

Allergic rhinitis, chronic rhinosinusitis, and symptom severity: a population-based study

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Background: Approximately 20% of the U.S. population suffers from allergic rhinitis (AR), and chronic rhinosinusitis (CRS) is estimated to affect 12.5% of the population. Frequently, many patients suffer from both disorders. In this study, we evaluated the relationship between AR and chronic rhinosinusitis as far as impact on nasal symptoms in a community-based case-control study of adult nonsmokers.

Methods: In Washington County, MD, 200 subjects were recruited and interviewed from the same community. Subjects were divided into 4 study groups: AR without CRS, CRS without AR, AR with CRS, and a control group without AR or CRS. A validated questionnaire was used to assess upper respiratory symptoms, and disease-specific quality of life.

Results: Upper respiratory symptoms were significantly more severe for the affected subjects when compared to controls. Symptom severity was greatest for the CRS

groups with or without AR, followed by AR without CRS, and controls least symptomatic. Subjects with AR plus CRS were most likely to have had previous nasal surgery, and use nasal decongestants when compared to the other groups.

Conclusion: While both AR and CRS are common in the United States, it appears that patients who suffer from both disorders have more severe symptoms and are more likely to have undergone nasal surgery than if they have only 1 of these disease states. © 2011 ARS-AAOA, LLC.

Key Words:

rhinosinusitis; allergy; rhinitis; nasal symptom; upper respiratory

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Allergic rhinitis (AR) and chronic rhinosinusitis (CRS) are common medical conditions encountered in the United States. AR has been estimated to affect 20% of the population,¹ and CRS approximately 12.5% of the population.² Frequently, patients may suffer from both disorders simultaneously.

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AR and CRS are common causes of nasal complaints. AR is a symptomatic disorder of the nose induced after immunoglobulin E (IgE)-mediated inflammation upon exposure to allergen in the atopic individual. Classic symptoms of AR include rhinorrhea, nasal obstruction, nasal itching, and sneezing. Clinical diagnosis of AR is based on history and physical examination, and is supported by either skin test methods or in vitro assays of antigen-specific IgE levels.³ Further clinical categorization of AR is based on severity and whether symptoms are seasonal, perennial, persistent, or intermittent.³

CRS is another leading reason for patient nasal complaints. Clinical diagnosis of CRS focuses on symptoms, including facial pain/pressure, facial congestion/fullness, nasal obstruction/blockage, nasal discharge/purulence, hyposmia/anosmia, headache, fever, halitosis, fatigue, dental pain, cough, and ear pain/pressure.⁴ Chronic disease is manifest by duration of symptoms for greater than 12 weeks. The clinical diagnosis is supported by symptoms and clinical examination. Supplemental evidence may be provided by computed tomography (CT) scans and nasal endoscopy.⁵ Newer subclassification and treatment guidelines for CRS have focused on the presence or absence of

nasal polyposis, severity of symptoms, and features of inflammatory disease.⁶

Frequently, patients may suffer from both AR and CRS. Prior studies have shown rhinosinusitis to be present in 25% to 30% of AR patients.⁷ Allergy has been found to be a significant factor in the development of sinusitis, with allergic subjects more likely to show more severe disease on CT scan.⁸ Studies have also shown a high prevalence of allergy in those refractory CRS patients requiring endoscopic sinus surgery.⁹

In this work, a community-based study was performed to evaluate nasal symptoms in those suffering from AR, CRS, or both disorders when compared to healthy controls. In particular, the relationship between AR and chronic rhinosinusitis as far as impact on nasal symptoms and treatment was examined.

Subjects and methods

Study design and recruitment of participants

This study represents a collaborative effort between the George Comstock Center of Public Health Research, an off-site research center of the Johns Hopkins Bloomberg School of Public Health that has been conducting community-based health research in Washington County, MD, and the Johns Hopkins Sinus Center in the Department of Otolaryngology–Head and Neck Surgery. The study was approved by the Institutional Review Board at the Johns Hopkins Bloomberg School of Public Health. The study participants for the current study were recruited from a subset of a population-based cohort of nonsmoking adult residents who have been followed for health status through annual surveys since 1996 at the George Comstock Center.¹⁰ In 2007, 7386 recruitment letters were mailed to cohort participants requesting their participation in a study to investigate determinants of diseases of the upper airway. A total of 2568 individuals (35%) responded and were screened over the phone. The present study examines a subset of 100 cases originally recruited with confirmed CRS and their 100 matched controls.¹¹ The 100 original cases were found after 173 respondents reported a previous physician diagnosis of chronic rhinosinusitis. Trained staff members contacted the 173 potential cases to evaluate eligibility and schedule in-person interviews. Of these 173 potential cases, 52 did not meet confirmation criteria for diagnosis of CRS, which was based on the criteria for CRS developed by the Rhinosinusitis Task Force and endorsed by the American Academy of Otolaryngology.¹² Another 27 were unable to schedule an interview, leaving 100 participants who did meet the Rhinosinusitis Task Force guidelines for CRS. Among the 100 participants with CRS, 78 had a confirmed physician diagnosis of CRS in which the treating doctors were able to confirm the diagnosis after being contacted by mail. Among the 200 participants, 83 individuals reported a previous physician diagnosis of AR or prior positive allergy testing, 65 of them with CRS and 18 without CRS. A total of 35 participants with CRS had no AR diagnosis and 82 partic-

ipants had no CRS nor AR and served as controls for this study. Exclusion criteria included any serious health condition that precluded completion of the interview process and active cigarette smoking in the past 2 years.

Participants were interviewed personally by trained staff members who were not aware of the disease status of the participants. The interviews were conducted using the identical study protocol and questionnaire for all participants.

Questionnaire design and data collection

This study utilized a questionnaire and interview process that were developed and evaluated using participatory research methods involving focus groups with community members and health care professionals, and one-on-one cognitive testing of the questionnaires. Details of a pilot study has been previously published regarding the full protocol that evaluated the adequacy of recruiting community-based cases as compared to clinic-based cases.¹³

The following data were captured by the questionnaire: AR history, chronic rhinosinusitis history, sociodemographic information (age, gender, education, and occupation), smoking history, family history, and other medical conditions. A 6-point Likert scale (from 0 = none to 5 = very severe) evaluating severity of sinonasal symptoms was included in the questionnaire.¹³ One portion of the questionnaire evaluated nasal symptoms over the preceding 12 weeks; a second portion of the questionnaire focused on nasal symptoms over the 2 weeks prior to administration of the questionnaire. Participants were also questioned on medication use over the last 12 weeks, and any history of prior nasal/sinus surgery.

Statistical analysis

Differences in participant demographics, major and minor sinonasal-related symptoms, and medication usage were evaluated by CRS and AR status using linear regression and logistic regression models for continuous and dichotomous variables, respectively, and comparing participants with CRS and no AR, AR and no CRS, and CRS and AR to participants without AR and CRS (control group). These models compare statistical differences in the evaluated characteristics for each of the disease status groups compared to the control group. The statistical significance level was set at $\alpha = 0.05$. All statistical analyses were 2-sided. To evaluate if there was a dose-response increase trend for in the severity of symptoms and the use of medication and surgery, we estimated the *p* value for trend assigning 0 to the control group, 1 to participants with only AR or only CRS, and 2 to participants with both AR and CRS.

Results

Participant characteristics by allergy and chronic rhinosinusitis status

The majority of participants were female (68.5%), and the mean age was 59.9 years (standard deviation [SD] 10.8 years) with no differences by group (Table 1). Regarding

TABLE 1. Participant characteristics by allergy and CRS status

	No allergies, no CRS (n = 82)	CRS and no allergies (n = 35)	Allergies and no CRS (n = 18)	Allergies and CRS (n = 65)	p Trend
Demographics					
Age, years, mean (SD)	60.4 (10.9)	61.9 (8.8)	59.1 (10.6)	58.4 (11.7)	0.28
Female, %	70.7	62.9	55.6	72.3	0.91
Education, % $\leq$ High school	52.4	51.4	27.8 ^b	35.4 ^a	0.04
Former smokers, %	37.8	60.0 ^a	55.7	32.3	0.62
Medical conditions					
Asthma, %	6.1	22.9 ^a	44.4 ^a	41.5 ^a	<0.001
Family history of chronic rhinosinusitis, %	26.8	77.1 ^a	27.8	81.5 ^a	<0.001
Chronic bronchitis, %	6.1	37.1 ^a	22.2 ^a	21.5 ^a	0.01
Heart disease, %	13.4	17.1	5.6	12.3	0.85
Diabetes, %	14.6	5.7	11.1	7.7	0.16

Case definition for allergy: self-reported physician diagnosis or positive to an allergy test.

^aValue of $p < 0.05$ compared to controls (no allergies, no CRS).

^bBorderline statistically significant compared to controls (no allergies, no CRS): $p = 0.07$.

CRS = chronic rhinosinusitis; SD = standard deviation.

education, participants with allergies (with or without CRS) were more educated compared to CRS without AR and to controls. Participants with CRS and no AR were more likely to be former smokers compared to controls. In comparison to the control group, all other groups were significantly more likely to suffer from asthma, chronic bronchitis, or have a family history of chronic rhinosinusitis. There was no such significant relationship for heart disease or diabetes.

Participant symptom severity by allergy and chronic rhinosinusitis status

Patient nasal and sinus symptoms over the preceding 12 weeks were captured by the symptom index survey of 12 common sinonasal symptoms (Table 2). When compared to controls, the CRS groups with and without allergies had a statistically significant increase in all symptoms except fevers, and these 2 groups scored similarly in all domains. For the group with AR without CRS there was no statistically significant difference in any of the symptoms. When comparing symptoms in the prior 2 weeks, the CRS groups with and without AR had significantly more severe symptoms in all 12 domains; the AR without CRS has a statistically significant increase in the domain “need to blow nose” and a borderline statistically significant increase in the domain “ear fullness (clogged).”

Participant treatment characteristics by allergy and chronic rhinosinusitis status

Participants were queried on their use of medications (decongestants, saline, nasal steroids, antihistamines, antibiotics, aspirin or other anti-inflammatory medications) over the past 2 weeks (Table 3). Those groups with CRS with or

without AR were significantly more likely to use all medications except aspirin/other anti-inflammatory medications. Those with AR without CRS had a significant increase in the use of nasal steroid sprays and antihistamines when compared to controls. Subjects were also questioned regarding previous sinus or nasal surgeries. The CRS with AR group was most likely to have prior surgery (33.9%), followed by the CRS without AR group (20.0%); both groups had a statistically significant increase in sinonasal surgeries when compared to controls (6.1%).

Discussion

This community-based study examined the relationship between CRS, AR, symptom severity, and treatment with medications and surgery. In this study, those with CRS with or without AR were most severely afflicted with sinonasal symptoms, followed by those with AR only, and the controls least symptomatic. Those with CRS with or without AR were more likely to use nasal decongestants, nasal saline sprays, nasal saline sprays, or antibiotics. Those subjects with both CRS and AR were the most likely group to have undergone prior nasal or sinus surgeries.

Previous studies have examined the relationship between AR and CRS. Several studies have shown that those with AR are more likely to have sinusitis and vice versa. Berrettini et al.¹⁴ demonstrated that greater than 60% of subjects with IgE-mediated AR had sinusitis. In those with perennial AR, more than one-half demonstrate abnormal sinus X-rays,¹⁵ and a subsequent study found in patients with seasonal AR that 60% had sinus CT abnormalities.¹⁶ Allergy has been associated with more frequent bouts of sinusitis in a retrospective review of radiographically documented sinusitis.¹⁷

TABLE 2. Symptom severity by allergy and CRS status

	No allergies, no CRS (n = 82)	CRS and no allergies (n = 35)	Allergies and no CRS (n = 18)	Allergies and CRS (n = 65)	p Trend
Symptom Index Survey (over the last 12 weeks)					
Facial pain, mean (SD)	0.2 (0.7)	1.6 (1.3) ^a	0.6 (1.1)	1.8 (1.4) ^a	<0.001
Facial congestion/fullness, mean (SD)	0.4 (0.9)	2.2 (1.2) ^a	0.7 (1.2)	2.2 (0.7) ^a	<0.001
Nasal obstruction/blockage (stiffness), mean (SD)	0.6 (1.1)	2.8 (1.1) ^a	0.9 (1.1)	2.7 (1.3) ^a	<0.001
Nasal discharge/drainage or postnasal drip, mean (SD)	0.7 (1.1)	2.9 (1.4) ^a	1.1 (1.3)	3.0 (1.3) ^a	<0.001
Decreased sense of smell, mean (SD)	0.4 (1.0)	1.9 (1.9) ^a	0.6 (1.3)	2.0 (1.8) ^a	<0.001
Headache, mean (SD)	0.5 (1.0)	1.7 (1.5) ^a	0.6 (1.1)	2.0 (1.5) ^a	<0.001
Fevers, mean (SD)	0.2 (0.7)	0.5 (1.3)	0.0 (0.0)	0.4 (1.1)	0.11
Halitosis (bad breath), mean (SD)	0.1 (0.5)	1.1 (1.6) ^a	0.2 (0.4)	0.9 (1.2) ^a	<0.001
Fatigue (tiredness), mean (SD)	1.0 (1.4)	1.9 (1.4) ^a	1.3 (1.0)	2.1 (1.5) ^a	<0.001
Dental pain, mean (SD)	0.2 (0.7)	0.7 (1.1) ^a	0.4 (1.0)	0.8 (1.3) ^a	0.05
Cough (excluding clearing of throat), mean (SD)	0.5 (1.1)	1.7 (1.4) ^a	0.7 (1.2)	1.7 (1.4) ^a	<0.001
Ear pain/pressure/fullness, mean (SD)	0.2 (0.7)	1.1 (1.3) ^a	0.6 (1.1)	1.6 (1.5) ^a	0.09
History of present illness (over the last 2 weeks)					
Need to blow nose, mean (SD)	1.4 (1.0)	3.1 (1.2) ^a	2.0 (1.3) ^a	2.9 (1.2) ^a	<0.001
Sneezing, mean (SD)	1.3 (1.3)	2.2 (1.2) ^a	1.7 (1.2)	2.4 (1.1) ^a	<0.001
Runny nose, mean (SD)	0.8 (1.0)	2.5 (1.5) ^a	1.3 (1.3)	2.5 (1.6) ^a	<0.001
Cough, mean (SD)	0.7 (1.1)	1.7 (1.5) ^a	0.9 (1.1)	1.7 (1.5) ^a	<0.001
Postnasal drip, mean (SD)	0.8 (1.1)	2.7 (1.4) ^a	1.1 (1.1)	2.8 (1.4) ^a	<0.001
Thick nasal drainage, mean (SD)	0.3 (0.8)	2.0 (1.6) ^a	0.7 (1.1)	2.0 (1.7) ^a	<0.001
Ear fullness (clogged), mean (SD)	0.2 (0.6)	1.3 (1.5) ^a	0.7 (1.2) ^b	1.6 (1.7) ^a	<0.001
Dizziness, mean (SD)	0.2 (0.6)	0.7 (1.2) ^a	0.0 (0.0)	0.8 (1.4) ^a	<0.001
Ear pain, mean (SD)	0.1 (0.3)	0.4 (0.8) ^a	0.2 (0.7)	0.7 (1.1) ^a	<0.001
Facial pain/pressure, mean (SD)	0.2 (0.5)	1.5 (1.0) ^a	0.5 (1.3)	1.6 (1.6) ^a	<0.001
Difficulty falling asleep, mean (SD)	0.9 (1.5)	1.6 (1.8) ^a	1.1 (1.0)	1.5 (1.7) ^a	0.02
Waking up at night, mean (SD)	1.6 (1.4)	2.4 (1.6) ^a	2.1 (1.3)	2.0 (1.5) ^a	0.03

Case definition for allergy: self-reported physician diagnosis or positive to an allergy test.

^aValue of $p < 0.05$ compared to controls (no allergies, no CRS).

^bBorderline statistically significant compared to controls (no allergies, no CRS): $p = 0.10$.

CRS = chronic rhinosinusitis; SD = standard deviation.

Conversely, those with rhinosinusitis have been found to more likely have AR, with estimates ranging from up to 62%.^{7,18} Studies suggest that perennial allergens are more common than seasonal¹⁹ in those with CRS that also have AR. In particular, dust mite and mold seen to be of particular importance in this subgroup.^{19,20}

AR has not only been linked to CRS, but has been suggested to be a causative factor. Nasal allergen challenge in allergic patients with chronic rhinosinusitis has been shown to result in symptoms and opacification of sinus X-rays within 2 hours in 78% of subjects.²¹ Other studies suggest that AR can delay mucociliary clearance in those with perennial AR, leading to chronic rhinosinusitis.²² Immunotherapy has been shown to improve nasal mucociliary

clearance in allergic subjects as well.²³ Allergy has also been linked to more severe sinusitis based on CT scan criteria.⁸ Other theories of AR as a causative component in the development of CRS include mucosal edema resulting in stasis and infection, AR upregulating existing inflammation, and AR leading to neurogenic inflammation.

Our current study found that those with CRS and AR were more likely to have undergone prior nasal surgery, supporting the findings of previous studies showing an increased rate of AR in those candidates for endoscopic sinus surgery. Prior studies by Houser and Keen⁹ and Emanuel and Shah²⁴ have found a high prevalence (56.4%-84%) of AR in those undergoing endoscopic sinus surgery. Treatment of AR after endoscopic sinus surgery with

TABLE 3. Participant treatment characteristics by allergy and CRS status

Treatment (medication over last 2 weeks and surgeries),%	No allergies, no CRS (n = 82)	CRS and no allergies (n = 35)	Allergies and no CRS (n = 18)	Allergies and CRS (n = 65)	p Trend
Nasal decongestants	15.9	34.3 ^a	16.7	46.2 ^a	<0.001
Nasal saline sprays or saline irrigations	9.8	54.3 ^a	16.7	55.4 ^a	<0.001
Nasal steroid sprays	4.9	68.6 ^a	33.3 ^a	64.6 ^a	<0.001
Antihistamines	11.0	57.1 ^a	55.6 ^a	60.0 ^a	<0.001
Antibiotics for respiratory problems	7.3	25.7 ^a	5.6	35.4 ^a	<0.001
Aspirin/other anti-inflammatory regularly	48.8	57.1	44.4	64.6 ^b	0.06
Sinus or nasal surgeries	6.1	20.0 ^a	11.1	33.9 ^a	<0.001

Case definition for allergy: self-reported physician diagnosis or positive to an allergy test.

^aValue of $p < 0.05$ compared to controls (no allergies, no CRS).

^bBorderline statistically significant compared to controls (no allergies, no CRS): $p = 0.06$

CRS = chronic rhinosinusitis.

immunotherapy has been linked to improved patient outcomes postoperatively.²⁵

Our study focused on community based methods to evaluate patient symptoms, and collect data on medical and surgical treatment when looking at AR and CRS. Advantages of our study include the standardized method for participant recruitment and interview protocol. The study questionnaire was developed using participatory methods, focusing on assessment of nasal symptom severity, and was evaluated in a previous pilot study.¹³ These are important advantages compared with previous studies most of which were based on clinic-based cases and self-administered questionnaires.

However, our study did have certain limitations. All allergic subjects reported a physician diagnosis of allergy, but skin testing results were not available on all of these

subjects. Other limitations of the current study include reliance on patient self-report, which introduces possible elements of bias that could result in overassessment of symptom scores. Finally, the study population was relatively old and our findings may not be applicable to younger populations.

Conclusion

While both AR and CRS are common in the United States, our study found that patients who suffer from CRS with or without AR are most symptomatic and use the greatest number of medications. In those with both CRS and AR, they are significantly more likely to have undergone previous sinonasal surgeries. 🌐

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