

Peculiarities of physical therapy for persistent bronchial asthma in order to preserve physical capacity and improve the psycho-emotional state of patients

Liudmyla Kletsenko¹, Yevheniia Vyshar¹, Lesia Klevaka², Vitalii Zaika¹, Viktoriia Donchenko³, Valeriy Zhamardiy³, Anatolii Yemets³

¹DEPARTMENT OF SOCIAL WORK AND SPECIAL EDUCATION POLTAVA INSTITUTE OF ECONOMICS AND LAW OF THE OPEN INTERNATIONAL UNIVERSITY OF HUMAN DEVELOPMENT „UKRAINE”, POLTAVA, UKRAINE

²DEPARTMENT OF PSYCHOLOGY AND PEDAGOGY, NATIONAL UNIVERSITY YURI KONDRATYUK POLTAVA POLYTECHNIC, POLTAVA, UKRAINE

³DEPARTMENT OF PHYSICAL AND REHABILITATION MEDICINE, POLTAVA STATE MEDICAL UNIVERSITY, POLTAVA, UKRAINE

ABSTRACT

Aim: The aim of the study is to experimentally determine the effectiveness of the author's technique of respiratory gymnastics and psychocorrective exercises for use in the polyclinic period during the rehabilitation of patients with persistent bronchial asthma of moderate severity in the exacerbation stage.

Materials and Methods: The program of the local pedagogical experiment was implemented through the realization of ascertaining and formative stages. The study was conducted on the basis of the therapeutic department of the Communal establishment «Poltava Regional Clinical Hospital named after M. V. Sklifosovsky». A total of 30 people aged 35 to 47 with a diagnosis of «Persistent moderate bronchial asthma in the exacerbation stage» took part in the study.

Results: After analyzing the duration and intervals of respiratory phases (according to Buteyko), we developed our own program of physical therapy for patients with persistent bronchial asthma of moderate severity in the exacerbation stage (aging 35 to 47 years). The essence of the author's technique developed by us is to increase the duration of each period, as well as to increase the time of each phase when performing respiratory gymnastics.

Conclusions: Therefore, the author's method of respiratory gymnastics presented in this scientific study for the rehabilitation of patients with persistent bronchial asthma of moderate severity in the exacerbation stage is effective for the rehabilitation of patients at the polyclinic stage, and its effectiveness has been proven experimentally.

KEY WORDS: bronchial asthma, respiratory gymnastics, health, physiotherapy and occupational therapy, patients

Acta Balneol. 2024;66(4):268-278. doi: 10.36740/ABAL202404109

INTRODUCTION

Bronchial asthma is one of the most common chronic diseases, which represents a significant medical and social problem for adults and children. According to World Health Organization, between 5% and 15% of the world population suffers from bronchial asthma. This means that there are about 300 million asthmatics in the world [1-3].

Currently, many different methods of treatment for bronchial asthma are proposed, but unfortunately, there is still no single scientifically proven, highly effective treatment regimen, so the vast majority of patients require systematic drug therapy and periodic hospitalization. At the same time, the insufficient effectiveness of drug therapy, the high cost of treatment, and the unsatisfactory quality of life of patients remain. Thus, bronchial asthma is a global problem in all countries of the world, regardless of their level of development [1].

Physiotherapy and occupational therapy play an important role in the rehabilitation of asthma patients. Physiotherapy methods can be used both during an exacerbation of the

disease and during remission. Many methods have proven themselves as effective means of helping patients with bronchial asthma. That is why the development of original methods of physiotherapy in the treatment of bronchial asthma is a relevant and important direction of scientific work.

Experimental methods of physical therapy in the treatment of bronchial asthma in a state of exacerbation can help patients to overcome the inconveniences that arise during the exacerbation of the disease, reduce the intensity of medical treatment and improve the quality of life of patients.

Taking into account the actuality of the problem of rehabilitation of patients with bronchial asthma, the National Academy of Medical Sciences of Ukraine, the Ministry of Health of Ukraine, the State Institution «National Institute of Phthisiatry and Pulmonology named after F. G. Yanovsky of the National Academy of Medical Sciences of Ukraine», the National Medical Academy of Postgraduate Education named after P. L. Shupyk and the Association of Pulmonologists of Ukraine have developed «Adapted evidence-based clinical guideline «Bronchial asthma» [2].

This instruction is dedicated to the current problem of pulmonology, namely, to bronchial asthma. It is based on the modern evidence base. The latest revisions of the generally accepted international standards for the management of asthma patients (GINA), national experience, research by national scientists were taken as prototypes for it. Definitions and classifications of bronchial asthma, modern epidemiological data on its prevalence, mortality and lethality rates are given in it. Issues of etiology, pathogenesis and diagnosis of the disease are covered in detail. Modern approaches to the treatment of patients with bronchial asthma, and the criteria for evaluating the effectiveness of treatment are described in detail. Algorithms for the treatment of patients with bronchial asthma during a stable course and during exacerbation are given, which will allow unifying the requirements for providing quality medical care to such patients and increase the effectiveness of their treatment in different departments of multidisciplinary medical institutions.

Despite the existence of such an instruction, the analysis and comparison of modern domestic and foreign practices of providing rehabilitation care to persons with bronchial asthma showed that in Ukraine there are insufficiently developed recommendations for physical therapy in inpatient and outpatient settings. Home programs, on-line support and patient education are lacking, just as there is no effective program aimed at a long-term therapeutic effect [4-8]. Regarding the effectiveness of some therapeutic exercises and optimal tools for evaluating physiotherapeutic interventions, research and discussions are being conducted.

AIM

The aim of the study is to experimentally determine the effectiveness of the author's technique of respiratory gymnastics and psychocorrective exercises for use in the polyclinic period during the rehabilitation of patients with persistent bronchial asthma of moderate severity in the exacerbation stage.

MATERIALS AND METHODS

The program of the local pedagogical experiment was implemented through the realization of ascertaining and formative stages. They made it possible to state the state of the researched problem, to understand and formulate the purpose of the research, to outline the tasks of the experimental work, to clarify the theoretical foundations of the determine the effectiveness of the author's technique of respiratory gymnastics and psychocorrective exercises for use in the polyclinic period during the rehabilitation of patients with persistent bronchial asthma of moderate severity in the exacerbation stage.

The confirmatory experiment provided for highlighting the state of the investigated problem, formulating the purpose of the study, outlining the tasks of the experimental work, clarifying the theoretical foundations of determining the effectiveness of the author's technique of respiratory gymnastics and psychocorrective exercises for use in the

polyclinic period during the rehabilitation of patients with persistent bronchial asthma of moderate severity in the exacerbation stage. Experimental verification of the effectiveness of the program (formative experiment) was 35 days – 5 weeks.

The study was conducted on the basis of the therapeutic department of the Communal establishment «Poltava Regional Clinical Hospital named after M. V. Sklifosovsky». Patients were involved in the study after receiving secondary (specialized) medical care, the basis of which was physical therapy treatment and exercise therapy in accordance with the clinical protocol approved by the internal order of the health care institution. A total of 30 people aged 35 to 47 with a diagnosis of «Persistent moderate bronchial asthma in the exacerbation stage» took part in the study. The main complaints were: progressive difficult cough with shortness of breath, wheezing, chest tightness.

The hypothesis of our research predicted that the duration of getting used to respiratory gymnastics will be longer, due to which the body's adaptation to new exercises will be gentler. At the same time, we slightly increased the duration of each phase and pauses to increase the effectiveness of breathing exercises.

According to the adapted evidence-based clinical guideline dated 01/21/2020, in the traditional program, patients were recommended a general rehabilitation program, a daily 20-minute walk and upper body muscle training. The experimental technique was based on supplementation and adaptation of voluntary elimination of deep breathing according to K. P. Buteyko (VEDB), according to the functional state of patients.

The so-called volitional elimination of deep breathing developed by K.P. Buteyko (VEDB) was the basis for the author's technique. It was decided to work with this technique for the rehabilitation of patients with persistent bronchial asthma of moderate severity in the exacerbation stage due to several factors:

- the Buteyko's method guarantees the safety and effectiveness of bronchial asthma treatment, especially in the acute phase, which allows you to eliminate the manifestations of the disease in a matter of minutes: an attack of hay fever, stop coughing and reduce shortness of breath, reduce the manifestations of allergies and nasal congestion;
- the Buteyko's method has been repeatedly studied in order to find out its effectiveness: the first foreign studies were carried out in 1999, since then the method is constantly in the field of view of foreign researchers;
- the Buteyko's method was included in the unified clinical protocol of primary, secondary (specialized) medical care «Bronchial asthma», approved by the Ministry of Health of Ukraine in 2013.

Buteyko's original method is as follows: voluntary elimination of deep breathing training is done in conditions of rest and muscle relaxation. At the same time, you should breathe only through your nose [7]. When holding your breath, you need to pinch your nose and make sure that your breath is shallow. After every 3-4 days of classes, the

duration of the breathing phases and the intervals between them should be increased. The duration of the first delays is 10 s, then they lengthen to 180-240 s. Breathing is held during inhalation and exhalation. The exercise time is 15-20 minutes. The duration of rehabilitation is 3 weeks. Exercises should be continued even after the period of exacerbation of the disease has subsided (Table 1).

The duration of the program was 5 weeks. The condition of the patients was assessed before and after 5 weeks of performing experimental respiratory gymnastics. We selected two groups of patients (15 patients each). Two groups of patients participated in the experimental study: control and experimental. The first group consists of patients who receive medical treatment, perform physiotherapeutic measures and breathing exercises according to the Buteyko's method. The second group consists of patients who receive medical treatment, perform physiotherapeutic measures and breathing exercises developed by the authors of the scientific study and psychocorrective exercises (methods of self-regulation). In turn, each group of patients was divided into three microgroups (5 people in each microgroup) for the purpose of more thorough control of patients by a physical therapist, because it is possible to qualitatively control the functional state of the patient and his performance of therapeutic exercises only in a small group [9].

It was planned to examine the patients before the beginning of breathing exercises and after 35 days. After 18 days, patients who performed classical breathing gymnastics according to Buteyko had their physical therapy sessions adjusted: they performed a complex of inhaling for 7 seconds, pause after inhaling for 14 seconds, exhaling for 9 seconds, pause after exhaling for 12 seconds.

It was expected that patients who will perform the author's complex of breathing exercises will have better results than those who performed breathing exercises according to Buteyko, as well as significantly better results than those who were treated only with medication.

A set of following research methods was used to achieve the goal and to test the hypothesis:

- *methods of psychological and pedagogical research*: assessment of disease symptoms, assessment of physical performance and movement, active daily activities, assessment of the level of anxiety and depression, quality of life (SF-36), self-assessment of emotional states, study of volitional organization of the individual, assessment

of perseverance, etc. A pedagogical experiment was used to determine the effectiveness of the rehabilitation program. Questionnaires of self-actualization test (SAT), hospital anxiety and depression scale (HADS), activity of daily living (ADL) recommended in many pulmonary rehabilitation programs were used;

- *medical and biological research methods*. In order to obtain a complete picture of the disease, we used clinical and anamnestic methods: analysis of medical documentation, study of anamnesis, complaints, smoking status. Physical methods, examination of the patient: attention was paid to the pattern of breathing, changes in the frequency of breathing, decrease in the depth of breathing, the shape of the chest, percussion of the limits of cardiac dullness and auscultation, pulse oximetry, tonometry were performed. We used following tests: the Asthma Control Test, which is widely used by medical professionals around the world, is scientifically based and verified on hundreds of patients with asthma; spirometry; morning and evening peak flowmetry;
- *methods of mathematical statistics*. Reliable conclusions about the effectiveness of the rehabilitation program can be obtained with the help of quantitative analysis, which is based on mathematical processing using statistical methods. Based on these measurements, the statistical reliability of the program's impact on the patients' functional state is determined. The comparison between the result before and after the intervention was performed using the paired t-test and the Wilcoxon signed-rank test. Correlation between was analyzed using Spearman's correlation. Correlation strength: correlation coefficients 0-0.19 very weak, 0.2-0.39 weak, 0.4-0.59 moderate, 0.6-0.79 strong, 0.8-1 very strong. Parametric (paired t-test) and non-parametric degrees of influence (Spearman's test) are used to analyze the reliability of the program's impact on the functional state of patients and to compare the strength of the program's impact on certain indicators of the functional state. Correlation between changes in spirometry indicators: the vital capacity of the lungs; inspiratory reserve volume; expiratory reserve volumes; forced vital capacity of the lungs; volume of forced exhalation in the first second; volume of forced exhalation in the second second; volume of forced exhalation in the third second; volume of forced exhalation in final second; R. Tiffeneau index; volume of forced exhalation in the first second/Forced

Table 1. Duration and intervals of respiratory phases (according to Buteyko)

Training days	Inhalation phase, s	Pause after inhalation, s	Exhalation phase, s	Pause after exhalation, s
1-3	2	4	4	6
4-6	3	6	5	7
7-9	4	8	6	8
10-12	5	9	7	8
13-15	6	12	8	10
16-18	7	14	9	12

vital capacity of the lungs; peak expiratory volume rate; instantaneous volume velocity 25; instantaneous volume velocity 50; instantaneous volume velocity 75; average volume exhalation rate 25-75 after the rehabilitation program was analyzed using Spearman's correlation.

The normality of the distribution was determined by the Spearman method. t-criterion was used by us to compare indicators of assessment of the functional state of patients, measured before and after the application of the rehabilitation program in the control and experimental groups.

The Ethics Commission of National University «Yuri Kondratyuk Poltava Polytechnic» National University «Yuri Kondratyuk Poltava Polytechnic» has no comments on the methods used in this study.

RESULTS

After analyzing the duration and intervals of respiratory phases (according to Buteyko), we developed our own program of physical therapy for patients with persistent bronchial asthma of moderate severity in the exacerbation stage (aging 35 to 47 years). The essence of the author's technique developed by us is to increase the duration of each period, as well as to increase the time of each phase when performing respiratory gymnastics. The suggested endurance and respiratory phase intervals according to the author's methodology are presented in table 2.

Also, with obstructive lung diseases according to the International Classification of Functioning, Disability and Health (ICF), following changes occur in patients: b130 Volitional and drive functions (General mental functions of physiological and psychological mechanisms that force an individual to constantly move to satisfy certain needs and general goals, which includes: functions of willpower, motivation, appetite, desire power (including the power of desire for substances that can be abused), impulse drive control; b134 Functions of sleep (General mental functions of periodic, reversible and selective physical and mental withdrawal directly from the environment, which is accompanied by characteristic physiological changes); b152 Functions of emotions (Specific mental functions related to sensory and affective components of mental processes, which include: functions of adequacy of emotions, regulation and range of emotions; affect; sadness, happiness, love, fear, anger, hatred, tension,

restlessness, joy, grief; instability of emotions; smoothing of affect); b1522 Range of emotions (Mental functions that provide the full range of experienced affects and feelings, such as love, hate, anxiety, sadness, joy, fear and anger). These indicators can be studied using the method «Self-assessment of emotional states» by A. Wesman and D. Ricks, the Hospital Anxiety and Depression Scale (HADS), the method of researching the volitional organization of the personality by M. Gutkin, the method «Readiness for risk» (Schubert's RFR), a questionnaire for assessing perseverance by E. Ilyin and E. Feshchenko, etc [12-16].

We were offered to use psychocorrective exercises for self-regulation of one's emotional state, namely [9]: exercise «5-4-3-2-1» aimed at focusing on your 5 senses (visual, tactile, auditory, olfactory, taste); the «Radio» exercise, which helps control intrusive thoughts, voices, and negative emotions; exercise «Who am I?», which gives an opportunity to focus on the present and return to reality; the «Visualization» exercise, which allows you to distract yourself from unwanted thoughts and feelings, focus on something pleasant, etc.

We selected two groups of patients (15 patients each). In turn, each group of patients was divided into microgroups (5 people in each microgroup) for the purpose of more careful control of patients by a physical therapist. The first group consisted of patients who received medical treatment, performed physiotherapeutic measures and breathing exercises according to the Buteyko's method. The second group consisted of patients who received medical treatment, performed physiotherapeutic measures and breathing exercises developed by the authors of this scientific study and executed special psychocorrective exercises (methods of self-regulation).

It was planned to examine the patients before the beginning of breathing exercises and after 35 days. After 18 days, patients who performed classical breathing gymnastics according to Buteyko had their physical therapy sessions adjusted: they performed a complex of inhaling for 7 seconds, pause after inhaling for 14 seconds, exhaling for 9 seconds, pause after exhaling for 12 seconds.

It was expected that patients who will perform the author's complex of breathing exercises will have better results than those who performed breathing exercises according to Buteyko, as well as significantly better results than those who were treated only with medication.

Table 2. Duration and intervals of respiratory phases according to the author's method

Training days	Inhalation phase, s	Pause after inhalation, s	Exhalation phase, s	Pause after exhalation, s
1-5	3	6	5	7
6-10	4	8	6	8
11-15	5	9	7	8
16-20	6	12	8	10
21-25	7	14	9	12
26-30	8	16	10	14
31-35	9	18	11	16

The study of the functional state of patients of group 1 with persistent bronchial asthma (asthma control test and peak flowmetry) before the start of the experiment revealed the results listed in Table 3, the spirometry indicators of patients of group 1 are given in Table 4.

The study of the functional state of patients of group 2 with persistent bronchial asthma (asthma control test and peak flowmetry) before the start of the experiment revealed the results listed in Table 5, the spirometry indicators of patients of group 1 in Table 6.

The results of the studies performed 5 weeks after the start of the experiment are shown below.

The study of the functional state of patients of group 1 with persistent bronchial asthma (asthma control test, and peak flowmetry) after the experiment revealed the results listed in Table 8, the spirometry indicators of patients of group 1 in Table 8.

The study of the functional state of the patients of group 2 with persistent bronchial asthma (asthma control test, and peak flowmetry) after the experiment revealed the results listed in Table 9, the spirometry indicators of patients of group 2 in Table 10.

The data in Table 1 contain well-known initial data Table 2 presents the intervals of respiratory phases according to

the author's method (the essence of the author's method developed by us is to increase the duration of each period, as well as to increase the time of each phase when performing respiratory gymnastics). Tables 3-10 present the results of diagnosing patients' condition according to the well-known methods of researching patients' functional condition described in the article.

The study of the functional state of patients of group 1 with persistent bronchial asthma (asthma control test, spirometry and peak flowmetry) before the start of the experiment revealed the results listed in Table 3, the spirometry indicators of patients of group 2 in Table 4. The obtained results indicate the absence of a statistically significant difference between the functional condition of patients of both groups.

The results of the self-assessment study of the emotional states of patients of groups 1 and 2 with persistent bronchial asthma (after the experiment) revealed the results shown in Fig. 1.

After analyzing the data of the experimental study of the first group presented in the tables, we found the following: the indicators of the asthma control test in the first group are on average equal to 20 peak flowmetry indicators (morning and evening, average result) – 83%; the indicators

Table 3. Indicators in the first group of subjects

The table shows the average indicators of the functional state in microgroups	Asthma control test	Peak flowmetry (morning and evening, average result)
Microgroup 1 (n=5)	15	55%
Microgroup 2 (n=5)	10	35%
Microgroup 3 (n=5)	12	60%

Table 4. Results of spirometry of patients of group 1

Parameter	Units of measurement	Norm	m 1 (n=5)	m 2 (n=5)	m 3 (n=5)
The vital capacity of the lungs	L	4.63	2.33	2.55	1.98
Inspiratory reserve volume	L	2.32	1.35	1.24	1.35
Expiratory reserve volumes	L	1.62	0.75	1.1	1.02
Forced vital capacity of the lungs	L	4.26	2.48	3.47	2.45
Volume of forced exhalation in the first second	L	3.26	1.55	2.15	1.51
Volume of forced exhalation in the second second	L	4.17	2.18	2.97	2.17
Volume of forced exhalation in the third second	L	4.35	2.85	2.65	2.69
Volume of forced exhalation in final second	L	1.02	0.159	0.42	0.159
R. Tiffeneau index	%	69.4	35.8	39.7	41.9
Volume of forced exhalation in the first second /Forced vital capacity of the lungs	%	76.9	39.7	46.5	43.8
Peak expiratory volume rate	L/s	8.3	3.48	4.36	3.45
Instantaneous volume velocity 25	L/s	7.48	1.45	2.19	1.17
Instantaneous volume velocity 50	L/s	4.47	0.70	1.20	0.81
Instantaneous volume velocity 75	L/s	1.35	0.472	0.91	0.380
Average volume exhalation rate 25-75	L/s	3.45	0.645	0.754	0.954

Table 5. Indicators in the second group of subjects

The table shows the average indicators of the functional state in microgroups	Asthma control test	Peak flowmetry (morning and evening, average result)
Microgroup 1 (n=5)	15	55%
Microgroup 2 (n=5)	12	40%
Microgroup 3 (n=5)	13	50%

Table 6. Results of spirometry of patients of group 2

Parameter	Units of measurement	Norm	m 1 (n=5)	m 2 (n=5)	m 3 (n=5)
The vital capacity of the lungs	L	4.63	2.28	2.17	2.96
Inspiratory reserve volume	L	2.32	0.98	1.02	1.49
Expiratory reserve volumes	L	1.62	1.0	1.12	0.89
Forced vital capacity of the lungs	L	4.26	2.69	3.57	2.48
Volume of forced exhalation in the first second	L	3.26	1.60	2.12	1.64
Volume of forced exhalation in the second second	L	4.17	2.23	3.12	2.19
Volume of forced exhalation in the third second	L	4.35	2.35	2.48	2.79
Volume of forced exhalation in final second	L	1.02	0.16	0.49	0.27
R. Tiffeneau index	%	69.4	40.5	50.2	38.9
Volume of forced exhalation in the first second /Forced vital capacity of the lungs	%	76.9	42.6	45.8	42.8
Peak expiratory volume rate	L/s	8.3	3.12	4.98	3.85
Instantaneous volume velocity 25	L/s	7.48	1.63	2.54	2.18
Instantaneous volume velocity 50	L/s	4.47	0.98	1.50	0.98
Instantaneous volume velocity 75	L/s	1.35	0.560	0.745	0.520
Average volume exhalation rate 25–75	L/s	3.45	0.985	1.05	0.974

Table 7. Indicators in the first group of subjects (5 weeks after the start of the experiment)

The table shows the average indicators of the functional state in microgroups	Asthma control test	Peak flowmetry (morning and evening, average result)
Microgroup 1 (n=5)	18	80%
Microgroup 2 (n=5)	20	84%
Microgroup 3 (n=5)	22	86%

of the asthma control test in the first group are on average equal to 23, the indicators of peak flowmetry (morning and evening, average result) – 93%. The results of spirometry of patients of group 1 are as follows: The vital capacity of the lungs – 4.2 (Normal – 4.63); Inspiratory reserve volume – 2.23 (Normal – 2.32); Expiratory reserve volumes – 1.22 (Normal – 1.62); Forced vital capacity of the lungs – 4.20 (Normal – 4.26); Volume of forced exhalation in the first second – 3.17 (Normal – 3.26); Volume of forced exhalation in the second second – 4.9 (Normal – 4.17); Volume of forced exhalation in the third second – 4.22 (Normal – 4.35); Volume of forced exhalation in final second – 0.97 (Normal – 1.02); R. Tiffeneau index – 66.1 (Normal – 69.4); Volume of forced exhalation in the first second/Forced

vital capacity of the lungs – 74.4 (Normal – 76.9); Peak expiratory volume rate – 8 (Normal – 8.3); Instantaneous volume velocity 25 – 7.15 (Normal – 7.48); Instantaneous volume velocity 50 – 4.23 (Normal – 4.47); Instantaneous volume velocity 75 – 1,1 (Normal – 1.35); Average volume exhalation rate 25–75 – 3,1 (Normal – 3.45).

After analyzing the data of the experimental study of the second group presented in the tables, we found the following: the asthma control test scores in the first group are on average equal to 23, the peak flowmetry scores (morning and evening, average result) are 93%. The results of spirometry of patients of group 2 are as follows: The vital capacity of the lungs – 4.63 (Normal – 4.63); Inspiratory reserve volume – 2.37 (Normal – 2.32); Expiratory reserve volumes – 1,62

Table 8. Results of spirometry of patients of group 1 (5 weeks after the start of the experiment)

Parameter	Units of measurement	Norm	m 1 (n=5)	m 2 (n=5)	m 3 (n=5)
The vital capacity of the lungs	L	4.63	4.00	4.10	4.50
Inspiratory reserve volume	L	2.32	2.25	2.20	2.18
Expiratory reserve volumes	L	1.62	1.45	1.63	1.58
Forced vital capacity of the lungs	L	4.26	4.25	4.19	4.17
Volume of forced exhalation in the first second	L	3.26	3.20	3.21	3.12
Volume of forced exhalation in the second second	L	4.17	4.02	4.10	4.15
Volume of forced exhalation in the third second	L	4.35	4.30	4.12	4.25
Volume of forced exhalation in final second	L	1.02	0.98	0.98	0.95
R. Tiffeneau index	%	69.4	65.8	69.0	64.3
Volume of forced exhalation in the first second /Forced vital capacity of the lungs	%	76.9	74.2	73.9	75.0
Peak expiratory volume rate	L/s	8.3	8.1	7.98	7.85
Instantaneous volume velocity 25	L/s	7.48	7.02	7.12	7.35
Instantaneous volume velocity 50	L/s	4.47	4.15	4.30	4.26
Instantaneous volume velocity 75	L/s	1.35	0.99	1.10	1.2
Average volume exhalation rate 25–75	L/s	3.45	3.12	3.30	2.98

Table 9. Indicators in the second group of subjects (5 weeks after the start of the experiment)

The table shows the average indicators of the functional state in microgroups	Asthma control test	Peak flowmetry (morning and evening, average result)
Microgroup 1 (n=5)	22	90%
Microgroup 2 (n=5)	23	100%
Microgroup 3 (n=5)	25	90%

Table 10. Results of spirometry of patients of group 2 (5 weeks after the start of the experiment)

Parameter	Units of measurement	Norm	m 1 (n=5)	m 2 (n=5)	m 3 (n=5)
The vital capacity of the lungs	L	4.63	4.63	4.60	4.68
Inspiratory reserve volume	L	2.32	2.45	2.30	2.40
Expiratory reserve volumes	L	1.62	1.60	1.63	1.61
Forced vital capacity of the lungs	L	4.26	4.26	4.30	4.27
Volume of forced exhalation in the first second	L	3.26	3.25	3.45	3.30
Volume of forced exhalation in the second second	L	4.17	4.17	4.20	4.18
Volume of forced exhalation in the third second	L	4.35	4.35	4.41	4.30
Volume of forced exhalation in final second	L	1.02	1.0	1.10	1.07
R. Tiffeneau index	%	69.4	70.0	69.5	71.3
Volume of forced exhalation in the first second /Forced vital capacity of the lungs	%	76.9	77.0	79.3	80.1
Peak expiratory volume rate	L/s	8.3	8.25	8.40	8.36
Instantaneous volume velocity 25	L/s	7.48	7.49	7.56	7.50
Instantaneous volume velocity 50	L/s	4.47	4.48	4.49	4.55
Instantaneous volume velocity 75	L/s	1.35	1.39	1.42	1.26
Average volume exhalation rate 25–75	L/s	3.45	3.60	3.56	3.45

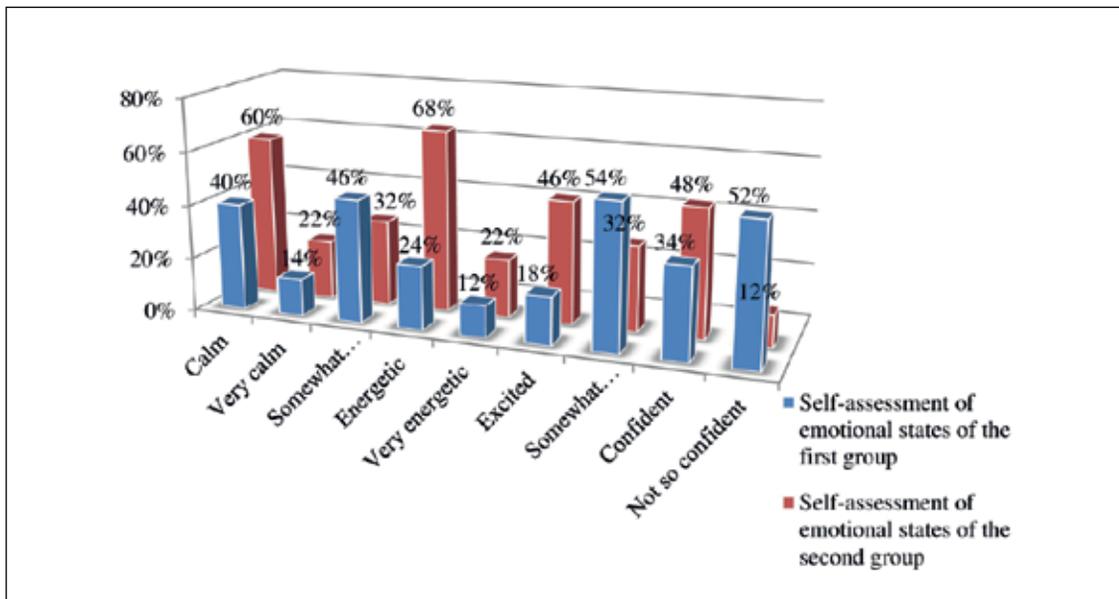


Fig. 1. Indicators of the manifestation of emotional states in the first and second groups of subjects after the psychocorrective influence.

(Normal – 1.62); Forced vital capacity of the lungs – 4.27 (Normal – 4.26); Volume of forced exhalation in the first second – 3.32 (Normal – 3.26); Volume of forced exhalation in the second second – 4.19 (Normal – 4.17); Volume of forced exhalation in the third second – 4.35 (Normal – 4.35); Volume of forced exhalation in final second – 1.2 (Normal – 1.2); R. Tiffeneau index – 69.9 (Normal – 69.4); Volume of forced exhalation in the first second / Forced vital capacity of the lungs – 77.4 (Normal – 76.9); Peak expiratory volume rate – 8.32 (Normal – 8.3); Instantaneous volume velocity 25 – 7.53 (Normal – 7.48); Instantaneous volume velocity 50 – 4.5 (Normal – 4.47); Instantaneous volume velocity 75 – 1.35 (Normal – 1.35); Average volume exhalation rate 25–75 – 3.5 (Normal – 3.45).

So, as shown by the presented data, the indicators of the functional state of the representatives of the second group reached normative values, in contrast to the indicators of the representatives of the first group. We found a significant improvement in a number of the following indicators in the patients of the second group in comparison with the patients of the first group: the indicators of the asthma control test in the first group prevailed by an average of 3 units; peak flowmetry by 10%; all the results of spirometry of the patients of the second group compared to the patients of the first group are significantly better: The vital capacity of the lungs – 0.43; Inspiratory reserve volume – 0.14; Expiratory reserve volumes – 0.4; Forced vital capacity of the lungs – 0.07; Volume of forced exhalation in the first second – 0.15; Volume of forced exhalation in the second second – 0.71; Volume of forced exhalation in the third second – 0.13; Volume of forced exhalation in final second – 0.23; R. Tiffeneau index – 3.8; Volume of forced exhalation in the first second / Forced vital capacity of the lungs – 3; Peak expiratory volume rate – 0.32; Instantaneous volume velocity 25 – 0.38; Instantaneous volume velocity 50 – 4.23

(Normal – 4.47); Instantaneous volume velocity 75 – 0.7; Average volume exhalation rate 25–75 – 0.4.

When comparing the indicators of the manifestation of emotional states of the first and second groups after psychocorrective influence, we can see that the emotional state of people who underwent psychocorrection of mastering their emotions improved significantly (Fig. 1). Moreover, the indicators of the first group remained unchanged at all stages of the study. Thus, the representatives of the second group became more calm (40% before and 60% after), very calm (14% before and 22% after), the number of slightly anxious people decreased (from 46% to 32%), a larger number of people became energetic (from 24% to 68%), very energetic (from 12% to 22%), elated (from 18% to 46%), the number of somewhat depressed decreased (from 54% to 32%), the number of confident increased (from 34% to 48%) and the number of not so confident decreased (from 52% to 12%).

DISCUSSION

The analysis and generalization of research results aimed at solving the problem of improving the functioning and life of people with persistent bronchial asthma due to the use of effective pulmonary rehabilitation programs, comparison with modern scientific data, makes it possible to claim that scientific information has been obtained that complements, clarifies and expands theoretical and methodological data on the issues of rehabilitation care of the specified nosological group of patients.

Peculiarities of the systemic nature of persistent bronchial asthma, the combination of pathology with other concomitant diseases, clinical features of the course of the disease were studied by Horvath I, Sorkness RL, Sterk PJ [10], Pinto Pereira LM, Seemungal TA [11], Humbert M, Boulet LP, Niven RM, Panahloo Z, Blogg M, Ayre G [12]. In the scientific works of the mentioned authors, the recommendations regarding

the scope and appropriate evaluation tools, the lack of a comprehensive system for evaluating the effectiveness of physical therapy, and the lack of recommendations regarding ways of implementing the psycho-emotional approach in physical therapy are insufficiently substantiated. This information was further developed in our scientific work, in particular, in the author's methodology of respiratory gymnastics as a supplement to the main treatment, general physiotherapy and the use of psychocorrective exercises to improve the psycho-emotional state of patients.

The work confirmed the data on the improvement of changes in peak flowmetry and spirometry indicators after the use of physical therapy and pulmonary rehabilitation programs; low indicators of the manifestation of emotional states in patients with persistent bronchial asthma were confirmed Cheung TK, Lam B, Lam KF, Ip M, Ng C, Kung R, et al. [13], Sundberg R, Toren K, Franklin KA et al. [14] and the possibility of improving these indicators through the use of the author's program of pulmonary rehabilitation has been proven.

In bronchial asthma, the leading pathophysiological mechanism of external breathing failure is violation of bronchial patency. In this regard, patients try to increase the volume of ventilation by hyperventilation, which leads to a higher tension of oxygen in the alveolar air and a low tension of carbon dioxide. This has a positive meaning, because it facilitates the diffusion of gases through the alveolar-capillary membrane [1-3, 5, 7].

On the other hand, hyperventilation leads to negative consequences, because the turbulence of the air flow in the bronchi and bronchial resistance increases. In addition, the functional dead space increases, excess removal of carbon dioxide from the alveoli and the body occurs, which reflexively increases the tone of the bronchial muscles, increasing their obstruction [15-21].

Breathing gymnastics techniques help to eliminate hyperventilation, keep the carbon dioxide content in the blood at an optimal level and eliminate bronchospasms. The most effective way to eliminate hyperventilation, keep the carbon dioxide content in the blood at an optimal level, and eliminate bronchospasms is the technique of respiratory gymnastics [3, 6, 8].

The basis for the development of the author's methodology, presented in this scientific study, became voluntary elimination of deep breathing according to K. P. Buteyko [1-3, 22, 23]. The essence of the author's technique developed by us is to increase the duration of each period, as well as increase the time of each phase when performing respiratory gymnastics. Thus, the duration of the rehabilitation period is extended to 5 weeks.

CONCLUSIONS

So, as shown by the presented data, the indicators of the functional state of the representatives of the second group reached normative values, in contrast to the indicators of the representatives of the first group. We found a significant improvement in a number of the following indicators in the patients of the second group in comparison with the patients of the first group: the indicators of the asthma

control test in the first group prevailed by an average of 3 units; peak flowmetry by 10%; all the results of spirometry of the patients of the second group compared to the patients of the first group are significantly better: The vital capacity of the lungs – 0.43; Inspiratory reserve volume – 0.14; Expiratory reserve volumes – 0.4; Forced vital capacity of the lungs – 0.07; Volume of forced exhalation in the first second – 0.15; Volume of forced exhalation in the second second – 0.71; Volume of forced exhalation in the third second – 0.13; Volume of forced exhalation in final second – 0.23; R. Tiffeneau index – 3.8; Volume of forced exhalation in the first second / Forced vital capacity of the lungs – 3; Peak expiratory volume rate – 0.32; Instantaneous volume velocity 25 – 0.38; Instantaneous volume velocity 50 – 4.23 (Normal – 4.47); Instantaneous volume velocity 75 – 0.7; Average volume exhalation rate 25–75 – 0.4.

When comparing the indicators of the manifestation of emotional states of the first and second groups after psychocorrective influence, we can see that the emotional state of people who underwent psychocorrection of mastering their emotions improved significantly (Fig. 1). Moreover, the indicators of the first group remained unchanged at all stages of the study. Thus, the representatives of the second group became more calm (40% before and 60% after), very calm (14% before and 22% after), the number of slightly anxious people decreased (from 46% to 32%), a larger number of people became energetic (from 24% to 68%), very energetic (from 12% to 22%), elated (from 18% to 46%), the number of somewhat depressed decreased (from 54% to 32%), the number of confident increased (from 34% to 48%) and the number of not so confident decreased (from 52% to 12%).

The given indicators of research results (asthma control test, peak flowmetry and spirometry) in the control and experimental groups allow us to draw the following conclusions:

- the initial check of the functional status of both groups of patients with the diagnosis «Persistent bronchial asthma of moderate severity in the exacerbation stage» revealed practically the same indicators;
- after drug treatment, the results of the first group of patients became satisfactory and correspond to expectations in the stage of remission;
- patients from group 2 showed better results than patients from group 1, because the author's method of breathing gymnastics was added to the drug treatment as an addition to the main treatment and general physiotherapy;
- indicators of volitional functions, sleep functions, and emotional functions in group 2 improved due to the addition of psychocorrective exercises to improve their psycho-emotional state.

Therefore, the author's method of respiratory gymnastics presented in this scientific study for the rehabilitation of patients with persistent bronchial asthma of moderate severity in the exacerbation stage is effective for the rehabilitation of patients at the polyclinic stage, and its effectiveness has been proven experimentally.

REFERENCES

1. Global Initiative for Asthma (GINA). Global Strategy for Asthma Management and Prevention. 2020. Access mode: https://ginasthma.org/wp-content/uploads/2020/04/GINA-2020-full-report_-final-_wms.pdf
2. Feshchenko YI, Yashina LO, Boyko DM, Gavrysiuk VK, Krakhmalova OO, Matyukha LF, Mostovyi YM, Pertseva TO, Polyanska MM, Rekalova OM, Ostrovskiy MM, Zaikov SV, Konopkina LI, Konstantinovich TV. Adaptovana klinichna nastanovu, zasnovana na dokazakh «Bronkhialna astma» [Adapted Evidence-Based Clinical Guideline «Bronchial Asthma»]. Natsionalna akademiia medychnykh nauk Ukrainy. 2020. Access mode: <http://amnu.gov.ua/wp-content/uploads/2020/files/05-2020/END-NASTANOVA.pdf> (Ukrainian)
3. Bousquet, Jeana; Anto, Josep M.; Bachert, Claus; Haahtela et al. ARIA digital anamorphosis: Digital transformation of health and care in airway diseases from research to practice *Allergy: European Journal of Allergy and Clinical Immunology*. 2021;76 (1):168-190 doi: 10.1111/all.14422.
4. Griban G, Prontenko K, Zhamardiy V et al. Professional Stages of a Physical Education Teacher as Determined Using Fitness Technologies. *Journal of Physical Education and Sport*, 2018;18(2):565-569. doi: 10.7752/jpes.2018.02082.
5. Abaturov AE. Prohnozuvannya indyvidualnoho ryzyku rozvytku bronkhialnoi obstruktsii pry hostrykh bronkhitakh [Prediction of individual risk of developing bronchial obstruction in acute bronchitis]. *Child's health*. 2015;1(60):55-60. (Ukrainian)
6. Donchenko VI, Zhamardiy VO, Shkola OM et al. Health-saving Competencies in Physical Education of Students. *Wiad Lek*. 2020;1:145-150. PMID:32124825
7. Wu J, Wu X, Zeng W, Guo D, Fang Z, Chen L et al. Chest CT Findings in Patients with Corona Virus Disease 2019 and its Relationship with Clinical Features. *Invest Radiol*. 2020;18 p.
8. Banadiga NV. Henetychni markery, shcho vyznachaiut vynykennia ta perebih bronkhialnoi astmy u ditei [Genetic markers determining the occurrence and course of bronchial asthma in children]. *Modern Pediatrics*. 2016;2:100-104. (Ukrainian)
9. Zaika VM. Vykorystannia tekhnik samorehuljatsii pry nadanni pershoi psykhologichnoi dopomohy u zminenykh stanakh svidomosti [The use of self-regulation techniques in the provision of psychological first aid in altered states of consciousness]. Materials of the All-Ukrainian scientific and practical conference with international participation «Emergency and urgent care in Ukraine: organizational, legal, clinical aspects», 24 February 2023. Poltava, 2023:26-29. (Ukrainian)
10. Horvath I, Sorkness RL, Sterk PJ. Airway physiology and pathophysiology in severe asthma. *European Respiratory Society Monograph*. 2011;51:182-188.
11. Pinto Pereira LM, Seemungal TA. Comorbid disease in asthma: the importance of diagnosis. *Expert Rev Respir Med*. 2010;4(3):271-4. doi: 10.1586/ers.10.31
12. Humbert M, Boulet LP, Niven RM, Panahloo Z, Blogg M, Ayre G. Omalizumab therapy: patients who achieve greatest benefit for their asthma experience greatest benefit for rhinitis. *Allergy*. 2009;64:81-84. doi: 10.1111/j.1398-9995.2008.01846.x.
13. Cheung TK, Lam B, Lam KF, Ip M, Ng C, Kung R et al. Gastroesophageal reflux disease is associated with poor asthma control, quality of life and psychological status in Chinese asthma patients. *Chest*. 2009;135(5):1181-5. doi: 10.1378/chest.08-1702
14. Sundberg R, Toren K, Franklin KA, et al. Asthma in men and women: treatment adherence, anxiety, and quality of sleep. *Respir Med*. 2010;104(3):337-344. doi: 10.1016/j.rmed.2009.10.017
15. Kapustianskyi D, Ivanytskyi I, Ivanytska T et al. Differential diagnosis of soft tissue tumors. *Wiad Lek*. 2022;6:1596-1599. doi: 10.36740/WLek202206131.
16. Vyshar EV, Kletsenko LV. Suchasni aspekty zastosuvannya sotsialno-psykhologichnykh zdoroviazberezhuvalnykh tekhnolohii u profesiinii diialnosti [Modern aspects of the application of socio-psychological health-saving technologies in professional activity]. «Science and technology today» (Series «Pedagogy»). 2022;6(6):114-123. (Ukrainian)
17. Hryn V, Kostylenko Y, Pinchuk V et al. Experimental analysis of ways viral infections into the human body. *Wiad Lek*. 2022;75;6:1544-1549. doi: 10.36740/WLek202206121.
18. Hryn V, Yudina K, Donchenko V et al. Eponymous terms in the morphology of angioarchitectonics of the human head. *Wiad Lek*. 2022;LXXV;6:1583-1591. doi: 10.36740/WLek202206129.
19. Zhamardiy VO, Donchenko VI, Yemets AV, Skrynnyk YO. Physical Development by Means of Fitness Technologies as One of General Aspects of Student's Health. *Wiad Lek*. 2019;LXXII;5:1074-1078. PMID: 31175747.
20. Zhamardiy VO, Shkola OM, Okhrimenko IM et al. Checking of the Methodical System Efficiency of Fitness Technologies Application in Students' Physical Education. *Wiad Lek*. 2020;LXXIII;2:332-341. PMID: 32248171.
21. Vyshar EV, Kletsenko LV. Osoblyvosti vykorystannia zdoroviazberezhuvalnykh tekhnolohii fakhivtsiamy z fizychnoi reabilitatsii u profesiinii diialnosti [Peculiarities of the use of health-saving technologies by physical rehabilitation specialists in their professional activities]. Prospects and innovations of science (Series «Medicine»). Kyiv: «Scientific perspectives», 2022;2(7):1012-1025. (Ukrainian)
22. Zhamardiy V, Shkola O, Tolchieva H, Saienko V. Fitness Technologies in the System of Physical Qualities Development by Young Students. *Journal of Physical Education and Sport (JPES)*. 2020;20(1):142-149. doi: 10.7752/jpes.2020.01019.
23. Shkola O, Otravenko O, Donchenko V et al. The influence of tae-bo on the development motor potential of students of medical and pedagogical specialties and its efficiency in the process of extracurricular activities. *Wiad Lek*. 2022;75;4:865-870. doi: 10.36740/WLek202204121.

ORCID AND CONTRIBUTIONSHIP

Liudmyla Kletsenko: 0000-0003-0092-381X **B C D F**

Yevheniia Vyshar: 0000-0003-0937-7042 **B C D F**

Lesia Klevaka: 0000-0001-6924-8221 **B C D F**

Vitalii Zaika: 0000-0001-5710-2997 **B C D F**

Viktoriia Donchenko: 0000-0002-9665-7204 **A E F**

Valeriy Zhamardiy: 0000-0002-3579-6112 **A E F**

Anatolii Yemets: 0000-0002-2088-8428 **A E F**

CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Valeriy Zhamardiy

Department of Physical and Rehabilitation Medicine,

Poltava State Medical University, Poltava, Ukraine

email: Shamardi@ukr.net

A – Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article

RECEIVED: 23.04.2024

ACCEPTED: 25.06.2024

