UDC 616.24-007.5-085.825
doi: 10.15330/fcult.44.91-94

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THE EFFECT OF A PERSONALIZED PHYSICAL THERAPY PROGRAM ON THE FUNCTIONAL STATUS OF PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Резюме. Мета – оцінити вплив розробленої програми фізичної терапії на функціональний стан дихальної системи у пацієнтів із ХОЗЛ II–III ступеня тяжкості. **Матеріал і методи дослідження.** У дослідженні взяли участь 30 пацієнтів віком 45–70 років, які перебували на стаціонарному лікуванні у терапевтичному відділенні МКЛ №1 м. Івано-Франківська. **Методи** дослідження: аналіз та узагальнення літературних джерел, спірометрія, математична статистика. Програма фізичної терапії тривалістю 31 день включала ЛФК (25–30 хв щодня), дихальні вправи за методиками Бутейка та Стрельнікової, фізіотерапевтичні процедури (електрофорез, магнітотерапія) та інгаляції декасаном (10 днів). **Отримані результати та висновки.** Результати дослідження показали статистично значуще покращення всіх оцінюваних спірометричних показників після завершення програми: ЧД знизилася з 22,2±1,30 до 18,3±1,50 д.р.·хв$^{-1}$, ДО зріс із 415,12±14,700 до 526,64±19,100 мл, ЖЄЛ – із 65,6±7,13% до 75,04±12,700%, ХОД – із 9,215±0,0645 до 9,637±0,447 л·хв$^{-1}$, ОФВ1 – із 48,8±5,51% до 61,0±8,96%. Найвираженіший ефект спостерігався для дихального об'єму, що підкреслює ефективність дихальних вправ. Запропонована програма фізичної терапії, доповнена локальними методами, сприяє значному покращенню вентиляційної функції, зменшенню задишки та підвищенню толерантності до фізичних навантажень у пацієнтів із ХОЗЛ, що узгоджується з рекомендаціями GOLD-2025.

Ключові слова: *хронічне обструктивне захворювання легень, фізична терапія, функціональний стан, дихальні вправи, спірометрія*

Summary. Chronic obstructive pulmonary disease (COPD) is a leading global cause of morbidity and mortality, characterized by progressive ventilation disorders and reduced exercise tolerance. **The aim** of this study was to evaluate the impact of a customized physical therapy program on the functional status of the respiratory system in patients with stage II-III COPD. **Materials and Methods** The study involved 30 patients (45–70 years old, 18 males and 12 females) hospitalized in the therapeutic department of Ivano-Frankivsk City Clinical Hospital No1. The sample was formed by analyzing medical records, excluding patients with stage I COPD. Spirometry was used to measure respiratory function parameters, including forced expiratory volume in 1 second (FEV1, % predicted), tidal volume (TV), vital capacity (VC, % predicted), minute ventilation (MV), and respiratory rate (RR). The 31-day physical therapy program incorporated a comprehensive approach: therapeutic physical exercises (25–30 minutes daily), breathing exercises based on the Buteyko method (shallow breathing with pauses) and the Strelnikova method (three sets of 32 sharp inhalations daily) as additional local techniques, physiotherapy procedures (electrophoresis, magnetotherapy), and Decasan inhalations (10 days). Statistical analysis was performed using the paired Student's t-test (after confirming normality with the Shapiro-Wilk test) to assess the significance of changes ($p<0.05$). **The results** demonstrated statistically significant improvements in all measured spirometric parameters post-intervention: RR decreased from 22.2±1.30 to 18.3±1.50 breaths·min^{-1} ($p<0.05$), TV increased from 415.12±14.700 to 526.64±19.10 mL ($p<0.001$), VC incresed from 65.6±7.13% to 75.04±12.700% ($p<0.05$), MV increased from 9.215±0.0645 to 9.637±0.0447 L·min^{-1} ($p<0.05$) and FEV1 improved from 48.8±5.51% to 61.0±8.96% ($p<0.05$). **Conclusions.** The most pronounced effect was observed for tidal volume, highlighting the efficacy of breathing exercises. The findings confirm that the proposed physical therapy program, supplemented with local methods, significantly enhances ventilatory function, reduces dyspnea, and improves exercise tolerance in COPD patients, aligning with GOLD-2025 guidelines and offering substantial clinical benefits for their rehabilitation and quality of life.

Key words: *chronic obstructive pulmonary disease, physical therapy, functional status, breathing exercises, spirometry*

The formulation of the problem and the analysis of the results of recent studies. Chronic obstructive pulmonary disease (COPD) is a major public health issue due to increasing prevalence, resistance to traditional treatments, and significant socioeconomic losses. According to the World Health Organization (WHO), COPD ranks third among causes of mortality worldwide [1]. It is one of the leading causes of morbidity and mortality, ranking in the top three for prevalence among adults [2]. Effective physical therapy and rehabilitation programs can substantially improve patients' functional status and reduce complication risks [3].

The core principles of COPD management include early intervention, risk factor elimination (e.g., smoking, air pollution), regular pharmacotherapy, and physical rehabilitation. Physical therapy plays a key role in halting disease progression and enhancing quality of life. However, identifying optimal rehabilitation methods remains relevant due to the limited efficacy of standard approaches in controlling systemic inflammation and COPD progression.

The aim is to evaluate the impact of a customized physical therapy program on the functional status of the respiratory system in patients with chronic obstructive pulmonary disease.

Material and methods. The study included 30 patients with stage II–III COPD who were hospitalized in the therapeutic department of Ivano-Frankivsk City Clinical Hospital No1. The sample was formed based on a retrospective analysis of medical records and prior examinations. Inclusion criteria: verified COPD diagnosis per GOLD guidelines, stable disease course without acute infection at hospitalization, and informed consent. Patients with stage I COPD, decompensated cardiovascular diseases, acute respiratory infections, or other pathologies affecting external respiration assessment were excluded.

External respiration function was assessed via spirometry, determining forced expiratory volume in 1 second (FEV1, % predicted), tidal volume (TV, mL), vital capacity (VC, % predicted), minute ventilation (MV, $L \cdot min^{-1}$), and respiratory rate (RR, $breaths \cdot min^{-1}$). Comparisons were made with normative values from the Global Lung Initiative (GLI-2012) for adults (matched for age 45–70 years and sex ratio) [4].

Patients underwent a 31-day physical therapy program, including: therapeutic physical exercises for 25–30 minutes daily; breathing exercises using the Buteyko method (shallow breathing: inhale 2–3 s, exhale 3–4 s with pauses) and Strelnikova method (energetic short inhalations, 3 sets of 32 daily) as supplementary local techniques; physiotherapy procedures (electrophoresis, magnetotherapy); and Decasan inhalations for 10 days to facilitate sputum clearance.

Data processing used MS Excel 2013. Normality was checked with the Shapiro-Wilk test; paired differences were assessed via Student's t-test or Wilcoxon signed-rank test if non-normal. Significance level: $p<0.05$.

Results. The results of functional assessments before and after the physical therapy program are presented in Table 1.

Table 1

Results of Functional Assessment in COPD Patients

№	Parameter	Norm (GLI-2012)	COPD Patients	
			Before	After
1	RR, $breaths \cdot min^{-1}$	12–20	22.2±1.30●	18.3±1.50*
2	TV, mL	500–700	415.12±14.700●	526.64±19.100**
3	VC, % predicted	80–100	65.6±7.13●	75.04±12.700*
4	MV, $L \cdot min^{-1}$	6–10	9.215±0.0645●	9.637±0.0447*
5	FEV1, % predicted	80–120	48.8±5.51●	61.0±8.96*

Notes: Probability of differences compared to baseline: * – $p<0.05$; ** – $p<0.001$; compared to norm: ● – $p<0.05$. Norms adapted for age 45–70 years [4]

Spirometric parameters were evaluated before and after the program, quantifying changes in respiratory function. At baseline, mean RR in COPD patients was 22.2±1.30 $breaths \cdot min^{-1}$, significantly exceeding the norm (12–20 $breaths \cdot min^{-1}$; $p<0.05$), indicating pronounced dyspnea typical for stage II-III COPD. Post-program, RR decreased to 18.3±1.50 $breaths \cdot min^{-1}$ ($p<0.05$), suggesting reduced dyspnea and approximation to physiological norms. TV at baseline was 415.12±14.700 mL, below the norm (500–700 mL; $p<0.01$), increasing to 526.64±19.100 mL post-treatment ($p<0.001$), evidencing improved lung ventilation capacity. VC was 65.6±7.13% predicted at baseline, below the norm (80–100%;

$p<0.05$), rising to 75.04±12.700% ($p<0.05$), demonstrating enhanced pulmonary reserve. MV at baseline was 9.215±0.0645 $L \cdot min^{-1}$, nearing the upper norm limit (6–10 $L \cdot min^{-1}$; $p<0.05$ due to compensatory increase); post-therapy, it rose to 9.637±0.0447 $L \cdot min^{-1}$ ($p<0.05$), approaching optimal efficiency. FEV1 was 48.8±5.51% predicted versus 80–120% norm ($p<0.05$), confirming bronchial obstruction; post-program, it increased to 61.0±8.96% ($p<0.05$), indicating partial obstruction reduction and improved airway patency.

Overall, the proposed physical therapy program showed significant improvements in all assessed spirometric parameters, confirming its efficacy in restoring respiratory function in stage II–III COPD patients. The most pronounced effect was for TV ($p<0.001$), underscoring the importance of breathing exercises in comprehensive rehabilitation.

Discussion. COPD is characterized by progressive course, limiting physical, social, and psychological aspects of life. The proposed program, combining breathing exercises, therapeutic gymnastics, and physiotherapy, demonstrated substantial functional improvements. Specifically, the Buteyko method aided tidal volume normalization, while Strelnikova gymnastics enhanced minute ventilation. Decasan inhalations facilitated sputum clearance, improving exercise tolerance.

Compared to literature data [5,6,7], our program exhibited higher efficacy due to a comprehensive approach and individualization. For instance, Priego-Jimenez et al. [5] showed exercise programs improve lung function (FEV1, VC) but without emphasis on breathing techniques, limiting dyspnea impact. Troosters et al. [6] found minimalist home rehabilitation enhances exercise tolerance but requires longer periods for spirometric changes. Unlike these, our program integrates Buteyko and Strelnikova breathing with physiotherapy, yielding faster, more pronounced improvements in all parameters ($p<0.05$). Kaur et al. [7] emphasize integrating breathing exercises with physical activity for better ventilatory capacity. Additionally, Serman [8] demonstrates respiratory exercises improve cardiovascular status under physical loads, synergizing with COPD effects. McCarthy et al. [9] note individualized breathing techniques reduce COPD exacerbations. Vilarinho et al. [10] confirm tailored rehabilitation, adapted to disease severity, improves quality of life and reduces dyspnea. However, sustained results require ongoing outpatient rehabilitation via multidisciplinary approaches.

These findings align with GOLD-2025 recommendations, which strongly support pulmonary rehabilitation (Evidence A) as a comprehensive intervention including exercise training, education, and behavioral changes to improve physical and psychological condition in COPD patients. While GOLD-2025 endorses breathing strategies like pursed-lip and diaphragmatic breathing (Evidence B), it does not specifically recommend Buteyko, Strelnikova, or Decasan, positioning them as supplementary local methods in our program.

Conclusions. The proposed physical therapy program leads to statistically significant improvements in the functional status of the respiratory system in patients with stage II–III COPD. Parameters including FEV1, TV, VC, MV, and RR significantly improved after 31 days of therapy ($p<0.05$). To consolidate results, a repeat one-week course is recommended. The outcomes support broader implementation of differentiated physical rehabilitation for COPD patients.

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Цитування на цю статтю:

Roksolana M. Gorbata. The effect of a personalized physical therapy program on the functional status of patients with chronic obstructive pulmonary disease. Вісник Прикарпатського університету. Серія: Фізична культура. 2025 Березень 03; 44: 91-94

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