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Assessment of Female Students Physical Fitness in the Context of the Educational Process at Higher Education Institution in the Pre-Pandemic and Pandemic Periods

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Abstract. A comparative study was conducted with an assessment of the effectiveness of the organization of physical training of female students of Siberian Federal University in the pre-pandemic and pandemic periods. The results of the control testing of the following academic years 2016–2017, 2017–2018, 2018–2019 and 2020–2021 were taken for the comparative analysis. Control exercises feature in the disciplines work programs: standing long jump, the 100 meters, shuttle run 3x10 meters, push-ups, lifting the torso from a supine position, standing forward bend, the 2000 meters. The results were processed using the Python programming language. The calculation work establishes no significant differences in the control exercise ‘standing long jump’, as in the pre-pandemic period, the values range from 160 to 165 cm, and in the pandemic period from 161 to 170 cm; in ‘the 100 meters’ no significant differences were revealed as well, the results here are equal to 17.5–18.1 and 17.2–18.1 sec respectively; in ‘push-ups’ no significant differences were found, the effectiveness made 13–14 and 14–15 times respectively; in ‘shuttle run 3x10 meters’ no significant differences were found, the effectiveness makes 8.4–8.5 and 8.5–8.9 sec respectively; in ‘lifting the torso from a supine position’ no significant differences were found, the effectiveness varies from 36 to 38 times; in ‘standing forward bend’ median values are 11 cm, also with no significant differences. Therefore, assessing the level of physical fitness of students in the pre-pandemic and pandemic period, no differences were found in the manifestation of speed, strength, dexterity and flexibility. But meanwhile, in the control exercise ‘the 2000 meters’ the following significant differences were revealed: for female students of the 2nd year of studies there was a decrease in the development of general endurance by 7.6 % and by 7.8 % for the third-year students. For the development of endurance, it is necessary to perform sets of physical exercises of moderate intensity for a long time, and the female students found themselves in the limited space and monotonous motor activity under conditions of self-isolation and social distancing.

Keywords: physical education, physical fitness, physical culture, educational process, Applied Physical Culture, conditions for organizing the educational process in pandemic period, organizing Physical Culture lessons in pandemic period.

Research area: physical education.

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Оценка результативности физической подготовки студенток в условиях реализации образовательного процесса в вузе в допандемийный и пандемийный периоды

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Аннотация. Проведено сравнительное исследование с оценкой эффективности организации физической подготовки студенток Сибирского федерального университета в допандемийный и пандемийный периоды. Для сравнительного анализа использовались результаты контрольного тестирования следующих учебных годов – 2016–2017, 2017–2018, 2018–2019 и 2020–2021. Контрольные упражнения отражены в рабочих программах по дисциплинам: прыжок в длину с места, бег 100 м, челночный бег 3x10 м, сгибание-разгибание рук в упоре лежа, поднятие туловища из положения лежа на спине, наклоны туловища вперед из положения стоя, бег 2000 м. Результаты обрабатывались с использованием языка программирования Python. В ходе расчетной работы установлено, что в контрольном упражнении «прыжок в длину с места» значимых различий не выявлено. Так, в допандемийный период значения колеблются в пределах от 160 до 165 см, а в пандемийный период от 161 до 170 см; «бег 100 м» – существенных различий также не выявлено, результаты равны 17,5–18,1 и 17,2–18,1 сек. соответственно; «сгибание-разгибание рук в упоре лежа» – значимых различий не выявлено, результативность составляет 13–14 и 14–15 раз соответственно; «челночный бег 3x10 м» – существенных различий не выявлено, результативность равна 8,4–8,5 и 8,5–8,9 сек. соответственно; «поднятие туловища из положения лежа на спине» – значимых различий не выявлено, результативность составляет от 36 до 38 раз; «наклоны туловища вперед из положения стоя» – медианные показатели составляют 11 см, также без достоверных величин различий. Следовательно, оценивая уровень физической подготовленности студенток в допандемийный и пандемийный периоды, не выявлено различий в проявлении быстроты, силы, ловкости и гибкости. Между тем в контрольном упражнении «бег 2000 м» выявлены значимые различия: для студенток 2 курса отмечается снижение показателей развития общей выносливости в 7,6 %; 3 курс – в 7,8 %. Для развития выносливости необходимо выполнять комплексы физических упражнений умеренной интенсивности длительное время, а в условиях

самоизоляции и социального дистанцирования студентки находились в ограниченном пространстве и однообразности двигательных действий.

Ключевые слова: физическое воспитание, физическая подготовка, физическая культура, образовательный процесс, прикладная физическая культура, условия организации образовательного процесса в период пандемии, организация уроков физической культуры в период пандемии.

Научная специальность: 5.8.4 – физическая культура и профессиональная физическая подготовка.

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Introduction to the research problem

Physical culture as part of the general culture of our society is aimed at maintaining and improving health, developing the psychophysical abilities of a person in the process of conscious physical activity. Its purpose is to create conditions for maintaining a sufficient level of physical fitness enabling you to maintain high physical and mental performance. The education system is designed in such a way that it provides regular and systematic physical exercises and forms a conscious and active attitude towards these activities in the oncoming generation.

Physical Culture holds a special place in the Federal State Educational Standard for almost all generations and is presented in a mandatory block designed to ensure the harmonization of the spiritual and physical forces of the younger generation.

Physical education in the bachelors curricula is regulated by the number of hours, is determined by the requirements for the content, as well as by the types of educational activities and forms of quality control of the assimilation of educational material. Physical education in bachelor programs (the latest-generation) must ensure the implementation of disciplines (modules) in Physical Culture and Sports: in the amount of at least 2 credits (72 hours) within the Discipline (module); in the amount of at least 328 academic hours, mandatory for mastering, not recalculated into credit units and not included in the scope of the undergraduate program within the framework of elective disciplines

(modules) in full-time education. Most often, the first discipline is called Physical Culture and Sports, the elective part as the discipline Applied Physical Culture and Sports.

The new educational standard, according to many authors, has an important task of the labor market pragmatic order (Grigor'ev et al., 2011). More specifically, the requirements for the content of disciplines are discussed within the framework of educational competencies. For the disciplines of Physical Culture and Sports, educational competence № 7 (EC-7) is defined as the ability to maintain the proper level of physical fitness to ensure full-fledged social and professional activities. However, the formation of students' knowledge, skills and abilities in the field of physical culture is carried out taking into account individual abilities and health status (Filimonova et al., 2020). And also, an important component is the medical and pedagogical control over the organization of physical education and monitoring of the physical development and physical fitness of students. The main types of educational activities in Physical Culture include academic studies in the form of lectures and practical classes. The quality control of the assimilation of educational material is carried out in the form of fulfillment of control standards, the following control exercises are provided in the working program of disciplines: standing long jump, the 100 meters, shuttle run 3x10 m, push-ups, lifting the torso from a supine position, standing forward bend, the 2000 meters.

Theoretical framework

The system of organization and teaching of physical culture at Siberian Federal University (hereinafter referred to as SibFU) has a scientific theoretical and methodological substantiation in the following works: the theory of physical education of students at the higher educational institution (Soboleva et al., 2021); a differentiated approach, including a sports-discipline approach, in the physical education of students at a higher educational institution (Gomboev et al., 2019; Doroshenko, 2011); bases of integration of information and communication technologies into the Physical Culture and Sports educational process (Dergach et al., 2019; Soboleva et al., 2021); formation of professionally applied physical training (Patarkashvili et al., 2021).

Recently, a separate subject of research by our colleagues has become the problem of the impact of restrictions, coming from the COVID-19 pandemic, on the quality of the educational process in higher educational institutions, and especially on the implementation of the physical education process (Zhigaryova et al., 2021; Osipov et al., 2021; Prohorov, 2022; Cherkasov, Semenova, 2022).

Statement of the problem

In the main provisions on the organization of physical education of students in SibFU), the emphasis is on the practical importance of disciplines aimed at solving the problems of increasing the physical fitness of students. This point of view is shared by other authors (Ulanov, Barabash, 2014).

In the new educational paradigm, the educational process in Physical Culture and Sports is under the threat of the COVID-19 pandemic caused by the SARS-CoV-2 virus. Coronavirus has changed the daily foundations of public life, humanity for the first time faced the global isolation. The educational process switched to a distance format, which implied a special form of learning, suggesting that the process of acquiring competencies occurs without direct contact with teachers (Tat'yanenko, 2021). The law on Education in the Russian Federation states that 'Organizations carrying out educational activities shall have the right to use

e-learning, distance learning technologies in the implementation of educational programs in accordance with the procedure established by the federal executive body responsible for developing and implementing state policy and normative legal regulation in higher education, in coordination with the federal executive body responsible for developing and implementing state policy and normative legal regulation in the field of general education (Federal'nyj zakon ob obrazovanii, 2012). Remote learning creates a 'distance' between the learner and the teacher, which can be bridged through specialized communication and training means, etc. To designate the form of mediated interaction, new terms 'remote learning format' and 'online learning' appeared in the vocabulary of participants of the educational process. Distance learning involves the use of various technologies, including online learning (Andreev, 2013). Online learning involves the acquisition of knowledge, skills and abilities using an Internet connection on various educational platforms.

Remote studying the discipline is based on electronic courses-educational complexes containing information on the discipline in various forms (video lectures, online lectures, webinars, electronic textbooks, multimedia presentations, virtual laboratory work, etc.) (Tat'yanenko, 2021).

The crisis caused by the pandemic required a fundamentally different way of organizing the process of physical training of students in higher education, taking into account the requirements for self-isolation, observing the norms of social distancing. The natural need for physical activity, which became difficult to fulfil due to voluntary or community quarantine measures, was carried out in restricted spaces. We know that sufficient physical activity is the key to a high quality of life, optimal performance and longevity. The sharp decrease in physical activity over the past decades led to the development of physical inactivity on a global scale, and the pandemic only exacerbated the situation. Students were a particular risk group, because, as the study points out (Soboleva et al., 2022), with the general transfer of the educational process to distance format, the

total study load increased and the amount of time spent in a static position at the computer increased. During this period of time, the only form of organizing Physical Culture and Sports was self-study at home following the task of the teacher or through remote contact and video communication.

Within the period from March 2020 to May 2021, students of the Siberian Federal University switched to distance learning in all disciplines of the curriculum, including the Physical Culture and Sports and Applied Physical Culture disciplines. Such forced measures gave us the opportunity to test the hypothesis of the study on the effectiveness of the organization of physical training of students using various electronic-digital teaching aids without direct support of educational activities and control of the success of mastering knowledge, skills and abilities by the teacher.

The purpose of the study, conducted on the basis of the Siberian Federal University, is to compare the effectiveness of the physical training of female students of 1–3 years of studying in the implementation of the educational process in the pre-pandemic and pandemic periods.

During the experiment, a variety of electronic information tools were used to support the educational activities of students in a remote format: for example, on the corporate platform of the university, the following electronic educational courses (hereinafter referred to as EEC) Physical Culture and Sports, Applied Physical Culture were created and used in the educational process. The EEC are filled with educational content and logically structured using information, control and methodological materials for the effective development of both theoretical and practical sections of the disciplines. To implement the principle of visibility in the electronic educational course, educational material is presented in the format of videos with complexes of physical exercises that correspond to the goals and objectives of the disciplines, as well as the subject of distance learning; instructions for the implementation of practical tasks and recommendations for the use of educational literature and other information sources, as well as control tools in

various versions-tests, questions, assignments, etc.

During the remote learning format, the possibility of both synchronous and asynchronous interaction of participants in the educational process is provided. That is, conditions were created for the timely exchange of information, preserving the possibility of effectively solving emerging issues on assignments during independent work.

Methods

The study involved 1199 female students of the first (n=454), second (n=429) and third (n=316) years of study in the Siberian Federal University of the main group. For comparative analysis, the results of the control testing of the following academic years were used: 2016–2017, 2017–2018, 2018–2019 and 2020–2021. As control exercises, motor tests featuring in working program of the discipline, were developed: standing long jump, the 100 meters, shuttle run 3x10 m, push-ups, lifting the torso from a supine position, standing forward bend, the 2000 meters.

The results of the control exercises were calculated using the Python programming language and the following libraries: Pandas, NumPy, Matplotlib, Seaborn, SciPy, Researchpy, Statsmodels (McKinney, 2010). The received device also made it possible to visualize the generalized data in the form of a boxplot. The data follows the law of normal distribution. The reliability of processing the results is high, since the law of a large number is observed in the graphical interpretation of the data (Hunter, 2007; Waskom, 2021). To describe the results of the study, we will refer to the median value for a group of students, since the median is more resistant to data fluctuations and possible outliers in the series of quantitative indicators.

Discussion

Taking into account the main goal of the study, when comparing the results of physical fitness of female students of 1–3 years of study, special attention was paid to the level of the pre-pandemic (from 2016 to 2019) and pandemic period (from 2020 to 2021). Students of Siberian Federal University pass the

control standards annually in May-June of the current academic year. Comparison in terms of the development of physical qualities in the 2019–2020 academic year is not possible due to the lack of contact forms of interaction between the teacher and groups of students during this period. In the fall of 2020, students followed the usual mode of study with partial use of distance learning during certain periods of isolation of a group of students or temporary measures to change the format of education at the peak of the increase in the number of cases.

In the standing long jump control exercise, as can be seen from the results of the graphical interpretation (Fig. 1), no significant differences were revealed. So the median for the 1st

year of the pre-pandemic period ranges from 160 cm (2017–2018 academic year) to 165 cm (2016–2017 and 2017–2018 academic year) and in the pandemic period is 165 cm (2020–2021 academic year); for the 2nd year-from 164 cm (2018–2019 academic year) to 170 cm (2017–2018 academic year) and 165 cm (2020–2021 academic year); for the 3rd year-from 161 cm (2018–2019 academic year) to 165 cm (2017–2018 academic year) and 170 cm (2020–2021 academic year).

In the 100 meters control exercise, as can be seen from the results of the graphical interpretation (Fig. 2), no significant differences were revealed. So the median for the 1st year of the pre-pandemic period ranges from 18.1

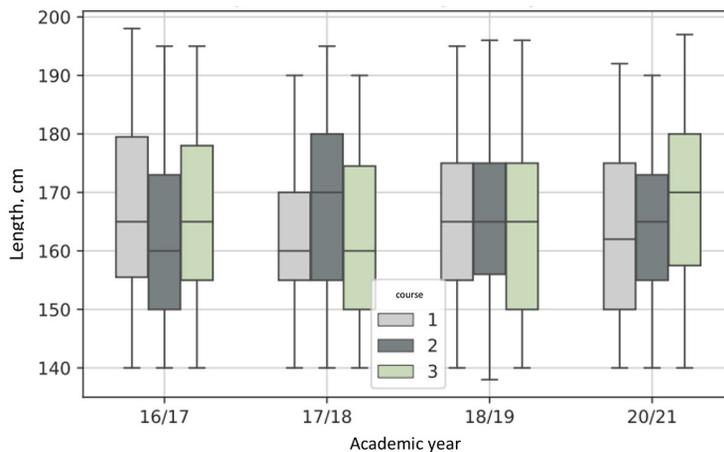


Fig. 1. Results of female students in the standing long jump control exercise

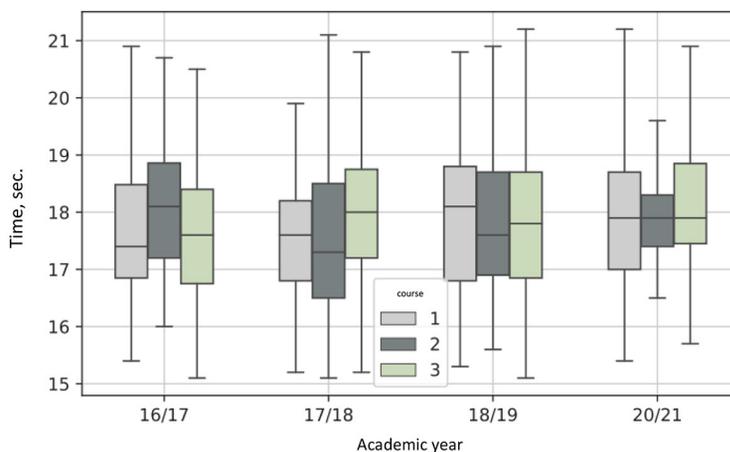


Fig. 2. Results of female students in the 100 meters (s) control exercise

seconds (2018–2019 academic year) to 17.5 seconds (2016–2017 academic year) and in the pandemic period is 17.9 seconds (2020–2021 academic year); for the 2nd year—from 18.1 seconds (2016–2017 academic year) to 17.2 seconds (2017–2018 academic year) and 17.95 cm (2020–2021 academic year); for the 3rd year – from 18 seconds (2017–2018 academic year) to 17.6 seconds (2016–2017 academic year) and 17.9 seconds (2020–2021 academic year).

In the shuttle run 3x10 m control exercise, as can be seen from the results of the graphical interpretation (Fig. 4), no significant differences were revealed. So the median indicators for the 1st year of the pre-pandemic period ranges from 8.5 (2016–2017 and 2017–2018 academ-

ic year) to 8.4 seconds (2018–2019 academic year) and in the pandemic period is 8.5 seconds (2020–2021 academic year); for the 2nd year—from 8.6 (2018–2019 academic year) to 8.5 seconds (2016–2017 and 2017–2018 academic year) and 8.9 seconds in the pandemic period; for the 3rd year – from 8.6 seconds (2017–2018 and 2018–2019 academic year) to 8.5 seconds (2016–2017 academic year) and 8.8 seconds (2020–2021 academic year).

In the control exercise lifting the torso from a supine position, as can be seen from the results of the graphical interpretation (Fig. 5), no significant differences were found. So, the median indicators for the 1st year of the pre-pandemic period ranges from 36 (2016–2017

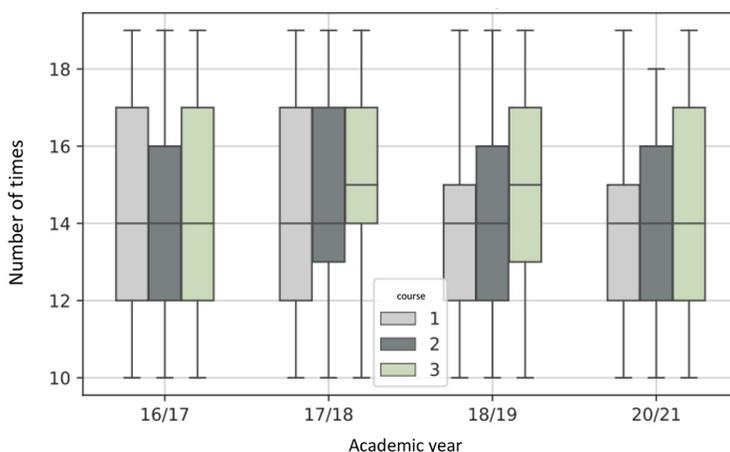


Fig. 3. Results of female students in the push-ups (no. of times) control exercise

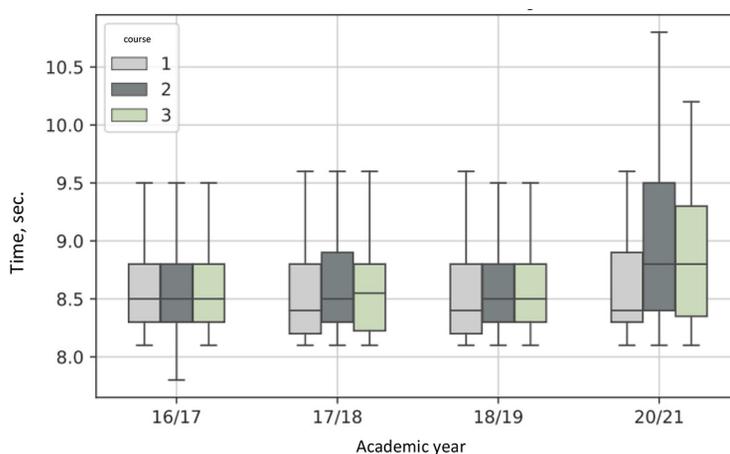


Fig. 4. Results of female students in the shuttle run 3x10 m (sec) control exercise

academic year) to 38 times (2018–2019 academic year) and in the pandemic period is 37 times (2020–2021 academic year); for the 2nd year—from 36 (2016–2017 and 2018–2019 academic year) to 38 times (2017–2018 academic year) and 36 times in the pandemic period; for the 3rd course – 36 times for both periods.

In the 2000 meters control exercise, as can be seen from the graphical representation of the processed data (Fig. 6), significant differences were revealed. However, the median indicators for the 1st year in both the pre-pandemic and pandemic periods are in the range of values from 734 to 710 seconds for all academic years and do not differ significantly. But the 2nd and 3rd year students have significant differences.

Thus, the 2nd year has the best indicators in the 2018–2019 academic year and is 708.5 seconds, in the pandemic period – 762.5 seconds; for the 3rd year – 710 seconds (2018–2019 academic year) in the pre-pandemic and 766 seconds in the pandemic period of study.

The difference in the level of female students' endurance development becomes the most obvious in the graphical data presented in Fig. 8. The interquartile interval increased significantly and the proportion of female students significantly increased, the control indicators here made the Q2 quartile, that is, the results of the control exercise performance are worse than the median indicator in the group as a whole.

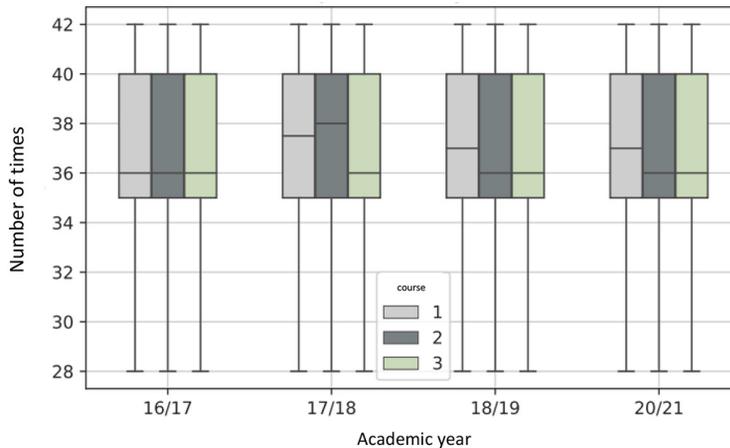


Fig. 5. Results of female students in the lifting the torso from a supine position control exercise

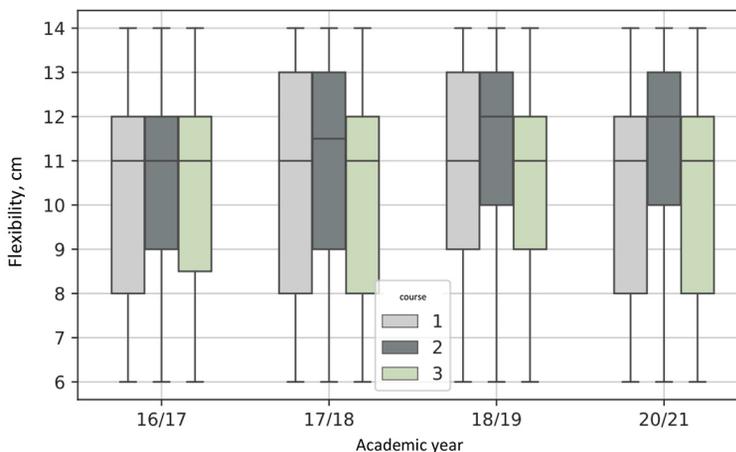


Fig. 6. Results of female students in the standing forward bend (cm) control exercise

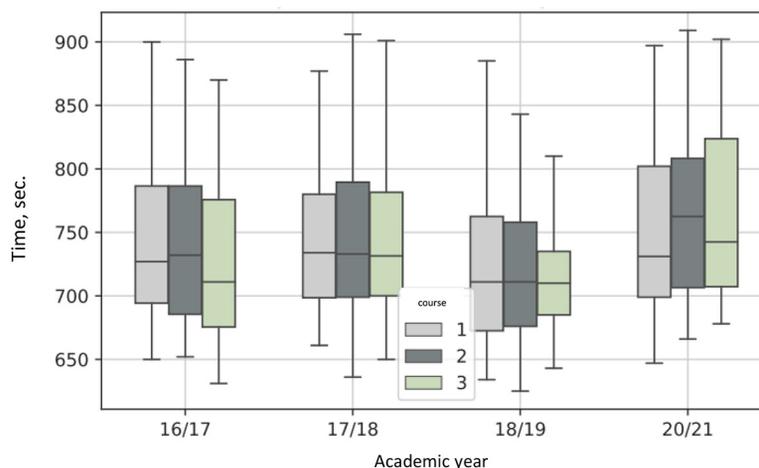


Fig. 7. Results of female students in the 2000 meters (sec) control exercise

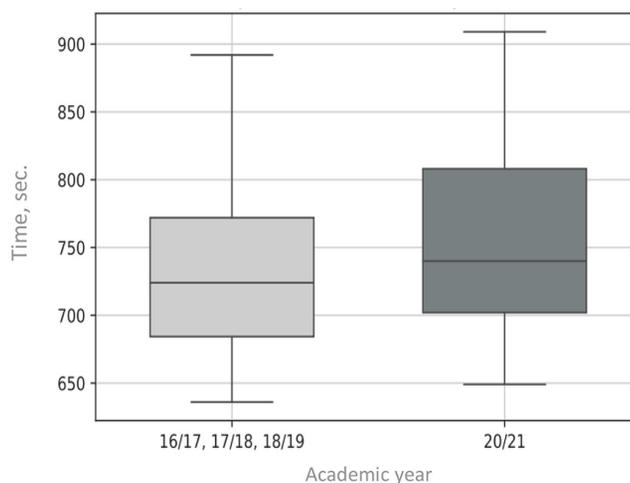


Fig. 8. Comparison of the results of female students in the pre-pandemic (16/17, 17/18, 18/19) and pandemic (20/21) period in the 2000 meters control exercise

Conclusion

Restrictive conditions in the implementation of the educational process on Physical Culture, which were introduced in connection with the spread of the SARS-CoV-2 virus, also affected the organization of educational activities of students in the disciplines of Physical Culture and Sports and Applied Physical Culture and Sports. The switching to the remote learning format requested the development of electronic training courses with relevant tasks in order to organize physical education classes and prevent a decrease in motor activity

even in conditions of self-isolation. Siberian Federal University has accumulated sufficient experience in using information resources in teaching students, therefore, during the pandemic, the teaching staff managed to organize the educational process for physical training of students, and assessing the level of physical fitness of students in the pre-pandemic and pandemic period revealed no differences in the development of such physical qualities as speed, strength, agility and flexibility. In the standing long jump control exercise in the pre-pandemic period the values of the exercise

range from 160 to 165 cm and appeared to be from 161 to 170 cm in the pandemic period, no significant differences were found. There were also no significant differences in the 100 meters control exercise while the median of the pre-pandemic period varies from 18.1 seconds to 17.5 seconds and remains from 18 seconds to 17.2 seconds in the pandemic period. In the push-up control exercise in the pre-pandemic period, the effectiveness of performance ranges from 13 to 14 times and corresponds to the limit of 14 to 15 times in the pandemic period, without significant differences in fitness indicators. There were no significant differences found in the shuttle run 3x10 m control exercise, so the median indicators of the pre-pandemic period ranged from 8.5 to 8.4 seconds and shown themselves to be 8.9–8.5 seconds in the pandemic period. In the lifting the torso from a supine position control exercise the effectiveness of the preparedness of female students of the pre-pandemic and pandemic period ranges from 36 to 38 times, the median indicators have no significant differences. In the standing forward bend control exercise the median indicators of the pre-pandemic

and pandemic periods are 11 cm, also without significant differences. Significant differences were revealed in the 2000 meters control exercise as for 2nd year students there is a decrease in the indicators of general endurance development by 7.6 %, the 3rd year indexes decreased by 7.8 %. No significant differences were found for 1st-year students in both the pre-pandemic and pandemic periods, which is most likely due to the transition of students from the previous stage of education (secondary educational school). However, when comparing the results in the 2000 meters control exercise, it becomes obvious that the indicators of the development of the overall endurance of female students in the pandemic period deteriorates. This allows us to make a statement about the difficulties of creating pedagogical conditions for the development of this quality during pandemic restrictions. To develop endurance, it is necessary to perform moderate-intensity physical exercises for a long time, and in conditions of self-isolation and social distancing, female students found themselves in the limited space and monotony of motor activities.

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