Motor and mental development of the 7 year old students (state and correlation dependence)

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Abstract.

The problems related to the physical fitness in general and specifically to some of its components in the primary school students have been studied a lot. There are relatively few studies on the mental condition of the students at this age. Moreover, our studies have shown that there are no thorough and science-based experimental studies revealing the dependence of such complex and dynamically changing components of the child's personality such as the mental and motor development. In this article we have tried to fill in to a certain extent this research gap. The results present interesting though not very high correlation dependencies (from 0.4 to 0.7) between the studied indicators on the mental and motor development at the 7-year-old students.

Key words: physical development, motor development, mental development, average values and variables, correlation dependencies

Introduction

Meaning of the main working terms:

Physical Development (PD): natural-biological process of morpho-somatic changes in the ontogenetic development of man. Commonly the PD is expressed in the level of development of the fundamental anthropometric characteristics such as height, weight and chest size.

Motor Development (MtrD): characteristic of the man, state or level with respect to his physical nature. MtrD is a process of sensorimotor changes and is related to the manifestation of the man in his motor activity. MtrD reflects the state of the motor abilities - conditional and coordinational.

Mental Development (MntD) - part of the overall psychoemotional development. It is a personal biosocial human characteristic, related to his spiritual "I" and it is a result of complex quantitative and qualitative changes in the intellectual field. MntD is a function of system and targeted cognitive activity, mainly realized in the process of training.

The willingness of people to develop harmoniously, to take care of their physical and mental nature is as old as the civilization. Very appropriate this has been summarized in the ancient saying "Sound mind in healthy body" (in lat. *Mens sana in corpore sano*). The ancient Athenians came to the fundamental conclusion that human progress is impossible if you do not make targeted efforts to harmonious (physical and mental) development of the people. This philosophy of life becomes even stronger during the European Renaissance, when philosophers, humanists and educators in their writings and theses, unequivocally impose the idea of the need for multilateral and harmonious development of the man. They further develop and specify the ideas of the ancient Greeks and Romans in this field by also providing different ways of their implementation. In that regard an essential role also have the national systems for physical education, that have emerged in 17-18 century in the developed European countries. The main idea in these systems, irrespective of the national specific characteristics and selection of means and methods of realization, is related to the multilateral and harmonious psycho-physical development of the young people.

Nowadays the issues of multilateral and harmonious developed of the adolescents are just as important as in the past. The physical activity, implemented in the physical education and sport lessons is an indispensable factor in the complex psycho-physical and motor development of the students [3]. Therefore, efforts in research and practically implemented activities related to the study of these problems are fully justified. Relatively often the problems of physical and motor development of the pupils from the primary school have been studied both in their whole as well as in their specific components. In this regard particular attention should be paid to the researches of Alipieva, V. (1974); Kuznetsova, Z. (1975); Fomin, N., Filin, V. (1975); Popov, Iv. (1976); Rachev, Kr., Peneva, B. (1980); Hripkova, R. et al. (1982); Kostov, K. (1983); Kotsev, Ch. (1998); Dokova, N. (2011); Kinov, S. (2014).

Relatively less in number are the researches on the mental development of the students of this age [Hr. Hristozov, R. Penushlieva (1970); L. Aydarova et al. (1986); Batoeva, D. et al. (1990); Minchev, B. et al. (1996);

Dokova, N. (2011) etc.]. Furthermore, our studies in this area showed that there is a lack of indepth and scientifically justified and experimental studies revealing the relationship (correlation) of such complex and dynamically changing components such as the physical, mental and motor development of the students in primary school age.

Methodology

The goal of our study is to determine the current state and the mutual dependence of some of the components of the physical, motor and mental development of the 7 years old students.

The study was conducted in October 2016 in 2nd Primary School and 3rd Primary School in the town of Blagoevgrad. A total of 42 children from the 1st class (7 years old) were examined with specially selected tests that allow to determine the status of some of the components of their physical, motor and mental development as follows: 1 - height (cm); 2 - weight (kg); 3, 4 and 5 - chest dimensions in inhaling, exhalation and the difference between them (cm); 6 - vital capacity (cm), 7 and 8 - running on 30 and 100 meters (sec); 9 and 10 - standing long jump and throwing a solid ball 1 kg (cm); 11 - doing crunches as many as able to do (no); 12 - shuttle run (sec); 13 - hand-held dynamometry (kg); 14 - body flexibility test - depth of the slope (cm) - "stretching"; 15 - retention on horizontal bar in hovering state with bent hands as much as able to retention (sec); 16 - arm knocking (no); 17 - mental development test - on Zambitsyavichene (SS); 18, 19 and 20 - attention concentration for 1, 2 and 3 minutes.

Brief description for the way of conducting the survey

1. Tests for determining the physical development and vital capacity have been held by the standardized methodology from the national studies [12]
 2. Tests for motor development (physical fitness) are widely known among the researchers in this field. They were conducted according to the well-known standardized methodologies [4, 6, 12, 13].
 3. For determining the mental development of the children we applied the "Methodology for determination of the level of mental development of children between 7 and 9 years old" proposed by E.F.Zambitsyavichene [8, p.94]. The main points of this methodology are related to the opportunities for evaluation of the following mental development components:

- a) abilities of distinguishing between significant and non-significant signs of the objects and phenomena as well as the knowledge of the child;
- b) the thinking operations generalization and abstraction as well as the possibilities to differentiate the essential features of the objects and phenomena;
- c) abilities to establish logical connections and relations between concepts;
- d) abilities to summarize.

The evaluation of the complex mental development (success score - SS) is formed in points which are aggregated score from the scores of each component (subtest) from a to d , 4 in total using the formula:

$$SS = \frac{X \cdot 100\%}{40}$$

where X is the amount of points for each child in all subtests.

The maximum score for mental development is 40 points, the minimum - 0 points.

The "test-retest" that we conducted in order to establish the statistical reliability of this methodology showed that the correlation coefficient is $r = 0,747$, which practically is quite enough.

4. The ability for attention concentrate was identified by the Toulouse-Pierron sample [8, p. 88]. An indicator (coefficient) for attention concentration is determined that is based on implementation time, made mistakes and the correct answers using the formula:

$$R = \frac{M}{w + p}$$

wherein R is the attention concentration indicator;

w - the mistakes made in the figure selection;

p - missed figures

The attention concentration was determined for the 1st, 2nd and 3rd minute.

Results and analysis

Average values of variation of the physical development indicators

Our results for the physical development of the students are presented in Tables 1, 2 and 3.

Table №1. BOYS

Indicator	Height	Weight	Inhaling (In)	Exhalation (Ex)	Difference between In/Ex	Vital capacity
	<i>l</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>
$\bar{X}$	123.5	23.8	62.85	58.45	4.4	1205
S	4.39	3.87	3.50	3.28	1.36	226.88
M	0.98	0.86	0.78	0.73	0.30	50.73
V (%)	3.55	16.25	5.56	5.61	30.83	18.83

Table №2. GIRLS

Indicator	Height	Weight	Inhaling (In)	Exhalation (Ex)	Difference between In/Ex	Vital capacity
	<i>l</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>
$\bar{X}$	122.64	23.73	61.91	57.41	4.41	1090.91
S	4.03	3.47	2.92	3.14	1.80	215.13
M	0.86	0.74	0.62	0.67	0.38	45.87
V (%)	3.29	14.61	4.72	5.47	40.84	19.72

Table №3. Student's t-test for independent samples

Tests	Sample 1			Sample 2			Difference	Significance		
	n	$\bar{X}_1$	s	n	$\bar{X}_2$	s	$\bar{X}_1 - \bar{X}_2$	t emp	A	P%
1	20	123.5	4.39	22	122.64	4.03	0.86	0.66	0.512	48.82
2	20	23.8	3.87	22	23.73	3.47	0.07	0.06	0.951	4.90
3	20	62.85	3.50	22	61.91	2.92	0.94	0.95	0.349	65.13
4	20	58.45	3.28	22	57.41	3.44	1.04	1.00	0.323	67.69
5	20	4.40	1.36	22	4.41	1.80	-0.01	0.02	0.984	1.60
6	20	1250	226.9	22	1090.91	215.13	114.09	1.67	0.102	89.78

Summarizing the results in the above tables, we can draw the following conclusions:

1. Between the two genders we did not find any statistically significant difference in none of the studied parameters (Tabl. №3). However, there is a trend for superiority of the boy in height, chest size and vital capacity, which probably can be proved statistically with a larger number of studied children.
2. The results give us reason to support with facts the tendency, determined also by other authors [14,7,9] of attenuation, and even halt of the acceleration in the physical development in the beginning of 21 century. The following table (Table №4) presents data on average values of some of the indicators for physical development, determined by different authors and in different years. The precise analysis discovers the following facts:
 - a) the acceleration process in the physical development is evidential up to 1980s;
 - b) our results from the year 2016, compared to the ones from 1982 [6] to 1987 [14] show not only attenuation acceleration in the physical development, but also of its halt, i.e. meaning that such "social phenomenon", "trend of the century" no longer exists. Some researchers note in this regard that "...it is possible the so-called genetic potential for children's growth to be realized" [7] in the different age and sex groups.
3. Variability of the studied parameters is within the existing statistics. The difference is only in the relatively higher variability in the vital capacity (around 19% in both sexes) and particularly in the respiratory difference (about 40%).

Table №4. Comparative data from different studies

Studies	Height		Weight		Chest dimensions		Vital capacity	
	<i>M</i>	<i>W</i>	<i>M</i>	<i>W</i>	<i>M</i>	<i>W</i>	<i>M</i>	<i>W</i>
St. Vatev (1906)	111.5	112.5	17.7	18.1	-	-	-	-
B. Yanev (1960)	121.9	123.0	23.2	23.5	64.1	62.6	1298.0	1200.0
B. Yanev (1970)	124.4	123.4	25.2	25.1	64.7	62.5	1334.4	1161.0
K. Kostov (1982)	125.1	123.0	26.4	24.0	62.1	60.5	-	-
A. Yovkova (1987)	123.3	122.3	24.5	24.3	63.1	61.8	1235.3	1065.5
K. Kostov (2016)	123.5	122.62	23.8	23.7	62.8	61.9	12.05	1090.9

Average values and variability indicators for motor development

The results are shown in tables №5, №6 and №7.

Table №5. BOYS

Tests	80 m (sec)	100 m (sec)	Standing long jump (cm)	Throwing a solid ball 1 kg (cm)	Doing crunches (no)	Shuttle run (sec)	Hand-held dynamometry (kg)	Streching	Holding onto horizontal bar	Typing test
	7	8	9	10	11	12	13	14	15	16
$\bar{X}$	6.805	23.25	120.95	315.25	14.10	21.265	12	103.6	6.765	29.733
S	0.71	2.14	16.54	57.26	5.50	2.68	1.76	4.08	4.75	3.04
Mx	0.16	0.48	3.70	12.80	1.23	0.60	0.39	0.91	1.06	0.68
V %	10.45	9.19	13.68	18.16	39.03	12.68	14.67	3.94	70.18	10.23

Table №6. GIRLS

Tests	80 m (sec)	100 m (sec)	Standing long jump (cm)	Throwing a solid ball 1 kg (cm)	Doing crunches (no)	Shuttle run (sec)	Hand-held dynamometry (kg)	Streching	Holding onto horizontal bar	Typing test
	7	8	9	10	11	12	13	14	15	16
$\bar{X}$	7.43	23.53	109.09	267.73	12.14	21.00	11.36	106.57	4.16	30.55
S	0.65	1.71	17.98	39.76	2.51	3.52	1.90	3.34	3.81	2.88
Mx	0.14	0.36	3.83	8.48	0.54	0.75	0.40	0.71	0.81	0.61
V %	8.69	7.27	16.48	14.85	20.68	16.76	16.69	3.14	91.60	9.44

Table №7. Student's t-test for independent samples

Tests	Sample 1			Sample 2			Difference	Significance		
	n	x	s	n	x	s		t emp	A	P %
7	20	6.805	0.71	22	7.43	0.65	-0.625	2.98	0.005	99.51
8	20	23.25	2.14	22	23.53	1.71	-0.28	0.47	0.641	35.94
9	20	121	16.54	22	109.09	17.98	11.86	2.22	0.032	96.77
10	20	315.3	57.26	22	267.73	39.76	47.52	3.15	0.003	99.69
11	20	14.1	5.50	22	12.14	2.51	1.96	1.51	0.139	86.08
12	20	21.27	2.69	22	21	3.52	0.256	0.27	0.787	21.30
13	20	12	1.76	22	11.36	1.90	0.64	1.13	0.266	73.44
14	20	103.6	4.08	22	106.57	3.334	-2.97	2.59	0.013	98.67
15	20	6.765	4.75	22	4.16	3.81	2.605	1.97	0.056	94.41
16	20	29.73	3.04	22	30.55	2.88	-0.817	0.89	0.377	62.35

The data show that in terms of motor development there are statistically significant gender differences in favor of the boys in the following components: speed of running (30 meters), explosive force (standing long jump and throw a solid ball), relative strength endurance (hovering).

Girls are better at flexibility (streching). We did not find gender differences in speed endurance (100 meters) and power endurance (crunches), the maximum force of the grip (manual dynamometry) in running with a change of direction ("shuttle") and speed of movements of upper limbs (hand knocking).

The comparative analysis of some of the indicators for motor development in similar studies carried out throughout the years (14, 6, 12 and 13) shows the following trends of change (table №8):

* The comparative results of national surveys in 1960 and 1970 show retardation in physical fitness of the 7-year-old students.

* The results in 1982 [6] and those in 2016, however, show improvement in the physical fitness compared to the results in 1960 and especially to those of 1970. As the tests that we compare have been made with the same standardized methodology, these differences can be explained either with the regional feature of the studied children (research in 1982 and 2016 were made only in the Blagoevgrad region) or that the "explosive power" over time shows understandable improvements in the studied age group.

Table №8. Data on motor development of the 7-year-old students in different years

Tests	B. Yanev (1960)		B. Yanev (1970)		K. Kostov (1982)		K. Kostov (2016)	
	M	Ж	M	Ж	M	Ж	M	Ж
Standing long jump	117.0	106.0	111.72	99.69	121.11	111.45	120.9	109.1
Throwing a solid ball 1 kg	-	-	-	-	3.47	2.83	3.15	2.68
Doing crunches	-	-	-	-	14.71	8.08	14.1	12.1
Hand-held dynamometry	14.44	12.40	13.63	11.08	14.08	13.16	12.0	11.4
Streching	1.36	3.08	-0.26	2.82	1.73	3.97	3.6	6.6
Holding onto horizontal	-	-	-	-	6.91	3.99	6.8	4.2

• In the manual dynamometers there is a slight decrease in both sexes in the last 50.

• Regarding the flexibility after a decline in 1970 compared to 1982 there is a significant improvement over 1982 and especially in 2016

- In relative power endurance of upper limbs for the past 40 years there are no significant differences.
- Variability of tested indicators for motor development is within a relatively stable (under 20%) in the abilities explosive strength, flexibility, running speed and movement of upper limbs to very high (40% to 90%), power endurance (crunches) and the relative power endurance (hovering). In the crunches the individual differences with the boys are twice bigger while in hovering the variability with the girls reaches 91.60% and with the boys up to 70%.

III.3. Average values and variability indicators for mental development and attention concentration

Table №9. Data on mental development and attention concentration

Tests	BOYS				GIRLS			
	Mental development	Concentration of attention			Mental development	Concentration of attention		
		1 мин.	2 мин.	3 мин.		1 мин.	2 мин.	3 мин.
	17	18	19	20	17	18	19	20
X	24.415	7.765	6.515	6.265	25.09	6.46	5.45	5.77
S	4.33	3.94	3.52	3.79	3.14	4.61	3.83	4.08
Mx	0.97	0.88	0.79	0.85	0.67	0.98	0.82	0.87
V %	17.72	50.75	54.00	60.50	12.53	71.39	70.33	70.58

Table №10. Student's t-test for independent samples

Tests	Sample 1			Sample 2			Difference x-x	Significance		
	n	x	s	n	x	s		t emp	A	P %
17	20	24.42	4.33	22	25.09	3.14	-0.675	0.58	0.564	43.63
18	20	7.765	3.94	22	6.46	4.61	1.305	0.98	0.332	66.76
19	20	6.515	3.52	22	5.45	3.83	1.065	0.94	0.355	64.47
20	20	6.265	3.79	22	5.77	4.08	0.495	0.41	0.687	31.32

A. The test results for the mental development can be analyzed by comparing them with the standards for this age (see 8, p.99 and table 11).

The 7-year-old children that we study are in the second level of success, with 25 points in average from 40 possible, which is about 62.5% success rate.

Given the fact that these are first-grade pupils, the assessment could be accepted as very high.

We found no gender differences into the mental development of students.

As concerns the variability of this indicator it is comparatively smaller for the girls.

Table №11. Levels of success (SS) Zambitsyavichene tests

IV level of success – 32 and above points (80-100 % LS)
III level of success – 31.5 – 26 points (79.9 – 65% LS)
II level of success – 25.5 - 20 points (64.9- 50% LS)
I level of success – 19.5 points and less (49.9% LS)

B. The attention concentration measured for three minutes period shows a logical line of development and although with insufficient geofunctional probability, there is a tendency to reduce the concentration in the second and especially the third minute.

- We found no gender differences in the ability to concentrate the attention in the studied students.
- Variability of this indicator was very high in both sexes, especially in girls.

III .4. Correlations between the examined indicators of physical, motor and mental development

Disclosure of the dependences between the examined indicators would significantly contribute to the practical pedagogical activity in the harmonious development of the child's personality. We have summarized our results in a correlation matrix (Table №12). They show the following:

Tab. №12. SUMMARY correlation MATRIX of the INDICATORS FOR physical, motor and mental development

3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.62	0.59	0.03	0.38	-0.22	-0.13	0.36	0.26	-0.20	-0.01	0.65	0.08	-0.18	0.08	0.03	0.12	-0.14	0.02
0.89	0.82	0.09	0.31	-0.06	0.20	0.15	0.27	-0.27	0.03	0.66	0.17	-0.24	0.15	-0.02	0.21	-0.04	0.19
0	0.88	0.20	0.37	-0.05	0.27	0.11	0.24	-0.28	-0.08	0.59	0.10	-0.30	0.02	0.00	0.24	-0.05	0.23
	0	-0.28	0.20	-0.09	0.25	0.10	0.23	-0.33	0.02	0.51	0.02	-0.33	0.00	-0.01	0.23	-0.05	0.15
		0	0.35	0.10	0.04	0.01	0.03	0.15	-0.16	0.12	0.13	0.06	0.11	0.00	-0.02	-0.09	0.10
			0	-0.28	-0.07	0.60	0.21	0.10	-0.12	0.41	-0.09	0.15	0.15	0.17	0.25	0.31	0.38
				0	0.65	-0.64	-0.43	-0.39	0.19	-0.43	0.29	-0.39	0.41	0.17	-0.18	-0.16	-0.02
					0	-0.49	-0.18	-0.41	0.15	-0.15	-0.01	-0.17	0.33	0.15	-0.16	0.03	0.12
						0	0.44	0.27	-0.11	0.46	-0.25	0.45	-0.28	0.03	0.18	0.18	0.12
							0	0.34	-0.03	0.44	-0.11	0.29	-0.18	0.03	0.17	0.02	0.18
								0	0.10	-0.04	-0.16	0.48	-0.12	0.00	0.13	0.13	0.11
									0	-0.25	0.03	0.03	-0.02	0.14	0.01	0.06	-0.01
										0	0.11	0.02	-0.12	-0.29	0.06	0.04	0.25
											0	-0.33	-0.06	-0.01	0.11	-0.12	0.11

												0	-0.28	0.17	0.11	0.39	0.24
													0	-0.12	-0.22	-0.17	-0.14
														0	0.33	0.35	0.32
															0	0.39	0.46
																0	0.52
																	0

1. The expected strong correlation between the indicators of physical development has been confirmed (0.6 - 0.9) (tests 1 to 4).
2. From all the indicators of physical fitness a visible correlation with the physical development indicators we found only in line with the indicator for grip strength (manual dynamometers) - N 13.
3. Among the indicators of physical and motor development on one hand and mental development on another we could not find any dependence, although we expected to find one.
4. We found out also relatively small correlation dependence between the separate indicators for motor development. This fact has its logical explanation, knowing that the tests we used correlate relatively weakly with each other but we chose them in order to measure various aspects of the motor development (physical fitness) of the surveyed students.
5. Modest but logical are also the relationships shown between attention concentration (tests 18, 19 and 20) and those for mental development (test 17), as well as between the different indicators for attention concentration (between 18, 19 and 20).

Conclusions

Every multidirectional and broad research should have not only theoretical, but also very practical dimensions. Therefore, our results prove on one hand some already well-known facts, that have been determined in another time period and in other socio-economic and sport-pedagogical conditions and factors, and on the other hand, our results revealed some new and very modern trends. Our data can be summarized in brief as follows: The results clearly state that the acceleration trends in the physical development are fading in the recent years. Indicators (tests) for physical fitness, which we found and analyzed from different periods of time, do not give us any basis to worry that there is a lack of the current generations regarding their physical fitness. In our results this fact might have a region basis (the study is carried out only on the territory of Blagoevgrad), but a fact is a fact and it has a positive sign. The statement, provoked by other authors, that between the motor and mental development of the students there is a logical relation was not proved by our results. On the contrary, in both sexes the correlation coefficient between the mental development test and all other tests applied does not exceed a value of 0.2, indicating a lack of any correlation between these elements of the personal development of the students.

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