# Sense of loneliness and meaning in life in chronic obstructive pulmonary disease patients. Preliminary studies

# Kasper Sipowicz<sup>1</sup>, Tadeusz Pietras<sup>2,3</sup>, Michał Sobstyl<sup>4</sup>, Anna Mosiołek<sup>5</sup>, Monika Różycka-Kosmalska<sup>6</sup>, Jadwiga Mosiołek<sup>7</sup>, Ewa Stefanik-Markowska<sup>2</sup>, Michał Ring<sup>2</sup>, Krystian Kamecki<sup>2</sup>, Marcin Kosmalski<sup>3</sup>

<sup>1</sup>Department of Interdisciplinary Research in the area of Social Inclusion, The Maria Grzegorzewska University in Warsaw, Warsaw, Poland; <sup>2</sup>The Second Department of Psychiatry, Institute of Psychiatry and Neurology in Warsaw, Warsaw, Poland; <sup>3</sup>Department of Clinical Pharmacology, Medical University of Lodz, Lodz, Poland; <sup>4</sup>Neurosurgery Department, Institute of Psychiatry and Neurology in Warsaw, Warsaw, Poland; <sup>5</sup>Department of Forensic Psychiatry, Institute of Psychiatry and Neurology in Warsaw, Warsaw, Poland; <sup>6</sup>Department of Electrocardiology, Medical University of Lodz, Lodz, Poland; <sup>7</sup>Department of Psychiatry, Medical University of Warsaw, Warsaw, Poland

**Background:** Chronic obstructive pulmonary disease (COPD) interferes with everyday functioning but its impact on the loneliness and the meaning in life of the patients is unclear. Objectives: to determine whether the COPD severity levels correlate with the sense of loneliness and dimensions of the sense of meaning in life.

**Methods:** 144 patients with COPD during a period of absence of an infectious exacerbation were examined. The number of infectious exacerbations over the past year, the Modified Medical Research Council (mMRC) dyspnea score, the COPD Assessment Test (CAT) score were determined as well as the feelings of loneliness using the De Jong Gierveld Loneliness Scale (DJGLS) and the sense of meaning in life using the Life Attitude Profile-Revised (LAP-R) questionnaire.

**Results:** The age, the mMRC and CAT scores, the number of pack/years, as well as the number of infectious exacerbations during the year correlated positively with the feeling of loneliness. These variables (except for age) correlated negatively with the LAP-R scales apart from Existential Vacuum, which correlated positively. The subjects from the COPD severity group D (the most seriously ill people) had the highest level of loneliness, while it was the lowest in the subjects from group A (the least ill people). No statistical difference was observed between groups B and C.

**Conclusions:** With the increase in the values of the selected parameters determining the severity of COPD the sense of meaning in life decreases and loneliness intensifies.

Key words: COPD, loneliness, life style, Psychiatric status Rating Scales

**Correspondence:** Marcin Kosmalski, MD, PhD, 95-100 Zgierz, Wiosenna 1a, Poland - Phone: +48728358504 - E-mail: marcin. kosmalski@umed.lodz.pl

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ABSTRACT

#### Background

In Poland, approximately 10% of the population suffers from COPD, which is also the fourth most common cause of death after cardiovascular diseases, malignant tumors, accidents, injuries, and poisonings [1, 2]. In Poland, more men than women suffer from COPD, and the average age of onset is between 55 and 60 years [3]. COPD is associated with extremely severe impairment of quality of life [4, 5].

Dynamic pulmonary distention accompanying the disease is the cause of chronic dyspnea both at rest and on exertion [6]. Chronic respiratory failure [7] and secondary pulmonary hypertension complicated by right ventricular heart failure [8-10] may develop as complications of COPD, all of which significantly impair the social functioning of patients [11]. This is associated with the possible loss of a job, the reduction of the social support network, loneliness, loss of life goals leading to a lack of meaning in life, and secondary anxiety and depressive disorders. The mental state of patients with COPD is additionally aggravated by high comorbidity including, for example, lung cancer, pancreatic tumors, type II diabetes, ischemic heart disease, and many others [12-16]. The levels of COPD severity are determined by the Cartesian product of the number of infectious exacerbations per year and the daily symptoms in the form of dyspnea measured by the modified Medical Research Council (mMRC) scale or the COPD Assessment Test (CAT) scale. Severity grade A means the mildest course of the disease, and risk grade D is the most severe. The question then arises as to whether the COPD severity grades correlate with feelings of loneliness and a sense of meaning in life. This question is important because, on the one hand, chronic shortness of breath, recurrent infections, as well as anxiety and depression may be unfavorable prognostic factors, and on the other hand, a high sense of meaning in life can protect against the psychological effects of COPD and provide motivation, for example, for moderate physical activity. Regular physical activity reduces shortness of breath in COPD and improves the prognosis along with the quality of life [17, 18]. Loneliness is the subjective feeling of the absence of a network of social support for the subject. Its most cohesive definition was presented by Cacioppo et al - loneliness results

from the discrepancy between the desired and actually achieved a level of social ties, which is the cause of discomfort for the subject [19]. Factors that determine the feeling of loneliness include people and global random events such as the COVID-19 pandemic [20, 21]. Loneliness is one of the correlates of the meaning in life [22]. The construct of meaning in life was introduced to psychology and medicine by Viktor Frankl [23], and further developed by Salvatore R. Maddi [24, 25]. This construct was developed in various theoretical approaches and led to the emergence of such well-known concepts as the sense of coherence in the sense of Aaron Antonovsky [26, 27], or the concept of the meaning in life by Gary T. Reker [28].

The aim of this study is to determine whether the degrees of COPD severity and the dimensions determining the qualification for individual grade of COPD severity (such as the number of infectious exacerbations, mMRC score and the CAT score) correlate with the sense of loneliness and dimensions of the sense of meaning in life. In connection with the stated research goal, the following research questions were formulated:

- 1. Do the dimensions of life meaning and loneliness correlate with:
  - the results of the mMRC dyspnea scale;
  - the results of the CAT scale;
  - the number of pack/years;
  - the number of infectious exacerbations per year;
  - the patients' age?
- 2. Do the COPD severity grades, i.e. A, B, C, D, differ in the intensity of feeling of loneliness and the dimensions of the Life Attitude Pro-file-Revised (LAP-R) scale?
- 3. Is there a correlation between the LAP-R dimensions and the feeling of loneliness in the group of patients with COPD?

#### Material and Methods

#### Subjects

The survey was conducted over a period of 6 months from 06.2022 to 12.2022. The criteria for

inclusion in the study were a diagnosis of COPD and at least one-year follow up of the patient in an outpatient clinic of lung diseases. All patients included in the study had previously been diagnosed with COPD based on spirometry with forced expiratory volume in one second (FEV<sub>1</sub>) and forced vital capacity (FVC) values. The inclusion criteria for the study were a diagnosis of COPD and informed consent of the patient to participate in the study. A group of 144 patients who were patients of the Medical University of Lodz Norbert Barlicki University Clinical Hospital No. 1 Outpatient Clinic of Lung Diseases was included in the study. That group was selected from among 186 patients with COPD. Ten out of these patients did not give their consent to the questionnaire study, 11 subjects returned incomplete questionnaires, 15 were excluded from the study because of cancer, stroke or heart attack, or a surgical procedure undergone in the past year and 6 were unable to complete the questionnaires due to dementia or other cognitive impairment, and the worsening of heart failure in III and IV class of The New York Heart Association functional classification (NYHA). Other severe systemic diseases were not a contraindication to participation in the study, as COPD is accompanied by high comorbidity. The patients were studied between infectious exacerbations. All were assessed by the number of infectious exacerbations over the past year, the mMRC dyspnea score, the CAT score, the feelings of loneliness using the DJGLS, and the sense of meaning in life using the LAP-R questionnaire.

#### Scales

#### De Jong Gierveld Loneliness Scale (DJGLS)

The feeling of loneliness was assessed according to the De Jong Gierveld Loneliness Scale (DJGLS) adapted in Polish by Paweł Grygiel et al. (2013), with the consent of the author of the tool (Cronbach's alpha 0.89) [29-31]. Detailed psychometric characteristics of the DJGLS can be found in the works of De Jong Gierveld and Grygiel [29, 30]. The tool has eleven questions and each item has a five-point answer scale [29]. A more profound sense of loneliness is reflected by a rise in the total DJGLS score [29]. The demographic data was collected in the form of a questionnaire, containing questions concerning the patients' age, gender, the number of pack/years, as well as the number of infectious exacerbations during the last year.

#### Life Attitude Profile – Revised (LAP-R)

The sense of meaning in life was measured using the Polish adaptation of the Life Attitude Profile -Revised (LAP-R) questionnaire, originally developed by Gary T. Reker, published by the Psychological Test Laboratory of the Polish Psychological Association (Cronbach's alpha between 0.70 and 0.80) [32, 33]. The questionnaire includes 8 scales (6 simple and 2 complex ones). The simple scales include Purpose (life goals and a sense of direction), Coherence (understanding of oneself and the environment), Choice/ Responsibleness (a view on the ability to make life choices), Death acceptance (lack of fear of death, and accepting death as normal), Existential vacuum (absence of meaning in life, goals and direction), Goal seeking (desire for new experiences). Each item is rated from 1 (strongly disagree) to 7 (strongly agree) and each subscale has 8 items. The Existential vacuum scale is scored negatively, all the other scales positively. The two complex scales are calculated from the simple scales. They include The Personal Meaning Index (life goals, sense of direction, understanding of themselves and environment), a sum of coherence and purpose, and Existential Transcendence (a general measure of life attitudes), a sum of purpose, coherence, choice/ responsibleness, death acceptance with subtraction of existential vacuum and goal seeking.

#### mMRC and COPD Assessment Test (CAT)

The mMRC and COPD Assessment Test (CAT) scales of dyspnea were taken from the commonly available COPD diagnostic and treatment standard referred to by the GOLD acronym (https://goldcopd. org/; 04.05.2021). The study was approved by the Bio-ethics Committee of the Medical University of Lodz (consent no. RNN/137/22/KE).

Each patient participating in the study received information for the patient with a detailed description of the study and an informed consent form. The patients were informed of the fully anonymous and voluntary nature of the study.

In the study, the internal consistency of the LAP-R scale was assessed with the use of Cronbach's Alpha along with the study of the inter-correlation between the dimensions of the scale. The numbers with percentages were used to describe nominal variables, and the median with 25 and 75% quartiles (Q1-Q3) was used to describe continuous variables with a distribution other than normal and ordinal. The distribution of continuous variables was tested using the Shapiro-Wilk W test. The Mann-Whitney U test was used to assess the differences between the two groups, while for groups > 2, the non-parametric ANOVA equivalent the Kruskal Wallis test - was used. After obtaining statistical significance for the p global analysis of variance, the post-hoc test - Dunn's test was performed. The relationship between the variables was investigated using Spearman's rank correlation. Statistical significance was assumed at the level of p <0.05. Statistical analyses were performed using the statistical program STATIS-TICA, version 13.3 (TIBCO 2022, Poland).

#### Results

The study included 144 patients diagnosed with COPD, the largest group of whom (over 79%) were male patients, and only 20.83% were females. The median age of the patients was 59 years (Q1-Q3 = 54.00-63.00). Among the subjects, the largest group were patients with mMRC = 2 (38.89%), with a severity level of COPD - D (29.86%). Patient demographics information is presented in Table 1.

The total internal consistency for all dimensions on the LAP-R scale was satisfactory and Cronbach's alpha was 0.78 (Table 2). In the study of intercorrelation between the simple dimensions, very strong positive correlations ( $r^2$ =0.946, p <0.001) were shown between the goal (PU) and choice/responsibleness (CR), PU and goal-seeking (GS) ( $r^2$  = 0.933, p <0.001) and CR and GS ( $r^2$  = 0.922, p <0.001). On the other hand, a strong negative correlation was observed between PU and existential vacuum (EV) ( $r^2$  = -0.840, p <0.001) (Table 3).

Table 1. Demographic data of the study population.

Factor		N (%) / Median (O1-O3)
Age [Years]		59.00 (54.00-63.00)
Gender	Male	114 (79.17%)
	Female	30 (20.83%)
mMRC	1	11 (7.64%)
	2	56 (38.89%)
	3	37 (25.69%)
	4	40 (27.78%)
Degree of risk f COPD	А	30 (20.83%)
of COPD		34 (23.61%)
of COPD	С	37 (25.69%)
	D	43 (29.86%)
CAT		13.00 (7.00-32.50)
Number of pack/years		50.00 (40.00-60.00)
Number of	0	15 (10.42%)
infectious	1	49 (34.03%)
exacerbations	2	32 (22.22%)
	3	31 (21.53%)
	4	14 (9.72%)
	5	2 (1.39%)
Gender mMRC Degree of risk of COPD CAT Number of pack/years Number of infectious exacerbations	6	1 (0.69%)

CAT, the COPD Assessment Test; COPD, chronic obstructive pulmonary disease; mMRC, the Modified Medical Research Council. Data is expressed as a number of patients (included %) and median (Quartile 1; Quartile 3) for age, CAT and number of pack/years.

The study showed statistically significant correlations between the dimensions of the LAP-R scale and the sense of loneliness according to the DJGLS scale, and factors such as mMRC, the obtained CAT result, the number of pack/years as well as the number of infectious exacerbations among COPD patients.

Significant but weak correlations were found between the LAP-R dimensions PU ( $R^2 = -0.269$ , p <0.001), CR ( $R^2 = -0.286$ , p <0.001), EV ( $R^2 = 0.258$ , p <0.001), GS ( $R^2 = -0.239$ , p <0.001), TMPI ( $R^2 = 0.250$ , p <0.001), ET ( $R^2 = -0.238$ , p <0.001) and the age of patients; however, no correlation was observed between age and coherence (CO) and acceptance of death (DA). Similarly weak, positive

LAP-R	Mean±SD	Median (Q1-Q3)	Cronbach's alpha	Correlations
Purpose (PU)	26.31±7.87	28.00 (23.00-31.50)	0.70	0.95
Coherence (CO)	35.65±6.85	39.00 (31.50-40.00)	0.72	0.90
Choice/Responsibleness (CR)	29.47±7.60	30.50 (27.00-35.00)	0.71	0.94
Death Acceptance (DA)	30.39±3.81	30.00 (29.00-31.00)	0.80	-0.03
Existenial Vacuum (EV)	36.19±8.78	33.00 (31.00-40.50)	0.90	-0.87
Goal Seeking (GS)	26.92±7.34	29.00 (27.00-30.00)	0.72	0.91
The Personal Meaning Index (TPMI)	61.97±14.09	67.00 (56.00-71.00)	0.65	0.98
Existential Transcendence (ET)	58.71±22.39	66.50 (47.50-74.50)	0.68	0.93
Total	_	_	0.78	_

Table 2. Analysis of the reliability of the LAP-R scale dimensions.

LAP-R, the Life Attitude Profile-Revised. Data are expressed as mean value ± standard deviation (SD) as well as median (Quartile 1; Quartile 3).

Table 3. Intercorrelations between the simple and complex dimensions of the LAP-R scale.

	PU	СО	CR	DA	EV	GS	TPMI	ET
PU	1.000							
СО	0.832*	1.000						
CR	0.946*	0.840*	1.000					
DA	-0.092	-0.101	-0.100	1.000				
EV	-0.840*	-0.749*	-0.776*	0.019	1.000			
GS	0.933*	0.814*	0.922*	-0.039	-0.798*	1.000		
TPMI	0.963*	0.951*	0.937*	-0.101	-0.833*	0.917*	1.000	
ET	0.935*	0.894*	0.914*	0.078	-0.915*	0.869*	0.957*	1.000

CO, coherence; CR, choice/responsibleness; DA, death acceptance; ET, existential transcendence; EV, existential vacuum; GS, goal seeking; PU, purpose; TPMI, the personal meaning index. \*p assessed using the Spearman's rank correlation. The bolded results indicate statistically significant differences (p < 0.001).

correlations were obtained between the DJGLS scale  $(R^2 = 0.222, p = 0.007)$  and age.

In the case of the LAP-R scale dimensions, negative (moderate to strong) correlations were obtained between the studied factors and the dimensions of PU, CR, GS, TMPI, ET (Table 4). Positive correlations were observed for the EV dimension of the LAP-R scale with mMRC R<sup>2</sup> = 0.624, CAT R<sup>2</sup> = 0.682, the number of pack/years R<sup>2</sup> = 0.776, the number of infectious exacerbations R<sup>2</sup> = 0.722 (p <0.001) and the DJGLS scale with mMRC (R<sup>2</sup> = 0.855), CAT (R<sup>2</sup> = 0.674), the number of pack/years (R<sup>2</sup> = 0.780), the number of infectious exacerbations (R<sup>2</sup> = 0.832) (all correlation p<0.001). The analysis of differences in the intensity of the feeling of loneliness according to the DJGLS scale and the COPD severity levels showed statistically significant differences in the results obtained in the DJGLS scale between groups A vs B (p <0.001), A vs C (p <0.001), A vs D (p <0.001), B vs C (p <0.001) and C vs D (p <0.001) (Figure 1). There were no statistically significant differences between people at severity of COPD B vs C (median = 34.00, Q1-Q3 = 32.00-37.00 vs median = 38.00, Q1-Q3 = 37.00-40.00; p = 0.457). The largest differences were observed between people at risk A (median = 20.00, Q1-Q3 = 14.00-27.00) and patients at risk D (median = 51.00, Q1-Q3 = 35.00-54.00).

The analysis of differences in the results obtained in the dimensions of the LAP-R scale with the COPD severity grades also showed no differences between the subjects belonging to the B vs C severity groups, for all 8 dimensions of the LAP-R scale. There were also no

		LAP-R scale							
Factors	PU	СО	CR	DA	EV	GS	TMPI	ET	DJGLS scale
Age [Years]	-0.269*	-0.148	-0.286*	0.011	0.258*	-0.239*	-0.250*	-0.238*	0.222**
mMRC	-0.635*	-0.631*	-0.620*	-0.286*	0.624*	-0.619*	-0.649*	-0.646*	0.855*
CAT	-0.715*	-0.719*	-0.685*	-0.334*	0.682*	-0.681*	-0.731*	-0.712*	0.674*
Number of pack/years	-0.856*	-0.723*	-0.831*	-0.336*	0.776*	-0.831*	-0.849*	-0.810*	0.780*
Number of infectious exacerbations	-0.842*	-0.716*	-0.824*	-0.264*	0.722*	-0.816*	-0.844*	-0.803*	0.832*

Table 4. Correlation of demographic factors with the dimensions of the LAP-r scale and the DJGLS scale of the sense of loneliness.

CAT, the COPD Assessment Test; CO, coherence; CR, choice/responsibleness; DA, death acceptance; DJGLS, the De Jong Gierveld Loneliness Scale; ET, existential transcendence; EV, existential vacuum; GS, goal seeking; LAP-R, the Life Attitude Profile-Revised; mMRC, the Modified Medical Research Council; PU, purpose; TPMI, the personal meaning index. p assessed using the Spearman's rank correlation. The bolded results indicate statistically significant differences (\*p<0.001; \*\*p<0.05).



**Figure 1.** Statistically significant differences (p global <0.001) in the intensity of loneliness on the DJGLS scale based on the COPD risk grade (A, B, C, D). The chart shows the most important difference between the paired patients from the A vs D risk group.

differences between groups B vs D and C vs D for the death acceptance dimension. However, a statistically significant, although slightly higher result obtained in the acceptance of death dimension was noticed in persons belonging to the severity group A in comparison with patients from groups B, C, and D.

For dimensions such as life goal (median = 15.00, Q1-Q3 = 10.00-23.00), choice/responsibleness (median = 25.00, Q1-Q3 = 13.00), coherence (median = 29.00, Q1-Q3 = 28.00-31.00), goal-seeking (median = 22.00, Q1-Q3 = 10.00-27.00), the personal meaning

index (median = 45, Q1-Q3 = 38.00-54.00) and the existential transcendence (median = 30.00. Q1-Q3 = 19.00-45.00), it was noticed that patients belonging to the COPD-D severity grade obtained statistically significantly lower results than other patients (Figure 1S and Table 1S - Supplement). However, in the case of experiencing an existential vacuum, as in the case of the feeling of loneliness on the DJGLS scale, patients with severity grade D obtained significantly higher EV scores (median = 45.00, Q1-Q3 = 19.00-45.00) than patients with other severity grades (A, B or C).

In the study of the relationship between the sense of loneliness on the DJGLS scale and all LAP-R dimensions, strong negative correlations were shown between the results obtained on the DJGLS scale and dimensions such as goal, coherence, choice/responsibleness, goal-seeking, personal meaning index and existential transcendence (Table 5). A negative, but weak, correlation was also shown between DJGLS and death acceptance (R2 = -0.368, p <0.001), while a positive relationship was found between the feeling of loneliness and existential vacuum.

#### Discussion

We demonstrated in our study that age, mMRC, and CAT scores, the number of pack/years, and the number of infectious exacerbations during the year correlated positively with feelings of loneliness. There

Table 5. Correlation between the DJGLS scale and the LAP-R scale.

	PU	СО	CR	DA	EV	GS	TMPI	ET
DJGLS scale	-0.937*	-0.835*	-0.909*	-0.368*	0.863*	-0.904*	-0.943*	-0.916*

CO, coherence; CR, choice/responsibleness; DA, death acceptance; DJGLS, the De Jong Gierveld Loneliness Scale; ET, existential transcendence; EV, existential vacuum; GS, goal seeking; LAP-R, the Life Attitude Profile-Revised; mMRC, the Modified Medical Research Council; PU, purpose; TPMI, the the personal meaning index. p assessed using the Spearman's rank correlation. The bolded results indicate statistically significant differences (\*p<0.001).

are no analogous correlation studies in the literature between the aforementioned variables in patients with COPD, except for age [34]. The same variables correlated positively with the intensity of the existential vacuum. Also, these variables, except for age, correlated negatively with the following scales: Purpose, Coherence, Choice/Responsibleness, Death Acceptance, Goal Seeking, The Personal Meaning Index, and Existential Transcendence. In the case of age, correlations with the Coherence scale and Death Acceptance did not reach statistical significance. The reliability of the tools used has been positively verified by us, which is presented in Tables 2 and 3. Based on the obtained results, it can be concluded that the sense of meaning in life decreases and loneliness intensifies with the increase in the selected parameters determining the severity of COPD (mMRC, CAT, number of pack/years, number of infectious exacerbations per year). Increased loneliness and lack of meaning in life translate into poor quality of life in COPD and increased depression, which has often been studied in the population of patients with COPD [15, 33]. The highest level of loneliness (Figure 1) was observed in severity group D (the patients most seriously ill), and the lowest in group A (the least ill ones). On the other hand, the lack of statistical significance in the severity of loneliness between people from risk groups B and C is noteworthy. Both group B and group C are people with moderate severity of COPD symptoms, but they differ clinically, because severity grade B means low dyspnea with frequent infectious exacerbations, whereas severity grade C means a high severity of symptoms with a low risk of infectious exacerbations [36]. It is noteworthy that most of the statistically significant correlations we obtained had an absolute value exceeding 0.6. It means that the correlations between the clinical variables and the LAP-R scale dimensions and the severity of loneliness (DJGLS) are very strong.

Table 5 shows that loneliness strongly correlates with the dimensions of the LAP-R scale, and the absolute value of most correlations is greater than 0.8. Possibly, both the sense of loneliness and the sense of meaning in life are dependent on one statistical factor. This factor probably determines the quality of life, although measuring the quality of life of COPD patients was not the goal of our study [35].

Paige et al. demonstrated that loneliness was an independent factor in the arrival of COPD patients at the hospital emergency departments [12]. In turn, Bu et al. showed that the feeling of loneliness did not correlate with the risk of hospitalization of patients with COPD, while poor social network correlated with hospitalizations in this group of people [34]. In 2004, interesting results of a population study of 15,010 participants were published. COPD was diagnosed in 307 men (4.3%) and 396 women (5.6%). It turned out that depression was diagnosed twice as often in the group of patients with COPD (16.2%) compared to healthy people (7.5%). Risk factors for depression in COPD patients were found to be loneliness, low levels of social support, social phobia, and type D of behavior [37]. Behavior type D is also defined as a stress-prone personality. People with type D personalities tend to feel negative emotions, e.g. anxiety, show a pessimistic approach to life, and feel constant tension and insecurity. They are withdrawn in social relations due to fear of rejection. The concept of type D personality was formulated by Johann Denollet as a risk factor for coronary heart disease, similar to the previously defined type A personality [38]. Our own research has demonstrated that type D is also associated with the risk of asthma and the severity of its course [39]. It should be noted that both asthma and COPD are associated with pulmonary obstruction and there are many clinical similarities between the two diseases, and differential diagnosis between them is quite difficult [40, 41].

In some patients, asthma co-occurs with COPD, which is referred to as asthma-chronic obstructive pulmonary disease overlap syndrome (ACOS) [42].

It has also been demonstrated that during the respiratory rehabilitation of patients with COPD, a greater sense of loneliness correlated positively with low exercise capacity, and worsening of depression and anxiety. Surprisingly, however, a greater sense of loneliness correlated with a greater improvement in the functioning of respiratory capacity in the process of respiratory rehabilitation [43]. Numerous studies indicate that the COVID-19 pandemic has significantly increased social distancing and feelings of loneliness in COPD patients [44, 45]. Therefore, it can be assumed that the percentage of diagnosed cases of depression in people with COPD will increase in the coming years. Moreover, research conducted by Reijnders et al. (2018) showed that the subjectively felt loneliness of COPD patients worsens their prognosis [43].

### Limitations of the study

Our research was performed and statistically developed before the publication of the GOLD standards of 2023 (https://goldcopd.org/2023-gold-report-2/; 02.12.2023). In this standard, COPD is divided into three risk levels: A, B, E. Risk level E is approximately the risk level C plus D included in the previous GOLD standards. In our study, the results of the examined variables of levels C and D differ, which raises some doubts whether the creation of category E is justified.

The disproportion between the number of women and the number of men in the studied sample was an important limitation of our study. The selection of patients was not random, although the predominance of men with COPD over women with COPD reflects the epidemiological trend. The current COPD epidemic reflects the prevalence of nicotine addiction syndrome about 20 years ago when men smoked much more often than women. The study also did not take into account the flow-volume parameters such as forced vital capacity of the lungs (FEV<sub>1</sub>), forced vital capacity of the lungs (VC), the Tiffeneau index, peak maximum flow (PEF), and small airway flows (MEF25, MEF50, MEF75) in the clinical characterization of patients. These parameters were taken into account when diagnosing COPD. However, their values were not analyzed. On the other hand, the classification of COPD severity according to spirometry criteria is currently being abandoned in favor of variables such as the severity of symptoms, the shortness of breath scale (mMRC), or the number of infectious exacerbations per year. Other recognized negative prognostic factors in COPD include low exercise capacity, low BMI, reduced carbon diffusion (DLCO in pedice), the presence of gasometric abnormalities, the volume of resting pulmonary hyperinflation, the presence of pulmonary hypertension, and high CRP concentration. Therefore, the values of parameters readable from the flow-volume loop are not the most important prognostic factors in the course of COPD. It would be good to determine in future studies whether the factors listed above are predictors of loneliness in patients with COPD [46].

#### Conclusion

The age, the mMRC, and CAT scores, the number of pack/years, as well as the number of infectious exacerbations during the year correlated positively with the feeling of loneliness and positively with the severity of the existential vacuum. These variables (except for age) correlated negatively with the scales: Purpose, Coherence, Choice/Responsibleness, Death Acceptance, Goal Seeking, The Personal Meaning Index, and Existential Transcendence. Statistical significance for the age variable was not obtained with respect to correlations with the Coherence and Death Acceptance scales, and the other scales correlated with that variable negatively. In view of the above, it can be concluded that with the increase in the values of the selected parameters determining the severity of COPD (mMRC, CAT, number of pack/years, number of infectious exacerbations per year), the sense of meaning in life decreases and loneliness intensifies. The subjects from the COPD severity group D (the most seriously ill people) had the highest level of loneliness, while it was the lowest in the subjects from group A (the least ill people). In contrast, there was no statistical significance between groups B and C.

Promoting health behaviors such as smoking cessation, physical activity, weight loss, and social

integration of COPD patients can improve not only the patient's somatic condition, but also have a positive effect on their mental state. Treating mental disorders in COPD patients can positively affect their mental state [37].

In the continuation of this study, it would also be necessary to find out whether cognitive impairment accompanying COPD has a prognostic significance in COPD [47].

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## Appendix

#### **Supplementary Materials**



**Figure 1S.** Statistically significant differences (p global <0.001) in the intensity of individual dimensions of the LAP-R scale, based on the risk of COPD (A, B, C, D); A) Purpose (PU) in risk groups A, B, C, D; B) Coherence (CO) in risk groups A, B, C, D; C) Choice / Responsibleness (CR) for risk groups A, B, C, D; D) Death Acceptance (DA) in risk groups A, B, C, D; E) Existential Vacuum (EV) in risk groups A, B, C, D; F) Goal seeking (GS) in risk groups A, B, C, D; G) The personal meaning index (TPMI) in risk groups A, B, C, D; H) Existential transcendence (ET) in risk groups A, B, C, D.



Figure 1S. (continued)

Table 1S. Differences between the COPD risk groups (A, B, C, D) for all dimensions of the LAP-R scale.

	LAP-R scale								
Risk of COPD groups	PU	СО	CR	DA	EV	GS	TPMI	ET	
A vs B	0,002	0,320	0,001	0,009	<0,001	<0,001	0,004	<0,001	
A vs C	<0,001	0,033	<0,001	0,032	<0,001	<0,001	<0,001	<0,001	
A vs D	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	
B vs C	0,157	1,000	0,105	1,000	1,000	0,185	0,188	0,609	
B vs D	<0,001	<0,001	<0,001	1,000	<0,001	<0,001	<0,001	<0,001	
C vs D	<0,001	<0,001	<0,001	0,672	<0,001	0,002	<0,001	<0,001	

CO, coherence; CR, choice/responsibleness; DA, death acceptance; ET, existential transcendence; EV, existential vacuum; GS, goal seeking; LAP-R, the Life Attitude Profile-Revised; PU, purpose; TPMI, the personal meaning index. \*p-value assessed using the Spearman's rank correlation.

The bolded results indicate statistically significant differences (*p*<0.001).