International Journal of Nutritional Sciences

Open Access

Austin Publishing Group

Research Article

Factors Affecting Quality of Life in Patients with Chronic Respiratory Diseases

Fekete M[1], Szarvas ZS[1], Fazekas-Pongor V[1], Szollosi G[2], Tarantini S[3,4] and Varga JT[5]*

[1]Department of Public Health, Semmelweis University, Faculty of Medicine, Budapest, Hungary

[2]Faculty of Public Health, University of Debrecen, Hungary

[3]Department of Biochemistry and Molecular Biology at University of Oklahoma Health Sciences Center, Oklahoma City, Oklahoma, USA

[4]Department of Health Promotion Sciences, College of Public Health, University of Oklahoma Health Sciences Center, Oklahoma City, Oklahoma, USA

[5]Department of Pulmonology, Semmelweis University, Budapest, Hungary

***Corresponding author:** Janos T Varga, Department of Pulmonology, Semmelweis University, Budapest, Tömő u. 25-29, H-1083, Hungary

Received: August 20, 2021; **Accepted:** September 14, 2021; **Published:** September 21, 2021

Abstract

Introduction: Chronic Obstructive Pulmonary Disease (COPD) is a progressive disease associated with worsening lung function, exacerbations and myriad factors affecting quality of life.

Aim: Our cross-sectional study aims was to assess the quality of life of COPD patients and its determinants.

Methods: 200 COPD patients aged over 40 years completed our questionnaire in Budapest at the Department of Pulmonary Rehabilitation of the National Koranyi Institute of Pulmonology between September 1, 2019 and March 1, 2020. We used the disease-specific COPD Assessment Test (CAT) questionnaire to measure quality of life, furthermore the Morisky Medication Adherence Scale (MMAS) to measure patients' medication adherence.

Results: The median age of patients was 67 years, with a sex ratio of 48.0% male and 52.0% female. Malnourished patients (n=44) had a significantly lower quality of life (CAT: 27 *vs*. 25; p=0.046) than normal or overweight patients. Vitamin D is taken regularly by 27.0% of patients (CAT: 25.0 *vs*. 26.5; p=0.049), while omega-3 fatty acid is taken by 5.0%, also with improved quality of life. There was a significant difference in quality of life indicators between patients who cooperated (69.0%) and those who did not (31.0%). Patients' education level, smoking status, influenza-, pneumococcal vaccination and physical activity also played a role in patients' quality of life.

Conclusion: Patients with COPD have low quality of life indicators due to their disease, which is influenced by a myriad of factors. Professionals, who treating patients, need to take these factors into account in order to improve the effectiveness of treatment.

Keywords: Chronic obstructive pulmonary disease; Quality of life; Nutritional status; Vitamin D; Omega-3; Adherence

Abbreviations

6MWT: Six-Minute Walking Test; BMI: Body Mass Index; CAT: COPD Assessment Test; COPD: Chronic Obstructive Pulmonary Disease; CRP: C-Reactive Protein; DHA: Docosahexaenoic Acid; EPA: Eicosapentaenoic Acid; FEV_1: Forced Expiratory Volume in One Second; FVC: Forced Vital Capacity; GOLD: Global Initiative for Chronic Obstructive Lung Disease; HDL: High-Density Lipoprotein; IL-6: Interleukin-6; IL-8: Interleukin-8; LDL: Low-Density Lipoprotein; mMRC: Modified Medical Research Council Dyspnea Scale; OR: Odds Ratio; PUFA: Polyunsaturated Fatty Acid; SD: Standard Deviation; TNF-α: Tumor Necrosis Factor Alpha; TUKEB: Regional Institutional Scientific Research Ethics Committee of Semmelweis University; WHO: World Health Organization

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a preventable chronic respiratory disease characterized by persistent and usually progressive bronchial obstruction [1]. Airway resistance flow obstruction is the result of an abnormally increased inflammatory response to inhalation of tissue-damaging gases and particles (most commonly tobacco smoke) in the lungs [2]. It has increase morbidity and mortality worldwide. The World Health Organization (WHO) projecting that it will become the third leading cause of death by 2030 [3]. Changes in smoking habits, ageing population and certain respiratory infectious diseases also being identified as causes of the disease [4].

Different factors influence the quality of life and the life expectancy of the COPD patients, like early detection of the disease, early diagnosis, patients' lifestyle, smoking, alcohol consumption, and physical activity [5]. It is essential that medication is optimally adjusted, that the patient is under long-term care, and that respiratory function is monitored regularly, at least annually, with possible medication modifications [6]. The cooperation, psychological support and motivation of the patient are essential factors. However, the quality of life is also influenced by a number of other co-morbidities such as vascular stenosis, heart disease, hypertension, other circulatory diseases (e.g. stroke), pneumonia, lung cancer, diabetes mellitus, osteoporosis, anxiety, depression, anaemia. The proper management or avoidance of that, which significantly increases the life expectancy of COPD patients and improves the outcome of the disease [7].

Citation: Fekete M, Szarvas ZS, Fazekas-Pongor V, Szollosi G, Tarantini S and Varga JT. Factors Affecting Quality of Life in Patients with Chronic Respiratory Diseases. Int J Nutr Sci. 2021; 6(3): 1059.

However, a less frequently mentioned factor affecting patients' quality of life is nutritional status. Malnutrition is common (10-45%) among COPD patients and is often associated with poor prognosis, increasing the number of exacerbations, length of hospital stay and health care costs [8, 9]. Recent observations have highlighted that the opposite of the aforementioned malnutrition, overweight is also a risk factor in COPD patients, because it is associated with a higher likelihood of developing the "cardiometabolic syndrome", which is associated with a worse disease course, more frequent exacerbations, poorer exercise tolerance, i.e. an increased co-morbidity index [10].

There is even less discussion of medical therapeutic cooperation (adherence) and its determinants, i.e. their awareness of their disease and their social support, which play a key role in the care of COPD patients. Patients' awareness and uptake of the different vaccines recommended for them (e.g. influenza, pneumococcal vaccine) is closely related to quality of life and the frequency of exacerbations with life-threatening complications, because the most frequent causes of exacerbations are tracheobronchial infections (70%) and air pollution [11].

Their quality of life is also positively affected by vitamin D supplementation, because vitamin D deficiency increases chronic airway and systemic inflammation, which is particularly dangerous in severe COPD patients with low FEV_1 (forced expiratory volume in one second) [12]. It should be noted that low serum 25-hydroxyvitamin D (25 (OH) D) levels, which reproduce vitamin D status, occur in 60-75% of patients with severe COPD [13]. An even less frequently mentioned important nutritional supplement is omega-3 polyunsaturated fatty acids, which have been shown to reduce blood inflammatory parameters (C-Reactive Protein (CRP); Interleukin-6 (IL-6); Interleukin-8 (IL-8); Tumour Necrosis Factor-alpha (TNF-α) and to reduce pulmonary vasoconstriction and hypertension caused by hypoxia by altering cell membrane composition [14].

The aim of the present study is to explore the quality of life of COPD patients and its determinants. We will analyses the impact of age, sex, education and medication adherence on quality of life, and identify and associate quality of life with patients who are taking vitamin D and omega-3 essential fatty acid supplementation. It may help professionals in patient care to improve the effectiveness of treatment, so that patients may live better quality of life.

Methods

Data collection was performed with volunteer participants, anonymously, using self-completed paper-based questionnaires between September 1, 2019 and March 1, 2020 among patients in the Department of Pulmonary Rehabilitation of the National Korányi Institute for Pulmonology, Budapest, Hungary. Two hundred patients over the age of 40 with COPD participated. Prior to completing the questionnaire, patients received detailed information about the purpose and time of the survey, anonymous and aggregated data processing, and the essence of the research. The study was approved by TUKEB (Scientific and Research Ethics Committee) (license number: TUKEB 44402-2/2018/EKU) and complies with the Declaration of Helsinki. Participants in the research did not receive any financial, any remuneration or any other allowances. Post-bronchodilator FEV_1 was measured in each patient and expressed as a percentage of the estimated values. Patients were graded into GOLD A-D (Global Initiative for Obstructive Lung Disease (international recommendation for COPD) stages based on current and future risk parameters according to spirometry values, symptoms and exacerbation rate [15]. Exclusion criteria included acute exacerbation, chronic oxygen therapy (resting oxygen saturation less than 89%), history of asthma, lung surgery or severe comorbidities such as severe heart failure or severe liver or kidney failure; acute coronary syndrome or acute cerebrovascular event.

We used the Hungarian validated version of the disease-specific COPD Assessment Test (CAT) [16] to measure quality of life, which provides a comprehensive assessment of the impact of COPD on health. The COPD Assessment Test asks the patient to rate their current symptoms of their disease. The CAT consists of 8 items, each scored between 0 and 5, giving a total score between 0 and 40, with 40 being the worst. A CAT score of ≥10 indicates a significant symptomatic level (GOLD, 2014) [16]. The questionnaire was completed by the patient in stable condition at the institution under the supervision of a coordinator. During the 6-Minute Walking Distance (6MWD) test, patients were asked to walk with the maximal speed in the corridor for 6 minutes and the maximum walking distance was detected [17].

The nutritional status of the patients was assessed by taking their body weight and height with an instrument, and further data were collected with a self-designed questionnaire. The questionnaire asked patients about their gender, age, education, smoking history and disease status, and they completed the Morisky Medication Adherence Scale (MMAS), which measures patients' adherence to therapy [18]. The MMAS is a 4-question, self-report questionnaire that can be used to reliably measure medication adherence in COPD patients. The questionnaire examines the disease-specific aspect of cooperation in terms of forgetfulness, inattention, worsening of the condition and improvement of the condition. The total score ranges from 0 to 4 points, with higher scores indicating better adherence, and the result is used to divide patients into cooperative and non-cooperative groups. Patients were considered to be cooperative with drug therapy if they scored 3-4, and non-cooperative if they scored 0-2 [18].

Statistical analysis

Descriptive analyses were performed using the STATA SE-10.0 (StataCorp, College Station, TX) software package. The distribution of the sample was checked using the Shapiro-Wilk test, continuous variables were not normally distributed, so median and interquartile range data were reported in the tables. A non-parametric test (Kruskal-Wallis test) was used to compare the different groups. Statistical tests were performed at 95% confidence intervals, with significance at $p < 0.05$.

Results

The median age of patients (n=200) was 67 (61-72) years, with a sex ratio of 48.0% male and 52.0% female. Median BMI was 25 (21-31) kg/m^2 and median FEV_1 (ref%) was 45 (33-58). Patients who had ever (95%) and currently smoked (43.5%); smoked an average of 20 cigarettes/day for 40 years. In terms of highest educational attainment, 37.5% of patients had primary school, 46.5% had secondary school/vocational secondary school/high school and 16.0% had college/

Table 1: Anthropometric and functional characteristics of COPD patients in the study (n=200).

	Man (n=96)	Woman (n=104)	p-value
Age (years) (IQR)	67 (61-72)	67 (61-73)	0.421
Smoking habit			
Active (n, %)	43 (46.23)	44 (42.31)	0.582
Former smoker (n, %)	47 (48.96)	56 (53.85)	
Non-smoker (n, %)	6 (6.25)	4 (3.84)	
Smoking (year)	40 (26-46)	40 (30-46)	0.406
Number of cigarettes (cigarettes/day)	20 (15-25)	20 (10-20)	0.014
BMI (kg/m^2)	24.3 (20.8-30.0)	25.6 (21.7-31.2)	0.053
FEV_1 (ref%)	44 (31-58)	46 (35-58)	0.121
FVC (%)	68 (55-83)	72 (60-85)	0.046
FEV_1/FVC (%)	49 (41-61)	52 (44-65)	0.006
GOLD groups			
GOLD A (n, %)	5 (5.37)	10 (9.61)	0.049
GOLD B (n, %)	30 (31.25)	32 (30.77)	0.797
GOLD C (n, %)	43 (44.79)	48 (46.15)	0.555
GOLD D (n, %)	18 (18.76)	14 (13.46)	0.392
Comorbidities (n, %)			
Hypertonia	69 (71.88)	76 (73.07)	0.684
Ischaemic heart disease	14 (14.58)	18 (17.31)	0.599
Diabetes mellitus	16 (16.66)	20 (19.23)	0.365
Metabolic syndrome	48 (50.00)	54 (51.92)	0.666
Psychiatric history	9 (9.37)	15 (14.42)	0.135
Osteoporosis	8 (8.33)	20 (19.2)	0.026
Lung cancer	3 (3.13)	2 (1.92)	0.586
6MWD (m)	300 (200-376)	225 (129-310)	<0.001

Data are presented as median (IQR) or as frequency and percentage; BMI: Body Mass Index; COPD: Chronic Obstructive Pulmonary Disease; GOLD: Global Initiative for Chronic Obstructive Lung Disease; FEV_1: Forced Expiratory Volume in the First Second; FVC: Forced Vital Capacity; CAT: COPD Assessment Test; 6MWD: 6-Minute Walk Distance; p <0.05 means the two indicators were significantly correlated.

university. Lung function and various anthropometric parameters are presented in Table 1.

Patients' nutritional status, education, smoking and alcohol consumption habits, cooperation with their doctor, physical activity, pulmonary function, influenza and pneumococcal vaccination status, vitamin D and omega-3 supplementation and the presence of comorbidities were found to be factors that determined patients' quality of life (Table 2). Notably only a low percent of patients (27.0%) consumed vitamin D according to the medical recommendation (2000-3000 IU/day). Significantly better quality of life was detected (CAT: 25.0 (18-28) *vs.* 26.5 (21-31); p=0.049). There were even fewer (5.0%) supplemented omega-3 polyunsaturated fatty acids (0.5g/day), which was also associated with a better quality of life. We found a strong correlation in patients' quality of life in their exercise capacity (CAT: 28 (22-32) *vs.* 24 (18-29); p <0.001), respiratory function (CAT: 29 (23-33) *vs.* 24 (18-30); p <0.001) and nutritional status (CAT: 27 (22-33) *vs.* 25 (18-31); p=0.046). A very low proportion of patients required and received recommended influenza and/or pneumococcal vaccinations, 21.0% and 12.5% of patients, respectively. Although improved quality of life was also detected in these cases. In terms of quality of life, patients' sex, age, serum cholesterol and blood lipid levels were not determinants.

Our results show that two-thirds of patients (69.0%) are cooperative with their doctors and health care staff (MMAS score = 3-4), while one-third of patients (31.0%) are uncooperative (MMAS score = 0-2) (Table 3). When examining the impact of adherence to medication on quality of life, there was a significant difference in quality of life indicators between adherent (n=138) and non-adherent (n=62) patients (CAT score: 26 (21-31) *vs.* 22 (10-30); p <0.001). Cooperating patients had significantly fewer years of smoking (35 (25-45) *vs.* 40 (30-50); p=0.025) and significantly fewer patients consumed alcohol (19 (13.76%) *vs.* 16 (25.81%); p=0.045) (Table 4). Patients who had a good compliance in administration of medication had fewer comorbidities (hypertension, ischaemic heart disease, diabetes mellitus, osteoporosis, lung cancer, psychiatric disease; p=0.213), and significantly lower number of exacerbations in the previous year (1 (0-3) *vs.* 2 (1-4); p <0.05). Patients with older age (≥65 years), lower education level (primary school) and currently active smokers (43.5%) had a higher prevalence of non-adherence to therapy (Table 4).

Discussion

Our study focused on the quality of life of patients with chronic respiratory diseases and related factors. The question is particularly relevant because this group of diseases is becoming more prevalent. In many cases, due to the progressiveness of the disease, improving quality of life should be a priority. Literature shows that among people with chronic respiratory disease, those diagnosed with COPD have a particularly poor quality of life [19,20] and therefore we should aim to maintain a better quality of life and increase life expectancy by encouraging patients to make lifestyle changes and engage with their doctor on a sustained basis. Our results show that patients' educational level, socioeconomic status, smoking and alcohol consumption habits, cooperation with physicians - based on good doctor-patient communication, physical activity, nutritional status, respiratory function, influenza and pneumococcal vaccination status, vitamin D and omega-3 supplementation, and the presence of comorbidities are significant factors influencing quality of life.

It is natural and well established that patients' quality of life deteriorates with age, but our results show that COPD patients experience their respiratory symptoms as a relatively age-independent burden. Our results showed that there was no significant difference in quality of life scores between men and women, i.e. neither age nor gender was a determining factor. Similar results were reported by Rosińczuk J et al. in their study, where quality of life was not related to patient gender nor age but higher education improved quality of life scores; the presence of comorbidities, longer duration of illness, worsening respiratory function and the need for oxygen therapy were identified as determinants [21].

Due to the chronic progressive nature of COPD (severe physical disability, respiratory insufficiency, significant reduction in exercise capacity), it is paramount important to draw attention to lifestyle changes, i.e. avoiding smoking and alcohol, depending on exercise

Table 2: Factors affecting quality of life in COPD patients (n=200).

Age (year)	<65 (n=69)	≥65 (n=131)			p-value
CAT (points)	26 (21-32)	26 (19-31)			0.238
Sex	Man (n=96)	Woman (n=104)			
CAT (points)	25 (18-30)	27 (21-31)			0.075
School	Primary (n=75)	Secondary/High (n=93)	College/University (n=32)		
CAT (points)	29 (26-32.75)	25 (20-28)	23 (17-28)		<0.001
Smoking habit	Active smoker (n= 87)	Former smoker (n=103)	Non-smoker (n=10)		
CAT (points)	27.5 (21-31)	25.5 (19-30)	22.5 (18-31)		0.049
Alcohol	Consumer (n=35)	Non-consumer (n=165)			
CAT (points)	28 (22-32)	25 (19-31)			0.138
Medication adherence	Adherent patient (n=138)	Non-adherent patient (n=62)			
CAT (points)	22 (10-30)	26 (21-31)			<0.001
BMI (kg/m^2)	<21 (n=44)	21–25 (n=55)	> 25 (n=101)		
CAT (points)	27 (22-33)	25.5 (19-30)	25 (18-31)		0.046
Cholesterin (mmol/l)	≥5.2 (n=86)	<5.2 (n=114)			
CAT (points)	26 (20-32)	26 (19-31)			0.152
Triglicerid	≥1.7	<1.7			
(mmol/l)	(n=61)	(n=129)			
CAT (points)	26.5 (20-32)	26 (19.25-30)			0.301
Vitamin D consumer	Consumer (n=54)	Non-consumer (n=146)			
CAT (points)	25 (18-28)	26.5 (21-31)			0.049
Omega-3 consumer	Consumer (n=10)	Non-consumer (n=190)			
CAT (points)	26 (20-28.5)	27 (20.5-29.5)			0.119
Vitamin D and Omega-3 consumer	Consumer (n=8)	Non-consumer (n=192)			
CAT (points)	25 (18-28)	26.5 (21-31.5)			0.047
FEV_1 (ref%)	>80 ref% (n=15)	50-80 ref% (n=64)	30-50 ref% (n=91)	<30 ref% (n=30)	
CAT (points)	24 (18-30)	26 (19-31)	27 (22-33)	29 (23-33)	<0.001
6MWD (m)	<250 (n=94)	≥250 (n=106)			
CAT (points)	28 (22-32)	24 (18-29)			<0.001
Influenza vaccine	Vaccinated (n=42)	Unvaccinated (n=158)			
CAT (points)	26 (23-30)	27 (22-31)			0.532
Pneumococcus vaccine	Vaccinated (n=25)	Unvaccinated (n=175)			
CAT (points)	26 (21-29)	27 (22-31)			0.895
Influenza and Pneumococcus vaccine	Vaccinated (n=10)	Unvaccinated (n=190)			
CAT (points)	26 (20-29)	27 (20-31)			0.509
Comorbidity	0 (n=17)	1-2 (n=99)	3-4 (n=65)	≥5 (n=19)	
CAT (points)	25 (18-31)	25 (19-31)	27 (20-32)	29.5 (22-34)	0.143

Data are presented as median (IQR). BMI: Body Mass Index; CAT: COPD Assessment Test; 6MWD: Six Minute Walking Distance; FEV_1: Forced Expiratory Volume in the First Second; p <0.05 means the two indicators were significantly correlated.

capacity, regular exercise in the open air, and supplementation of essential vitamins (e.g. vitamin D), as in our study vitamin D intake was also found to be suboptimal. Research supports the hypothesis [22,23], that vitamin D supplementation is effective, safe, necessary and cost-effective in the management of COPD, with optimal serum levels of vitamin D reducing systemic inflammation and the frequency of exacerbations, yet it is consumed at very low rates by patients, only 27% of patients in our present study. Of note, low serum 25-hydroxyvitamin D (25 (OH) D) levels, which reproduce vitamin D status, occur in 60-75% of patients with severe COPD [24]. Studies have described that vitamin D supplementation significantly improved patients' 6-minute walking distance (6MWD), a very important parameter, as physical activity and exercise capacity are important predictors of survival in COPD patients [25]. Rezk and colleagues described a significant improvement (p <0.003) in the mMRC (Modified Medical Research Council) Dyspnea Scale, a

Table 3: Medication adherence of COPD patients (n=200).

	n	(%)
Adherent patient (MMAS point = 3-4)	138	69
Non-adherent patient (MMAS point = 0-2)	62	31
MMAS questions on COPD medication (n, %)	Yes (n, %)	No (n, %)
1. Do you ever forget to take your medications? (yes=0, no=1)	52 (26.00)	148 (74.00)
2. Are you careless at times about taking your medications? (yes=0, no=1)	62 (31.00)	138 (69.00)
3. When you feel better do you sometimes stop taking your medications? (yes=0, no=1)	68 (34.00)	132 (66.00)
4. Sometimes if you feel worse when you take your medication, do you stop taking it? (yes=0, no=1)	58 (29.00)	142 (71.00)

COPD: Chronic Obstructive Pulmonary Disease; MMAS: Morisky Medication.

Table 4: Comparison of cooperative and non-cooperative patients (n=200).

Variables	Adherent (n, %)	Non-adherent (n, %)	p-value
n=200	138 (69.00)	62 (31.00)	
Age (in years)	59 (62-73)	66 (60-71)	0.367
Sex			
Man	62 (44.92)	34 (54.84)	0.194
Woman	76 (55.08)	28 (45.16)	
School education			
Primary school	43 (31.16)	32 (51.61)	0.009
Secondary /High school	70 (50.72)	23 (37.09)	0.089
College/University	25 (18.12)	7 (11.30)	0.291
Smoking status			
Active smoker	59 (43.38)	28 (43.75)	0.961
Non-smoker	8 (5.88)	2 (3.12)	0.403
Former smoker	69 (50.74)	34 (53.13)	0.752
Smoking (years)	35 (25-45)	40 (30-50)	0.025
Alcohol consumer			
Yes	19 (13.76)	16 (25.81)	0.045
No	119 (86.23)	46 (74.19)	
Comorbidity			
None	14 (10.14)	3 (4.84)	0.213
≥1	124 (89.86)	59 (95.16)	
GOLD stage			
A, B	57 (41.31)	20 (32.26)	0.223
C, D	81 (58.69)	42 (67.74)	
FEV_1 (ref%)	47 (34.2-58.7)	45 (33.5-53.5)	0.262
6MWD (m)	310 (158-345)	250 (150-358)	0.878
CAT (points)	22 (10-30)	26 (21-31)	<0.001
COPD exacerbation ≥2	23 (16.67)	22 (35.48)	0.041

Data are presented as median (IQR) or as frequency and percentage; COPD: Chronic Obstructive Pulmonary Disease; GOLD: Global Initiative for Chronic Obstructive Lung Disease; FEV_1: Forced Expiratory Volume in First Second; CAT: COPD Assessment Test; 6MWD: 6-Minute Walk Distance; p <0.05 means the two indicators were significantly correlated.

significant decrease (p <0.001) in the number of exacerbations (p <0.001) and a significant decrease (p <0.001) in the level of C-Reactive Protein (CRP), one year after starting vitamin D supplementation [26]. In our own previous research, when we asked patients about the main functions of vitamin D in human body, only half of the patients

Table 5: Influenza and pneumococcal vaccination coverage and WHO recommendation for COPD patients.

	Vaccination coverage		
	Influenza vaccination coverage (%)	Pneumococcal vaccination coverage (%)	WHO recommendation (%)
Hungary	23.6	10.8	75
USA	70	49.9	90
UK	36.1	16.8	75
Spain	49.4	32.5	75
Germany	46.5	14.6	75
France	73	53	75
Italy	30.5	13.3	75
Turkey	36.5	14.1	75

WHO: World Health Organization; USA: United States of America; UK: United Kingdom; Source: 51-55.

(49%) answered correctly that it regulates calcium and phosphorus metabolism, maintains bone health and supports the immune system. Some people incorrectly associated it with healthy bowel function (13%), keeping eyesight sharp (10%), keeping hair and nails healthy (9%), healthy cell function (8%) and some could not tell at all what vitamin D does (11%). Asking about the time that they usually spend each day outdoor in sunny weather, only one third (35%) of patients answered spending 20 minutes or more, and two thirds (65%) spent less than 15 minutes a day outdoor [23]. In conclusion, vitamin D in addition to regulating many important physiological functions is essential for the proper functioning of the immune system and improves the quality of life of patients, yet very few patients take it regularly, so patients need to be informed about the need for vitamin D supplementation.

Researchers are increasingly recognizing that COPD patients require a holistic approach from healthcare professionals, who need to take into account not only basic medical parameters, but also other indicators that affect overall well-being, i.e. identifying factors that have the potential to positively influence their quality of life and incorporating them into a comprehensive treatment programme [27-29]. One of these very important prognostic and modifiable factors is malnutrition, which is common in COPD (upto 45%) and often associated with a poor prognosis [30], poorer quality of life, increased exacerbations, longer hospital stays and higher healthcare costs [31]. Timely screening and initiation of nutritional therapy can lead to significant improvements in respiratory function, exercise tolerance and quality of life, as well as reduce morbidity and mortality in COPD patients [32], and low BMI has been shown to be an independent risk

factor for mortality in COPD patients [33]. Previous studies have shown that the majority of COPD patients (more than 80%) do not meet their body's energy and protein needs, Vitamin D and omega-3 requirements through their diet [8,34]. In our previous research asking about the food they like to eat, most people said pasta (pizza, pastries and other confectionery), followed by meat, vegetables, fruit, oilseeds and fish. However, it should be noted that more than half of the respondents (53%) do not eat fish (sardines, salmon, tuna, cod). One third of the patients surveyed (29%) do not consume dairy products, one reason for that is lactose intolerance (5%). This means that foods, which are rich in vitamin D and omega-3 (fish, dairy products, oilseeds) are presented in very low proportions in the diets of COPD patients [23]. Nutrition counselling should include the following key messages: patients should choose from a variety of foods each day, focusing on protein-rich foods such as meat, seafood, eggs, milk, oilseeds, choose energy- and protein-rich foods that are locally available, and also include smaller meals in addition to the three main meals [35].

Research has described that polyunsaturated fatty acid intake may be associated with quality of life in patients with COPD [36,37]. The PUFA (polyunsaturated fatty acids) intake recommended by the American Dietetic Association is daily >0.5g EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid) [38], compared to which the daily intake is extremely low, with an average EPA + DHA intake for COPD patients (mean ± SD: 0.11 ± 0.21g) [14,39]. Our study found that patients' omega-3 intake is inadequate, with only 5% of patients taking 0.5g/day regularly. It is also clear and certain that new anti-inflammatory strategies need to be developed, as no single agent, including corticosteroids, can slow down the chronically progressive inflammatory process in COPD [40]. A diet, rich in vitamin D and omega-3 fatty acids has anti-inflammatory effects, improves patients' exercise tolerance and is a safe and practical method when supplemented of treating COPD without side effects [41,42]. A case-control study demonstrated that those who received omega-3 supplementation (0.5-1.0 g/day) had fewer infectious complications and higher 6-Minute Walk Distance (6MWD) [43]. Among the beneficial effects of omega-3 fatty acids, the best known are their inhibitory effects on inflammation and tumour growth, inhibiting the production of prostaglandins and leukotrienes derived from arachidonic acid, and inhibiting proliferation in cancer cell lines [44,45]. Dietary supplementation with polyunsaturated fatty acids reduces the incidence of cardiovascular disease, and its anti-atherosclerotic effect is based on reducing lipoprotein lipase production, lowering serum triglyceride, LDL cholesterol, increasing HDL cholesterol and improving cell membrane phospholipid composition [46]. Polyunsaturated fatty acids also have a positive cardiac haemodynamic effect, increasing cardiac oxygenation, improving cardiac diastolic and respiratory function, and reducing exercise-induced bronchoconstriction [47]. Despite the numerous positive effects of polyunsaturated fatty acid intake, the omega-3 intake of patients is still insufficient.

The WHO (World Health Organization) renewed recommendations include detailed guideline for the management of COPD patients, which are also reflected in everyday therapy [48]. To facilitate this, programmes are needed to motivate patients to help improve their own condition. A triad of smoking cessation programmes, prevention and effective treatment management is needed to manage the disease in a cost-effective way. Evidence shows that informed patients are more likely to adhere to treatment [49]. Our results demonstrate a significant association between adherence and disease-specific quality of life (CAT), in line with previous work by Corden et al. [50]. Discontinuation of medication can increase the frequency of exacerbations, the number of hospitalizations and mortality rates, and non-adherence to therapies can result in poorer health and increased healthcare costs [51]. In the present study, the proportion of cooperative patients was relatively high (69.0%), while another similar study from Hungary found that the proportion of COPD patients with optimal adherence was around 60% [52]. There is a wide variation in patient adherence among COPD patients in summary studies (20%-60%), even higher in clinical studies (up to 70-90%) [53]. In our present study, the high rate is due to and explained by the fact that we interviewed patients in the hospital pulmonology ward undergoing rehabilitation, who were cooperative in their attendance at treatments, rehabilitation programmes, education and motivated to change their lifestyle.

Last but not least an important element of our research is the uptake of influenza and pneumococcal vaccinations, which are recommended for all COPD patients by the WHO, with influenza vaccination every year and pneumococcal vaccination every five years [4,54]. In our present study, the influenza vaccination rate among patients was 21.0% and the pneumococcal vaccination rate was 12.5%. The WHO influenza and pneumococcal vaccination targets for patients with COPD are shown in Table 5, and studies worldwide have shown [55-59] that vaccination coverage rates for both vaccines are much lower than the target, despite evidence of a reduced risk of developing deep respiratory tract infections and thus mortality in COPD [59]. When researching the reasons for refusal of vaccinations, Vandebos and his research team suggest that the main reasons for refusal of flu vaccination are negative attitudes towards vaccination and the lack of recommendation from a GP or other doctor, it is very important that doctors and health professionals recommend these vaccinations to patients [60]. In their study, Ciblak et al. identified the following as the main reasons for vaccine non-adherence: patients do not believe in the efficacy of vaccines, they do not believe that they are at risk, and patients are worried and fearful about the undesirable consequences of vaccination [61]. In our own previous research, we found that less than a third (28.4%) of COPD patients were adequately informed by their doctors about the need for recommended vaccinations for their chronic disease. In addition to that only a third (36%) of the patients found that the flu vaccine is useful and important, while only a quarter (26%) thought that it was beneficial to receive the pneumococcal vaccine. A third of patients (31.2%) believe that the influenza virus causes only mild illness, and more than half of patients (54%) have never heard of the Pneumococcus bacteria and the vaccine against it [59]. Related to the non-vaccination of recommended vaccines it is also important to mention the effects of extremely damaging anti-vaccine campaigns. On the internet and social media, false and misleading information is claimed on the composition, side effects and long-term health complications of vaccines, causing great harm [62]. The members of these campaigns most often live in developed countries and mislead people, sharing false information among themselves, which is causing serious damage in the current epidemiological situation.

These observations show that patients are not well informed about vaccines and draw attention to the preventive role of doctors and health workers in communicating the effectiveness of vaccines, which is of paramount importance in the current epidemic situation.

Besides presenting our results, we should also mention the limitations of our study, the disadvantage is that it was a cross-sectional, observational study with single-center patient recruitment; the survey was conducted with a self-completion questionnaire without measuring serum vitamin D levels. However, in the present study, we explored factors potentially influencing quality of life in COPD patients through subjective experience of the disease management and found clear positive evidence of influencing factors. COPD therapy essentially aims at maintaining a stable state and restoring health as fully as possible, with the goal of bringing life-year gains and quality of life improvements to patients.

Conclusion

COPD significantly impairs the quality of life of patients, and its measurement is utmost importance in clinical practice, as it helps in the early detection of the disease and the long-term management of COPD patients. In summary, taking quality of life and its determinants into account in everyday patient care could optimize the care of COPD patients, leading to a long-term reduction in the burden of COPD.

Declarations

Authors' contribution: MF and JTV: Designed the study, wrote and published the manuscript. ZSSZ, ST: Supplemented and reviewed the manuscript. VFP, GSZ: Prepared the manuscript for publication. All authors read and approved the final manuscript.

References

1. Varga J. Practical and theoretical principles of pulmonary rehabilitation. Levels of treatment. Korányi Bulletin. 2016; 1: 44-47.
2. Varga J. Chronic obstructive pulmonary disease. [Krónikus obstruktív tüdőbetegség] Háziorv Továbbk Szle. 2018; 23: 26-30.
3. World Health Statistics. 2019.
4. Böszörményi NGy, Balikó Z, Kovács G, Somfay A, Strausz J, Szilasi M, et al. Diagnostic and therapeutic protocols of chronic lung diseases (chronic obstructive pulmonary disease - COPD) in the primary, secondary and emergency health care. [Egészségügyi szakmai irányelv a krónikus tüdőbetegség (COPD) diagnosztikájáról és kezeléséről, az alap-, szak-, és sürgősségi ellátás területére]. Med Thor. 2014; 67: 76-112.
5. Varga J. Mechanisms to dyspnoea and dynamic hyperinflation related exercise intolerance in COPD (Review). 2015; 102: 163-175.
6. Varga J. Theoretical and practical basics of the respiratory rehabilitation, the scenes of care. [A légzésrehabilitáció elméleti és gyakorlati alapjai, ellátási színterei.] Korányi Bulletin. 2016; 1: 44-47.
7. Szucs B, Szucs C, Petrekanits M, Varga JT. Molecular Characteristics and Treatment of Endothelial Dysfunction in Patients with COPD: A Review Article. Int J Mol Sci. 2019; 20: 4329.
8. Fekete M, Fazekas-Pongor V, Balazs P, Tarantini S, Szollosi G, Pako J, et al. Effect of malnutrition and body composition on the quality of life of COPD patients. Physiol Int. 2021.
9. Kerti M, Balogh ZS, Varga J. New measures of physiotherapy in pulmonology. Med Thor. 2015; 68: 200-205.
10. Fekete M, Fazekas-Pongor V, Szőllősi G, Varga JT. A krónikus obstruktív tüdőbetegség metabolikus következményei [Metabolic consequences of chronic obstructive pulmonary disease]. Orv Hetil. 2021; 162: 185-191.
11. Miravitlles M, Anzueto A. Role of infection in exacerbations of chronic obstructive pulmonary disease. Curr Opin Pulm Med. 2015; 21: 278-283.
12. Hurst JR, Vestbo J, Anzueto A, Locantore N, Müllerova H, Tal-Singer R, et al. Susceptibility to exacerbation in chronic obstructive pulmonary disease. New Engl J Med. 2010; 363: 1128-1138.
13. Ross AC, Manson JE, Abrams SA, Aloia JF, Brannon PM, Clinton SK, et al. The 2011 report on dietary reference intakes for calcium and vitamin D from the Institute of Medicine: what clinicians need to know. J Clin Endocrinol Metab. 2011; 96: 53-58.
14. Lemoine S CM, Brigham EP, Woo H, Hanson CK, McCormack MC, Koch A, et al. Omega-3 fatty acid intake and prevalent respiratory symptoms among U.S. adults with COPD. BMC Pulm Med. 2019; 19: 97.
15. Singh D, Agusti A, Anzueto A, Barnes PJ, Bourbeau J, Celli BR, et al. Global strategy for the diagnosis, management, and prevention of chronic obstructive lung disease: the GOLD science committee report 2019. Eur Respir J. 2019; 53: 1900164.
16. The COPD Assessment Test (CAT).
17. ATS Committee on Proficiency Standards for Clinical Pulmonary Function Laboratories. ATS statement: guidelines for the six-minute walk test. Am J Respir Crit Care Med. 2002; 166: 111-117.
18. Barnestein-Fonseca P, Leiva-Fernandez J, Vidal-Espana F, Garcia-Ruiz A, Prados-Torres D, Leiva-Fernandez F. Is it possible to diagnose the therapeutic adherence of patients with COPD in clinical practice? A cohort study. BMC Pulm Med. 2011; 11: 6.
19. Fazekas-Pongor V, Fekete M, Balazs P, Árva D, Pénzes M, Tarantini S, et al. Health-related quality of life of COPD patients aged over 40 years. Physiol Int. 2021; 10.1556/2060.2021.00017.
20. Szucs B, Petrekanits M, Varga J. Effectiveness of a 4-week rehabilitation program on endothelial function, blood vessel elasticity in patients with chronic obstructive pulmonary disease. J Thorac Dis. 2018; 10: 6482-6490.
21. Rosińczuk J, Przyszlak M, Uchmanowicz I. Sociodemographic and clinical factors affecting the quality of life of patients with chronic obstructive pulmonary disease. Int J Chron Obstruct Pulmon Dis. 2018; 13: 2869-2882.
22. Hurst JR, Vestbo J, Anzueto A, Locantore N, Müllerova H, Tal-Singer R, et al. Susceptibility to exacerbation in chronic obstructive pulmonary disease. New Engl J Med. 2010; 363: 1128-1138.
23. Fekete M, Fazekas-Pongor V, Németh A, Szőllősi G, Varga JT. Vitamin D supplementation in COPD: a national questionnaire study. [D-vitamin-pótlás COPD-ben: hazai kérdőíves vizsgálat.] Orvostovábbképző Szemle. 2020; 27: 37-44.
24. Akbar MR, Wibowo A, Pranata R, Setiabudiawan B. Low Serum 25-hydroxyvitamin D (Vitamin D) Level Is Associated With Susceptibility to COVID-19, Severity, and Mortality: A Systematic Review and Meta-Analysis. Front Nutr. 2021; 8: 660420.
25. Gharabaghi MA, Ghrabaghi MA, Arabi M, Anaraki MRZ, Deilami GD. High Dose Vitamin D3 Improves Exercise Tolerance in Elderly Patients with Chronic Obstructive Pulmonary Disease. J Gerontol Geriat Res. 2013; 2: 3.
26. Rezk N, Aly N, Hewidy AAH. Effect of vitamin D replacement in chronic obstructive pulmonary disease patients with vitamin D deficiency. Egyptian J Chest Dis Tuber. 2015; 64: 353-357.
27. Vagvolgyi A, Rozgonyi Z, Kerti M, Vadasz P, Varga J. Effectiveness of perioperative pulmonary rehabilitation in thoracic surgery. J Thorac Dis. 2017: 9: 1584-1591.
28. Varga J, Porszasz J, Boda K, Casaburi R. Exploring the effect of high intensity continuous and interval training and at-home training respectively on rehabilitation of COPD patients. Med Thor. 2008; 61: 135-143.
29. Hegedűs B, Varga J, Somfay A. Az interdiszciplináris rehabilitáció hatása spondylitis ankylopoeticában szenvedő betegekben [Interdisciplinary rehabilitation in patients with ankylosing spondylitis]. Orv Hetil. 2016; 157: 1126-1132.

30. Schols AM, Ferreira IM, Franssen FM, Gosker HR, Janssens W, Muscaritoli M, et al. Nutritional assessment and therapy in COPD: a European Respiratory Society statement. Eur Respir J. 2014; 44: 1504-1520.

31. Collins PF, Stratton RJ, Kurukulaaratchy RJ, Elia M. Influence of deprivation on health care use, health care costs, and mortality in COPD. Int J Chron Obstruct Pulmon Dis. 2018; 13: 1289-1296.

32. Varga J, Munkácsi A, Máthé Cs, Somfay A, Balint B, Lovasz O, et al. The effect of the inspiratory muscles training on physical condition in COPD. [A belégző izmok tréningjének hatása a betegek fizikai állapotára COPDben]. Med Thor. 2018; 71: 96-102.

33. Fekete M, Pákó J, Szőllősi G, Tóth K, Szabó M, Horváth D, et al. A tápláltsági állapot felmérése és jelentősége krónikus obstruktív tüdőbetegségben [Significance of nutritional status in chronic obstructive pulmonary disease: a survey]. Orv Hetil. 2020; 161: 1711-1719.

34. Bauer J, Biolo G, Cederholm T, Cesari M, Cruz-Jentoft AJ, Morley JE, et al. Evidence-based recommendations for optimal dietary protein intake in older people: a position paper from the PROT-AGE Study Group. J Am Med Dir Assoc. 2013; 14: 542-559.

35. Eyles HC, Mhurchu CN. Does tailoring make a difference? A systematic review of the long-term effectiveness of tailored nutrition education for adults. Nutr Rev. 2009; 67: 464-480.

36. Choi H, Kim T. Polyunsaturated fatty acids, lung function, and health-related quality of life in patients with chronic obstructive pulmonary disease. Yeungnam Univ J Med. 2020; 37: 194-201.

37. Fekete M, Szőllősi G, Németh AN, Varga JT. Az ómega-3 zsírsavak pótlásának klinikai értéke krónikus obstruktív tüdőbetegségben [Clinical value of omega-3 polyunsaturated fatty acid supplementation in chronic obstructive pulmonary disease]. Orv Hetil. 2021; 162: 23-30.

38. Kris-Etherton PM, Innis S, Ammerican Dietetic Assocition, Dietitians of Canada. Position of the American Dietetic Association and Dietitians of Canada: dietary fatty acids. J Am Diet Assoc. 2007; 107: 1599-1611.

39. Broekhuizen R, Wouters EF, Creutzberg EC, Weling-Scheepers CA, Schols AM. Polyunsaturated fatty acids improve exercise capacity in chronic obstructive pulmonary disease. Thorax. 2005; 60: 376-382.

40. Varga J. Handbook of Pulmonary Rehabilitation. [A pulmonológiai rehabilitáció kézikönyve]. Spring Med Kiadó, Budapest. 2018.

41. Wood LG. Omega-3 polyunsaturated fatty acids and chronic obstructive pulmonary disease. Curr Opin Clin Nutr Metab Care. 2015; 18: 128-132.

42. Buckley CD, Gilroy DW, Serhan CN. Proresolving lipid mediators and mechanisms in the resolution of acute inflammation. Immunity. 2014; 40: 315-327.

43. Gold DR, Litonjua AA, Carey VJ, Manson JE, Buring JE, Lee IM. Lung VITAL: Rationale, design, and baseline characteristics of an ancillary study evaluating the effects of vitamin D and/or marine omega-3 fatty acid supplements on acute exacerbations of chronic respiratory disease, asthma control, pneumonia and lung function in adults. Contemp Clin Trials. 2016; 47: 185-195.

44. Fuentes NR, Kim E, Fan YY, Chapkin RS. Omega-3 fatty acids, membrane remodeling and cancer prevention. Molecular aspects of medicine. 2018; 64: 79-91.

45. Márton J, Farkas G, Nagy Z, Takács T, Varga J, Szász Z, et al. Plasma levels of TNF and IL-6 following induction of acute pancreatitis and pentoxifylline treatment in rats. Acta Chir Hung. 1997; 36: 223-225.

46. Siscovick DS, Raghunathan TE, King I, Weinmann S, Wicklund KG, Albright J, et al. Dietary intake and cell membrane levels of long-chain n-3 polyunsaturated fatty acids and the risk of primary cardiac arrest. JAMA. 1995; 274: 1363-1367.

47. Gammone MA, Riccioni G, Parrinello G, D'Orazio N. Omega-3 Polyunsaturated Fatty Acids: Benefits and Endpoints in Sport. Nutrients. 2018; 11: 46.

48. World Health Organization. Adherence to long-term therapies: evidence for action. WHO, Geneva. 2003.

49. Sanduzzi A, Balbo P, Candoli P, Catapano GA, Contini P, Mattei A, et al. COPD: adherence to therapy. Multidiscip Respir Med. 2014; 9: 60.

50. Corden ZM, Bosley CM, Rees PJ, Cochrane GM. Home nebulized therapy for patients with COPD: patient compliance with treatment and its relation to quality of life. Chest. 1997; 112: 1278-1282.

51. Osthoff M, Leuppi JD. Management of chronic obstructive pulmonary disease patients after hospitalization for acute exacerbation. Respiration. 2010; 79: 255-261.

52. Ágh T, Inotai A, Mészáros Á. Factors associated with medication adherence in patients with chronic obstructive pulmonary disease. Respiration 2011; 82: 328-334.

53. Sanduzzi A, Balbo P, Candoli P, Catapano GA, Contini P, Mattei A, et al. COPD: adherence to therapy. Multidiscip Respir Med. 2014; 9: 60.

54. Mereckiene J. Seasonal influenza vaccination in Europe: Vaccination recommendations and coverage rates in the EU Member States for eight influenza seasons, 2007-2008 to 2014-2015. 2017.

55. Chiatti C, Barbadoro P, Marigliano A, Ricciardi A, Stanislao F, Di, Prospero E. Determinants of influenza vaccination among the adult and older Italian population with chronic obstructive pulmonary disease: a secondary analysis of the multipurpose ISTAT survey on health and health care use. Hum Vaccin. 2011; 7: 1021-1025.

56. Vandenbos F, Gal J, Radicchi B. Vaccination coverage against influenza and pneumococcus for patients admitted to a pulmonary care service. Rev Mal Respir. 2013; 30: 746-751.

57. Arinez-Fernandez MC, Carraco-Garrido P, Garcia-Carballo M, Hernandez-Barrera V, Miguel AG, de, Jimenez-Garcia R. Determinants of pneumococcal vaccination among patients with chronic obstructive pulmonary disease in Spain. Hum Vaccin. 2006; 2: 99-104.

58. Aka Aktürk Ü, Görek Dilektaşlı A, Şengül A, Musaffa Salepçi B, Oktay N, Düger M, et al. Influenza and Pneumonia Vaccination Rates and Factors Affecting Vaccination among Patients with Chronic Obstructive Pulmonary Disease. Balkan Med J. 2017; 34: 206-211.

59. Fekete M, Pako J, Nemeth AN, Tarantini S, Varga JT. Prevalence of influenza and pneumococcal vaccination in chronic obstructive pulmonary disease patients in association with the occurrence of acute exacerbations. J Thorac Dis. 2020; 12: 4233-4242.

60. Vandenbos F, Gal J, Radicchi B. Vaccination coverage against influenza and pneumococcus for patients admitted to a pulmonary care service. Rev Mal Respir. 2013; 30: 746-751.

61. Ciblak MA. Grip Platformu. Influenza vaccination in Turkey: prevalence of risk groups, current vaccination status, factors influencing vaccine uptake and steps taken to increase vaccination rate. Vaccine. 2013; 31: 518-523.

62. Pandolfi F, Franza L, Todi L, Carusi V, Centrone M, Buonomo A, et al. The Importance of Complying with Vaccination Protocols in Developed Countries: "Anti-Vax" Hysteria and the Spread of Severe Preventable Diseases. Curr Med Chem. 2018; 25: 6070-6081.