

# Effect of Physical Therapy on Respiratory Function in Patients with Chronic Obstructive Pulmonary Disease

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## ABSTRACT

*Chronic obstructive pulmonary disease is one of the most common forms of disease, which leads to high morbidity and mortality of patients, causing significant economic losses. The aim – to examine the effectiveness of the impact of the proposed method of physical therapy on respiratory function in patients with chronic obstructive pulmonary disease. Analyzing the average values of respiratory function of patients in both groups at baseline, it was determined that they are lower than normal and did not significantly differ, indicating that poor functional capacity of the lungs and bronchial patency. This confirms the poor functional health status of patients and requires appropriate treatment and rehabilitation. The physical therapy of patients included several stages: assessment of the patient; learning patient; measures for correction of body weight; physical drilling program; psychological support. For each patient with chronic obstructive pulmonary disease selected individual program of physical therapy, taking into account the physical features of lung function parameters, specific physiological and psychopathological disorders caused by primary and / or related conditions. Evaluation of physical capabilities of each patient was performed using conventional tests with load (treadmill test, 6-minute walk, etc.). As a result of the comparative analysis of survey data of 130 patients in the control (consisting of those men (n = 32) and female (n = 30) sex) and basic (consisting of those men (n = 36) and female (n = 32) sex) groups were identified following. The use of physical therapy resulted in increasing the functional capacity of patients expressed increasing average values of indicators of lung function studied in the main group at the end of studies that demonstrate its effectiveness.*

**Key words:** patients, chronic obstructive pulmonary disease, physical therapy, respiratory function

## Introduction

Among chronic nonspecific inflammatory lung disease mortality chronic obstructive pulmonary disease (COPD) is more than 80%. In the United States due to COPD dies every year 100 thousand patients in Europe 200–300 thousand. WHO predicts that deaths related to COPD will rise and the disease will be the third cause of death in the world. COPD is currently the problem that tends to rapid growth worldwide, long runs and latent diagnosed late, takes 70–80% in the structure of non-specific lung diseases, has recently called disease-killer XXI century. Over the last decade the incidence of COPD in the world increased by 25% in men and 69% – women. In Europe, the cost of providing medical care to patients with respiratory diseases amount to 6% of the budget allocated to health

care, which make up 56% of the costs of treating COPD (38.6 billion euros). In the US, the direct cost of treating COPD are 29.5, indirect – 20.4 billion dollars. The largest share of expenditure accounted for with the treatment of exacerbations. The apparent dependence is total cost of the severity of COPD<sup>1,2,5,6,8,10</sup>.

The dominant concept in the world for the diagnosis, treatment, rehabilitation and prevention of COPD is GOLD (Global Initiative for Chronic Obstructive Lung Disease) – a joint project of the Institute of Heart, Lung and Blood (USA) and WHO, which was launched in 1998, the latest revision of the concept GOLD held in 2017. The materials GOLD emphasizes that in developing countries, the direct costs of treating COPD have a lower contribu-

tion than the costs associated with the patient's inability to fulfill professional responsibilities and lead normal lives. As the initiative states that the severe form of the disease affects not only the patient's life, disrupting its performance and reducing quality of life but also his family, who have to take care of the patient<sup>3,4,7,9</sup>.

Analysis of the scientific and technical, special and medical literature on treatment and physical therapy COPD patients showed that there is a need for improved approaches to physical therapy. That is of theoretical, practical and social importance to preserve, maintain and promote health patients.

The aim of the study – study the effectiveness of the proposed method of physical impact therapy on respiratory function in patients with chronic obstructive pulmonary disease.

## Materials and methods

Research conducted at the branch pulmonary Rivne Regional Hospital. The accumulation of research results conducted as admission of patients to hospital treatment. All patients (COPD, and stage light flow) were distributed by randomization to control (CG 1 – consisted of persons of male ( $n = 32$ ) and female ( $n = 30$ ) sex) and basic (BG 1 – consisted of those men ( $n = 36$ ) and female ( $n = 32$ ) sex) groups in proportion to the extent of admission. All patients were examined at the beginning and end of the study, were under medical supervision. Stage COPD and pulmonary disease degree was determined according to clinical changes in the patient functional status and data spirographic study, analyzed changes of external respiratory function (ERF).

## Results

Diagnosis of COPD patients confirmed by clinical symptoms (complaints of chronic cough, sputum excretion, dyspnea, objectively – hard breathing, wheezing availability whistling sometimes weakened respiratory noise, prolonged exhalation) and ERF data.

Rehabilitation technology included the use of the optimal level of rehabilitation facilities under the terms of the proposed regime, depending on general condition of the patient. The main purpose of the use of physical therapy was a decrease in the intensity of dyspnea, number and duration of hospitalizations; improving exercise tolerance, quality of life, reducing anxiety and depression associated with COPD.

Analyzing the average values of ERF COPD patients in both groups at baseline, we see that they are lower than normal and did not differ significantly, which indicates poor functional capacity of the lungs and bronchial patency. This indicates poor functional health status of patients and requires appropriate treatment and rehabilitation.

The physical therapy patients included several stages: assessment of the patient; learning patient; measures for correction of body weight; physical drilling program; psychological support. For each patient with COPD selected individual program of physical therapy taking into account the physical capabilities, performance ERF specific physiological and psychopathological disorders caused by primary and / or related conditions. Evaluation of physical capabilities of each patient was performed using conventional tests with load (treadmill test, 6-minute walk, etc.). To select the best rehabilitation investigated health indicators and the impact of dyspnea on daily activities were evaluated quality of life. At all stages of rehabilitation patient education was important, because patients with COPD should understand the nature of their illness and thoroughly implement the recommendations of the doctor and physical therapist. A very important point was the refusal of smoking at any stage of the disease. In addition, the study included diet, active lifestyle, proper breathing.

In bronchitic type of COPD include active rehabilitation exercise in sparing mode since morning hygienic gymnastics, breathing exercises, therapeutic walking on a flat surface. The main objectives of the exercise in the type of emphysematous COPD could increase the mobility of the chest, maintaining good posture, learning proper breathing with prolonged exhalation, the diaphragm increase excursions. In complex exercises include static and dynamic breathing exercises with emphasis on exhalation. Therapeutic Exercises is the basic physical therapy COPD patients hospitalized stage. If severe condition they first trained to control the act of breathing in general and, in particular, breathing through clenched lips. Due to the simplicity (tension of certain groups of muscles) is used as isometric exercises transition to regular exercise in very debilitated patients. Initially, training patients with severe disease course needed primary care professional physical therapy due to severe weakness and irrigation because even experienced difficulties when trying to sit on a chair. If you experience shortness of breath, stop classes, restoring breathing, and continued training, using a slow and deep breathing through clenched lips. The patient explained, you need to be patient and gradually achieve smooth and quiet breathing further increase physical activity. With the increasing strength and peripheral muscle endurance patients better tolerated exercise, which allowed to increase the intensity sessions, focusing on the level of dyspnea, which the patient can control. To improve the general condition of the day added physiotherapy, therapeutic dosed walking, bicycle.

Physical therapy efficiency determined by a number of parameters, the most important of which were fluctuations in forced expiratory volume in the first second (FEV1), changes in lung vital capacity (VC), which is traditionally considered the best indicators for assessing the degree of airway obstruction. To determine the reversibility of airflow obstruction (RAO) for bronchial reactivity indices bronchodilatation test conducted  $\beta_2$ -agonists short-term action.

Results of physical therapy we examined the dynamics that made it possible to objectively establish the effectiveness of the proposed rehabilitation measures. As a result of the comparative analysis of survey data of 130 patients (COPD, and stage light flow) control (CG 1 – consisted of persons of male (n = 32) and female (n = 30) sex) and basic (BG 1 – comprised persons male (n = 36) and female (n = 32) sex) groups were identified following. Patients BG previously observed positive trend: decreasing clinical symptoms of COPD, improved discharge of phlegm, wheezing disappeared in the lungs, improved sleep and health.

Especially important it should be noted that the disease they become controlled, as evidenced by statistically significant increase in the average compared with ERF (Fig. 1–6, where the horizontal scale marked with numbers of patients, and the vertical – the figures in% of ERF appropriate values). (Figure 1)

If the average baseline FEV1 in patients CG women with COPD were  $76,93 \pm 0,64\%$  BG –  $76,28 \pm 0,56\%$ ; at the end of the study, respectively  $-78,00 \pm 0,42\%$  and  $89,65 \pm 0,59\%$  ( $P < 0.05$ ). Averages FEV1 at the end of the study in female patients with COPD BG, engaged the developed physical concept therapy exceed those patients CG.

Mean values of FEV1 at baseline in patients with male CG COPD were  $77,40 \pm 0,52\%$  BG –  $76,94 \pm 0,53\%$ ; and the end of the study, respectively  $-78,22 \pm 0,52\%$  and  $91,15 \pm 0,53\%$  ( $P < 0.05$ ). The use of physical therapy resulted in increasing the functional capacity of patients expressed with increasing average indicators FEV1 in male patients with COPD BG exceeding these patients CG.

When analyzing the performance VC observed that at the beginning of the study were female patients CG –  $77,04 \pm 0,54\%$  In BG –  $77,00 \pm 0,51\%$ ; The study  $-77,98 \pm 0,45\%$  and  $91,01 \pm 0,70\%$  ( $P < 0.05$ ), respectively. (Figures 2,3)

Mean values of VC at the beginning of the study were male patients with COPD CG –  $79,83 \pm 0,43\%$  In BG –  $79,59 \pm 0,52\%$ ; The study  $-79,83 \pm 0,43\%$  and  $94,56 \pm 0,63\%$  ( $P < 0.05$ ), respectively. We see a significant increase in VC parameters in patients with male and female BGs end of the study.

At baseline the average RAO female patients with COPD were CG  $16,83 \pm 0,09\%$  BG –  $17,11 \pm 0,11\%$ ; end of the study, respectively  $-15,66 \pm 0,12\%$  ( $P < 0.05$ ) and  $9,19 \pm 0,11\%$  ( $P < 0.05$ ). Averages RAO in patients with COPD

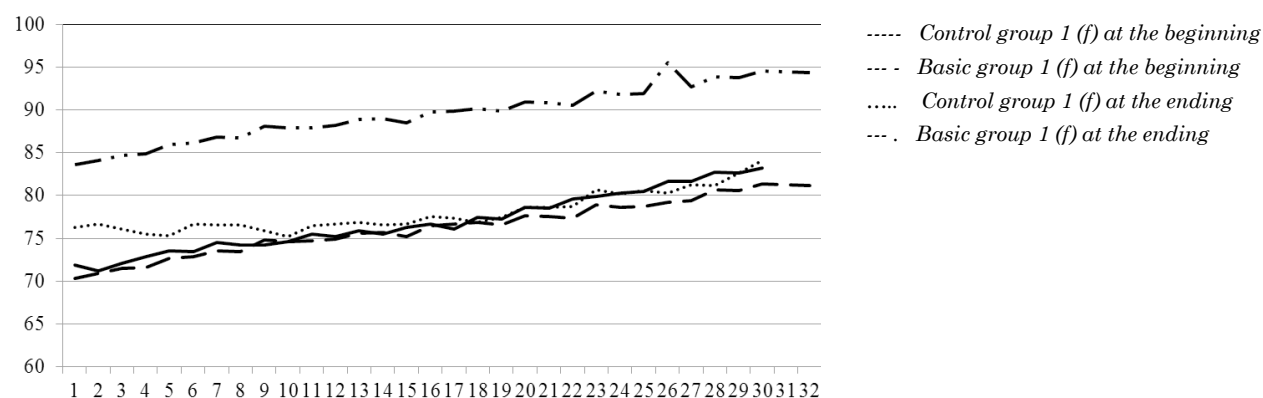


Fig. 1. Performance FEV1 in patients with COPD female at the beginning and end of the study.

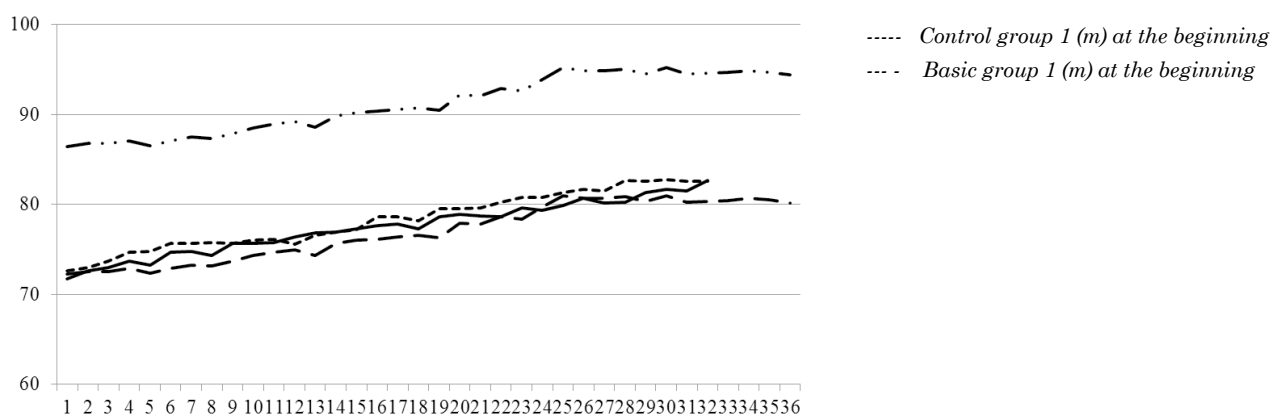


Fig. 2. Indicators FEV1 in patients with COPD male at the beginning and end of the study.

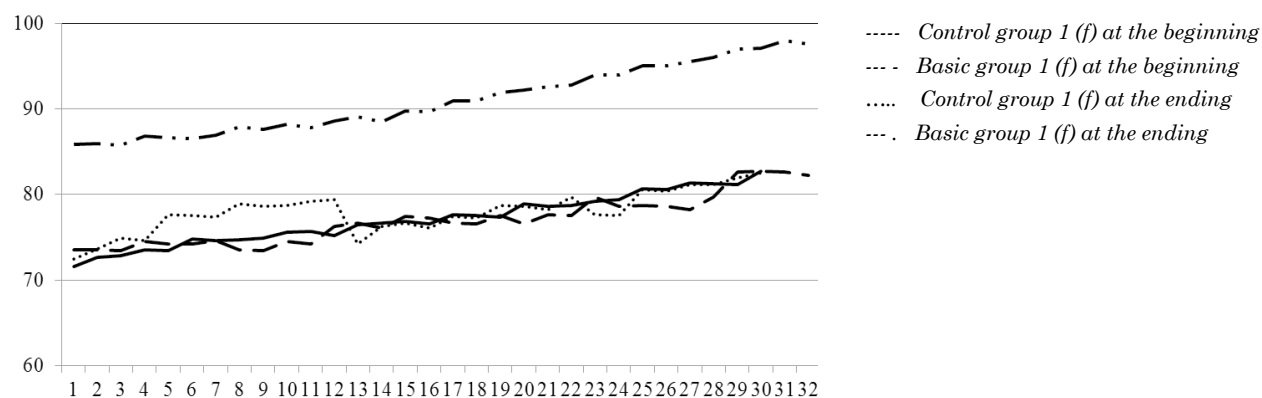


Fig. 3. Indicators VC female patients with COPD at the start and end of the study.

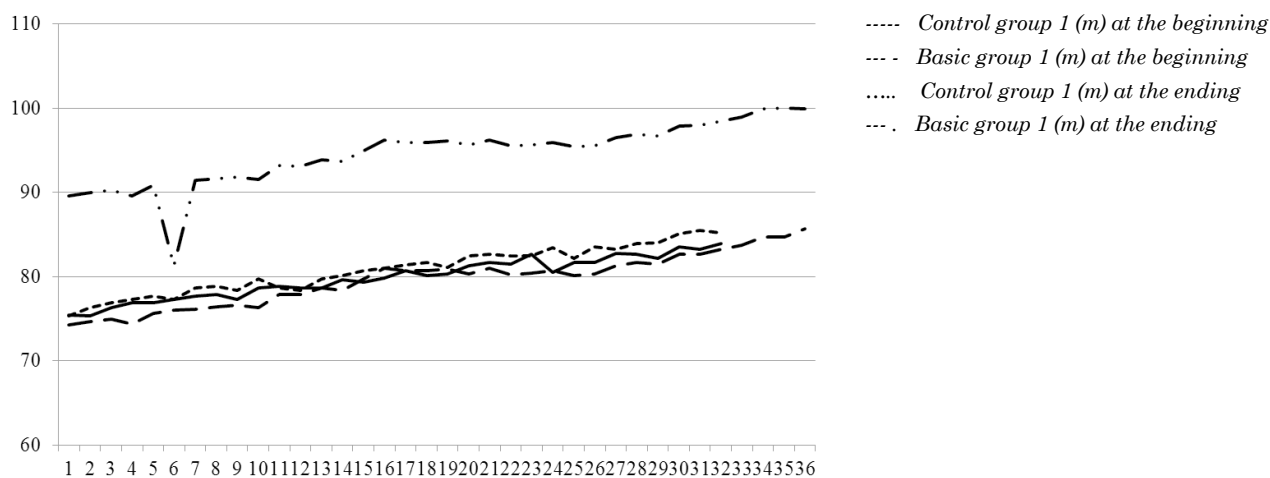


Fig. 4. Indicators VC male patients with COPD at the start and end of the study.

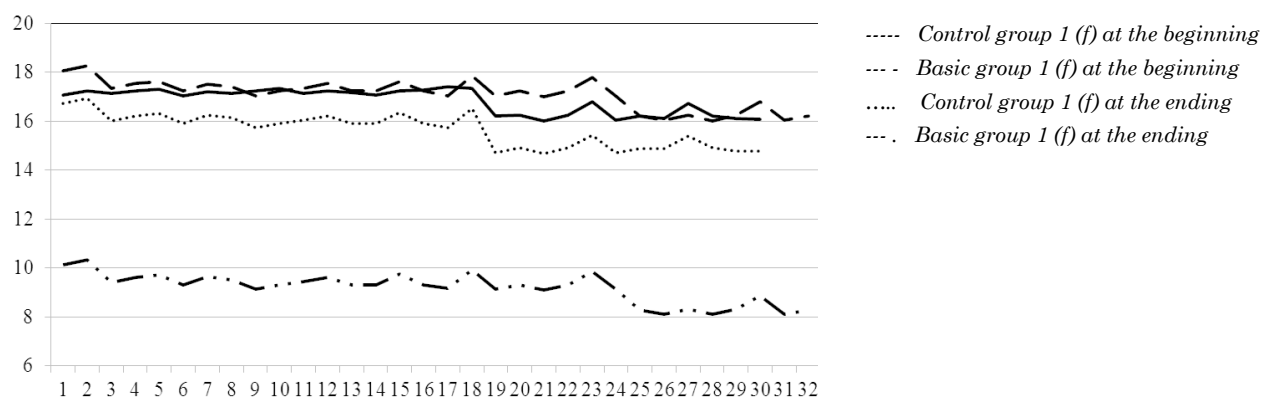


Fig. 5. Performance RAO female patients with COPD at the start and end of the study.

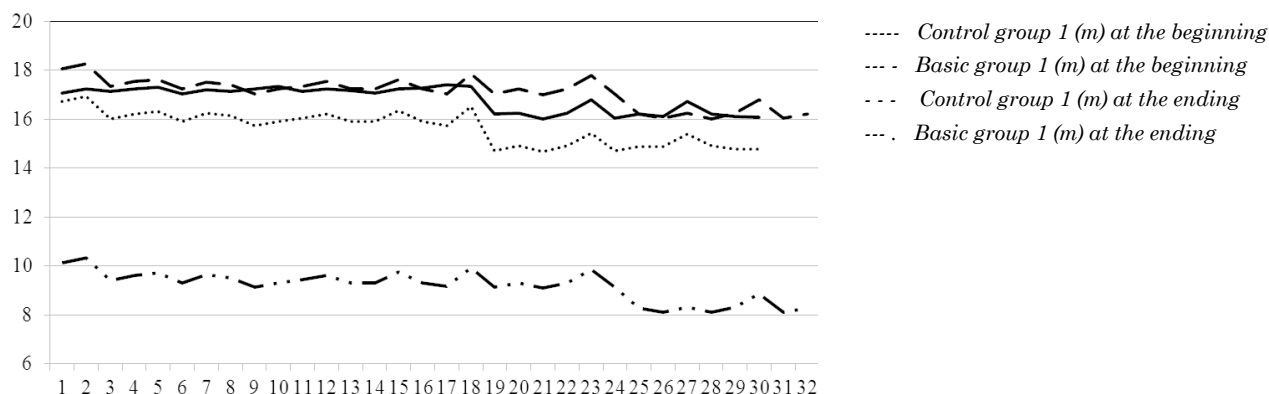


Fig. 6. Indicators RAO male patients with COPD at the start and end of the study.

BGs involved in the developed physical concept therapy exceed those patients CG.

If the baseline average RAO male patients with COPD were CG  $16,90 \pm 0,12\%$  BG –  $17,09 \pm 0,12\%$ ; at the end of the study, respectively  $15,67 \pm 0,12\%$  ( $P < 0.05$ ) and  $9,71 \pm 0,12\%$  ( $P < 0.05$ ). Averages RAO in patients with COPD BGs involved in the developed physical concept therapy exceed those patients CG.

That is, we can say that significant changes have occurred with indicators of bronchial reactivity in patients with male and female COPD BG which statistically significantly decreased after the implementation of programs of physical therapy ( $p < 0.05$ ), which did not happen in the control group.

Overall dynamics of ERF patients in both groups in the study is presented in Table 1 and Table 2. (Tables 1,2)

**TABLE 1**  
OVERALL DYNAMICS OF ERF (% OF APPROPRIATE VALUES) IN PATIENTS WITH COPD FEMALES  
IN BOTH GROUPS AT THE BEGINNING AND END OF THE STUDY

Groups	Stages of research	FEV1%	VC%	RAO%
CG 1 (h)	early	$76,93 \pm 0,64$	$77,04 \pm 0,54$	$16,83 \pm 0,09$
	in the end	<b><math>78,00 \pm 0,42</math></b>	<b><math>77,98 \pm 0,45</math></b>	<b><math>15,66 \pm 0,12 *</math></b>
BG-1 (i)	early	$76,28 \pm 0,56$	$77,00 \pm 0,51$	$17,11 \pm 0,11$
	in the end	<b><math>89,65 \pm 0,59 *, **</math></b>	<b><math>91,01 \pm 0,70 *, **</math></b>	<b><math>9,19 \pm 0,11 *, **</math></b>

**Remarks**

\* - the difference between the indexes statistically significant within group ( $r < 0,05$ )

\*\* - difference between the indexes statistically significant between the groups ( $p < 0.05$ )

**TABLE 2**  
OVERALL DYNAMICS OF ERF (% OF APPROPRIATE VALUES) MALE PATIENTS WITH COPD BOTH GROUPS AT THE BEGINNING AND  
END OF THE STUDY

Groups	Stages of research	FEV1%	VC%	RAO%
CG 1 (h)	early	$77,40 \pm 0,52$	$79,83 \pm 0,43$	$16,90 \pm 0,12$
	in the end	<b><math>78,22 \pm 0,52</math></b>	<b><math>80,78 \pm 0,49</math></b>	<b><math>15,67 \pm 0,12 *</math></b>
BG-1 (h)	early	$76,94 \pm 0,53$	$79,59 \pm 0,52$	$17,09 \pm 0,12$
	in the end	<b><math>91,15 \pm 0,53 *, **</math></b>	<b><math>94,56 \pm 0,63 *, **</math></b>	<b><math>9,71 \pm 0,12 *, **</math></b>

**Remarks**

\* - the difference between the indexes statistically significant inside group ( $p < 0.05$ )

\*\* - difference between the indexes statistically significant between the groups ( $p < 0.05$ )

## Discussion

Analyzing the average values of ERF COPD patients in both groups, we see that at the beginning of the study, these figures were not significantly different, and the end of the study in patients BGs they were higher (approached to the proper ones), indicating an improvement of patency of small bronchi, which is especially important for patients. Intuitively, we see increase in average values of FEV1 to 13.37%, VC – by 14.01%, RAO – by 7.92% in patients with female BGs, and in patients with male BGs: OFV1na 12.93% VC – on 14.97% RAO – on 7.38% at the end of the study. The use of physical therapy resulted in increasing the functional capacity of patients expressed increasing medium values of ERF studied in the BG end of the study. Improving the functional state of the respiratory system studied in the BG indicates the positive effect of physical therapy the developed methodology on motor capabilities of patients with COPD. In general it can be noted that all patients with BG treatment and physical therapy led to normalization of the ERF.

Introduced in daily physical treatment therapy we can reduce the symptoms of the disease, optimize functional status of the patient and reduce the cost of treatment by stabilization or reduction of systemic manifestations of the disease.

Treatment of COPD continues virtually all the patient's life, including normalization regime of work, rest, nutrition, medications, and do not always produce the expected results. And the need for general physical tasks therapy is to achieve inverse regression and stabilization of irreversible changes in the bronchi, restoration and improvement of respiratory function and physical performance. The implementation of these tasks may vary depending on nosology, features and course of COPD individual patient, form and degree of destruction of the respiratory system.

## Conclusions

Today COPD is one of the most common forms of disease, which leads to high morbidity and mortality of patients. Economic losses associated with the treatment of exacerbations, compensation for disability, disability affected by occupational diseases are increasing worldwide. The use of physical therapy in patients with COPD has led to increasing functional capacity of patients expressed increasing average values of indicators of lung function studied in the BG end of studies that demonstrate its effectiveness. Improving the functional state of the respiratory system in patients BG demonstrates the positive impact of physical therapy the developed methodology on motor capabilities of patients with COPD.

## REFERENCES

1. GRYGUS IM. Fizychna reabilitatsiya v pul'monolohiyi: navch. posibnyk. [Physical Rehabilitation in Pulmonology: Teach. Manual]. Rivne: NUVHP, 2015. 258 p. (In Ukrainian). — 2. MAYSTRUK MI, GRYGUS IM. Obruntuvannya neobkhidnosti provedennya fizychnoyi reabilitatsiyi khvorykh na khronichni obstruktyvni zakhvoryuvannya lehen'. [Substantiation of the necessity of physical rehabilitation of patients with chronic obstructive pulmonary diseases]. Zdorov'e dlya vseh: Materyaly VI mezhdunarodnoy nauchno-praktycheskoy konferentsiyi, UO «Polesky Hosudarstvennyy Unyversytet», Pynsk, 23–24 aprelya 2015 h. Mynysterstvo obrazovannya Respubliky Belarus' i dr.; redkol.: KK Shebeko i dr. Pynsk: Poles. HU, 2015. 120–122. (In Ukrainian). — 3. CRINER GJ, BOURBEAU J, DIEKEMPER RL, OUELLETTE DR, GOODRIDGE DP, HERNANDEZ ET AL. Prevention of acute exacerbations of COPD: American College of Chest Physicians and Canadian Thoracic Society Guideline. Chest. 2015. Apr 147 (4). 894–2. — 4. Global Strategy for the Diagnosis, Management and Prevention of Chronic Obstructive Pulmonary Disease, GOLD Executive Summary. — Updated 2017. <http://goldcopd.org/gold-2017-global-strategy-diagnosis-management-prevention-copd>. — 5. GRYGUS I, MAYSTRUK M. OBECNY stan przewleklej obturacyjnej choroby pluc. [The present state of chronic obstructive pulmonary diseases]. Journal of Health Sciences. 2013; 3 (10): 729–744. (In Polish). — 6. GUARASCIO AJ, SHAUNTA MR, FINCH CK et al. The clinical and economic burden of chronic obstructive pulmonary disease in the USA. Clinicoecon Outcomes Res. 2013; 5: 235–45. — 7. JONES PW, G NADEAU, SMALL M, ADAMEK L. Characteristics of a COPD population categorized using the GOLD framework by health status and exacerbations. Respir. Med. — 2014. Vol. 108 (1). 129–135. — 8. KIM JK, LEE CM, PARK JY et al. Active case finding strategy for chronic obstructive pulmonary disease with handheld spirometry. Medicine (Baltimore). 2016 Dec; 95 (50): e5683. — 9. MAIO S., BALDACCIO S., MARTINI F., CERRAI S., SARNO G., BORBOTTI M. et al. COPD management according to old and new GOLD guidelines: an observational study with Italian general practitioners. Curr Med Res Opin. 2014. June. 30 (6). 1033–42. — 10. REPRESAS-REPRESAS C., FERNANDEZ-VILLAR A., RUANO-RAVINA A. et al. Screening for chronic obstructive pulmonary disease: validity and reliability of a portable device in non-specialized healthcare settings. PLoS One 2016; 11: e0145571.

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## UČINAK FIZIKALNE TERAPIJE NA RESPIRATORNE FUNKCIJE U BOLESNIKA

### SAŽETAK

Kronična opstruktivna plućna bolest je jedan od najčešćih oblika bolesti, što dovodi do visokog morbiditeta i smrtnosti pacijenata, što uzrokuje značajne ekonomske gubitke. Cilj – ispitati učinkovitost utjecaja predložene metode fizikalne

terapije na respiratornu funkciju u bolesnika s kroničnom opstruktivnom plućnom bolesti. Analizom prosječnih vrijednosti respiratorne funkcije pacijenata u obje skupine na početku, utvrđeno je da su niže od normalne i nisu se značajno razlikovale, što ukazuje na lošu funkcionalnu sposobnost pluća i prohodnost bronha. To potvrđuje loše funkcionalno zdravstveno stanje pacijenata i zahtijeva odgovarajuće liječenje i rehabilitaciju. Fizička terapija pacijenata uključivala je nekoliko faza: procjenu pacijenta; učenje pacijenta; mjere za ispravak tjelesne težine; fizički program bušenja; psihološka podrška. Za svakog bolesnika s kroničnom opstruktivnom plućnom bolesti izabran je pojedinačni program fizikalne terapije, uzimajući u obzir fizičke značajke parametara funkcije pluća, specifičnih fizioloških i psihopatoloških poremećaja uzrokovanih primarnim i / ili srodnim uvjetima. Evaluacija fizičkih sposobnosti svakog pacijenta provedena je korištenjem konvencionalnih testova s opterećenjem (tredmil test, 6 minuta hoda, itd.). Kao rezultat komparativne analize podataka iz 130 bolesnika u kontrolnoj skupini (koji se sastoji od muškaraca ( $n = 32$ ) i ženskog ( $n = 30$ ) spola) i bazičnih (koji se sastoji od muškaraca ( $n = 36$ ) i žena ( $n = 32$ ) spol) identificirane su slijedeće. Korištenje fizikalne terapije rezultiralo je povećanjem funkcionalne sposobnosti bolesnika izraženim povećanim prosječnim vrijednostima pokazatelja funkcije pluća proučene u glavnoj skupini na kraju studija koje pokazuju njegovu učinkovitost.

