Smoking, Respiratory Symptoms, and Pulmonary Function Among a Population of Hispanic Farmworkers*

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We conducted a cross-sectional study in the agricultural Central Valley to evaluate the prevalence of respiratory symptoms, smoking status, and pulmonary function in Hispanic California farmworkers. Of 759 farmworkers completing questionnaires and spirometry, 747 were Hispanic. The prevalences of current, former, and never smokers (29, 17, and 54 percent, respectively) were comparable to rates in other studies of Hispanics, but daily cigarette consumption (median-five for men and three for women) was lower than in comparison populations. Prevalences of chronic cough, chronic phlegm, and persistent wheeze were low (1.6, 5.1, and 2.8 percent, respectively). Current smoking, increased age, female sex, and working ≥8 months per year in agriculture were associated with increased prevalence of respiratory symptoms. Adjusted lung function was higher than for reference populations. Hispanic California farmworkers have a similar smoking prevalence to other Hispanic populations, but lower respiratory symptom prevalences and higher pulmonary function are consistent with lower daily cigarette consumption and the "healthy worker effect." *(Chest 1992; 101:1361-68)*

ATS = American Thoracic Society; ATS-DLD = American Thoracic Society, Division of Lung Diseases

Agricultural farmworkers comprise one of the largest occupational groups in the United States. Hired farmworkers may be resident permanent employees, resident seasonal workers, or migrant workers. Estimates of the size of this population vary from 1.0 to 5.0 million.[1-3] California, the nation's leading agricultural state, is heavily dependent on farmworkers for crop production and harvesting.[1]

The majority of farmworkers in California are Mexican natives or Mexican-American and may designate themselves "Hispanic." In spite of the size and economic importance of this occupational group and the emergence of the Hispanic population as a dominant ethnic group in California, few data exist on the respiratory health, smoking behavior, or pulmonary function of Hispanic California farmworkers.[1]

Several studies have observed differences in the respiratory and cardiovascular disease prevalence between Hispanic and non-Hispanic populations.[4-6] A portion of the observed differences in morbidity between these ethnic groups has been ascribed to differences in smoking behavior between these two populations.[4,5,7,8] Recent studies of Hispanic populations have found that the prevalence of current smoking in Hispanic men is comparable to the prevalence in Non-Hispanic white men, but that the number of cigarettes smoked per day is generally lower in Hispanic populations.[6,9] Hispanic women, in contrast, have been reported to have a lower smoking prevalence and lower daily cigarette consumption[6,9] than non-Hispanic white women.

The occurrence of respiratory illness arising from agricultural exposures has been well documented. studies demonstrating increased mortality from nonmalignant lung disease,[10-12] and increased respiratory symptoms in agricultural workers compared to nonagricultural controls[13-18] indicate that agricultural employees are at increased risk for pulmonary disease. High exposures to pulmonary toxicants such as organic and inorganic dusts have been measured in agricultural populations.[19-24] Migrant and seasonal farmworkers may be at greater risk of occupational lung disease than other agricultural workers because of higher workplace exposures, but there exist no respiratory health studies of this population.

Pulmonary function has been analyzed with prediction equations developed for several populations in the United States, and ethnicity may be a significant predictor of lung function.[25,26] Hispanics of Mexican heritage constitute one of the largest and most rapidly increasing ethnic groups in the United States, but there are few studies of pulmonary function in this population.

We conducted a cross-sectional study of respiratory health in a population of Hispanic farmworkers in California's Central Valley. The goals of this study were the following: (1) to assess the prevalence of cigarette

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smoking and respiratory symptoms among the Hispanic population; (2) to evaluate specific risk factors for adverse respiratory outcomes among farmworkers; and (3) to establish normal regression equations for never-smoking asymptomatic Hispanic men and women and compare these results to established reference groups.

Materials and Methods

Study Population

Study subjects were selected during harvesting operations in California's Central Valley. Several growers of agricultural produce were invited to participate, yielding a volunteer sample of participating growers. An approximate balance was sought between workers in three major crops in the Central Valley region: grapes, citrus, and tomatoes. The data collection team used a large mobile van that was driven to each work site. Workers were approached in the field at work, where their participation was requested and informed consent was obtained. This study was approved by the UC Davis Human Subjects Review Committee. Data collection was performed from March to June of 1988. The standardized ATS-DLD questionnaire,[27] modified to include information about agriculture-specific work exposures and occupational history, was administered to workers in the subject's preferred language.

Data Collection and Analysis

Ethnicity was defined by self-report. Subjects were asked whether they considered themselves to be "Hispanic," "white," "black," "Asian," "American Indian," or "other." Outcome variables were defined from questionnaire results as follows: persistent wheeze—wheezing with colds and wheezing apart from colds or wheezing most days and nights; chronic cough—coughing for three consecutive months or more during the year; chronic phlegm—phlegm brought up from the chest on most days for three consecutive months or more during the year; wheeze in fields—chest wheezing or whistling occurring when working in the fields; cough most work days—cough occurring most days of the week at work.

Predictor variables used in logistic regression models were smoking status (never, former, current), months per year in agriculture (<8 months, ≥8 months), age category (<25 years, 25 to 34 years, 35 to 44 years, and ≥45 years), sex, and crop worked (grape, citrus, or tomato). Also explored as predictor variables were interviewer and interviewer sex (to evaluate possible interviewer bias), job activity (harvester vs nonharvester), lifetime hay fever history (yes/no), lifetime asthma history (yes/no), education level (0 to 6 yr, 7 to 12 yr, and >12 yr), months per year with the present employer (0 to 3, 4-5, 6-8, ≥9), cumulative pack years smoking cigarettes (0, 1-5, 6-10, ≥11), years in agriculture (<5, 5 to 10, 11 to 20, >20), and hours per week in the fields (<35, 35 to 45, 46 to 55, >55).

Data were analyzed using the statistical analysis system[28] and BMDP.[29] The relationship of predictor variables to the respiratory symptom outcomes were analyzed using stepwise logistic regression models. Comparison of smoking prevalences in the farmworker population to other published studies of Hispanics was performed by directly standardizing observed smoking rates in other studies to the age and sex distribution of the farmworker population reported here.

Pulmonary function methods were based on American Thoracic Society criteria[30] and are described elsewhere.[31] All testing was performed on a Stead-Wells spirometer. The sample was divided into three age and sex groups: men less than 25 years, men 25 or older, and women 20 years or older. A group of "healthy" Hispanic individuals was defined as never smoking, without chronic cough, chronic phlegm, or persistent wheeze, with pulmonary function results meeting ATS acceptability criteria.[30] After exclusions, multiple linear regression analysis of age and height on lung function was performed separately in each of the three age and sex groups. Also considered were the logs of age and height, and the square of age. Predicted values were calculated from published reference equations obtained from studies of Hispanics in New Mexico[32] and whites in Arizona.[33]

Results

Of the 759 subjects sampled, 747 were Hispanic. A total of 27 work crews were studied at 18 different sites at four central California counties. Each crew consisted of 15 to 40 individuals. The overall participation rate was 93 percent.

Population Demographics

The population was relatively young (median age, 28 years, range, 15 to 70 yr) and predominantly male subjects (Table 1). Women were somewhat older than men and were more likely to be grape workers (Table 1). Half of the sample had worked ten years or more in agriculture, and half had worked six or more months per year with their current employer (Table 1). Most subjects (56 percent) worked more than 40-hour weeks. All but four of the Hispanics were interviewed in Spanish (99.5 percent).

Cigarette Smoking

The crude prevalence of current smoking in Hispanics was higher in men (34 percent) than women (13 percent). Among smokers, the median number of self-reported cigarettes per day was also higher in

Table 1—*Demographic Characteristics of Hispanic Study Subjects UCD Farmworker Health Study, 1988*

	Men	Women	Total
Sample population, No. (%)	575 (77)	172 (23)	747 (100)
Crop worked No. (%)			
Citrus	147 (26)	18 (10)	165 (22)
Grapes	134 (25)	98 (57)	232 (31)
Tomatoes	294 (51)	56 (33)	350 (47)
Age, yr			
Median	26	31	28
Q1-Q3*	22-36	24-41	22-37
Education, yr			
Median	5	6	5
Q1-Q3*	3-6	4-8	3-6
Months per Year in Agriculture			
Median	9	8	8
Q1-Q3*	6-10	6-10	6-10
Months working with current employer			
Median	6	7	6
Q1-Q3*	2-8	4-9	3-8
Hours worked per week			
Median	42	48	45
Q1-Q3*	32-48	40-54	35-53
Years worked in agriculture			
Median	10	9	10
Q1-Q3*	5-19	4-14	4-18

*Q1 = 25th percentile, Q3 = 75th percentile.

Table 2—*Cigarette Smoking Prevalence by Age and Sex in Hispanic Subjects (UCD Farmworker Health Study, 1988)*

Age	Smoking Status	Men No. (%*)	Men Median Cigs/Day	Women No. (%*)	Women Median Cigs/Day
<25	Current	72 (30)	4	6 (13)	3
	Former	40 (17)	3	1 (2)	2
	Never	128 (53)		40 (80)	
25-34	Current	63 (37)	7	6 (10)	2
	Former	33 (19)	5	2 (3)	3
	Never	75 (44)		51 (87)	
35-44	Current	27 (33)	10	2 (7)	7
	Former	20 (25)	5	2 (7)	12
	Never	34 (42)		26 (87)	
≥45	Current	29 (39)	6	9 (25)	6
	Former	20 (27)	15	5 (14)	3
	Never	25 (34)		22 (61)	

*% = percentage of total in each age and sex group, excluding five subjects with no information as to smoking status.

men (median = 5) than women (median = 3). Cigarette consumption was higher among older individuals of both sexes, with the highest smoking prevalence and cigarette consumption found in men 35 to 44 yr (median = 10 cigarettes/day) (Table 2).

The prevalence of current smoking in our population was similar to sex and age-adjusted published figures for Hispanics living in urban San Francisco,[34] semi-rural Belen, New Mexico,[5] urban and rural United States,[35-38] and urban San Antonio, Texas[6] (Table 3). Adjusted smoking prevalences in the external reference populations ranged from 28 to 38 percent, compared to 29 percent in the current study. Comparisons for men and women separately showed similar results.

Respiratory Symptoms

Crude prevalences for chronic cough, chronic phlegm, and persistent wheeze in the Hispanic group were low (1.6, 5.1, and 2.8 percent, respectively). Wheezing with fieldwork was reported by 3.1 percent and 4.3 percent reported cough most work days. In men, the prevalences of chronic cough, cough most work days, and wheeze with field work were highest in heavy (ten or more cigarettes/day) smokers, but no clear association emerged between smoking and chronic phlegm or persistant wheeze (Table 4). In women, symptom prevalences were all elevated in ever smokers compared to never smokers (Table 4),

Table 3—*Comparison of Current Smoking Prevalences in Hispanics (UCD Farmworker Health Study, 1988 and Previously Published Data)*

Study	Date Study Data Gathered	Sample (n)*	Geographic Location	% Current Smoking
UCD Farmworker health study	1988	759	Rural California Central Valley	29
UCSF Hispanic telephone survey[34]	1987	1,669	Urban San Francisco, California	29†
University of New Mexico Population survey[5]	1984-5	2,111	Semirural Belen, New Mexico	30‡
National health interview survey[37]	1985	1,774	Urban/rural 50 states in US	28‡
Hispanic Hanes Survey[35]	1982-84	8,554	Urban/rural five southwest states in US	38‡
Texas Behavioral risk factor survey[38]	1981-3	1,119	Urban/rural Texas	32‡
San Antonio heart study[6]	1979-88	3,301	Urban Texas	33‡

*Sample number was taken from studies of Hispanics in the US; percentage Mexican heritage usually not directly obtained.
†Directly adjusted to UCD Farmworker Study sex distribution.
‡Directly adjusted to UCD Farmworker Study sex and age distribution.

Table 4—*Prevalence of Respiratory Symptoms by Smoking Status in Hispanics (UCD Farmworker Health Study, 1988)**

Smoking status	No.	Chronic Cough No. (%)†	Chronic Phlegm No. (%)†	Persistent Wheeze No. (%)†	Wheeze with Fieldwork No. (%)†	Cough Most Work Days No. (%)†
Men						
Never	262	3 (1.1)	10 (3.7)	5 (1.9)	6 (2.2)	12 (4.4)
Ever	300	6 (2.0)	16 (5.3)	10 (3.3)	6 (2.0)	10 (3.3)
Former	113	1 (0.9)	7 (6.2)	3 (2.7)	1 (0.9)	4 (3.5)
1-9 cpd‡	126	1 (0.8)	7 (5.6)	5 (4.0)	3 (2.4)	3 (2.4)
10+ cpd‡	61	4 (6.3)	2 (3.1)	2 (3.2)	2 (3.2)	3 (4.8)
Women						
Never	139	2 (1.4)	8 (5.8)	3 (2.2)	7 (5.0)	6 (4.3)
Ever	33	1 (3.0)	3 (9.1)	3 (9.1)	4 (12.1)	3 (9.1)

*Omitted from analysis are five subjects with no information on smoking status and eight smokers with insufficient information on current smoking activity.
†Percentage of total in each sex and smoking group.
‡Cigarettes smoked per day.

Table 5—*Adjusted* Odds Ratios of Symptom Prevalence for Smoking and Months per Year in Agriculture (Farmworker Health Study, 1988)*

Symptom	Smoking Status Current vs Never		Months Per Year in Agriculture High vs Low†	
	Odds ratio*	90% Confidence interval	Odds ratio*	90% Confidence interval
Cough most days at work	0.95	0.5-1.9	2.7	1.3-5.9
Wheeze in field	1.5	0.6-3.4	1.3	0.9-4.3
Chronic phlegm	1.3	0.7-2.6	1.1	0.6-1.9
Chronic cough	2.1	0.7-6.2	1.8	0.6-5.5
Persistent wheeze	1.8	0.8-4.2	1.6	0.0-3.6

*Adjusted for age and sex.

†High exposure = eight months or more per year in agriculture; low exposure = less than 8 months per year in agriculture.

but low numbers prevented a dose-response analysis.

Surrogate measures of agricultural exposure, including the average hours worked in agriculture per week, average hours worked in agriculture per day, average days worked in agriculture per week, and job activity were found in initial analyses not to be significant predictors of respiratory outcomes and were dropped from subsequent models. No significant association was present for sample site, crop worked, interviewer, or interviewer sex and the prevalence of respiratory outcomes, after controlling for age, sex, smoking status, and months per year in agriculture. The number of years in agriculture was highly correlated with age ($r^2 = .70$) and was therefore dropped from further analysis.

Multivariate logistic regression analysis of all farmworkers showed increased risk for nearly all respiratory symptoms among women, current smokers, older individuals, and those working eight or more months per year in agriculture. Significant associations were found for increased age and report of persistant wheeze, female sex and report of wheeze while working in the fields, and working eight or more months per year in agriculture with report of cough most work days. The odds ratios of respiratory symptoms for those working ≥8 months per year ("high") compared to those working <8 months per year in agriculture ("low") were similar to those found for current smokers compared to never smokers (Table 5). An exception was cough most work days, for which the odds ratio was 2.7 in the group with ≥8 months compared to the low exposure group, but which showed no association with cigarette smoking (Table 5).

Pulmonary Function

The population of 759 workers was divided for analysis as follows: men (<25 year old (n = 258), men ≥25 years old (n = 327), women <20 years old (n = 17), and women ≥20 years (n = 157). To define a population of "healthy" Hispanic individuals for regression analysis, individuals were excluded as follows: unable to perform spirometry (n = 6, 1 percent of the population); non-Hispanic individuals (n = 12, 2 percent); individuals whose spirometry tracings were readable but did not meet ATS reproducibility criteria (9 percent of men <25 years, 10 percent of men ≥25 and 9 percent of women ≥20); symptomatic individuals reporting chronic cough, chronic phlegm, or persistent wheeze (5, 9, and 8 percent of these respective groups); and ever smokers (47, 59, and 19 percent, respectively). Based on these exclusions, 431 subjects (55 percent) were omitted. Similar proportions of workers in each crop were excluded. Pulmonary function for women <20 yr was not analyzed due to small sample size. The resultant sample size were

Table 6—*Coefficients for Regression Equations of Spirometric Parameters: by Age and Sex Groups* (Farmworker Health Study, 1988)*

Parameter	Intercept (SE)†	Age (SE),† yr	Height SE,† cm	R^2
FVC, L				
M<25	−6.162 (1.130)	0.0374 (0.0179)	0.0611 (0.0068)	.45
M≥25	−3.258 (1.411)	−0.0227 (0.0053)	0.0523 (0.0083)	.38
F≥20	−2.490 (1.057)	−0.0197 (0.0037)	0.0415 (0.0066)	.45
FEV_1, L				
M<25	−3.767 (0.923)	0.0233 (0.0147)	0.0435 (0.0056)	.38
M≥25	−1.879 (1.246)	−0.0294 (0.0047)	0.0395 (0.0073)	.42
F≥20	−1.401 (0.783)	−0.0216 (0.0027)	0.0314 (0.0049)	.55
FEF25-75 (L/s)				
M<25	0.413 (2.238)	0.0511 (0.0355)	0.0170 (0.0135)	.04
M≥25	−0.163 (2.672)	−0.0457 (0.0101)	0.0325 (0.0158)	.22
F≥20	0.661 (1.862)	−0.0307 (0.0065)	0.0230 (0.0116)	.23

*All estimates controlled simultaneously for age and height as linear terms.

†Standard error.

†M = male subjects; F = female subjects.

as follow: men <25 years (n = 118); men ≥25 (n = 103); and women ≥20 (n = 107), for a total of 328 individuals.

After exclusions, multiple linear regression estimates for the effects of age and height on FVC, FEV_1, and FEF25-75 were derived (Table 6). The log and square terms of age and height and the effect of crop on pulmonary function in this group did not add significantly to the model and were dropped from further analysis. Age and height were significant predictors of pulmonary function as linear terms except among younger men, where age was not a significant predictor of FEV_1, and neither age nor height was predictive of FEF25-75.

Illustrative comparison of predicted pulmonary function for 26 and 56 year-old men and women of two different heights (Fig 1) reveals that predicted FVC from our data is slightly higher for both women and men than FVC predicted by external reference populations.[32-33] However, the regression coefficients for age and height were not significantly different between our study group and the external comparison populations. Predicted FEV_1 from our data is similar to FEV_1 predicted from the reference populations.

Discussion

Cigarette smoking remains one of the greatest preventable causes of respiratory morbidity and mortality in the United States.[39] Studies of ethnic groups have consistently found that sex and age predict smoking patterns, whereas the roles of occupation, ethnicity, urban vs rural living, acculturation, and socioeconomic status are not well defined.

The main findings of this study were as follow: (1) the prevalence of smoking in Hispanic farmworkers was similar to other Hispanic populations, but the reported number of cigarettes smoked per day was lower than in other populations; (2) the prevalence of respiratory symptoms in farmworkers was low, but increased in current smokers, women, older individuals, and individuals working eight or more months per year in agriculture; and (3) FVC in Hispanic farmworkers was higher than predicted, based on reference white and Hispanic populations.

Several sources of potential bias may have affected the results observed in this study. First, selection bias may have entered at several levels. Farm working is a physically demanding occupation, and sick workers may not enter or may be selected out of this occupation. Therefore, in a cross-sectional study of actively employed individuals, respiratory symptoms are likely to be lower and pulmonary function to be higher than similar measures in community based studies. Evi-

Predicted FVC by sex for two heights and ages: Present study vs. Arizona and New Mexico studies

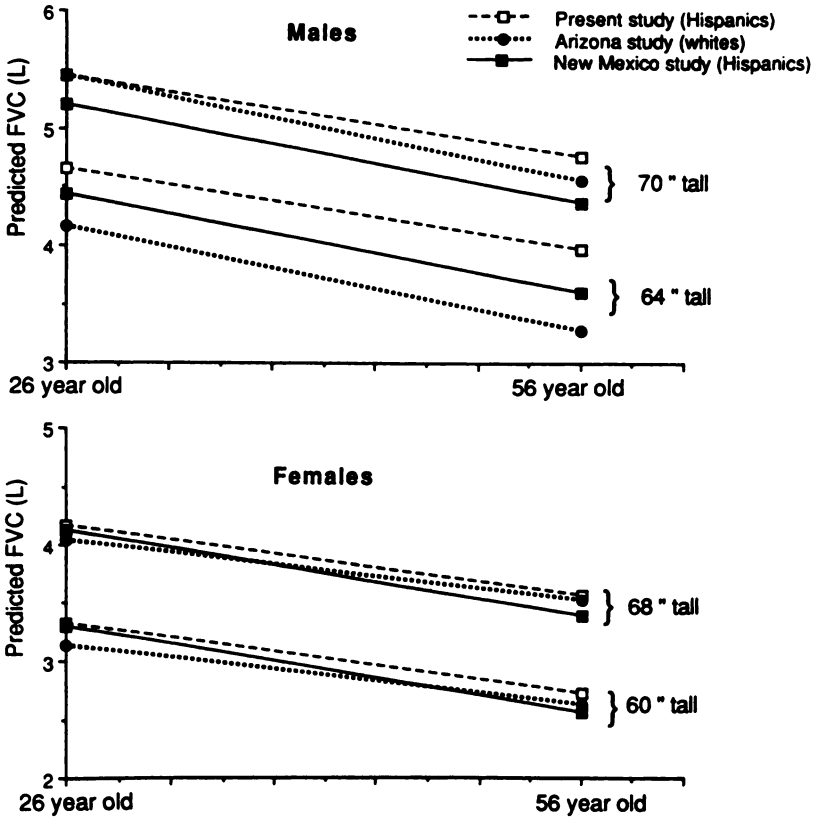

FIGURE 1. Comparison of predicted FVC by sex for two ages and heights. Present study vs Arizona and New Mexico studies. Top graph is predicted FVC for 26- and 56-year-old men of 162.6 cm and 177.8 cm standing height, and bottom graph is predicted FVC for 152.4 cm and 172.7 cm women of the same ages. Predicted FVC for never smoking asymptomatic Hispanic California farm workers are consistently higher than predicted values based on community-based studies of Arizona whites[33] and New Mexico Hispanics.[38]

dence in this study for a "healthy worker effect" comes from both the low prevalence of respiratory symptoms on questionnaire and the increased FVC in pulmonary function data. The sampling frame may have been another source of selection bias, as farmworkers selected from a convenience sample of cooperating growers may be more healthy than a random sample of farmworkers in California, but we have no evidence of this. We cannot comment on the generalizability of these results beyond the target population of employed farmworkers.

Reporting bias may also have affected the results. Farmworkers sampled at the work site may be reluctant to report cigarette consumption or respiratory symptoms due to factors such as concern about employment status, leading to underestimation of smoking prevalences and respiratory morbidity rates. Underreporting of respiratory symptoms due to translation or cultural differences may also occur. Reporting biases in the sampling of Hispanics have been described.[4,34,40-42] We attempted to minimize translation problems and increase comparability to other study results by use of the standardized ATS-DLD questionnaire and fluent bilingual-bicultural interviewers. Discrepancies have been found between self-reported smoking status and biologic markers of cigarette exposure in studies of Hispanics, suggesting that underreporting of cigarette consumption in this population may occur.[9,43] We have no independent verification of cigarette consumption.

In addition to the "healthy worker effect," there are several additional reasons why prediction equations from reference white[33] and Hispanic[32] populations underestimated pulmonary function in California farmworkers, but regression coefficients for age and height were similar. These differences may be due to random variation, genetic differences between populations, or methodology. Variation due to methodology was minimized by following American Thoracic Society guidelines. Variation due to differences in ethnicity is possible, since the ethnic composition of California farmworkers, many of whom are born in Mexico,[44] may be different from that of New Mexico Hispanics. The generalizability of these prediction equations therefore should be limited to California Hispanic farmworkers.

A low prevalence of smoking in women compared to men has been described in several population-based studies of Hispanics,[5-6,34] but the reported number of cigarettes smoked per day (median of five in men and three in women) is lower in this study than previously reported. The San Antonio Heart Study, a random sample of households in urban San Antonio, Texas, found an average cigarette consumption of 11 to 16 cigarettes per day in male current smokers of various age categories, and seven to nine cigarettes per day in female current smokers.[6] A study of semirural New Mexico Hispanics, chosen randomly based on dwelling units, found a median cigarette consumption of 10 to 20 cigarettes per day in men and seven to ten per day in women.[5] The 1985 National Health Information Survey found approximately half of both male and female Hispanic smokers smoked more than ten cigarettes per day.[37] A 1987 study of urban San Francisco Hispanics, chosen randomly by phone number, reported a mean of 9 to 16 cigarettes per day for men and 7 to 11 per day for women.[34]

The similarity of current smoking prevalences in urban San Francisco, semi-rural Belen, New Mexico, and rural California farmworkers implies that urban or rural lifestyle is not an important predictor of current smoking prevalence in Hispanic populations. However, rural living and/or farm working may be associated with smoking fewer cigarettes per day. In the San Francisco telephone survey,[34] acculturation defined by a five-item psychosocial scale was associated with a higher prevalence of smoking in women, a lower prevalence in men, and a greater cigarette consumption in both sexes. Our sample may have been less acculturated than that of the Marin study, given the rural setting for our study, the lower average educational level (median of 5 years compared to 12 in the Marin study), and the higher percentage of interviews performed in Spanish (99.5 percent in this study compared to 67 percent in the Marin study). In contrast to the Marin study, a study of three generations of Hispanic families in Texas found that parental smoking behavior was more predictive of current smoking than was acculturation.[45] We have no comparative information on parental smoking.

Respiratory Symptoms

We observed lower prevalences of reported respiratory symptoms in farmworkers than have been reported in other Hispanic populations. For example, the prevalence of chronic phlegm was 4.7 percent in men and 6.4 percent in women. In contrast, Samet and co-workers[5] found a prevalence of 12 percent in men and 9 percent in women.[5] age and sex adjusted prevalences of reported hypertension, diabetes, and tuberculosis were also lower than those found in the 1982 to 1984 Hispanic HANES survey.[35]

The comparison of respiratory symptom prevalences in California farmworkers to studies of agricultural communities worldwide is hampered by a lack of internationally accepted definitions and reporting criteria. However, respiratory symptom prevalences were lower in this study than in other cross-sectional studies of agricultural populations. For example, prolonged bronchitis prevalence (defined as sputum production most days for three consecutive months per year for at least two years) was 10 to 12 percent in

farmers aged 20 to 70 years in Saskatchewan, and 6 to 12 percent in control subjects,[17] as contrasted to the prevalence of chronic phlegm in our study of 5 percent. A similar study of Danish farmers found the prevalence of "cough and daily production of phlegm" to be 18 to 32 percent.[46] The significance of these comparisons is unclear, as the prevalences of current smoking in these comparison populations were higher than our study (*eg*, 42 percent in Danish dairy farmers). The same pattern was observed when respiratory prevalences were compared within smoking categories. For example, the prevalence of "phlegm in the morning or during the day or night for more than three months" in a group of Canadian grain workers[47] was 18 percent in nonsmokers and 45 percent in current smokers. These figures contrast with under 4 percent of never smoking and 6 percent of currently smoking farmworkers in this study reporting chronic phlegm.

The finding that working eight or more months per year in agriculture was associated with increased prevalences of respiratory symptoms indicates that the agricultural environment may contribute to respiratory symptoms in this population. Despite the low overall prevalence of respiratory symptoms, the magnitude of the "agriculture" effect in this population was comparable to the effect of current cigarette smoking. This effect may represent the consequences of occupational exposure to inhaled pulmonary toxins such as inorganic or organic dusts, but further studies are necessary to specifically address this question.

Gender differences in the reporting of medical symptoms in population surveys have been described.[48] The finding that most respiratory symptoms were higher in women than men is consistent with recent studies of Hispanic populations[5,35,40] and may relate to true biologic differences, reporting biases, differences in exposures, or differences in protective measures.

The small impact of cigarette smoking on respiratory symptom prevalence may be due to a combination of low prevalences of smoking in this population, low number of cigarettes smoked per day, the low cumulative pack-years smoked, and the relative health of this working population.

Pulmonary Function

Few data exist concerning reference values of pulmonary function in "normal" Hispanics. Values have been developed for Hispanic children in urban Texas,[49] children in Mexico City,[50] and both children and adult Hispanics in semirural New Mexico.[32] These were community-based studies, which may sample a less healthy population than this study of employed workers (healthy worker effect). The slightly higher FVC seen in farmworkers when compared to New Mexico Hispanics[32] or Arizona whites[33] is consistent with this effect.

The selection of biologically appropriate age categories for prediction equations is controversial.[32-33] We selected age categories to allow comparability to Arizona whites.[33] Our results reinforce the findings of others[32-33] that age is less predictive of lung function than height in younger individuals, but increases in significance with age ≥25 years.

Future investigations such as longitudinal cohort studies incorporating improved exposure assessment techniques are needed to separate specific occupational pulmonary effects from the influence of smoking on respiratory symptom prevalence and pulmonary function. Biologic markers of exposure to cigarette smoke such as cotinine would be of value to verify smoking information obtained from questionnaires. In addition, the international adoption of unified guidelines for the definition of respiratory symptoms and presentation of data would greatly enhance comparison of symptom prevalences between diverse populations.

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