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Research Article

Rehabilitation of patients after a new coronavirus infection COVID-19 at the second and third stage

Denis V. Kovlen[1], Gul'nara R. Abuseva[1, 2], Stella S. Khozyainova[1, 2], Elena F. Kondrina[1, 2], Liudmila A. Podberezkina[1], Vladimir N. Ischuk[1], Tamara N. Karpova[1], Ivan V. Konoplyankin[1], Alexey S. Kovalev[1], Sergei V. Tolmachev[1]

[1] Military Medical Academy, Saint Petersburg, Russia;
[2] I.I. Mechnikov North-West State Medical University, Saint Petersburg, Russia

BACKGROUND: Patients who have undergone a COVID-19 infection are in need of comprehensive rehabilitation, taking the polysyndromic manifestations of the post- COVID syndrome and comorbidities into account.

AIM: The purpose of this article is the need to evaluate the effectiveness of medical rehabilitation programs for patients who underwent a COVID-19 infection at the second and third stages of medical rehabilitation from the standpoint of evidence-based medicine.

MATERIALS AND METHODS: 330 medical rehabilitation programs for patients who had a COVID-19 infection were examined. All patients underwent functional tests: control of blood oxygen saturation (SpO_2), spirometry, Stange, and Gench tests, testing on the Borg exercise tolerance scale and the MRC dyspnea scale; the EQ-5D quality of life questionnaire was completed. Patients were divided into 2 representative groups (160 and 170 people). The average duration of treatment was 14 days. The methods of physical and rehabilitation medicine: therapeutic exercises, breathing exercises, and inhalation therapy were applied to the patients in the observation group. Patients in the observation group underwent rehabilitation treatment programs depending on comorbidities and severity of symptoms in organs and systems. The survey was conducted at 2 control points: 1 day (first), and 14 day (second).

RESULTS: The observation group showed significantly better recovery results ($p < 0.05$). The average values of the Stange and Gench samples showed a positive trend. There was an improvement in the subjective assessment of the tolerability of the 6-minute walk test on the Borg scale, a decrease in the severity of dyspnea on the MRC dyspnea scale, and an improvement in the quality of life on the EQ-5D scale.

CONCLUSION: The structure of the rehabilitation programs used in the clinic of medical rehabilitation and recovery treatment was analysed, showing positive results that have indicated the effectiveness of the methods of physical and rehabilitation medicine in patients with various manifestations of post-COVID syndrome.

Keywords: COVID-19; efficiency; medical rehabilitation; pathology; physical and rehabilitation medicine; post-COVID syndrome; rehabilitation treatment.

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Научная статья

Реабилитация пациентов, перенесших новую коронавирусную инфекцию COVID-19, на втором и третьем этапах

Д.В. Ковлен[1], Г.Р. Абусева[1, 2], С.С. Хозяинова[1, 2], Е.Ф. Кондрина[1, 2], Л.А. Подберезкина[1], В.Н. Ищук[1], Т.Н. Карпова[1], И.В. Коноплянкин[1], А.С. Ковалев[1], С.В. Толмачев[1]

[1] Военно-медицинская академия, Санкт-Петербург, Россия;
[2] Северо-Западный государственный медицинский университет имени И.И. Мечникова, Санкт-Петербург, Россия

Актуальность. Пациенты, перенесшие новую коронавирусную инфекцию, нуждаются в комплексной реабилитации, учитывая полисиндромальные проявления постковидного синдрома и сопутствующую патологию.

Цель исследования — оценить эффективность программ медицинской реабилитации пациентов, перенесших новую коронавирусную инфекцию COVID-19, на втором и третьем этапах этой реабилитации с позиции доказательной медицины.

Материалы и методы. Было обследовано 330 человек по программе медицинской реабилитации пациентов, перенесших новую коронавирусную инфекцию. Всем им проводились функциональные пробы: контроль насыщения крови кислородом (SpO_2), спирометрия, пробы Штанге и Генча, тестирование по шкале переносимости физических нагрузок Борга и шкале одышки MRC, а также заполнялся опросник качества жизни EQ-5D. Пациенты были разделены на 2 репрезентативные группы (160 и 170 человек). Средняя продолжительность курса лечения составила 14 дней. В процессе реабилитации пациентов группы сравнения использовались методы физической и реабилитационной медицины: лечебная гимнастика, дыхательные упражнения, ингаляционная терапия, а пациентов группы наблюдения — программы восстановительного лечения в зависимости от сопутствующей патологии и выраженности симптомов со стороны органов и систем. Обследование проводилось по 2 контрольным точкам: 1 день (первая), 14 день (вторая).

Результаты. Группа наблюдения показала достоверно лучшие результаты восстановления ($p < 0,05$). Средние значения проб Штанге и Генча свидетельствовали о положительной динамике. Было отмечено улучшение качества жизни по шкале EQ-5D и субъективной оценки переносимости теста с 6-минутной ходьбой по шкале Борга, а также уменьшение выраженности одышки по шкале одышки MRC.

Заключение. Анализ структуры реабилитационных программ, применяемых в клинике медицинской реабилитации и восстановительного лечения, показал эффективность применения методов физической и реабилитационной медицины при лечении пациентов с различными проявлениями постковидного синдрома.

Ключевые слова: восстановительное лечение; медицинская реабилитация; новая коронавирусная инфекция COVID-19; патология; постковидный синдром; физическая и реабилитационная медицина; эффективность.

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ЭКО•ВЕКТОР

BACKGROUND

Although the number of patients with acute coronavirus disease 2019 (COVID-19) worldwide is decreasing, the pandemic is still not under full control, and the post-COVID syndrome is a challenging problem because of the lack of systematization of multiorgan sequelae. Many patients (16%–87%) experience post-COVID syndrome, with pneumologic and neuropsychologic symptoms being the most frequent manifestations. Pulmonary fibrosis was the most common organ complication found in patients with post-COVID syndrome. The number of symptoms of acute COVID-19, disease severity, and high serum D-dimer levels have been associated with a high risk of post-COVID syndrome, which is listed in the International Classification of Diseases as U09.9 "Condition after COVID19 unspecified." It can significantly affect the health status of surviving patients [1–3].

In general, the spectrum of clinical manifestations of both novel coronavirus infection (NCI) itself and post-COVID syndrome is extremely variable. In most cases, the respiratory system is affected; however, the most lasting effects are noted on the nervous system. The most frequent neuropsychiatric symptom was sleep disturbance (cumulative prevalence, 27.4% [95%, confidence interval 21.4%–34.4%]), followed by fatigue (24.4% [17.5%–32.9%]), objective cognitive impairment (20.2% [10.3–35.7%]), anxiety (19.1% [13.3%–26.8%]), and post-traumatic stress (15.7% [9.9–24.1%]). Neuropsychiatric symptoms are common and persist in patients even after recovery from NCI. The literature on long-term sequelae is still growing; however, available data suggest a high prevalence of insomnia, fatigue, cognitive impairment, and anxiety disorders in the first 6 months after infection [4–6]. The number of patients with complaints of musculoskeletal pain after NCI was also increasing. Thus, in a systematic review consisting of a sample of 14,639 hospitalized and 11,070 nonhospitalized patients with NCI, the overall rates of postcoital myalgia, joint pain, and chest pain were 5.65%–18.15%, 4.6%–12.1%, and 7.8%–23.6%, respectively, at different follow-up periods (after 30, 60, 90, and ⩾180 days) during the first year after infection. The time trend analysis showed a decrease in the prevalence of musculoskeletal pain after NCI from symptom onset until day 30, increased after 60 days, and a second decrease after ⩾180 days [7]. This makes it important to consider multidisciplinary rehabilitation programs in the follow-up of patients of working age. For 2021–2022, >3300 publications on the rehabilitation of patients with NCI, including 113 systematic reviews, have been deposited in the PubMed and Cochrane databases, with >1700 studies and 70 systematic reviews in 2022.

Owing to the large flow of patients with moderate, severe, and extremely severe NCI, physical and rehabilitative medicine in patients with post-COVID syndrome must be defined. On average, nearly one-third of NCI survivors were rehospitalized within the first 5 months after discharge and more than 1 in 10 died (4 and 8 times higher than in the general population). The rates are higher for persons aged >70 [8].

The study aimed to evaluate the effectiveness of medical rehabilitation programs for patients with NCI in the second and third stages of medical rehabilitation from the perspective of evidence-based medicine due to the large flow of people with post-COVID syndrome.

MATERIALS AND METHODS

Given the polysyndromal manifestations of chronic NCI, the development of rehabilitation programs should be based on a syndrome-pathogenetic approach. This approach is used in programs for patients with post-COVID syndrome at all rehabilitation stages in the medical rehabilitation and restorative treatment clinic of S.M. Kirov Military Medical Academy. From September 2020 to December 2021, 330 patients with NCI of varying severity levels were treated. Of these patients, 197 were in the medical rehabilitation clinic (second stage), and another 133 underwent rehabilitation on an outpatient basis (third stage). Patients in the second and third stages were evaluated using the rehabilitation routing scale SHRM2 score. They were divided into two representative groups: the observation group (n = 170) and the comparison group (n = 160).

Individual rehabilitation programs for the observation group were developed depending on the prevailing manifestations of post-COVID syndrome and taking into account evidence-based recommendations [9] (Table 1),

Table 1. Evidence-based rehabilitation techniques for patients with post-COVID syndrome

Main	Additional	Auxiliary
Physical exercise (1, A)	Continuous positive airway pressure (2, B)	Low-frequency magnetotherapy (3, B)
Breathing exercises (1, A)	High-intensity laser therapy (2, B)	Climatotherapy (3, B)
Inhalation therapy (1, A)	Therapeutic massage (3, B)	Oscillatory modulation of
Noninvasive ventilation (2, B)	Hydrokinesotherapy (2, B)	breathing (3, B)
	Neuromyostimulation (2, B)	Short-wave diathermy (3, B)

using the scale for assessing the severity of functional disorders in post-COVID syndrome [10].

The level of cogency of evidence and the validity of recommendations for specific treatment methods were weighted and ranked according to the regulatory document (GOST R56034–2014) and the order of the Ministry of Health of the Russian Federation No. 103n dated 28.03.2019 "On approval of the procedure and terms for the development of clinical recommendations, their revision, the standard form of clinical recommendations and requirements for their structure, composition and scientific validity of the information included in clinical recommendations."

Classes of Recommendations. Class 1 includes conditions under which, according to research data and/or the general opinion of experts, the performance of procedures or a particular treatment method is useful, effective, and advantageous. Class 2 refers to conditions under which research evidence is inconsistent, and expert opinion about the usefulness and/or effectiveness of a procedure or specific treatment method differs. Class 3 includes conditions in which according to available data and the general opinion of the experts, the procedure is not useful or effective and in some cases may cause harm.

Levels of evidence. Level A refers to evidence from multiple randomized clinical trials or meta-analyses. Level B refers to data from a single randomized clinical trial or large nonrandomized studies.

Breathing exercises and physical therapy were conducted on all patients of the Medical Rehabilitation and Restorative Treatment Clinic.

The comparison group utilized the physical and rehabilitation medicine methods of the main group according to the evidence-based patient rehabilitation technology table.

In the group with post-COVID syndrome receiving care in the clinic for medical rehabilitation and restorative treatment, restorative treatment programs were applied depending on the concomitant pathology and severity of symptoms in respiratory, cardiovascular, nervous, and other systems.

Patients with prevailing symptoms in the respiratory and cardiovascular systems underwent a course of positional and postural drainage, inhalation therapy with mucolytics, haloinhalation therapy, and low- and high-frequency magnetic therapy in combination with ultraphonophoresis/electrophoresis of anti-fibrotic drugs.

In the rehabilitation program for patients with respiratory insufficiency and prevention of heart attack and stroke, a course of interval hypoxic-hyperoxic therapy consisting of 3–7 procedures was an obligatory component.

Patients with psychoneurological manifestations received a course of transcranial and general magnetotherapy, darsonvalization of the scalp and collar zone in combination with a course of psychotherapy, electroson therapy, breathing exercises with arbitrary muscle relaxation, and manual therapy.

Patients with muscular and musculoskeletal disorders should have increased tolerance to physical activity by performing physical exercises to improve strength and endurance, such as mechanotrainers, robotic simulators, biofeedback simulators, and massage.

A universal method used in rehabilitation programs for patients with polysyndromal manifestations is low-frequency low-intensity magnetotherapy. The average treatment duration was 14 days.

Upon admission to the clinic and at the end of the rehabilitation treatment, all patients underwent a standard examination: subjective status was assessed, physical examination, functional tests such as blood oxygen saturation (SpO_2), spirometry, Stange and Hench tests, Borg exercise tolerance scale, and MRC dyspnea scale were evaluated, and the EQ5D quality-of-life questionnaire was completed.

STUDY RESULTS AND DISCUSSION

Based on the results of the analysis of the dynamics of individual indicators monitored at the beginning and end of medical rehabilitation of patients with NCI, the blood oxygen saturation indices normalized in the comparison group from 92.03 ± 0.30 (90%–96%) to 96.76 ± 0.32 (93%–99%, $p < 0.05$) and in the observation group from 92.78 ± 0.37 (90%–97%) to 98.22 ± 0.23 (96%–100%, $p < 0.05$) (Fig. 1). The mean values of the Stange and Hench tests in the observation and comparison groups showed positive dynamics (Fig. 2). In the observation group, the Stange test before treatment was 39.14 ± 1.44 s; after treatment, 55.31 ± 1.63 s ($p < 0.05$); Hinch's test before treatment, 34.18 ± 1.43 s; after treatment, 48.34 ± 1.24 s ($p < 0.05$). In the comparison group, the Stange test values before and after treatment were 35.74 ± 1.44 s and 53.32 ± 1.63 s ($p < 0.05$), respectively. Hinch's test values before and after treatment were 33.12 ± 1.42 s and 42.54 ± 1.42 s, respectively ($p < 0.05$).

According to spirography data, the vital capacity of the lungs of the main and control groups with respiratory system diseases was within the physiological norm in the presence of clinical symptoms.

The subjective assessment of the tolerability to the 6-min walk test using the Borg scale from 4.33 ± 0.27 (2–5 points) to 0.86 ± 0.15 (0–2 points) in the observation group and from 4.45 ± 0.26 (2–6 points) to 1.91 ± 0.18 (1–3 points) ($p < 0.05$) in the comparison group (Fig. 3).

The severity of dyspnea according to the MRC dyspnea scale decreased from 3.33 ± 0.34 (4 to 1 point) to 1.33 ± 0.15 (2–1 point) in the comparison group and

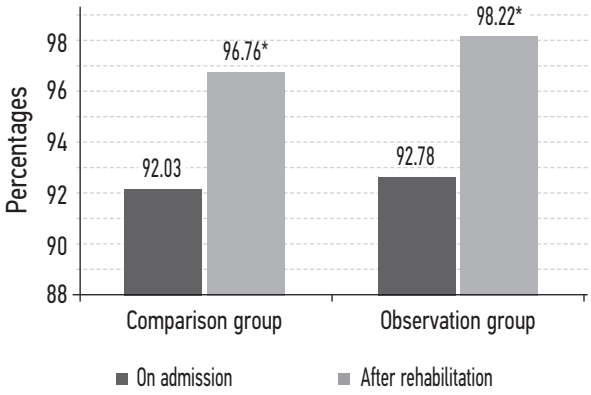

Fig. 1. Dynamics of blood oxygen saturation indices in the comparison and observation groups before and after rehabilitation (SpO_2), *$p < 0.05$

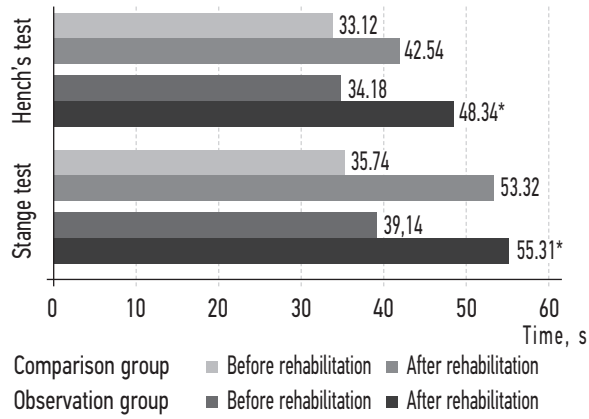

Fig. 2. Dynamics of functional test parameters in the comparison and observation groups before and after rehabilitation (*$p < 0.05$)

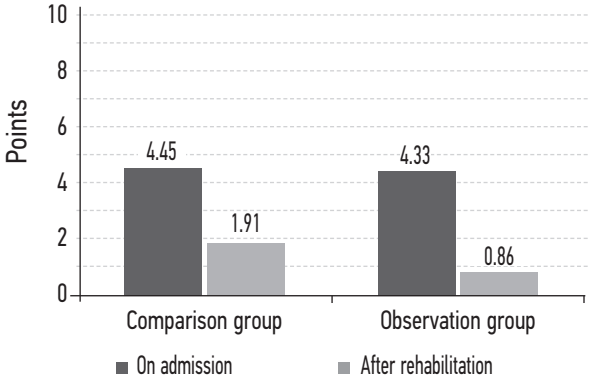

Fig. 3. Dynamics of the subjective assessment of tolerability to the 6-min walk test according to the Borg scale in the comparison and observation groups before and after rehabilitation

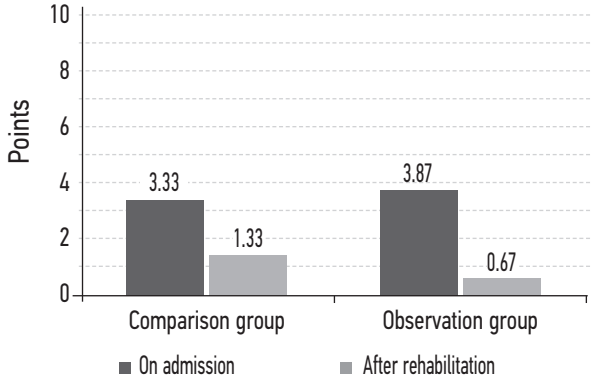

Fig. 4. Dynamics of dyspnea severity reduction according to the MRC dyspnea scale

from 3.84 ± 0.21 (4–1 point) to 0.67 ± 0.15 (1–0 point) ($p < 0.05$) in the observation group (Fig. 4).

In the analysis of patients' quality of life, the presence of health problems of varying degrees in patients of both groups remains. According to the EQ5D questionnaire, patients in both groups reported improved health and quality of life. In patients in the observation group, the before and after treatment values were 1.48 ± 0.18 and 1.12 ± 0.14, respectively ($p < 0.05$). In the comparison group, the values before and after treatment were 1.76 ± 0.23 and 1.18 ± 0.13, respectively ($p < 0.05$).

CONCLUSION

The analysis of rehabilitation programs used in the clinic for medical rehabilitation and rehabilitative treatment has shown the possibility and effectiveness of using physical and rehabilitation medicine methods in patients with various manifestations of the post-COVID syndrome. The rehabilitation needs of patients with NCI are increasingly recognized with a focus on combating respiratory and neuromuscular dysfunction. Nevertheless, our data and data from worldwide scientific sources indicate an urgent need to develop new educational and training programs aimed at interdisciplinary rehabilitation of patients with post-COVID syndrome.

ADDITIONAL INFORMATION

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Conflict of interest. The authors declare that there are no obvious and potential conflicts of interest related to the publication of this article.

Ethical review. The study was approved by the local ethical committee of the S.M. Kirov Military Medical Academy, Ministry of Defense of the Russian Federation (Protocol No. 210 of 24.06.2022).

Authors' contribution. All authors substantially contributed to the study and article and have read and approved the final version of this article before publication.

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AUTHORS' INFO

***Denis V. Kovlen**, M.D., D.Sc. (Medicine),
the Head of the Physical and Rehabilitation Medicine Department;
address: 6, Akademika Lebedeva str.,
Saint Peterburg, 194044, Russia;
ORCID: https://orcid.org/0000-0001-6773-9713;
eLibrary SPIN: 6002-2766; Author ID: 689410;
e-mail: denis.kovlen@mail.ru

ОБ АВТОРАХ

***Денис Викторович Ковлен**, докт. мед. наук,
начальник кафедры физической и реабилитационной медицины;
адрес: Россия, 194044, г. Санкт-Петербург,
ул. Академика Лебедева, д. 6;
ORCID: https://orcid.org/0000-0001-6773-9713;
eLibrary SPIN: 6002-2766;
Author ID: 689410; e-mail: denis.kovlen@mail.ru

* Corresponding author / Автор, ответственный за переписку

AUTHORS' INFO

Gul'nara R. Abuseva, M.D., Senior Lecturer of the Physical and Rehabilitation Medicine Department, Assistant of the Physical and Rehabilitation Medicine Department;
ORCID: https://orcid.org/0000-0002-9525-6361;
eLibrary SPIN: 9864-9534; Author ID: 1004262;
e-mail: bomar-oz@ya.ru

Stella S. Khoziainova, M.D., Lecturer of the Physical and Rehabilitation Medicine Department, Assistant of the Physical and Rehabilitation Medicine Department;
ORCID: https://orcid.org/0000-0002-7231-6018;
eLibrary SPIN: 4950-2424; Author ID: 1004305;
e-mail: stella.khozyainova@gmail.com

Elena F. Kondrina, M.D., Ph.D. (medicine), Associate Professor, Associate Professor of Physical and Rehabilitation Medicine Department; ORCID: https://orcid.org/0000-0001-5182-1464;
eLibrary SPIN: 8402-9864; Author ID: 1005302;
e-mail: ekondrina@gmail.com

Liudmila A. Podberezkina, M.D., Ph.D. (Medicine), Associate Professor, Associate Professor of Physical and Rehabilitation Medicine Department; ORCID: https://orcid.org/0000-0003-3680-1240;
eLibrary SPIN: 2592-8505; Author ID: 1006116;
e-mail: podberezkina.mila@mail.ru

Vladimir N. Ischuk, M.D., Ph.D. (Medicine); Associate Professor of Physical and Rehabilitation Medicine Department;
ORCID: https://orcid.org/0000-0002-0137-259X;
eLibrary SPIN: 7061-7647; Author ID: 944174;
e-mail: docisch@mail.ru

Tamara N. Karpova, M.D., Ph.D. (Medicine), Lecturer of the Physical and Rehabilitation Medicine Department;
ORCID: https://orcid.org/0000-0002-2750-2305;
eLibrary SPIN: 7631-8107; Author ID: 925967;
e-mail: tamarakarpova51@mail.ru

Ivan V. Konoplyankin, M.D., Ph.D. (Medicine), Lecturer of the Physical and Rehabilitation Medicine Department;
ORCID: https://orcid.org/0000-0003-0198-151X;
eLibrary SPIN: 1815-5183; Author ID: 1004800;
e-mail: vankon89@yandex.ru

Alexey S. Kovalev, M.D., D.Sc. (Medicine), Lecturer of the Physical and Rehabilitation Medicine Department;
ORCID: https://orcid.org/0000-0002-0646-8603;
e-mail: kovalevaolga@bk.ru

Sergei V. Tolmachev, M.D., Lecturer of the Physical and Rehabilitation Medicine Department;
e-mail: lana.tolmacheva.57@mail.ru

ОБ АВТОРАХ

Гюльнара Рякитовна Абусева, старший преподаватель кафедры физической и реабилитационной медицины, ассистент кафедры физической и реабилитационной медицины;
ORCID: https://orcid.org/0000-0002-9525-6361;
eLibrary SPIN: 9864-9534; Author ID: 1004262;
e-mail: bomar-oz@ya.ru

Стелла Самвеловна Хозяинова, преподаватель кафедры физической и реабилитационной медицины, ассистент кафедры физической и реабилитационной медицины;
ORCID: https://orcid.org/0000-0002-7231-6018;
eLibrary SPIN: 4950-2424; Author ID: 1004305;
e-mail: stella.khozyainova@gmail.com

Елена Федоровна Кондрина, канд. мед. наук, доцент, доцент кафедры физической и реабилитационной медицины;
ORCID: https://orcid.org/0000-0001-5182-1464;
eLibrary SPIN: 8402-9864; Author ID: 1005302;
e-mail: ekondrina@gmail.com

Людмила Александровна Подберезкина, канд. мед. наук, доцент, доцент кафедры физической и реабилитационной медицины; ORCID: https://orcid.org/0000-0003-3680-1240;
eLibrary SPIN: 2592-8505; Author ID: 1006116;
e-mail: podberezkina.mila@mail.ru

Владимир Николаевич Ищук, канд. мед. наук, доцент кафедры физической и реабилитационной медицины;
ORCID: https://orcid.org/0000-0002-0137-259X;
eLibrary SPIN: 7061-7647; Author ID: 944174;
e-mail: docisch@mail.ru

Тамара Николаевна Карпова, канд. мед. наук, преподаватель кафедры физической и реабилитационной медицины;
ORCID: https://orcid.org/0000-0002-2750-2305;
eLibrary SPIN: 7631-8107; Author ID: 925967;
e-mail: tamarakarpova51@mail.ru

Иван Валентинович Коноплянкин, канд. мед. наук, преподаватель кафедры физической и реабилитационной медицины;
ORCID: https://orcid.org/0000-0003-0198-151X;
eLibrary SPIN: 1815-5183; Author ID: 1004800;
e-mail: vankon89@yandex.ru

Алексей Сергеевич Ковалев, докт. мед. наук, преподаватель кафедры физической и реабилитационной медицины; ORCID: https://orcid.org/0000-0002-0646-8603;
e-mail: kovalevaolga@bk.ru

Сергей Владимирович Толмачев, преподаватель кафедры физической и реабилитационной медицины;
e-mail: lana.tolmacheva.57@mail.ru