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Features of eating habits, smoking and physical activity in chronic obstructive pulmonary disease patients with mineral metabolism disorders

Key words: *chronic obstructive pulmonary disease, mineral metabolism, food habits, smoking, physical activity.*

Nowadays chronic obstructive pulmonary disease (COPD) remains one of the most pressing medical and social issues due to high level of incidence, disablement and lethality resulting from the disease itself as well as from concomitant to COPD pathologies [1, 2, 12].

Alongside lungs damage, COPD leads to considerable extrapulmonary systemic impacts and concomitant diseases. The pathology develops primarily among the middle-age and senior patients with prolonged smoking history. As a rule, by this time the patients have already had other illnesses where age and smoking are a development risk factor [12, 19]. COPD patients with advancing breathing disorders and gradual development of hypoxia lead a less active lifestyle compared to healthy individuals, which, in turn, leads to muscle fitness reduction [7, 9], causes their atrophy and failure of the normal functioning of the entire bone and muscle system [15, 16, 20].

Besides, chronic inflammatory process contributes to the increase of the level of cytokines that are a part of bone resorption [9, 22, 23]. Most cytokines are not only endogenous regulators of immunity reactions but are also key to inflammation reaction inducing and acute phase response generating factors of the body; they can have immunity pathology influence on the cells and tissues of the entire body. First of all they regulate development of local defense mechanisms in tissues involving different types of blood cells and endothelium. Inflammation develops in response to damage and pathogens penetrating the tissues with pro-inflammatory cytokines that include: IL-1, TNF-α, IL-6, IL-8, chemokines playing a leading role in COPD pathogenesis [10]. The cytokines generated during a systemic inflammatory process also damage bone tissues which leads to gradual resorption of all the body bones and, thus, to fracture [17].

The tumor necrosis factor (TNF), that induces proliferation and maturity of osteoclasts, has the greatest influence on bone resorption. IL-1 and IL-6 are also among powerful osteoclastogenesis mediators. Along with other cytokines, these ensure a link between the inflammatory process in the bronchopulmonary system and the bone remodeling. Imbalance in these processes leads to bone tissue mineral density loss [5, 10].

Thus special medical attention should be given to cases that combine bronchial obstructive diseases and bone tissues mineral metabolism disorders. Many researches support that COPD patients receiving large doses of inhaled gluco-corticosteroids (IGCS) or any dose of oral gluco-corticosteroids (GCS) have decreased physical activity and physical exertion tolerance, belong to osteoporosis and bone fracture risk group [1, 22, 23].

Therefore, the main factors leading to bone tissue mineral metabolism disorder in COPD patients should be viewed as the following:

- Chronic inflammatory process, increased level of inflammatory cytokines;
- Hypoxia arising from bronchial obstruction progression, lung hyperinflation and hypoventilation, lowering per-minute

breathing volume, blood circulation deficiency, CO_2 and lactic acid accumulation in blood and development of chronic respiratory acidosis;

- Decrease of physical activity and physical excertion tolerance;

- Administration of inhaled and systemic GCS.

As reported by some of the authors, 90 % of patients with severe COPD have hyper-resorption of bone tissue that has to do with vitamin D deficiency and low physical activity. It has been proved that a 6- to 8-week immobilization of a patient leads to a 10 % loss in bone density and nearly doubles the risk of fracture [10, 21].

The age of the patient should be considered as an important factor. COPD is known to develop after 40 [3, 8, 23, 29], therefore secondary to COPD osteoporosis develops on the background of involutional osteoporosis that may be of two types: postmenopausal or senile. The postmenopausal osteoporosis develops due to estrogen deficiency in women [3, 4, 9], while the senile occurs both in men and women of senior age. Aging processes are the cause of the senile osteoporosis [3, 9, 14, 24].

Eating habits and lifestyle are a great factor to osteoporosis prevention and treatment [6, 13]. Research findings on influence of eating habits and physical activity on the state of bone tissue in women between 40 and 60 years of age were presented at the World Congress of Osteoporosis, Osteoarthritis and Muscular-Skeletal System Diseases (WCO-IOF-ESCEO-2014). A clear connection has been established between a low intake level of dairy products, fowl and meat and the high risk level of osteoporosis. It was determined that high level of physical activity, daily exposure to direct sunlight, healthy eating habits and foods rich in vitamins and minerals – all reduce the risk of bone tissue loss. Physical activity has positive impact on supporting-motor apparatus pathology development risk reduction and the pain syndrome connected with it. It was noted that early menopause increases the risk of osteoporosis [6].

The following are generally considered to be main secondary osteoporosis development risk factors: senior age, reduction of bone tissue mineral density (BTMD), low body mass index (BMI), bone fractures in medical history prior to age 50, smoking, family anamnesis, GCS intake exceeding 5 mg of prednisolone per day for over 3 months, alcohol abuse, systemic diseases [6, 11, 18].

Also osteoporosis development risk factors include hard physical labor and low calcium intake with food [6].

Thus, any systemic disease, including COPD, accelerates bone resorption processes considerably, especially among senior citizens and in postmenopausal women [6, 14, 15, 22]. At the same time osteoporosis development is greatly impacted by a patient's diet, smoking habits and physical activity [6].

Therefore the study of influence of these factors on bone tissues mineral metabolism disorders in COPD patients is currently important.

The Goal of the Study – to research features of eating habits, smoking and physical activity in COPD patients with mineral metabolism disorders.

The work was carried out at the expense of the funds of the State Budget of Ukraine.

Research Materials and Techniques

Group I consisted of 63 COPD patients who were examined: 41 men and 22 women, between the age of 40 and 80, average age – (63,8 ± 1,1) years. Forced expiratory volume over the first second (FEV_1) in this group before test with bronchial spasmolytic was (46,2 ± 2,0) %; FEV_1/forced vital lung capacity (FVC) – (50,6 ± 1,6). FEV_1 after test with bronchial spasmolytic was (48,8 ± 2,1) %; FEV_1/FVC – (51,6 ± 1,6).

Patients selection was conducted according to severity of disease as per order of Ministry of Healthcare of Ukraine dated June 27, 2013 No 555 "Unified Clinical Protocol of Primary, Secondary (Specialized), Tertiary (Highly Specialized) Medical Assistance and Medical Rehabilitation, 'Chronic Obstructive Pulmonary Disease'" [8].

Control Group (Group II) consisted of 30 individuals: 18 men and 12 women, between the age of 40 and 80, average age – (59,6 ± 1,3) years. FEV_1 (111,0 ± 3,3) %; FEV_1/FVC – (78,0 ± 0,6), with no COPD or any other chronic physical pathology in their medical history, who volunteered to participate in the study. Patients of the main and the control groups were similar in their gender, age, height, weight and BMI (Table 1, 2).

All the patients went through a questionnaire, clinical functional test methods, quantitative computer densitometry (3D QCT) [11].

Questionnaire for COPD patients was specifically developed at the State Enterprise National Institute of Phthisiology and Pulmonology Named after F. H. Yanovskii NAMS of Ukraine. It consisted of two parts. Part 1: "General Data" where passport data, place of work and any professional hazards were indicated. Also the questionnaire provided the date when a patient's informed consent to participate in the study was signed.

Part two was the actual questionnaire containing questions on when COPD was diagnosed, frequency of acute conditions, disease development control, whether the patient turned to emergency medical care on account of COPD, whether the patient was ever hospitalized due to COPD exacerbation, what was the basic therapy and whether it was effective, whether the patient complied with the doctor's recommendations, etc. The questionnaire included a number of questions that touched upon eating habits, smoking status and physical activeness of the patients.

To assess severity of their disease, COPD patients were asked to fill in the Modified Medical Research Council Dyspnea Scale (mMRCDS) and COPD Assessment Test (CAT).

The mMRCDS scale show only one symptom – dyspnea; it correlates well with other health status measurement tools and predicts future morbidity risk. The CAT test gives a better understanding of the influence of the disease on everyday activities of a patient and his well-being. It includes 8 points to measure any worsening of health status in COPD. The general score can be anywhere from 0 to 40 [8, 19, 25].

The patients' clinical groups were determined based on assessment of clinical COPD symptoms manifestations, functional performance and risk of possible complications [8, 19].

Table 1

Group I and II Patients' Gender Breakdown

Group I (n = 63)				Group II (n = 30)			
Men		Women		Men		Women	
Absolute	%	Absolute	%	Absolute	%	Absolute	%
41	65,1 ± 6,0	22	34,9 ± 6,0	18	60,0 ± 8,9	12	40,0 ± 8,9

Note. No statistically significant differences noted between the two groups.

Table 2

Group I and II Patients Gender, Height and Weight Breakdown

Groups of Patients	COPD Patients Group I (n = 63)	Practically Healthy Individuals Group II (n = 30)
Average age (years)	63,8 ± 1,1	59,6 ± 1,3
Average height (cm)	169,3 ± 1,2	170,6 ± 1,2
Average Weight (kg)	74,4 ± 2,1	79,5 ± 2,6
BMI	25,90 ± 0,62	27,37 ± 0,90

Note. No statistically significant differences noted between the two groups.

Lung ventilation function test was conducted in all patients according to the spirogram data by analyzing the "flow-volume" curve of the forced expiration and general plethysmography of the body on the «Master Screen PFT» device by «Cardinal Health» (Germany). The following criteria were evaluated before and after bronchial spasmolytic: FEV_1, FEV_1/FVC ratio. The test was conducted in the morning, after a 12- to 14-hour break in taking medication. To detect a bronchial obstruction and estimate its reversibility, a respiratory function test was conducted before and 15-30 minutes after 2 inhalations of 200 mkg of short-acting β_2-agonist (salbutamol).

Osteoporosis was diagnosed on a multi-slice computer tomograph Aquilion TSX-101A «Tochiba» (Japan) with the help of licensed software program «QST Pro» based on assessment of mineral density of lumbar vertebrae (L1-L3) [11].

Data aggregation and its mathematical processing were conducted with the help of licensed software products included in Microsoft Office Professional 2007 package, license Russian Academic OPEN No Level № 17016297. Statistical processing was done with the use of mathematical and statistical capabilities of MS Excel. Descriptive statistics methods were used at that; parametric (Student's t-test) and non-parametric (Wilcoxon signed-rank test) criteria; correlative analysis was conducted with the use of Pearson's parametric criteria (r) and Spearman's non-parametric criteria (ρ).

Results and their Discussion

During examination of the 63 COPD patients these were divided into groups depending on manifestation of their clinical symptoms, functional performance and risk of possible complications [8, 19]. It should be noted that the patients participating in the study had all been observed by the clinics of the institute, all of them had moderate or severe clinical picture, thus during questioning and clinical and functional testing no patients were found fit for the clinical group A. Among the examined 22 (34,9 %) of the patients were assigned to the clinical group B, 12 (19,1 %) – the to the clinical group C, 29 patients (46,0 %) – to the clinical group D. Such clinical group breakdown of the examined patients speaks of the fact that most of the COPD patients referred from other medical institutions to the institute's clinics for diagnosis clarification, aggravation treatment and basic therapy correction were patients of the clinical group D.

COPD behavior features in the patients studied is provided in Table 3.

Average number of days of disability for the past year amounts to (24,4 ± 1,4) days. FEV_1 at the time of the study – (46,2 ± 2,0) % of the norm, FEV_1/FVC – (50,6 ± 1,6), reversibility of FEV_1 when tested with a bronchial spasmolytic – (8,1 ± 2,3) %.

Clinical-functional values in COPD clinical groups are provided in table 4.

As the collected data shows, the examined patients in clinical groups B, C, and D had no statistical distinctions in age when COPD was diagnosed, in average duration of COPD, clinical symptoms under mMRCDS scale and functional performance. The clinical groups C and D patients, however, had statistically greater number of exacerbations over the recent 12 months as compared to clinical group B patients; and clinical group D patients had more outstanding clinical symptoms according to COPD test as compared to clinical group C patients – (23,7 ± 0,9) pints and (9,4 ± 0,3) points, $p < 0,01$ respectfully.

As part of their anti-inflammation therapy 52 (82,5 ± 4,8) % of COPD patients were taking corticosteroids. 49 (77,8 ± 5,2) % of patients (Table 5) were taking inhaled gluco-corticosteroids as part of their basic therapy. These patients were receiving combined basic therapy that included Seretide Diskus, measured powder for inhalations, manufactured by "Glaxo Operations UK Limited", Great Britain (each dose containing 250 mkg of fluticasone propionate and

Table 3

COPD behavior features in the patients studied (M ± m)

Indicator	Quantity and % of Patients (n = 63)	
	Absolute	%
Frequency of exacerbations (times per year):		
1 – 2	52	82,5 ± 4,8
3 – 4	11	17,5 ± 4,8
Severity of exacerbation:		
Mild	15	23,8 ± 5,4
Moderate	54	85,7 ± 4,4
Sever	12	19,0 ± 4,9
Frequency of hospitalizations (times per year):		
1 – 2	23	36,5 ± 6,1
> 2	2	3,2 ± 2,2
Duration of exacerbations (days):		
Up to 14	15	23,8 ± 5,4
14 – 21	48	76,2 ± 5,4
> 21	18	28,6 ± 5,7

Table 4

Clinical-functional values in COPD clinical groups (M ± m)

Indicator	All patients (n = 63)	Clinical Group B (n = 22)	Clinical Group C (n = 12)	Clinical Group D (n = 29)
Average age when COPD was diagnosed, years	52,4 ± 1,5	53,3 ± 2,6	50,3 ± 2,2	54,6 ± 1,9
Average duration of COPD, years	11,2 ± 1,3	8,0 ±2,2	14,0 ± 2,7	11,1 ± 0,9
mMRCDS, points	2,3 ± 0,1	2,1 ± 0,1	1,9 ± 0,2	2,5 ± 0,1
COPD test, points	19,3 ± 0,8	18,5 ± 1,1	9,4 ± 0,3*	23,7 ± 0,9*#
FEV_1, % before the test with bronchial spasmolytic	46,2 ± 2,0	50,0 ± 4,0	47,3 ± 2,5	43,0 ± 3,0
FEV_1, % after the test with bronchial spasmolytic	48,8 ± 2,1	52,8 ± 4,1	52,6 ± 3,6	44,2 ± 2,9
FEV_1/FVC before the test with bronchial spasmolytic	50,6 ± 1,6	54,2 ± 3,0	50,2 ± 2,9	48,0 ± 2,4
FEV_1/FVC after the test with bronchial spasmolytic	51,6 ± 1,6	54,0 ± 2,6	53,6 ± 3,6	48,9 ± 2,5
Number of exacerbations over the last 12 months:	1,8 ± 0,1	1,0 ± 0,0	2,5 ± 0,3*	2,2 ± 01*

Notes:
1. * – the difference compared to the clinical group B is statistically significant (p < 0,01).
2. # – the difference compared to the clinical group C is statistically significant (p < 0,01).

50 mkg of salmeterol) – 1-2 inhalations twice a day; Spiriva powder capsules manufactured by "Boehringer Ingelheim Pharma GmbH & Co. KG", Germany (active ingredient – tiotropium 18 mkg per each inhalation, complete with Handy Hailer device), 1 capsule a day. For emergency medical assistance the patients received short-acting β_2-agonist – Salbutamol, metered dose aerosol for inhalation manufactured by "GlaxoSmithKline Pharmaceuticals S.A.", Poland (each dose contains 0,1 mg of salbutamol) - on demand.

Systemic corticosteroids were administered to 45 (71,4 ± 5,7) % of patients. 3 of them were taking prednisolone. At the same time 1 patient was taking doses of 5 mg per day of prednisolone as part of her basic medication therapy, and 2 patients were taking courses of prednisolone – 20 mg over the course of 20 days (250 mg per each course). 42 (66,7 ± 5,9) % of patients were taking courses of dexamethasone (60 mg per course) as intravenous injections. Average number of courses over 12 months – (1,4 ± 0,1), an average course duration – (10,4 ± 0,5) days.

Only 1 patient who was taking 5 mg of prednisolone per day over the course of 5 years (1.825 mg per year) as part of her basic therapy reported systemic side effects. There was osteoporosis diagnosed through densitometry, foot fracture in 2004, and hip arthroplasty in 2008 in her health history.

Table 6 provides concurrent conditions of group I and II patients.

Table 5

Anti-inflammatory therapy administered to COPD patients (M ± m)

Indicator	Quantity	% of Patients (n = 63)
Take corticosteroids	52	82,5 ± 4,8
Do not take corticosteroids	11	17,5 ± 4,8
Take systemic corticosteroids	45	71,4 ± 5,7
Regularly take prednisolone	1	1,6 ± 1,6
Take courses of prednisolone	2	3,2 ± 2,2
Take courses of dexamethasone	42	66,7 ± 5,9
Take inhaled corticosteroids	49	77,8 ± 5,2
Have side effects: local	-	-
systemic	1	1,6 ± 1,6

Table 6

Concurrent conditions of group I and II patients (M ± m)

Concurrent conditions	Group I (n = 63)		Group II (n = 30)	
	Absolute	%	Absolute	%
Osteoporosis	3	4,8 ± 2,7	-	-
Confirmed by densitometry	3	4,8 ± 2,7	-	-
By other methods	-	-	-	-
Fractures	14	22,2 ± 5,2	11	36,7 ± 8,8
Osteoporosis-related fractures	-	-	-	-
Traumatic fractures	14	22,2 ± 5,2	11	36,7 ± 8,8
Dental diseases (periodontitis)	22	34,9 ± 6,0	21	70,0 ± 8,4#
Cardiovascular diseases	41	65,1 ± 6,0	0	0,0 ± 12,2#
Endocrine diseases	12	19,0 ± 4,9	0	0,0 ± 12,2
Other diseases	15	23,8 ± 5,4	0	0,0 ± 12,2
Menopause in women	22	100	9	75,0 ± 12,5

Note. # – the difference between groups I and II is statistically significant ($p < 0,01$).

The collected data shows that patients with no somatic pathology were not examined for osteoporosis, and out of the 63 COPD patients only 3 (4,8 ± 2,7) % received a densitometry and were diagnosed with osteoporosis. Patients of the II Group had the highest incidence of traumatic fractures – 11 (36,7 ± 8,8) %, COPD patience had it more rarely – 14 (22,2 ± 5,2) % which, in our opinion, was conditioned by less physical activity of the group I patients, however this difference was not statistically significant.

Most frequently diagnosed concurrent somatic diseases in COPD patients were cardio-vascular pathologies – 41 (65,1 ± 6,0) % of patients.

Most often these were individuals without somatic pathologies who received treatment of dental diseases (primarily generalized periodontitis) – 21 (70,0 ± 8,4) % rather than COPD patients – 22 (34,9 ± 6,0) %, p < 0,01. The control group patients turned for periodontal treatment and orthopedic dental assistance more promptly. The COPD patients paid greater attention to their main disease turning for dental assistance only in case of evident periodontitis, pain syndrome and considerable tooth loss when chewing effectiveness dropped and there was a need for a denture.

All 22 women of group I and 9 (75,0 ± 12,5) % from group II were post menopausal. The beginning of the menopause in women of both groups was noted at approximately the same age – in Group I at (49,2 ± 1,0) years and in group II at (50,9 ± 0,9) years. Average menopause duration in group I women was (13,6 ± 1,8) years, and in the control group – (8,7 ± 2,6) years, p > 0,05.

Eating habits contributing to development of osteoporosis, smoking and physical activity of groups I and II patients are provided in table 7.

Regular physical activity, morning exercise routine, and walking were marked by patients of groups I and II with equal frequency. However, 23 (36,5 ± 6,1) % of group I patients considered their lifestyle as inactive, but only 2 (6,7 ± 4,6) % patients of group II did so, p < 0,001.

27 (90,0 ± 5,5) % out of 30 individuals with no somatic pathology in their health history had moderately active lifestyle as compared to COPD patients – 40 (63,5 ± 6,1) %, p < 0,01. Inasmuch no COPD patients specified tendency to highly active lifestyle.

Group II individuals – 7 (23,3 ± 7,7 %) – more often than COPD patients – 1 (1,6 ± 1,6) %, p < 0,01 – participated in active recreation that included bicycling.

The 6-minute walking test indicated a considerable drop in physical activity and tolerance to physical exercise in COPD patients. Thus, an average distance in meters that COPD patients covered walking for 6 minutes amounted to (297,7 ± 11,7) m, while the control group patients walked a distance of (630,7 ± 14,9) m, p < 0,001 over the same period of time.

It was noted that control group patients were exposed to sunlight more often – 26 (86,7 ± 6,2) % – than group I patients – 40 (63,5 ± 6,1) %, p < 0,01. Only 4 (13,3 ± 6,2) % group II patients avoided exposure to sunlight, which was of statistically significant different from the same value in COPD patients – 23 (36,5 ± 6,1) %, p < 0,01.

The questionnaire survey showed that eating habits of group I and II patients were not different. It was established that only 6 (9,5 ± 3,7) % group I patients and 1 (3,3 ± 3,3) % group II patient were limiting intake of calcium-rich foods. However statistically significant larger number of COPD patients – 10 (15,9 ± 4,6) % – took calcium supplements following their treating physician's advice as compared to control group individuals – 1 (3,3 ± 3,3) %, p < 0,05.

Smoking health history analysis revealed that 14 (22,2 ± 5,2) COPD patients and 4 (13,3 ± 6,2) of control group patients smoke currently. A statistically greater number of control group patients – 24 (80,0 ± 7,3) % do not smoke now, but used to do so in the past, as compared to – 31 (49,2 ± 6,3) %, p < 0,01 of the main group.

Table 8 provides smoking status of group I and II patients.

The collected data indicates that COPD patients had a statistically greater smoking history, used to smoke or smoke a greater number of cigarettes per day. The average pack/year index in group I was (21,6 ± 3,3), and in group II – (7,1 ± 2,7), p < 0,01.

Z- and T-criteria were determined during examination of COPD patients and practically healthy individuals of the same age and gender by means of quantitative computer densitometry. The T-criterion determined any presence of osteopenia or osteoporosis. It should be noted here that the term osteopenia was used to indicate the pre-clinical stage of osteoporosis. The T-criterion value was interpreted as follows: from 3,0 to -1,0 – normal; from -1,0 to -2,5 – osteopenia; from -2,5 to -5,0 – osteoporosis.

The results of the tests conducted show that almost all of the COPD patients indicated systemic pathological bone tissue changes. Osteopenia was detected in 18 (28,6 ± 5,7) % out of 63 patients, and osteoporosis in 44 (63,8 ± 5,8) %, which exceeded the frequency of osteoporosis diagnosing in the control group by 6 times. Only 1 patient showed no pathologic changes of bone tissue (Table 9).

The control group had significantly more individuals - 13 (43,3 ± 9,0) % - without skeletal system pathologies as compared to group I – 1 (1,6 ± 1,6) %, p < 0,01 and significantly fewer individuals – 3 (10,0 ± 5,5) % - with osteoporosis than in group I – 44 (63,8 ± 5,8) %, p < 0,01.

Osteoporosis was diagnosed only in 3 women of the control group who were in post menopause period for 5 years or more. It should be noted that 14 (46,7 ± 9,1) % of individuals of group II had manifestations of osteopenia that were primarily preconditioned by senior age of the patients and the presence of involutional processes, which corresponded to the general statistical research data among the population as indicated in the literature [19, 24].

The main and the control groups were significantly different in their Z- and T-criteria. Thus, Z-criterion in group I was (-1,03 ± 0,13), and in group II it was – (0,59 ± 0,23), p < 0,001. T-criterion in group I was (-3,19 ± 0,14), and in group II it was – (-1,29 ± 0,17), p < 0,001.

Correlative analysis revealed weak negative ratio between T-criterion and COPD duration (ρ = – 0,255, p < 0,05), which speaks of increased risk of osteoporosis in long-term COPD. Notice that in the research conducted the duration of COPD was calculated from the time of diagnosis. In clinical group B COPD duration was (8,0 ± 2,2) years, in group C

Table 7

Eating habits, smoking and physical activity of groups I and II patients (M ± m)

Indicator	Group I (n = 63)		Group II (n = 30)	
	Absolute	%	Absolute	%
Currently a smoker	14	22,2 ± 5,2	4	13,3 ± 6,2
Currently a non-smoker (but used to be a smoker)	31	49,2 ± 6,3	24	80,0 ± 7,3#
Limited calcium-rich products intake	6	9,5 ± 3,7	1	3,3 ± 3,3
Not limited calcium-rich products intake	57	90,5 ± 3,7	29	97,7 ± 3,3
Took calcium supplements	10	15,9 ± 4,6	1	3.3 ± 3,3*
Coffee drinkers	44	69,8 ± 5,8	16	53,3 ± 9,1
Cups of coffee per day	1,6 ± 0,2		1,5 ± 0,3	-
Drink (or used to drink) alcohol	30	47,6 ± 6,3	19	63,3 ± 8,8
Inactive lifestyle	23	36,5 ± 6,1&	2	6,7 ± 4,6&
Moderately active lifestyle	40	63,5 ± 6,1	27	90,0 ± 5,5#
Highly active lifestyle	-	-	1	3,3 ± 3,3
Types of activity				
Morning exercise routine	16	25,4 ± 5,5	13	43,3 ± 9,0
Gym	0	0	5	16,7 ± 6,8
Swimming pool	0	0	5	16,7 ± 6,8
Walking	53	84,1 ± 4,6	23	76,7 ± 7,7
Bicycling	1	1,6 ± 1,6	7	23,3 ± 7,7#
Regular physical activity	19	30,2 ± 5,8	11	36,7 ± 8,8
Irregular physical activity	44	69,8 ± 5,8	19	63,3 ± 8,8
Exposed to sunlight	40	63,5 ± 6,1	26	86,7 ± 6,2#
Considerable exposure to sunlight	14	22,2 ± 5.2	9	30,0 ± 8,4
Moderate exposure to sunlight	26	41,3 ± 6,2	17	56,7 ± 9,0
Avoid sunlight	23	36,5 ± 6,1	4	13,3 ± 6,2#
Muscle weakness	42	66,7 ± 5,9	7	30,0 ± 8,4&
Leg pains	48	76,2 ± 5,4	7	23,3 ± 7,7&
Joint pains	43	68,3 ± 5,9	9	30,0 ± 8,4&
Orthopedic diagnosis	18	28,6 ± 5,7	2	6,7 ± 4,6#

Notes:
1. * – the difference between groups I and II is statistically significant (p < 0,05).
2. # – the difference between groups I and II is statistically significant (p < 0,01).
3. & – the difference between groups I and II is statistically significant (p < 0,001).

Table 8

Smoking status of group I and II patients (M ± m)

Indicator	Group I (n = 63)	Group II (n = 30)
Smokes (or used to), years	17,5 ± 2,3	7,4 ± 2,2*
Used to smoke (number of cigarettes per day)	4,6 ± 1,2	1,4 ± 0,8*
Smokes (number of cigarettes per day)	8,8 ± 1,3	4,7 ± 1,9*
Pack/year	21,6 ± 3,3	7,1 ± 2,7#

Notes:
1. * – the difference between groups I and II is statistically significant (p < 0,05).
2. # – the difference between groups I and II is statistically significant (p < 0,01).

Table 9

Frequency of identification of mineral metabolism disorders in group I and II patients

Mineral metabolism disorder	Group I (n = 63)		Group II (n = 30)	
	Absolute	%	Absolute	%
No mineral metabolism disorders	1	1,6 ± 1,6	13	43,3 ± 9,0[&]
Osteopenia	18	28,6 ± 5,7*	14	46,7 ± 9,1
Osteoporosis	44	63,8 ± 5,8*#	3	10,0 ± 5,5*#&

Notes:
1. * – the difference compared to the "no mineral metabolism disorders" patients within the groups is statistically significant (p < 0,01).
2. # – the difference between osteopenia and osteoporosis within the groups is statistically significant (p < 0,01).
3. & – the difference between the groups is statistically significant (p < 0,01).

it was (14,0 ± 2,7) years, and in group D – (11,1 ± 0,9) years (Table 4).

It should also be noted that many patients had their first symptoms many years prior to diagnosing, and many patients received treatment for other diseases before their final diagnosis of COPD was established. Therefore it is unlikely to establish the real COPD duration in this contingency of patients.

A weak direct correlational tie was established between the Z-criterion and FEV_1 ($\rho = 0{,}260$, $p < 0{,}05$), a week negative ratio between Z-, T-criteria and the duration of smoking ($\rho = -0{,}200$, $p < 0{,}05$). However no correlational ties were found between the osteoporosis criteria and the eating habits of the patients.

Thus, the received research data shows that timely diagnosing and treatment of COPD and control of smoking should be considered basic measures of secondary systemic osteoporosis development prevention in this patient contingency.

Conclusion

It was established that the patients studied have mineral metabolism disorders associated both with COPD and with age-related body changes, which was demonstrated by the results of control studies of a respectful age category (from 40 to 80 years).

COPD patients get osteoporosis 6 times more often than individuals of the same age and gender without somatic pathology, which allows for consideration of COPD as a notable risk factor of secondary systemic osteoporosis development.

Questionnaire survey analysis did not indicate any statistical difference between eating habits of COPD patients and that of individuals with no somatic pathology.

The factors inducing mineral metabolism disorders in COPD patients are long smoking history, high pack/year index (21,6 ± 3,3) which exceeds this indicator in other people with no somatic pathology – (7,1 ± 2,7), $p < 0{,}01$ – associated dental and cardio-vascular diseases, inactive lifestyle, insufficient exposure to sunlight, administration of inhaled and systemic gluco-corticosteroids.

By means of correlational analysis it was proved that the risk of osteoporosis in COPD patients rises over the time of duration of the main disease, the time of smoking and with advancement of bronchial obstruction. Thus, timely diagnosing and treatment of COPD and control of smoking should be considered basic measures of secondary systemic osteoporosis development prevention.

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ОСОБЕННОСТИ ПИЩЕВЫХ ПРИВЫЧЕК, ТАБАКОКУРЕНИЯ И ФИЗИЧЕСКОЙ АКТИВНОСТИ У БОЛЬНЫХ ХРОНИЧЕСКИМ ОБСТРУКТИВНЫМ ЗАБОЛЕВАНИЕМ ЛЕГКИХ С НАРУШЕНИЯМИ МИНЕРАЛЬНОГО ОБМЕНА

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Резюме

Системные заболевания, в том числе хроническое обструктивное заболевание легких (ХОЗЛ), значительно влияют на процессы нарушения минерального обмена, особенно у лиц пожилого возраста и у женщин в период постменопаузы. При этом огромное влияние на развитие остеопороза оказывают: питание больного, табакокурение и поддержание физической активности.

Цель исследования – *исследовать особенности пищевых привычек, табакокурения и физической активности у больных ХОЗЛ с нарушениями минерального обмена костной ткани.*

Объект исследования: *63 больных ХОЗЛ составили I группу, из них – 41 мужчина и 22 женщины в возрасте от 40 до 80 лет, средний возраст – (63,8 ± 1,1) года. $ОФВ_1$ до пробы с бронхолитиком составил (46,2 ± 2,0) %; $ОФВ_1$/ФЖЕЛ – (50,6 ± 1,6). $ОФВ_1$ после пробы с бронхолитиком – (48,8 ± 2,1) %; $ОФВ_1$/ФЖЕЛ – (51,6 ± 1,6). Контрольную группу (II группу) составили 30 человек, из них 18 мужчин и 12 женщин в возрасте от 40 до 80 лет, средний возраст – (59,6 ± 1,3) года. $ОФВ_1$ – (111,0 ± 3,3) %; $ОФВ_1$/ФЖЕЛ – (78,0 ± 0,6), которые в анамнезе не имели ХОЗЛ или другой хронической соматической патологии и добровольно согласились принять участие в исследовании. Пациенты основной и контрольной групп не отличались по полу, возрасту, росту, массе тела и ИМТ.*

Методы исследования: *анкетирование, клинико-функциональные методы исследования, количественная компьютерная денситометрия (3D QCT), статистические.*

Результаты. *В результате проведенного исследования установлено, что у обследуемых больных нарушения минерального обмена связаны как с заболеванием ХОЗЛ, так и с возрастными изменениями организма, что продемонстрировали результаты контрольных исследований у лиц без соматической патологии соответствующей возрастной категории (от 40 до 80 лет).*

Почти у всех больных ХОЗЛ были выявлены системные патологические изменения костной ткани. У 18 (28,6 ± 5,7) % больных из 63 была выявлена остеопения, у 44 (63,8 ± 5,8) % – остеопороз. Остеопороз у больных ХОЗЛ выявляли в 6 раз чаще, чем у лиц того же возраста и пола без соматической патологии, что позволяет считать наличие ХОЗЛ весомым фактором риска развития вторичного системного остеопороза.

Анализ анкетных данных не обнаружил статистически значимой разницы между пищевыми привычками больных ХОЗЛ и лиц без соматической патологии.

Факторами, которые способствуют нарушению минерального обмена у больных ХОЗЛ, являются: длительный стаж курения, высокий индекс пачко-лет (21,6 ± 3,3), что значительно превышает этот показатель по сравнению с лицами без соматической патологии – (7,1 ± 2,7), $p < 0,01$, сопутствующие стоматологические и сердечно-сосудистые заболевания, малоподвижный образ жизни, недостаточное время пребывания на солнце, применение ингаляционных и системных глюкокортикостероидов.

По критериям остеопороза Z и T основная и контрольная группы достоверно отличались между собой. Так, Z-критерий в первой группе составил (–1,03 ± 0,13), во II группе – (0,59 ± 0,23), $p < 0,001$. T-критерий в первой группе составил (–3,19 ± 0,14), во II группе – (–1,29 ± 0,17), $p < 0,001$.

Установлена слабая корреляционная отрицательная связь между T-критерием и продолжительностью ХОЗЛ ($\rho = -0,255$, $p < 0,05$), между Z-, T-критериями и продолжительностью курения ($\rho = -0,200$, $p < 0,05$), слабая прямая корреляционная связь между Z-критерием и $ОФВ_1$ ($\rho = 0,260$, $p < 0,05$), что свидетельствует о повышении риска возникновения остеопороза при длительном течении ХОЗЛ, длительном табакокурении и прогрессировании бронхообструкции. При этом не выявлено корреляционных связей критериев остеопороза с пищевыми привычками пациентов.

Выводы. *Методом корреляционного анализа доказано, что риск возникновения остеопороза у больных ХОЗЛ повышается с длительностью основного заболевания, с продолжительностью курения и прогрессированием бронхообструкции. Поэтому своевременную диагностику и лечение ХОЗЛ, борьбу с табакокурением следует считать базовыми мерами профилактики развития вторичного системного остеопороза.*

Ключевые слова: *хроническое обструктивное заболевание легких, минеральный обмен, пищевые привычки, курение, физическая активность.*

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FEATURES OF FOOD HABITS SMOKING AND PHYSICAL ACTIVITY IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE PATIENTS IN VIOLATION OF MINERAL METABOLISM

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Summary

Systemic diseases, including COPD, significantly influence the processes of disturbances of mineral metabolism, especially in the elderly and in women during menopause. Thus a considerable influence on the development of osteoporosis become: patient nutrition, smoking and support physical activity.

The aim – *to explore the features of food habits, smoking and physical activity in COPD patients with disorders of mineral in bone.*

Object of study: *63 COPD patients (I group), including 41 men and 22 women, aged 40 to 80 years, mean age – (63,8 ± 1,1) years. FEV_1 before bronchodilators test was (46,2 ± 2,0) %; FEV_1/FVC – (50,6 ± 1,6). FEV_1 after bronchodilators test – (48,8 ± 2,1) %; FEV_1/FVC – (51,6 ± 1,6). The control (group II) consisted of 30 people, including 18 men and 12 women aged 40 to 80 years, mean age – (59,6 ± 1,3) years. FEV_1 – (111,0 ± 3,3) %; FEV_1/FVC – (78,0 ± 0,6), who had a history of COPD or other chronic somatic diseases and voluntarily agreed to participate in the study. Patients and control group did not differ by sex, age, height, weight and BMI.*

Methods: *questionnaire, clinical and functional methods, quantitative computed densitometry (3D QCT), statistics.*

Results. *As a result, the survey found that in the studied patients of mineral metabolism disturbances associated as with COPD and age-related changes in the body that have demonstrated research results in relevant age group (40 to 80 years) patients without somatic pathology.*

Almost all patients with COPD were identified systemic pathological changes in bone. In 18 (28,6 ± 5,7) % fore 63 patients osteopenia was found and in 44 (63,8 ± 5,8) % – osteoporosis. Osteoporosis in patients with COPD showed 6 times more likely than people of the same age and without somatic pathology that suggests the presence of COPD is an important risk factor for osteoporosis secondary system.

Questionnaries analysis revealed no statistically significant difference between food habits in COPD patients and persons without somatic pathology.

Factors that contribute to mineral metabolism disturbances in COPD patients were: a long smoking hystory and high index of pack-years (21,6 ± 3,3), which is much higher than this parameter compared with those without somatic pathology – (7,1 ± 2,7), p < 0,01, dental and related cardiovascular disease, sedentary lifestyle, lack of time in the sun, use of inhaled and systemic corticosteroids.

By Z and T criteria of osteoporosis I and control groups was significantly different. So, Z-criteria in group I was (-1,03 ± 0,13), and in the second group – (0,59 ± 0,23), p < 0,001. T-criteria in group I was (-3,19 ± 0,14), and in the second group – (-1,29 ± 0,17), p < 0,001.

Negative weak inverse correlation relationship was found between T-criteria and duration of COPD (ρ = -0,255, p < 0,05), between Z-, T-criteria and duration of smoking (ρ = -0,200, p < 0,05), weak direct correlation relationship between Z-criterion and FEV_1 (ρ = 0,260, p < 0,05), indicating increased risk of osteoporosis with prolonged duration of COPD, smoking and prolonged progression bronhial obstruction. It is not found correlation criteria osteloporosis with food habits of patients.

Conclusions. *The method of correlation analysis demonstrated that the risk of osteoporosis in patients with COPD increases with the duration of the underlying disease, duration of smoking and progression of bronchial obstruction. Therefore, timely diagnosis and treatment of COPD, tobacco control efforts should be considered as basic measures of prevention of secondary systemic osteoporosis.*

Key words: *chronic obstructive pulmonary disease, mineral metabolism, food habits, smoking, physical activity.*

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