



MAIN FACTORS OF THE PHYSICAL CAPACITY OF 15–16-YEAR-OLD STUDENTS (AFTER THE COVID-19 PANDEMIC IN THE SCHOOL YEAR 2019/2020)

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ABSTRACT

The aim of the study was to reveal the factor structure and to derive the main factors of physical capacity in 15–16-year-old boys after the first period of isolation during the COVID-19 pandemic. This would help optimize the online learning process in physical education and sports during the next school years. 252 students took part in the study. The following research methods were applied for the realization of the research: study of the literature and theoretical analysis of the specialized literature, and sports-pedagogical testing. To assess the physical capacity 5 tests were applied: Running 30 m (1), long jump with both feet from place (2), 3 kg medicine ball throwing with both hands from a standing position over the head (3), 200 m running (4) and the Test for Agility and Spatial Coordination (5).

The results were processed with SPSS using mathematical and statistical methods: variation analysis, sigma deviation method and factor analysis.

CONCLUSIONS: The studied students have average level of physical capacity, compared to the same age group for Bulgarian students. In 15–16-year-old boys the factor structure is composed of 3 main factors, which explain the very high percentage of the initial variance of the studied trend (87.37%). The most important is the first factor, which is related to the explosive force of the lower limbs in horizontal efforts, speed capabilities and the endurance of the examined boys.

Key words: students, secondary education, online education

INTRODUCTION

The physical capacity is assessed based on determining the level of development of physical qualities, which is established by quantitative assessment of the result of the performance of various motor tasks (1). The main elements of physical capacity are defined as the physical and motor abilities, as well as the intellectual and mental abilities of the personality (2). Human motor abilities are revealed in the form of certain motor actions of varying complexity. They are part of everyday activity, work activity, sports activity, and others that a person performs. In the physical

education and sports, these actions are more focused and are combined into complex sets of physical exercises. (3). One of the main tasks in the physical education process is the optimal development of the physical abilities.

In the theory of physical education, it is accepted that the individual development of a person's motor abilities can be conditionally defined as motor /physical/ qualities. In the scientific and methodological literature, the notion of the existence of five main motor qualities is widespread: speed, strength, endurance, flexibility, and agility. Their level of development determines a person's physical performance. There are common patterns in their development, as they are all a function of the human neuromuscular apparatus (3).

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The complex indication of motor qualities is the basis of a person's physical training, physical capacity, and health status, respectively. Physical training is a necessary and mandatory element in the motor activity of those engaged in exercise and sports (4).

In 2020, all people in the world are placed in an unknown and critical situation for humanity - the global pandemic of COVID-19. In order to prevent the infection of a large number of people, the governments of most countries in the world have been forced to declare quarantine for an indefinite period. For Bulgaria, this was the period from March 13 to the end of the 2019/2020 school year for students.

The emergency pandemic situation was a challenge for all teachers and students, who were forced to dive into a completely new form of learning - e-learning, without prior training. Therefore, it was necessary for extremely short periods of time for teachers to learn how to carry out the learning process in an electronic environment. These were force majeure circumstances that were perceived, analyzed, and adapted differently by each teacher. Unlike the second lockdown, when the learning process in all schools in Bulgaria was conducted online through the Microsoft Teams platform, during the first lockdown, learning activities were conducted remotely through asynchronous learning. The hours of physical education and sports of the students in the secondary education level are two per week, as well as one additional hour of "sports activities", as their duration in electronic environment is 30 minutes.

The effectiveness of distance learning has yet to be analyzed and optimized. The analysis and assessments of physical capacity of students at the entry level for physical capacity before COVID-19 and their comparison with the same after the pandemic, will support targeted training in physical education and sports in the next school year, which would improve their physical capacity and respectively their health status.

An interesting conclusion is made by V. Ivanov, who reports that a study of the level of physical capacity of school students and first-year university students in 2019 found that

grades differ, by nearly one unit in favor of school grades (5). A similar kind of conclusions formed the idea of the current study.

The aim of the study is to reveal the factor structure and to derive the main factors of physical capacity in 15–16-year-old students after the lockdown period during the COVID-19 pandemic, which will support the learning process in physical education and sports in subsequent school years to be optimized.

METHODOLOGY

This study was conducted for the period from October 2019 to October 2020 in compliance with all ethical norms and requirements for testing children under 18 years of age. The subject of the research is the physical capacity of the school students.

The object of the study are the main signs of physical capacity. 252 boys, students from ninth and tenth grade from a High school in Burgas, were studied. For the needs of the research, all students were tested at the beginning of the 2019/2020 and 2020/2021 school years on the 5 indicators of the new normative assessment system, which brings information about the main signs of physical capacity. During the quarantine period in the 2019/2020 school year, students were taught remotely by teachers, and each student had to perform exercises in a special, pre-designed training program. The program includes 15 exercises, divided into 5 complexes, which are performed in 4 series. Every week the complexes rotated, and during the second rotation the load also was increased.

To achieve the set goal and tasks of the research, the following research methods have been applied: review and theoretical analysis of the specialized literature and sports-pedagogical testing. 5 tests were used as follows (**Table 1**).

For the needs of the research the following mathematical and statistical methods are applied: variational and factor analysis, method of sigma deviations - for quantitative assessment of the condition of the measured signs. Based on the average level of the measured characteristics for the given age group, T-scores are calculated, which are

normalized values, presented in a six-point and 20-point system (6), which allows to compare the achievements of different sized tests and

indicators (number, time, %, etc.). The average level of the whole population corresponds to 10 points.

Table 1. Tests to measure physical capacity

№	Test	Unit	Measurement direction
1.	Running 30 m	0.01 s	-
2.	Long jump from a place	1.00 cm	+
3.	3 kg medicine ball throwing with both hands from a standing position over the head	1.00 cm	+
4.	Running 200 m	0.01	-
5.	Agility test	0.01	-

RESULTS AND ANALYSIS

The results of the variational analysis of the observed indicators of physical capacity show that the values are normal and close to the normal distribution, and the observed population is homogeneous and relatively homogeneous with respect to the studied indicators.

As noted in the Methodology for assessment of students from the school in Burgas on the

studied indicators, we applied the new system for assessment of students from I to XII grade (6) To solve the purpose and tasks of the study, we applied a comparative analysis of the grades from two sports and pedagogical tests of students from Burgas.

Table 2 presents a comparative analysis of the average scores on the indicators of physical capacity.

Table 2. Comparative analysis of the average values and the average scores on the studied indicators in the two studies

Indicator	First assessment				Second assessment			
	n1	X1	Evaluation mark	Score on the 20-point system	n2	X2	Evaluation mark	Score on the 20-point system
1. Running 30 m	124	4,88	4.00	14.00	127	4,76	4.00	14.00
2. Long jump from a place	124	202,28	4.00	13.00	127	204,95	4.00	12.00
3. 3 kg medicine ball throwing with both hands from a standing position over the head	124	606,38	4.00	10.00	127	693,32	4.00	11.00
4. Running 200 m	124	40,34	4.00	12.00	127	39,71	4.00	12.00
5. Agility test	124	13,87	6.00	16.00	127	13,60	5.00	16.00
An average grade			4.40	13.00	An average grade		4.20	13.00

The analysis of the table shows that despite the fact that in the second study on all grounds the mean values are better, the scores on the six-point system are the same - good 4.

The generalized mean score after the second study was lower by 0.20 points compared to the first study ($\sum T1 = 4.40$; $\sum T2 = 4.20$). In order to confirm the growth in the achievements of the students, we also applied the 20-point system, which shows us that in the indicator "long jump from a place" we observe a lower grade by 1 point, and in the indicator "throwing a solid ball 3 kg." the assessment is 1 point higher, while for the other three indicators the assessments retain their values. The lower generalized average value shows

that despite the better results and the established growth in some indicators in the second study, students have a lower level of physical capacity compared to the average level of the same age group for Bulgaria. In a similar study and analyzed data of 10,300 students from I to XII grade, it is clear that boys from 8th grade (15 years) are found to have less "poor and average grades" and more „good and very good" grades (7).

To solve the purpose and tasks of the study we applied factor analysis. In 15–16-year-old boys the factor structure is composed of 3 main factors (**Table 3**), which explain the very high percentage of the initial variance of the studied trend (87.37%).

Table 3. Factor structure of the physical capacity of 15-16-year-old students

№	Indicator	I	II	III	h ²	1-h ²
1.	Running 30 m	,885	,202	-,121	,839	,161
2.	Long jump from a place	-,837	-,122	,121	,729	,271
3.	3 kg medicine ball throwing with both hands from a standing position over the head	-,495	,830	,251	,996	,004
4.	Running 200 m	,832	,283	-,181	,805	,195
5.	Agility test	,659	-,161	,734	,998	,002
$\sum a^2 = 87,37 \%$		57,10%	17,00%	13,26 %		

In addition to the factor weights, the table also presents data on the magnitude of the explained (h^2) as well as the unexplained ($1-h^2$) of the initial variance of each studied feature. The analysis of Table 4 shows that the first derived factor explains 57.10% of the initial variance of the studied trend. The following two factors have a lower contribution to the total physical capacity of students, 17.00% and 13.26%, respectively.

The first factor in the factor structure of the physical capacity of 15–16-year-old boys is determined by three indicators and explains the highest percentage of the initial variance of the studied phenomenon (57.10%). This factor is related to the explosive force of the lower limbs in horizontal efforts, speed capabilities and speed endurance of boys.

The second factor is determined by only one factor, which is related to the strength of the upper limbs and the shoulder girdle of the students.

The third factor in the factor structure of the physical capacity of 15-16-year-old students

explains the lowest percentage (13.26%) of the initial variance of the studied phenomenon and is related to the ability of spatial orientation and agility of students.

DISCUSSION

A previous and more extensive study conducted by part of the research teams found that the development of the quality "strength" shows a clear dependence on gender and age. In 15–16-year-old boys there is an increase in strength capabilities and by the age of 16-17 the topography of muscle strength is formed as an adult type, by 18-20 years the strength increases and reaches its maximum values (8). A similar study by another author involving 52, 16-year-old active sports students found very different levels of strength in both the upper and lower limbs (9). From a methodological point of view, the coordination of the movements is considered as a component of agility. Sensitive periods for the development of coordination abilities are between 7 and 12 years and after puberty, but the highest indicators are shown at the age of 13-14 years. At the age of about 15-16 years, it

is recommended to work persistently to improve agility, otherwise there is a decrease in the abilities in both sexes, which is confirmed by the last derived factor, which includes the agility test. The means and methods used in the lesson work to develop the strength of the lower limbs should be differentiated according to gender, according to the specifics of the motor quality (10).

A study with university students found that the results of the study show that regular sports activities have a positive impact on the concentration of thought processes (11).

Knowledge and creative mastery of knowledge in this field of science and their application in practice changes in a positive direction the physical development and capacity, and as a result, the health status and academic and working performance of students (12).

A study of the issue of motivation and active participation in sports classes shows that the motivation of students to training for physical activity is a polymotivated activity, and the order of the motives by importance does not differ significantly (13).

CONCLUSION

As a main conclusion from the study, we could conclude that in both studies the group is homogeneous and relatively homogeneous in terms of physical capacity as students have physical capacity at the average level for the same age group for Bulgaria. In 15–16-year-old students the factor structure is composed of 3 main factors that explain a very high percentage of the initial variance of the studied phenomenon (87.37%), the most important is the first factor, which is related to the explosive power of the lower limbs in horizontal effort, speed capabilities and endurance of the boys. The process of training in physical education and sports should emphasize the importance of physical capacity for the health status of the young generation. It is extremely important to stimulate both the active participation of students in the lessons of physical education and sports, and their participation in systematic extracurricular activities with physical exercises and sports

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