

The work impact of asthma and rhinitis: Findings from a population-based survey

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Abstract

Asthma and rhinitis are common chronic conditions that affect adults of working age. Little is known about their relative impacts on work loss and decreased productivity. Using random digit telephone dialing, we carried out a population-survey of adults in Northern California aged 18–50 years. We interviewed 125 persons with asthma (with or without concomitant rhinitis) and 175 persons with rhinitis alone. Study eligibility was based on subject report of a physician's diagnosis of asthma and/or a rhinitis-related condition. Any adult labor force participation since condition onset was lower among those with asthma (88%) than among those with rhinitis alone (97%) ($P = 0.002$). In contrast, among those still employed, decreased job effectiveness was more frequently reported in the rhinitis group (43 of 121; 36%) compared to those with asthma (14 of 72; 19%) ($P = 0.02$). Condition-attributed lost work was common in both groups, with more than 20% reporting one or more complete or partial work days lost in the 4 weeks previous to interview. Taking into account age, gender, race, and smoking status, those with asthma were more likely to have no labor force participation after diagnosis (OR = 3.0; 95% CI 1.1–7.7) and less likely to report decreased job effectiveness among those remaining employed (OR = 0.4; 95% CI 0.2–0.9). Excluding subjects from the rhinitis group most likely to have unreported asthma based on past medication use had little impact on these associations. Both asthma and rhinitis negatively affect work productivity. Those with asthma are less likely to be employed at all, while among those remaining on the job, rhinitis is a more potent cause of decreased work effectiveness. The economic impact of asthma and rhinitis and related conditions may be under-appreciated. © 2001 Elsevier Science Inc. All rights reserved.

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1. Introduction

Asthma and rhinitis are both common and costly conditions among persons of working age. The negative impacts of these health conditions on work and employment can be defined in a number of different ways, including lower labor force participation rates, changes in employment or job responsibilities as an adjustment to the condition, lost work time due to illness, or decreased work effectiveness of productivity while still on the job. Related negative impacts in-

clude general limitation of activities or impairment of quality of life.

For asthma these negative impacts have been studied more than they have been for rhinitis. Among adults in the U.S., asthma is one of the leading non-musculoskeletal causes of work limitations affecting the employment of millions of Americans [1]. When quantified in terms of indirect health costs, decreased work productivity due to asthma, based on two separate estimates, accounted for hundreds of millions of dollars annually in the U.S. [2,3]. International data suggest a similar global burden of disease [4].

Estimates of the occupational impact of rhinitis are limited. The most widely cited U.S. cost estimate for work and productivity loss is based on the National Medical Expenditure Survey and is limited to allergic rhinitis [5]. In that

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study, the estimated costs of lost work productivity due to rhinitis were only 15% as much as those derived using similar methods for asthma [2,5]. These productivity assumptions, however, may have been too conservative. For example, a recent clinical drug trial in seasonal allergic rhinitis using a more direct assessment found that those with rhinitis and employed reported a 1.8% loss of work time and a 38.7% work impairment while on the job [6]. We evaluated the work impacts of asthma and rhinitis compared to one another using a population-based survey. We hypothesized that both conditions would have important occupational effects, but that the impact of asthma would be greater.

2. Methods

2.1. Overview

We studied the prevalence of work and other activity limitations among adults with asthma or rhinitis by analyzing survey responses to telephone interviews carried out in a random population-based sample. Subjects were identified through random digit dialing. Screening questions identified potentially eligible subjects based on age and reported physician diagnosis of the conditions of study interest. Structured telephone interviews assessed demographic characteristics, health status, health care utilization, and occupational variables, including work status and self-rated effectiveness on the job. We compared survey responses among those with a reported physician diagnosis of asthma, with or without concomitant rhinitis, to those reporting a physician diagnosis of rhinitis alone. The study was performed with the approval of the University of California San Francisco Committee on Human Research.

2.2. Subject selection

Subjects were recruited for interviews through random digit dialing. All sampling and interviewing was conducted by Field Research Corporation (San Francisco, CA) during an 8-week period from May 28 through July 21, 1999. The geographic catchment areas for telephone calls, based on area codes, was limited to Northern California, including rural, suburban, and urban regions within that area. Calls were attempted between 3 to 9 p.m. weekdays, 9 a.m. to 9 p.m. Saturdays and 10 a.m. to 9 p.m. Sundays, with at least six attempts before a number was considered a nonresponse. Upon contact and verification that a telephone number was residential (as opposed to a non-residential business), we screened for any potential household respondent present between the ages of 18–50 years of age. Only one subject per household was interviewed. If more than one potential subject was at home at the time of the telephone contact, a hierarchical approach was used to preferentially recruit the youngest male as the respondent for study participation. Subjects who spoke Spanish had the option of being interviewed in Spanish; subjects not able to be interviewed in either English or Spanish were considered ineligible for study.

2.3. Health condition eligibility

Our goal was to study subjects with asthma compared to subjects with rhinitis without asthma. The health condition definition we used was hierarchical: if a medical diagnosis of asthma was reported, the subject fell into the asthma group, whether or not a concomitant diagnosis of an upper airway condition such as allergic rhinitis, post-nasal drip, or hay fever was also reported by that individual. To fall into the group with rhinitis alone, one of several upper airway diagnoses could be reported, but a physician diagnosis of asthma could not be reported.

To ascertain diagnosis-based eligibility among subjects within the study age range, we asked a series of health condition screening questions following the introduction, “Has a medical doctor ever told you that you have any of the following medical conditions?” We defined the rhinitis group by a positive report of either “allergic rhinitis, sinusitis or hay fever” or, separately ascertained, “chronic post nasal drip,” if there was no concomitant report of physician-diagnosed asthma. We defined asthma by report of this condition whether or not one of the rhinitis conditions was also reported. Our condition checklist also included cystic fibrosis and emphysema. No age-eligible subjects reported cystic fibrosis, but we excluded six subjects who reported a physician diagnosis of emphysema. We did not screen for chronic obstructive pulmonary disease (COPD) or bronchitis.

2.4. Recruitment targets and performance

Our *a priori* recruitment target was 125 adults aged 18–50 years with asthma and 175 adults aged 18–50 years with rhinitis but without a reported physician diagnosis of asthma. The recruitment flow among individual households successfully contacted is summarized in Fig. 1. Screening interviews were completed for 3666 individuals of all ages to yield 455 persons within the age range and reporting the conditions of interest. The 125 participating subjects with asthma represented 68% of 183 age- and condition-eligible subjects (32% decline rate). The 175 participating subjects with rhinitis comprised 64% of 272 condition-eligible subjects. Owing to the greater prevalence of rhinitis without asthma, the target recruitment for that condition group was achieved prior to completing the recruitment for the asthma sample. Accordingly, of the 97 with rhinitis that were eligible but not interviewed, only 86 were true declines (32% of 272). Among subjects who were eligible based on age, but not study-eligible on the basis of one of the targeted health conditions, we also carried out a brief symptom screening battery in a subset with a target recruitment of 250 (254 were actually interviewed; see Fig. 1).

2.5. Interview content

The survey structure was parallel, but not identical, for the subjects in the group with asthma (with or without concomitant rhinitis) compared to the subjects with rhinitis alone. Both groups were asked to respond to a respiratory

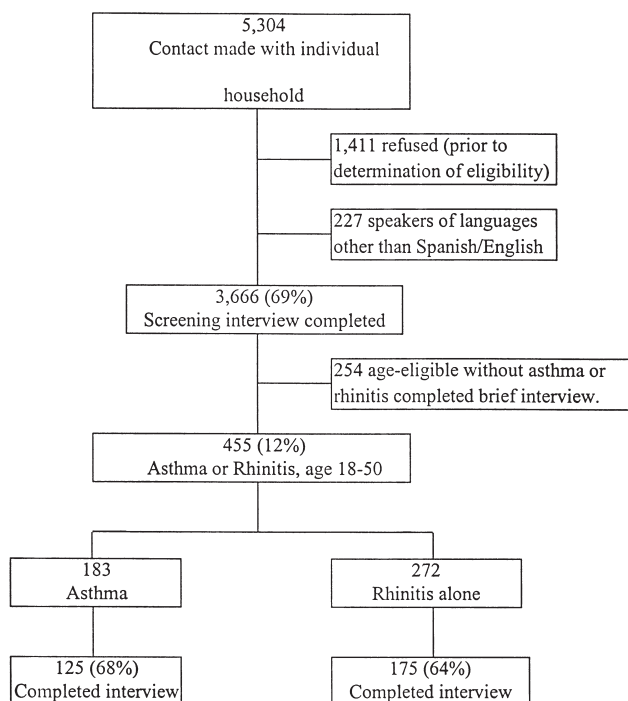


Fig. 1. Subject recruitment flow. Percentages expressed are relative to immediate upstream sample n . Of 97 subjects reporting allergic rhinitis but not asthma who did not then complete interview, 86 declined participation and 11 were not recruited because target recruitment ($n = 175$) had already been achieved.

symptom checklist for complaints that might have occurred over the preceding 12 months. Questions ascertaining age of disease symptom onset and diagnosis were condition-specific, however. Both groups were also asked about respiratory and nasal medications (prescription, over-the-counter, and alternative therapies). Oral bronchodilator inhaler sprays were differentiated from nasal sprays.

All subjects were asked about health care utilization using condition-specific questions. We assessed general health status using the SF-12 calculating summary scores for both the Physical (PCS-12) and Mental Component Scores (MCS-12) of the battery, which has normative score for PCS-12 of 53 ± 7 and for MCS-12 of 49.5 ± 9 among U.S. adults 18–44 [7,8]. In addition to general health status, we also assessed disease-specific severity among those with asthma using a 28-point scale we have previously validated. We have shown scores for this scale ranging from a 9 ± 5 for adults aged 18–50 treated by family practice specialists to 12 ± 6 for adults treated by pulmonary specialists [9].

Employment data included current occupation and industry of employment (job) and the job held at the time that the subject's condition first became troubling as an adult. For those who at age 18 were already troubled by their condition, the first job held after that age, if any, was ascertained. Subjects reporting that their occupational status as "unable to work" were asked whether this was due at least in part to

their health condition (asthma or rhinitis). We asked about job change or changed job duties due to their condition. We also asked subjects how many complete work days and how many partial work days they had missed specifically due to their condition.

We assessed work effectiveness adapting an item originally developed to study headache-related disability [10]: "Over the past four weeks, based on the days you were at work, how would you rate your effectiveness on the job because of your nasal or sinus condition [asthma]? To do this, say 0% if you were unable to work at all because of your nasal or sinus condition [asthma] and say 100% if your job effectiveness was not at all affected by your nasal or sinus condition [asthma]. Of course you can choose any percentage between 0 and 100 for your answer."

2.6. Statistical analysis

We compared those with asthma (with or without rhinitis) to those with rhinitis alone for demographics and health status using the t -test (continuous variables), the chi-square test for trend (educational level and self-rated disease severity) or chi-square (all other categorical variables). For clinical variables, functional status, and employment variables, we calculated the 95% confidence intervals about observed proportions assuming a normal distribution.

Our principal *a priori* hypothesis was that those reporting a diagnosis of asthma would have worse work status compared to those with rhinitis alone. We anticipated that some of these differences might be explained by demographic differences between the two groups. We defined several measures of work status to serve as dependent variables. We defined "no labor force participation since condition diagnosis" based on a survey response of no full- or part-time salaried employment at any time between the age when a physician first diagnosed the condition or age 18 (which ever was greater) and the time of the interview.

We defined "not currently employed" as holding no part-time or full-time salaried employment at the time of interview. We defined "job or duty change" as respondent attributed change of job or job duties at any point in the past attributed to the specific health condition. We defined "lost work days" as either complete or partial lost work days attributed to the specific condition, occurring in the 4 weeks preceding interview among those currently employed. We defined "reduced work effectiveness" as a 90% or less self-rated level, because this corresponded to the lowest quartile of self-ratings among all those currently employed. We estimated the direction and strength of the association between health condition and employment measures (as dependent variables) using multiple logistic regression analysis. To take into account potential demographic confounders, we included in these models age, gender, race and ethnicity (white, non-Hispanic compared to all others), highest educational level achieved (high school or less or some college, with college graduate as the referent), and smoking status (current or former, with never as the referent).

We analyzed these relationships using two separate models: Model 1 tested the association with the employment-related dependent variables of study interest for asthma (whether or not the subject had concomitant rhinitis) as a risk factor compared to rhinitis alone. Model 2 tested the relationships with the same dependent variables of asthma with concomitant rhinitis and, separately, asthma without concomitant rhinitis as two independent risk factors compared to rhinitis alone. The rationale for the second model was to examine the partitioning of risk for adverse outcomes within the asthma group based on rhinitis co-morbidity.

We also re-analyzed key outcomes, excluding as undiagnosed asthmatics subjects in the rhinitis group who reported ever using steroids for breathing problems or recent use of inhaler medications. We carried out this analysis to test whether excluding those subjects most likely to have been mis-categorized in terms of asthma affected the associations we observed.

3. Results

Table 1 shows the demographic data for the 125 subjects with asthma (with or without concomitant rhinitis) compared to the 175 subject with rhinitis alone. A significantly greater proportion of those with asthma reported household incomes below \$20,000 (25% vs. 10%, $P < 0.001$). A significantly greater proportion of those in the rhinitis group were married or living with a partner (65% vs. 49% for asthma, $P = 0.01$). Although there were not other statistically significant differences in the other demographic variables between the groups shown in Table 1, age, gender, race or ethnicity, and education all exhibited differences that were of at least marginal significance ($0.05 < P < 0.20$). In contrast, smoking and health insurance status were similar between the two groups.

Clinical features of those with asthma compared to those with rhinitis are detailed in Table 2. There were a number of important between-group differences. Among those with rhinitis alone, a greater proportion reported being “troubled” by their condition in the last 12 months (89%) compared to those with asthma (62%). Consistent with this, self-rated condition severity was significantly greater, overall, among those with rhinitis (chi-square test for trend = 32.6; $P = 0.001$). Nonetheless, respiratory symptoms during the preceding 12 months were reported by 90% (95% CI 85–96%) of those with asthma (Table 2). Moreover, subject-reported urgent care and emergency department (unscheduled) visits for their conditions were similar in frequency comparing the asthma with rhinitis groups. Hospitalization was infrequent overall. Only three subjects in the asthma group and one in the rhinitis group reported hospitalization for their condition in the 12 months prior to interview.

Among the 125 subjects with asthma, 72 (58%) also reported a physician diagnosis of rhinitis. By study definition (see Methods), none of those in the rhinitis group reported a

Table 1

Demographics, smoking status, and health insurance status among 300 adults aged 18–50 with asthma (with or without concomitant rhinitis) compared to rhinitis alone

Characteristics	Health condition group				P-value
	Asthma (<i>n</i> = 125)		Rhinitis (<i>n</i> = 175)		
	<i>n</i>	%	<i>n</i>	%	
Female gender	81	65	126	72	0.18
Race/ethnicity					0.13
White, non Hispanic	89	72	128	74	
Black, non Hispanic	8	6	4	2	
Latino	22	18	27	16	
Asian/Other	5	4	15	9	
Education					0.09
Less than high school	7	6	6	3	
High school graduate	27	22	28	16	
Some college	44	35	62	35	
College graduate	47	38	79	45	
Annual household income <\$20,000	31	25	17	10	0.001
Married or living with partner	61	49	114	65	0.01
Smoking status					0.50
Current smoker	22	18	27	16	
Former smoker	40	32	48	28	
Never smoked	62	50	99	57	
Insured for health care	108	86	156	89	0.47

For asthma, mean age = 35 ± 9 years; for rhinitis mean age = 37 ± 9 years ($P = 0.08$).

P-values for Mantel–Haenszel chi-square test for trend (education), chi-square test (all others).

Race/ethnicity missing for one subject in each condition group.

Smoking status missing for one subject in each condition group.

physician diagnosis of asthma. Nonetheless, respiratory symptoms and the use of respiratory medications was frequent among those with rhinitis alone, although statistically less frequent than among those with asthma. Altogether, 37 (21%; 95% CI 15–27%) of those with rhinitis reported either ever having used oral corticosteroids for breathing problems or recent use of inhaler medication, even though none reported a physician diagnosis of asthma.

We also asked subjects in the rhinitis group to respond to a checklist of specific physician diagnoses that was more detailed than that ascertained in the initial subject screening battery. Among these conditions, which could be overlapping, 114 (65%) reported hay fever, 71 (41%) reported allergic sinusitis, 52 (30%) allergic rhinitis, and 41 (23%) chronic sinusitis. At least one of these physician diagnoses was reported by 159 (91%) of 175 subjects in the rhinitis group. There were 35 subjects in the rhinitis group who reported a physician diagnosis of chronic bronchitis. Of these subjects, 9 (26%) had also reported bronchodilator or corticosteroid use.

As indicated in Fig. 1, we also briefly surveyed a random subject of telephone respondents who were age-eligible for study participation but did not report one of the conditions of study interest. The goal of this brief, supplemental battery was to ascertain the background prevalence of respira-

Table 2
Health and clinical status among subjects with asthma compared to those with rhinitis

Health measure	Health condition group		n	% (95% CI)	P-value
	Asthma (n = 125)	Rhinitis (n = 175)			
Troubled by condition in past 12 months	77	62 (53–70%)	155	89 (84–93%)	0.001
Condition onset prior to age 18 years	71	59 (50–68%)	74	44 (36–51%)	0.01
Self-reported severity of condition					0.001
Severe	8	6 (2–11%)	38	22 (16–28%)	
Moderate	40	32 (24–40%)	85	49 (41–56%)	
Mild or no symptoms	77	62 (53–70%)	51	29 (23–36%)	
Symptoms experienced in past 12 months					
Wheezing	92	74 (66–81%)	61	35 (28–42%)	0.001
Shortness of breath at rest	45	36 (28–44%)	30	17 (12–23%)	0.001
Shortness of breath with exercise	81	65 (56–73%)	65	37 (30–44%)	0.001
Awakened by shortness of breath	37	30 (22–38%)	20	11 (7–16%)	0.001
Awakened by cough	81	65 (56–73%)	92	53 (45–60%)	0.03
Any of above 5 symptoms	113	90 (85–96%)	133	76 (70–82%)	0.001
All of above 5 symptoms	16	13 (7–19%)	1	1 (0–2%)	0.001
Health care utilization in past 12 months					
Urgent care visit for condition	34	27 (19–35%)	56	32 (25–39%)	0.44
Emergency department visit for condition	12	10 (4–15%)	11	6 (1–10%)	0.41
Medications used in past 2 weeks					
Prescription inhaler	48	38 (30–47%)	16	9 (5–13%)	0.001
Prescription nasal spray	27	22 (14–29%)	43	25 (18–31%)	0.55
Antihistamines	67	54 (45–62%)	104	59 (52–67%)	0.32
Ever used steroids for breathing problems	47	38 (29–46%)	23	13 (8–18%)	0.001

P-values for Mantel–Haenszel chi-square test for trend (severity), chi-square test (all others).

For asthma, mean age of condition onset = 18 ± 13 years; for rhinitis age of onset = 20 ± 11 years ($P = 0.09$). Age of condition onset missing for five subjects with asthma and five with rhinitis. Self-reported severity missing for one subject with asthma. Of the 125 subjects with asthma, 72 (58%) also reported rhinitis.

tory symptom reporting among those who were not eligible for study on the basis of the physician diagnoses of study interest. Among 254 persons without asthma or rhinitis surveyed, the frequency of at least one of the same five respiratory symptoms as those listed in Table 2 was 38%; only two of these controls (1%), however, reported all five. The most common respiratory symptom among the condition-free group was being awakened by cough ($n = 59$; 23%), while the least common was shortness of breath at rest ($n = 10$; 4%). There were 36 (14%) who reported wheezing.

Measures of work- and non-work-related functional status are summarized in Table 3. Health status measured by the SF-12 battery was similar between the two groups. The mean SF-12 Physical Health Component Score was 47 ± 9 for asthma compared to 49 ± 10 for rhinitis ($P = 0.15$). The mean SF-12 Mental Health Component Score was 50 ± 10 for asthma compared to 48 ± 11 for rhinitis ($P = 0.18$). A similar proportion in both groups (30%) reported any activity limitation in the past month from either lung or nasal symptoms. For the asthma group we also assessed diseased severity using a condition-specific measure. The mean severity of asthma score was 5 ± 4 (median 3; 24th to 75th percentile range 0–7).

In contradistinction to the similarities in general health status and activity indicators, the occupational status of the two groups differed in several aspects. Overall, labor force

participation was significantly lower among those with asthma. Among the asthma group, 12% had not worked at any point since the age of condition onset, compared to only 3% of those with rhinitis alone ($P = 0.002$). When limited to subjects with condition onset before age 18, the difference in rates was similar: the proportions for no labor force participation were 14% among those with asthma and 1% among those with rhinitis alone. Current employment also was reported less frequently among those with asthma (58% vs. 69%, $P = 0.04$).

Despite these differences, among those with asthma currently employed ($n = 72$), compared to those with rhinitis alone ($n = 121$), remarkably similar proportions (24% vs. 23%) reported one or more partial or full lost work day in the previous 4 weeks specifically attributed to their health condition. Partial lost work days were more frequent among those with rhinitis alone, while full lost work days were more frequent among those with asthma, but in neither case was the difference statistically significant. Self-rated work effectiveness was 90% or less among a statistically greater proportion of those with rhinitis ($n = 43$; 36%) compared to asthma ($n = 14$; 19%) ($P = 0.02$).

To further study the inter-relationships among asthma, rhinitis, and work status, we carried out multiple logistic regression analyses using two sets of predictive models, both taking into account the potential demographic differences

Table 3

Functional status, employment, and work loss among subjects with asthma compared to those with rhinitis

	Health condition group		P-value
	Asthma (<i>n</i> = 125)	Rhinitis (<i>n</i> = 175)	
General functional status			
SF-12 physical component score; mean ± SD	47 ± 9	49 ± 10	0.15
SF-12 mental component score; mean ± SD	50 ± 10	48 ± 11	0.18
Activity limitations due to condition (previous month); <i>n</i> , %, (95% CI)	37 30% (22–38%)	52 30% (23–37%)	0.91
Work status			
Labor force participation (LFP) since condition onset; <i>n</i> , %, (95% CI)	110 88% (82–94%)	168 97% (95–100%)	0.002
LFP among subjects with condition onset prior to age 18; <i>n</i> , %, (95% CI)	61 86% (78–94%)	72 99% (96–100%)	0.004
Changed jobs or duties due to condition (among subjects with LFP since onset); <i>n</i> , %, (95% CI)	26 24% (16–32%)	30 18% (12–24%)	0.24
Currently employed; <i>n</i> , %, (95% CI)	72 58% (49–66%)	121 69% (62–76%)	0.04
Any partial or complete lost work days, last 4 weeks due to condition; <i>n</i> , %, (95% CI)	17 24% (14–33%)	28 23% (16–31%)	0.90
Any partial lost work days due to condition last 4 weeks; <i>n</i> , %, (95% CI)	14 19% (10–29%)	24 20% (13–27%)	0.98
Any complete lost work days due to condition last 4 weeks; <i>n</i> , %, (95% CI)	7 10% (3–17%)	16 13% (7–19%)	0.49
Self-rated effectiveness on job ≤90% due to condition last 4 weeks; <i>n</i> , %, (95% CI)	14 19% (10–29%)	43 36% (27–44%)	0.02

P-values for *t*-test (SF-12) and chi-square test (all others).

SF-12 scores missing for five subjects with asthma and two with rhinitis.

Activity limitation missing for two subjects with rhinitis.

LFP since onset missing for two subjects with rhinitis.

Lost work days missing for one subject with asthma.

Three subjects with asthma (none with rhinitis) reported being unable to work due to the condition.

noted previously (Table 4). In the first predictive model, asthma with or without concomitant allergic rhinitis was tested against rhinitis alone. The second model included two asthma risk factors: asthma without concomitant rhinitis and asthma with rhinitis (rhinitis alone as the referent category). Taking into account demographic variables, asthma remained a risk factor for decreased labor force participation since diagnosis and, less potently, for not being currently employed. When re-analyzed in the second model, asthma alone without concomitant rhinitis was an even more potent risk factor for decreased labor force participation (OR = 4.5; 95% CI 1.4–14.3), while asthma with rhinitis (relative to rhinitis alone) was less strongly associated with labor force participation (OR = 2.1; 95% CI 0.7–6.6). The confidence intervals for these two estimates, however, overlap substantially.

Using the same predictive models, those with asthma were significantly less likely to report reduced effectiveness (OR = 0.4; 95% CI 0.2–0.9). This reduced risk was more prominent among those with asthma alone (OR = 0.3; 95% CI 0.1–0.8) than among those with asthma and concomitant allergic rhinitis (OR = 0.6; 95% CI 0.2–1.3), but the CIs overlap. Overall, there was no consistent pattern of differences compared to rhinitis alone for asthma with concomitant rhinitis and asthma without this co-morbidity.

Because some of those with allergic rhinitis appeared likely to have asthma that was undiagnosed or which they did not report, we re-estimated the logistic regressions excluding subjects (*n* = 35) who reported recent bronchodilator use or who reported ever using oral steroids for breathing problems. The association between asthma and decreased labor force participation remained strong (OR = 2.7; 95%

CI 0.99–7.48). For current employment, the point estimate of asthma-associated risk was similar but the confidence intervals were wider (OR = 1.5; 95% CI 0.9–2.5). Finally, those with asthma remained less likely to report decreased work effectiveness (OR = 0.5; 95% CI 0.2–0.97).

4. Discussion

Our findings indicate that both asthma and rhinitis, independently, have major quality-of-life and economic impacts through occupational disability. Occupational disability can take many forms, including decreased labor force participation rates, change of job or job responsibilities due to health reasons, lost work days, or decreased effectiveness on the job because of illness. For asthma, reduced labor force participation appears to be a more prominent disability effect. For rhinitis, decreased work productivity is more common, affecting more than one-third of those we surveyed. Among both groups, lost work days due to illness were common.

Our population-based survey approach to asthma and rhinitis has important strengths and limitations which should be weighted in the interpretation of these findings. Because we performed random digit telephone dialing to recruit our subjects, the respondents we studied should reflect the general population within the geographic region sampled. The key limitations that should be taken into account include potential diagnostic heterogeneity, the reliability of subject self-report of diagnosis and of work status, and the appropriateness of generalizing of our findings.

Population-based studies frequently define disease on the basis of self-reported condition, whether or not the condition in question was reported by the respondent to have

Table 4

Asthma, with or without concomitant rhinitis, as a risk factor for differential work status compared with rhinitis alone (Results of multiple logistic regression analyses)

Work status	Risk groups			
	Rhinitis (referent) OR	All asthma OR (95% CI)	Asthma by rhinitis status	
			Asthma alone OR (95% CI)	Asthma with rhinitis OR (95% CI)
	(<i>n</i> = 173)	(<i>n</i> = 123)	(<i>n</i> = 53)	(<i>n</i> = 70)
No LF participation	1.0	3.0 (1.1–7.7)	4.5 (1.4–14.3)	2.1 (0.7–6.6)
Not currently employed	1.0	1.6 (1.0–2.6)	1.7 (0.8–3.3)	1.6 (0.9–2.8)
	(<i>n</i> = 166)	(<i>n</i> = 109)	(<i>n</i> = 45)	(<i>n</i> = 64)
Job or duty change	1.0	1.3 (0.7–2.4)	1.2 (0.5–2.9)	1.4 (0.7–2.8)
	(<i>n</i> = 120)	(<i>n</i> = 72)	(<i>n</i> = 30)	(<i>n</i> = 42)
Lost work days	1.0	1.1 (0.5–2.2)	0.7 (0.2–2.1)	1.4 (0.6–3.3)
Reduced effectiveness	1.0	0.4 (0.2–0.9)	0.3 (0.1–0.8)	0.6 (0.2–1.3)

Multiple logistic regression includes age, gender, race/ethnicity (non-Hispanic white vs. all others), education (high school or less, some college, vs. graduate), and smoking (current, former vs. never).

No LF participation = No labor force participation since condition onset.

Job or duty change = changed jobs or changed duties within a job secondary to condition.

Lost work days = lost complete or partial work days due to condition in 4 weeks prior to interview.

Reduced effectiveness = Self-rated job effectiveness \leq 90% due to condition in 4 weeks prior to interview.

For analyses of no LF participation and not currently employed, four subjects excluded because of missing data for at least one covariate.

For job change, analysis limited to those with labor force participation since condition onset (*n* = 278), excluding three further subjects with missing data.

Lost work days and effectiveness analyses limited to currently employed subjects (*n* = 193), further excluding one subject for missing data.

been diagnosed by a physician. For example, this approach is used by the U.S. National Health Interview Survey (NHIS), upon which many estimates of disease prevalence are based. In a validation study of the NHIS by the National Center for Health Statistics (NCHS), comparison of interview data with medical records showed that the interview performed moderately well in identifying asthma by self-report, but did poorly for “allergic rhinitis without asthma” and “chronic sinusitis,” especially when these were treated as separate condition categories [11].

The NCHS assessment of this problem is particularly relevant to our methods [11]:

First, chronic sinusitis and allergic rhinitis may be easily confused. In the NHIS recode definitions, allergic rhinitis includes hay fever, pollinosis, and spasmodic rhinorrhea, but chronic sinusitis includes postnasal drip and sinus drainage. For example, some respondents may consider postnasal drip to be a symptom of allergy rather than sinusitis. Second, both allergic rhinitis and chronic sinusitis are frequently self-treated. . . . Review of mismatched medical records and interviews revealed that often these two conditions occur in tandem.

Even after combining the self-reported conditions not based on a reported physician diagnosis, the NCHS observed a kappa value of only 0.16 for rhinitis or chronic sinusitis (as a measure of medical record agreement), compared to 0.55 for asthma.

In contrast to the NHIS approach, our case definition required report of a physician diagnosis. For asthma, a recent study from Finland found that of 335 subjects recruited

from the general public on the basis of subject self-report of a physician diagnosis of asthma, for 293 (87%) medical records confirmed or made probable the diagnosis, whereas 14 were felt to only have “possible asthma” and 12 were found more likely to be smoking-related COPD (the age range of those recruited was 16–83 years) [12]. The same study also asked these subjects whether they had physician-diagnosed “allergic rhinitis.” Among 159 reporting the concomitant physician diagnosis of allergic rhinitis, 57% were atopic based on response to common aero-allergens by the Phadiatop method (positive predictive value) [12]. Among 115 with asthma not reporting allergic rhinitis, 36 (31%) were atopic by that test. Among family members without asthma, a reported physician diagnosis of allergic rhinitis had a lower positive predictive value of 43%.

Although our definition of asthma, based on subject report of physician diagnosis, is likely to be reliable, we recognize that the definition of rhinitis we used is broad and heterogeneous, subsuming allergic rhinitis (both perennial and seasonal), non-allergic rhinitis, and sinusitis of multiple etiologies. To the extent that this broad definition misclassifies persons with trivial or unrelated conditions, it would be more likely to weaken rather than strengthen the observed associations, making our findings, if anything, conservative.

Moreover, despite our wide study definition of rhinitis, it is probable that the predominant diagnostic group represented is allergic rather than non-allergic upper airway disease. This interpretation is consistent with the most common specific diagnoses reported among our subjects (hay fever, allergic rhinitis and allergic sinusitis) and with the fact that chronic sinusitis is a common comorbidity [13]. It

is also consistent with the relative frequency of rhinitis among the study subjects with asthma. A recent study of 1245 persons with asthma under 65 years of age found that 653 (52%) had medical record documentation of concomitant allergic rhinitis [14]. This compares to 58% among our asthma sample reporting rhinitis by our broader case definition.

If some of those with rhinitis have undiagnosed or diagnosed but unreported asthma, this would tend to make the rhinitis group appear closer to the asthma group. Studies of those without reported asthma but with rhinitis suggest that increased nonspecific airways reactivity is more common than in the general population [15]. Furthermore, the medication use patterns and lower respiratory symptoms reported by the rhinitis group (although some of the “breathing” symptoms in this group may have been misreporting of upper airway complaints) suggest that at least some of those with rhinitis alone were in fact likely to have asthma, whether or not they have ever received that diagnosis. Nonetheless, this would not explain a greater prevalence for any finding among those with rhinitis alone (for example, impaired work effectiveness) nor were estimates substantially affected by excluding from the rhinitis group those most likely to have asthma.

The measures of general functional and employment status that we used were based on self-report. We did not confirm work absences with employment records. Comparison of face-to-face interviews with telephone-administered, computer-assisted (CATI) interviews, has found that subjects are more likely to report lost work days by CATI, but that study could not confirm which was the more accurate measure [16]. Self-assessed work effectiveness is a qualitative measure. The survey item we used was originally validated in a study of the work impact of migraine headaches, not asthma or rhinitis [10]. It is important to note that there was no incentive for our subjects to report or deny work limitations, given that the study population was recruited independent of any insurance or disability assessment or reimbursement mechanism.

There may be other limitations to generalizability. Were our subjects to represent a severe spectrum of disease, we might be overestimating the impact of asthma and rhinitis on work limitations among all those with these conditions. This is unlikely to be the case. As a measure of general health status, the mean PCS-12 and MCS-12 scores were close to those reported for the general population of similar age range, with a decrement consistent with that attributable to a co-morbid condition [7,8]. Condition-related urgent care visits were reported by less than a third of the group and hospitalization was infrequent, even among those with asthma. Moreover, asthma-specific severity scores for the group were lower than for subjects recruited from clinical settings, consistent with milder disease in this study group [9]. Nonetheless, we did not have clinical measures of severity, such as lung function measurement or radiographic scoring of sinus disease, that might allow further characterization of condition severity.

Although the population we studied did not appear to have severe disease, they may have differed from all persons with these conditions in other ways. Our subjects reported a high proportion of health insurance coverage which may reflect selection bias inherent in requiring a report of a physician’s diagnosis for study eligibility. The population of Northern California may differ from other regions in type of disease. NHIS data, for example, show that the West is the only region of the U.S. where the prevalence of reported hay fever or allergic rhinitis without asthma is greater than the prevalence of reported chronic sinusitis [17]. Finally, our study was carried out in late spring and early summer, thus potentially over-representing the impact of seasonal allergic rhinitis, particularly to weeds and grasses. Aero-allergen data specific to Southern California show peak weed and grass pollens April through July, with tree allergens peaking earlier in the spring and fungal spores demonstrating variability more related to wetness of season than time of year [18]. Although our study population was from Northern California, which differs somewhat climatically, other data have shown little difference in the patterns of atopy by region in California among patients with symptomatic allergic rhinitis or asthma [19].

Previous studies have emphasized the indirect health costs of asthma and of rhinitis attributable to work disability. Our study provides further evidence that this is indeed an important problem among both conditions, either separately or when concomitant. In particular, these data suggest that rhinitis, which is more common than asthma, may actually have a bigger impact among those who stay in the labor force “working through” their symptoms.

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