DYNAMICS OF THE DEVELOPMENT OF THE PHYSICAL ABILITY OF PUPILS OF PRIMARY SCHOOL AGE

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ABSTRACT

This article presents data from a national scientific project of the National Sports Academy "V. Levski" and the Ministry of Education and Science to study the physical capability of students from secondary schools in the Republic of Bulgaria. Our aim is to establish the initial level of physical qualities of pupils at primary schools. In order to achieve the aim, we set the following tasks: To conduct a testing of the pupils at primary schools; To process and analyze the obtained results; To create exemplary methods for improvement of the testing results. In October 2018, we tested 83 pupils from 1st to 4th grade, aged between 7 and 10 years at Secondary School "Chernorizets Hrabar" in the town of Plovdiv. The testing (chronometry) and mathematical-statistical methods (variation analysis and one-factor dispersion analysis – f-criterion of Fisher) are methods were used in our study. The analysis of speed and endurance tests (running at 30 m. and 200 m.) showed that the values were close and the tested classes were homogeneous – the coefficient of variation ranged from 7,59% to 11,06%. However, it is noteworthy that in the other tests, the coefficient of variation is greater, indicating that the groups are approximately homogeneous. In the age aspect, the results follow their logical tendency towards improvement, which for most groups is statistically significant. The least improve of the results is observed in the agility test. The difference in values is very small and not statistically significant. This gives us reason to propose an example methodology to improve spatial orientation and coordination as components of agility. It will include gymnastic movements, moveable games and naturally-applied exercises.

Key words: *physical capability, pupils, testing*

INTRODUCTION

This article presents data from a national scientific project of the National Sports Academy "V. Levski" and the Ministry of Education and Science to study the physical capability of students from secondary schools in the Republic of Bulgaria.

In the theory of physical education the different sides of motor abilities are defined as motor qualities – speed, strength, endurance, flexibility, and agility (Rachev, K. et al., 2006; Jeliakov, Ts., Dashedva, D., 2017). The development of these qualities and their dynamics through the years of children's growth are subject to numerous surveys, which, however, are partial or serve private purposes (Lazarova, K., 2006; Naydenova, K., 2014; Naydenova, K., Alachev, S., 2019; Petkov, K., 2017).

The tests for evaluation of motor qualities and the indicators of physical development are the basis for control of children's health condition (Borukova, M., Encheva, M., Stoychev, D., 2017; Lazarova, K., Tsvetkova, N., 2007).

According to a number of authors (Petkova, L., Kvartirnikova, M., 1985; Slanchev, P., 1992) the contemporary generation's way of life is characterized with reduced motor activity, lower physical ability, and as a whole, worse health condition.

The research in the field of physical education and sport in Bulgarian schools finds out that motor activity in classes does not correspond to the needs of rising generation, which imposes the necessity of additional physical activity through other forms of physical exercises and sport (Bankov, P., 2007; Peneva, B., 2002; Tosheva, I., 2002; Staikova, V., 2007; Petrova, M., 2005; Tarnichkova, M., et al., 2009).

Andonov, K. (2019) has optimized gymnastics curricula by paying special attention to the development of the qualities speed, endurance, and speed-strength qualities. These are the qualities which, in his opinion, ensure the better acquisition of the educational material. The author has introduced methods with an increased number of gymnastics exercises which undoubtedly leads to an increase in these qualities.

Aim and objectives of the study

Our aim is to establish the initial level of physical qualities of pupils at primary schools. In order to achieve the aim, we set the following tasks:

1. To conduct a testing of the pupils at primary schools.
2. To process and analyze the obtained results.
3. To create exemplary methods for improvement of the testing results.

METHODS

The research was done in October 2018 at Secondary School "Chernorizets Hrabur" in the town of Plovdiv. The research was done among 83 pupils from 1st to 4th grade, aged between 7 and 10 years. We used a testing battery which bears information about the main indicators of physical ability. The battery includes five tests – *running 30 m*, *standing long jump*, *medicine ball throwing (1 kg)*, *running 200m (shuttle running)*, *agility and spatial coordination test* (Miladinov, et al., 2019).

The first four tests are standard and are applied in physical education and sport classes. The only new

test is that for agility and spatial coordination. The pupils participated voluntarily in the research and were instructed before performing each test.

We used the following methods in our research: *sports-pedagogical testing* and *math-statistical methods*: variation analysis and one-factor dispersion analysis – f-criterion of Fisher. The results from the research were processed with SPSS-19.0. (Gigova, 1999, 2002; Gigova, Damianova, 012).

RESULTS

The results from the variation analysis along all indicators of physical ability showed that the values had a normal distribution as regards asymmetry (As) and excess (Ex).

The researched classes showed there were not big variations from the mean value in the test "Running 30 m" which means that the groups were very homogeneous – the coefficient of variation ranged between 7.59% and 11.06% (Table 1).

The same was observed in the second and fourth grades in the test "Running 200 m" - V = 8.9% and 9.91%. In all the other tests the homogeneity of the groups was relatively homogeneous, and the coefficient of variation was over 12%.

Table 1. Variation analysis of the researched indicators of physical ability

Indexes	Grade	N	X	S	Min	Max	V
Running 30 m	1-st	18	6,88	0,52	7,89	5,76	7,59
	2-nd	20	6,53	0,51	8,11	5,86	7,90
	3-rd	20	6,25	0,69	7,81	4,68	11,06
	4-th	25	6,10	0,47	7,18	5,36	7,85
Running 200 m	1-st	18	59,89	7,62	80,79	48,88	12,73
	2-nd	20	55,94	4,97	66,33	48,39	8,90
	3-rd	20	53,29	6,61	70,35	43,53	12,41
	4-th	25	51,03	5,05	63,1	44,44	9,91
Standing Long jump	1-st	18	112,5	13,18	86	134	11,72
	2-nd	20	114,25	19,17	79	143	16,79
	3-rd	20	119,85	23,20	73	158	19,36
	4-th	25	138,16	18,14	100	170	13,14
Medicine ball throwing	1-st	18	313,66	68,23	213	446	21,75
	2-nd	20	301,45	85,39	167	459	28,33
	3-rd	20	346,9	88,17	210	590	25,42
	4-th	25	479,24	106,62	292	689	22,25
Agility test	1-st	18	20,63	2,78	27,63	17,96	13,51
	2-nd	20	19,38	3,32	29,93	15,89	17,14
	3-rd	20	20,00	3,17	27,15	16,15	15,88
	4-th	25	18,28	2,23	22,06	14,74	12,20

It is known that due to the representativeness of the samples, the decisions to be taken in the check of the statistical hypotheses are probable (Gigova, 1999). The acceptance or rejection of the zero

hypothesis is made at certain security level and at the same time the possibility of making a statistical mistake is considered.

In order to check the zero hypothesis about the significance of the observed differences between the average levels of the researched indicators in the different samples (83 pupils from 1st to 4th grade, aged from 7 to 10 years), we used one-factor dispersion analysis. We calculated F-criterion of Fisher at a high level of statistical reliability ($P_t \geq 95\%$). The results from the comparison allow us to make conclusions about the degree of influence of a certain factor (manifested in nominal or ordinal scale)

– each group in our case, on the researched indicators. The first step in one-factor analysis is related to determining the number and character of the so-called inter-group and among group dispersions along each indicator at the same levels of freedom, respectively $\kappa_1 = m - 1$ (where m is the number of the compared samples) and $\kappa_2 = n - m$, on which basis the values of F-criterion of Fisher and their corresponding levels of significance α and $P(F)$ are calculated.

Table 2 presents the dispersion criteria obtained from the comparison of the researched indicators.

Table 2. Dispersion criteria ($F_{\text{tabl}} = 2,78$)

№	Indexes	$F_{(\text{emp})}$	Sig.	$P_{(F)}$
1.	Running 30 m	7,646	0	100,00
2.	Running 200 m	8,100	0	100,00
3.	Standing Long jump	8,846	0	100,00
4.	1 kg medicine ball throwing	18,977	0	100,00
5.	Agility test	2,629	0,056	94,44

The analysis of the table shows that the calculated values of F-criterion of Fisher (F_{emp}) in most of the indicators were higher than the critical value ($F_{\text{tabl}} = 2.78$). This allows us, with high guarantee probability, to reject the zero hypothesis and to accept the alternative hypothesis according to which the observed differences among the mean levels of four of the researched indexes for the different classes are significant. This fact is confirmed by the level of significance α , which took values below 0.05. Only as regards indicator 5 “Agility” there were no statistically significant differences among different classes. In order to determine the exact differences among

different samples, we used the second step of dispersion analysis, which is related to calculation of the so-called Tukey’s Honestly Significant Difference. This allowed us to compare each pair of samples along the principle “each against each”. The number of the possible combinations for each indicator is determined with the formula: $A = n(n-1) / 2$. The number of the compared samples is 4, therefore the possible combinations here are 6.

The results from the comparison of the indicators, which confirm the alternative hypothesis, are presented in special matrixes, where the rejection of the zero hypothesis is presented with a star (*).

Table 3. Differences among the researched classes’ mean values of indicators

	1-st test running 30 m				2-nd test running 200 m				3-rd test long jump				4-th test ball throwing (1 kg.)				5-th test agility test			
grade	1-st	2-nd	3-rd	4-th	1-st	2-nd	3-rd	4-th	1-st	2-nd	3-rd	4-th	1-st	2-nd	3-rd	4-th	1-st	2-nd	3-rd	4-th
1-st			*	*			*	*				*				*				*
2-nd								*				*				*				
3-rd	*				*							*				*				
4-th	*				*	*			*	*	*		*	*	*		*			

DISCUSSION

Table 3 presents the existing differences among the mean values of indicator “Running 30 m” of the pupils from the researched classes. We can see that

there was a statistically significant difference in the results between 1st and 3rd grade, as well as between 1st and 4th grade. Nevertheless, there is a positive change in the mean values every year (Figure 1),

which shows that the speed of the pupils is improving.

Figure 1. Dynamics of development of the “Running 30 m.” indicator

In the second test “Shuttle run 200m” the mean values decreased, which shows a significant improvement in the results of every subsequent grade (Figure 2).

This improvement in the results is statistically re-

liable only between some of the grades (Table 3). There is a statistically significant difference between 1st and 3rd grade, 1st and 4th grade, and 2nd and 4th grade. The growth in the mean values between 1st and 2nd grade, as well as between 2nd and 3rd grade is accidental and is not statistically reliable.

Figure 2. Dynamics of development of the “Running 200 m.” indicator

The next test is “Standing long jump”. We used it to trace the development of the explosive power of the lower limbs in horizontal efforts. Figure 3 presents the dynamics of the mean values of the researched indicator. We can see that the values increase gradually from 1st to 3rd grade, but the differences are

not statistically significant. We believe that this fact may be due to the more complex technique in the execution of the exercise which was not learnt well. However, the bigger difference of 18.31 cm between 3rd and 4th grade should be pointed out and it is statistically significant. There are statistically signifi-

cant differences between 1st and 4th grade and 2nd and 4th grade (Table3).

Figure 3. Dynamics of development of the “Standing Long jump” indicator

Table 3 presents the differences in the mean values of the indicator “Medicine ball throwing 1m”. Their statistical reliability is the same as in the test “Long jump”. There is a statistically significant difference between 1st and 4th grade, 2nd and 4th grade, and 3rd and 4th grade.

There was a growth of 45.45 cm between 2nd and 3rd grade but it is not significant (Figure 4). The in-

crease in the mean value between 3rd and 4th grade is the most significant – 132.34 cm.

In this test we can observe a decrease in the mean value from 1st to 2nd grade, which might be due to accidental circumstances (poor technique of throwing, weaker explosive power of upper limbs, lack of motivation for showing maximum performance, etc.).

Figure 4. Dynamics of development of the “Ball throwing (1 kg.)” indicator

The last test assesses pupils’ agility and includes movements for coordination and spatial orientation, object agility and precision. The pupils had to

carry four small balls one after the other and place them in a target by running in a T-shape (Figure 5). All motor actions in the test should be performed

with maximal speed which set requirements to the development of velocity and corresponded, in our

opinion, to the test “Running 30m” and “Shuttle running 200m”.

Figure 5. *Agility test*

Tracing the dynamics of the development of the 1st and 4th – grade pupils’ agility, we found out that the results, as a whole, improved slightly (Figure 6). There is a statistically significant difference only between 1st and 4th grade (table 7), and it is 2.35 sec.

The small difference between 1st and 2nd, as well as 3rd and 4th grade is statistically unreliable. The worse results of the 3-grade pupils should be taken into consideration.

Figure 6. *Dynamics of development of the “Agility test” indicator*

In conclusion we can sum up that in the four tests, which require easier motor actions such as running and jumping, pupils’ results from 1st to 4th grade improve logically. The results, however, do not follow this progression for the other two tests (“Medicine ball throwing” and “Agility test”). We believe that this is due to the more complex structure of the movements and the necessity of additional teaching before their execution.

Having in mind that the sensitive periods of the development of coordination abilities is between 7 and 12 years and through adolescence, as well as the achieved poorer results from the agility test, we can introduce some exemplary gymnastics exercises for improvement of spatial orientation and coordination (moving in straddle position and moving in straddle pike position; rolls, passing through a hoop, jumping, jumping over, and carrying).

We suggest that these exercises should be learnt performed in competitive games so that pupils' well in the physical education classes before being physical fitness be improved (Table 4).

Table 4. Exemplary games to improve physical fitness

1st Example game for 1st and 2nd grade

actions: 1- running on zig-zag; 2- rolling around the longitudinal axis; 3- passing through the hoop; 4- moving in straddle pike position or straddle back support; final

1st Example game for 3rd and 4th grade

actions: 1- running with the circumference of each cone; 2- passing through the hoop; 3- moving in straddle pike position or straddle back support; final

2nd Example game for 1st and 2nd grade

actions: 1- running to the hoop and taking the ball; 2- running on zig zag; 3- placing the ball in the hoop; 4- running; final (the next player returns the ball to the first hoop)

2nd Example game for 3rd and 4th grade

actions: 1- running to the hoop and taking the ball; 2- multiple jumps through the hoops; 3- placing the ball in the hoop and take the other; 4- running, placing the ball in the first hoop; final

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