Published in final edited form as:

J Psychosom Res. 2011 February ; 70(2): 161–167. doi:10.1016/j.jpsychores.2010.06.005.

Associations Between Illness Perceptions and Health-Related Quality of Life in Adults with Cystic Fibrosis

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Abstract

Objective—To examine the relationship between illness perception, health status, and health-related quality of life (HRQOL) in a cohort of adults with cystic fibrosis (CF).

Methods—In the Project on Adult Care in Cystic Fibrosis (PAC-CF), we administered five subscales (Illness Consequences, Illness Coherence, Illness Timeline-Cyclical, Personal Control, Treatment Control) of the Illness Perception Questionnaire-Revised (IPQ-R). Multivariable linear regression analyses explored the associations between illness perception, health status, symptom burden, and physical and psychosocial HRQOL as measured by various domains of the CF Questionnaire-Revised (CFQ-R).

Results—Among the 199 respondents (63% female, mean age 36.8±10.2 years), IPQ-R scores did not differ based on age, gender, or lung function. In multivariable regression models neither clinical characteristics nor physical or psychological symptom burden scores were associated with CFQ-R physical domains. In contrast, higher scores on Illness Consequences were associated with lower psychosocial CFQ-R scores. Higher scores on Illness Coherence and Personal Control scales were associated with higher psychosocial CFQ-R scores.

Conclusion—Adults with CF report a high understanding of their disease, feel that CF has significant consequences, and endorse both personal and treatment control over their outcomes. Illness perceptions did not vary with increased age or worsening disease severity, suggesting that illness perceptions may develop during adolescence. Illness perceptions were associated with psychosocial but not physical aspects of HRQOL. Efforts to modify illness perceptions as part of routine clinical care and counseling may lead to improved quality of life for adults with CF.

Keywords

Cystic fibrosis; quality of life; illness perceptions

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Introduction

Cystic fibrosis (CF) is the most common life-limiting genetic disease affecting the Caucasian population. Due to advances in clinical care, survival of CF patients has increased such that over 40% of patients with CF in the US currently are over the age of 18 (1). During adolescence and adulthood, CF complications including worsening obstructive lung disease, chronic infections, malnutrition, CF-related diabetes and bone disease frequently arise (2). Adults with CF often struggle with issues of adherence to daily medical regimens in the face of high symptom burden and a demanding treatment burden (3,4). The daily treatment requirements for most adults with CF include use of pancreatic replacement enzymes, monitoring of caloric intake, chest physical therapy (CPT), inhaled bronchodilators, inhaled antibiotics, inhaled mucolytics, and anti-inflammatory therapies (2,5). Worsening disease severity, combined with these challenges to daily self-management, may impact the overall health related quality of life (HRQOL) of adults with CF. Previous research into HRQOL in CF has demonstrated significant associations with demographics, markers of disease severity such as frequency of pulmonary exacerbations and daily symptom burden, and measures of psychological health such as depression and mechanisms of coping (3,6-9). In recent years, several patient self-report measures have been evaluated in CF populations as markers of health status and HRQOL. A key marker of health status in chronic disease is symptom burden, which has been characterized in CF with measures such as the Memorial Symptom Assessment Scale (MSAS) (3). In addition, the Cystic Fibrosis Questionnaire-Revised (CFQ-R) has been validated as a disease-specific HRQOL measure and used as a patient-reported outcome in clinical research trials (10,11).

Illness perceptions, defined as the manner in which an individual identifies with and understands their disease, may influence overall HRQOL, especially emotional or psychological well-being. The Illness Perception Model (IPM) posits that organized beliefs about illness and treatment influence quality of life. The central proposition of IPM theory is that beliefs or representations that patients have about their illness influence their responses to the challenges of chronic disease self-management, which in turn may influence HRQOL (12). Cognitive components of illness perception can be broadly divided into knowledge and understanding of the illness and views on how the illness can be managed. The IPM conceptualizes these factors into the following domains: (1) *cause*, or the personal ideas about various causes of illness; (2) *consequences*, or views about the expected outcome of the illness; (3) *timeline*, or views about the illness trajectory (particularly the cyclical nature) of chronic disease; and (4) *control*, or views on how to control symptoms. The 'cause' domain consists of beliefs about biological, emotional, environmental, or psychological causes of illness, while the 'consequence' domain consists of beliefs about the impact of illness on functional status or overall quality of life. Timeline refers to beliefs about the course of the illness and the persistence of symptoms. Finally, the control domain consists of beliefs about whether the illness can be controlled (13).

Research based on the IPM suggests that illness perceptions may influence health outcomes such as HRQOL independently of coping strategies (14). The IPM has been extended to delineate the influence of illness perceptions and treatment beliefs on treatment decisions such as adherence (15-17). Additionally, it has been suggested that the IPM holds promise for understanding treatment decisions and adherence in adults with CF (18).

The Illness Perception Questionnaire-Revised (IPQ-R) has been developed and validated as a quantitative measure of the different domains of the IPM (19). This instrument has been studied in patients with different chronic illnesses including diabetes, COPD, and asthma as a way to assess patients' representations of their illness (20-22). In a small study of adolescents with CF, the IPQ-R treatment control domain was associated with adherence to

treatment (23). We hypothesized that illness perceptions would also be associated with HRQOL in adults with CF. In addition, we hypothesized that illness perceptions would be affected by health status and daily symptom burden. Therefore, as a part of the Project on Adult Care in CF (PAC-CF), we administered the IPQ-R to a cohort of adults with CF in order to explore these relationships between illness perception, health status and HRQOL.

Methods

Study participants

The Project on Adult Care in Cystic Fibrosis (PAC-CF) is an ongoing prospective, longitudinal panel study of adults with CF. Adults 18 years of age or older were recruited from one of ten participating CF Centers for the study. The design of PAC-CF has been previously described (24). Recruitment in PAC-CF was based on a stratified sampling design in which each participant was assigned a survivorship score based on a previously validated model of survival in CF (25). The survivorship score is based on nine clinical characteristics: age, gender, lung function (measured by FEV1% predicted), weight-for-age (z-score), use of pancreatic enzyme supplements, infection with *Staphylococcus aureus*, infection with *Burkholderia cepacia*, and the number of acute exacerbations in the past year and was developed and validated with data on CF patients from the US CF Foundation data registry (25). These data were used to calculate each individual's predicted probability of surviving 5 years, and all adults with a predicted probability of 5-year survival less than 0.975 and a randomly selected 25% of adults with a predicted probability of 0.975 or higher were approached for participation in the study. This stratified sampling strategy was employed in order to limit the number of adults in the study with a very high predicted probability of 5-year survival as the primary aim of the PAC-CF project was to evaluate health outcomes for patients with advanced disease. The study coordinator at each participating CF Center provided, without any identifying information, clinical and demographic variables from the patient's medical record. A total of 333 adults with CF enrolled in the study in Fall 2004 and received mailed surveys over the subsequent 5 years. The study protocol was approved by the Institutional Review Boards at Educational Development Center, Inc., the ten hospitals in which the participating CF Centers are located. PAC-CF participants received mail surveys in regular intervals starting in 2004. The data presented here are from the ninth survey of PAC-CF, administered in January 2008 (272 eligible participants).

Measures

To assess illness perception, we administered a modified version of the Illness Perception Questionnaire-Revised (IPQ-R)(19). The original IPQ-R items were reworded replacing the generic term for illness with CF. We assessed 5 subscales from the IPQ-R: Illness Consequences (6 items), Illness Coherence (5 items), and Illness Timeline-Cyclical (4 items). Treatment Control (5 items), Personal Control (6 items), Each IPQ-R item is scored on 5-point Likert-type scale of 1-5 (1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, and 5=strongly agree), with a composite score calculated as the mean of each of the individual item scores within the 5 subscales. As items in the IPQ-R are worded in both positive and negative terms, those items which were negatively worded were reverse coded such that a higher score reflected strong agreement with the construct assessed by the individual IPQ-R scale.

Our primary health outcome measure was the Cystic Fibrosis Questionnaire (CFQ-R) a validated CF-specific measure of HRQOL containing 12 subscales (10). All items on the CFQ-R are rated on a 4 point Likert scale and the score for each CFQ-R subscale is standardized on a 0- to 100-point scale on which higher scores represent a higher quality of

life. The CFQ-R includes 5 scales measuring physical HRQOL (Physical functioning, Eating disturbances, Digestive symptoms, Respiratory symptoms, Weight) and 7 scales measuring psychosocial HRQOL (Body image, Health perceptions, Vitality, Treatment burden, Emotional functioning, Social functioning, and Role). To assess symptom burden, we included the Memorial Symptom Assessment Scale (MSAS), a 22 item questionnaire assessing the severity, frequency, and distress caused by symptoms over a 2 week recall period using 5-point Likert scales to evaluate the 3 dimensions for each symptom (26). Prior work in PAC-CF developed 3 CF specific MSAS symptom scales (respiratory symptoms, gastrointestinal symptoms, and psychological symptoms) on a 0- to 5-point scale (3). Each of these subscales reflects a respondent's current symptom burden in discrete groupings of symptoms. Health status measures, including forced expiratory volume in 1 second (FEV₁ % predicted), a standard measure of lung function, body mass index, presence of common CF airway pathogens, and frequency of CF pulmonary exacerbations requiring intravenous antibiotics, were provided by each participating site.

Statistical Analysis

Descriptive statistics, calculated using sample selection weights (the inverse of the probability of selection into the study) to adjust for the stratified sampling design, were used to summarize the demographic and clinical characteristics of the PAC-CF sample and to describe the subscale scores for the IPQ-R, MSAS, and CFQ-R. Cronbach's alpha was calculated to assess the internal consistency reliability of the IPQ-R subscales in the adult CF population. Differences in IPQ-R subscale scores by respondent age, gender, and FEV₁ were assessed using chi-square test, t-test, or ANOVA, as appropriate. Respondents were divided into four age groups: 18-24, 25-34, 35-44, and 45+ and three groups based on their best FEV₁ (% predicted) in 2007 as obtained from clinical data: less than 40%, 40-69%, and 70% and greater.

Multivariate linear regression analyses were performed to explore the associations between IPQ-R scores and HRQOL as measured by the CFQ-R. A separate regression model was constructed for each of the 12 CFQ-R domains. For each domain, sequential regression analyses in which clinical, symptom scale, and illness perception measures were considered in "block-wise" sequence. We first constructed regression models for each CFQ-R domain using only demographic (age, gender) and health status indicators (lung function, BMI, frequency of pulmonary exacerbations, and presence of *Pseudomonas aeruginosa* and *Burkholderia cepacia complex* in respiratory cultures). A design variable, a binary indicator of whether the individual had $\geq 97.5\%$ predicted 5-year survivorship score (23), was forced into all models to account for the stratified sampling design. Any demographic or clinical variables that met statistical significance with a p-value < 0.05 were carried forward into a second model that added the three MSAS CF symptom burden scales. Finally, all statistically significant clinical, demographic, and MSAS scales were used as covariates in a final model incorporating the 5 IPQ-R scales. All analyses were performed with SAS software version 9.1 (SAS Institute, Cary, NC).

Results

199 PAC-CF respondents completed the IPQ-R (response rate 73%). The mean age of respondents was 35.8 years, 62% were female, and the mean FEV₁ was 62.5 % predicted (Table 1).

In general, respondents agreed with statements included in the Illness Consequences subscale such as "my CF has major consequences on my life" and in the Illness Timeline-Cyclical subscale such as "I go through cycles in which my CF gets better and worse" (Figure 1). In contrast, respondents tended to disagree with statements reflecting low

personal control (“my actions will have no effect on the outcome of my CF”) or low treatment control (“there is nothing which can help my CF”). Among our respondents, all 5 IPQ-R subscales had high inter-item reliability with Cronbach’s alpha coefficients ranging from 0.69 to 0.89 (Table 2). The results for individual item scores are available in the online appendix. IPQ-R subscale scores (Table 2) were highest in the Personal Control (mean 4.1 ± 0.5), Illness Coherence (mean 3.9 ± 0.8), and Illness Consequences (mean 3.8 ± 0.6) subscales, and were lower in the Treatment Control (mean 3.4 ± 0.4) and Illness Timeline-Cyclical (mean 3.3 ± 0.7) subscales.

Table 2 displays mean IPQ-R subscale scores based on respondent age, gender, baseline lung function, and presence of a recent CF pulmonary exacerbation. Very few differences in IPQ-R domain scores were found based on these clinical or demographic characteristics. Females had significantly higher scores on the Illness Timeline-Cyclical subscale and younger respondents (age 18-24 years) had significantly higher scores on the Personal Control subscale. Respondents who had developed a CF pulmonary exacerbation within the prior 12 months had significantly higher scores on the Illness Coherence subscale and significantly lower scores on the Treatment Control subscale.

In order to examine the relationship with illness perceptions and health-related quality of life as indicated by CFQ-R domain scores, we constructed multivariable linear regression models controlling for clinical-demographic factors and symptom burden. Table 3 shows the results of the regression models for the 5 CFQ-R physical health domains. Clinical and demographic characteristics were associated with several CFQ-R physical domain scores, with higher FEV1 associated with higher CFQ-R Physical Functioning scores, higher BMI associated with higher CFQ-R Weight scores, and recent CF pulmonary exacerbations associated with lower scores on CFQ-R Respiratory Symptoms and CFQ-R Eating Disturbances. The addition of MSAS scales to the models revealed a strong association between reported respiratory, GI, and psychological symptom burden and physical CFQ-R scores. In the final models, IPQ-R subscale scores were not associated with physical CFQ-R domains.

Results for the models with CFQ-R psychosocial health domains as outcomes (Table 4) were similar with regards to clinical, demographic, and symptom burden associations. In particular, higher respiratory symptom burden was associated with lower CFQ-R scores in Vitality, Health perceptions, Emotional Functioning, Social Functioning, Role, and Treatment Burden. Higher psychological symptom burden was similarly associated with lower CFQ-R scores in Body Image, Vitality, Health Perceptions, Emotional Functioning, Social Functioning, and Role domains. In these models, addition of IPQ-R scales did result in significant findings. Higher scores on the IPQ-R Consequences subscale were associated with lower CFQ-R scores in the Body Image, Health Perceptions, Emotional Functioning, Social Functioning, Role, and Treatment Burden scales. Higher scores on the IPQ-R Coherence subscale were associated with higher scores on the CFQ-R Emotional Functioning, Social Functioning, and Role domains. Higher scores on the IPQ-R Personal Control subscale were associated with higher scores on CFQ-R Health Perceptions and Emotional Functioning domains. In these models, addition of IPQ-R subscales led to increases in overall model R-square ranging from 0.05 to 0.11.

Discussion

In this study, we have described illness perceptions in a large cohort of adults with CF using a well-validated measure (IPQ-R) (19) based on the components of the Leventhal Illness Perception Model (12) and found that illness perception, particularly the view that CF has

significant consequences on daily life, is associated with psychosocial, but not physical, aspects of health-related quality of life (HRQOL).

Prior research has shown that illness perceptions are associated with numerous health behaviors and outcomes in chronic diseases of childhood onset such as diabetes (20). The IPQ-R has also been utilized in one prior study of adolescents with CF (23). The internal consistency of the IPQ-R in our cohort is higher than that reported in the adolescent study, perhaps due to our larger sample size. It is also possible that the questionnaire is better understood by an adult population or that illness perceptions are being developed during adolescence but are more firmly established by young adulthood. Overall, our data suggests that the IPQ-R is a valid measure for illness perception in adults with CF.

In general, CF is diagnosed either at birth or in the first few years of life, so when an individual with CF reaches adulthood they have had many years to develop their understanding of their illness experience. Therefore, it is not surprising that we found the highest overall scores in the IPQ-R Coherence and Consequences subscales, as these scales are designed to measure the understanding of illness and the reported impact of that illness on daily life. In contrast, our respondents had lower overall scores in the Illness Timeline-Cyclical subscale. This finding likely reflects the variable individual experience of CF, as some adult patients may have frequent symptoms and perceive their illness as present at all times, whereas others may not have many daily symptoms and view their disease as more episodic. As we did not see any age differences in these knowledge and understanding-based subscales, it may be that these illness representations were developed during adolescence or earlier, at a time when treatment burden may have increased in the face of new therapies or development of CF-related complications, although further longitudinal research would be needed to test that hypothesis. If illness perceptions are indeed developed before entering adulthood, then educational interventions designed to address illness behaviors may be best initiated during adolescence or earlier.

Our respondents had generally high scores in the IPQ-R Personal Control subscale, suggesting a belief that personal actions can affect health outcomes. This result is encouraging in light of efforts focusing on self-management skills to promote adherence among adults with CF. In contrast, we found lower average scores in the IPQ-R Treatment Control subscales, particularly in respondents who had experienced a recent pulmonary exacerbation. These lower scores in Treatment Control suggest that some adults with CF, particularly those with frequent life disruptions due to their illness, are concerned that existing therapies may not be able to prevent declines in health. Such beliefs would not be surprising in CF, a progressive disease with no available cure. An individual with low treatment control beliefs might be expected to exhibit poor adherence to prescribed regimens, particularly in the face of a burdensome treatment regimen which is focused on prevention rather than immediate relief of symptoms. We are limited in our ability to evaluate the connection between illness perception and adherence as we did not include a direct assessment of adherence in our study. If the relationship between treatment control and adherence behavior is confirmed by further research, then programs to improve adherence may be more effective if they directly address the beliefs surrounding treatment control (27).

Our current study focuses on the relationship between illness perception and HRQOL. In order to assess for the possible independent contribution of illness perception to HRQOL, we controlled for clinical and demographic factors previously known to impact HRQOL, particularly lung function, gender, frequency of exacerbations and overall symptoms burden (3,7-9). Other co-morbidities in CF, including CF-related diabetes and depression, may impact the relationship between illness perception and HRQOL, but these were not assessed

in our data. In our models, we found that illness perceptions were not associated with physical domains of HRQOL. This suggests that views on the illness experience do not contribute to an individual's reported physical health in addition to the expected contributions of health status and daily symptoms. However, we did find interesting relationships between several facets of illness perception and psychosocial domains of HRQOL. Perceiving greater consequences of illness was associated with decreased HRQOL in six of the seven psychosocial domains measured. Conversely, perceiving greater personal control over illness and perceiving a greater understanding of illness was associated with increased psychosocial HRQOL in areas such as overall health perceptions, and social and emotional well-being. Prior research has identified a relationship between external control beliefs coming from physicians and treatment adherence in CF (28). Our findings suggest that personal beliefs have an additional impact over psychosocial well-being in adults with CF and mirror other studies in psychosocial health in CF which have demonstrated the importance of coping and social support in improved health outcomes (6,29). As assessment of HRQOL, using instruments such as the CFQ-R, becomes more common in routine clinical monitoring of patients with CF, clinicians need to be aware of how HRQOL can be affected and modified by individual illness perception. In this way, changes in HRQOL may be followed by interventions assessing and incorporating illness perception into overall CF self-management strategies.

In summary, we have identified a link between illness perceptions and health outcomes in adults with CF. Efforts to modify illness perceptions during routine clinical care and counseling may lead to improved quality of life for adults with CF. Such improvements in psychological HRQOL in adults with CF may strengthen the relationships of an adult with CF and their caregivers and potentially improve adherence and disease self-management skills.

Acknowledgments

Supported by a grant from the National Heart, Lung, Blood Institute (R01 HL72938). Results from this study were presented in abstract form at the 2009 North American Cystic Fibrosis Conference, Minneapolis, MN.

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Table I
PAC-CF Respondent Demographic and Clinical Characteristics

	Summary Statistics *
Number of Respondents (n)	199
Female (%)	123 (62%)
Age (years) (Mean $\pm$ SD)	35.8 $\pm$ 10.3
Maximum FEV ₁ (% predicted) in 2007 (Mean $\pm$ SD)	62.5% $\pm$ 22.8%
FEV ₁ <40% predicted	41 (21%)
FEV ₁ 40-69% predicted	94 (47%)
FEV ₁ $\geq$ 70% predicted	47 (24%)
Body Mass Index (Mean $\pm$ SD)	22.2 $\pm$ 4.0
CF Pulmonary Exacerbations in 2007 (%)	
None	94 (47%)
One or More	105 (53%)
Pseudomonas aeruginosa positive ** (%)	153 (77%)
Burkholderia cepacia complex positive ** (%)	16 (8%)

* Descriptive statistics were calculated using sample selection weights to adjust for the disproportionate stratified sampling design.

** Respiratory culture data reflects at least one documented positive culture from any year in 2005-2007

Table II

Illness Perception Questionnaire-Revised (IPQ-R) Scale Scores

	IPQ-R Scale			
	Illness Consequences	Illness Coherence	Timeline-Cyclical	Treatment Control
Overall	3.8 ± 0.6	3.9 ± 0.8	3.3 ± 0.7	3.4 ± 0.4
Cronbach's alpha	0.74	0.89	0.69	0.78
<i>Demographic Characteristics</i>	<i>Mean (SD)</i>	<i>Mean (SD)</i>	<i>Mean (SD)</i>	<i>Mean (SD)</i>
Male	3.8 (0.6)	3.9 (0.8)	3.2 (0.6)	3.3 (0.4)
Female	3.8 (0.6)	3.9 (0.8)	3.4 (0.7)	3.4 (0.4)
18-24 years	4.0 (0.6)	3.9 (1.1)	3.3 (0.9)	3.6 (0.5)
25-34 years	3.8 (0.6)	3.9 (0.6)	3.4 (0.6)	3.3 (0.5)
35-44 years	4.0 (0.7)	4.1 (0.8)	3.3 (0.7)	3.3 (0.4)
45+ years	3.7 (0.7)	3.8 (0.8)	3.3 (0.7)	3.4 (0.4)
FEV1 <40	4.0 (0.6)	4.0 (0.7)	3.3 (0.6)	3.2 (0.3)
FEV1 40-69	3.8 (0.6)	4.1 (0.6)	3.3 (0.7)	3.3 (0.4)
FEV1 ≥70	3.9 (0.8)	3.8 (1.1)	3.4 (0.8)	3.4 (0.5)
>1 CF Exacerbation in past 12 months	3.9 (0.5)	4.1 (0.7)*	3.4 (0.6)	3.3 (0.4)*
No CF Exacerbations in past 12 months	3.8 (0.8)	3.8 (0.9)	3.3 (0.8)	3.4 (0.4)

* Bold values reflect statistically significant group differences ($p < 0.05$) using t-test or ANOVA to compare mean IPQ-R scale scores based on respondent gender, age, lung function or frequency of CF exacerbations.

Table III

Multivariable Linear Regression Models for CFQ-R Physical Domain Scores*

		CFQ-R Domain Score				
		Digestive Symptoms	Weight	Eating Disturbances	Respiratory Symptoms	Physical Functioning
Model 1						
Female Gender						-11.8
Age						0.4
Maximum FEV1			3.0			
Body Mass Index				-7.6	-7.3	
1 or more exacerbations						
+B. cepacia						
+P. aeruginosa						
R-square		0.01	0.22	0.11	0.13	0.25
Model 2						
MSAS Respiratory Symptoms		-7.9	8.9		-20.4	-17.7
MSAS GI Symptoms			-30.9	-19.8		
MSAS Psychological Symptoms		-4.1		-4.0	3.8	
R-square added		0.19	0.17	0.37	0.42	0.22
Model 3						
IPQ-R Consequences						
IPQ-R Coherence						
IPQ-R Cyclical						
IPQ-R Personal Control						
IPQ-R Treatment Control						
R-square added		0	0	0	0	0
N	190	171	176	170	175	
Model 3 R-square	0.20	0.39	0.48	0.55	0.47	

* Results shown are the significant ($p < 0.05$) beta-estimates for covariates in regression models predicting CFQ-R domain scores. All models control for predicted survivorship score in order to account for stratified sampling design of PAC-CF. Model 1 includes only the clinical and demographic covariates listed in the table. Model 2 includes the 3 MSAS scale scores and all clinical/demographic covariates that were significant ($p < 0.05$) in Model 1. Model 3 includes all IPQ-R scale scores and the significant covariates ($p < 0.05$) from Model 2.

Table IV

Multivariable Linear Regression Models for CFQ-R Psychosocial Domains*

		CFQ-R Domain Score						
		Body Image	Vitality	Health Perceptions	Emotional Functioning	Social Functioning	Role	Treatment Burden
Model 1								
Female Gender		17.7						0.34
Age								
Max FEV1			0.58					
BMI		2.0						
1 or more exacerbations		-8.4					-8.2	
+ <i>B. cepacia</i>							-11.1	
+ <i>P. aeruginosa</i>								
R-square		0.24	0.13	0.15	0.03	0.002	0.15	0.04
Model 2								
MSAS Respiratory Symptoms			-16.8	-12.4	-3.8	-7.4	-9.7	-5.6
MSAS GI Symptoms	-10.8						-5.5	
MSAS Psychological Symptoms	-5.8		-3.2	-3.7	-12.7	-4.7	-4.0	
R-square added	0.14	0.42	0.31	0.54	0.36	0.31	0.12	
Model 3								
IPQ-R Consequences	-6.6			-10.2	-5.9	-10.3	-7.4	-11.3
IPQ-R Coherence					3.7	5.6	5.6	
IPQ-R Cyclical						4.3		
IPQ-R Personal Control				6.0	4.9			
IPQ-R Treatment Control								
R-square added	0.02	0	0.05	0.07	0.11	0.05	0.09	
N	174	175	171	192	188	173	188	
Model 3 R-square	0.40	0.55	0.51	0.64	0.47	0.52	0.25	

* Results shown are the significant ($p < 0.05$) covariates in regression models predicting CFQ-R domain scores. All models control for predicted survivorship score in order to account for stratified sampling design of PAC-CF. Model 1 includes only the clinical and demographic covariates listed in the table. Model 2 includes the 3 MSAS scale scores and all clinical/demographic covariates that were significant ($p < 0.05$) in Model 1. Model 3 includes all IPQ-R scale scores and the significant covariates ($p < 0.05$) from Model 2.