THE DYNAMICS OF RECOVERY PROCESSES OF PHYSICAL ACTIVITY OF PEOPLE WHO RECOVERED FROM COVID-19

INTRODUCTION
The most common clinical manifestation of COVID-19 is bilateral pneumonia, which is specific and may be accompanied by distress in 3-4% of cases (LIANG et al., 2020). A large amount of damage to the lung tissue, the duration and severity of the course, progressive respiratory failure, including the need for artificial ventilation, may well lead to the development of fibrosis of the lung tissue, dysfunction of vital organs and body systems (WANG et al., 2020; LAZZERI et al., 2020). Patients who have undergone Covid-19 often develop weakness, since in a mono hospital they are inactive due to a forced posture (position) to improve breathing. In this case, immobility of the patient leads to damage of the skeletal and respiratory muscles (CHEN et al., 2020). The presence of associated diseases is an aggravating factor in the course of Covid-19. The high risk of negative outcomes in people with severe coronavirus pneumonia and existing chronic diseases was a prerequisite for rehabilitation doctors and medical specialists of all countries in solving urgent problems of optimizing and timely implementation of a complex of rehabilitation measures throughout the cycle of treatment, recovery and rehabilitation measures (KOKHAN et al., 2021).

The available recommendations of the World Health Organization, the analysis of scientific literature allow us to focus on the main issue - how to carry out these activities focused on the complete or partial restoration of the morphological and functional state of post covid patients, prevention of possible complications and restoration of working capacity (New guide to respiratory rehabilitation for pneumonia due to coronavirus (second edition), 2020; THOMAS et al., 2020).

Currently, methods of pulmonary rehabilitation (PR) are a standard addition to rehabilitation practice in people with bronchopulmonary pathology. Specialized breathing exercises play an important role in HR (WYTRYCHOWSKI et al., 2020; TINGBO et al., 2020).

The development of individual PR programs for those who have had COVID-19 help improve the quality of life of patients, reduce shortness of breath, the severity of functional disorders, improve exercise tolerance, physical activity, and psychological state (McCONNEL, 2011; BUTAKOVA et al., 2019). The use of the PR program promotes long-term health improvement in patients with pulmonary disease (American Thoracic Society. European Respiratory Society, 2002).

The aim of the study is to study the effect of pulmonary rehabilitation on the parameters of the respiratory activity of the lungs in patients with pneumonia associated with COVID-19.
MATERIALS AND METHODS
An individual medical rehabilitation program developed by a multidisciplinary team of employees of a multidisciplinary institution and included a differentiated comprehensive exercise therapy technique in combination with breathing exercises Strelnikova and Shatalova (ZINATULIN, 2013) for the experimental group (EG) - 25 patients who had had COVID-19, in the control group (CG) included - 23 patients with whom classes were conducted according to the standard method of physical exercise therapy.

The conditions and duration of the study
The study was conducted on the basis of the rehabilitation department of the innovative clinic "Academy of Health".

The study included patients discharged from the hospital with confirmed coronavirus infection and the presence of pneumonia, confirmed by the results of computed tomography (CT) of the chest organs (from CT-2 to CT-4). During the third wave of the Covid-19 pandemic, after the end of a two-week self-isolation at home, all patients who had taken part in the experiment received comprehensive outpatient rehabilitation. The study involved 48 people at the age from 39 to 67 years old, of which 21 were men (43.8 %), women - 27 people (56.2 %). The average age was 47± 9.1 years.

Before the start of rehabilitation measures, all patients underwent a medical examination. The complex of rehabilitation measures, including PR, was selected individually for each patient, taking into account the severity of the disease and the existing associated diseases and its complications. During one month of training, the patients of the first group (FG) focused their attention on the implementation of the elements of respiratory gymnastics during exercise therapy. Classes were conducted under the guidance of a physical therapy instructor. Patients in the CG performed exercise therapy according to the standard scheme.

The results of the study
The participants in the experimental and control groups completed the full course of the prescribed rehabilitation. There were no side effects or negative consequences.

The registration of rehabilitation outcomes included data on the history of life and illness, the results of clinical-functional and instrumental methods before and after the completion of the complex of rehabilitation measures. All study participants completed the CAP-Sym-12 survey on the symptoms of community-acquired pneumonia (LAMING, 2002). The dynamics of the state of those who had recovered from the two groups was assessed according to the following indicators: assessment of the severity of dyspnea - mMRS scale, data from Shtange and Genchi functional tests, hospital scale of anxiety and depression HADS and questionnaire of quality of life EQ-5D.

Ethical expertise
Each patient participating in the study was verbally informed about the nature and time of the rehabilitation measures and the expected results. Before starting the study, each participant gave written consent. The study was conducted taking into account the principles of GCP (Good Clinical Practice), national norms and ethical principles of the Declaration of Helsinki.

Statistical analysis
Statistical processing of the research results was carried out using Microsoft Office Excel (2010) and the package of applied statistical programs STATISTICA 10.0. The differences were considered statistically significant at an error level of p <0.05.

RESULTS
Analysis of the results using the Cap-Sym-12 questionnaire revealed the reliable results of resolving the symptoms of coronavirus pneumonia after the end of physiotherapy exercises with the inclusion of respiratory gymnastics techniques in patients from the experimental group, in comparison with the control (graph 1). So, at the beginning of physical rehabilitation, the indicators in the two groups were 45.7 and 46.3 points. In the control results, the first group received (p <0.05) the best result in comparison with the indicators of the second group.
Fig. 1. The dynamics of symptoms of coronavirus pneumonia in patients of two groups

![Graph](image)

* differences are significant in comparison with the indicators after a course of physiotherapy exercises, p<0.05

**Source:** Search data.

The indices of the degree of shortness of breath in the dynamics of the CG and the EG are presented in Table 1. After the end of the cycle of exercise therapy in combination with a complex of breathing exercises, the differences are significant in the EG (p <0.05) in comparison with the results before rehabilitation. In the CG, the indicators obtained increased slightly. The lack of results in patients of two groups with severe dyspnea indicates that they have chronic bronchopulmonary pathology, in which the rehabilitation process will take a fairly long time.

Table 1. The dynamics of average indicators of the degree of dyspnea (mMRS scale)

| The level of breath shortness | EG       | CG       |
|------------------------------|----------|----------|
| Before                       | After    | Before   | After    |
| 1-2                          | 15       | 7        | 13       | 9        |
| p<0,05                       | p>0,05   |          |          |
| 3                            | 1        | 2        | 2        | 2        |
| NS*                          |          |          |          |

* no statistical differences were found

**Source:** Search data.

SpO2 saturation before exercise therapy in two groups was <94.95%. At the end of rehabilitation in the EG the saturation data reached - on average 98%, in the CG - no more than 96%. To understand the process of oxygen supply to the body and indicators of the level of physical endurance and fitness of those who had been ill with Covid-19, we used the Shtange (breath holding during inhalation) and Genchi (exhalation) tests, Table 2. Before the start of the course of physical rehabilitation, the indicators of these tests were significantly lower than the standard indicators. However, during control measurements, significant changes were revealed in the experimental group in comparison with the data in the control group.

Table 2. The dynamics of the average indicators of the Shtange and Genchi’s samples in the process of rehabilitation

| Study group | Shtange’s test | Genchiz’s test |
|-------------|----------------|----------------|
|              | Before         | After          | Before       | After       |                             |
| EG          | 26±2.6         | 35±1.7         | 17±0.8       | 25±1.1      |
| p           | p<0.05         |                |              |             |
| CG          | 25±1.2         | 30±0.8         | 17±1.3       | 20±1.2      |
| p           | p>0.05         |                |              |             |

**Source:** Search data.
Analyzing the psychological and emotional state according to the hospital scale of anxiety and depression HADS in the two groups who had recovered, the symptoms of anxiety were reliably absent: in the EG - in 18 people (72%), in the CG in 16 people (69.6%), and indicators of depression were absent in 19 people (76%) - the EG and 18 people (78.3%) - CG. The average indicators of the severity of anxiety before exercise therapy were 5, 3 points in 1 gr. and 5, 2 points in 2 gr. The data on depression were: in the EG - 4.5 points, in the CG - 4.6 points. During the control testing of the psychological and emotional state of patients in two groups, there was a significant improvement in the emotional status. Anxiety-depressive symptoms were registered at the level: the severity of anxiety in the EG was 3.7 points, in the CG - 3.9 (p> 0.05). Depression indices also decreased: EG - 3.3 and CG - 3.2 points. Thus, there were no significant differences in the two groups of the influence of exercise therapy on the indices of the HADS anxiety-depression scales.

The data of the quality of life assessment (European questionnaire of the quality of life EQ-5D) at the end of the training showed significantly better results in comparison with the testing of patients from the CG. The average indicator in the EG was 7, 9 points in comparison with 6, 9 in the EG (p <0.05).

**DISCUSSIONS**

Recovery from coronavirus pneumonia is the most important moment in preventing the development of respiratory failure, the growth of chronic diseases and the transformation of the process into POST-COVID-19 syndrome (GORYACHEVA, BARASHVILI, 2021). The earlier rehabilitation measures are started, the less negative consequences for those who have recovered (DOVGALYUK et al., 2020). The inclusion of a variety of methods of respiratory rehabilitation in the postcovid recovery of patients contributes to the improvement of blood circulation, ventilation-perfusion capacity of the pulmonary system, and restoration of the skeletal muscles.

In addition to the organization and implementation of comprehensive rehabilitation, an important point is to conduct, before clinical prevention of the development of various morpho-functional complications in patients who have recovered from Covid-19 and who have chronic non-infectious diseases.

**CONCLUSIONS**

The use of complex outpatient rehabilitation with the inclusion of a differentiated exercise therapy technique in combination with respiratory gymnastics in patients of the experimental group (group 1) who have had pneumonia associated with Covid-19 significantly contributes to the results of resolving the clinical symptoms of coronavirus pneumonia and the restoration of the volume of external respiration function.

The results of functional tests also indicate a decrease in the fatigability of the respiratory muscles and an increase in the resistance to hypoxia of the organism of those who have recovered from the 1st group. In the control group, the above changes were not recorded so intensively. There were no significant differences in the effect of various complexes of exercise therapy on HADS indices in both study groups. The best results of the EQ-5D quality of life assessment were recorded in the EG, which is associated with the most intensive improvement in the indicators of well-being and quality of life.

**CONFLICT OF INTEREST**

The authors declare no conflict of interest.

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The dynamics of recovery processes of physical activity of people who recovered from COVID-19

A dinâmica dos processos de recuperação da atividade física de pessoas que se recuperaram da COVID-19

La dinámica de los procesos de recuperación de la actividad física de las personas que se recuperaron del COVID-19

Resumo
O artigo mostra os resultados da fisioterapia de quem teve infecção por coronavírus COVID-19 e que completou um mês de curso de reabilitação física como parte das medidas de reabilitação nas condições da clínica inovadora "Academia da Saúde". O objetivo da pesquisa é estudar o impacto de programas de reabilitação pulmonar para pacientes com COVID-19 moderado a grave. A implementação de exercícios respiratórios especiais possibilitou melhorar a saturação de oxigênio no sangue, reduzir a falta de ar e os indicadores de sintomas respiratórios. A tolerância ao exercício aumentou; a atividade física e a qualidade de vida dos pacientes com pneumonia associada ao COVID-19 melhoraram. Os melhores resultados da avaliação da qualidade de vida do EQ-5D foram registrados no grupo experimental em comparação com o grupo controle.

Palavras-chave: Reabilitação respiratória. COVID-19. Atividade física. Falta de ar. Qualidade de vida. Paciente.

Abstract
The article shows the results of physical therapy of those who have had coronavirus infection COVID-19 and who have completed a month's course of physical rehabilitation as a part of rehabilitation measures in the conditions of the innovative clinic "Academy of Health". The aim of the research is to study the impact of pulmonary rehabilitation programs for patients with moderate to severe COVID-19. The implementation of special breathing exercises made it possible to improve the oxygen saturation in the blood, to reduce shortness of breath and indicators of respiratory symptoms. The tolerance to exercise has increased; physical activity and the quality of life of patients with pneumonia associated with COVID-19 have improved. The best results of the EQ-5D quality of life assessment were recorded in the experimental group compared to the control group.

Keywords: Respiratory rehabilitation. COVID-19. Physical activity. Shortness of breath. Quality of life. Patient.

Resumen
El artículo muestra los resultados de la fisioterapia de aquellos que han tenido la infección por coronavirus COVID-19 y que han completado un curso de rehabilitación física de un mes como parte de las medidas de rehabilitación en las condiciones de la clínica inovadora "Academy of Health". El objetivo de la investigación es estudiar el impacto de los programas de rehabilitación pulmonar para pacientes con COVID-19 de moderado a grave. La implementación de ejercicios especiales de respiración permitió mejorar la saturación de oxígeno en la sangre, reducir la dificultad para respirar y los indicadores de síntomas respiratorios. Ha aumentado la tolerancia al ejercicio; La actividad física y la calidad de vida de los pacientes con neumonía asociada a COVID-19 han mejorado. Los mejores resultados de la evaluación de la calidad de vida EQ-5D se registraron en el grupo experimental en comparación con el grupo de control.

Palabras-clave: Rehabilitación respiratoria. COVID-19. Actividad física. Dificultad para respirar. Calidad de vida. Paciente.