

Results of monitoring the physical health of female students during the COVID-19 pandemic

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Abstract

The article analyzes the results of monitoring the physical health of 17-19-year-old students. The influence of COVID-19 on morphofunctional indicators of physical development of female students was determined. The study involved 889 female students. **Methods:** Anthropometric measurements were made: body length; body weight; chest girth. The cardiovascular system was assessed: calm state heart rate; systolic blood pressure; diastolic blood pressure; respiratory system. The analysis of morphofunctional changes has been made in the following indicators: life index, development proportionality index, body mass index, Robinson index, Ruffier-Dixon test. **Results.** It was found that during the 2019-2020 academic year, there were significant changes in the morphofunctional state of female students, which go beyond the statistical error and are caused by the limitations of COVID-19. There is a trend towards an increase in HR +1.83% and SBP +3.82% with a simultaneous decrease in BK -3.19%, which together indicates a decrease in functional capabilities and a deterioration in physical health of female students. The limitations of COVID-19 led to a decrease in the vital index by 6.58 %, a deterioration of the cardiovascular system indicators for physical activity by 5.46 %, a decrease in the functional capabilities of the body by 7.38 %. **Conclusions:** Physical education teachers and coaches were not prepared to conduct classes in the conditions of COVID-19 and were not able to provide alternative, interesting for students forms and ways of organizing individual training that would allow maintaining morphofunctional indicators of physical health. New realities of modern life require changes in approaches to the organization of physical culture and sports work, as well as improvement of the system of special training of physical culture specialists. **Key words:** monitoring, physical health, female students, anthropological indicators, morphofunctional capabilities, COVID-19.

Introduction.

Analysis of scientific publications shows that *any minimal but regular physical activity is very useful for health*. Motor activity is one of the main factors that determine the level of physical health of young people. A sufficient level of motor activity of students is the basis for the harmonious development of the body. New requirements in the organization of daily life and study of students, caused by the spread of the COVID-19 pandemic, have led to a variety of restrictions, primarily related to the motor activity of students, opportunities to play sports and lead an active lifestyle. Anti-epidemic measures introduced in the country in connection with the spread of COVID-19 have a negative impact on human health and mental condition, due to the sharp decline in physical activity. The World Health Organization did not make separate recommendations to physical exercise during the pandemic. Consequently, to avoid the possibility of contracting COVID-19, most students during this period led isolated and mostly sedentary lifestyles.

Fitness and physical activity should become a fundamental component of the country's health care system in the face of the COVID-19 pandemic. They help to strengthen and improve the immune system, reduce the risk of viral diseases, stabilize the mental condition of a person. By denying Ukrainians physical activity, we deprive them of the only way to fight the disease on their own, making them vulnerable to the threat.

To study the changes that occurred during the COVID-19 pandemic, we monitored the morphofunctional state of female students and compared it with previous years. Monitoring the physical health of students makes it possible to systematically obtain information about the physical condition of young people, to determine changes in the physical development of a person, his/her functional state and state of health, to carry out a comparative analysis of the individual level of development in accordance with age and gender norms. (Makarova, L.N. & Romashevskaya, N.I. 2017; Kozhokar, N., Kurnyshev, Y. et al. 2018; Macri, A. & Vasile, A. 2018). Monitoring of the physical and functional state of a person is a complex of diagnostic studies that are carried out over a certain period of time (Kemin, O. 2015; Korol, S. A. 2014; Paunescu, M., Grigore, V. et al. 2018). Method of rapid assessment is considered to be one of the most informative and acceptable methods from the point of view of practical application, when the level of health is determined by quantitative indicators that characterize the functioning of the most important human life support systems (Blavt O. Z. 2012; Leuciuc, F. 2019; Mozolev, O., Bloshchynskyi, I., Alieksiieiev, O., Romanyshyna, L., Zdanevych, L., Melnychuk, I., Prontenko, K., & Prontenko, V. 2019). Objective indicators of a person's physical condition include anthropometric indicators: measurements of body weight; height; circumference of chest, neck, shoulder, thigh, and calf; respiratory rate; vital capacity of the lungs; frequency of cardiovascular contractions, and blood pressure. Subjective indicators of a person's physical condition include indicators of health, performance, sleep, appetite, and mood.

The aim is to monitor the physical health of female students aged 17-19, and to determine the impact of COVID-19 quarantine restrictions on the indicators of morphofunctional and physical development of female students.

Tasks:

- to study the indicators of physical development of female students aged 17-19 for the period 2016-2020;
- determine the level of development of morphofunctional capabilities and state of health of female students aged 17-19;
- to make a comparative analysis of the physical and functional development of female students aged 17-19 who were trained in the 1st-2nd year of study in Khmelnytskyi Humanitarian and Pedagogical Academy in the period 2016-2020;
- to investigate the influence of COVID-19 on morphofunctional indicators and the level of physical health of female students aged 17-19.

Materials and methods.

The participants of the experiment: 889 female students aged 17-19, who studied in the 1st-2nd year of Khmelnytskyi Humanitarian and Pedagogical Academy.

Methods. To obtain the necessary information, we used general scientific methods at the theoretical level of research, namely: analysis of scientific and methodological sources; survey; questionnaire; pedagogical observation; anthropometric; functional; morphological methods; comparative analysis and methods of mathematical statistics.

The analysis of scientific and methodological sources was used to study the current state of scholars' views on the problem of organizing physical education classes for young people aged 17-19. The survey and questionnaire were conducted to determine the state of health and establish deviations in the state of physical development and health of students. Pedagogical observation was carried out as a purposeful systematic assessment of changes in the physical and morphofunctional state of female students. In order to determine the indicators of physical development of female students, anthropometric measurements were made that characterized the level of morphological features: body length (BL); body weight (BW); chest girth (ChG). Physiological research methods were used to assess the state of the cardiovascular system: resting heart rate (HR); systolic blood pressure (SBP); diastolic blood pressure (DBP); to assess respiratory system – vital capacity of the lungs (BK).

The assessment of physical health of female students was carried out according to the method of G. L. Apanasenko (2011) and T. Y. Krutsevich (2011). The comparative analysis was made to determine the level of physical health and changes of morphofunctional indicators of female students aged 17-19, that were caused by a sedentary lifestyle during the period of COVID-19 quarantine restrictions. Methods of mathematical statistics were used to reliably determine the indicators of morphofunctional capabilities and state of health of female students aged 17-19 years.

Organization of the research: the Research was carried out on the basis of Khmelnytskyi Humanitarian and Pedagogical Academy in the period 2016-2020. Studied: 2016-2017 academic year – 246 female students; 2017-2018 academic year – 227 female students; 2018-2019 academic year – 214 female students. 2019-2020 academic year – 202 students.

The study included the following stages:

1. survey of female students about their state of health and the possibility of participating in the study;

2. determining indicators of physical development of female students and conducting anthropometric studies, which included measurements of body length (BL); body weight (BW); chest girth (ChG);
3. determination of functional indicators of physical condition of female students: resting heart rate (HR); systolic blood pressure (SBP); diastolic blood pressure (DBP); vital capacity of the lungs (VC);
4. determination of the level of development of morphofunctional features and the state of health of female students aged 17-19, provided for getting results from the following indicators: life index (LI) defines the functional possibilities of the respiratory system; the index of proportionality development (IPD) – defines the development of the chest; the body mass index (BMI) – defines the conformity assessment of human body weight to the human height; index of Robinson (IR), quantifying human energy potential; the index of Rufe-Dixon (IRD) – defines physical heart performance;
5. making comparative analysis of the influence of COVID-19 on morphofunctional indicators and the level of physical health of female students aged 17-19.

Results

According to the established goal of research, we conducted a study of the components of physical health of female students aged 17-19, which included studies of physical development, functional status and working capacity. The influence of motor limits caused by COVID-19 on the physical health indicators of female students was studied.

The study of indicators of physical development of female students and conducting anthropometric studies of body length (BL); body weight (BW); chest girth (ChG) are presented in table 1.

Table 1. Average statistic indices of physical development of 17-19-year-old girls (n = 889).

Indicators under study	Year	n	\bar{x}		S		25 %		75 %		Changes %
			A	B	A	B	A	B	A	B	
BL, cm	2016-2017	246	162.6	162.9	4.52	4.61	158.1	158.4	167.1	167.5	+ 0,18
	2017-2018	227	163.2	163.4	4.81	4.75	158.4	158.6	168.1	168.2	+ 0,12
	2018-2019	214	162.6	163.0	4.46	4.58	158.1	158.4	167.0	167.6	+ 0,24
	2019-2020	202	163.3	163.6	4.87	4.67	158.4	158.9	168.2	168.3	+ 0,18
BW, kg	2016-2017	246	55.2	55.7	5.22	5.48	50.0	50.2	60.4	61.2	+ 0,91
	2017-2018	227	54.9	55.5	5.41	5.62	49.5	49.9	60.3	61.1	+ 1,09
	2018-2019	214	55.4	56.1	5.57	5.37	49.8	50.7	61.0	61.5	+ 1,26
	2019-2020	202	55.9	57.8	5.76	6.14	50.1	51.6	61.6	63.9	+ 3,40
ChG, cm	2016-2017	246	78.8	80.4	6.8	7.2	72.0	73.2	85.6	87.6	+ 2,03
	2017-2018	227	79.7	81.2	7.5	8.0	72.2	73.2	87.2	89.2	+ 1,88
	2018-2019	214	80.2	82.0	7.3	7.8	72.9	74.2	87.5	89.8	+ 2,24
	2019-2020	202	80.8	84.3	7.4	8.6	73.4	75.7	88.2	92.9	+ 4,33

Where: A is an indicator at the beginning of the study;
B is an indicator at the end of the study.

Analysis of statistical indicators of physical development of girls aged 17-19 showed that 84.6 % of students meet the standards of age-related physical development.

Indicators of body weight, height and body composition of girls to a great extent determine the level of their health. The proper level of health is achieved due to the mandatory normalization of all components of body weight, that provides the necessary conditions for the normal flow of metabolic processes for the coordinated work of the functional systems of the body.

There is a general trend towards a gradual increase of body weight and chest volume of girls. Analysis of the body weight Index and anthropometric indicators of girls aged 17-19 showed that there is a general trend that the number of overweight female students increased. In the period between 2016-2019, this indicator gradually increased from 9.4 % to 11.6 % ($p < 0.05$), and in 2020 it was 14.1 % ($p < 0.05$). The number of female students with 1-2 degrees of obesity has also increased, which was 1.2 % - 1.7 % in 2016-2019 to 2.4 % in 2020 ($p > 0.05$).

This phenomenon, in our opinion, is primarily associated with a decrease in the motor activity of female students, which occurred due to the limitations of COVID-19. It should be noted that the index of body mass of girls who studied in 2019-2020 at the beginning of the study was within the statistical error and did not differ significantly from the indicators that girls had in 2016-2019.

We determined the functional state of physical health of female students aged 17-19 by determining the following indicators: resting heart rate (HR); systolic blood pressure (SBP); diastolic blood pressure (DBP); vital lung capacity (VC), which are presented in table 2.

Table 2. Functional indices of physical condition of students of 17-19-year-old (n = 889).

Indicators under study	Year	n	\bar{x}		S		25 %		75 %		Changes %
			A	B	A	B	A	B	A	B	
HR beats/ min-1	2016-2017	246	76.5	76.0	6.5	6.2	70.0	71.8	83.0	82.2	- 0.65
	2017-2018	227	77.4	76.2	7.6	6.7	69.8	69.5	85.1	82.9	- 1.55
	2018-2019	214	76.8	76.3	7.2	6.5	69.6	69.8	84.0	82.8	- 0.65
	2019-2020	202	76.4	77.8	6.2	8.0	70.2	68.4	86.2	85.8	+ 1.83
SBP mmHg	2016-2017	246	117.0	117.5	5.5	6.0	111.5	111.5	122.5	123.5	+ 0.43
	2017-2018	227	118.0	120.0	7.0	7.5	111.0	112.5	125.0	127.5	+ 1.72
	2018-2019	214	116.5	118.0	6.5	7.5	110.0	110.5	123.0	125.5	+ 1.28
	2019-2020	202	117.5	122	6.0	9.5	111.5	112.5	125	131.5	+ 3.82
DBP mmHg	2016-2017	246	72.5	72.0	4.5	5.0	68.0	67.0	77.0	77.0	- 0.69
	2017-2018	227	74.0	73.0	5.0	6.0	69.0	67.0	79.0	79.0	- 1.34
	2018-2019	214	73.5	74.0	5.5	6.0	68.0	68.0	79.0	80.0	+ 0.68
	2019-2020	202	74.0	77.5	6.5	8.5	67.5	69.0	80.5	86.0	+ 4.73
BK ml	2016-2017	246	2880	2900	110	100	2770	2800	2990	3000	+ 0.69
	2017-2018	227	2850	2870	120	120	2730	2750	2970	2990	+ 0.70
	2018-2019	214	2850	2880	100	120	2750	2760	2950	3000	+ 1.05
	2019-2020	202	2820	2730	90	130	2730	2600	2910	2860	- 3.19

According to the results of our study, 82.4% of 1st-and 2nd-year students did not have deviations in age-related heart rate indicators, 9.1% had top higher SBP, and 6.3% of girls' DBP index was below the norm. In General, HR and DBP indicators for girls aged 17-19 fluctuated within the normal range and did not change significantly during 2016-2019, which indicates that the functional capabilities of female students were supported at a sufficient level. There is a trend towards an increase in HR + 1.83% and SBP + 3.82% with a simultaneous decrease in BC – 3.19%, which together indicates a decrease in functional capabilities and a deterioration in physical health of female students aged 17-19. This fact indicates that the means of physical training offered by teachers in the conditions of COVID-19 did not give the necessary result. Particular attention is drawn to the decrease in the BK index – 3.19%, which indicates an insufficient level of aerobic activity, which is caused by urbanization and living conditions that developed during the COVID-19 pandemic. A survey of female students in June 2020 confirmed that the vast majority during the quarantine period led a sedentary lifestyle, preferred to use modern means of communication (telephone, Internet, television) and as a result, there was a lack of aerobic exercise and favorable conditions for the development of hypodynamia were created.

The analysis of average statistical data describing the level of development of morphofunctional capabilities and the state of health of students aged 17-19 is shown in table 3.

Table 3. Morphofunctional indices health condition of 17-19-year-old female students (n = 889).

Indicators under study	Year	n	\bar{x}		S		25 %		75 %		Changes %
			A	B	A	B	A	B	A	B	
LI (ml/kg)	2016-2017	246	52.17	52.06	3.62	3.78	48.55	48.28	55.79	55.84	- 0.21
	2017-2018	227	51.91	51.71	3.34	3.52	48.57	48.19	55.25	55.23	- 0.39
	2018-2019	214	51.44	51.33	3.57	3.40	47.87	47.93	55.01	54.73	- 0.22
	2019-2020	202	50.45	47.23	3.68	3.96	46.77	43.27	54.13	51.19	- 6.58
IPD (cm)	2016-2017	246	- 2.5	- 1.1	0.8	1.0	- 3.6	- 2.0	- 1.7	- 0.1	-
	2017-2018	227	- 2.9	- 0.5	1.3	0.9	- 4.2	- 1.8	- 1.6	+ 0.8	-
	2018-2019	214	- 2.1	+ 0.5	1.2	1.3	- 3.3	- 0.8	- 0.9	+ 1.8	-
	2019-2020	202	- 0.8	+ 2.5	1.4	1.8	- 2.2	+ 0.7	+ 0.6	+ 4.3	-
BMI (kg/m ²)	2016-2017	246	20.91	21.01	1.75	1.84	19.16	19.17	22.66	22.85	+0.48
	2017-2018	227	20.64	20.79	1.82	1.92	18.82	18.87	22.46	22.71	+0.73
	2018-2019	214	20.98	21.17	1.88	1.95	19.10	19.22	22.86	23.12	+0.91
	2019-2020	202	21.02	21.57	1.90	2.12	19.12	19.45	22.92	23.69	+2.61
IR (unit)	2016-2017	246	89.51	88.92	5.74	5.57	83.77	83.35	95.25	94.49	+0.66
	2017-2018	227	91.33	91.44	6.18	6.02	85.15	85.42	97.51	97.46	- 0.12
	2018-2019	214	89.47	90.03	5.48	5.65	83.99	84.38	94.95	95.68	- 0.63
	2019-2020	202	89.77	94.67	5.52	6.18	84.25	88.49	95.29	100.85	- 5.46
IRD (unit)	2016-2017	246	9.52	9.34	1.42	1.32	8.10	8.02	10.94	10.66	+1.89
	2017-2018	227	9.78	9.75	1.61	1.53	8.17	8.22	11.39	11.28	+0.31
	2018-2019	214	9.64	9.68	1.63	1.56	8.01	8.12	11.27	11.24	- 0.41
	2019-2020	202	9.75	10.47	1.48	1.81	8.27	8.66	11.23	12.28	- 7.38

The results of our study found that the average statistical data of morphofunctional indicators of state of health of female students aged 17-19 in the period of 2016-2019 academic years were within the age norms of physical development. There is a negative dynamics of LI and IR indicators, which indicates that the level of development of the respiratory system and energy potential of girls are at a level below average development and tend to deteriorate during training.

The analysis of morphofunctional indicators of the health status of female students in June 2020 showed significant differences compared to the values of 2016-2019. The decrease in LI indicators by -6.58 % ($p < 0.05$), IR by -5.46 % ($p < 0.05$), IRD-7.38 % ($p < 0.05$), indicates the appearance of excess weight, deterioration of the respiratory system, and as a result, a decrease in the performance of the heart system and students' energy potential. It should be noted that these indicators based on the results of the midterm control in February 2020 were within the norm and did not differ significantly from the indicators of female students in 2016-2019. This fact, in our opinion, is directly related to the restrictions that were introduced during the COVID-19 pandemic, which did not allow to conduct traditional physical education classes and to carry out active physical recreation of students. Restrictions on movement, training, collective sports and communication during physical exercises have led to a deterioration in the physical condition of students.

The dynamics of changes in morphofunctional indicators of female students aged 17-19 during the COVID-19 pandemic is shown in Fig. 1.

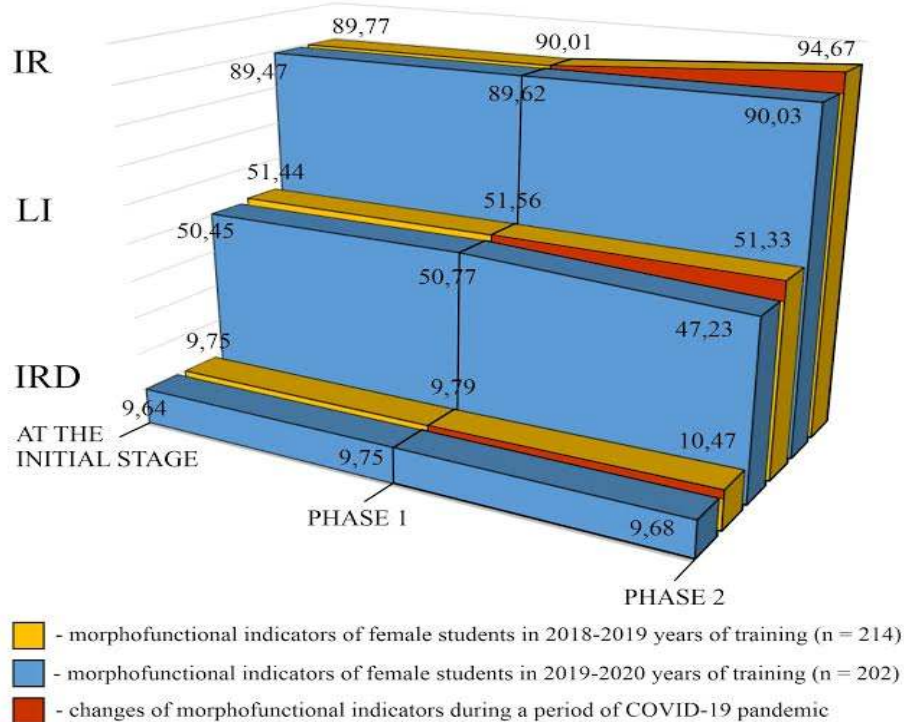


Figure 1: Dynamics of changes in morphofunctional indicators of female students aged 17-19 during the COVID-19 pandemic

Discussion.

Health is the highest value for every person and determines his/her comprehensive and harmonious development. The problem of preserving the health of young people is relevant to society, since it is an indicator of the state's civility. Today, health is not considered as a purely medical problem, it covers a significant wide range of issues, which are based on anthropometric, physiometric and morphofunctional indicators.

Professor H. L. Apanasenko (1985, 2011) has developed and justified the method of quantitative rapid assessment of the level of human somatic health. It is based on anthropometric indicators (height, body weight), physiometric (vital volume of the lungs, heart rate, hand strength, systolic pressure level). He believes that a person's somatic health can be assessed by the total amount of the body's energy potential. Researchers Turchyna, N. I. 2010; Fomenko, Ye. V. 2014; Wengerova, N. N. 2009 consider the features of physical development using anthropometry and determine the main methods for assessing the level of somatic health of students: anthropometric standards, correlations and indices.

Research on the problem of monitoring the physical health of students in order to further correlate training programs scientists consider in the plane:

- research of indicators of the state of physical health of students at various stages of training, analysis of external and internal factors that influence the dynamics of their development (Vasyenko, N. I. 2014; Sazanov, A. V., Sazanova, M. L., Demyna, N. L., & Popova, H. A. 2015; Usachov Yu. 2007);
- conducting a comparative analysis and making timely adjustments to youth physical development programs (Bergier, J., Niznikowska, E., Bergier, B. et al. 2017; Mozolev, O., Khmara, M., Shorobura, I. et al. 2019);
- introduction of the most effective and popular modern types of sports among young people, taking into account various restrictions (Kashuba, V., Rosa, M., Rudnytskyi, O., et al. 2017; Zhamardiy, V., Shkola, O., Okhrimenko, I., et al. 2020);
- motivation of young people to preserve their health and the vital need for regular sports (Khlebodarova, I., Koryak, E. 2014; Pavlenko, I. O. 2010; Mozolev, O., Khmara, M. et al. 2019);
- timely changes in the training of specialists in the field of physical culture and sports, taking into account current trends in the development of physical education (Mozolev, O., Halus, O., Bloschchynskiy, I., & Kovalchuk, R. 2019);

The analysis of the obtained results of our research confirms the research of Blavt, O. Z. 2012; Korol, S. A. 2014; Khlebodarova, I., Koryak, Ye. 2014 on the priority value of physical health in the system of motives for physical education classes. Based on the results of our research, the data were expanded by Vasyenko N. I. 2014; Krutsevych, T. Yu., Vorobiov, M. I., Bezverkhnia, M. M. 2011; Apanasenko, H. L. 2011; Fomenko, Ye. V. 2014 on the methodology for monitoring the physical condition of female students.

The research confirmed and expanded the scientific views of Blagiy, O. L., Yachnyuk, M. Yu. 2015; Gorelov, A. A., Rumba, O. H. 2013; Makarova, L. N., Romashevska, N. I. 2017; on the need for systematic assessment of the level of physical health and functional state of students at each stage of training, which will allow making timely changes and adjustments to the curriculum.

By monitoring the state of physical health of students aged 17-19, we have obtained new results of indicators of physical development, functional state and morphofunctional capabilities of body systems. The analysis in comparison with the indicators of 2016-2019 allowed us to investigate the changes that occurred in the body of girls under the conditions of quarantine restrictions of motor activity, which were caused by COVID-19 and affected their level of physical health.

Conclusions.

The results of monitoring the physical health of students aged 17-19 showed that the restriction of physical activity caused by COVID-19 led to a decrease in their functional state, which was reflected in an increase in the heart rate at rest by 1.83 %, an increase in systolic blood pressure by 3.82 %, and a deterioration in the respiratory system by 3.19 %, which together indicates a decrease in the functional capabilities of the body of students.

Morphofunctional indicators of physical health of female students in June 2020 significantly differed from the average indicators of students in 2016-2019. The limitations of COVID-19 led to a decrease in the vital index by 6.58 % ($p < 0.05$), a deterioration of the cardiovascular system indicators for physical activity by 5.46 % ($p < 0.05$), a decrease in the functional capabilities of the body by 7.38 % ($p < 0.05$). These results were obtained due to the appearance of excess weight, deterioration of the respiratory system, and as a result, a decrease in the performance of the heart system and female students energy potential.

Physical education teachers and coaches were not prepared to conduct classes in the conditions of COVID-19 and were not able to provide alternative, interesting for students forms and ways of organizing individual training that would allow maintaining morphofunctional indicators of physical health at the required level. The unpredictability of COVID-19 causes the need to develop new forms of organizing physical education classes.

The new realities of modern life require changes in approaches to the organization of physical culture and sports work, and, accordingly, improvement of the system of special training of physical culture specialists, who could conduct classes not only under the conditions of COVID-19 quarantine restrictions, but also other possible challenges of our time.

Conflicts of interest: No conflicts of interest exist.

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