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Skeletal muscle dysfunction, sarcopenia and sarcopenic obesity in patients with chronic obstructive pulmonary disease

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Abstract. Background. Chronic obstructive pulmonary disease (COPD) is often associated with musculoskeletal dysfunction, including skeletal muscle dysfunction, sarcopenia, osteoporosis, and obesity. The purpose was to assess skeletal muscle status and determine the prevalence of sarcopenia and sarcopenic obesity in patients with COPD. **Materials and methods.** 66 patients with COPD and 35 healthy subjects had been examined. Sarcopenia was established using EWGSOP2 criteria, and sarcopenic obesity was defined in the presence of sarcopenia with a body mass index $> 25 \text{ kg/m}^2$. **Results.** In 59.1 % of the patients with COPD, a decrease in skeletal muscle strength was found, in particular, by 28.2 % in women and by 39.1 % in men at GOLD 4 in comparison with GOLD 1 and by 40.7 % and 54.3 %, respectively, compared to the control. A decrease in leg circumference (by 16.3 % in women and by 20.8 % in men) was determined at GOLD 4 compared to GOLD 1. A decrease in walking speed by 20 % in women and by 27.3 % in men was determined at GOLD 4 in comparison with GOLD 1 and a reliable correlation inverse connection between age and walking speed ($r = -0.72$ — in women and $r = -0.61$ — in men). A significant decrease in the lean mass of the limbs was established in COPD patients over 45 years old and with GOLD 2, lean and fat mass indices — with GOLD 3, appendicular lean mass — with GOLD 4 and over 60 years old. A direct correlation link was established between the severity of COPD and android type of obesity ($r = 0.41$; $p < 0.05$). **Conclusions.** Sarcopenia was diagnosed in 66.7 % of the patients with COPD and 5.7 % of the control group, and sarcopenic obesity was diagnosed in 27.3 % of the patients with COPD. An increase in the share of sarcopenia was observed with age (from 50 % among young people to 91.7 % among subjects over 60 years old) and sarcopenic obesity (from 25 % of subjects under 45 years old to 55.6 % over 60 years old) and with increasing severity of COPD (from 20 % with GOLD 1 to 100 % with GOLD 4 and from 42.9 % with GOLD 1 to 50 % with GOLD 4, respectively). **Keywords:** chronic obstructive pulmonary disease (COPD); muscle tissue; lean mass; skeletal muscle dysfunction; sarcopenia; sarcopenic obesity; age

Introduction

Chronic obstructive pulmonary disease (COPD) is a pathology with a complex and not fully studied pathogenesis, which is characterized by a high frequency of concomitant pathology [1-3] or systemic manifestations, in particular, a decrease in nutritional status and tolerance to physical exertion, skeletal muscle dysfunction, sarcopenia, osteoporosis, obesity and, as a result, disorders of musculoskeletal function [4, 5].

Sarcopenia, in accordance with the updated recommendations of the European Working Group on the study of sarcopenia (European Working Group of Sarcopenia in Older People (EWGSOP2), 2018), is a muscle disease (muscle

failure) that is characterized by a progressive generalized loss of strength and muscle mass and increase the risk of developing such complications as impaired motor activity and reduced quality of life [6-8]. Sarcopenia is common among adults of old age and is caused by muscle changes that are accumulated throughout life; however, today it has many other reasons, besides aging, for its occurrence and development [7].

COPD leads to the dysfunction of the muscular component of the diaphragm and can lead to insufficient ventilation of the lungs, while loss of peripheral muscle mass and/or function because of COPD limits physical capabilities in daily life, that is leading to an increase of body weight

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[9]. As a result, lung function decreases, cardiovascular and metabolic diseases occur more often, and sarcopenic obesity develops [10, 11].

The questions of the systemic nature of muscle changes and the single processes in different groups of muscles that lead to sarcopenia are debatable for today. Many authors consider skeletal muscle dysfunction to be a direct consequence of inflammatory processes during COPD [9, 12, 13]. Others suggest that sarcopenia is an independent process that contributes to systemic inflammation and progression of the principle disease [12, 14]. The available modern scientific data substantiate the relevance of the study of skeletal muscles in patients with COPD.

The aim of the study was to assess the body composition and to determine the prevalence of sarcopenia and sarcopenic obesity in patients with COPD.

Materials and methods

Population

A one-center open study was conducted at our clinical department during the year, in which 66 patients with COPD had participated. The patients had been included in the study only if they gave their voluntary informed consent with the purpose and scope of the planned studies. The study had been approved by the local ethical committee of Vinnytsia National Medical University. The criteria for inclusion in the study: hospitalization in a hospital because of exacerbation of COPD; the diagnosis of COPD was established at least 6 months before the start of the study; the age of the patients is more than 27 years. The average age of the patients was 53.59 ± 12.83 years. Male and female persons are equally distributed – 50.0 % (33 persons of each gender). Shortness of breath was evaluated in accordance with the mMRC scale (Modified scale of the Medical Research Council) and the COPD assessment test (CAT) [2, 15]. According to the results of the testing, all patients had been divided into clinical groups (Table 1).

The control group consisted of 35 healthy subjects (16 women and 19 men) at the age of 49.62 ± 10.81 years old.

Methods

We determined the degree of the development of adipose tissue, and the body mass index (BMI) was calculated. In all groups of the subjects, the BMI index cor-

responded to excess body weight (the average index was 27.77 ± 0.16 kg/m²).

The diagnosis of sarcopenia was established on the basis of the EWGSOP2 criteria, according to which "cutoff" points for the diagnosis of sarcopenia had been proposed. The following stages are distinguished: I – probable sarcopenia, that is characterized by a decrease in the strength of skeletal muscles without a decrease in their mass and function; II stage – sarcopenia, that is characterized by a decrease in the strength of skeletal muscles with a decrease in their mass or function; Stage III is severe sarcopenia, that is characterized by a decrease in all three criteria (mass, strength, and function) [6, 7]. Sarcopenic obesity was established in the patients with sarcopenia with a BMI > 25 kg/m² [8].

Skeletal muscle strength (kg) was assessed using a manual spring dynamometer DRP-10, which the patient squeezes with the hand of an extended upper limb. A decrease of muscle strength was recorded at the following values: in men < 27 kg, in women < 16 kg.

The lower leg circumference reflected the muscle mass (a lower leg circumference < 31 cm was considered as reduced).

An 8-step walking test for the speed assessment was used to estimate the functional capabilities of skeletal muscles (a speed of < 0.8 m/s was considered as reduced).

Body composition indices had been calculated using dual-photon X-ray absorptiometry (DXA) («Prodigy», GEHC Lunar, Madison, WI, USA):

lean mass index (LMI) = lean body mass (kg) / height (m²). Cut-off point of LMI < 16 kg/m²;

appendicular lean mass index (upper and lower limbs) (ALMI) = lean mass of upper (Lean Arms) and lower (Lean Legs) limbs (kg) / height (m²). ALMI cut-off point < 7.0 kg/m² in men, < 6.0 kg/m² in women;

fat mass index (FMI) = body fat mass (Fat) (kg) / height (m²).

Statistical analysis was performed out using the computer program "Statistica 6.1." (Stat Soft Inc., USA). Data are presented as mean values and their standard deviations (M ± SD). Comparison of two independent groups was performed using the Student's test (t) for unrelated samples. The estimation of the correlations between indices was evaluated using the Pearson's test (r). The critical level of

Table 1. Division of COPD patients by age and degree of severity

Groups	n	Age	Clinical characteristics
Group A, GOLD 1	15	42.75 ± 0.29	mMRC=0–1 and/or by CAT < 10 points and up to 1 exacerbation of COPD during the past year
Group B, GOLD 2	25	55.20 ± 0.36	mMRC ≥ 2 and/or by CAT ≥ 10 points and/or 0–1 exacerbation of COPD during the past year
Group C, GOLD 3	20	64.22 ± 1.05	mMRC=0–1 and/or by CAT < 10 points and 2 and more exacerbation of COPD during the past year
Group D, GOLD 4	6	60.67 ± 0.92	mMRC ≥ 2 and/or by CAT ≥ 10 points and 2 and more exacerbation of COPD during the past year

significance when testing statistical hypotheses was considered $p < 0.05$.

Results

Based on the diagnostic criteria EWGSOP2, sarcopenia was diagnosed in 5.7 % of the subjects of the control group and 66.7 % of COPD patients.

In accordance with the results of hand dynamometry, 59.1 % of the patients with COPD (25 women and 14 men) had decreased skeletal muscle strength. In the group of women with COPD a strong negative correlation between age and hand grip strength had been established ($r = -0.65$; $p < 0.05$). 28.15 % lower indices of hand grip strength were observed in GOLD 4 compared to indices of GOLD 1 women and by 40.74 % in comparison with the control group. In men, a weak negative correlation between age and hand grip strength had been established ($r = -0.32$; $p < 0.05$). Significantly lower indices of hand dynamometry (by 39.13 %) were observed in GOLD 4 compared to GOLD 1, and by 54.3 % compared to the control group. Among the women of the control group, only 25.0 % showed a decrease in dynamometric indices, while none of the men showed decrease in hand dynamometric indices (Table 2). Therefore, the results of the study of muscle strength indicate the development of probable sarcopenia and testify to the dependence of the development of skeletal muscle dysfunction on gender, age, and severity of COPD.

Leg circumference indices corresponding to the diagnostic criteria of sarcopenia were found in 6 women (18.18 %

and 3 men (9.09 %), patients with COPD (total 13.64 % of the patients). A weak negative correlation between age and leg circumference was established ($r = -0.17$ and $r = -0.28$, respectively for men and women, $p < 0.05$). A significant decrease in the circumference of the lower leg of the patients was determined with GOLD 4 in comparison with GOLD 1. There were significant differences in the indices both among women and men of the control group and GOLD 1 (Table 3).

The study of skeletal muscle function gave the following results: in 17 (51.5 %) of the women among those suffering from COPD, a decrease in walking speed was detected and a strong negative correlation was established ($r = -0.72$; $p < 0.05$) between age and walking speed, a significant decrease in walking speed in GOLD 4 compared to GOLD 1 and the control group ($p < 0.05$). On the other hand, in the control group, only 25.0 % of the women had demonstrated slowing of walking speed. 15 men among the subjects with COPD (45.45 %) had demonstrated a decrease in walking speed, and an negative correlation between age and walking speed had been established ($r = -0.61$; $p < 0.05$). Among the men of the control group, only 15.8 % had a slowing of walking speed (Table 4).

Probable sarcopenia based on the criteria EWGSOP2 was found in 37.9 % of the subjects, sarcopenia - in 13.6 % of the patients, and severe sarcopenia - in 15.2 % of the patients with COPD.

The study of the body composition parameters using DXA of the patients with COPD established a significant

Table 2. Dynamometry indices depending on age, gender and severity of COPD ($M \pm SD$)

Group	GOLD 1	GOLD 2	GOLD 3	GOLD 4	Control group
Women younger than 45 years	19.0 \pm 0.7	18.2 \pm 0.4	16.7 \pm 0.9*	16.0 \pm 1.3*	21.0 \pm 0.9
Women 45 years old and older	15.6 \pm 2.2	15.0 \pm 2.2	13.7 \pm 2.2	11.0 \pm 2.3*	17.0 \pm 1.3
Men younger than 45 years	32.1 \pm 1.6	31.7 \pm 1.3	33.0 \pm 1.8	27.0 \pm 0.9*	37.0 \pm 1.4
Men 45 years old and older	32.0 \pm 2.1	28.6 \pm 2.6	24.7 \pm 2.1*	19.0 \pm 2.5*	34.0 \pm 2.2

Note. * – significant differences ($p < 0.05$) of the indices compared to GOLD 1.

Table 3. Estimation of muscle mass depending on age, gender and severity of COPD ($M \pm SD$)

Group	GOLD 1	GOLD 2	GOLD 3	GOLD 4	Control group
Women younger than 45 years	32.29 \pm 1.40	31.30 \pm 1.60	29.79 \pm 1.60	28.0 \pm 1.7*	39.0 \pm 1.4#
Women 45 years old and older	29.3 \pm 1.2	27.6 \pm 1.7	26.9 \pm 1.9	25.0 \pm 1.5*	35.0 \pm 1.5#
Men younger than 45 years	38.3 \pm 1.6	37.1 \pm 2.3	36.2 \pm 2.6	33.0 \pm 2.1*	43.1 \pm 0.7#
Men 45 years old and older	34.2 \pm 1.9	31.2 \pm 2.1	29.7 \pm 2.7	27.2 \pm 2.1*	39.6 \pm 1.8#

Notes: * – significant differences ($p < 0.05$) of the indices compared to GOLD 1; # – significant differences ($p < 0.05$) of the indices of the control group compared to GOLD 1.

($p < 0.05$) decrease of LMI and FMI, and ALMI with the age (Table 5).

Among the patients aged 45 years and older, the lean mass of both the upper and lower limbs and FMI significantly decreased. In the patients older than 60 years, also ALMI significantly decreased. Sarcopenia was determined in different age groups with a frequency of 44.4 % in young subjects, 70 % in subjects at the age 45-59 years old and 94.7 % in patients over 60 years old. Therefore, with age, the frequency of sarcopenia increases in the patients with COPD, the proportion of both lean and fat mass decreases, moreover, the loss of muscle mass often occurs with excess adipose tissue. Also, a significant ($p < 0.05$) decrease in the lean mass of the limbs was established already at GOLD

2, LMI and FMI – at GOLD 3, and ALMI – at GOLD 4 (Table 6).

Sarcopenia was detected in 7 (46.7 %) of the subjects with GOLD 1, 14 (56 %) with GOLD 2, 17 (85 %) with GOLD 3, and 6 (100 %) with GOLD 4. The increase in FMI was simultaneously with a decrease in ALMI with GOLD 4 and was a confirmation of the development of sarcopenic obesity, which had been diagnosed in 3 subjects (42.9 %) with GOLD 1, in 5 (35.7 %) with GOLD 2; in 7 (41.2 %) – GOLD 3, and in 3 (50 %) – GOLD 4.

The study of BMI, depending on the age of the patients, revealed the signs of obesity in 30 % of the subjects at the age of 45-59 years old and in 31.6 % – over 60 years old, moreover, of these, the android type of adipose tissue occurred in

Table 4. Functional ability of skeletal muscles depending on age, gender and severity of COPD ($M \pm SD$)

Group	GOLD 1	GOLD 2	GOLD 3	GOLD 4	Control group
Women younger than 45 years	0.85 ± 0.08	0.78 ± 0.12	0.72 ± 0.10	0.70 ± 0.10	1.00 ± 0.20
Women 45 years old and older	0.60 ± 0.13	0.56 ± 0.16	0.53 ± 0.09*	0.50 ± 0.13*	0.80 ± 0.11
Men younger than 45 years	0.90 ± 0.07	0.83 ± 0.06	0.78 ± 0.07	0.76 ± 0.09	1.00 ± 0.13
Men 45 years old and older	0.70 ± 0.07	0.67 ± 0.10	0.63 ± 0.13	0.55 ± 0.07*	0.82 ± 0.15

Note. * – significant differences ($p < 0.05$) of the indices compared to GOLD 1.

Table 5. Indices of body composition depending on the age of the patients with COPD ($M \pm SD$)

Index	Younger than 45 years old	45-59 years old	60-75 years old
Lean mass of the upper extremities, g	3449.00 ± 8.59	5059.50 ± 6.03*	4358.83 ± 1.90*
Lean mass of the lower extremities, g	11720.00 ± 10.11	15004.60 ± 13.12*	13178.17 ± 3.33*
LMI, kg/m ²	15.320 ± 1.037	15.48 ± 0.19	10.03 ± 0.09*
ALMI, kg/m ²	5.35 ± 0.33	4.84 ± 0.20	4.45 ± 0.27*
FMI, kg/m ²	11.56 ± 0.74	9.26 ± 0.47*	7.14 ± 0.20*

Notes. LMI – lean mass index; ALMI – appendicular lean mass index; FMI – fat mass index; * – significant differences ($p < 0.05$) of the indices compared to the group of subjects younger than 45 years old.

Table 6. Indices of body composition depending on the severity of COPD ($M \pm SD$)

Index	GOLD 1	GOLD 2	GOLD 3	GOLD 4
Lean mass of the upper extremities, g	5477.60 ± 10.57	4660.44 ± 3.58*	4074.75 ± 3.12*	4028.00 ± 3.71*
Lean mass of the lower extremities, g	13101.00 ± 4.08	15224.00 ± 12.72*	13961.67 ± 8.99*	12907.50 ± 4.67*
LMI, kg/m ²	15.08 ± 0.42	15.49 ± 0.69	11.05 ± 0.08*	11.43 ± 0.18*
ALMI, kg/m ²	5.48 ± 0.30	5.034 ± 0.18	5.068 ± 0.660	4.65 ± 0.09*
FMI, kg/m ²	8.39 ± 0.33	8.82 ± 0.28	7.49 ± 0.04*	9.38 ± 0.33*

Notes. LMI – lean mass index; ALMI – appendicular lean mass index; FMI – fat mass index; * – significant differences ($p < 0.05$) of indices compared to GOLD 1.

a third part of the subjects at the age of 45-59 years old and in more than half patients over 60 years old. Depending on the severity of COPD, obesity was found in 13.3 % of the patients with GOLD 1, 24 % of GOLD 2, 20 % of GOLD 3 and 33.3 % of GOLD 4, with significant differences between GOLD 1 and GOLD 2 and GOLD 4 groups ($p < 0.05$). Accumulation of adipose tissue in android areas with a relative decrease in the limb area was diagnosed in 50 % of GOLD 1, in 66.7 % – GOLD 2 and 75 % – GOLD 3, in 100 % – GOLD 4. A positive correlation was established between the severity of COPD and android type of obesity ($r = 0.41$; $p < 0.05$). Therefore, an increase in the proportion of the patients with visceral (abdominal) obesity is observed with progression of COPD.

Among the patients diagnosed with sarcopenia (66.7 % of the patients with COPD), signs of sarcopenic obesity were found in 40.9 % of the subjects, in particular, in 25 % of persons younger than 45 years old, in 35.7 % – 45-59 years old, in 55.6 % – older than 60 years old; in 42.9 % with GOLD 1, 35.7 % with GOLD 2; 41.2 % – GOLD 3, and 50 % GOLD 4. Therefore, there is a trend towards an increase in the frequency of sarcopenic obesity with age and severity of COPD, which is confirmed by established by us reliable increase in FMI at GOLD 4. This fact is a confirmation that the value of BMI cannot distinguish the two most significant components of the body: FMI and LMI, therefore it does not fully reflect the body composition, and its increase does not necessarily indicate an adequate muscle performance and/or muscle mass in a patient with COPD.

Discussion

According to the literature data, the prevalence of sarcopenia in the patients with COPD is higher than in healthy elderly persons, so COPD may be one of its causes [16]. According to the literature sources, the frequency of sarcopenia in stable COPD was from 15 to 25 % [8, 17, 18]. Severe sarcopenia was found in approximately 2.5 % and only 0.8 % had sarcopenic obesity. Factors associated with sarcopenia were age, severity of COPD, indiscriminate hospitalization during the past 12 months, and BMI [8].

According to meta-analyses conducted in 2019-2020, the prevalence of sarcopenia among the patients with COPD was 21.6 % [19] and 27.5 % [20], while in our study it was significantly higher and amounted to 66.67 %.

The conducted research had confirmed the dependence of the frequency of sarcopenia on the severity of COPD. Thus, sarcopenia was found in 20 % of COPD patients with GOLD 1–2 severity, and in 40 % of the patients with GOLD 3–4 [21]. This fact is confirmed by the established direct correlation between exercise tolerance and skeletal muscle function in patients with COPD depending on the GOLD stage [22]. This dependence is also observed in our study. We have found that the frequency of sarcopenia is significantly higher in severe and extremely severe COPD and is 65 % and 100.0 % in GOLD 3 and 4, respectively.

In recently published reviews, up to a third part of COPD patients have some form of muscle dysfunction, including

muscle atrophy and muscle weakness [23, 24]. Functional disorders of strength and endurance of the muscles of the limbs are associated with COPD and lead to low work capacity and increased shortness of breath during daily physical activity [25]. The authors suggest that lean body mass, particularly LMI or ALMI, plays an important role in lung function, as subjects with sarcopenia had 6.99 % lower FEV1 than those who hadn't it [26]. In another study, the presence of muscle dysfunction in COPD was independent of muscle mass or severity of airflow obstruction [27]. Thus, muscle weakness prevailed in half of the patients with COPD, but was weakly correlated with the degree of airflow limitation [28].

In women with COPD, limb muscle loss and their weakness are more common compared to men (36 vs. 13 %, $p = 0.01$) [29]. The prevalence of sarcopenia in men with COPD ranges from 20 to 40 %, depending on the age of the studied population and methods of measurement [8]. These data are consistent with our results.

The prevalence of sarcopenic obesity in COPD in a study in Brazil was very low (0.8 %), whereas its prevalence in Asia was about 15 % [8]. According to the results of the prospective study of National Health and Nutrition Examination Survey (NHANES) III, within which 4652 elderly subjects had been examined over a period of 14 years, the prevalence of sarcopenic obesity was 18.1 % in women and 42.9 % in men [30]. Whereas according to the data of NHANES IV, the prevalence of sarcopenic obesity was 7.6 % for men and 9.1 % for women [11]. Another study with the participation of Koreans ($n = 2221$) at the age over 60 years old reported the following prevalence of sarcopenic obesity: 6.1% for men and 7.3 % for women [31]. The rapidly increasing prevalence of obesity in the world indicates a likely corresponding increase in sarcopenic obesity in these persons [11, 32]. When adipose tissue distribution is examined in the context of obesity, abdominal obesity plays an important role in the function of lungs [33]. A study with the participation of subjects at the age over 50 years old showed that the patients with abdominal obesity had reduced lung function. Moreover, pulmonary function was even lower in the patients with generalized obesity [27, 34]. And the assessment of obesity by BMI is contradictory today [27], because it cannot distinguish the two most significant components of body composition: fat and lean mass [35], which was called the paradox of obesity [19] and was reflected in the results of our study.

Therefore, it can be assumed that muscle dysfunction and loss of muscle strength together with obesity and changes in the structure of the broncho-pulmonary apparatus close the part of the causal circle of interconnections in COPD.

Limitations of this study: study design (conducting it in one center), and small study size (inclusion of only 66 patients with COPD).

Conclusions

Sarcopenia was diagnosed in 66.67 % of the patients with COPD and 5.71 % of the subjects of the control group. At the same time, probable sarcopenia was established in 37.9 % of

the subjects, sarcopenia in 13.6 % of the patients, and severe sarcopenia in 15.15 % of the patients with COPD.

Depending on the age of the patients with COPD, sarcopenia was found in 50 % of subjects younger than 45 years old, 40 % of persons at the age of 45-59 years old, and 91.7 % of subjects over 60 years old. Depending on the severity of COPD, sarcopenia was detected in 20 % of GOLD 1, 40 % of GOLD 2, 65 % of GOLD 3 and 100 % of GOLD 4 patients.

A decrease in lean body mass simultaneously with an increase in fat mass is a confirmation of the development of sarcopenic obesity, which is diagnosed in 27.3 % of the patients with COPD.

An increase in the proportion of sarcopenic obesity was established with the age of the patients (from 25 % of the persons younger than 45 years old to 55.6 % in the persons older than 60 years old) and the severity of COPD (from 42.86 % with GOLD 1 to 50.0 % with GOLD 4).

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Масік Н.П., Степанюк Т.В., Масік О.І.

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Порушення функції скелетних м'язів, саркопенія та саркопенічне ожиріння у хворих на хронічне обструктивне захворювання легень

Резюме. *Актуальність.* Хронічне обструктивне захворювання легень (ХОЗЛ) часто поєднується з порушеннями функції опорно-рухового апарату, зокрема дисфункцією скелетних м'язів, саркопенією, остеопорозом та ожирінням. *Мета:* оцінити стан скелетних м'язів та визначити поширеність саркопенії та саркопенічного ожиріння у пацієнтів із ХОЗЛ. *Матеріали та методи.* Обстежено 66 хворих на ХОЗЛ і 35 здорових осіб. Саркопенію встановлювали на основі критеріїв EWGSOP2, а саркопенічне ожиріння — за наявності саркопенії з індексом маси тіла $> 25 \text{ кг/м}^2$. *Результати.* У 59,1 % хворих на ХОЗЛ виявлено зниження сили скелетних м'язів, зокрема, на 28,2 % у жінок і на 39,1 % у чоловіків при GOLD 4 порівняно з GOLD 1 і на 40,7 і 54,3 % відповідно порівняно з контролем. Зменшення окружності гомілки (на 16,3 % у жінок і на 20,8 % у чоловіків) визначено при GOLD 4 порівняно з GOLD 1. Встановлено зниження швидкості ходи на 20 % у жінок і на 27,3 % у чоловіків при GOLD 4 порівняно з GOLD 1 та вірогідний кореляційний зворотний зв'язок між віком та

швидкістю ходи ($r = -0,72$ — у жінок та $r = -0,61$ — у чоловіків). Встановлено вірогідне зниження знежиреної маси кінцівок у хворих на ХОЗЛ старше 45 років і при GOLD 2, індексів знежиреної й жирової маси — при GOLD 3, апендикулярної знежиреної маси — при GOLD 4 і у хворих старше 60 років. Встановлено прямий кореляційний зв'язок між тяжкістю ХОЗЛ і андройдним типом ожиріння ($r = 0,41$; $p < 0,05$). *Висновки.* Саркопенію діагностовано у 66,7 % хворих на ХОЗЛ та 5,7 % контрольної групи, а саркопенічне ожиріння — у 27,3 % хворих на ХОЗЛ. Зростання частки саркопенії спостеріглось з віком (з 50 % у молодих осіб до 91,7 % в осіб старше 60 років), так само, як і саркопенічного ожиріння (з 25 % осіб молодше 45 років до 55,6 % старше 60 років), та зі збільшенням тяжкості ХОЗЛ (з 20 % при GOLD 1 до 100 % при GOLD 4 і з 42,9 % з GOLD 1 до 50 % з GOLD 4 відповідно).

Ключові слова: хронічне обструктивне захворювання легень; м'язова тканина; знежирена маса; дисфункція скелетних м'язів; саркопенія; саркопенічне ожиріння; вік