnik, & A. Ušaj (Eds.), *Proceedings of the 6. Sport Kinetics Conference '99. Theories of Human Motor Performance and their Reflections in Practice* (pp. 62-65). Ljubljana: University of Ljubljana, Faculty of Sport.

Bala, G. (1999b). Some problems and suggestions in measuring motor behaviour of pre-school children. *Kinesiologia Slovenica,* 5 (1-2), 5-10.

Bala, G. (2003). Quantitative differences in motor abilities of pre-school boys and girls. *Kinesiologia Slovenica,* 9(2), 5-16.

Bala, G., Sabo, E., & Popović, B. (2005). Relationship between motor abilities and school readiness in pre-school children. *Kinesiologia Slovenica,* 11 (1), 5-12.

Del Giudice, E., Grossi, D., Angelini, R., Crisanti, A., Latte, F., Fragassi, N., & Trojano, L. (2000). Spatial cognition in children: Development of drawing-related (visuospatial and constructional) abilities in pre-school and early school years. *Brain Development, 22*(6), 362-367.

Dolenec, M., Pistotnik, B., & Pinter, S. (2002). Correlation between co-ordination and cognitive abilities of girls 7-11 years of age. In D. Milanović & F. Prot (Eds.), 3rd international scientific conference of kinesiology, Opatija, Croatia. *Proceedings book,* 105-108. Zagreb: Faculty of Kinesiology, University of Zagreb.

Gredelj, M., Metikoš, D., Hošek, A., & Momirović, K. (1975). Model hijerarhijske strukture motoričkih sposobnosti: Rezultati dobijeni primjenom jednog neoklasičnog postupka za procjenu latentnih dimenzija [A model of the hierarchical structure of motor abilities: Results obtained using a neo-classical method for estimating latent dimensions]. *Kineziologija, 5* (5), 7-81.

Ismail, A.H., & Gruber, J.J. (1971). *Integrated development: Motor aptitude and intellectual performance.* Columbus: Charles E. Merrill.

Krombholz, H. (1997). Physical performance in relation to age, sex, social class and sports activities in kindergarten and elementary school. *Perceptual Motor Skills, 84*(3), 1168-1170.

Kurelić, N., Momirović, K., Stojanović, M., Šturm, J., Radojević, Đ., & Viskić-Štalec, N. (1975). *Struktura i razvoj morfoloških i motoričkih dimenzija omladine* [The structure and development of morphological and motor dimensions of youth]. Belgrade: Institute for Scientific Research of the Faculty of Physical Education.

Lohman, T.G., Roche, A.F., & Martorell, R. (1988). *Anthropometric standardization reference manual.* Champaign: Human Kinetics.

Oja, L., & Jurimae, T. (2002). Physical activity, motor ability, and school readiness of 6-years-old children. *Perceptual Motor Skills, 95*(2), 407-415.

Pistotnik, B., Dolenec, M., & Pinter, S. (2002). Analiza povezanosti koordinacijskih in kognitivnih sposobnosti dečkov, starih 7 do 11 let [Correlation between co-ordination and cognitive abilities of boys 7 to 11 years of age]. In R. Pišot, V. Štemberger, F. Krpač, & T. Filipčič (Eds.), *Otrok v gibanju: Zbornik prispevkov,* pp. 337-341. Maribor: Teachers College.

Planinšec, J. (2002). Relations between the motor and cognitive dimensions of pre-school girls and boys. *Perceptual Motor Skills, 94*(2), 415-23.

Sabo, E. (2002). Psihosomatski status dece predškolskog uzrasta pri upisu u osnovnu školu [Psychosomatics status of pre-school children upon enrolment in school]. Unpublished doctoral dissertation, Novi Sad: University of Novi Sad, Faculty of Physical Education.

Toličič, I. (1986). *POŠ-test za ispitivanje spremnosti dece za školu* [POŠ-test for investigating children's school-readiness]. Ljubljana: Zavod SR Slovenije za produktivnost dela.