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Differences in nutritional status of patients with chronic obstructive pulmonary disease between Mediterranean and non-Mediterranean regions in Croatia

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Abstract

The nutritional status of patients with chronic obstructive pulmonary disease (COPD) is a significant factor that influences the prognosis of the disease. This observational study aimed to analyse the nutritional status of COPD patients and assess the associations between nutritional status, disease severity, and exercise capacity in four different regions of Croatia. In this multicentre study, 534 COPD patients were recruited and evaluated concerning fat-free mass (FFM), fat-free mass index (FFMI), skeletal muscle mass index (SMMI), phase angle (PhA), pulmonary function tests, and the 6-minute walk test (6MWT). There were 325 (60.9%) male and 209 (39.1%) female patients with a mean age of 66.7±8.4 years. Most patients (73.2%) exhibited a moderate to severely abnormal obstructive pattern and had a reduced 6MWT distance (396.5±110.8 m). Among the participants, 32.8% were overweight and 22.3% were obese, and they had satisfactory values for nutritional status variables (FFM, FFMI, SMMI, PhA). There were no statistical differences between the centres in terms of nutritional status variables. There was a significantly positive correlation of FEV1 with BMI (r=0.148, p=0.001), PhA (r=0.256, p=0.00), FFM (r=0.365, p=0.00), and SMMI (r=0.238, p=0.00). However, there was no significant correlation of the 6MWT with BMI (r=-0.049, p=0.254), FFM (r=0.065, p=0.133), and SMMI (r=-0.007, p=0.867). The data analysis demonstrated that our patients were not underweight and that there was no significant difference between the centres in terms of BMI, FFM, FFMI, SMMI, and PhA. This lack of significant difference was observed even though one of the regions studied was Mediterranean.

Keywords: nutritional status; chronic obstructive pulmonary disease; bioelectrical impedance; obesity; Mediterranean region; continental region.

Introduction

Chronic obstructive pulmonary disease (COPD) is a preventable and treatable condition, and it ranks as one of the three most common causes of death globally [1,2]. The worldwide burden of COPD is expected to increase due to continued exposure to COPD risk factors and the aging of the population [3]. Although COPD has traditionally been associated with malnutrition and depletion of muscle mass, the prevalence of obesity in COPD patients has been reported to range between 18–54%. Notably, an increase in the prevalence of higher body weight has been observed in the earlier stages of the disease [4-7].

Existing nutrition screening and assessment tools that consider only BMI may overlook important changes in body composition, leading to incomplete management of COPD patients [8-10]. Bioelectrical impedance analysis (BIA) is a widely used method for evaluating body composition in patients with COPD. Raw BIA variables, such as phase angle (PhA), provide information on the water distribution between intracellular and extracellular compartments, and therefore offer insights into body cell mass and cellular integrity. COPD patients with malnutrition or sarcopenia are characterized by an increased extracellular/intracellular water ratio, with a concomitant decrease in body cell mass. Very low values of PhA ($< 4.2°$) are likely to indicate a significantly higher risk of poor nutritional status and mortality in COPD patients [11]. Fat-free mass index (FFMI) is significantly correlated with exercise capacity, dyspnoea, spirometry results (FEV1), and can help estimate the burden of COPD [11]. Nutritional depletion in COPD is a known and complex problem, presenting with several different characterizable phenotypes. These phenotypes are, to varying degrees, associated with increased healthcare use, reduction in functional capacity, and poorer clinical outcomes [13,14]. The traditional Mediterranean diet is characterized by a high intake of vegetables, fruits, nuts, unrefined cereals, olive oil, and fish, along with a low intake of saturated fats and meat. This contrasts with the regular Continental diet. A Mediterranean-like diet is described as inversely associated with the development of COPD [15,16]. The aim of this study was to assess the nutritional status of COPD patients and to investigate the association between nutritional status, disease severity, and exercise capacity in four different regions of Croatia. Since a significant part of Croatia is Mediterranean, we expected to find a difference in the nutritional status of patients from the Mediterranean region compared to patients from other regions of the country. This assumption was based on the expectation that the Mediterranean diet is still prevalent in the Mediterranean region of Croatia.

Methods

Patients

This was an observational, multicentre study involving a total of 534 patients with COPD, who were recruited and evaluated in 2018 and 2019. The patients' assessments included body composition measurements obtained through bioelectrical impedance analysis: fat-free mass (FFM), FFMI, skeletal muscle mass index (SMMI), and PhA. Additionally, the following measurements were performed: pulmonary function tests (spirometry, diffusing capacity of the lung for carbon monoxide) and the 6-minute walking test (6MWT). Five different centres participated in this study: two from the Mediterranean region and three from continental Croatia (Figure 1).

The Ethics Committees approved the study protocol. All participants provided signed informed consent. COPD diagnosis was made as recommended by the 2019 GOLD guidelines [1]. Patients with a history suggestive of asthma or positive bronchodilator tests were excluded from the study. Additionally, patients with musculoskeletal, neurological, or other diseases that could impact the results of the 6MWT were also excluded.

Respiratory tests

Spirometry and the diffusing capacity of the lung for carbon monoxide were performed according to the ATS/ERS standards. The 6MWT was conducted in accordance with the ATS/ERS statement [17]. Body composition measurements were taken using the TANITA MC-780MA P, utilizing the eight-contact electrode method, as per the manufacturer's instructions and as recommended by Kyle *et al.* [18].

Statistical analysis

Statistical analysis was performed using the Minitab 19 and Social Science Statistics software packages. Parametric tests were used for the analysis of data with a normal distribution, and nonparametric tests were used for the analysis of data without a normal distribution. In comparisons between groups, if variables were gender-sensitive, they were analysed separately by sex. In the analysis, the Kruskal-Wallis test, one-way and two-way ANOVA tests, and the

Spearman correlation test were also used. A p-value (2-sided) of <0.05 was considered to indicate a statistically significant difference in all comparisons.

Results

There were 325 (60.9%) male and 209 (39.1%) female patients, with a mean age of 66.7±8.4 years. A small percentage of patients were underweight (2.4%) while most patients were overweight (32.8%) and obese (22.3%) (Figure 2). Only 3.1% of males had FFMI lower than 16 kg/m^2, while FFMI was lower than 15 kg/m^2 in 3.8% of females. SMMI was lower than 7 kg/m^2 in 11.7% of males and lower than 5,7kg/m^2 in 8.1% of females. All patients were grouped according to the GOLD classification groups, with most patients in group B, II, and III (Figures 3 and 4). The average FVC was 3.20±0.9L for males and 2.42±0.7L for females; FEV1 was 1.60±0.7L for males and 1.30±0.6L for females; DLCO was 57.56±20.9%; and the 6MWT result was 396.5±110.8m, with a significant statistical difference observed between centres (Table 1). The BMI was 26.3±5.5 kg/m²; FFM was 61.8±10 kg for males and 46±8.3 kg for females; FFMI was 20.6±2.8 kg/m² for males and 18.6±3.1 kg/m² for females; SMMI was 8.2±1.4 kg/m² for males and 6.9±1 kg/m² for females; and PhA was 6±1.8° for males and 5.6±1.7° for females. There was no statistical difference between centres in these measurements (Table 1). The most common comorbidities among all patients were arterial hypertension (47.6%), gastroesophageal reflux disease (12.4%), coronary heart disease (9%), osteoporosis (8%) and diabetes mellitus (7.5%). There was significant positive correlation of FEV1 with BMI ($r=0.148$, $p=0.001$), PhA ($r=0.256$, $p=0.00$), FFM ($r=0.365$, $p=0.00$), SMMI ($r=0.238$, $p=0.00$), but no significant correlation of 6MWT with BMI ($r= -0.049$, $p=0.254$), FFM ($r=0.065$, $p=0.133$) or SMMI ($r= -0.007$, $p=0.867$).

Discussion

Over the past four decades, we have transitioned from a world in which the prevalence of underweight was more than twice that of obesity, to one in which more people are obese than underweight [19]. About 25.3% of men and about 34.1% of women in Croatia are considered obese [20,21]. It can be assumed that this is the reason why patients in our study, on average, did not have a lower BMI, and why there was no significant difference between centres with regard to BMI. We can speculate that the Mediterranean diet was not adhered to in our

Mediterranean regions. In our study, the average values of FFM, FFMI, SMMI and phase angle were satisfactory and there were no differences between the centres. Contrary to previous results, the patients in this study, with elevated BMI values, continued to have satisfactory FFM, FFMI, SSMI and PhA [8,9].

More than 50% of Croatian COPD patients analysed in this study are men, older than 65 years and classified in GOLD group B, which is similar to other patients analysed in earlier studies elsewhere [22-25]. The most commonly described comorbidities were also the same as those reported in previous studies [26-28]..

The reason for the average values of lung function tests in the first centre to be lower than in the other hospitals was likely because the Clinic for Lung Diseases, is a tertiary care institution that is treating patients who are on the lung transplant list.

Previous nutritional status studies of COPD patients have shown that there was a significant correlation between nutritional status and disease severity [10,29]. A correlation between these values was also found in our study.

Obesity could impair exercise capacity in COPD patients due to the increased mechanical load from carrying the extra weight, independent of the degree of airflow limitation [30]. However, in our study this correlation was not demonstrated.

The limitation of this study is that patients living in the Mediterranean region were not questioned about their diet.

Conclusions

This multicentre study conducted in four regions of Croatia is the first interregional study of COPD patients in the country. Considering the recent publication of recommendations for prevention and treatment of malnutrition in patients with chronic obstructive pulmonary disease in Croatia [31], it was expected that this study would provide an answer to the question of whether there was a specific region in Croatia with the lowest nutritional status values, thus requiring specific interventions at the health policy level. As the majority of Croatian COPD patients were not underweight with a high percentage of obese patients, it appears there is a need for additional health interventions aimed at weight reduction and increase in physical activity of this patient category.

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Table 1. Results of demographic analysis, pulmonary function test, bioelectrical impedance analysis and 6-minute walk test and comparison between centres.

	First centre (n=164)	Second centre (n=100)	Third centre (n=83)	Forth centre (n=76)	Fifth centre (n=111)	All (n=534)	p-value
Age (years)	64.56±8.56	67.73±8.93	65.78±8.1	68.75±7.04	67.98±8.02	66.65±8.37	**0.000**
Pack years (median)	40	50	35	40	43	40	**0.004**
FVC (L)	2.76	3.29	2.65	2.75	2.58	2.81±0.83	**0.000**
FEV1 (%)	51.59	61.31	59.36	55.06	55.76	55.87±21.56	**0.005**
FEV1 (L)	1.357	1.501	1.517	1.441	1.485	1.45±0.63	**0.000**
FEV1/FVC (%)	50.50	45.42	56.00	51.47	55.49	51.49±15.48	**0.000**
DLCO (%)	52.23	56.88	61.86	63.53	57.25	57.56±20.86	**0.002**
6MWD (m)	393.0	419.9	371.4	466.8	351.0	396.53±110.83	**0.000**
BMI (kg/m^2)	26.56±5.62	26.25±5.62	27.18±5.35	26.37±5.48	25.52±5.10	26.36±5.46	0.313
FFM (kg)							
male	61.83	62.55	61.03	61.64	61.68	61.80±10.04	0.971
female	45.43	45.05	48.07	46.31	46.23	46.04±8.34	0.565
FFMI (kg/m^2)							
male	20.53	20.88	20.69	20.77	20.37	20.60±2.84	0.860
female	18.79	18.64	19.22	18.22	19.05	18.75±3.13	0.690
SMMI	7.66	7.50	7.69	7.56	7.45	7.73±1.49	0.562
Phase angle	5.84	5.43	5.98	5.18	5.76	5.8±1.78	0.316

BMI – body mass index, FVC – forced vital capacity, FEV_1 – forced expiratory volume in one second, DLCO – diffusing capacity of lung for carbon monoxide, 6MWD – six-minute walk distance, FFM- fat free mass, FFMI – fat free mass index, SMMI – skeletal muscle mass index.

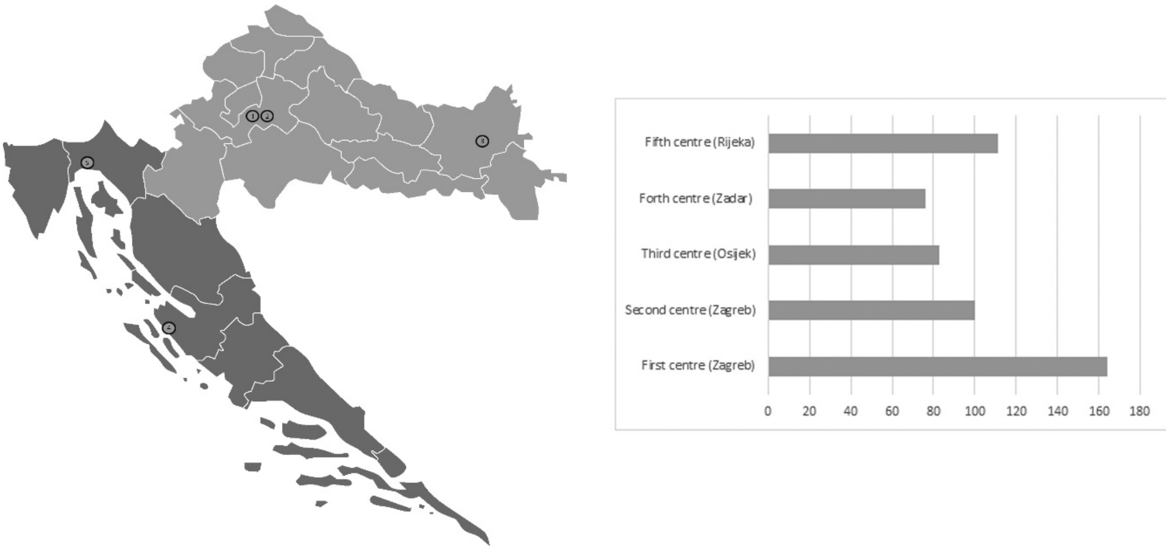

Figure 1. Location and number of patients from each centre (Rijeka and Zadar from Mediterranean, Osijek and Zagreb from non- Mediterranean regions in Croatia).

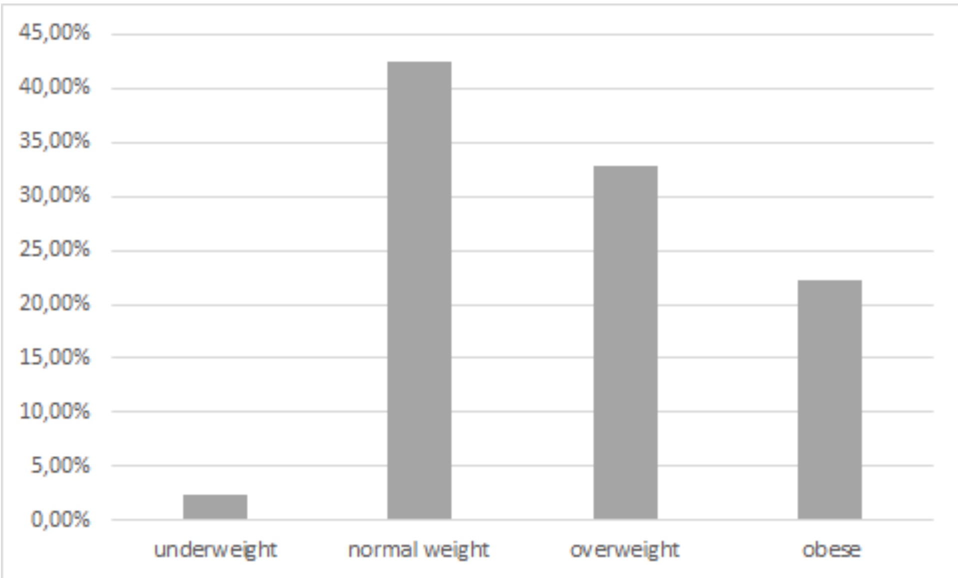

Figure 2. Percentage of BMI groups in all patients - underweight (under 18.5 kg/m^2), normal weight (18.5 to 24.9 kg/m^2), overweight (25 to 29.9 kg/m^2), and obese (over 30 kg/m^2).

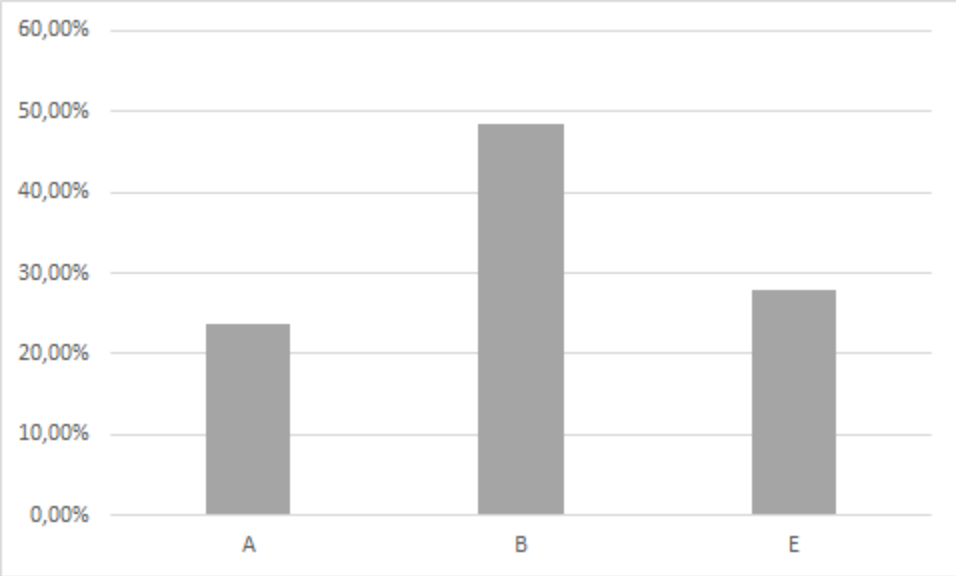

Figure 3. Percentage of new GOLD classification groups in all patients - A, B and E (former C and D).

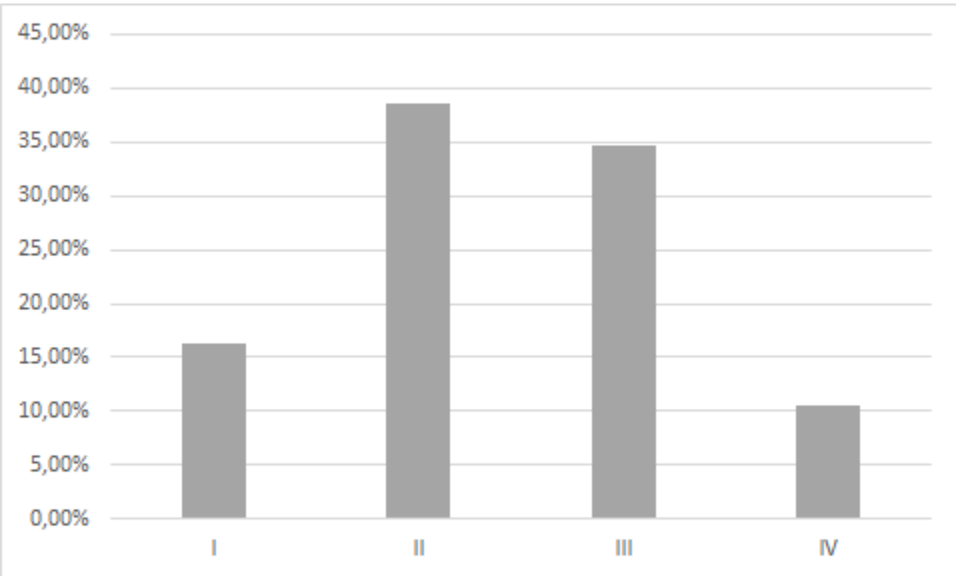

Figure 4. Percentage of GOLD categories according to severity of airflow limitation in all patients - I (mild): FEV_1 ≥80% predicted; II (moderate): FEV_1 50-79% predicted; III (severe): FEV_1 30-49% predicted; and IV (very severe): FEV_1 <30% predicted.