

# The effect of 3-week sanatorium rehabilitation on exercise capacity and subjective perception of health of patients with asthma and COPD

## Authors' Contribution:

- A Study Design
- B Data Collection
- C Statistical Analysis
- D Data Interpretation
- E Manuscript Preparation
- F Literature Search
- G Funds Collection

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## abstract

- Background** Asthma and COPD are common diseases of the respiratory system. An important element in the medical treatment of these patients is physiotherapy, focused on the reduction of symptoms and improvement of quality of life. Therefore, the aim of this study was to evaluate the response of patients with asthma and COPD on a three-week sanatorium rehabilitation in terms of exercise capacity and perception of health.
- Material/Methods** COPD group (n = 17; age 52 ±3 years); asthma group (n = 20; age 55 ±5 years). During the three-week rehabilitation, patients used breathing and group exercises, inhalation, magnetic therapy, crenotherapy, Sollux lamp irradiation, massage. Exercise capacity was evaluated by 6-minute walk test, while health status by VAS.
- Results** After rehabilitation, patients with COPD and asthma much better ( $p \leq 0.05$ ) evaluated their health. Distance covered in the walk test in patients with COPD increased by 9 m, and in patients with asthma by 17.5 m ( $p \leq 0.05$ ). Blood pressure after test was lower in both groups ( $p \leq 0.05$ ). There was observed a decrease in heart rate, both at rest and exercise-induced, in patients with COPD and asthma ( $p \leq 0.05$ ).
- Conclusions** The three-week comprehensive rehabilitation led to an increase in exercise capacity and health self-assessment of patients with both COPD and asthma.
- Key words** asthma, COPD, exercise capacity, rehabilitation, sanatorium treatment

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## INTRODUCTION

Asthma and chronic obstructive pulmonary disease are some of the more common diseases of the respiratory system. Asthma is a heterogeneous disorder that is characterized by variable airflow obstruction, airway inflammation and hyper-responsiveness, and either spontaneous or resulting from treatment reversibility [1]. Globally, bronchial asthma is one of the most frequently occurring chronic conditions. According to the Global Initiative for Asthma (GINA) report, the estimated number of asthma patients is 300 million individuals worldwide, and the number of patients may increase by another 100 million by 2025 [2]. Between 5–20% of individuals in Europe suffer from bronchial asthma [3]. In Poland, the overall prevalence of asthma is approximately 8.6% (95% confidence interval, 7.7–9.6%) among children and 5.4% (95% CI, 5.0–5.8%) among adults [4].

Chronic obstructive pulmonary disease (COPD) is defined as a common preventable and treatable disease, characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and the lungs to noxious particles or gases [5]. Flow limitation in the airways is expressed in a reduced ratio of FEV1/FVC. Risk factors of COPD include: age  $\geq$  40 years; smoking history; at least one of the following symptoms: daily cough with or without sputum production, dyspnea on exertion, wheezing, or frequent respiratory infections during the year [6]. In the world, about 4–10% of people over 40 years of age suffer from COPD [7].

Physiotherapy is an important element in the medical treatment of patients with respiratory diseases. The main objectives are a reduction of symptoms and an improvement in the quality of life [8]. Respiratory kinesiotherapy, physical therapy elements and massage are used in the rehabilitation process. From the scope of kinesiotherapy, group and breathing exercises are applied. In diseases of the respiratory system, physical treatments in the form of inhalations or chest irradiation with a Sollux lamp with a red filter is used. Relaxing manual massage of the chest, massage with vibration apparatus and chest percussion are also performed. Helping COPD patients change health behavior in order to improve their quality of life

The aim of this study was to evaluate the response of patients with asthma and COPD to three-week sanatorium rehabilitation in terms of exercise capacity and subjective perception of health. In relation to the differentiation of pathogenesis, clinical symptoms and the course of both diseases, the problem was to test whether standard, sanatorium physiotherapy equally affects the status of patients with distinct disease entities which are qualified together to the group of obstructive lung diseases.

## MATERIAL AND METHODS

The study was conducted at the Sanatorium Ewa-Med in Szczawno Zdrój. There were 2 study groups. The COPD group consisted of 17 patients (10 women and 7 men) whose mean age was 52 ( $\pm$ 3) years. They were patients with GOLD I (mild COPD; FEV1/FVC  $<$  0.7 and FEV1  $\geq$  80% predicted) and GOLD II (moderate COPD; FEV1/FVC  $<$  0.7 and 50%  $\leq$  FEV1  $<$  80% predicted) [5,9]. Dyspnea perception assessed with the Modified Borg Scale (0–10) [10] was 2.4  $\pm$  2.1. In the ASTHMA group there were 20 patients (10 women

and 10 men) aged 55 ( $\pm 5$ ) years, FEV1/FVC  $< 0.7$  and  $60\% \leq FEV1 < 80\%$  predicted, dyspnea perception  $2.8 \pm 2.4$ .

During the three-week stay, the patients were subjected to comprehensive rehabilitation. Individual inhalations were held every day – alternating brine and spring water Mieszko (0.32% bicarbonate-sodium) inhalations. Three times daily, before meals, crenotherapy (3 x 250 ml) with water Mieszko and Młynarz (0.19% bicarbonate-sodium-magnesium) was used. Every day Sollux lamp irradiation of the chest, magnetotherapy and chest massage using tapotement (percussion) technique were applied. Patients individually performed breathing exercises, which they had learned earlier, and had at least a 15-minute walk. Group gymnastics, during which breathing and general improvement exercises dominated, was carried out 3 times a week and lasted 30 minutes. Pulmonary rehabilitation included aerosol therapy by bronchodilators (solution of 0.5 ml Berodual/3 ml 0.9% NaCl) through an inhalator (jet nebuliser) under 5 kPa pressure. Aerosol therapy took approximately 10 min. During that time the patient was breathing diaphragmatic under the instructions and supervision of a physiotherapist.

For the subjective evaluation of the patients' health status, the Visual Analogue Scale (VAS) was used. Patients were asked twice (on the first and last day of the stay) about the assessment of their health status on a scale from 0 (poor health) to 10 (very good health).

The evaluation of exercise capacity was based on the 6-minute walk test. Immediately before the test the patients' heart rate and blood pressure were measured, and they were instructed about the course of the test. Measurements of blood pressure and the heart rate were made in a sitting position on the left arm using an electronic sphygmomanometer SOHO 350. A length of 30-meter was determined in the corridor, and the patient was instructed to march as quickly as possible within 6 minutes. The tested person was informed that in case of dyspnea, fatigue or discomfort he/she should slow down, rest or stop the test. During the march, every 2 minutes, the time remaining to complete the test was given. After 6 minutes the heart rate and blood pressure were measured again. The test was performed twice - on the first (TEST 1) and last (TEST 2) day of the stay.

The results were analyzed in two separate groups of patients: COPD and ASTHMA. Mean values and standard deviations of the measured parameters were calculated. The normality of data distribution was verified with the Shapiro-Wilk test. As the distribution of the data was consistent with a normal distribution, in order to compare the results obtained during the performed tests at the beginning and in the final phase of the stay, Student's t-test for dependent groups was used. Statistically significant differences were considered when  $p \leq 0.05$ . Statistical analyses were performed using the computer program STATISTICA 10.0 (StatSoft).

Abbreviations of the measured parameters:

SBP1 – systolic blood pressure measured directly before the 6-minute walk test  
SBP2 – systolic blood pressure measured immediately after the 6-minute walk test  
DBP1 – diastolic blood pressure measured directly before the 6-minute walk test  
DBP2 – diastolic blood pressure measured immediately after the 6-minute walk test

HR1 - heart rate measured directly before the 6-minute walk test  
 HR2 - heart rate measured immediately after the 6-minute walk test

## RESULTS

On the last day of the stay in the sanatorium, patients with COPD significantly better ( $p \leq 0.05$ ) evaluated their health by VAS (8.3 cm) than at the time they had arrived (7.3 cm) - Tab.1. During rehabilitation, the distance covered by the patients in the marching test increased by an average of 9 m ( $p \leq 0.05$ ). Between successive tests there were no statistically significant changes in the image of resting blood pressure. The average systolic blood pressure after finishing the test in the final phase of the rehabilitation stay was 6 mmHg lower in comparison to a study on the first day of the stay ( $p \leq 0.05$ ). A similar difference between successive tests (5 mmHg,  $p \leq 0.05$ ) was observed in the image of diastolic blood pressure recorded immediately after completing the marching test.

In the first study, the average heart rate at rest was 69.6 bpm, in the second study - 67.8 bpm ( $p \leq 0.05$ ). Also the exercise heart rate (measured directly after the 6-minute walk test) was significantly lower ( $p \leq 0.05$ ) at the end of 3weeks' rehabilitation. The decrease in the exercise heart rate was about 3 bpm.

Table 1. The mean values ( $\pm$ SD) of the parameters recorded during the 6-minute walk test in patients with COPD

PARAMETER	TEST 1	TEST 2	STATISTICAL SIGNIFICANCE*
VAS [cm]	7.3 ( $\pm$ 1.01)	8.3 ( $\pm$ 0.85)	*
DISTANCE [m]	479.4 ( $\pm$ 17.84)	488.8 ( $\pm$ 17.63)	*
SBP1 [mmHg]	115.3 ( $\pm$ 6.95)	113.8 ( $\pm$ 7.18)	
DBP1 [mmHg]	76.8 ( $\pm$ 7.89)	75.9 ( $\pm$ 6.43)	
HR1 [bpm]	69.6 ( $\pm$ 6.25)	67.8 ( $\pm$ 5.14)	*
SBP2 [mmHg]	125.0 ( $\pm$ 7.07)	119.0 ( $\pm$ 7.26)	*
DBP2 [mmHg]	87.0 ( $\pm$ 5.60)	82.0 ( $\pm$ 9.03)	*
HR2 [bpm]	96.2 ( $\pm$ 11.80)	93.4 ( $\pm$ 9.76)	*

\* statistical significance of Student's t-test for dependent samples at  $p \leq 0.05$ ; TEST 1 - the first day of the stay, TEST 2 the last day of the stay.

Very similar changes in the measured parameters were observed in patients with bronchial asthma. In this group self-assessed health also significantly improved. On arrival, the mean VAS score was 6.7 cm, while on the last day of the sanatorium stay the VAS score was on average 1 cm higher ( $p \leq 0.05$ ) - Tab. 2. During the 6-minute walk test conducted on their last day of rehabilitation, patients covered a distance of up to 17.5 m longer than the distance covered on the first day ( $p \leq 0.05$ ). The values of resting blood pressure remained almost unchanged between the successive tests. Average systolic blood pressure measured immediately after exercise during the second test was about 3 mmHg lower in comparison with the first study ( $p \leq 0.05$ ). Exercise diastolic blood pressure was approximately 4 mmHg lower in the second study

( $p \leq 0.05$ ). Resting heart rate measured in the final phase of the stay was on average 2 bpm lower than that measured in the first study ( $p \leq 0.05$ ). An even greater decrease (7 bpm) was observed in the exercise heart rate ( $p \leq 0.05$ ).

Table 2. The mean values ( $\pm$ SD) of the parameters recorded during the 6-minute walk test in patients with bronchial asthma

PARAMETER	TEST 1	TEST 2	STATISTICAL SIGNIFICANCE*
VAS [cm]	6.7 ( $\pm$ 0.93)	7.7 ( $\pm$ 1.00)	*
DISTANCE [m]	482.8 ( $\pm$ 31.35)	500.3 ( $\pm$ 30.88)	*
SBP1 [mmHg]	118.5 ( $\pm$ 10.01)	119.1 ( $\pm$ 7.18)	
DBP1 [mmHg]	81.0 ( $\pm$ 9.11)	81.5 ( $\pm$ 6.70)	
HR1 [bpm]	64.6 ( $\pm$ 4.68)	62.6 ( $\pm$ 4.35)	*
SBP2 [mmHg]	129.0 ( $\pm$ 7.88)	126 ( $\pm$ 5.52)	*
DBP2 [mmHg]	92.3 ( $\pm$ 6.97)	88.5 ( $\pm$ 6.90)	*
HR2 [bpm]	100.3 ( $\pm$ 0.09)	93.15 ( $\pm$ 7.1)	*

\* statistical significance of Student's t-test for dependent samples at  $p \leq 0.05$ ; TEST 1 – the first day of the stay, TEST 2 – the last day of the stay.

## DISCUSSION

Both in patients with COPD and in patients with asthma there was an increase in the distance covered in the 6-minute walk test after the 3-week comprehensive rehabilitation. Leke et al. conducting a rehabilitation program in the form of circuit exercise training also showed statistically significant improvement in the distance covered in the 6-minute walk test, with the difference that in their case, the patients participated in 8 weeks' rehabilitation [11]. Szczegielniak et al. also observed lengthening of the covered distance in the 6-minute walk test during the 3-week comprehensive rehabilitation, both in patients with stable COPD course, and patients being in the period of exacerbation of the disease [12]. Works of other researchers confirm the effect of exercise training on the growth of exercise tolerance of patients with COPD [13,14].

In both groups a statistically significant decrease in the heart rate measured after completion of the 6-minute walk test was observed. Exercise heart rate was significantly lower in the second test (TEST 2), in which patients covered a longer distance, which means that patients sustained lower physiological cost doing more work at the same time. A subjective evaluation of the health status of patients during the rehabilitation stay significantly improved. Also, the results of Lewczuk and Piszko suggest a beneficial effect in terms of improving health after sanatorium treatment of patients with respiratory diseases [15].

A stay in the sanatorium shows to patients positive effects of physiotherapy and motivates them to undertake exercise. Sanatorium treatment that uses the healing properties of natural remedies such as medicinal water and the climate is much more favorable than ambulatory rehabilitation. Sanatorium treatment is carried out in a place less exposed to environmental pollution and away from the problems of everyday life [16].

## CONCLUSIONS

A three-week stay in a sanatorium, during which comprehensive rehabilitation was conducted, caused an increase in exercise capacity in patients with COPD and asthma, which manifested itself in an elongation of the distance covered in the walk test and a reduction in the heart rate and blood pressure immediately after exercise.

After completion of a rehabilitation stay, self-assessed health of the patients improved in both of the examined groups.

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