Asthma and Smoking Status in a Population-Based Study of California Adults

Mark D. Eisner, MD, MPH[a]
Edward H. Yelin, PhD[b]
Laura Trupin, MPH[c]
Paul D. Blanc, MD, MSPH[d]

SYNOPSIS

Objective. Because they experience respiratory symptoms, adults with asthma might be expected to avoid cigarette smoking. However, previous studies have not adequately addressed whether adults with asthma have a lower prevalence of smoking than the general population. The authors sought to determine whether adult asthmatics are less likely to smoke cigarettes than members of the general population.

Methods. The authors used data from a random sample of 2,902 California adults ages 18 years or older, with oversampling of African Americans, Asian/Pacific Islanders, adults with disabilities, and adults aged 45 to 70 years. Sampling weights were used in all analyses. In this cross-sectional study, 217 participants (7.5%) reported a physician diagnosis of asthma.

Results. The prevalence of "ever smoking" was similar among adults with asthma (48.3%) and those without asthma (43.0%) (risk difference 5.3%; 95% CI –1.6%, 12.2%). There was also no difference in the prevalence of "current smoking" among adults with asthma (20.2%) compared with the non-asthmatic subjects (18.8%) (risk difference 1.4%; 95% CI –4.2%, 6.9%). After controlling for age, gender, race, and education, there was no evidence that adults with asthma were less likely to ever smoke. Although the confidence intervals did not exclude "no association," asthma was actually associated with an increased risk of ever smoking (OR 1.3; 95% CI 1.0, 1.8). There was also no association between asthma and the risk of current smoking after controlling for covariates (OR 1.1; 95% CI 0.8, 1.6). Moreover, there were no differences in "age of smoking initiation," "duration of smoking," or "intensity of smoking" after adjusting for demographic characteristics. Redefining the referent group to exclude respondents with other chronic lung diseases did not appreciably change study conclusions.

Conclusion. Adults with asthma do not appear to selectively avoid cigarette smoking. Specific smoking prevention and cessation efforts should be targeted to adults with asthma.

[a] Division of Occupational and Environmental Medicine and the Division of Pulmonary and Critical Care Medicine, Department of Medicine, University of California, San Francisco

[b] Department of Medicine and the Institute for Health Policy Studies; Principal Investigator for the California Work and Health Study, University of California, San Francisco

[c] Institute for Health Policy Studies and Co-Principal Investigator for the California Work and Health Study, University of California, San Francisco

[d] Division of Occupational and Environmental Medicine, Department of Medicine, and the Cardiovascular Research Institute, University of California, San Francisco

This work was supported by a grant from the California Wellness Foundation and by National Heart, Lung, and Blood Institute awards K04 HL03225 (Dr. Eisner) and K23 HL04201 (Dr. Blanc).

Address correspondence to: Mark D. Eisner, MD, MPH, UCSF, 350 Parnassus Ave., Suite 609, San Francisco, CA 94117; tel. 415-476-7351; fax 415-476-6426; e-mail <eisner@itsa.ucsf.edu>.

Cigarette smoking adversely affects adults with asthma, resulting in greater asthma symptoms, more rapid decline in pulmonary function, and higher rates of hospitalization.[1–3] As a result, adults with asthma might be expected to avoid cigarette smoking. Nonetheless, smoking appears to be common among U.S. adults with asthma.[4–9] Whether adults with asthma are less likely to smoke than the general population remains uncertain, because previous studies have not controlled for demographic correlates of smoking, such as age and educational attainment. In a population-based sample of California adults, the present study evaluates the association between asthma and cigarette smoking. We hypothesized that adults with asthma would be less likely to initiate and maintain cigarette smoking, resulting in a lower prevalence of ever and current smoking.

METHODS

We used data from the California Work and Health Survey, a population-based telephone survey of California adults (EHY was the principal investigator, and LT was co-principal investigator). The interview was conducted twice with independent samples, in 1998 (n = 1,771) and 1999 (n = 1,131). In the combined sample of 2,902 participating subjects, we examined whether adults with asthma have a lower likelihood of cigarette smoking than members of the general population.

Sample recruitment

The methods of random sample recruitment have been previously reported in detail.[10] Of the 1,771 participating subjects in 1998, 1,500 were selected by random digit dialing. Up to six attempts were made to contact an adult household member (ages 18 years or older) by telephone. To increase the accuracy of survey estimates among selected groups of interest, an additional 271 interviews were conducted among African Americans, Asian/Pacific Islanders, and adults with disabilities. Each group was randomly oversampled using previously described procedures.[10] A screening question determined whether the respondent was a member of the particular group of interest. In all analyses, we employed sampling weights to account for oversampling. The sampling weights were developed for the overall survey using a denominator based on the estimated 1998–1999 California population.[11]

In 1999, the same methods were used to recruit a second random sample of California adults. Of the 1,131 subjects, 700 were obtained through random digit dialing. An additional 431 subjects were randomly oversampled among African Americans, Asian/Pacific Islanders, and adults with disabilities. Unlike the first survey, adults ages 45 to70 years were also oversampled, using a screening age question at interview initiation. The completion rates for the 1998 and 1999 surveys were both 57%.

The survey ascertained whether respondents were of Latino or Hispanic descent. Respondents further indicated their race/ethnicity by choosing from several categories: "white," "black/African American," "Asian/Pacific Islander," or "other." To assess disability, a survey item asked respondents if they were limited in their activities by a long-term physical or mental impairment.

Survey interviews included a list of common chronic health conditions. Subjects were asked whether they had ever received a physician diagnosis of each condition. In this study, we defined adults with asthma as respondents who reported ever having a physician diagnosis of asthma. In our primary analysis we did not consider respondents who also indicated ever receiving a physician diagnosis of "a chronic lung disease, like emphysema or chronic bronchitis," to have asthma. Although there is no "gold standard" for asthma diagnosis, self-reported physician-diagnosed asthma has been commonly employed in survey research.[12–14]

Survey instrument

Interviews were conducted in either English or Spanish depending on the subject's language preference. The survey included extensive coverage of employment status, demographic characteristics, and physical health status. Cigarette smoking was evaluated using standard questions.[15] We assessed the prevalence of ever smoking using the following question: "Have you smoked at least 100 cigarettes in your entire life?" Interviews also ascertained current smoking, age of smoking initiation, duration of smoking, and daily cigarette consumption.

We examined demographic and personal characteristics that are potentially related to cigarette smoking. In the survey, household income was ascertained as a series of $20,000 increments, with more detailed query for income less than $40,000. We defined *low income* as less than 125% of the federal poverty line.[16] Self-rated general health was assessed with a question developed for the National Health Interview Survey and used in the SF-36 questionnaire, the most widely used generic health status instrument.[17] We defined blue-collar occupations as service, manual, or agricultural occupations.

Statistical analysis

We performed statistical analysis using SAS 6.12 (SAS Institute, Cary, NC). In all analyses, sampling weights were used to account for oversampling of African Americans, Asian/Pacific Islanders, adults with disabilities, and adults aged 45 to70 years. We report weighted results in all instances, including prevalence proportions. For bivariate comparisons, we used the *t*-test for continuous, normally distributed variables, the Wilcoxon signed-rank test for continuous non-normal variables, and the chi-square test for dichotomous variables.

To evaluate whether adults with asthma are more or less likely to ever smoke cigarettes than the general population after controlling for potential confounding factors, we fit a series of nested logistic regression models that adjusted for demographic covariates. The impact of each covariate set was evaluated using the likelihood ratio test.[18] The first model included constitutional factors that have been previously linked with smoking: age, gender, and race.[15,19–21] The next model included educational attainment, an important socioeconomic indicator.[15,19,20,22] Based on the survey, we defined education in three categories: "high school or less," "some college," or "completed college or greater." The final model contained low household income (less than 125% of federal poverty line), an additional socioeconomic variable.[23] Because present income may not reflect a person's income at the time of smoking initiation, this model was considered separately. To assess the association between asthma and current smoking, we employed the same analytic approach using a series of nested logistic regression models to control for demographic covariates.

The prevalence of cigarette smoking changes with age.[15,20,24] As age increases, the prevalence of ever smoking increases, whereas current smoking decreases. Because smoking and age are related, we examined whether the association between asthma and smoking varied by age. Based on *a priori* clinical grounds, we defined three age categories: 18 to 35 years, 36 to 50 years, and 51 years or older. The 50-year cut-point is commonly chosen to reduce misclassification of chronic obstructive pulmonary disease as asthma.[7,25] In bivariate analysis, we used the Breslow-Day test to evaluate heterogeneity in the relationship between asthma and smoking among the three age categories (i.e., evidence of interaction between age and asthma). In multiple logistic regression, we evaluated models (as described above) with addition of age–asthma interaction terms using the likelihood ratio test. We used a conservative *P* value cut-off to indicate a potentially significant interaction ($P < 0.20$).

Multiple linear regression was used to evaluate whether adults with asthma had lower duration (years) and intensity of smoking, after controlling for demographic covariates. We defined smoking intensity as daily cigarette consumption (packs/day) and cumulative intensity (pack-years). For non-normally distributed outcome variables, we performed logarithmic transformation for multivariate analysis that controlled for age, gender, race, and education.

We performed sensitivity analyses to evaluate the impact of other chronic lung disease, such as chronic bronchitis and emphysema, on the relationship between asthma and smoking. The general population referent group may contain some subjects with smoking-related chronic obstructive pulmonary disease, which could diminish observed differences in smoking between adults with asthma and the referent group. To address this possibility, we repeated key analyses excluding from the referent group subjects who also reported a physician diagnosis of another chronic lung disease. We also evaluated the impact of excluding subjects with other concomitant chronic lung disease from our asthma definition by repeating key analyses using an alternate asthma definition that did not exclude these subjects.

RESULTS

Asthma and personal characteristics

A significant proportion of subjects reported physician-diagnosed asthma ($n = 217$; 7.5%; 95% CI 6.5%, 8.5%). Compared with the general population, respondents with asthma were three years younger and less likely to be married (Table 1). Fewer adults with asthma reported birth outside the United States. Other demographic characteristics were similar, with no statistical differences in gender, race, or socioeconomic indicators such as educational attainment, income, or current employment (Table 1). Although adults with asthma were more likely to indicate additional nonrespiratory chronic health conditions (64% vs. 54%), there were no differences in self-assessed general health status (60% vs. 62% reporting excellent or very good health).

Asthma and the prevalence of cigarette smoking

The prevalence of ever smoking was similar among adults with asthma (48.3%) and those without asthma (43.0%) (risk difference 5.3%; 95% CI −1.6%, 12.2%). Similarly, there was no difference in the prevalence of current smoking among adults with asthma (20.2%) compared with non-asthmatic subjects (18.8%) (risk difference 1.4%; 95% CI −4.2%, 6.9%). Paralleling

Table 1. Demographic and personal characteristics of people with and without asthma[a]

Characteristic	*Asthma (n = 217)*		*No asthma (n = 2685)*		*P value*	*Proportion of respondents with asthma (%)[b]*
Age (mean yr ± sd)	*39.9 ± 15.5*		*42.9 ± 14.4*			
Age category			0.26			
18–35 years	100	(46%)	1084	(40%)		8.5
36–50 years	59	(27%)	810	(30%)		6.8
51 years	58	(27%)	790	(29%)		6.8
Gender					0.98	
Female	108	(50%)	1328	(50%)		7.5
Male	109	(50%)	1357	(50%)		7.5
Race/ethnicity					0.6	
White, non-Hispanic	129	(59%)	1553	(58%)		7.7
Other	88	(41%)	1132	(42%)		7.2
Educational attainment					0.1	
High school or less	65	(30%)	984	(37%)		6.2
Some college	84	(39%)	881	(33%)		8.7
Completed college or greater	69	(32%)	821	(31%)		7.7
Low income[c]	32	(15%)	455	(17%)	0.4	6.5
Married (or cohabitating)	91	(42%)	1320	(49%)	0.04	6.4
Foreign born (outside U.S.)	27	(13%)	697	(26%)	0.001	3.7
Currently employed[d]	139	(76%)	1563	(76%)	0.99	8.2
Blue-collar occupation	30	(14%)	532	(20%)	0.03	5.3
Any nonrespiratory chronic health condition	140	(64%)	1452	(54%)	0.003	8.8
General health			0.5			
Excellent or very good	130	(60%)	1652	(62%)		7.3
Good or fair	75	(35%)	922	(34%)		7.5
Poor	10	(5%)	108	(4%)		8.5

[a]All results are weighted to account for over-sampling of African Americans, Asian/Pacific Islanders, persons with disabilities, and persons aged 45 to 70 years.

[b]Proportion of respondents in each category indicating physician-diagnosed asthma (i.e., row proportion)

[c]Low income category corresponds to <125% of poverty level.

[d]Current employment among persons not retired or students (*n* = 2233)

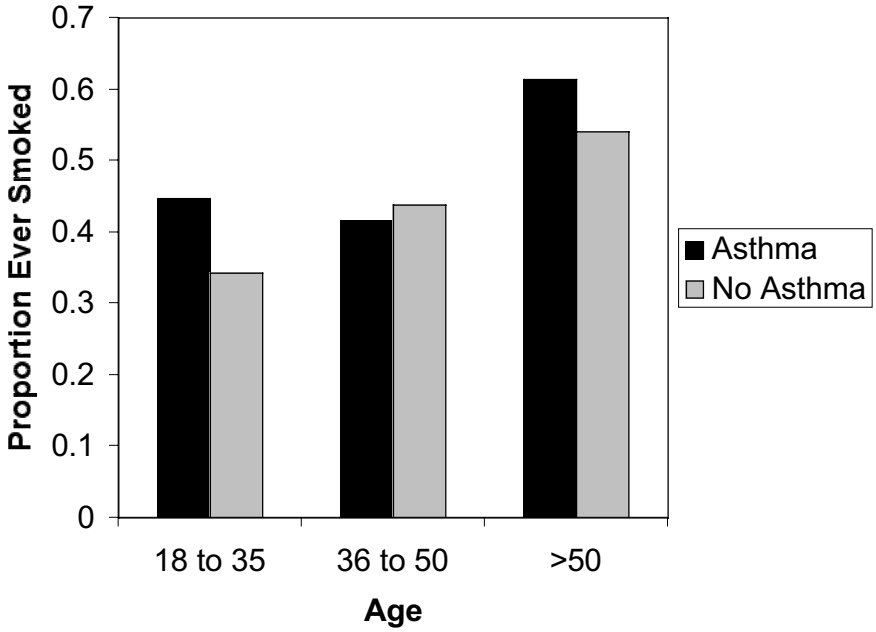
these findings, there was also no difference in the prevalence of former smoking (28.1% vs. 24.2%) (risk difference 3.9%; 95% CI −2.3%, 10.1%.)

As shown in Figure 1, the prevalence of ever smoking was similar among adults with and without asthma in each age category (18 to 35 years, 36 to 50 years, and 51 years or older). There was no evidence of heterogeneity by age group (Breslow-Day test, $P = 0.3$). Conversely, the prevalence of current smoking appeared to vary by age category (Fig. 2; Breslow-Day test, $P = 0.14$). In the youngest age group (18 to 35 years), current smoking was more common among adults with asthma (27.6%) than among non-asthmatic subjects (20.4%). Among adults aged 36 to 50 years, the prevalence of current smoking was similar in adults with (17.0%) and without asthma (19.3%). In the older subjects (> 50 years), current smoking was less common among adults with asthma (10.6%) than among non-asthmatic subjects (16.2%).

Association between asthma and ever smoking

As shown in Table 2, there was no significant association between asthma and the risk of ever smoking (OR 1.2; 95% CI 0.9, 1.6). To further examine whether asthma was related to ever smoking cigarettes, we fit a series of nested logistic regression models to control for variables known to affect the risk of smoking. In each nested model the addition of covariates

Figure 1. Prevalence of "ever smoking" among adults with and without asthma. The graph depicts the proportion of subjects in each age group who reported ever smoking. Among the 2,902 adult subjects, 217 (7.5%) indicated physician-diagnosed asthma. There were 1,184 subjects aged 18 to 35 years, 869 subjects aged 36 to 50 years, and 848 subjects aged 51 years or older. Data are weighted to account for oversampling of specific demographic subgroups.



significantly improved model fit. Controlling for constitutional factors (age, gender, and race), there was no indication that adults with asthma were less likely to ever smoke. Asthma was actually related to a greater risk of ever smoking, although the confidence intervals did not exclude "no association" (OR 1.3; 95% CI 1.0, 1.7). Adding education and low income to the model did not appreciably affect the point estimate or confidence interval (Table 2). Similarly, controlling for other nonrespiratory chronic health conditions, blue-collar occupation, and foreign-born status did not affect these results (data not shown). There was

Table 2. The assocation between asthma and ever smoking cigarettes[a]

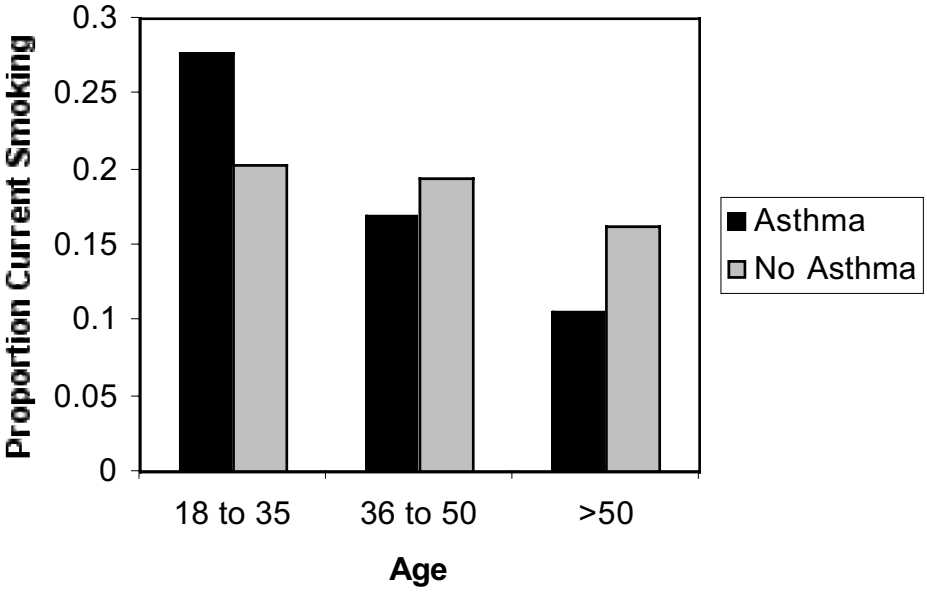
Variables included in model[b]	*OR*	*(95% CI)*	*Difference in model χ^2 (df) for additional covariates*[c]	*P value for additional covariates*
Asthma only	1.2	(0.9 to 1.6)	—	—
Asthma, age, gender, race	1.3	(1.0 to 1.7)	151.2 (4)	<0.0001
Asthma, age, gender, race, and education	1.3	(1.0 to 1.8)	65.0 (2)	<0.0001
Asthma, age, gender, race, education, and income	1.3	(1.0 to 1.8)	3.9 (1)	0.05

[a]All results are weighted to account for over-sampling of African Americans, Asian/Pacific Islanders, persons with disabilities, and persons aged 45 to 70 years

[b]Race = white, non-Hispanic vs. non-white; education = high school or less, some college, or completed college or higher level; income = lowest quartile vs. upper three quartiles

[c]Difference in model chi-square illustrates impact of adding each set of covariates on logistic regression model fit.

Figure 2. Prevalence of "current smoking" among adults with and without asthma. The graph depicts the proportion of subjects in each age group who reported current smoking. As for Figure 1, among the 2,902 adult subjects, 217 (7.5%) indicated physician-diagnosed asthma. There were 1,184 subjects aged 18 to 35 years, 869 subjects aged 36 to 50 years, and 848 subjects aged 51 years or older. Data are weighted to account for oversampling of specific demographic subgroups.



no evidence that age modified the relationship between asthma and ever smoking (p for interaction = 0.44).

Association between asthma and current smoking

In the multiple logistic regression model, there was modest evidence that the association between asthma and current smoking varied by age category (p for interaction = 0.18). The results are presented with and without consideration of effect modification by age.

As shown in Table 3, there was no association between asthma and the risk of current smoking in the model without age–asthma interaction (OR 1.1; 95% CI 0.8, 1.5). Controlling for constitutional factors (age, gender, and race), there was still no apparent relationship between asthma and current smoking (OR 1.1; 95% CI 0.8, 1.5). Although controlling for educational attainment improved model fit, there was no appreciable effect on the point estimate or confidence interval (Table 3). Addition of low income did not improve model fit. Furthermore, controlling for foreign born status, blue-collar occupation, and other nonrespiratory chronic conditions did not alter these results (data not shown).

When the interaction between age and asthma was considered, asthma was associated with an increased likelihood of current smoking among respondents ages 18 to 35 years, after adjusting for constitutional factors and education (OR 1.5; 95% CI 0.93, 2.4). However, the confidence interval did not exclude "no association." There was no apparent association between asthma and current smoking in the 36 to 50 years group (OR 0.9; 95% CI 0.5, 1.9) or in those older than 50 years (OR 0.6; 95% CI 0.3, 1.5).

Duration and intensity of smoking

Among the ever smoking subjects, there was no difference in the age of smoking initiation among adults with asthma (17.0 years) and those without asthma (17.1 years; Table 4). Compared to smokers in the general population, adults with asthma indicated a shorter duration of smoking (median 14 years vs. 18 years, p = 0.03). After controlling for demographic covariates in multiple linear regression analysis, there was no statistical difference in duration of smoking

Table 3. The assocation between asthma and current smoking[a]

Variables included in model[b]	*OR*	*(95% CI)*	*Difference in model χ^2 (df) for additional covariates*[c]	*P value for additional covariates*
Asthma only	1.1	(0.8 to 1.5)	—	—
Asthma, age, gender, race	1.1	(0.8 to 1.5)	25.9 (4)	<0.0001
Asthma, age, gender, race, and education	1.1	(0.8 to 1.6)	54.6 (2)	<0.0001
Asthma, age, gender, race, education, and income	1.1	(0.8 to 1.6)	1.6 (1)	0.2

[a]All results are weighted to account for over-sampling of African-Americans, Asian / Pacific Islanders, persons with disabilities, and persons aged 45-70 years

[b]Race = white, non-hispanic vs. non-white; education = high school or less, some college, or completed college or higher level; income = lowest quartile vs. upper three quartiles

[c]Difference in model chi-square illustrates impact of adding each set of covariates on logistic regression model fit.

($p = 0.4$). There were also no appreciable differences in daily cigarette consumption or cumulative smoking intensity (Table 4).

Relationship between asthma and smoking: impact of chronic lung disease

To further examine the association between asthma and smoking, we repeated key analyses comparing adults with asthma to members of the general population who did not report other chronic lung disease, such as chronic bronchitis or emphysema ($n = 2{,}551$). These analyses yielded results similar to those using the general population referent group without exclusions for chronic lung disease. The prevalence of ever smoking was similar among adults with asthma (48.3%) and those without asthma or other chronic lung disease (41.7%) (risk difference 6.6%; 95% CI −2.6%, 13.6%). The prevalence of smoking was also comparable in the two groups (20.2% and 18.5%; risk difference 1.7%; 95% CI −3.8%, 7.3%). There was no evidence that adults with asthma were less likely to ever smoke, controlling for age, gender, race, education, and low income (OR 1.4; 95% CI 1.0, 1.8). Controlling for the same covariates, there was no statistical relationship between asthma and current smoking (OR 1.1; 95% CI 0.8, 1.6). Moreover, there were no differences in smoking duration or intensity (data not shown).

Table 4. Duration and intensity of cigarette smoking among ever smokers[a]

Duration of smoking	*Asthma (n = 105)*	*Non-asthma (n = 1154)*	*Bivariate P value*[b]	*Adjusted P value*[c]
Age of smoking initiation (mean yr)	17.0 ± 4.0	17.1 ± 4.6	0.6	0.7
Duration of smoking (median yr)	14 (5–28)	18 (7–30)	0.03	0.4
Daily cigarette consumption (median packs/day)	0.5 (0.3–1.0)	0.5 (0.25–1.0)	0.6	0.7
Cumulative smoking intensity (median packs/year)	7.5 (1.4–25)	10.5 (2.5–26)	0.15	0.3

[a]All results are weighted to account for over-sampling of African Americans, Asian/Pacific Islanders, persons with disabilities, and persons aged 45 to 70 years.

[b]*t*-test for age of smoking initiation, Wilcoxon-signed rank test for all other bivariate analyses.

[c]Adjusted for age, gender, race, and education by multiple linear regression analysis. Log transformation was used for, duration of smoking, daily cigarette consumption, and cumulative smoking intensity.

[d]Means are presented with standard deviations, medians with 25th to 75th interquartile range.

We also examined the relation between asthma and smoking status, redefining 53 subjects who indicated both asthma and another chronic lung disease as having asthma (total $n = 270$). There was still no evidence that adults with asthma were less likely to smoke than members of the general population. As redefined above, asthma was associated with a greater risk of ever smoking (OR 1.5; 95% CI 1.2, 2.0), controlling for age, gender, race, education, and income. There was no statistical relationship between asthma and risk of current smoking (OR 1.1; 95% CI 0.8, 1.6), controlling for the same covariates.

DISCUSSION

Because adults with asthma experience respiratory symptoms, they might be expected to avoid cigarette smoking. In this population-based study, however, we found no evidence that asthmatics selectively avoid smoking. Even after controlling for variables related to the risk of smoking, there was no indication that adults with asthma had a lower prevalence of ever smoking or current- smoking than the general population. We also found no evidence that adult asthmatics have reduced duration or intensity of smoking. Contrary to expectation, cigarette smoking by adults with asthma constitutes a significant public health problem.

Several earlier studies demonstrated a similar prevalence of smoking among adults with and without asthma residing in the United States.[4,6,9,13,26,27] However, none of these studies adequately controlled for the potential confounding effects of demographic characteristics that are strongly associated with smoking status. Older age, female gender, white race, lower educational attainment, and low income have been strongly linked with cigarette smoking.[15,19–23] The best controlled previous study found no association between asthma and the prevalence of current smoking among Australian adults, after controlling for age, gender, and occupation.[28] Nonetheless, the investigators did not adjust for race, income, or educational attainment, the most potent correlates of smoking.[15,19,20,22] In the present study, we addressed these limitations by using population-based data and controlling for important demographic covariates.

We found modest evidence that adults with asthma have a higher prevalence of ever smoking than the general population. Younger respondents with asthma (ages 18 to 35 years) also appeared to have a greater prevalence of current smoking than those without asthma. It seems unlikely that people with previously established asthma initiate smoking at a greater rate than those without asthma. Alternatively, smoking initiation during young adulthood may increase the risk of developing asthma or asthma-like symptoms. Supporting this view, several prospective cohort studies have linked cigarette smoking with a greater risk of incident asthma.[13,29–31]

Conclusions from the present study are subject to several limitations. Based on the survey, we identified respondents who indicated *ever* having a physician diagnosis of asthma. However, the survey did not assess *current* self-reported asthma status, respiratory symptoms, or medication use. Previous investigators found that self-report of ever having physician-diagnosed asthma is highly specific for current bronchial hyperresponsiveness among adults.[32] This finding supports the validity of using "ever" asthma to identify adults with current asthma. Even so, we cannot exclude the possibility that some subjects with asthma could have had remote asthma that subsequently underwent remission by adulthood.[33] Although up to 60% of children and young adults with asthma may experience remission during the following decade, the remission rate drops sharply with age to about 10% among adults older than 18 years.[34] In a cohort of adolescents and young adults with asthma, only 11% had remission of asthma during a 25-year follow-up period.[35] Of those who experience remission, nearly half have a subsequent relapse of asthma.[33,34] Based on these findings, we believe that most adults who report ever having a physician diagnosis of asthma have adult asthma. Nonetheless, the lack of specific information on current asthma remains a study limitation.

Although subjects reported physician-diagnosed asthma, we cannot exclude some misclassification of asthma status, especially with chronic obstructive pulmonary disease (COPD). In survey-based research, there is no fully satisfactory method for addressing the potential overlap between asthma and COPD.[14] Because adults with asthma can also have concomitant chronic bronchitis or emphysema, excluding these subjects may affect the study's target population of adults with asthma. As used in previous epidemiologic surveys, our approach was to define asthma by excluding subjects who also reported emphysema, chronic bronchitis, or other chronic lung disease to reduce misclassification with smoking-related COPD.[12,27] When we repeated key analyses using an alternate definition of asthma that did not exclude other chronic lung disease, there was still no evidence that adults with asthma are less likely to smoke than members of the general population.

The reliance on self-reported smoking habits could result in misclassification of some subjects. In particular, respondents with asthma may be reluctant to admit

current smoking. Furthermore, we had inadequate study power to evaluate the impact of asthma on longitudinal smoking initiation and cessation. Because we studied adults living in California, a state with a lower prevalence of smoking than nationwide, generalizability of these results to other geographic areas may be reduced.[36]

The relatively low survey response rate (57%) could have introduced selection bias. In the present study, the prevalence of current smoking (18.9%) is similar to that reported in California (19.2%).[36] Similarly, the observed prevalence of asthma (7.5%) is similar to that in California (7.1%).[37] Based on these findings, non-response probably did not significantly bias the observed relationship between smoking and asthma.

Although the prevalence of current smoking has declined since the 1960s, recent reports indicate a plateau in these trends.[15,38] Among adolescents, the incidence of smoking initiation increased by 50% during the 1990s.[24] At the same time, the morbidity and mortality from asthma markedly increased. In the past decade, the prevalence of asthma increased by 75% and the mortality rate more than doubled.[39] Because adults with asthma do not appear to selectively avoid cigarette smoking, the public health impact of these national smoking trends on adults with asthma will likely be substantial.

At the same time, there is a general belief in the scientific and medical communities that patients with asthma are unlikely to smoke.[40] This attitude is unfortunate, because it may reduce clinical and policy opportunities to intervene with smoking cessation efforts in this vulnerable group. Smoking cessation programs that specifically target adults with asthma could have particular efficacy. In a controlled clinical trial, a smoking cessation program that incorporated measures of respiratory symptoms and lung function was more effective than a traditional smoking cessation program.[41] Increased recognition that adults with asthma do not selectively avoid smoking should stimulate policy efforts that facilitate smoking cessation programs designed for adults with asthma.

REFERENCES

1. Althuis MD, Sexton M, Prybylski D. Cigarette smoking and asthma symptom severity among adult asthmatics. J Asthma 1999;36:257-64.
2. Lange P, Parner J, Vestbo J, Schnohr P, Jensen G. A 15-year follow-up study of ventilatory function in adults with asthma. N Engl J Med 1998;339:1194-1200.
3. Sippel JM, Pedula KL, Vollmer WM, Buist AS, Osborne ML. Associations of smoking with hospital-based care and quality of life in patients with obstructive airway disease. Chest 1999;115:691-6.
4. Burrows B, Barbee RA, Cline MG, Knudson RJ, Lebowitz MD. Characteristics of asthma among elderly adults in a sample of the general population. Chest 1991; 100:935-42.
5. Cline MG, Dodge R, Lebowitz MD, Burrows B. Determinants of percent predicted FEV1 in current asthmatic subjects. Chest 1994;106:1089-93.
6. Enright PL, McClelland RL, Newman AB, Gottlieb DJ, Lebowitz MD. Underdiagnosis and undertreatment of asthma in the elderly. Cardiovascular Health Study Research Group. Chest 1999;116:603-13.
7. Osborne ML, Vollmer WM, Linton KL, Buist AS. Characteristics of patients with asthma within a large HMO: a comparison by age and gender. Am J Respir Crit Care Med 1998;157:123-8.
8. Troisi RJ, Speizer FE, Rosner B, Trichopoulos D, Willett WC. Cigarette smoking and incidence of chronic bronchitis and asthma in women. Chest 1995;108:1557-61.
9. Schachter EN, Doyle CA, Beck GJ. A prospective study of asthma in a rural community. Chest 1984;85:623-30.
10. California Work and Health Survey, 1999. Available from: URL: www.medicine.ucsf.edu/programs/cwhs
11. State of California. Department of Finance. Race/ethnic population with age and sex detail, 1970–2040. Available from: URL: www.dof.ca.gov/html/demograp/data.htm
12. McWhorter WP, Polis MA, Kaslow RA. Occurrence, predictors, and consequences of adult asthma in NHANESI and follow-up survey. Am Rev Respir Dis 1989;139: 721-4.
13. Dodge RR, Burrows B. The prevalence and incidence of asthma and asthma-like symptoms in a general population sample. Am Rev Respir Dis 1980;122:567-75.
14. Toraen K, Brisman J, Jearvholm B. Asthma and asthma-like symptoms in adults assessed by questionnaires: a literature review. Chest 1993;104:600-8.
15. Cigarette smoking among adults—United States, 1997. MMWR Morb Mortal Wkly Rep 1999;48:993-6.
16. Census Bureau, Statistical Abstract of the United States. Available from: URL: www.census.gov/prod/3/98pubs/98statab.htm
17. Ware JE, Jr., Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care 1992;30:473-83.
18. Hosmer DW, Lemeshow S. Applied logistic regression. New York: John Wiley and Sons; 1989.
19. Escobedo LG, Anda RF, Smith PF, Remington PL, Mast EE. Sociodemographic characteristics of cigarette smoking initiation in the United States: implications for smoking prevention policy. JAMA 1990;264:1550-5.
20. Escobedo LG, Peddicord JP. Smoking prevalence in US birth cohorts: the influence of gender and education. Am J Public Health 1996;86:231-6.
21. Fiore MC, Novotny TE, Pierce JP, Hatziandreu EJ, Patel KM, Davis RM. Trends in cigarette smoking in the United States: the changing influence of gender and race. JAMA 1989;261:49-55.

22. Pierce JP, Fiore MC, Novotny TE, Hatziandreu EJ, Davis RM. Trends in cigarette smoking in the United States: educational differences are increasing. JAMA 1989; 261:56-60.
23. Flint AJ, Novotny TE. Poverty status and cigarette smoking prevalence and cessation in the United States, 1983–1993: the independent risk of being poor. Tob Control 1997;6:14-8.
24. Incidence of initiation of cigarette smoking—United States, 1965–1996. MMWR Morb Mortal Wkly Rep 1999; 47:837-40.
25. Blanc PD, Cisternas M, Smith S, Yelin EH. Asthma, employment status, and disability among adults treated by pulmonary and allergy specialists. Chest 1996;109: 688-96.
26. Broder I, Higgins MW, Mathews KP, Keller JB. Epidemiology of asthma and allergic rhinitis in a total community, Tecumseh, Michigan. IV. Natural history. J Allergy Clin Immunol 1974;54:100-10.
27. Dodge R, Cline MG, Burrows B. Comparisons of asthma, emphysema, and chronic bronchitis diagnoses in a general population sample. Am Rev Respir Dis 1986;133: 981-6.
28. Wakefield M, Ruffin R, Campbell D, Roberts L, Wilson D. Smoking-related beliefs and behaviour among adults with asthma in a representative population sample. Aust N Z J Med 1995;25:12-7.
29. Bodner CH, Ross S, Little J, Douglas JG, Legge JS, Friend JA, et al. Risk factors for adult onset wheeze: a case control study. Am J Respir Crit Care Med 1998; 157:35-42.
30. Toraen K, Hermansson BA. Incidence rate of adult-onset asthma in relation to age, sex, atopy and smoking: a Swedish population-based study of 15,813 adults. Int J Tuberc Lung Dis 1999;3:192-7.
31. Strachan DP, Butland BK, Anderson HR. Incidence and prognosis of asthma and wheezing illness from early childhood to age 33 in a national British cohort. BMJ 1996;312:1195-9.
32. Enarson DA, Vedal S, Schulzer M, Dybuncio A, Chan-Yeung M. Asthma, asthmalike symptoms, chronic bronchitis, and the degree of bronchial hyperresponsiveness in epidemiologic surveys. Am Rev Respir Dis 1987; 136:613-7.
33. Jarvholm B, Brisman J, Toren K. The association between epidemiological measures of the occurrence of asthma. Int J Tuberc Lung Dis 1998;2:1029-36.
34. Bronnimann S, Burrows B. A prospective study of the natural history of asthma: remission and relapse rates. Chest 1986;90:480-4.
35. Panhuysen CI, Vonk JM, Koeter GH, Schouten JP, van Altera R, Bleecker ER, et al. Adult patients may outgrow their asthma: a 25-year follow-up study [published erratum appears in Am J Respir Crit Care Med 1997 Aug;156(2 Pt 1):674]. Am J Respir Crit Care Med 1997;155:1267-72.
36. State-specific prevalence of current cigarette and cigar smoking among adults—United States, 1998. MMWR Morb Mortal Wkly Rep 1999;48:1034-9.
37. Forecasted state-specific estimates of self-reported asthma prevalence—United States, 1998. MMWR Morb Mortal Wkly Rep 1998;47:1022-5.
38. Achievements in public health, 1900–1999: tobacco use, United States, 1900–1999. MMWR Morb Mortal Wkly Rep 1999;48:986-93.
39. Mannino DM, Homa DM, Pertowski CA, Ashizawa A, Nixon LL, Johnson CA, et al. Surveillance for asthma—United States, 1960–1995. MMWR Morb Mortal Wkly Rep 1998;47:1-27.
40. Panhuysen CI, Bleecker ER, Koeter GH, Meyers DA, Postma DS. Characterization of obstructive airway disease in family members of probands with asthma. An algorithm for the diagnosis of asthma. Am J Respir Crit Care Med 1998;157:1734-42.
41. Risser NL, Belcher DW. Adding spirometry, carbon monoxide, and pulmonary symptom results to smoking cessation counseling: a randomized trial. J Gen Intern Med 1990;5:16-22.