

Special aspects of changes in physical readiness indicators of young men with different somatotypes between 15 and 17 years of age

GENNADII IEDYNAK¹, LESIA GALAMANDJUK², OKSANA KYSELYTSIA³, IHOR NAKONECHNYI⁴, ANNA HAKMAN⁵, OLENA CHOPIK⁶

^{1,2,6}Department of Theory and Methodology of Physical Education, Ivan Ogienko National University in Kamianets-Podilsky, UKRAINE

^{3,4,5}Department of Theory and Methodology of Physical Education, Chernivtsi Yuriy Fedkovych National University, UKRAINE

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Abstract

During the three academic years, we identified the differences between the same boys with different somatotypes, as well as similar trends in the development of physical qualities. There were 88 boys who at the beginning of the experiment turned 15 years old, namely 22 with asthenic somatotype, thoracic somatotype, muscular and digestive somatotypes. It is established that between 15 and 16 years is similar for all four somatotypes, the trend is to increase the frequency of movements, between 16 and 17 years - in manifestation on the achieved level of speed characteristics and aerobic capacity. During the first specified period, a similar trend was also established for three somatotypes, namely increase flexibility, muscular strength, speed qualities and coordination cyclic locomotion. Between 16 and 17 years a similar tendency of improvement in three somatotypes was noted for speed strength and coordination in ballistic movements to the maximum distance by the leading hand, in two somatotypes – muscular strength coordination in ballistic movements for the maximum distance with the not leading arm. The obtained data must be taken into account in order to differentiate the parameters of the loads directed to the development of the physical qualities of the young men. After additional research, it is advisable to implement a differentiated approach in assessing the development status of the physical qualities of young men.

Keywords: physical education, differentiated approach, somatotypes, physical qualities, features of development.

Introduction

The situation with military operations in Ukraine and the physical condition of high school students, which at the present stage is lower than necessary (Bergier, Tsos, 2016; Iedynak, Mysyv, Skavronsky, 2012), actualize the problem of increasing the effectiveness of their physical education.

One of the most promising in solving this problem is the implementation of a differentiated approach in the classes, taking into account the individual characteristics of school students (Ashmore, 2005; Buns, 2015; Campos, Martins, Simões, Franco, 2017; D'isanto, Di Tore, 2016; Katzmarzyk, Silva, 2013; Lukavenko, Iedynak, 2012; Rolyuk, Romanchuk, & Lojko, 2016). The determining factor in this approach is the feature used to divide the school students into as homogeneous samples as possible. Proposals here are diverse, but the leading ones are signs with constant characteristics. These are the dermatoglyphics indices, blood group (El-Sayed, Koenen, Galea, 2013), the type of temperament or higher nervous activity (Dyussenbayev, 2013), such as somatic constitution (Carter, Heath, 1990; Iedynak, Zubal, Mysyv, 2011). Without going into the analysis of these signs from the standpoint of their feasibility, the possibility and effectiveness of use in the practice of physical education in school, we only note that the priority today is the composition of the body or somatotype (Armstrong, Mechelen, 2009; Brtková, Bakalár, Matuš, Hančová, Rimárová, 2014; Malina, Bouchard, Bar-Or, 2004). The use of this particular feature for the realization of a differentiated approach during the physical education of school-age young men is due, at least to the following: long-term successful practice in sports (Cochrane, Housh, & Cramer, 2015; Kutseryb, Vovkanych, Hrynkyv, Majevska, 2017; Noh, Kim, Lee, & Kim, 2014); possibility to diagnose already at preschool age; lack of a large number of methods in the diagnostic procedure, the simplicity and standard of measurement procedures (Carter, Heath, 1990; Katzmarzyk, Silva, 2013; Pělucha, Hančák, 2016). At the same time, it was found that studies on the implementation of a differentiated approach in the physical education of young men 15-17 years of age with different somatotype are single (Iedynak, Zubal, Mysyv, 2011). Other available studies (Kvintová, Sigmund, 2016; Mysev, Iedynak, 2016; Pělucha, Hančák, 2016; Zapletalová, 2011) do not reflect the peculiarities of age dynamics of different indicators of such students group, including their physical fitness. Thus, there is practically no data on the

peculiarities of development of physical qualities in representatives of different somatotypes between the ages of 15 and 17. This indicates the need for such studies.

Materials and methods

The study was long-term: we studied the results of physical fitness tests of the same boys from 15 to 17 years old. There were 88 boys who at the beginning of the experiment turned 15 years old, namely 22 with asthenic somatotype (A-type), thoracic somatotype (T-type), muscular (M-type) and digestive (D-type) somatotypes. Somatotype was diagnosed at the beginning of the experiment, the Shtefko-Ostrovsky scheme was used in the modification S. Darskaja (1975). Based on the basic characteristics of a very similar to it, there is the Heath-Carter scheme (1990), which is most often used by researchers from Europe and the United States. Selection Shtefko-Ostrovsky scheme causes extremely possibility to establish certain trend, especially manifestations and changes of physical readiness in comparison with the data of other researchers.

To obtain the necessary data, a battery of tests was formed. It met the established requirements (Serhiyenko, 2001; Schmidt, Lee, 2013; Turvey, Fonseca, 2009) and contained the most common in the practice of physical education motor tasks (Eurofit, 1993; Fitness testing, 2017; Omorczyk, Lah, 2009; (Thomas, Nelson, & Silverman, 2011; What is physical fitness, 2017). Evaluation of the development of such physical qualities: dynamometry – muscular strength; 5-second run in place – the maximum frequency of movements; jump in length from the place – speed force; 6-minute run at a maximum distance – aerobic capacity; forward tilt – flexibility. Taking into account the recommendations, we also studied some manifestations of coordination, in particular in cyclic locomotion's (shuttle run 4x9 m), in acrobatic motions (three somersaults forward), in ballistic movements at the maximum distance by the leading arm (throwing a tennis ball leading arm) and not leading arm (throwing a tennis ball not leading arm) (Omorczyk, Lah, 2009). Used run at 20 m from the course allowed to evaluate in the complex development of two independent components of speed qualities, namely the speed of the individual movement and the frequency of movements. In this case, another independent component (the time of the motor reaction) in the test was isolated so that it did not affect the result. The formation of a battery of tests used at the beginning of each new school year. The data was compared with each other, namely: results in tests of representatives of A-type in 15 and 16 years, then in 16 and 17 years; results in tests of representatives of every other somatotype. Results of descriptive statistics in this study were presented as arithmetic mean of the sample, standard error of the mean. The comparison have established whether there is a statistically significant difference between the two averages. The data were normally distributed in each test. This allowed using the T-test for related samples; and 0.05, 0.01 and 0.001 probability levels were used to indicate statistical significance. All statistical analyses were performed using SPSS Version 21. The obtained data was interpreted as follows: in the case where the difference between the two averages was statistically significant ($p < 0.05$, $p < 0.01$ or $p < 0.001$), we concluded that there was a significant change in the result. Such a change could be a deterioration or improvement of the result in the test of physical fitness, and therefore the level of development of physical quality, which was evaluated by this test. The change in the result in each test containing the tables was given in absolute value; deterioration of the result was indicated by the symbol "-". The research was conducted in compliance with WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects, 2013. The study protocol was approved by the Ethical Committee of Ivan Ogienko National University in Kamianets-Podilsky.

Results

By the study, we found out that in young men with different somatotype between 15 and 17 years, there is a change in the indicators of physical readiness. This change in the representatives of the A-type is seen from Table 1, in representatives of the T-type – with Table 2, M-type and D-type – respectively Table 3 and Table 4. In the most general form, the data obtained indicate similar trends, as well as the peculiarities of changes in physical fitness indicators of boys with different somatotypes at a certain age of the period of 15-17 years.

Specifying the results of representatives of a certain somatotype noted the following. Between 15 and 16 years, all young men significantly ($p < 0.01$) increases the maximum frequency of movements. In all, with the exception of the M-type, the speed strength also increases, in all, with the exception of the T-type – coordination in acrobatic motions. The boys A- and M- types also increase their flexibility, while for the boys T- and D- types it remains on the level achieved previously. The latter is evidenced by the lack of significant change in result in the forward tilt. At the same time, representatives of T- and D- types develop muscular strength, coordination in cyclic locomotion, as well as the speed of the individual movement and the frequency of movements based on the test "run at 20 m from the course". In the representatives of other somatotypes, these physical qualities remain at the previously reached level. For the boys of the D-type we also found a significant improvement in aerobic capacity and coordination in ballistic movements to the maximum distance with the leading hand. For representatives of other somatotypes, the development of these physical qualities remained at the level reached before.

Table 1. Changes in physical readiness indicators for A-type between 15 and 17 years (n=22)

Physical readiness indicators	15 years		16 years		Δ	17 years		Δ
	M	SE _M	M	SE _M		M	SE _M	
Dynamometry of deadlift, kg	102,1	1,21	105,8	3,3	3,7	109,1	2,95	3,3
5-second run in place, quantity	21,9	0,81	24,9	0,54	3,0**	22,1	0,45	-2,8**
Run at 20 m from the course, s	2,9	0,06	2,8	0,04	-0,1	2,8	0,02	0
Jump in length from the place, sm	178,3	3,33	206,7	5,83	28,4***	215,3	3,43	8,6
6-minute run, m	1533,9	22,83	1528,9	13,58	-5,0	1539,4	9,8	10,5
Forward tilt, sm	9,4	0,83	12,4	0,3	3,0**	11,4	0,65	-1,0
Shuttle run 4x9 m, s	9,5	0,12	9,5	0,11	0	9,9	0,13	0,4*
Throwing a tennis ball leading arm, m	34,9	1,18	38,8	1,78	3,9	40,2	1,34	1,4
Throwing a tennis ball not leading arm, m	16,1	0,86	16,5	2,45	0,4	16,7	2,18	0,2
Three somersaults forward, s	3,8	0,16	3,1	0,12	-0,7***	3,4	0,1	0,3

Note: * p <0.05, **p <0.01, *** p <0.001

Table 2. Changes in physical readiness indicators for T-type between 15 and 17 years (n=22)

Physical readiness indicators	15 years		16 years		Δ	17 years		Δ
	M	SE _M	M	SE _M		M	SE _M	
Dynamometry of deadlift, kg	112,8	1,79	118,0	1,72	5,2*	122,5	1,56	4,5
5-second run in place, quantity	23,0	0,28	24,1	0,23	1,1*	23,3	0,15	-0,8*
Run at 20 m from the course, s	2,8	0,02	2,7	0,02	-0,1**	2,7	0,02	0
Jump in length from the place, sm	207,6	1,72	212,5	1,64	4,9*	221,4	1,39	8,9*
6-minute run, m	1476,2	11,56	1456,5	9,25	-19,7	1464,3	7,77	7,8
Forward tilt, sm	10,6	0,52	11,5	0,42	0,9	8,1	0,31	-3,4***
Shuttle run 4x9 m, s	9,7	0,04	9,4	0,04	-0,3***	9,7	0,05	0,3***
Throwing a tennis ball leading arm, m	39,4	0,62	40,2	0,36	0,8	44,7	0,33	4,5*
Throwing a tennis ball not leading arm, m	16,8	0,4	15,2	0,3	-1,6**	16,1	0,26	0,9*
Three somersaults forward, s	3,6	0,05	3,5	0,06	-0,1	3,5	0,06	0

Note: * p <0.05, **p <0.01, *** p <0.001

With regard to deterioration in the level of development, this change was marked only by coordination in ballistic movements at maximum distance by the not leading hand and only in representatives of the T- and M- types.

In the period between 16 and 17 years, the differentiation in physical fitness of boys with different somatotypes increases. Thus, we did not find a common for all development of a certain physical quality, whereas between age 15 and 16 this was the frequency of movements. In return, for all boys, with the exception of the A-type, it is essential (of p <0.01 to p <0.001) to increase the speed and coordination in ballistic movements to the maximum distance by the leading hand. Young men of M- and D- types, the level of development of muscular strength is additionally increased, young men of T- and D- types – level of coordination development in ballistic movements at the maximum distance by the no leading hand.

In addition, we noted a significant difference in data on the deterioration in the level of development of physical qualities. In particular, with the exception of young men D-type, in other significant (of p <0.05 to p <0.001) coordination in cyclic locomotion and maximum frequency of movement are worsen. Flexibility of young men of the T-, M- types is also getting worse, in the latter –

Table 3. Changes in physical readiness indicators for M-type between 15 and 17 years (n=22)

Physical readiness indicators	15 years		16 years		Δ	17 years		Δ
	M	SE _M	M	SE _M		M	SE _M	
Dynamometry of deadlift, kg	117,8	1,89	119,6	1,51	1,8	127,6	1,55	8,0*
5-second run in place, quantity	23,5	0,25	24,5	0,36	1,0*	22,3	0,29	-2,2**
Run at 20 m from the course, s	2,7	0,02	2,7	0,02	0	2,7	0,02	0
Jump in length from the place, sm	212,8	1,6	209,1	1,56	-3,7	217,8	1,16	8,7***
6-minute run, m	1462,0	10,59	1453,2	8,24	-8,8	1457,6	6,67	4,4
Forward tilt, sm	11,3	0,44	14,2	0,3	2,9***	10,1	0,18	-4,1***
Shuttle run 4x9 m, s	9,6	0,04	9,3	0,05	-0,3***	9,8	0,05	0,7***
Throwing a tennis ball leading arm, m	41,0	0,68	39,1	0,78	-1,9	41,5	0,41	2,4**
Throwing a tennis ball not leading arm, m	17,9	0,44	16,3	0,33	-1,6*	16,9	0,24	0,6
Three somersaults forward, s	3,6	0,05	3,4	0,05	-0,2*	3,7	0,06	0,3***

Note: * p < 0.05, **p < 0.01, *** p < 0.001

Table 4. Changes in physical readiness indicators for D-type between 15 and 17 years (n=22)

Physical readiness indicators	15 years		16 years		Δ	17 years		Δ
	M	SE _M	M	SE _M		M	SE _M	
Dynamometry of deadlift, kg	115,4	3,34	126,4	3,63	11,0*	142,0	2,98	15,6**
5-second run in place, quantity	21,2	0,31	23,7	0,51	2,5**	25,8	0,6	2,1*
Run at 20 m from the course, s	3,3	0,06	2,7	0,04	-0,6***	2,7	0,05	0
Jump in length from the place, sm	175,0	1,05	189,8	1,74	14,8***	205,5	1,14	15,7
6-minute run, m	1013,2	12,73	1035,9	7,83	22,7	1055,5	8,0	19,6
Forward tilt, sm	7,4	0,4	8,2	0,49	0,8	10,4	0,65	2,2*
Shuttle run 4x9 m, s	10,1	0,19	10,4	0,16	0,3	10,5	0,15	0,1
Throwing a tennis ball leading arm, m	35,3	0,37	38,8	0,55	3,5***	42,5	0,78	3,7***
Throwing a tennis ball not leading arm, m	17,9	0,45	18,9	0,57	1,0	21,0	0,57	2,1*
Three somersaults forward, s	3,7	0,06	3,2	0,07	-0,5***	3,2	0,06	0

Note: * p < 0.05, **p < 0.01, *** p < 0.001

additionally coordination in acrobatic motor activity. In D-type young men, the level of development of the latter quality and coordination in cyclic locomotion's remain at the achieved level, and the maximum frequency of movements and flexibility – significantly (at the level of p < 0.05) increase.

Discussion

The obtained data indicated differences in the development of physical qualities among representatives of different somatotypes between 15 and 17 years. The revealed discrepancies were associated with a complex of causes. In the most general form, one of the reasons is the uneven pace of morphological and functional maturation of different somatotypes representatives. In particular, in such maturation T-type representatives lag behind the M-type, on average, for half a year, A-type representatives lag behind the latter for one year, and D-type - for one and a half or two (Iedynak, Zubal, Mysyv, 2011; Katzmarzyk, Silva, 2013). Such a discrepancy affects the display of various characteristics, including physical qualities (Wilmore, Costill, Kenney, 2012; Zapletalová, 2011). This is due to the fact that the development of each physical quality to a large extent depends on the morphological and functional maturation of those organs and systems that provide a display of this quality (Armstrong, Mechelen, 2009; Malina, Bouchard, Bar-Or, 2004). It is in this regard that the period during which a certain physical quality develops more intensively than in other periods is considered, as well as the fact that for different qualities these periods are different (Iedynak, Mysyv, Skavronsky, 2012;

Ivashchenko, Khudolii, & Nosko, 2016; Lukavenko, Iedynak, 2012; Omorzcyk, Lah, 2009; Turvey, Fonseca, 2009). In other words, the difference in the morphological and functional maturity of boys of different somatotypes from 15 to 17 years leads to a discrepancy of their period during which a certain physical quality develops more intensively than in other periods. This is partly confirmed by the information that each somatotype has his sensitive periods of development of physical qualities; such periods do not coincide (Mysev, Iedynak, 2016; Pěluha, Hančák, 2016). The above is consistent with the understanding of the somatotype as an external display of the human constitution (Carter, Heath, 1990; Iedynak, Zupal, Mysyv, 2011). Thus, the human constitution in the modern sense is the integrity of the morphological and functional properties inherited and acquired, relatively stable in time, which are related to the pace of individual development, the peculiarities of reactivity of the organism, the style of activity and material preconditions of human abilities (Ashmore, 2005; Brtková, Bakalár, & Rimárová, 2014; Malina, Bouchard, Bar-Or, 2004).

In connection with the above mentioned, we considered other reasons for the results obtained in our study. At the same time, we noted that taking into account the received data to a certain extent contributes to the solution of the problem by implementing a differentiated approach to children and adolescents during physical education. After all, the obtained data allow to take into account the individual tempo and certain features of the morphological and functional maturation of a child with a certain somatotype in solving problems of physical education (Ashmore, 2005; Katzmarzyk, Silva, 2013; Wilmore, Costill, Kenney, 2012). First of all, this concerns the development of physical qualities: taking into account the sex and age of the child (adolescent) with a certain somatotype, determine the qualities at this age that are intensively growing. It is on them that the teacher plans to influence special exercises during classes (Brtková, Bakalár, Matúš, Hančová, Rimárová, 2014; Carter, Heath, 1990; Iedynak, Zupal, Mysyv, 2011). Herewith, additional and important information is about the manifestation of physical qualities in young men with different somatotype at every age of 15-17 years. This is due to the fact that the data obtained can be used to assess the achievements of such young men students in terms of physical qualities development. Evaluation on such basis will be objective, because it takes into account the characteristics of each student (Di Tore, Schiavo, D'isanto, 2016; Lukavenko, Iedynak, 2012; Schmidt, Lee, 2013; Turvey, Fonseca, 2009). It will also stimulate activity, because objective evaluation is an effective factor in strengthening the individual's desire to achieve higher results, particularly in physical activity (Buns, 2015; Delas, Lafrenière, Fenouillet, Paquet, Martin-Krumm, 2017).

With regard to the information on the differences in the state of development of a certain physical quality for young men with different somatotypes at a certain age of the period of 15-17 years, then it is necessary to conduct a separate study. During such a study, it is necessary to process the data of Table 1-4 by adequate methods of mathematical statistics and analyze them. But if taking into account the previously obtained data (Brtková, Bakalár, Matúš, Hančová, Rimárová, 2014; Iedynak, Zupal, Mysyv, 2011; Iedynak, Mysyv, Skavronsky, 2012; Pěluha, Hančák, 2016), one can note the existence of physical qualities in each somatotype, the level of development of which is significantly higher for its representatives than the level of development of these qualities for representatives of other somatotypes.

Conclusions

From 15 to 17 years young men with different somatotype there are changes in the indices of physical readiness. Taking into account the obtained data, it is necessary to differentiate the parameters of the loads aimed at the development of the physical qualities of young men: the emphasis should be on qualities that are marked by significant growth between 15 and 16 or 16 and 17 years. It is also advisable to take into account the data on similar trends in the development of a certain physical quality, which will allow the integration of representatives of several somatotypes to solve the same problem. After further analysis of the data obtained, it is advisable to implement a differentiated approach in assessing achievements related to the development of physical qualities of young men.

Conflicts of interest

No conflicts of interest exist.

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