

## Association between Chronic Rhinosinusitis and Health-Related Quality of Life in Adults with Cystic Fibrosis

Al-Rahim R. Habib<sup>1,2</sup>, Jane A. Buxton<sup>1</sup>, Joel Singer<sup>1</sup>, Pearce G. Wilcox<sup>3</sup>, Amin R. Javer<sup>2,\*</sup>, and Bradley S. Quon<sup>3,\*</sup>

<sup>1</sup>School of Population and Public Health, <sup>2</sup>Division of Otolaryngology, St. Paul's Sinus Centre, and <sup>3</sup>Division of Respiriology, Department of Medicine, St. Paul's Hospital, University of British Columbia, Vancouver, British Columbia, Canada

ORCID ID: 0000-0003-2295-393X (J.A.B.).

### Abstract

**Rationale:** Over the past four decades, the median age of survival has nearly doubled for individuals living with cystic fibrosis (CF). Chronic diseases such as chronic rhinosinusitis increase in prevalence with age. In the non-CF population, chronic rhinosinusitis is associated with reduced health-related quality of life.

**Objectives:** Our objectives were to determine the prevalence of chronic rhinosinusitis among adults with CF and to evaluate the impact of chronic rhinosinusitis on health-related quality of life.

**Methods:** Individuals from a large academic teaching hospital in Vancouver, British Columbia, Canada, were eligible to participate in this cross-sectional study. Included subjects were at least 19 years of age, had a confirmed diagnosis of CF, and attended the CF clinic between September 2013 and April 2014. Participants completed a CF-specific health-related quality of life questionnaire (the Cystic Fibrosis Questionnaire-Revised for adolescents and adults over 14 years of age [CFQ-R 14+]) and underwent symptom and endoscopic assessment for diagnosis of chronic rhinosinusitis. Medical charts were reviewed for potential confounders, including sociodemographic (age, sex, and body mass index) and clinical (age at CF diagnosis, type of CF mutation, lung function, and chronic *Pseudomonas aeruginosa* infection) factors. Multivariable linear regression was used to model the relationship between chronic

rhinosinusitis and CFQ-R 14+ domains, adjusted for potential confounders.

**Measurements and Main Results:** A total of 121 individuals were contacted in the clinic, of whom 113 (93.4%) consented to participate. The prevalence of chronic rhinosinusitis was found to be 59.2% (95% confidence interval [CI], 49.6–68.2%). Sociodemographic and clinical factors were similarly distributed between chronic rhinosinusitis-positive and chronic rhinosinusitis-negative groups. Lung function, as measured by FEV<sub>1</sub> (% predicted value), did not significantly differ between participants with versus those without chronic rhinosinusitis (mean difference, 2.0%; 95% CI, –8.1% to 13.0%). Following adjustment for sex and lung function, individuals with chronic rhinosinusitis reported significantly worse scores on the respiratory symptoms domains compared with their counterparts without chronic rhinosinusitis (regression coefficient, –3.93; 95% CI, –8.02 to 0.15).

**Conclusions:** The majority of adults with CF have evidence of concomitant chronic rhinosinusitis. Chronic rhinosinusitis is independently associated with worse respiratory symptom on the CFQ-R 14+. Chronic rhinosinusitis should be diagnosed and managed to optimize the health-related quality of life of adults with CF.

Clinical trial registered with clinicaltrials.gov (NCT02003079).

**Keywords:** cystic fibrosis; quality of life; sinusitis

(Received in original form April 5, 2015; accepted in final form May 14, 2015)

\*Co-senior authors.

Prior abstract publication and poster presentation at the 2014 North American Cystic Fibrosis Conference, October 9–11, 2014, Atlanta, GA.

**Author Contributions:** A.-R.R.H.: study design, data collection, statistical analysis, interpretation of data, drafting and revision of the manuscript, and final approval of the manuscript version to be published; J.A.B.: study design, revision of the manuscript, and final approval of the manuscript version to be published; J.S.: study design, statistical analysis, and revision of the manuscript; P.G.W.: revision of the manuscript and final approval of the manuscript version to be published; A.R.J.: study design, revision of the manuscript, and final approval of the manuscript version to be published; and B.S.Q.: study design, interpretation of data, drafting and revision of the manuscript, and final approval of the manuscript version to be published.

Correspondence and requests for reprints should be addressed to Al-Rahim R. Habib, M.Sc., St. Paul's Sinus Centre, 1081 Burrard Street, Vancouver, BC, V6Z 1Y6 Canada. E-mail: arhabib9@gmail.com

Ann Am Thorac Soc Vol 12, No 8, pp 1163–1169, Aug 2015

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DOI: 10.1513/AnnalsATS.201504-191OC

Internet address: www.atsjournals.org

The age demographic of individuals living with cystic fibrosis (CF) has shifted over the past four decades. Recent estimates indicate the median age of survival has nearly doubled and that over half of individuals living with CF are adults (age  $\geq 18$  yr) (1–4). In parallel, the prevalence of extrapulmonary comorbidities is also rising. These include chronic rhinosinusitis, CF-related diabetes, CF-related liver disease, bone disease, arthropathy, and anxiety and/or depression (1–3).

Chronic rhinosinusitis is an inflammatory and infectious disease of the paranasal sinuses. It is characterized by five major symptoms lasting for at least 12 weeks: nasal congestion, facial pain or pressure, nasal obstruction, anterior or posterior nasal discharge, and loss of smell (5, 6). Objectively, chronic rhinosinusitis is characterized by the presence of nasal polyps, discolored mucus, and pus or inflammation in the middle meatus (7). In the non-CF population, the prevalences of chronic rhinosinusitis have been estimated to range from 14% to 16% in the United States and to be 5% in Canada (8–10). However, the prevalence of chronic rhinosinusitis is estimated to be four- to fivefold higher in those with CF (11). Individuals without CF who have chronic rhinosinusitis have previously reported significantly worse health-related quality of life scores compared with their counterparts without chronic rhinosinusitis (12, 13). When compared with the impact of other chronic diseases, individuals with chronic rhinosinusitis report significantly more bodily pain and limitations in social functioning than individuals with congestive heart failure, chronic obstructive pulmonary disease, angina, and chronic back pain (17). Moreover, chronic rhinosinusitis has been associated with depressive symptoms, increased frequency of visiting a mental health professional, and greater use of antidepressants and sleeping pills (14).

The impact of chronic rhinosinusitis on health-related quality of life in the CF population remains understudied. In prior studies of the impact of chronic rhinosinusitis on health-related quality of life in CF, researchers have used instruments that are not CF-specific (i.e., Rhinosinusitis Disability Index and Chronic Sinusitis Survey) (15). The findings of these studies thus may not be applicable to the CF population, as these instruments are insensitive to the unique challenges and

complexities of living with a lifelong genetic disease. Therefore, investigating the effect of chronic rhinosinusitis on health-related quality of life using a CF-specific instrument is warranted. Currently, the Cystic Fibrosis Questionnaire-Revised for adolescents and adults over 14 years of age (CFQ-R 14+) is considered the gold standard to measure health-related quality of life in adults with CF (16).

The purpose of this study was to evaluate the impact of chronic rhinosinusitis on health-related quality of life using the CFQ-R 14+. It was hypothesized that adults with CF who have chronic rhinosinusitis would report significantly worse health-related quality of life than their counterparts without chronic rhinosinusitis, specifically on the respiratory symptom domain of the CFQ-R 14+. Some of the findings described in this article have been reported previously in the form of an abstract (17).

## Methods

### Study Population

The target population for this cross-sectional study was adults ( $\geq 19$  yr of age) with an established diagnosis of CF based on standard criteria (18) who were enrolled at the St. Paul's Cystic Fibrosis Clinic in Vancouver, British Columbia, Canada, between September 2013 and April 2014. Ethical approval was obtained from the University of British Columbia Clinical Research Ethics Board, and all subjects included in the study provided written informed consent (approval number H13-01848).

### Conduct of Study

Individuals who provided consent were given paper copies of the CFQ-R 14+ to complete during their routine visits. Participants who elected to undergo nasal endoscopy were directed to the St. Paul's Sinus Centre, also located at St. Paul's Hospital. An otorhinolaryngologist (A.R.J.) performed a standard nasal assessment that included an interview about sinus-related symptoms, history of treatment, and nasal endoscopy.

### Predictor Measurement: Diagnosis of Chronic Rhinosinusitis

Chronic rhinosinusitis was diagnosed based on the Canadian Clinical Practice

Guidelines for Acute and Chronic Rhinosinusitis, which recommend the presence of at least two major symptoms (nasal congestion, facial pain or pressure, nasal obstruction, anterior or posterior nasal discharge, and loss of sense of smell) for at least 12 weeks and at least one objective clinical finding (7). Objective findings were evaluated using a 3.0-mm nasal endoscope (Karl Storz GmbH and Co. KG, Tuttlingen, Germany) to identify nasal polyps, discolored mucus, and pus or inflammation within the middle meatus. The middle meatus was visualized by direct endoscopy and findings were recorded on individualized data collection forms. For individuals who refused nasal endoscopy, clinically requested sinus computed tomographic (CT) scans (i.e., up to 1 year before the conduct of the research study) were reviewed for diagnostic purposes to support the objective component of the chronic rhinosinusitis diagnosis. If sinus CT scans were unavailable, previous history of sinus surgery or nasal polypectomy was evaluated. This was decided following consultation with clinical experts, as clinical experience to date suggests that individuals with CF and a history of sinus surgery are not cured of their disease and often require chronic sinus-related treatment postsurgery.

### Outcome Measurement: Health-Related Quality of Life

The CFQ-R 14+ was used to measure health-related quality of life among study participants (19). This is a validated, disease-specific instrument used to assess health-related quality of life in adolescents and adults with CF ages 14 years and older (20, 21). The U.S. Food and Drug Administration has recommended the use of the respiratory symptoms domain as an endpoint in CF-related clinical trials (16).

### Covariates

Covariate data collected included age (in years); sex (male or female); currently employed or attending school (yes or no); body mass index (in kilograms per square meter); age at CF diagnosis (in years); classes I to III *CFTR* mutations (yes or no) (11); lung function (FEV<sub>1</sub> [% predicted]); and chronic *Pseudomonas aeruginosa* infection, defined as three positive sputum cultures within 6 months before enrollment (yes or no) (22). Additional categorical binary variables recorded were pancreatic

insufficiency, history of lung transplant, and current use of antidepressants.

### Statistical Analysis

To determine sample representativeness, sociodemographic (age, sex) and clinical factors (BMI, FEV<sub>1</sub> [% predicted], age at CF diagnosis) were compared between the study sample and the clinic-specific data collected for the purposes of the Cystic Fibrosis Canada Registry. Bivariable analysis was performed to compare sociodemographic and clinical factors between individuals with versus those without chronic rhinosinusitis, as well as to evaluate CFQ-R 14+ domain scores between individuals with versus those without chronic rhinosinusitis. This included summarizing continuous variables (mean  $\pm$  SD or median and interquartile range) and use of Student's *t* test and the Wilcoxon rank-sum test for parametric and nonparametric variables, respectively. Categorical variables were summarized by absolute frequencies, and significance tests used included the  $\chi^2$  test and Fisher's exact test if expected cell counts were less than 5. A type I error rate of less than 0.05 was considered statistically significant, and corresponding 95% confidence intervals (CIs) were reported.

Linear regression was used to model the relationship between chronic rhinosinusitis status and CFQ-R 14+ domain scores. Simple linear regression estimated the difference in domain scores between participants with versus those without chronic rhinosinusitis, without adjustment for potential confounders. Following this analysis, multivariate linear regression was used to estimate the difference in domain scores between participants with versus those without chronic rhinosinusitis, following adjustment for sex, FEV<sub>1</sub> (% predicted), and *CFTR* genotype grouping. These factors were selected for adjustment *a priori* because they were considered confounders and would minimize collinearity between the covariates. Regression parameters, including regression coefficients ( $\beta$ ), SEs, and degrees of freedom, were reported for adjusted models. Statistical analysis was completed using SAS Version 9.4 software (SAS Institute, Cary, NC).

### Sample Size

A sample size calculation was performed to determine the number of patients required

to compare scores on the respiratory symptoms domain of the CFQ-R 14+ between those with versus those without chronic rhinosinusitis. Consultation with clinical experts suggested a relative difference of 15% on this domain would be clinically significant. To determine the appropriate number of participants required, a sample size calculation comparing continuous variables between two independent samples, a type I error rate of 5% and a type II error rate of 20% were used. Published estimates of clinically stable participants from a previously conducted, national, multicenter study were used as the reference mean and SD values (21). The calculation indicated that a sample size of 38 participants per group would be sufficient to achieve statistical power of 80%. Although we could not predict the exact proportion of individuals with chronic rhinosinusitis, a target of at least 100 participants was more than sufficient to provide adequate power.

## Results

### Participant Recruitment

A total of 121 individuals were approached in the CF clinic between September 2013 and April 2014, of whom 113 (93.4%) provided informed consent and 8 (6.6%) refused to participate. Of the 113 patients who provided informed consent, 103 (91.2%) completed the questionnaires and 67 (59.3%) underwent endoscopy. Figure 1 describes the frequency of individuals approached, refusing to participate, and completing study questionnaires. The study sample was representative of the total clinic population when compared with previously collected, clinic-specific CF Registry data in terms of age (35.9 yr in sample population vs. 36.1 yr in clinic population), sex (66.0% males in sample population vs. 57.5% males in clinic population), body mass index (23.4 kg/m<sup>2</sup> in sample population vs. 22.6 kg/m<sup>2</sup> in clinic population), FEV<sub>1</sub> (73.9% of predicted in sample population vs. 73.1% of predicted in clinic population), and mean age at CF diagnosis (9.4 yr in sample population vs. 9.0 yr in clinic population).

### Prevalence of Chronic Rhinosinusitis

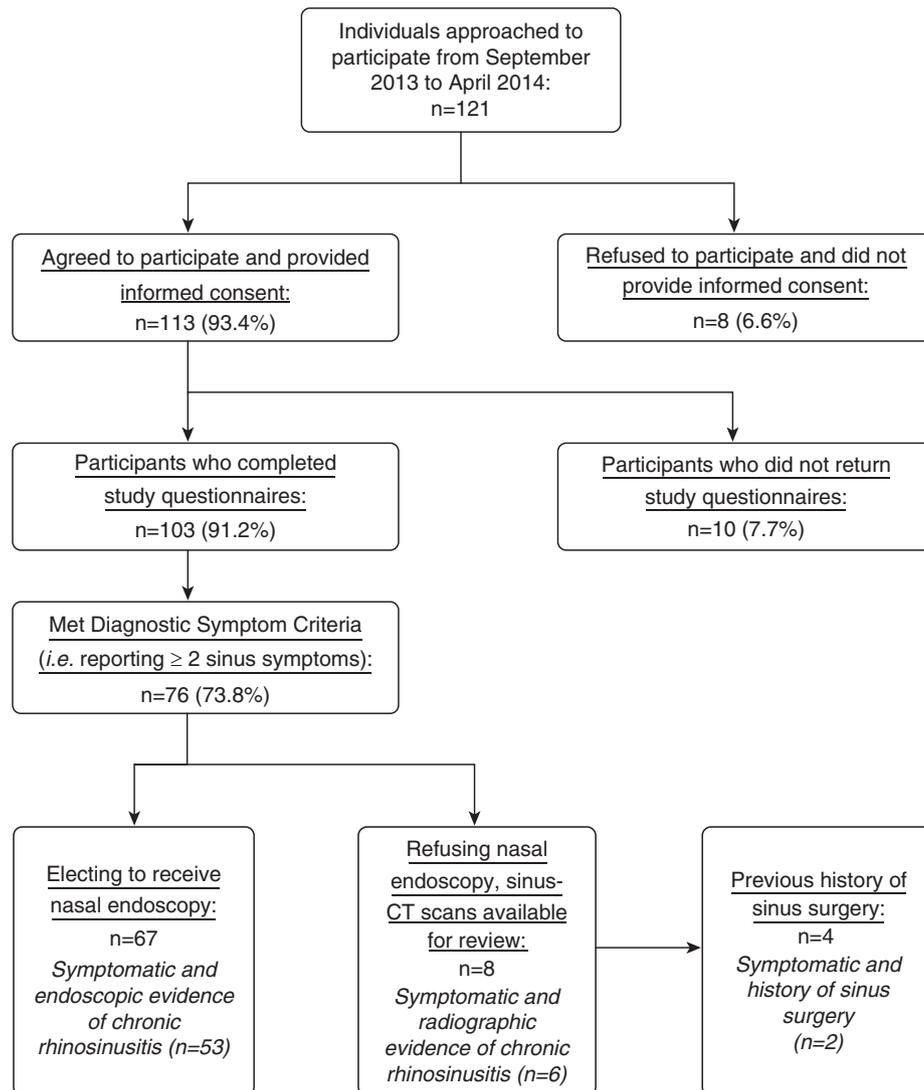
**Subjective criteria.** A total of 76 (73.8%) of 103 (95% CI, 64.6–81.3%) participants were

symptomatic for chronic rhinosinusitis, reporting at least two sinus symptoms in the past 12 weeks. The most common sinus symptoms reported were nasal congestion (71.2%; 95% CI, 61.8–79.0%), anterior or posterior nasal discharge (64.4%; 95% CI, 54.9–73.0%), and loss of sense of smell or taste (56.7%; 95% CI, 47.1–65.8%). Among individuals reporting chronic rhinosinusitis symptoms (*n* = 76), 60 (78.9%) had previously visited an otolaryngologist (<2 years ago: *n* = 37; 2–5 years ago: *n* = 8; >5 years ago: *n* = 15), 29 (38.2%) were using intranasal corticosteroid sprays, and 32 (42.1%) were using saline irrigation at the time of their interview.

**Objective criteria.** Of the 67 patients who underwent nasal endoscopy, there was evidence of chronic rhinosinusitis in 53 participants (79.1%; 95% CI: 67.9–87.1%). Of the remaining 36 patients who did not undergo endoscopy, 8 had evidence of chronic rhinosinusitis based on sinus CT scans (6 symptomatic, 2 asymptomatic). Of the 28 patients who did not undergo endoscopy or sinus CT, 4 reported a history of sinus surgery (2 symptomatic, 2 asymptomatic).

**Standardized diagnostic criteria for chronic rhinosinusitis.** Incorporating both subjective and objective findings, the prevalence of chronic rhinosinusitis was 61 (59.2%) of 103 or (95% CI: 49.6–68.2%). Among the 61 individuals considered chronic rhinosinusitis-positive, the presence of two or more sinus symptoms and objective evidence of chronic rhinosinusitis were observed (endoscopic evidence: *n* = 53; radiographic evidence if endoscopy was refused: *n* = 6; previous history of sinus surgery if endoscopy was refused and sinus CT scans were unavailable: *n* = 2). Fifty-one individuals (83.6%) identified as having chronic rhinosinusitis had previously visited an otolaryngologist (<2 years ago: *n* = 28; 2–5 years ago: *n* = 8; >5 years ago: *n* = 15), 23 (37.8%) were using intranasal corticosteroid sprays, and 31 (60.8%) were using saline irrigation at the time of their interview.

Among participants considered chronic rhinosinusitis-negative (*n* = 42), 15 were symptomatic and 27 were asymptomatic. Of the 15 participants who were symptomatic, there was no evidence of chronic rhinosinusitis based on endoscopy (*n* = 9), sinus CT scans (*n* = 3), or previous history of sinus surgery if endoscopy was refused and sinus CT scans were unavailable (*n* = 3). Of the 27 asymptomatic



**Figure 1.** Description of number and frequency of individuals eligible, approached, participating, refusing to participate, and completing study questionnaires and nasal endoscopy for this cross-sectional study of the relationship between chronic rhinosinusitis and health-related quality of lifehealth-related quality of life in adults with cystic fibrosis. CT = computed tomographic.

individuals, objective evidence of chronic rhinosinusitis was visualized with endoscopy ( $n = 9$ ), sinus CT scans ( $n = 3$ ), and previous history of sinus surgery if endoscopy was refused or sinus CT scans were unavailable ( $n = 2$ ).

### Sociodemographic and Clinical Factors

The study sample was composed primarily of males (66.0%), and the mean age of participants was  $35.9 \pm 12.9$  years. The median age at CF diagnosis was 3.0 years (IQR: 0.5–11.8), and 70.8% had classes I–III genetic mutations. Mean lung function, as measured by percentage of predicted FEV<sub>1</sub>, was  $73.7 \pm 25.9\%$ . Chronic *P. aeruginosa*

infection was identified in 39.8% of participants, 19.2% were currently using antidepressants at the time of enrollment, and 12.6% had previously undergone bilateral lung transplant.

As shown in Table 1, no significant differences were found between individuals with or without chronic rhinosinusitis with regard to any sociodemographic or clinical factors. Percentage of predicted FEV<sub>1</sub> did not significantly differ between participants with versus those without chronic rhinosinusitis (mean difference, 2.0%; 95% CI,  $-8.1$  to  $13.0\%$ ). Participants with chronic rhinosinusitis had an earlier diagnosis of CF than chronic rhinosinusitis-negative counterparts

(median age: 2.0 vs. 4.3 yr, respectively); however, this finding was not significant ( $P = 0.17$ ).

### Association between Chronic Rhinosinusitis and CFQ-R 14+ Domain Scores

CFQ-R 14+ domain scores are stratified by chronic rhinosinusitis status in Table 2, and unadjusted and adjusted linear regression results are provided in Table 3. In the unadjusted linear regression analysis, CFQ-R 14+ scores of chronic rhinosinusitis-positive participants were significantly worse on the respiratory symptoms domain (mean difference,  $-4.34$ ; 95% CI,  $-8.49$  to  $-0.17$ ;  $P = 0.03$ ) than

**Table 1.** Comparison of sociodemographic factors and clinical characteristics between participants with or without chronic rhinosinusitis

	Chronic Rhinosinusitis–Positive (n = 61)	Chronic Rhinosinusitis– Negative (n = 42)	P Value
Age (yr)	34.9 (11.9)	37.2 (14.5)	0.40
Males	39 (64%)	29 (69%)	0.42
Age at diagnosis of cystic fibrosis (yr)	2.0 (0.5–9.0)	4.3 (0.4–17.5)	0.17*
Genotype (classes I–III mutations)	45 (74%)	28 (67%)	0.42
FEV <sub>1</sub> (% predicted)	74.5 (24.3)	72.5 (28.5)	0.71
Body mass index (kg/m <sup>2</sup> )	23.8 (3.6)	22.8 (3.4)	0.15
Pancreatic insufficiency	46 (75%)	30 (74%)	0.65
Chronic <i>Pseudomonas aeruginosa</i> infection	27 (44%)	14 (33%)	0.22
Use of antidepressants	15 (25%)	5 (12%)	0.10†
Employed or attending school	36 (59%)	28 (67%)	0.43
History of lung transplant	9 (15%)	4 (10%)	0.43†

Data are presented as mean (SD), number (%), or median (interquartile range).

\*Nonparametric Wilcoxon rank-sum test.

†Nonparametric Fisher's exact test.

scores of individuals without chronic rhinosinusitis. In multivariable linear regression following adjustment for sex, percentage of predicted FEV<sub>1</sub>, and genotype, the respiratory symptoms domain continued to be the only domain that significantly differed between participants with and those without chronic rhinosinusitis (regression coefficient,  $-3.93$ ; 95% CI,  $-8.02$  to  $-0.15$ ;  $P = 0.04$ ).

## Discussion

In this large adult CF sample, the prevalence of chronic rhinosinusitis was similar to rates

reported in prior studies (11, 23). Chronic rhinosinusitis is a highly prevalent chronic condition in the CF population, yet there remains a paucity of evidence available to evaluate its impact on health-related quality of life using CF-specific instruments.

Previously, non-CF-specific instruments, such as the Rhinosinusitis Disability Index and the Chronic Sinusitis Survey, have been used to assess chronic rhinosinusitis-specific health-related quality of life in adults with CF undergoing functional endoscopic sinus surgery (FESS).

Preoperative scores did not differ significantly between participants with and those without CF (15). However, a comparison with adults with CF who do

not have chronic rhinosinusitis is required to determine the impact of chronic rhinosinusitis on health-related quality of life in CF. Given that individuals with CF have been shown to respond differently from those without CF on generic Health-related quality of life instruments (24), the use of a CF-specific questionnaire may be more appropriate for evaluating this relationship. The objective of the present study was to identify sociodemographic and clinical factors associated with chronic rhinosinusitis status and determine their effect on health-related quality of life.

Although lung function did not significantly differ between participants with and those without chronic rhinosinusitis,

**Table 2.** Descriptive summary of domain scores for study participants who completed the CFQ-R 14+ based on chronic rhinosinusitis status

CFQ-R 14+ Domain	Chronic Rhinosinusitis–Positive (n = 61)	Chronic Rhinosinusitis–Negative (n = 42)	P Value
Physical functioning	63.8 (29.5)	64.8 (30.1)	0.87*
Vitality	51.9 (21.7)	54.8 (24.1)	0.53
Emotion	72.0 (15.1)	72.1 (21.7)	0.99
Social functioning	62.4 (18.3)	64.0 (19.9)	0.67
Role functioning	74.1 (19.3)	75.5 (22.2)	0.74
Eating disturbances	85.6 (19.7)	87.3 (23.1)	0.69*
Body image	75.5 (23.9)	68.3 (29.4)	0.17
Treatment burden	63.6 (23.2)	63.8 (22.9)	0.97
Health perception	58.1 (23.2)	59.7 (22.9)	0.74
Respiratory symptoms	61.8 (21.8)	70.5 (19.6)	0.04
Digestion	77.4 (22.1)	83.4 (14.8)	0.13*
Weight	76.0 (35.0)	66.7 (39.7)	0.21*

Definition of abbreviation: CFQ-R 14+ = Cystic Fibrosis Questionnaire-Revised for adolescents and adults over 14 years of age.

Data are presented as mean (SD) scores.

\*Nonparametric Wilcoxon rank-sum test.

**Table 3.** Unadjusted and adjusted linear regression  $\beta$ -coefficients comparing CFQ-R 14+ domain scores between participants with and those without chronic rhinosinusitis

CFQ-R 14+ Domains	Unadjusted Linear Regression*		Adjusted Linear Regression†	
	$\beta$ (SE)	P Value	$\beta$ (SE)	P Value
Physical functioning	-0.48 (2.98)	0.87	-2.59 (2.63)	0.33
Vitality	-1.42 (2.28)	0.53	-2.95 (2.23)	0.19
Emotion	-0.02 (1.81)	0.99	-2.00 (1.76)	0.26
Social functioning	-0.81 (1.91)	0.67	-2.80 (1.88)	0.14
Role functioning	-0.69 (2.06)	0.74	-3.13 (1.99)	0.12
Eating disturbances	-0.84 (2.12)	0.69	-1.87 (2.31)	0.42
Body image	3.63 (2.64)	0.17	2.59 (2.68)	0.34
Treatment burden	-0.09 (2.31)	0.97	-1.06 (2.38)	0.66
Health perception	-0.77 (2.31)	0.74	-2.42 (2.24)	0.28
Respiratory symptoms	-4.34 (2.09)	0.03	-3.93 (2.06)	0.04
Digestion	-2.96 (1.95)	0.11	-3.49 (2.03)	0.06
Weight	4.65 (3.70)	0.21	3.06 (3.60)	0.40

*Definition of abbreviation:* CFQ-R 14+ = Cystic Fibrosis Questionnaire-Revised for adolescents and adults over 14 years of age.

\*The reference group in the unadjusted linear regression analysis comprised chronic rhinosinusitis-negative participants.

†Adjusted for sex, FEV<sub>1</sub> (% predicted), and genotype. The reference group in the adjusted linear regression analysis comprised chronic rhinosinusitis-negative participants, females, and genotypes other than classes I-III.

those with chronic rhinosinusitis reported significantly worse scores on the respiratory symptoms domain of the CFQ-R 14+. The difference in scores on the respiratory symptoms domain was expected, as some of the items could be sinus-related. For example, this domain comprises five questions related to congestion, daytime coughing, waking up from coughing, mucus color resulting from coughing, wheezing, and trouble breathing. Nasal congestion is a characteristic symptom of chronic rhinosinusitis, and posterior nasal discharge may contribute to coughing both during the day and at night. This finding persisted despite adjustment for sex, lung function, and *CFTR* genotype, suggesting that the difference in scores is likely attributable to the presence of chronic rhinosinusitis. There was a trend toward increased symptomatology pertaining to gas, diarrhea, and abdominal pain (i.e., digestion) in those individuals with chronic rhinosinusitis compared with those without, but this association was not significantly different.

This study is limited by its cross-sectional design. First, it is unclear if health-related quality of life was lower as a result of chronic rhinosinusitis or if health-related quality of life was already reduced before the diagnosis of chronic rhinosinusitis. Longitudinal studies would be required to clarify cause and effect. Second, to prevent

potential bias in the diagnosis of chronic rhinosinusitis, standardized guidelines were used to diagnose chronic rhinosinusitis. However, these guidelines were developed for individuals without CF, and it is uncertain if interpretations of symptomatology are similar between CF and non-CF populations. CF is often diagnosed at birth, and individuals learn to cope with their symptoms as they grow older. This may limit the ability of individuals to note changes in symptoms as they constantly adapt to a higher baseline level of symptoms. Currently, a guideline for diagnosis of CF-specific chronic rhinosinusitis is not available. Endoscopic evidence of chronic rhinosinusitis was visualized among participants considered chronic rhinosinusitis-negative, as these individuals did not report concurrent symptoms. Therefore, the true prevalence of chronic rhinosinusitis in adults with CF may be underestimated in this study. This may reflect that the threshold of symptomatology (in both presence and severity) used for individuals without CF may not be suitable for adults with CF.

Despite the high prevalence of chronic rhinosinusitis in adults with CF, current evidence remains controversial regarding the optimal management strategy (25–27). Medical treatment with topical nasal steroids has previously been shown to improve symptoms, reduce inflammation,

and shrink nasal polyps (28). Interestingly, in the present study, the majority of patients with symptoms or who met the diagnostic criteria for chronic rhinosinusitis were not using medical therapy. Alternatively, obstructed sinus ostia can be opened with FESS. Evidence to date suggests that FESS can moderately reduce the incidence of pulmonary exacerbations and improve chronic rhinosinusitis-specific Health-related quality of life (29, 30). However, few studies have used the CFQ-R 14+ to measure changes in Health-related quality of life before and after chronic rhinosinusitis-related treatment. Aanaes and colleagues found that individuals receiving sinus surgery reported significant improvements in total CFQ-R 14+ scores up to 6 months after this procedure compared with preoperative scores (30). In future studies, researchers evaluating sinus interventions should stratify total scores by CFQ-R 14+ domain to determine which interventions improve the respiratory symptoms domain.

In the present study, the majority of individuals who met the diagnostic criteria for chronic rhinosinusitis had last visited an otolaryngologist over 2 years before inclusion. This suggests that patients who present with symptoms and subsequently with chronic rhinosinusitis are infrequently followed. CF care providers may find utility in chronic rhinosinusitis-specific questionnaires to aid identification of patients for whom more detailed sinonasal assessment is warranted, also given the adverse impact of chronic rhinosinusitis on the respiratory symptoms domain of the CFQ-R 14+. The Sinonasal Outcomes Test 22 is a chronic rhinosinusitis-related questionnaire that is composed of 22 items related to major and associated symptoms of chronic rhinosinusitis. This questionnaire has previously been shown to differentiate between individuals with chronic rhinosinusitis and healthy controls without chronic rhinosinusitis (31).

The changing age demographic of the CF population and the increasing prevalence of age-related chronic diseases such as chronic rhinosinusitis have contributed to complexities in care and treatment burden. With the new opportunities and challenges in the lives of these individuals, the focus on health-related quality of life has become more important. Chronic rhinosinusitis is a prevalent condition that has been shown to be negatively associated with respiratory

system-related health-related quality of life in adults with CF. Future endeavors may be directed at establishing CF-specific guidelines for the diagnosis of chronic rhinosinusitis and predictive models to assist CF care providers by identifying individuals who require specialist care. Further research evaluating the effect of sinus treatment on health-related

quality of life using CF-specific instruments is warranted. ■

**Author disclosures** are available with the text of this article at [www.atsjournals.org](http://www.atsjournals.org).

**Acknowledgment:** The authors acknowledge the incredible efforts of Erin Wuss, Karina

Tofttrup, Rachele Dar Santos, Frances Hanson Monnie, Eri Flores, Stephanie Maganja, Joanne LaViolette, and the entire staff at the St. Paul's Sinus Centre and St. Paul's Cystic Fibrosis Clinic. The authors are most grateful to all the participants for sharing their time and experiences. Without their participation, this study could not have been conducted.

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