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Chronic Obstructive Pulmonary Disease Illness and Medication Beliefs are Associated with Medication Adherence

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Abstract

Almost half of patients with COPD do not adhere to their medications. Illness and medication beliefs are important determinants of adherence in other chronic diseases. Using the framework of the Common Sense Model of Self Regulation (CSM), we determined associations between potentially modifiable beliefs and adherence to COPD medications in a cohort of English- and Spanish-speaking adults with COPD from New York and Chicago. Medication adherence was assessed using the Medication Adherence Report Scale. Illness and medication beliefs along CSM domains were evaluated using the Brief Illness Perception Questionnaire (B-IPQ) and the Beliefs about Medications Questionnaire (BMQ). Unadjusted analysis (with Cohen's *d* effect sizes) and multiple logistic regression were used to assess the relationship between illness and medication beliefs with adherence. The study included 188 participants (47% Black, 13% Hispanics); 109 (58%) were adherent. Non-adherent participants were younger ($p<0.001$), more likely to be Black or Hispanic ($p=0.001$), to have reported low income ($p=0.02$), and had fewer years of formal education ($p=0.002$). In unadjusted comparisons, non-adherent participants reported being more concerned about their COPD ($p=0.011$; Cohen's $d=0.43$), more emotionally affected by the disease ($p=0.001$; Cohen's $d=0.54$), and had greater concerns about COPD medications ($p<0.001$, Cohen's $d=0.81$). In adjusted analyses, concerns about COPD medications independently predicted non-adherence (odds ratio: 0.52, 95% confidence interval: 0.36–0.75). In this cohort of urban minority adults, concerns about medications were associated with non-adherence. Future

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Declaration of Interest:

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work should explore interventions to influence patient adherence by addressing concerns about the safety profile and long-term effects of COPD medications.

Keywords

health beliefs; outcomes; self-management; vulnerable population

Background

Chronic obstructive pulmonary disease (COPD) affects approximately 7% of the United States (US) population, is currently the 5th leading cause of global mortality, and poses a growing public health problem worldwide.(1, 2) COPD impacts diverse populations, including women, African-Americans and the elderly, and its costs to the health care system, estimated in the U.S. to be almost \$2,000 per patient annually, are considerable.(3–6)

Patients with COPD who exercise proper self-management behaviors experience better quality of life, fewer disease-related flares, less-frequent hospitalization, and faster recovery from exacerbations.(7–9) The cornerstone of COPD self-management remains appropriate medication use. Large randomized trials have demonstrated that long-term use of long-acting bronchodilators and inhaled corticosteroids slows lung function decline and may decrease mortality.(10–12) Despite the association between COPD medications and improved disease outcomes, the majority of patients use their inhalers ineffectively, and close to 50% do not adhere to their COPD medications.(13–18) The consequences of non-adherence to COPD medications are well-documented, and include poorer quality of life, worsening symptoms, increased rates of exacerbations, increased hospitalizations and related costs, and higher mortality.(19–21)

Illness and medication beliefs are important patient-level determinants of self-management behaviors (in particular medication adherence) in a wide range of chronic diseases.(22–25) Misbeliefs about the timeline of a chronic disease have been shown to be associated with low adherence in patients with diabetes, asthma and congestive heart failure.(22, 24) Medication concerns –specifically the balance between perceived benefits vs. possible harms – have also been associated with adherence in other chronic diseases, such as HIV. (26) However, except for few studies in non-US populations, there is limited information regarding the impact of illness and medication beliefs on COPD self-management behaviors, particularly in minorities.(27, 28) A better understanding on potentially modifiable factors that may underlie medication non-adherence among an ethnically diverse population of adults with COPD is important for addressing this problem.

In this study of urban, minority patients with COPD, we used the framework of the Common Sense Model (CSM) of Self-Regulation to further characterize illness and medication beliefs in patients with COPD, and to assess the association of these beliefs with self-reported adherence to medications.

Methods

We used data from an ongoing observational study examining health literacy and cognition in patients with COPD. Recruited participants were English- or Spanish-speaking, 55 years old, with a diagnosis of COPD made by a health care provider. Individuals were excluded if they had concurrent diagnoses of asthma or other chronic respiratory disease, dementia, or any condition profoundly affecting cognition (including advanced cases of Parkinson's disease, stroke, or schizophrenia). Participants were recruited from outpatient primary care and pulmonary clinics as well as the inpatient service of the Mount Sinai Medical Center (East Harlem, New York), Northwestern Memorial Faculty Foundation (Chicago, Illinois), and Mercy Family Health Center (Chicago, Illinois). We identified potentially eligible patients through queries of the electronic medical records and registration systems of participating sites. After obtaining permission to approach these patients from their providers, trained, bilingual research assistants administered eligibility screeners to individuals interested in participating. Eligible subjects were then scheduled for an in-person interview, at which time written, informed consent was obtained. The study was approved by the Institutional Review Boards of the Icahn School of Medicine at Mount Sinai and the Feinberg School of Medicine at Northwestern University.

Study Outcome: COPD Medication Adherence

The primary study outcome was adherence to COPD medications, a key self-management behavior. Self-reported adherence was assessed with the Medication Adherence Reporting Scale (MARS), a validated tool that performs accurately when compared to objective electronic monitoring.(29) MARS is validated in English and Spanish, has good inter-item correlation (Cronbach alpha=0.85 and 0.86 in English and Spanish, respectively) and good test-retest reliability.(29) The instrument has been used in a variety of populations, and across multiple chronic diseases, including COPD.(27, 30–35) The 10 items included in the instrument address primary medication use and are phrased to avoid social desirability bias. (29) Responses are scored on a 5-point Likert scale, and a final score is assigned based on the average of the 10 responses. Higher scores correlate to better self-reported adherence; a score of 4.5 has been used as an acceptable cut-off to indicate good adherence.(29)

COPD Illness and Medication Beliefs

The Common Sense Model (CSM) of Self-Regulation provided the framework for studying how patients' representations of COPD influence medication adherence. According to the CSM, patients develop mental models of illnesses, which guide self-management and health-seeking behaviors based on their experiences with acute and chronic diseases. Specifically, the CSM attempts to reconcile two parallel conceptual processes that an individual undergoes in response to their personal experience with an illness – a mental model based on a set of cognitions, and an emotional or affective model, which accounts for feelings, such as worry or anxiety that may be triggered by disease-related experiences. The outcome of these combined pathways influences behavioral responses to illnesses, in particular self-management. The CSM organizes disease representations into several cognitive domains: 1) identity, or the label and attribution of symptoms (i.e., are shortness of breath and fatigue attributed to COPD or to other conditions); 2) cause, or the etiology of a

disease (i.e., smoking, stress, etc.); 3) timeline, or the rate of disease onset, progression, and expected duration (i.e., COPD is a progressive, chronic illness vs. a series of acute unrelated episodes); 4) control, or the extent to which a patient believes COPD can be controlled by medication and behaviors (i.e., medications can slow down progression vs. nothing can be done to improve the disease or forestall unfavorable outcomes); and 5) consequences, or the perceived and anticipated health impacts of a disease (i.e., COPD will have a major impact on functional status and mortality). In addition to these cognitive domains, the CSM incorporates emotional representations of illness, such as fear, worry and anxiety.(36)

Illness beliefs were assessed using the Brief Illness Perceptions Questionnaire (B-IPQ; Table 2).(37, 38) This is a validated (English and Spanish) instrument that contains nine items designed to assess cognitive and emotional illness representations according to the domains of the CSM. The instrument has been shown to have adequate test-retest reliability ($r=0.42-0.75$) as well as good predictive validity.(37) Each item is scored on a scale of 0–10, and higher scores correlate to greater disease congruence (i.e., concordance with the biomedical model of the disease).

According to the CSM, adherence is also due, in part, to a rational decision-making process based on beliefs about medication necessity and concerns about medication's potential harms. Patients consider both the pros and cons of taking medication, and would be expected to be adherent when they believe their medication necessary and effective and, conversely, non-adherent when their beliefs are dominated by concerns about side effects and safety.(39, 40) We measured beliefs about COPD medications with the Beliefs about Medications Questionnaire (BMQ), a validated (English and Spanish) instrument designed to quantify these factors.(41) The BMQ consists of two five-item subscales representing: 1) beliefs about medication necessity and 2) concerns about these medications, such as beliefs about toxicities and potential for dependence. Participants were asked to respond to each question on a 5-point Likert scale. Responses for each question within a subdomain were summed into a total score (possible range 5–25). In the necessity subdomain, higher scores indicate beliefs that medications are less necessary. In the concerns subdomain, higher scores reflected greater concern about untoward effects of medication use.

Sociodemographic Characteristics and other Covariates

Sociodemographic characteristics (age, sex, race, ethnicity, income and education), and English language proficiency were obtained by self-report using validated items.(42) COPD medication regimen and history (acute resource utilization and history of intubation due to COPD exacerbation) were also obtained by self-report.(42) COPD severity was characterized using the COPD Severity Index, a validated survey instrument based on respiratory symptoms, systemic corticosteroid use, other COPD medications, home oxygen use, hospitalizations and intubation history.(43, 44) Possible scores range from 0–25, with higher values indicating greater disease severity. The index correlates well with physiologic assessments of COPD severity and health-related quality of life.(43)

Statistical Analysis

Differences in the baseline characteristics of patients with and without good adherence were assessed using the chi-square test, t-test, and Wilcoxon rank sum test, as appropriate. We used the Wilcoxon rank sum test to determine differences in illness and medication beliefs between adherent vs. non-adherent patients. The corresponding effect size was calculated using Cohen's *d*; consistent with the literature, cutoffs for a small, moderate, and large effect size are 0.2, 0.5, and 0.8, respectively).(45)

Adjusted associations between illness and medication beliefs with adherence were assessed using logistic regression analysis. First, we tested each belief individually while controlling for sociodemographic characteristics and COPD severity. Then, we fitted a model including all significant beliefs, to identify independent predictors of adherence. In these models, the beta coefficients represent the change in the log odds ratio of adherence for a 3-unit (the approximate value of the standard deviation of these scores) change in belief scores. All analyses were conducted in SAS version 9.2 (SAS Institute, Cary, NC) using two-sided p-values.

Results

Study Cohort

From November 2011 to June 2013, we screened 591 potential study subjects identified via queries of the electronic medical records and registration systems of the participating sites. Of those, 179 refused or passively declined, 74 were ineligible, 100 stated interest but had not been enrolled at the time of this analysis, yielding a final eligible cohort of 238 participants with COPD. For this analysis, we excluded participants who solely used as-needed bronchodilators, or did not use any COPD medication, resulting in a sample of 188 (79%) participants. Cronbach alpha coefficients within our cohort for MARS, B-IPQ, BMQ necessity score and BMQ concerns score were 0.76, 0.65, 0.80 and 0.75, respectively.

Overall, 109 (58%) participants were non-adherent to their COPD medications (Table 1). Compared to adherent participants, those non-adherent participants were younger ($p<0.001$), more likely to be black or Hispanic ($p=0.001$), to report an income at or below the federal poverty level ($p=0.02$), and to have fewer years of formal education ($p=0.002$). Non-adherent participants also had greater COPD severity scores ($p=0.04$). Adherent and non-adherent patients did not differ in terms of sex, English proficiency, prior ED visits for COPD, or history of intubation ($p>0.05$ for all comparisons).

Unadjusted Associations of Beliefs with Self-reported Adherence

Responses to B-IPQ items addressing emotional representations of COPD differed significantly among adherent vs. non-adherent patients (Table 2). Non-adherent participants reported being more concerned about their COPD ($p=0.01$; Cohen's $d=0.43$) and more emotionally affected by the disease ($p=0.001$; Cohen's $d=0.54$). However, no significant difference in the score distribution of items assessing COPD cognitive representations along the CSM domains were found among adherent vs. non-adherent participants ($p>0.05$ for all comparisons).

Non-adherent participants also had higher scores in the concerns subdomain of the BMQ, indicating increased worries about COPD medications ($p<0.0001$; Cohen's $d=0.81$). Conversely, there were no significant differences among adherent vs. non-adherent participants in the responses to the medication necessity subdomain ($p=0.54$, Cohen's $d=0.07$).

Adjusted Analyses

In adjusted analyses evaluating individual beliefs, increased emotional responses to COPD were associated with significantly lower odds of adherence (Table 3). Specifically, higher emotional effect of COPD was associated with lower odds (odds ratio [OR]: 0.68, 95% confidence interval [CI]: 0.48–0.96) of self-reported adherence to COPD medications after controlling for age, sex, race, education, and disease severity. Similarly, higher concerns about COPD medications were also associated with lower odds of adherence (OR: 0.49, 95% CI: 0.35–0.70), adjusting for the same factors.

In our final model, which included all significant illness and medication beliefs, as well as sociodemographic characteristics and COPD severity, concerns about COPD medications remained a significant predictor of medication adherence (OR: 0.52, 95% CI: 0.36–0.75). However, beliefs about medication necessity, emotional representations of COPD, and beliefs from the CSM cognitive domains were not independently associated with adherence.

Discussion

Effective self-management in patients with COPD is an important determinant of a variety of disease-related outcomes.(7–9) Proper use of some COPD medications, such as long-acting bronchodilators and inhaled corticosteroids, slows lung function decline and likely decreases mortality.(10–12) Yet, low rates of adherence are a common problem among patients with COPD and an important barrier to improved outcomes.(13–18) In this cohort of urban, minority adults with COPD, we found that concerns about medications were important predictors of non-adherence. These beliefs are potentially mutable factors that might serve as targets of educational or behavioral interventions seeking to improve adherence to COPD medications and other self-management behaviors.

Almost 60% of participants in our study were non-adherent to their COPD regimen, underscoring the need for information about the underlying reasons for non-adherence to potentially life-saving medications. This high rate of non-adherence is consistent with findings in several COPD studies, including of US veterans and of Australian patients participating in pulmonary rehabilitation and support group programs, highlighting the extent of this problem across varied settings.(18, 27) On the other hand, the non-adherence rate in our cohort exceeded rates reported in other studies.(16, 28) These differences might be explained, in part, by the diverse sociodemographic composition of our study population. Overall, our results show that concerns about non-adherence to COPD medications are highly relevant in this cohort of inner-city minority patients, a vulnerable population at higher risk for poor outcomes. Furthermore, these data support that addressing COPD medication non-adherence can have a broad public health impact, given the high prevalence of this problem.(5)

Illness and medication beliefs have been shown to influence self-management behaviors in patients with several chronic diseases, and there is growing acceptance that these factors should be considered when evaluating determinants of key self-management behaviors.(24–27) Prior work using the CSM to explore associations between beliefs and medication adherence in patients with asthma, showed that several misbeliefs, such as an acute illness characterization (“no symptoms, no asthma” belief) and negative beliefs about the necessity of asthma therapies, were associated with lower odds of adherence.(46) However, few previous studies have explored the potential impact of these factors on adherence to COPD medications. In a study of 173 outpatients with COPD, Khmour et al. used the framework of the Health Belief Model (HBM) to assess the associations of self-efficacy, COPD knowledge, and health beliefs with self-reported adherence.(28) The investigators found that higher perceived barriers to treatment, as well as increased medication concerns, were predictive of low adherence. A study conducted by George et al., evaluated responses to a self-administered questionnaire given to Australian ambulatory patients with chronic lung conditions, including COPD.(27) In this study, participants with high adherence more commonly held beliefs that their regimen would control COPD or that they understood their disease, whereas those with low adherence were more likely to report being confused about the management of their illness. Additionally, preferences towards natural medicines were associated with lower adherence. These findings point to the significance of patients’ beliefs related to understanding medication options and their benefits, as well as potential concerns about their safety and untoward effects. Our findings build upon these studies by showing the importance of concerns about COPD medications as determinants of COPD self-management in a large, racially and ethnically diverse, inner-city sample of US patients.

Unadjusted analyses found that several emotional responses to COPD and its treatment were associated with non-adherence. However, concerns about medications, which may be partially driven by emotional responses, were the only predictors of adherence in adjusted analyses. These findings suggest that emotional representations of COPD may have a greater impact compared to cognitive processes (i.e., identity, cause, timeline, control, and consequences) as determinants of adherence. Depression is associated with low adherence in COPD, as well as with negative automatic thoughts that may magnify worries about COPD and/or its treatment.(47, 48) Beliefs related to emotional representations of COPD should therefore be explored as mediators in the pathway linking affective states, such as depression, and intentional decisions about medication use. The relationships between depression, beliefs, and other important self-management behaviors – such as receipt of routine care, vaccines and action plan use – might also be considered, and explored as possible targets for interventions to improve COPD outcomes.

Interventions focused on COPD self-management have suggested a positive effect on outcomes, such as decreasing acute resource utilization and improving quality of life.(7, 49, 50) Furthermore, widely accepted COPD guidelines include recommendations for educational interventions to improve patient knowledge of a range of topics, including COPD pathophysiology, medication use, the importance of physical activity, and smoking cessation.(51, 52) However, time for patient counseling is generally limited during routine clinical encounters, and therefore these efforts should be tailored to maximize efficacy. In this context, the findings of our study have specific, practical implications. Eliciting and

addressing illness beliefs specifically about medication concerns, while linking counseling about COPD medication adherence with discussions about side effects and long-term benefits of medication use, may prove to be an efficient mechanism for targeted counseling about adherence to COPD treatment.

Some limitations to this study warrant comment. Because adherence was assessed by self-report, patients' responses may have been subject to reporting bias. However, we used the MARS instrument which has been specifically designed to limit social desirability bias and has performed well when tested against electronic adherence measures.⁽²⁹⁾ Moreover, over 50% of study subjects acknowledged low-adherence, suggesting that over-reporting was not a major limitation in this case. In addition, because our cohort was recruited from urban, hospital-affiliated primary care practices or inpatient wards, the study results may not be generalizable to other populations with COPD. However, the majority of our patients were older, low-income and from minority populations, thus representing some of the groups most vulnerable to poor COPD outcomes. Because our study was cross-sectional, we were not able to evaluate the causal relationship between beliefs and adherence. Finally, we chose to focus on adherence as representative of self-management behaviors, as it remains central to disease outcomes. However, we did not evaluate factors associated with other self-management behaviors, such as receipt of recommended vaccinations, smoking cessation, or adherence to action plans.

Conclusions

Identifying mechanisms that reinforce and improve medication adherence in patients with COPD will likely improve disease-related outcomes. This study adds to our understanding of how illness and medication beliefs, in particular concerns about medications, are associated with this key self-management behavior. These results illustrate potential elements that might be included in targeted interventions to address medication adherence in patients with COPD. Future work should also explore the impact of medication and illness beliefs on other critical components of COPD self-management.

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Table 1

Characteristics of COPD Patients by Self-Reported Medication Adherence

Characteristic	Total n= 188	Adherent n= 79	Non-Adherent n= 109	P-value
Age, years, median (IQR)	67 (62–74)	71 (67–76)	64 (61–71)	<0.0001
Male, no. (%)	62 (33)	26 (33)	36 (33)	0.99
Race, no. (%)				
White	69 (37)	42 (53)	27 (25)	0.001
Black	89 (47)	29 (37)	60 (55)	
Hispanic	26 (13)	7 (9)	19 (17)	
Other	4 (2)	1 (1)	3 (3)	
Income, monthly <\$1350, no. (%)	90 (48)	30 (38)	60 (55)	0.02
Education, no. (%)				
Some high school or less	45 (24)	10 (13)	35 (32)	0.002
High school graduate	37 (20)	19 (24)	18 (17)	
Some college	50 (27)	18 (23)	32 (30)	
College graduate or more years	55 (29)	32 (40)	23 (21)	
Limited English proficiency, no. (%)	15 (8)	4 (5)	11 (10)	0.21
COPD Severity Scale score, median (IQR)	5 (3–8)	5 (2–8)	6 (4–9)	0.04
1 ED visit for COPD in past year, no. (%)	47 (25)	18 (23)	29 (27)	0.56
Ever intubated for COPD, no. (%)	11 (6)	6 (8)	5 (5)	0.39

COPD: chronic obstructive pulmonary disease; ED: emergency department

Table 2

Unadjusted Comparisons of Beliefs According to Self-reported Adherence

Illness and Medication Beliefs	Adherent Mean (SD)	Non- Adherent Mean (SD)	Effect Size	P-value
Brief Illness Perceptions Questionnaire¹				
<i>CSM² Domain: Identity</i>				
How much do you experience symptoms from your COPD?	6.1 (2.9)	6.4 (2.7)	0.14	0.46
<i>CSM Domain: Timeline</i>				
How long do you think your COPD will continue?	9.1 (2.1)	8.9 (2.5)	0.09	0.79
<i>CSM Domain: Control</i>				
How much control do you feel you have over your COPD?	6.8 (2.5)	6.6 (2.5)	0.04	0.76
How much do you think your treatment can help your COPD?	7.9 (2.2)	7.7 (2.4)	0.11	0.60
<i>CSM Domain: Consequences</i>				
How much does your COPD affect your life?	5.8 (3.0)	6.4 (2.7)	0.23	0.15
<i>Emotional Representations</i>				
How concerned are you about your COPD?	7.6 (3.4)	8.8 (2.2)	0.43	0.01
How much does your COPD affect you emotionally?	4.8 (3.6)	6.6 (3.3)	0.54	0.001
<i>Comprehensibility</i>				
How well do you understand your COPD	8.5 (2.2)	8.2 (2.4)	0.15	0.29
Beliefs about Medications Questionnaire				
Medication Necessity Score ²	14.4 (4.0)	14.1 (4.7)	0.07	0.54
Concerns About Medications Score ³	11.4 (3.2)	14.4 (4.1)	0.81	<0.0001

¹ Each item scored on scale of 0–10; higher scores indicate greater disease congruence

² Possible score range 5–25; higher score indicates greater belief that COPD medications are necessary

³ Possible score range 5–25; higher score indicates greater worry about COPD medications

CSM: Common Sense Model of Self Regulation

Table 3

Adjusted Association Between COPD Illness and Medication Beliefs and Medication Adherence

Illness and Medication Beliefs	Odds Ratio ¹	95% Confidence Interval
Brief Illness Perceptions Questionnaire²		
<i>CSM Domain: Identity</i>		
How much do you experience symptoms from your COPD?	1.23	0.77–1.99
<i>CSM Domain: Timeline</i>		
How long do you think your COPD will continue?	0.94	0.57–1.56
<i>CSM Domain: Control</i>		
How much control do you feel you have over your COPD?	0.95	0.61–1.48
How much do you think your treatment can help your COPD?	1.29	0.80–2.09
<i>CSM Domain: Consequences</i>		
How much does your COPD affect your life?	1.03	0.67–1.59
<i>Emotional Representations</i>		
How concerned are you about your COPD?	0.79	0.52–1.20
How much does your COPD affect you emotionally?	0.68	0.48–0.96
<i>Comprehensibility</i>		
How well do you understand your COPD	1.20	0.76–1.92
Beliefs about Medications Questionnaire		
Medication Necessity Score ³	0.95	0.76–1.20
Concerns About Medications Score ⁴	0.49	0.35–0.70

¹ Adjusted for age, sex, race, education, COPD severity and beliefs² Higher scores indicate greater disease congruence of a belief³ Higher score indicates greater belief that COPD medications are necessary⁴ Higher score indicates greater worry about COPD medications

CSM: Common Sense Model of Self Regulation