fizjoterapia polska

POLISH JOURNAL OF PHYSIOTHERAPY

OFICJALNE PISMO POLSKIEGO TOWARZYSTWA FIZJOTERAPII

THE OFFICIAL JOURNAL OF THE POLISH SOCIETY OF PHYSIOTHERAPY

NR 1/2018 (18) KWARTALNIK ISSN 1642-0136

Wpływ lecznictwa uzdrowiskowego na funkcję ręki u kobiet z reumatoidalnym zapaleniem stawów

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Assessment of overload changes in the lumbar spine of employees with sedentary nature of work

fizjoterapia polska
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Kwalifikacja do fizjoterapii chorych na POChP na podstawie testu 6-minutowego marszu i testu na bieżni ruchomej

Eligibility of COPD patients for physiotherapy based on a six minute walk test and treadmill test

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Streszczenie

Cel pracy. Celem pracy była ocena efektów fizjoterapii chorych na POChP zakwalifikowanych do odpowiedniego modelu usprawniania przy użyciu testu 6-MWT i testu na bieżni ruchomej wg zmodyfikowanego protokołu Bruce'a.
Materiał i metody badań. Zbadano 80 chorych na POChP leczonych stacjonarnie w Szpitalu Specjalistycznym MSWiA w Głuchołazach od maja 2017 roku do września 2017 roku. Przed i po 3-tygodniowej kompleksowej fizjoterapii w obu grupach badanych chorych na POChP przeprowadzono test wysiłkowy, badanie spirometryczne oraz ocenę duszności w zmodyfikowanej 10-stopniowej skali Borga.
Wyniki badań. Obliczenia wykonano w programie IBM SPSS. W celu oceny zgodności rozkładów z rozkładem normalnym zastosowano test Kołmogorowa-Smirnowa. Ponieważ rozkłady odbiegały od rozkładu normalnego w dalszych analizach stosowano metody nieparametryczne. Do oceny istotności różnic między dwiema grupami w zakresie zmiennych ilościowych stosowano testy Manna-Whitneya, w przypadku oceny istotności zmian w czasie u tych samych pacjentów (pary wiązane) stosowano testy Wilcoxona dla prób zależnych. Jako granicę istotności statystycznej przyjęto $p < 0,001$.
Wnioski
1. Stwierdzono istotną poprawę tolerancji wysiłkowej po zastosowaniu fizjoterapii zarówno w grupie chorych ocenianych testem wg zmodyfikowanego protokołu Bruce'a jak i 6-minutowego testu marszowego
2. Wykazano istotną poprawę wartości wskaźników spirometrycznych po zastosowaniu fizjoterapii zarówno w grupie chorych ocenianych testem wg zmodyfikowanego protokołu Bruce'a jak i 6-minutowego testu marszowego
3. Wykazano zmniejszenie duszności po zastosowaniu fizjoterapii zarówno w grupie chorych ocenianych testem wg zmodyfikowanego protokołu Bruce'a jak i 6-minutowego testu marszowego

Słowa kluczowe:
POChP, zmodyfikowany protokół Bruce'a, test 6-MWT, fizjoterapia

Abstract

Objective. The aim of the paper was to assess the results of physiotherapy of COPD patients whose elgibility for the relevant rehabilitation model was assessed with the help of the 6-MWT test and the treadmill test according to the modified Bruce protocol.
Materials and methods. 80 individuals suffering from COPD treated as in-patients at the MSWiA Specialist Hospital in Głuchołazy between May 2017 and September 2017 were examined. After a 3-week comprehensive physiotherapy, the exercise stress test, spirometry test and dyspnoea assessment on the modified 10-point Borg scale were repeated in both groups of COPD patients.
Results. Calculations were performed using the IBM SPSS software. In order to assess consistency between the distribution of the results with the normal distribution, the Kolmogorov-Smirnov test was used. As the distribution differed from the normal distribution, nonparametric methods were used for further analysis. In order to assess the significance of differences between the two groups in terms of quantitative variables, Mann-Whitney tests were used, while Wilcoxon tests were used for dependent samples to assess the significance of changes over time in the same patients (bound pairs). The statistical significance threshold was set at $p < 0.001$.
Conclusions
1. A significant improvement was noticed in the level of exercise stress tolerance after physiotherapy both among patients assessed according to the modified Bruce test and patients assessed with the 6-minute walk test.
2. A significant improvement was shown in the values of spirometric indicators after physiotherapy both among patients assessed according to the modified Bruce test and patients assessed with the 6-minute walk test.
3. A significant decrease was shown in the level of dyspnoea after physiotherapy both among patients assessed according to the modified Bruce test and patients assessed with the 6-minute walk test.

Key words:
COPD, modified Bruce protocol, 6-MWT test, physiotherapy

Introduction

In case of patients suffering from chronic obstructive pulmonary disease (COPD), their eligibility for physiotherapy and its potential effectiveness should be assessed on the basis of exercise stress tests. While assessing patients' eligibility for the right rehabilitation model, the results of a pulmonary function test should also be taken into consideration as the basis for selecting specific breathing exercises and the right level of stress during exercises [1, 2, 3, 4, 5, 6, 7, 8]. An important eligibility criterion is also the presence of dyspnoea, usually assessed on the modified Borg scale or the visual analogue scale [1, 6, 9, 10, 11].
Currently there are no literary publications regarding standards of use of exercise stress tests in the assessment of eligibility and effectiveness of physiotherapy in case of COPD patients. Therefore, it was decided to examine whether the use of an exercise stress test performed on a treadmill according to the modified Bruce protocol and the 6-MWT in the assessment of patients' eligibility for the right rehabilitation model has an impact on the results of rehabilitation of COPD patients.

Objective

The aim of the paper was to assess the results of physiotherapy of COPD patients whose elgibility for the relevant rehabilitation model was assessed with the help of the 6-MWT test and the treadmill test according to the modified Bruce protocol.

Materials and methods

80 individuals suffering from COPD treated as in-patients at the MSWiA Specialist Hospital in Głuchołazy between May 2017 and September 2017 were examined. The study eligibility criteria were: diagnosed COPD, referral for physiotherapy, patient's consent to participate in the study. The study exclusion criteria were: co-morbidities impacting the patient's functioning, diseases of the locomotor system obstructing locomotion, non-standard pharmacological treatment.
The patients were randomly divided into two groups; group I (test group) included 40 patients (25 females and 15 males), group II (control group) included 40 patients (27 females and 13 males). The average age of the test group was 63 years old (SD = 9.20), in the control group 64 years old (SD = 9.34) (Fig. 1).

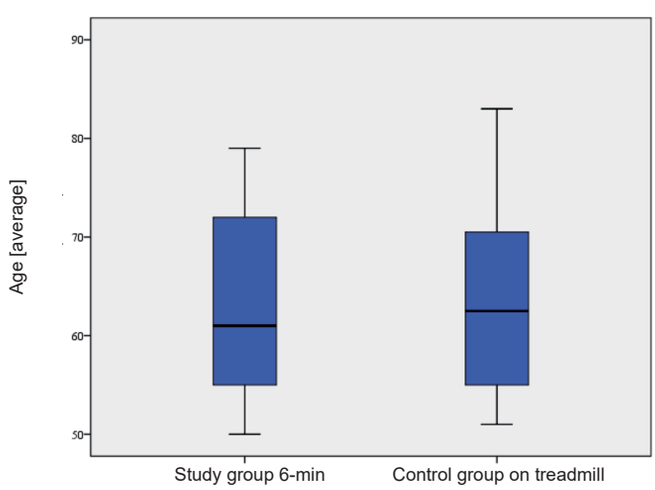

Fig.1. The average age of the test group and in the control group

All patients were assessed in terms of exercise stress tolerance in order to assess their eligibility for the relevant rehabilitation model and to assess the results of physiotherapy.
The 6-MWT was performed on group I (test group). The test took place in the hospital corridor and involved waking the furthest possible distance in 6 minutes. The level of dyspnoea of each patient was assessed before and directly after the test. The patients were informed about the aim of the test, the test procedure and the method of dyspnoea assessment according to the 10-point Borg scale.
Based on the distance travelled and walking time, the walking speed and energy expenditure expressed in METS were calculated. The average walking speed of the patients was calculated on the basis of the following formula [6]:

Average walking speed = (number of metres x 10)/1000.

In case of patients who walked under 250 metres, the energy expenditure value was calculated on the basis of the following formula [12]:

MET = [(walking speed x 1.667)+3.5]/3.5.

In case of patients who walked over 250 metres, the energy expenditure value was calculated on the basis of the following formula [12]:

MET = -0.0971 x V3 +1.5021 x V2 – 5.3762 x V.

In group II (control group), the exercise stress test was performed on a treadmill to assess the energy expenditure value expressed in METs according to the modified Bruce protocol up to the submaximal heart rate, i.e. to achieving 85% of the maximum heart rate in accordance with the applicable standards. The level of dyspnoea of each patient was assessed before and directly after the test on the 10-point Borg scale [6, 11, 12].
In order to assess the patients' eligibility for physiotherapy, a spirometry test was also performed with the use of the MasterLab-Transfer device by Jaeger. For assessment purposes, first second forced expiratory flow index (FEV1) was taken into account and compared with independent values [Tab. 1].
The basic physiotherapy eligibility criterion in both groups was the exercise stress tolerance test and a pulmonary ventilation function test (FEV1 index); another aspect considered was also dyspnoea according to the modified 10-point Borg scale as well as general physical fitness [13].
The results of the exercise stress test also constituted the basis for selecting the level of exercise stress individually for each patient [2, 3, 13].
All patients participated in pulmonary rehabilitation model C [2, 3], which comprised of: breathing exercises, general rehabilitation exercises, functional training on a bicycle ergometer with individually established stress level taking into consideration the results of the exercise stress test, 0.9% NaCl solution inhalations, postural drainage and effective cough, tapping the chest (Tab. 2).

Table 1. Eligibility to t A, B or C pulmonary rehabilitation model

Exercise stress test / spirometry	< 3 MET / < 50 W	3-4, 9 MET / 50-75 W	5-6, 9 MET / 75-100 W	≥ 7 MET / ≥ 100 W
< 30% FEV_1	D	D	D	B
30-50% FEV_1	D	D/C	C/B	B/A
50-80% FEV_1	D	C	B	A
> 80% FEV_1	D	C	B	A

Tab. 2. Model C rehabilitacji pulmonologicznej [2, 3]
Tab.2. Pulmonary rehabilitation model C [2, 3]

Model C	Breathing exercises 1 x once daily 30 minutes am, general rehabilitation exercises 1 x once daily 30 minutes am, functional training on a bicycle ergometer (up to training heart rate) 1 x once daily 30 minutes am, solution inhalations, postural drainage and effective cough, tapping the chest

After a 3-week comprehensive physiotherapy, the exercise stress test, spirometry test and dyspnoea assessment on the modified 10-point Borg scale were repeated in both groups of COPD patients.

Results

Calculations were performed using the IBM SPSS software. In order to assess consistency between the distribution of the results with the normal distribution, the Kolmogorov-Smirnov test was used. As the distribution differed from the normal distribution, nonparametric methods were used for further analysis. In order to assess the significance of differences between the two groups in terms of quantitative variables, Mann-Whitney tests were used, while Wilcoxon tests were used for dependent samples to assess the significance of changes over time in the same patients (bound pairs). The statistical significance threshold was set at $p < 0.001$.
Own research showed that before physiotherapy the average energy expenditure values expressed in METs reached 4.1695 for the test group (group I).
After 3 weeks of physiotherapy, the average energy expenditure values expressed in METs reached 6.1268. In case of patients from the test group, statistically significant increase in energy expenditure was noticed during the 6-MWT on the level of $p < 0.001$ (Tab. 3, Fig. 2, 3).

Table 3. 6-MWT test before and after physiotherapy

	Test 6-MWT						
	Mean	Me	SD	Min	Max	N	P
MET in 6-MWT before physiotherapy	4.1695	4.1250	0.71004	3.09	5.33	40	< 0.001
MET in 6-MWT after physiotherapy	6.1268	6.2850	0.78566	4.47	7.91	40	

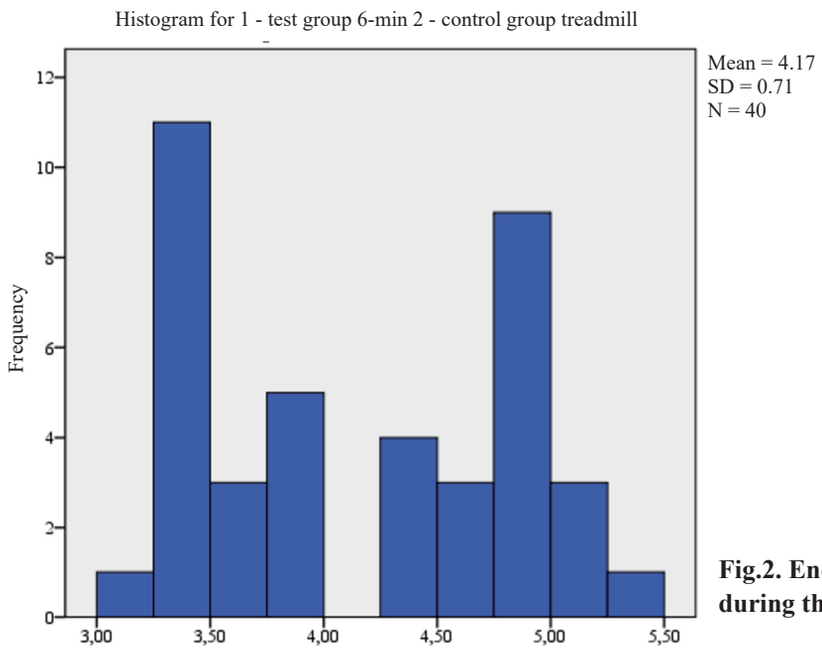

Fig.2. Energy expenditure values expressed in METs during the 6-MWT before physiotherapy

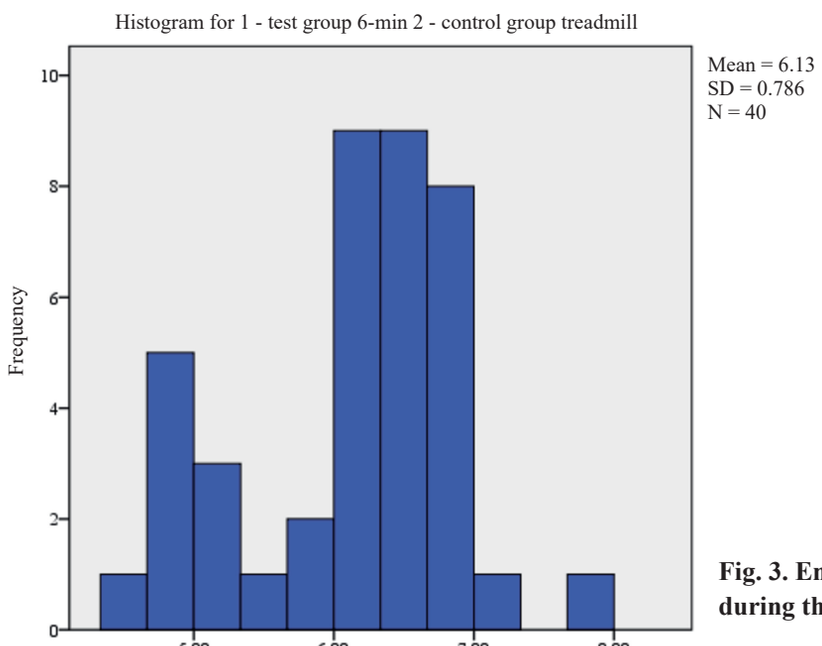

Fig. 3. Energy expenditure values expressed in METs during the 6-MWT after physiotherapy

The study showed that before physiotherapy the average energy expenditure values expressed in METs reached 4.3918 for the control group (group II).
After 3 weeks of physiotherapy, the average energy expenditure values expressed in METs reached 5.0353. In case of patients from the test group, statistically significant increase in energy expenditure was noticed during the 6-MWT on the level of $p < 0.001$ (Tab. 4; Fig. 4, 5, 6).

Table 4. 6-MWT test before and after physiotherapy

	Test 6-MWT						
	Mean	Me	SD	Min	Max	N	P
MET in 6-MWT before physiotherapy	4.3918	4.5700	0.60366	3.22	5.22	40	< 0.001
MET in 6-MWT after physiotherapy	5.0353	5.2400	0.67277	3.54	5.91	40	

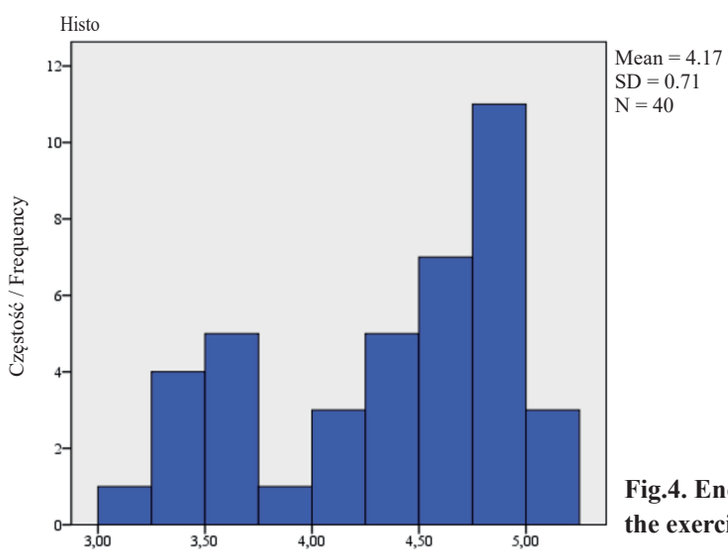

Fig.4. Energy expenditure values expressed in METs during the exercise stress test on a treadmill before physiotherapy

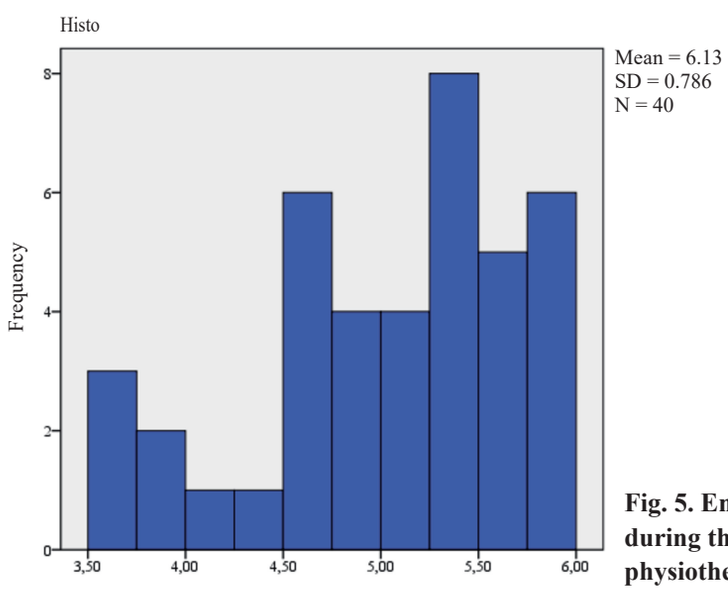

Fig. 5. Energy expenditure values expressed in METs during the exercise stress test on a treadmill after physiotherapy

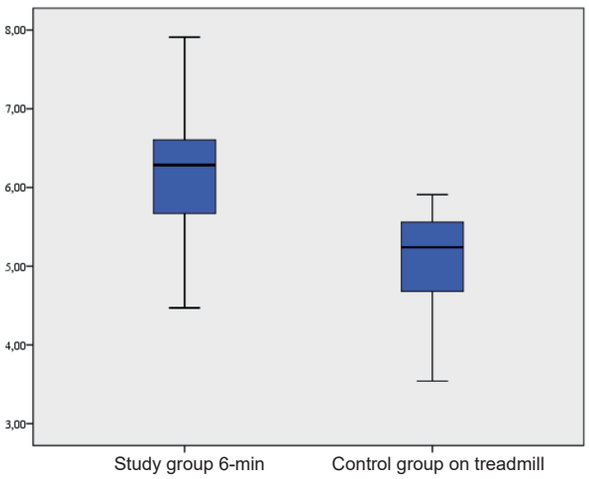

Fig.6. Energy expenditure values expressed in METs during the exercise stress test on a treadmill and 6-MWT after physiotherapy

In the test group, before physiotherapy the average FEV_1 index values reached 71.50% of the predicted normal value in COPD patients. After 3 weeks of physiotherapy, the average values of the FEV_1 index reached 85.78% of the predicted normal value. In the test group, a statistically significant increase in the examined index was noticed in the COPD patients at the level of $p < 0.001$ (Tab. 5).

Tab.5. Spirometry test before and after physiotherapy in study group

	Wskaźnik FEV_1 / Values of the FEV_1						
	Mean	Me	SD	Min	Max	N	P
FEV_1 before physiotherapy	71.50	68.50	90.50 13.906	13.302	52	94	40
FEV_1 after physiotherapy	85.78			51		103	

In the control group, before physiotherapy the average FEV_1 index values reached 74.43% of the predicted normal value in COPD patients. After 3 weeks of physiotherapy, the average values of the FEV1 index reached 83.45% of the predicted normal value. In the control group, a statistically significant increase in all examined indexes was noticed in the COPD patients at the level of $p < 0.001$ (Tab. 6, Fig. 7, 8).
Own research showed that before physiotherapy, the level of dyspnoea after the 6-MWT test reached 4.28 on the 10-point

	Values of the FEV_1						
	Mean	Me	SD	Min	Max	N	P
FEV_1 before physiotherapy	74.43	75.00	14.650	42	96	40	< 0.001
FEV_1 after physiotherapy	83.45	85.00	14.333	49	109	40	

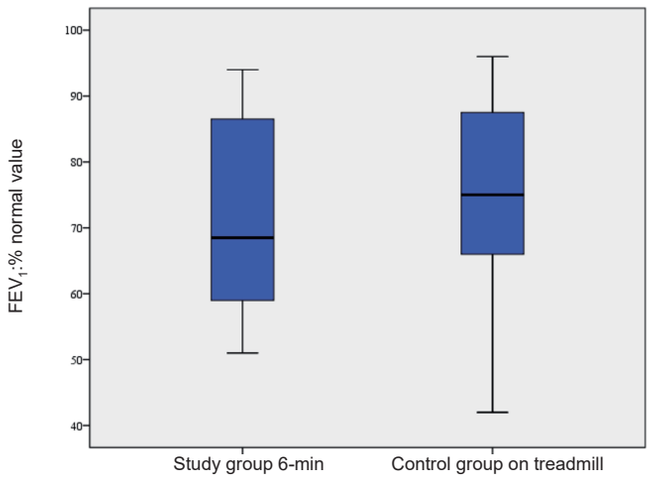

Fig.7. FEV_1 in the test and control group before physiotherapy

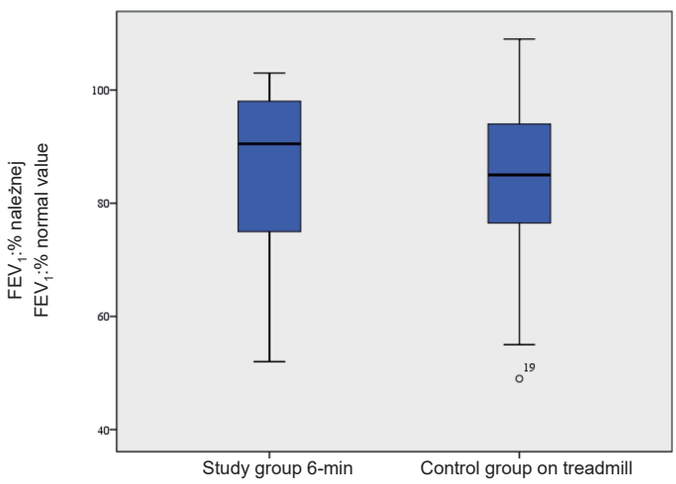

Fig. 8. FEV_1 in the test and control group after physiotherapy

Borg scale in the test group (group I). After 3 weeks of physiotherapy, the level of dyspnoea after the 6-MWT test fell to 1.70. In case of patients from the test group, statistically significant drop in the level of dyspnoea was noticed after the 6-MWT on the level of $p < 0.001$ (Tab. 7).

Own research showed that before physiotherapy, the level of dyspnoea after the 6-MWT test reached 4.08 on the 10-point

Tab.7. Dyspnoea after the 6-MWT before and after physiotherapy - study group

	6-MWT Test						
	Mean	Me	SD	Min	Max	N	P
Dyspnoea after test before physiotherapy	4.28	4.00	0.716	3	6	40	< 0.001
Dyspnoea after test after physiotherapy	1.70	1.00	1.897	0	12	40	

Borg scale in the test group (group I). After 3 weeks of physiotherapy, the level of dyspnoea after the 6-MWT test fell to 3.30. In case of patients from the test group, statistically significant drop in the level of dyspnoea was noticed after the 6-MWT on the level of $p < 0.001$ (Tab. 8, Fig. 9).

Table 8. Dyspnoea after exercise stress test on a treadmill before and after physiotherapy - control group

	Exercise stress test on a treadmill						
	Mean	Me	SD	Min	Max	N	P
Dyspnoea after test before physiotherapy	4.08	4.00	0.797	3	5	40	< 0.001
Dyspnoea after test after physiotherapy	3.30	3.00	0.853	2	5	40	

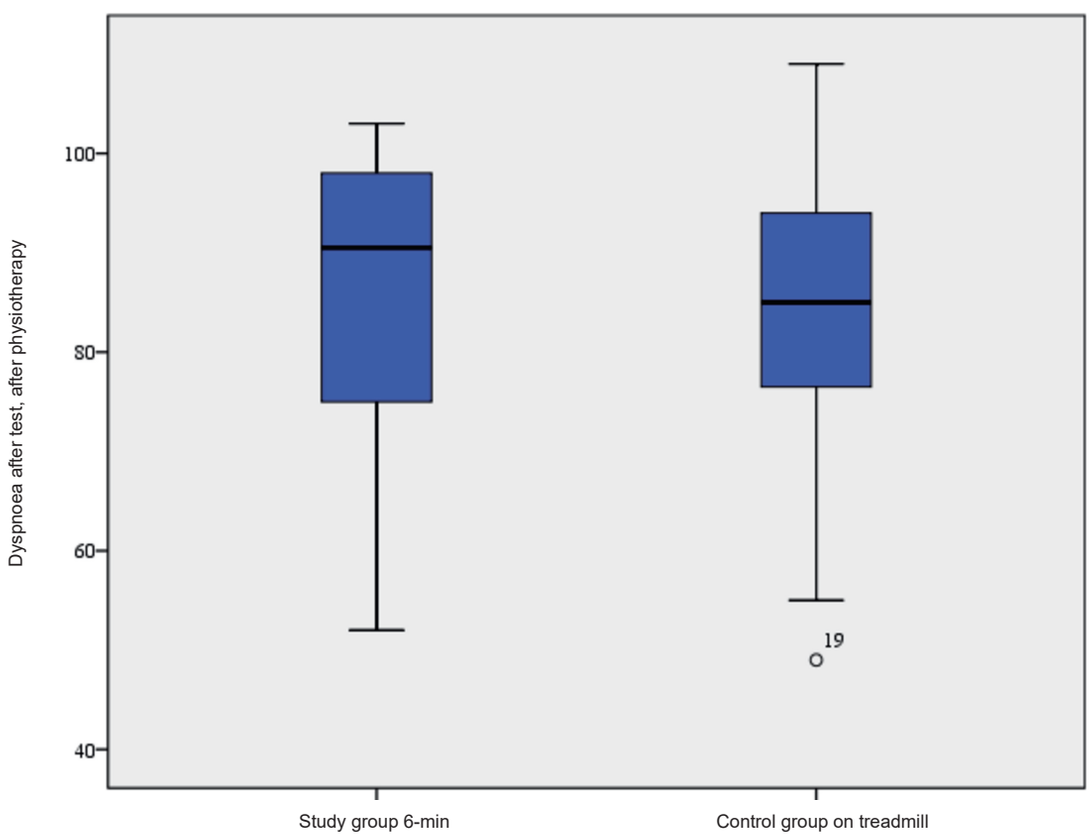

Fig. 9. Dyspnoea after test in both group after physiotherapy

Discussion

Reduced stress tolerance and exercise-induced dyspnoea are among the main symptoms of COPD [14]. There are many papers available whose authors set out the tasks of physiotherapy for COPD patients, which mostly include an individualised physiotherapy programme, paying particular attention to the right level of stress during exercises [24, 27, 28, 29, 30, 31, 32]. With physiotherapy stress tolerance and physical fitness improve in COPD patients, which contributes to an increased quality of life

of such patients, reduced tiredness and dyspnoea [15, 16]. Individualised treatment should be based on an in-depth examination of the patient and correct assessment of their eligibility for physiotherapy to ensure that the stress level is safe for the patient and at the same time that the exercise is intense enough to improve their tolerance and physical functioning [17].

According to the authors, while assessing patients' eligibility for physiotherapy we should consider the results of a stress tolerance test and physical function test, level of dyspnoea, spirometry test, muscle strength and quality of life assessment. According to ATS/ERS guidelines, the efficiency of a pulmonary rehabilitation programme should be based on, among others, the results of an exercise stress test [10, 19, 32, 25, 33, 34, 35, 36, 37, 38, 39, 40]. Therefore, in the authors' opinion, it seems justified to perform an exercise stress test on patients who do not show symptoms of exercise-induced dyspnoea and have no contraindications related to the cardiovascular system before commencing physiotherapy [18, 19, 20, 21, 22, 23]. However, there are no detailed guidelines with regard to the performance of tests used to assess patient eligibility and to determine the level of exercise stress. There are no guidelines with regard to the use of tests which are the most effective in establishing stress tolerance and stress levels.

Own research shows that assessment of patients' eligibility for the relevant physiotherapy model may be based on both a treadmill test and a 6-MWT test. The analysis shows that exercise capacity can be determined on the basis of the 6-MWT test in order to determine the right level of exercise stress in COPD patients.

During the study, an improvement was seen in the examined parameters in both group I and II, which proves that the assessment of the patients' eligibility for pulmonary physiotherapy was correct and that the level of exercise stress was appropriate. In the proposed physiotherapy method, the assessment of exercise stress tolerance also constituted the basis for selecting the level of exercise stress. Selection of the right, precise level of stress taking into account the heart rate determined during the exercise stress test allowed for an improvement in stress tolerance and a reduction in the level of dyspnoea in COPD patients after completion of the physiotherapy programme.

Conclusions

1. A significant improvement was noticed in the level of exercise stress tolerance after physiotherapy both among patients assessed according to the modified Bruce test and patients assessed with the 6-minute walk test.
2. A significant improvement was shown in the values of spirometric indicators after physiotherapy both among patients assessed according to the modified Bruce test and patients assessed with the 6-minute walk test.

3. A significant decrease was shown in the level of dyspnoea after physiotherapy both among patients assessed according to the modified Bruce test and patients assessed with the 6-minute walk test.

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