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Original article

Symptom control in chronic rhinosinusitis is an independent predictor of productivity loss

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ABSTRACT

Aims: Sinonasal symptoms cause significant productivity losses in patients with chronic rhinosinusitis (CRS). Patient-perceived CRS symptom control is a longitudinal measure of CRS symptomatology and is directly associated with general health-related quality of life (QOL) in patients with CRS. The aim of this study was to better understand the relationship between symptom control and productivity loss in CRS.
Materials and methods: Prospective cross-sectional cohort study of 200 patients with CRS. Patients categorized their CRS symptom control as "Not at all", "A little", "Somewhat", "Very", and "Completely". Lost productivity was assessed by determining the number of work and/or school days missed in the last 3 months due to CRS symptoms. Sinonasal symptom severity was measured using the 22-item Sinonasal Outcomes Test (SNOT-22). Associations were sought between lost productivity and patient-perceived CRS symptom control.
Objective: To determine the association between patient-perceived longitudinal symptom control and productivity in patients with CRS.
Results: A total of 200 participants (48% male, 52% female), with a mean age of 52 years (Standard Deviation [SD]: 16) were enrolled. The mean SNOT-22 score of participants was 33.5 (SD: 22.4). Participants missed a mean of 3 days (SD: 10) of work or school due to CRS. CRS symptom control classified as "not at all" was associated with 11 days of lost productivity due to CRS on univariate analysis ($\beta = 11.16$, 95% CI: 5.39–16.94, $P < 0.001$) and 8 days of lost productivity on multivariate analysis ($\beta = 8.02$, 95% CI: 1.92–14.13, $P = 0.011$). None of the other categories of patient-reported CRS symptom control were associated with lost productivity due to CRS.
Conclusions: Patient-perceived control of CRS symptoms, an important metric previously shown to be significantly associated with QOL in CRS patients, is independently associated with lost productivity. These results motivate longitudinal studies to determine if improvement of CRS symptom control may reduce losses in productivity.

1. Introduction

Chronic rhinosinusitis (CRS) is a systemic inflammatory disease primarily affecting the sinonasal mucosa that causes a decrease in patients' quality of life (QOL) due to sinonasal symptomatology, acute exacerbations and comorbid pulmonary conditions [1–3]. Multiple inflammatory mechanisms [4–6] have been proposed as the etiology of CRS, all of which lead to the clinical phenotype that defines the disease [7]. In addition to the individual detriment to patient QOL, CRS is also a significant burden to society in indirect costs due to missed days of work and school [8].

The primary goal of CRS treatment, via medical and surgical means, is to maintain sinonasal symptoms and QOL at levels that are acceptable to the patient. Therefore, one of the principle determinants of initiation or escalation of CRS treatment is symptom control [9,10]. In contrast to cross-sectional metrics of sinonasal symptomatology, such as surveys of symptom severity, [11] symptom control is a longitudinal measure that reflects the ability to keep symptom severity within an acceptable range over a period

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of time. As a longitudinal metric that captures symptom trends, the notion of control may be more appropriate for outcome measures that evolve over time. For other chronic diseases, such as asthma, patient-perceived disease and symptom control is utilized as a routine part of clinical decision-making and disease management [12]. It is therefore of great importance to patients and healthcare providers to determine patients' perceptions of their CRS symptom control, which has been shown to be directly associated with the general health-related QOL of CRS patients [13]. However, the significance of patient-perceived CRS symptom control as it relates to the functional consequences of CRS, for example lost productivity due to the disease, has never been described.

Previous studies have found that the severity of CRS symptoms taken at one time point may be associated with past CRS-related productivity loss [14,15]. However, no prior study has examined whether patient-perceived symptom control, an important longitudinal measure of CRS symptomatology [13], is associated with lost productivity due to CRS. In an effort to decrease productivity losses associated with CRS, it is essential to determine the factors and markers most associated with missed time at work or school. Only by determining factors associated with CRS-related productivity loss will we be able to design interventional studies designed to identify methods for reducing lost productivity due to CRS. Given the importance of patient-perceived CRS symptom control, [13] we hypothesized that patients' perceptions of CRS symptom control would be associated with the frequency with which they missed days of work or school due to CRS. In this study, we therefore sought to determine associations between patient-perceived CRS symptom control and the frequency with which patients missed days of work or school due to CRS.

2. Materials and methods

2.1. Study participants

The institutional Human Studies Committee approved this study. We prospectively recruited and enrolled adult patients aged 18 years or older who met established consensus guideline criteria for CRS [7]. All study participants provided written informed consent for inclusion in this study. In order to narrow the study population to CRS patients and avoid any sinonasal diseases with extra-rhinologic features, exclusion criteria were created including comorbid diagnoses of vasculitis, cystic fibrosis, sarcoidosis and immunodeficiency. In order to avoid confounding results due to treatment, any patient who had underwent sinonasal surgery in the last 6 months was excluded. Patients in the midst of an acute CRS exacerbation were also excluded.

2.2. Study design and data collection

This was a cross-sectional cohort study. A total of 200 study participants were prospectively recruited for this study and all data was collected at the time of enrolment. The age, gender, race, history of previous sinus surgery and smoking history of all participants was collected. At enrolment, participants were assessed by the evaluating rhinologist for a history of aeroallergen hypersensitivity based on formal allergy testing, asthma based on clinical history and prior diagnosis, nasal polyps based on nasal endoscopy or prior diagnosis, topical, intranasal corticosteroid use and a history of aspirin sensitivity based on formal testing or clinical diagnosis. All participants completed a SNOT-22 questionnaire [11] to measure baseline CRS symptom severity. In order to determine the number of CRS exacerbations, participants were asked to report the number of antibiotic courses taken in the last three months for CRS symptoms, as previously described to reflect the frequency of CRS exacerbations [2]. To evaluate for productivity losses, participants were asked to report how many days of work or school were missed in the last three months due to CRS, as previously described for CRS [15–17]. This method of assessing disease-specific productivity loss has been previously validated as an accurate means of determining missed days of work or school due a chronic disease [18–20]. All participants in our study were also asked to categorize their CRS symptom control as "Not at All", "A Little", "Somewhat", "Very", and "Completely", as previously described for assessing patient-perceived sinonasal symptom control [13,21].

2.3. Characteristics of study participants

A total of 200 patients (48% male, 52% female) were enrolled in the study with a mean age of 52 years (standard deviation [SD]: 16) and their characteristics are summarized in Table 1. Of those enrolled, 25% were smokers, 39% had a history of aeroallergen hypersensitivity, 28% a history of asthma and 5% had been diagnosed with aspirin sensitivity. With respect to CRS characteristics, 43% of study participants had a history of nasal polyps (CRS with nasal polyps) while 57% had CRS without nasal polyps and 38% of all participants had undergone prior endoscopic sinus surgery. The mean SNOT-22 score was 33.5 (SD: 22.4) and the mean number of CRS exacerbations was 0.7 (SD: 1.3). The mean lost days of productivity in the preceding three months secondary to CRS was 3 (SD: 10). Patient perceptions of symptom control were 17% "Completely", 31% "Very", 28% "Somewhat", 16% "A Little", and 8% "Not at all".

2.4. Statistical analysis

All analysis was performed with the statistical software package R (www.r-project.org). A total of 200 participants were recruited, which was sufficient to detect an association of small to medium effect size (Cohen's d = 0.09) between the five levels of symptom control while controlling for eight additional confounders at a significance level of 0.05 with power of 0.8. A Pearson correlation test was used to evaluate the relationship between SNOT-22 scores and lost productivity. An association between lost days of productivity

Table 1
Characteristics of study participants.

	Study participants(n = 200)
Demographics	
Age, mean in years, (SD)	51.8 (15.8)
Gender	
Male	48%
Female	52%
Race	
White	68%
Black or African American	2%
American Indian/Alaskan Native	2%
Asian	2%
Other	1%
Declined to respond	25%
Smoking history	25%
Comorbidities	
Aeroallergen hypersensitivity	39%
Asthma	28%
Aspirin sensitivity	5%
CRS characteristics	
Nasal polyps	43%
Previous sinus surgery	38%
Intranasal corticosteroid use	72%
SNOT-22 score, mean (SD)	33.5 (22.4)
Courses of CRS-related antibiotics taken in the last 3 months (SD)	0.7 (1.3)
Lost days of work or school in the last 3 months due to CRS, mean (SD)	2.5 (10.1)

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