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Depressed mood is associated with loss of productivity in allergic rhinitis

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Abstract

Allergic rhinitis (AR) is associated with significant decreases in quality of life and productivity losses. We hypothesized that symptoms of AR may differentially associate with lost productivity due to AR. We performed a cross-sectional cohort study of 105 prospectively recruited patients with persistent AR. AR control, severity of depressed mood and sinonasal symptoms were assessed with the Rhinitis Control Assessment Test (RCAT), Patient Health Questionnaire (PHQ-2), and the 22-item Sinonasal Outcome Test (SNOT-22) respectively. Lost productivity was assessed by asking the number of days of work/school missed due to AR in the last 3 months. Patients missed a mean of 1.5 days (SD:2.9) of work or school. Lost productivity was associated with PHQ-2 (adjusted linear regression coefficient [β]=0.68, 95%CI: 0.20–1.15, $p=0.007$) analysis but not SNOT-22 or RCAT scores. Productivity losses due to AR are associated with severity of depressed mood rather than classic nasal or extra-nasal symptoms of AR.

Introduction

Allergic rhinitis (AR) is a highly prevalent inflammatory disease of the nasal cavity that manifests with classic nasal symptoms of sneezing, rhinorrhea, pruritus, and obstruction.^{1,2} AR is also associated with extra-nasal symptoms including sleep disturbance, otologic symptoms such as ear pressure, and depressed mood.³ The severity of AR symptoms is associated with a significant decrease in quality of life (QOL).³ The symptoms of AR are known to impact work and school performance, with lost productivity representing a major burden of AR on society.^{4,5}

Previous study of chronic rhinosinusitis (CRS), an inflammatory condition of the paranasal sinuses that is commonly comorbid with AR, revealed that the severity of depressed mood is the dominant symptom associated with lost productivity due to CRS.⁶

Meanwhile, the severity of sinonasal symptoms classically associated with—and diagnostic for—CRS were not associated with lost productivity.⁶ Although lost productivity has been previously reported as a direct consequence of AR symptoms, the primary symptomatic driver of these losses has yet to be determined. Given the intriguing finding that productivity losses in CRS are primarily associated with depressed mood rather than the sinonasal symptoms classically associated with the disease, we hypothesized that a similar association may exist in AR. In this study, we sought to determine whether, and the extent to which, depressed mood was associated with productivity losses due to AR.

Methods

Study participants

The Massachusetts Eye and Ear Infirmary Human Studies Committee approved this study. We prospectively recruited adult patients aged 18 years or older who met established guideline criteria for persistent AR,² and all with perennial symptomatology. All study participants provided informed consent for inclusion in this study. In order to narrow the study population to AR patients and avoid confounding by other diseases with sinonasal manifestations, exclusion criteria included comorbid diagnoses of vasculitis, cystic fibrosis, sarcoidosis, immunodeficiency, and CRS. CRS was excluded by evaluating for a clinical history consistent with consensus guidelines for a diagnosis of CRS,⁷ nasal endoscopy, and, when necessary as a matter of routine clinical care, a sinus computed tomography scan.

Study design and data collection

This is a cross-sectional cohort study for which 105 study participants were prospectively recruited. Age, gender and race were collected from all participants. All participants who were active or former tobacco smokers were considered smokers for this study. Intranasal corticosteroid spray

and antihistamine use over the preceding three months was also collected. A diagnosis of comorbid asthma was determined based on consensus clinical guidelines.⁸ All participants completed a Rhinitis Control Assessment Test (RCAT) to measure AR control,⁹ 22-item Sinonasal Outcomes Test (SNOT-22) to measure severity of nasal and extra-nasal AR symptoms,³ and a Patient Health Questionnaire-2 (PHQ-2), which queries the severity of two symptoms: feeling “sad, down or depressed” and anhedonia, to measure severity of depressed mood.¹⁰ SNOT-22 nasal (items 1-6, 21, and 22), otologic (items 7-10), sleep (items 11-18) and emotional (items 19 and 20) subdomains were calculated as previously described and rigorously validated (Supplemental Table 1).^{3,11} Our means for measuring productivity loss attributed to AR was to ask participants how many days of work or school they missed in the last three months due to their AR.

Statistical analysis

All analysis was performed with the statistical software package R (www.r-project.org).¹² To detect an association of medium effect size (Cohen’s $f^2=0.15$) between lost days of productivity while controlling for seven additional confounders at a significance level of 0.05 with power of 0.8, enrollment was performed on a continuing basis in order to recruit 105 participants. All associations between lost days of productivity (dependent variable) and RCAT, SNOT-22 and PHQ-2 scores (independent variables) were investigated with linear regression. Next, a multivariable model was used to study the association between lost days of productivity and PHQ-2 scores while controlling for RCAT and SNOT-22 scores, age, gender, intranasal corticosteroid or antihistamine use, asthma and smoking history.

Results

Characteristics of study participants

A total of 105 participants and their characteristics are summarized in Table 1. Of all participants, 65.7% had an RCAT score less than 22 which is indicative of poorly controlled rhinitis and 37.1% of participants had a PHQ-2 score that was greater than zero. The mean number of lost days of productivity in the preceding three months secondary to AR was 1.5 (SD: 2.8).

Lost Days of Productivity due to AR symptoms is Associated with PHQ-2 scores

We first sought association between the number of missed days of work or school due to AR (dependent variable) and predictor variables: RCAT, SNOT-22 and PHQ-2 scores (Table 2). On univariate analysis, the number of missed days of work or school due to AR was significantly associated with SNOT-22 (linear regression coefficient [β]=0.04, 95%CI: 0.01–0.06, $p=0.002$) and PHQ-2 ($\beta=0.68$, 95%CI: 0.27–1.09, $p=0.001$), but not RCAT ($\beta=-0.09$, 95%CI: -0.20–0.02, $p=0.116$). In our multivariable model, the number of missed days of work or school due to AR was associated with PHQ-2 ($\beta=0.68$, 95%CI: 0.20–1.15, $p=0.007$), but not SNOT-22 ($\beta=0.03$, 95%CI: -0.01–0.07, $p=0.093$) or RCAT ($\beta=0.08$, 95%CI: -0.07–0.24, $p=0.290$). None of the confounder variables were associated with lost productivity. These results suggest that depressed mood is the most dominant symptom associated with lost productivity due to AR.

Because the SNOT-22 reflects nasal, sleep, otologic and emotional symptoms, represented numerically by the corresponding SNOT-22 subdomain scores, we sought associations between lost productivity due to AR and SNOT-22 subdomain scores. On univariate analysis, we found that lost productivity due to AR was associated with SNOT-22

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sleep ($\beta=0.07$, 95%CI: 0.02–0.11, $p=0.005$), otologic ($\beta=0.18$, 95%CI: 0.08–0.28, $p=0.001$) and emotional ($\beta=0.50$, 95%CI: 0.29–0.71, $p<0.001$) subdomain scores but not the SNOT-22 nasal subdomain score ($\beta=0.04$, 95%CI: -0.02–0.11, $p=0.170$). We next checked for association with lost productivity due to AR (dependent variable) using a multivariable model including nasal, sleep, otologic and emotional SNOT-22 subdomain scores as well as age, gender, intranasal corticosteroid spray or antihistamine use, comorbid asthma and smoking history. We found that only the emotional ($\beta=0.47$, 95%CI: 0.18–0.75, $p=0.002$) SNOT-22 subdomain score (which reflects symptoms of feeling “sad” and “embarrassed”), but no other SNOT-22 subdomain ($p>0.05$ in all cases), was associated with lost productivity due to AR. These results highlight the dominant association between the severity of depressed mood and lost productivity due to AR.

Discussion

Mood is increasingly recognized as an important determinant of the impact that chronic diseases have on patients' QOL. Previous work has shown that lost productivity due to CRS, an inflammatory disease of the paranasal sinuses with consequences of decreasing QOL and productivity in affected patients, is associated primarily with the severity of depressed mood.⁶ In addition to the clinical, pathologic, and epidemiologic similarities between AR and CRS, the primary consequences of AR are decreased patient QOL and productivity. We therefore hypothesized that depressed mood could be the dominant determinant of lost productivity due to AR. In this study, we found that the severity of depressed mood was strongly associated with the number of days of missed work or school due to AR, while neither the degree of AR control nor other AR symptoms including nasal, sleep or otologic symptoms, were associated with this lost productivity.

Previous work has shown that AR is associated with lost productivity in affected patients.^{4,5,13} Patients with AR missed an average of 1 hour of work due to allergy symptoms per week.⁴ In our study, patients reported missing a mean of 1.5 days of work or school due to AR over a three month period, which, based on an 8 hour work day, is similar to prior studies.⁴ Consistent with our current findings, previous work has also found that decreased ability to sleep due to allergy symptoms was associated with decreased productivity, while symptoms of nasal congestion were not.⁴

Past work has shown that depressed mood, in general, is associated with lost productivity.¹⁴ However, AR is associated with many other symptoms—both nasal and extra-nasal—and the impact of depressed mood on lost productivity due to AR in the context of these symptoms was unclear. In this study, we present the novel finding that depressed mood is the dominant symptom associated with lost productivity due to AR. After accounting for depressed mood, the symptoms classically associated with AR—such as nasal symptoms, poor sleep, or ear pressure—were not associated with lost productivity due to AR. This finding is consistent with what has been previously described for CRS, another inflammatory disease of the upper airway.^{6,14}

Our study has several limitations. Its cross-sectional design does not reveal directionality or causality in the association between depressed mood and lost productivity. Moreover, depressed mood is distinct from a clinical diagnosis of depression. Although the PHQ-2 may be used as a screening tool for depression, the symptoms it—as well as the emotional subdomain of the SNOT-22—assesses are broadly reflective of depressed mood. We also cannot identify the exact etiology of patients' depressed mood—whether a consequence of classic AR symptoms, a systemic manifestation of AR or some other etiology. Finally, that our study population is recruited from a tertiary care center and also consists largely of white women should be considered towards the general applicability of

these results. Nevertheless, our results, coupled with past work on CRS, increasingly suggest the importance of mood on the impact of these diseases whose primary effect is to decrease QOL. This finding has important implications for the care of AR patients, highlighting the need for a holistic approach that not only accounts for symptoms classically associated with AR, but also the emotional well-being of these patients.

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Table 1. Characteristics of study participants

	Study participants (N=105)
Clinical and demographic characteristics	
Age, mean in years, (SD)	42.6 (15.8)
Gender	
Male	37.1%
Female	62.9%
Race	
White	63.8%
Black of African American	1.9%
Other	13.3%
Declined to respond	21.0%
Smoking	21.9%
Asthma	14.3%
Allergic rhinitis characteristics	
Using intranasal corticosteroid (ICS)	55.2%
Using antihistamine	58.1%
Using ICS or antihistamine	75.2%
RCAT score, mean (SD)	19.6 (4.7)
SNOT-22 score, mean (SD)	38.5 (22.8)
PHQ-2 score, mean (SD)	0.8 (1.2)
Lost days of work or school in the last 3 months due to allergic rhinitis, mean (SD)	1.5 (2.8)

Table 2. Association of patient-reported outcome measures and lost productivity due to allergic rhinitis

	Univariate analysis		Multivariable analysis ¹	
	$\beta^{\square}$ (95% CI)	P value	$\beta^{\square}$ (95% CI)	P value
RCAT	-0.09 (-0.20 – 0.02)	0.116	0.08 (-0.07 – 0.24)	0.290
SNOT-22	0.04 (0.01 – 0.06)	0.002	0.03 (-0.01 – 0.07)	0.093
PHQ-2	0.68 (0.27 – 1.09)	0.001	0.68 (0.20 – 1.15)	0.007

¹Multivariable model includes RCAT score, SNOT-22 score, PHQ-2 score as well as age, gender, intranasal steroid and antihistamine use, smoking history, comorbid asthma

[□] Linear regression coefficient

Supplemental Table 1. Organization of SNOT-22 items into subdomains¹

	SNOT-22 subdomain structure
Item No.	
	Nasal subdomain
1	Need to blow nose
2	Sneezing
3	Runny nose
4	Cough
5	Post nasal discharge
6	Thick nasal discharge
21	Sense of taste/smell
22	Blockage/congestion of nose
	Otologic subdomain
7	Ear fullness
8	Dizziness
9	Ear pain/pressure
10	Facial pain/pressure
	Sleep subdomain
11	Difficulty falling asleep
12	Waking up at night
13	Lack of a good night's sleep
14	Waking up tired
15	Fatigue during the day
16	Reduced productivity
17	Reduced concentration
18	Frustrated/restless/irritable
	Emotional subdomain
19	Sad
20	Embarrassed

¹Feng AL, Wesely NC, Hoehle LP, et al. A validated model for the 22-item sino-nasal outcome test subdomain structure in chronic rhinosinusitis. *Int Forum Allergy Rhinol.* 2017. doi: 10.1002/alr.22025 [doi].