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GENERAL

IMPACT OF EDUCATION ON DIMENSIONS OF ADHERENCE IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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Abstract: To assess the impact of patient education on medication adherence and quality-of-life (QoL) in Hungarian subjects with chronic obstructive pulmonary disease (COPD). A longitudinal, non-interventional study conducted at three pulmonology outpatient centers in and around Budapest, Hungary. Subjects visiting the center with COPD were invited to participate in the study. Data collected at baseline included subject demographics, medical history, and responses to the adherence (Morisky Medication Adherence Scale-8 (MMAS-8)) and QoL (EuroQoL-5D-5L (EQ5D), St. George's Respiratory Questionnaire (SGRQ), and COPD Assessment Tool (CAT)) scales. Subjects were also provided with patient education designed with standardized content. Subjects were asked to provide responses to adherence and QoL scales again at the 3-month follow-up visit. The medication was left unchanged during the course of the study. Statistical analysis included independent and paired-samples *t*-tests, one-way ANOVA, mixed-measures ANOVA, and ANCOVA. Mean (± standard deviation (SD)) overall adherence score on MMAS-8 scale increased from 6.72 (± 1.46) at baseline to 7.01 (± 1.15) at follow-up ($p = 0.040$). A similar increase in mean (± SD) score was observed for question 4 on the MMAS-8 which deals with remembering to carry COPD medication when leaving house (baseline = 0.81 (± 0.40) versus follow-up = 0.89 (± 0.31); $p = 0.018$). Patient education has a positive outcome on medication adherence in subjects with COPD. Further studies will be required to assess if these benefits are translated into patients' QoL.

Keywords*:* COPD, patient education, adherence, quality of life

Abbreviations: act–activity component; imp–impact component, symp–symptoms component, ANCOVA–analysis of covariance, ANOVA–analysis of variance, CAT–COPD Assessment Tool, COPD–chronic obstructive pulmonary disease, EQ5D–EuroQoL-5D-5L, MMAS-8–Morisky Medication Adherence Scale-8, QoL–quality-of-life, SGRQ–St. George's Respiratory Questionnaire

Chronic obstructive pulmonary disease (COPD) is a severe respiratory disorder that poses a tremendous burden on healthcare and economic resources. The prevalence of COPD has been steadily rising globally (1) and COPD-associated mortality is predicted to be the third-leading cause of death by 2020 (2). While smoking is one of the major risk factors for developing COPD, other triggers include age, genetic predisposition, and history of bronchial asthma and recurrent respiratory infections (3). Age and COPD prevalence appears to have a positive correlation and approximately 9.0-10.0% of the >40-years population presents with COPD (4).

The main goal of COPD management is to maintain stable lung function and prevent acute exacerbations. The pharmacotherapy of COPD includes bronchodilators such as ß2-adrenergic agonists (BAs) and muscarinic antagonists (MAs), and inhaled corticosteroids (5). The preferred route of administration of these agents is via the inhalation due to its advantages

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– smaller dose, rapid onset of action, and lower incidence of side-effects (6) numerous inhaler devices are available to COPD patients for use in maintenance therapy. However, similar to other chronic conditions, successful disease management relies intrinsically on treatment adherence, and poor adherence to inhaler therapies has been shown to be associated with an increase in mortality rates, hospitalization, and disease burden in COPD patients (7, 8).

Chronic health-related conditions such as COPD have an enormous impact on the patient's quality-of-life (QoL) and result in increased utilization of health services. Patients who are unable to self-manage their chronic condition also score low on health literacy, a modifiable risk factor that can be rectified through effective patient communication (9). Patient education programs improve patients' health awareness and knowledge, symptom management, self-care practices and overall health status (10-12) thereby reducing the propensity for negative outcomes and associated treatment costs (13, 14). Similar programs designed for patients with COPD have been implemented, especially around exacerbations (15-17), in community pharmacy settings (18-19), or during rehabilitation (20, 21). In recent years there have been studies that have looked at the impact of patient education programs on QoL or adherence or both (22-26) in patients with COPD.

Despite an enormous wealth of information on the effectiveness of patient education in the management of COPD in other parts of the world, there is a noticeable paucity of data from Hungary. Hence, the main goal of our study was to address these shortcomings and our primary objective was to assess the effect of patient education on medication adherence and QoL in COPD patients. We also sought to analyze whether demographic and subgroup parameters influenced adherence and QoL.

Table 1. Sociodemographic characteristics of and self-reported perceptions of outcomes in study patients.

		n (%)
Gender	Male	48 (40.68)
	Female	70 (59.32)
Age in years, mean (SD)	Male	68.83 (8.39)
	Female	66.16 (9.91)
	Total	67.25 (9.38)
Smoking status	Yes	47 (39.83)
Daily cigarette consumption, mean (SD)		11.15 (5.94)
Residential location	Urban	88 (74.58)
	Semi-urban	20 (16.95)
	Rural	10 (8.47)
Education	University	28 (23.73)
	High School	68 (57.63)
	Basic	22 (18.64)
Social status	Good	4 (3.39)
	Above average	99 (83.90)
	Below average	14 (11.86)
	Poor	1 (0.85)
Adherence to COPD medication vs. other medication	Same or better	113 (95.76)
	Worse	5 (4.24)
Quality of received education	Comfortable	113 (95.76)
Less or more comfortable	5 (4.24)	
Importance of COPD check-ups vs. other check-ups	Same or more	117 (99.15)
Less	1 (0.85)	
Trust in pulmonologist vs. general practitioner	Better	109 (92.37)
Worse	9 (7.63)	

Abbreviations: SD-standard deviation; COPD-chronic obstructive pulmonary disease.

EXPERIMENTAL

Study design

This non-interventional, multicenter, longitudinal study was conducted at three pulmonology outpatient centers in and around Budapest, Hungary (district 13 and 19 in Budapest and Vác). Study subjects were patients visiting the center, having an established diagnosis of COPD by a pulmonologist, and providing informed consent to participate in the study. Patients were excluded if they had any condition which precluded them from completing the questionnaire or had a concomitant condition affecting their QoL such as heart disease or pulmonary fibrosis or if they had a COPD exacerbation within three months of enrolment or if they had been diagnosed with an acute respiratory disease, fibrosis, or tumor. Subject recruitment was random in the sense that every tenth patient visiting the center for consultation was invited to participate in the study and if eligible and providing consent, enrolled. In case the tenth patient was ineligible or refused consent, the next patient was invited and so on till a subject was recruited. Study subjects underwent two study visits – one at baseline and the other at follow-up approximately three months later. At baseline, subjects' sociodemographic and medical data were collected, subjects were asked to fill in the adherence, symptom perception, and QoL questionnaires (described below), and patient education was provided (described below). At the follow-up visit, subjects were asked to fill in the same questionnaires again. Medication against COPD was left unchanged for the duration of the study. Subjects' education level was assessed on a scale of three, ranging from basic to university level. The social status of the subjects as well as their perception of certain outcomes was self-reported as given in Table 1.

The study was conducted in accordance with the principles stated in the Declaration of Helsinki (1961) and its subsequent revisions, Good Clinical Practice guidelines, as well as national laws. Prior approval of the study was obtained from the Semmelweis University Regional and Institutional Committee of Science and Research Ethics.

Patient education

Patient education, based on fixed content, was conducted face-to-face by nurses or pulmonology assistants who had been previously trained to instruct subjects using the standardized content. Subjects were encouraged to ask questions and provided with take-home lessons at the end of the session. By keeping the same for all study subjects, we ensured uniform patient education, although by answering subjects' questions we also allowed for an individualized approach.

Education provided during personal meetings was reiterated through a short leaflet, which subjects took with them. Information contained in the leaflets was based on that provided by pulmonologists in a previous in-depth interview as well as systematic reviews (17, 27, 28). The leaflet contained the following key blocks: disease, treatment, and self-management. The disease block provided information on COPD and symptomatic alterations in the lungs and identified the present type and state of the subject's COPD. The treatment block contained information about use and medications such as short-acting BAs and MAs to prevent exacerbations, correct technique for inhaler use, and symptoms of and actions to be taken in case of exacerbations. The third block informed subjects about smoking cessation, breathing techniques in case of shortness of breath, physical exercise, and lifestyle modifications.

Assessment questionnaire

Quality-of-life scales were selected in accordance with currently employed general and disease-specific algorithms (15, 28, 29). For adherence, we used the Morisky Medication Adherence Scale (MMAS-8) which has been validated for chronic disease conditions as well as COPD (22, 30).

Each study subject was provided with a standardized questionnaire at enrolment and follow-up. The questionnaire included three QoL algorithms designed to assess general and disease-specific QoL and one adherence algorithm. Wherever possible, validated Hungarian versions of these algorithms were procured and used with the written permission of the holders of the intellectual property of the same.

QoL algorithm

a) Generic measurement tools: EQ-5D-5L and EQ-5D-VAS

The EuroQoL-5D-5L measures five parameters related to health: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression, each on an ascending scale peaking at 5 (31). The visual analog scale (VAS) allows the patient to indicate their current wellbeing on a scale of 0-100. Values on these scales range from 0.281 to 1.000, with higher values indicating better QoL (32, 33).

b) Disease-specific measurement tools: SGRQ and CAT

The St. George's Respiratory Questionnaire (SGRQ) is a comprehensive scale that measures

symptoms, activity, and impact scores (34). Questions 1-8 relate to the patient recollection of their symptoms in the preceding period while questions 9-16 inquire about the patient's current state on which activity and impact scores are calculated. The SGRQ scores range from 0 to 100, with lower values indicating better QoL and a reduction of four units is generally taken as a clinically significant improvement (35).

The COPD Assessment Tool (CAT) is an 8-item questionnaire for the assessment of symptoms. Patients rate their symptoms (cough, phlegm, tightness in the chest, etc) on an ascending scale till 5. Scores range from 0 to 40 and higher scores indicate higher severity and debilitation in patients (36).

Adherence algorithm

The eight-item MMAS-8 (37-39) has been widely used and recently validated through a meta-analysis for evaluation of adherence. Higher scores indicate higher adherence.

Sample size calculation and data analysis

While calculating sample size we operated on the assumption that at least 10 subjects per variable would be required in order to achieve the primary objective

Table 2. Comparison of baseline and follow-up scores on self-reporting of COPD symptom, QoL, and treatment adherence.

	Score, mean (SD)		*t*(df = 117)	*P*
	Baseline	Follow-up		
CAT_Total	16.65 (7.61)	16.9 (7.93)	-0.441	0.660
CAT1	2.45 (1.22)	2.44 (1.13)	0.101	0.920
CAT2	**2.21 (1.38)**	**2.04 (1.30)**	**1.860**	**0.065+**
CAT3	1.35 (1.26)	1.41 (1.39)	-0.531	0.597
CAT4	3.17 (1.50)	3.08 (1.48)	0.716	0.475
CAT5	1.90 (1.49)	2.05 (1.58)	-1.233	0.220
CAT6	1.25 (1.51)	1.41 (1.66)	-1.149	0.253
CAT7	1.92 (1.35)	1.86 (1.44)	0.377	0.707
CAT8	**2.41 (1.26)**	**2.6 (1.13)**	**-1.714**	**0.089+**
MMAS-8_Total	**6.72 (1.46)**	**7.01 (1.15)**	**-2.073**	**0.040***
MMAS-8_1	0.73 (0.45)	0.75 (0.43)	-0.598	0.551
MMAS-8_2	**0.84 (0.37)**	**0.91 (0.29)**	**-1.806**	**0.074+**
MMAS-8_3	0.85 (0.36)	0.89 (0.31)	-1.295	0.198
MMAS-8_4	**0.81 (0.40)**	**0.89 (0.31)**	**-2.404**	**0.018***
MMAS-8_5	0.20 (0.40)	0.19 (0.41)	0.323	0.747
MMAS-8_6	0.92 (0.28)	0.92 (0.28)	0.000	1.000
MMAS-8_7	**0.86 (0.35)**	**0.92 (0.27)**	**-1.907**	**0.059+**
MMAS-8_8	0.74 (0.12)	0.72 (0.14)	1.274	0.205
EQ5D_VAS	67.41 (16.91)	68.62 (17.42)	-0.784	0.435
EQ5D1	2.08 (1.03)	2.19 (1.04)	-1.416	0.159
EQ5D2	1.27 (0.62)	1.29 (0.67)	-0.342	0.733
EQ5D3	1.72 (0.84)	1.83 (0.95)	-1.470	0.144
EQ5D4	1.87 (0.79)	1.89 (0.87)	-0.232	0.817
EQ5D5	1.54 (0.75)	1.57 (0.84)	-0.403	0.688
SGRQ_Total	37.86 (15.83)	37.79 (17.67)	0.063	0.950
SGRQ_symp	38.66 (23.85)	37.17 (25.71)	0.825	0.411
SGRQ_act	52.58 (18.41)	52.34 (18.89)	0.149	0.882
SGRQ_imp	29.22 (16.26)	29.68 (18.94)	-0.332	0.740

$^{+}p < 0.1$; $^{*}p < 0.05$; Highlighted rows indicate covariables that were either demonstrate a statistically significant association or a trend towards it.

Table 3. Comparison of results for scales (*t*- and *F*-values given) for adherence, COPD symptoms, and QoL by time, gender, occupation, and education with mixed measures (ANOVA and ANCOVA).

Effect	*t*	*F*	df		*P*
			Hypothesis	Error	
Adherence					
TIME(2) ∞ MMAS(8) ∞ GENDER(2)	0.103	1.630	7	99	0.136
TIME(2) ∞ MMAS(8) ∞ OCCUPATION(2)	0.043	0.632	7	99	0.728
TIME(2) ∞ MMAS(8) ∞ EDUCATION(3)	**0.284**	**2.364**	**14**	**200**	**0.005***
MMAS_Total(2) ∞ GENDER(2)	0.017	2.013	1	114	0.103
MMAS_Total(2) ∞ OCCUPATION(2)	0.001	0.074	1	114	0.787
MMAS_Total(2) ∞ EDUCATION(3)	0.019	1.066	2	113	0.348
COPD symptoms					
TIME(2) ∞ CAT(8) ∞ GENDER(2)	**0.182**	**3.138**	**7**	**99**	**0.005***
TIME(2) ∞ CAT(8) ∞ OCCUPATION(2)	0.074	1.135	7	99	0.348
TIME(2) ∞ CAT(8) ∞ EDUCATION(3)	0.189	1.492	14	200	0.117
CAT_Total(2) ∞ GENDER(2)	0.002	0.245	1	114	0.622
CAT_Total(2) ∞ OCCUPATION(2)	0.004	0.372	1	114	0.543
CAT_Total(2) ∞ EDUCATION(3)	0.034	1.821	2	113	0.167
Quality of life					
TIME(2) ∞ EQ5D(5) ∞ GENDER(2)	0.024	0.616	4	101	0.652
TIME(2) ∞ EQ5D(5) ∞ OCCUPATION(2)	0.018	0.461	4	101	0.764
TIME(2) ∞ EQ5D(5) ∞ EDUCATION(3)	0.062	0.817	8	204	0.589
EQ5D_Total(2) ∞ GENDER(2)	0.002	0.240	1	114	0.625
EQ5D_Total(2) ∞ OCCUPATION(2)	0.003	0.306	1	114	0.581
EQ5D_Total(2) ∞ EDUCATION(3)	0.002	0.121	2	113	0.886

*p < 0.05; Numbers in brackets indicate the number of the given variable. Time: 1-Baseline, 2-Follow-up; Gender: 1-Male, 2-Female; Education: 1-Basic, 2-High School, 3-University; MMAS/CAT/EQ5D_Total: total scores of scales at 1-Baseline, 2-Follow-up; Occupation: 1-active working status, 2-pensioner; MMAS/CAT/EQ5D (X)-where 'X' is the number of questions in the specific questionnaire.

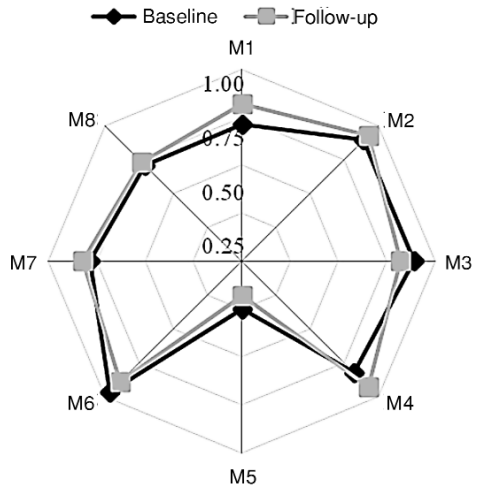
and impart enough power to the study (40). Moreover, we also considered adherence (MMAS-8) and COPD symptomatology (CAT) scores to be important markers for us to be able to distinguish the effects of patient education. Bearing these requirements in mind, we estimated that a sample size of approximately 100 subjects would be sufficiently large to yield statistically significant results and achieve the research objective.

We analyzed our data using IBM SPSS ver.22.0. Quantitative variables were evaluated by paired-samples *t*-tests and mixed-measures ANOVA and ANCOVA to study temporal effect. For the study the effect of independent variables such as age, education, etc., we used the *t*-test, one-way ANOVA, and mixed-measures ANCOVA. Furthermore, we employed a correlation analysis to compare baseline data to the follow-up data. Results were considered significant at $p < 0.05$.

RESULTS

Subject characteristics

We enrolled a total of 118 subjects in our study. The study cohort had a predominance of women (n = 70, 59.3%) and an average (± standard deviation (SD)) age of 67.3 (± 9.4) years (Table 1). A total of 39.8% (n = 47) of our subjects were current smokers. A substantial majority of the cohort were urban residents (n = 88, 74.6%) with university or high school education (n = 96, 81.4%), and good or above-average social status (n = 103, 87.3%). The self-reported responses of >90.0% of the subjects to questions on adherence, the quality of received education, regular check-ups, and trust in their pulmonologist were positive. At the follow-up visit, subject adherence to treatment was self-reported to be good (n = 49, 41.5%) or moderate (n = 51, 43.2%).



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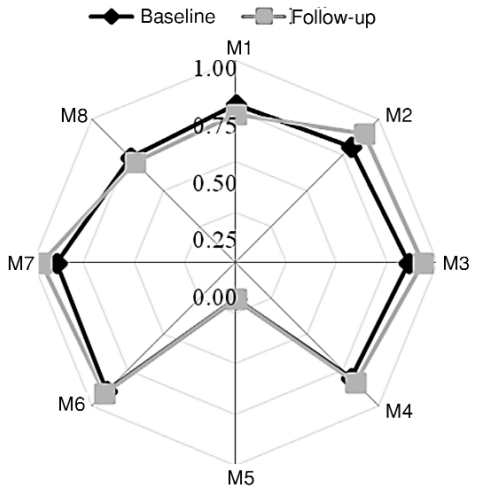

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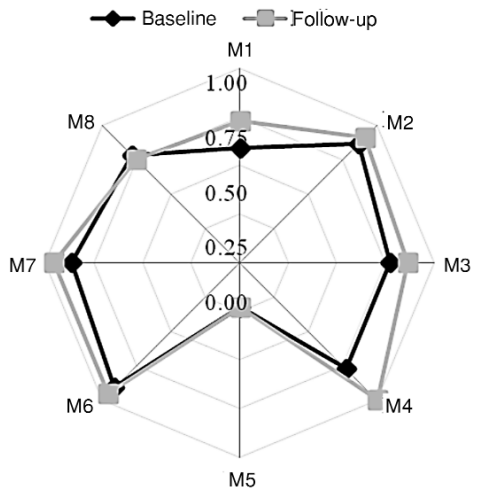
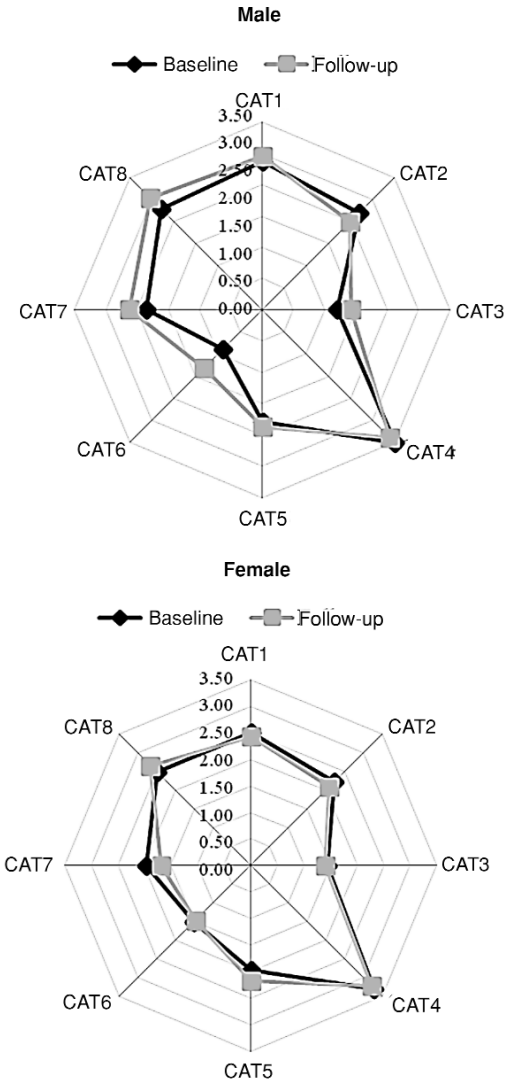


(A) Differences in pattern of adherence (MMAS-8) by education and time.



(B) Differences in pattern of symptomatology (CAT) by gender and time with mixed measures (ANOVA).
Figure 1. Difference in pattern of adherence (A) and COPD symptomatology (B) at baseline and follow-up.

Assessment questionnaire performance scores

Table 2 shows the comparison between baseline and follow-up scores for CAT, MMAS-8, EQ5D and SGRQ scales using the paired samples *t*-test. We noticed an overall increase in adherence with mean (± SD) MMAS-8 total scores increasing from 6.72 (± 1.46) at baseline to 7.01 (± 1.15) at follow-up (t = -2.073; p = 0.04). With respect to severity of COPD symptoms the improvement in CAT scores proved to be non-significant (t = -0.441; p = 0.660). There was no significant difference in the QoL (EQ5D; t = -0.784; p = 0.435) and general symptoms (SGRQ; t = -0.063; p = 0.950) scores between baseline and follow-up. Mean scores and comparisons of subscales are also shown in Table 2.

Effect of gender, occupation, and education on performance scores

We also evaluated our data to identify the effects of gender, occupation, and education as inter-subject variables on the change in assessment scores. Due to smaller sizes of subgroups, we investigated only the main effects while controlling for other independent variables as covariates.

Overall, we could not discern any significant association between gender and occupation on the change in total scores (Table 3). Besides examining total scores, we looked at the pattern of individual questions of the questionnaires, and we identified a significant difference in two cases. Thus, we discovered that there is a difference between subjects

based on their education level on the pattern of MMAS-8 scores by time (TIME(2) 8 MMAS(8) 8 EDUCATION(3)) (F = 2.364; p = 0.005). *Post hoc* *t*-tests showed a significant improvement in MMAS-8 scores in patients with basic education for questions M4 (t = -2.485; p = 0.021) and M8 (t = -1.766; p = 0.046). Differences in the pattern of adherence (MMAS-8) by education and time are shown in Figure 1A.

We also observed a statistically significant difference between genders in CAT score patterns (TIME(2) 8 CAT(8) 8 GENDER(2)) (F = 3.138, p = 0.005) (Table 3). There was no significant difference in scores for any item on the CAT questionnaire in female subjects. In contrast, on *post hoc* analysis we noticed that in male patients, CAT6 (difficulties in leaving home) scores had increased significantly by the time of follow-up (t = -1.543; p = 0.049) (Figure 1B). Comparing the two groups (male vs. female) by independent sample *t*-test, the significant difference in CAT6 scores between the genders was found to be only at the baseline. This implies that male patients found their symptoms preventing them from leaving their home much less disturbing than female patients (t = -2.267; p = 0.025) at baseline. but by the time of follow-up this difference was not detectable (t = -0.159; p = 0.312). Differences in pattern of COPD symptomatology (CAT) by gender and time are shown in Figure 1B. To measure the relationship between the changes in the different assessment algorithms we used, we created one variable per scale using the ratio of baseline to follow-up scores. In most cases, we found the interaction between the changes to be negligible or not statistically significant (Table 4). However, there was a weak interaction between the changes in CAT and the SRGQ scores.

DISCUSSION AND CONCLUSION

In this first of its kind study to determine the effect of patient education on treatment adherence and QoL in subjects with COPD, we noticed a clear association between patient education and adherence at the time of follow up. In the parameters tested using the MMAS-8 scale, there were statistically significant changes in total score and for M4 and positive trends in M2, M4, and M7 (Table 2). This implies that adherence improved in relation to – (1) taking medication in the two weeks preceding the follow-up visit, (2) remembering to take medications when traveling or leaving home, and (3) being more comfortable with the treatments. Furthermore, a substantial proportion of our subjects reported either good (41.5%) or moderate (43.2%) adherence by the end of the study.

The assumption that patient education would result in the improvement of patients' QoL has been well-supported by numerous studies (19, 20, 26), including in a hospital setting (15). Although the change in our subjects' overall QoL scores at follow-up were not statistically valid, we were able to discern noticeable trends in certain aspects of the QoL algorithms. Two of these were the CAT2 and CAT8 scores (Table 2) which implies that patient education improved subject perception of the amount of mucus in their respiratory system. With these algorithms, we also noted that our subjects reported feeling less energetic at follow-up although we speculate that this could be due to a change in patient attitudes for the lengthy follow-up procedure. We also observed certain gender-specific trends: our male subjects tended to show an improvement in CAT3 and CAT6-8 scores indicating that they felt less chest pain, were more confident when leaving their homes, were sleeping better, and felt more energetic due to the educational intervention. On the other hand, the changes in CAT6 scores in our female subjects suggest that they were more symptom-conscious at the time of follow-up. These findings suggest that perhaps patient education programs will have to be tailored by gender as well as the individual in order for patients to successfully manage their COPD. We must also note

Table 4. Correlations in between changes in respective adherence and QoL scales between baseline and follow-up.

		MMAS-8	EQ5D	CAT	SGRQ_Total	SGRQ_symp	SGRQ_act	SGRQ_imp
MMAS-8	r	-	-0.025	0.066	0.061	0.022	0.082	0.055
	p	-	0.789	0.479	0.514	0.813	0.379	0.558
EQ5D	r	-	-	-0.158	-0.237**	-0.135	-0.070	-0.178
	p	-	-	0.087	0.010	0.148	0.454	0.057
CAT	r	-	-	-	0.303**	0.321**	0.232*	0.192*
	p	-	-	-	0.001	0.000	0.012	0.039

*p < 0.05; **p < 0.001.

here that while we designed our education content in order to keep it simple and provide key messages to our subjects. And in the interest of consistency, we provided the same content to all study subjects without any personalization or alteration.

Medication adherence has been shown to be associated with certain sociodemographic characteristics such as gender, age, affluence, and education (41). Higher education levels in patients are associated with better health literacy and medication knowledge (42-44). Consequently, these patients could be more proactive about seeking medical attention, adherent to prescribed treatments, and seek to make appropriate lifestyle changes. In our study, we noticed that subjects who had a university-level education scored better on question M8 on the MMAS-8 scale, which asked subjects if they had trouble remembering to take their medication. This observation further supports previous reports on education levels and adherence. However, this finding also indicates that other appropriate measures will have to be developed to help improve adherence in patients who are not as educated.

One of the goals of our study was to identify any three-way correlation between patient education, adherence, and QoL. However, we could not discover any statistically valid correlation between adherence and QoL. Despite this, we did notice a loose association between changes in SGRQ and CAT scores implying that patient perception of symptoms, as measured by CAT, correlate to decrease in QoL scores, as measured by SGRQ. In other words, the more symptoms a patient perceives, the worse they score on the QoL scale, especially on issues related to daily activities and societal impact. Additionally, the changes in SGRQ were paralleled by changes in the EQ-5D scores indicating that these trends move in the same direction. Larger studies will be required in the future in order to ascertain whether such patterns are a true effect or an aberration.

While our study provides a few insights on the association between patient education and management of COPD in the outpatient scenario, it was limited in scope. Since our study was a longitudinal cohort investigation, we did not have a control group, i.e., subjects who received no professional counseling, similar to the less mainstream longitudinal cohort studies (45). While our sample size was adequate for our main objective, the results from our sub-group analysis cannot be reliably extrapolated to the general population with COPD. Furthermore, we did not classify our subjects according to the Global Initiative for Chronic Obstructive Lung Disease guidelines (46), which would have helped us better understand their status, symptoms, and risk of exacerbation. Lastly, we did not analyze the data from our subjects for the effect of seasonal fluctuations, which are known to have an impact on the severity of COPD symptoms (47).

In conclusion, although we did not establish a clear relationship between patient education and QoL, we were successful in demonstrating an association between patient education and medication adherence. Our research highlights the groups that are receptive to education and parameters that affect adherence in an outpatient pulmonology center environment, where the context is fixed, internal consistency of the education ensured, and patients continue with their medications for a period of three months. Patient education results in an improvement in adherence, especially in unique situations such as being away from home. Larger studies will be required to assess the adequacy of current patient counseling strategies and implement newer and improved policies to ensure successful self-management of COPD in Hungary.

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