

CHEST[®]

THE CARDIOPULMONARY
AND CRITICAL CARE JOURNAL

FOR PULMONOLOGISTS, CARDIOLOGISTS, CARDIOTHORACIC SURGEONS,
CRITICAL CARE PHYSICIANS, AND RELATED SPECIALISTS

Allergic Rhinitis, Asthma, and Atopy Among Grape Farmers in a Rural Population in Crete, Greece

Leda Chatzi, Emmanuel Prokopakis, Nikolaos Tzanakis, Athanasios Alegakis,
Ioannis Bizakis, Nikolaos Siafakas and Christos Lionis

Chest 2005;127;372-378

DOI: 10.1378/chest.127.1.372

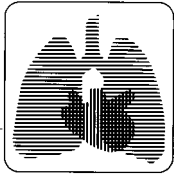
This information is current as of July 18, 2005

The online version of this article, along with updated information and services, is
located on the World Wide Web at:

<http://www.chestjournal.org/cgi/content/full/127/1/372>

CHEST is the official journal of the American College of Chest Physicians. It has been published monthly since 1935. Copyright 2005 by the American College of Chest Physicians, 3300 Dundee Road, Northbrook IL 60062. All rights reserved. No part of this article or PDF may be reproduced or distributed without the prior written permission of the copyright holder. ISSN: 0012-3692.

A M E R I C A N C O L L E G E O F
 **C H E S T**
P H Y S I C I A N S



occupational and environmental lung disease

Allergic Rhinitis, Asthma, and Atopy Among Grape Farmers in a Rural Population in Crete, Greece*

Leda Chatzi, MD; Emmanuel Prokopakis, MD; Nikolaos Tzanakis, MD, PhD;
Athanasios Alegakis, PhD; Ioannis Bizakis, MD, PhD;
Nikolaos Siafakas, MD, FCCP; and Christos Lionis, MD, PhD

Study objective: To measure the prevalence of allergic rhinitis, atopy, and asthma among grape farmers, and to compare the respiratory and atopic status in grape farmers with those of nonexposed control subjects.

Design: Cross-sectional study.

Setting: Malevisi region in northern Crete, Greece.

Subjects and methods: One hundred twenty grape farmers and 100 control subjects living in the Malevisi region were examined. The protocol comprised a questionnaire, skin prick tests for 16 common allergens, measurement of specific IgE antibodies against 8 allergens, and spirometry before and after bronchodilation.

Results: Grape farmers were found to have an excess of respiratory symptoms. The comparison with the control group, after adjusting for age, sex, and smoking status, showed that the differences were statistically significant for rhinorrhea (odds ratio [OR], 2.7; 95% confidence interval [CI], 1.5 to 5.1; $p < 0.001$), sneezing (OR, 2.2; 95% CI, 1.2 to 4.0; $p < 0.01$), and nasal itching (OR, 1.9; 95% CI, 1.0 to 3.6; $p < 0.05$), but were nonsignificant for asthma-related symptoms. In the multiple logistic regression model, grape farmers were found to have increased work-related symptoms, such as sneezing (OR, 2.9; 95% CI, 1.3 to 6.6; $p < 0.01$), rhinorrhea (OR, 2.9; 95% CI, 1.3 to 6.6; $p < 0.01$), cough (OR, 3.7; 95% CI, 1.2 to 11.4; $p < 0.05$), and dyspnea (OR, 3.8; 95% CI, 1.1 to 13.3; $p < 0.05$). The prevalence of allergic rhinitis was 40.8% in grape farmers and 26% in control subjects (OR, 2.0; 95% CI, 1.1 to 3.5; $p < 0.02$). Increased but statistically nonsignificant values of asthma prevalence were found in grape farmers (6.7%) compared with the control group (2.0%). The prevalence of atopy was 64.2% in grape farmers and 38.0% in the control group (OR, 2.2; 95% CI, 1.2 to 3.5; $p < 0.01$). Mean FEV₁ was significantly lower in grape farmers than in control subjects ($p < 0.05$), after adjusting for age, sex, and smoking status. Bronchial obstruction was reversible in 23 grape farmers (19.2%) and in 6 control subjects (6%; $p < 0.01$).

Conclusions: The study mainly demonstrated the high prevalence of allergic rhinitis and work-related respiratory symptoms in grape farmers compared to control subjects. It also suggested that grape farming is possibly associated with increased allergic sensitization to specific pollens, low baseline FEV₁, and increased bronchial hyper-responsiveness. Further studies are needed to determine the potential risk factors for these disorders among the farming population.

(CHEST 2005; 127:372–378)

Key words: allergic rhinitis; asthma; atopy; grape farmers; work-related symptoms

Abbreviations: CI = confidence interval; EIA = enzyme immunoassay; OR = odds ratio; SPT = skin prick test

Epidemiologic studies have shown that farmers are exposed to a variety of inhaled agents including inorganic/organic dust, micro-organisms, mycotoxins, endotoxins, pollens, mites, molds, animal

danders, and pesticides.¹ These exposures have been shown to give rise to a variety of respiratory disorders such as asthma, chronic bronchitis, hypersensitivity pneumonitis, and organic dust toxic syndrome.^{1–3}

Kogevinas et al,⁴ in a study on occupational asthma in Europe and other industrialized areas, have shown that farmers and agricultural workers were among the occupations with the highest risk of asthma.

The prevalence and the type of allergic respiratory disorders among agricultural populations differ due to the diversity of agricultural practices in different regions of the world. Respiratory disorders and allergy are well-documented in animal farmers⁵⁻⁹ but, there is a lack of data for allergic respiratory disorders in crop farmers. The European Farmers' study^{10,11} suggested that flower growing is an important risk factor for asthma, whereas the cultivation of oil plants is associated with acute respiratory symptoms in European crop farmers. It has also been reported¹² that the cultivation of flowers and/or ornamental plants inside greenhouses is related to occupational asthma through sensitization to flower allergens and workplace molds. There are few data regarding allergic respiratory disorders in grape farmers.^{13,14} Gamsky et al¹³ found that California grape farmers had lower FVC lung volumes compared to tomato and citrus farmers.

Grape farming is a traditional agricultural practice in Crete, one of the largest grape growing areas in Greece. The basic variety is "sultana" raisin, and the cultivation of grapes is focused on raisin production more than wine production. The farms are small in size, and the cultivation of grapes is in most cases a family enterprise. Grape farmers have no regular contact with livestock, and agricultural practices are restricted to grape cultivation. Cultivation is performed in the open field, starting in early spring and continuing until the end of September (the blossom period of most plants in Crete). The use of pesticides and fertilizers in grape cultivation is a common everyday practice. The principal chemical agents used are herbicides to control weeds, fungicides to control fungus, and insecticides to control various insects.

The present study is a cross-sectional study that was conducted in order to measure the prevalence of allergic rhinitis, atopy, and asthma among grape farm-

ers, and to investigate whether grape farming is associated with a high risk of allergic respiratory disorders.

MATERIALS AND METHODS

Study Population

This cross-sectional study was carried out from April 2002 until November 2002 in the Malevisi region, a rural area in northern Crete (including the villages of St. Myronas, Petrokefalo, and Pentamodi), which is one of the most important grape-growing regions in Crete. The total number of grape farmers listed in the Agricultural Cooperatives in the Malevisi region is 670. Of these, 179 were reported in the records of the agricultural insurance as having another main occupation besides grape farming, so they were excluded from the study. Of the remaining 491 farmers in the age group of 25 to 70 years, there were 459 subjects. From these, we took a random sample of 150 farmers, who formed our study population group.

For the control group, we chose the occupational group of employees in the tourist industry, since tourism is the second major occupation in this region after agriculture. For this reason, we selected from the local municipal rolls and the records from the Tourism Employees' Association in Crete, the number of tourism employees who live in the Malevisi region (408 employees). Of those employees, in the age group 25 to 70 years, there were 362 subjects. From these 362 tourism employees, we took a random sample of 150 subjects, who formed our control group.

All subjects from both groups were first informed of the objectives of the study as well as its practical procedures (medical examinations) with a written information form. Each subject who agreed to participate in the study was asked to give his/her informed consent. The Ethical Committee of the University Hospital of Crete, Greece, has approved the study protocol.

The study protocol comprised a questionnaire, skin prick tests (SPTs), blood sampling for the measurement of specific IgE antibodies, and spirometry before and after bronchodilation. All medical examinations were carried out at the University Hospital of Heraklion, Crete, Greece.

Questionnaire

The questionnaire was completed during a face-to-face interview that was performed by the same trained physician for both groups. The interviews took place at participants' houses. The questionnaire included questions on medical and occupational history, and had two parts:

1. The first part included questions regarding demographic data, respiratory symptoms (present in the last 12 months, apart from a cold), personal and family history of respiratory and allergic diseases, smoking habits, alcohol consumption, and home environment information. An adapted version of the short version of European Community Respiratory Health Survey questionnaire¹⁵ was used to identify asthma symptoms. The definition of current asthma was based on asthma symptoms or medication according to the questionnaire (*ie*, attack of asthma during the last 12 months, having been woken up by an attack of shortness of breath during the last 12 months, or current use of asthma medication),⁴ followed by a positive bronchodilation test result. Allergic rhinitis was defined as the occurrence of two or more nasal symptoms (*eg*, rhinorrhea, sneezing, nasal obstruction, and nasal itching) on most days during the last 12 months, apart from a cold, followed by a

*From the Department of Social Medicine (Drs. Chatzi and Lionis), Clinic of Social and Family Medicine, the Departments of Otolaryngology (Drs. Prokopakis and Bizakis) and Thoracic Medicine (Drs. Tzanakis and Siafakas), and the Biostatistics Laboratory (Dr. Alegakis), Faculty of Medicine, University of Crete, Heraklion, Crete, Greece.

Manuscript received December 29, 2003; revision accepted June 4, 2004.

Reproduction of this article is prohibited without written permission from the American College of Chest Physicians (e-mail: permissions@chestnet.org).

Correspondence to: Leda Chatzi, MD, Clinic of Social and Family Medicine, Department of Social Medicine, Faculty of Medicine, University of Crete, PO Box 2208, 71003, Heraklion, Crete, Greece; e-mail: ledachatzi@yahoo.gr

positive SPT test result and/or a positive test result for the measurement of specific IgE antibodies.^{16–18}

- The second part of the questionnaire was created by the authors in close collaboration with agronomists experienced in grape cultivation in the Malevisi region, and included a detailed occupational history. It asked about the type and duration (in years) of grape cultivation, the number of hours spent working on grape cultivation daily, the use of pesticides, the preventive measures used under any circumstances, and specific respiratory symptoms that were directly associated with the work (*ie*, work-related symptoms). Work-related symptoms were defined as symptoms that were present during working hours and that showed improvement during evenings, weekends, and holidays.¹⁹

Allergic Tests

SPTs were performed, by a trained physician, on the volar side of the forearm with a standardized skin test needle for 16 different allergens among four groups of allergens (S.A.R.M. Allergens LTD; Rome, Italy), as follows: Pollens: Gramineae mix, *Cynodon dactylon*, composite mix, *Parietaria officinalis*, *Parietaria judaica*, *Parietaria* plus, tree mix, and olive European; Mites: *Dermatophagoides farinae*, *Dermatophagoides pteronyssinus*, *Glycyphagus domesticus*, *Acarus siro*; Molds: *Alternaria tenuis*, *Cladosporium herbarum*, and *Mucor* mix; and Animal epithelium: Cat epithelium. Histamine and blank solutions were used as controls. The reaction was evaluated after 15 min. A positive SPT result was defined as the presence of a mean wheal diameter of 3 mm more than that of the negative control.

The enzyme immunoassay (EIA) method was used to quantify IgE antibodies against eight different allergens in four groups of allergens (Cypress diagnostics, CV; Langdorp, Belgium), as follows: Pollens: Grass mix, *P officinalis*, olive European, and common ragweed; Mites: *D farinae* and *D pteronyssinus*; Molds: Molds mix; and Animal epithelium: Cat epithelium. A positive EIA test result was defined as ≥ 0.35 EU/mL.

All subjects receiving medication for any allergic disease were asked to stop their medication 1 week prior to the examination. In the present study, a subject was considered to be atopic if he or she demonstrated a positive reaction to one or more of the tested allergens in the SPT and/or when at least one specific IgE measurement was ≥ 0.35 EU/mL.

Spirometry

Spirometry was performed by a trained technician, using a calibrated pneumotachograph spirometer (Flowmate, version E2.0; Jaeger; Wurzburg, Germany). The device was calibrated daily, and the values were recorded at body temperature pressure, saturated. Each subject completed a dynamic spirometry with at least three acceptable and two reproducible maneuvers according to standard guidelines.²⁰ Predicted values were obtained from the new standardized lung function testing guidelines of the European Community for Steel and Coal Luxembourg, 1993.²⁰ All data were expressed as percentages of predicted values. A bronchodilation test was performed using 400 μ g salbutamol. An increase of $> 12\%$ predicted in FEV₁ was considered to be a positive bronchodilator response.²⁰ All subjects receiving medication for any obstructive lung disease were asked to stop taking their medication 12 h prior to undergoing spirometry.

Statistical Analysis

Continuous variables were presented as the means and SD. A univariate analysis of categorical variables was made using the

Pearson χ^2 test. A multiple logistic regression model was used to estimate odds ratios (ORs) for grape farming after adjusting for age (continuous variable), sex (female and male), and smoking status (nonsmokers, ex-smokers, and current smokers). Comparisons of continuous variables were made using both a parametric test (independent samples *t* test) and a nonparametric test (Mann-Whitney), as appropriate. A multiple linear regression was used in order to estimate the effect of exposure (*ie*, grape farmers vs control subjects) on lung function volumes after adjustment for age (continuous variable), sex (female and male), and smoking status (nonsmokers, ex-smokers, and current smokers). For all statistical tests, a probability of 0.05 was taken to be significant. Data analysis was performed using a statistical software package (SPSS, version 11.5; SPSS Inc; Chicago, IL).

RESULTS

Population

The response rate was 80.0% for the farmers (120 of 150) and 66.7% for the control group (100 of 150). The nonresponders from both groups were contacted and interviewed by telephone, and were comparable to the responders in terms of mean age, sex, and smoking status. The reasons for not participating in the study were lack of time and lack of interest in health examinations in most cases. All grape farmers were contacted successfully, whereas 2 of 50 control subjects (4.0%) did not respond. Of the nonresponders, 5 of 30 grape farmers (16.7%) and 6 of 50 control subjects (12.0%) had a history of allergic rhinitis, whereas 1 of 30 grape farmers (3.3%) and none of the control subjects were self-reported as being asthmatic. All of the participants underwent the interview and the clinical examinations (*ie*, SPT, EIA test, and spirometry).

Table 1 shows the main characteristics of the grape farmers and control subjects in terms of age,

Table 1—Main Characteristics of Grape Farmers and Control Subjects*

Characteristics	Farmers (n = 120)	Control Subjects (n = 100)	p Value
Age,† yr	45.6 (12.1)	34.9 (7.4)	< 0.001
Age groups, yr			
< 35	27 (22.5)	50 (50.0)	
35–50	43 (35.8)	46 (46.0)	< 0.001
> 50	50 (41.7)	4 (4.0)	
Sex			
Male	43 (35.8)	29 (29.0)	NS
Female	77 (64.2)	71 (71.0)	
Smoking			
Nonsmokers	71 (59.2)	32 (32.0)	< 0.001
Current smokers	34 (28.3)	59 (59.0)	
Ex-smokers	15 (12.5)	9 (9.0)	

*Values given as No. (%), unless otherwise indicated. NS = not statistically significant.

†Values given as mean (SD).

sex, and smoking status. Grape farmers had been working in grape cultivation for a mean ($\pm$ SD) period of 25.0 years (mean duration of grape farming, 25.0 ± 11.7 years; mean age at start of grape farming, 20.6 ± 7.7 years; mean time worked per day, 6.9 ± 2.3 h), were older than the control subjects ($p < 0.001$), and smoked less than the control subjects ($p < 0.001$).

Respiratory Symptoms

The proportion of subjects reporting respiratory symptoms was higher in grape farmers than in control subjects (Table 2). After using a multiple logistic regression model and adjusting for age, sex, and smoking status, the differences remained statistically significant for rhinorrhea (OR, 2.7; 95% confidence interval [CI], 1.5 to 5.1; $p < 0.001$), sneezing (OR, 2.2; 95% CI, 1.2 to 4.0; $p < 0.01$), and nasal itching (OR, 1.9; 95% CI, 1.0 to 3.6; $p < 0.05$). Concerning the asthma-related symptoms (*ie*, dyspnea, wheezing, wheezing with breathlessness, being awoken by cough, being awoken by shortness of breath, being awoken by chest tightness, and attack of asthma), there was a tendency toward increased prevalence rates in grape farmers, but this increase was not statistically significant. The prevalence of allergic rhinitis was found to be 40.8% for grape farmers and 26% for the control subjects (OR, 2.0; 95% CI, 1.1 to 3.5; $p < 0.02$). The prevalence of current asthma was 6.7% for grape farmers and 2% for the control group (difference not significant). All subjects with a current diagnosis of asthma were found to be atopic.

Regarding work-related respiratory symptoms, grape farmers had significantly elevated ORs for work-related sneezing (OR, 2.9; 95% CI, 1.3 to 6.6; $p < 0.01$), work-related rhinorrhea (OR, 2.9; 95% CI, 1.3 to 6.6; $p < 0.01$), work-related cough (OR, 3.7; 95% CI, 1.2 to 11.4; $p < 0.05$), and work-related dyspnea (OR, 3.8; 95% CI, 1.1 to 1.3; $p < 0.05$), but not for work-related wheezing, compared to the control subjects after adjustment for age, sex, and smoking status.

Allergic Tests

The prevalence of atopy was calculated to be 64.2% for the group of grape farmers and 38.0% for the control group (OR, 2.2; 95% CI, 1.2 to 3.5; $p < 0.01$). The proportion of subjects with one or more positive SPT results was significantly greater in the grape farmer group than in the control group (OR, 2.2; 95% CI, 1.3 to 3.8; $p < 0.005$). Analysis by type of allergen showed a significantly greater proportion of farmers with positive SPT results for pollens compared to the control group (OR, 2.3; 95% CI, 1.3 to 4.1; $p < 0.01$). More specifically, the most prevalent pollens for which the presence of allergen-specific IgE was demonstrated were as follows: (1) Gramineae mix (30 grape farmers, 25.0%; 8 control subjects, 8.0%; OR, 3.8; 95% CI, 1.7 to 8.8; $p < 0.01$); (2) *C dactylon* (25 grape farmers, 20.8%; 10 control subjects, 10.0%; OR, 2.3; 95% CI, 1.3 to 4.1; $p < 0.01$); and (3) composite mix (20 grape farmers, 16.7%; 3 control subjects, 3.0%; OR, 4.8; 95% CI, 1.3 to 18.2; $p < 0.001$). According to the results of EIA tests, there were no significant differ-

Table 2—Prevalence of Allergic Rhinitis and Asthma Symptoms in Grape Farmers and Control Subjects*

Variables	Grape Farmers (n = 120)	Control Subjects (n = 100)	OR (95% CI)	p Value
Rhinorrhea†	47 (39.2)	19 (19.0)	2.7 (1.5–5.1)	< 0.001
Sneezing†	58 (48.3)	31 (31.0)	2.2 (1.2–4.0)	< 0.01
Nasal obstruction†	50 (41.7)	31 (31.0)	1.6 (0.9–2.8)	NS
Nasal itching†	37 (30.8)	19 (19.0)	1.9 (1.0–3.6)	< 0.05
Allergic rhinitis‡	55 (45.8)	27 (27.0)	2.3 (1.3–4.1)	< 0.01
Allergic rhinitis§	49 (40.8)	26 (26.0)	2.0 (1.1–3.5)	< 0.02
Dyspnea†	36 (30.0)	26 (26.0)	1.1 (0.5–2.3)	NS
Wheezing†	22 (18.3)	11 (11.0)	1.5 (0.6–3.9)	NS
Woken by SOB†	14 (11.7)	6 (6.0)	1.0 (0.3–4.0)	NS
Attack of asthma†	6 (5.0)	4 (4.0)	1.1 (0.3–6.1)	NS
Ever received asthma diagnosis	8 (6.7)	6 (6.0)	1.0 (0.1–35.2)	NS
Medication for asthma	8 (6.7)	2 (2.0)	3.5 (0.7–17.0)	NS
Current asthma‡	11 (9.1)	4 (4.0)	2.7 (0.6–9.7)	NS
Current asthma	8 (6.7)	2 (2.0)	3.5 (0.7–17.0)	NS

*Values given as No. (%), unless otherwise indicated. See Table 1 for abbreviation not used in the text. SOB = shortness of breath.

†Symptoms that were present in the last 12 mo, apart from a cold.

‡According to the questionnaire.

§According to the questionnaire, followed by a positive SPT test result and/or a positive EIA test result.

||According to the questionnaire, followed by a positive bronchodilator response.

ences regarding allergic sensitization between grape farmers and control subjects. The main characteristics of the allergic profile in the two groups are summarized in Table 3.

Respiratory Function

The mean ($\pm$ SD) of lung functions volumes in grape farmers and control subjects are shown in Table 4. Grape farmers had lower lung function volumes compared to control subjects. A multiple linear regression model was used to estimate the effect of occupation on respiratory function in the two groups, after adjustment for age, sex, and smoking status. The results of the analysis showed that the mean adjusted percent predicted value of FEV₁ was significantly lower in grape farmers than in control subjects ($p = 0.03$). The mean adjusted FVC and the FEV₁/FVC ratio did not differ significantly between the two groups. Twenty-three grape farmers (19.2%) and 6 control subjects (6.0%) showed a positive bronchodilation test result. The differences in the response to the bronchodilation remained after using a logistic regression model and adjusting for age, sex, and smoking status (OR, 3.7; 95% CI, 1.5 to 9.5; $p < 0.01$).

DISCUSSION

The purpose of this study was to measure the prevalence of allergic respiratory disorders among grape farmers in the Malevisi region in Northern Crete. We found high prevalence rates of allergic rhinitis symptoms in grape farmers and a twofold greater risk of allergic rhinitis compared to the control subjects. These findings are higher than the respective values reported from other recently published studies in crop-farming populations.^{11,21–25}

Table 4—Lung Function Measurements in Grape Farmers and Control Subjects*

Variables	Grape Farmers (n = 120)	Control Subjects (n = 100)	p Value
FVC, % predicted	106.3 (21.9)	113.6 (14.5)	0.17
FEV ₁ , % predicted	100.9 (24.2)	112.6 (14.4)	0.03†
FEV ₁ /FVC, % predicted	99.5 (10.7)	104.1 (7.8)	0.08
FEV ₁ ', % predicted	107.3 (24.9)	115.6 (14.6)	0.10

*Values given as mean (SD), unless otherwise indicated.
FEV₁' = FEV₁ after bronchodilation.

†Statistically significant ($p < 0.05$).

The high prevalence of allergic rhinitis could be explained by the equivalent high allergic sensitization that we found among grape farmers, as the definition of allergic rhinitis in the present study was based partly on allergic sensitization. There are no epidemiologic data on the prevalence of nasal allergies among farming populations in Greece.

In our group of farmers, the prevalence of asthma was 6.7% and did not differ significantly from that of the control group. The prevalence of asthma diagnosed by a doctor or treated with medication has generally been reported to be between 3 and 12% in crop-farming populations.^{11,12,21,23,24} The asthma prevalence in the European Farmers' Study¹¹ was 3.2% for crop farmers, 5.1% for flower and/or ornamental plant growers, and did not differ from that reported for the general European population.²⁶ The prevalence of asthma in our control group is in accordance with that reported for the city of Athens, Greece, in the European Community Respiratory Health Survey.²⁷ However, in the present study, the prevalence rates of specific asthma symptoms (dyspnea, wheezing, being awoken by shortness of breath, etc) seemed to be higher in the grape farmer group than in the control group. It is possible that

Table 3—Prevalence of Positive Allergic Test Results in Grape Farmers and Control Subjects*

Variables	Grape Farmers (n = 120)	Control Subjects (n = 100)	OR (95% CI)	p Value
At least 1 positive SPT	61 (50.8)	32 (32.0)	2.2 (1.3–3.8)	< 0.005
Positive SPT pollens	54 (45.0)	26 (26.0)	2.3 (1.3–4.1)	< 0.01
Positive SPT mites	19 (15.8)	16 (16.0)	1.6 (0.3–1.5)	NS
Positive SPT molds	7 (5.8)	3 (3.0)	2.2 (0.5–8.7)	NS
Positive SPT cat	3 (2.5)	1 (1.0)	2.8 (0.3–27.9)	NS
At least 1 positive EIA	49 (40.8)	36 (36.0)	1.2 (0.6–2.1)	NS
Positive EIA pollens	33 (27.5)	24 (24.0)	1.6 (0.8–3.2)	NS
Positive EIA mites	25 (20.8)	14 (14.0)	1.4 (0.6–3.1)	NS
Positive EIA molds	8 (6.7)	4 (4.0)	1.4 (0.3–5.6)	NS
Positive EIA cat	7 (5.8)	2 (2.0)	3.0 (0.6–15.0)	NS
Atopy†	77 (64.2)	38 (38.0)	2.2 (1.2–3.5)	< 0.01

*Values given as No. (%) unless otherwise indicated. See Table 1 for abbreviation not used in the text.

†Signifies at least one positive SPT or EIA test result.

these differences did not reach statistical significance because of the inadequacy of the sample size.

We found lower FEV₁ volumes among grape farmers compared to control subjects. Gamsky et al¹³ have shown that California grape workers had lower FVC volumes compared to tomato and citrus workers. In our study, grape farmers with lower FEV₁ volumes did not present with a high prevalence of asthma symptoms compared to control subjects, but they showed an excess of work-related symptoms such as cough, dyspnea, and rhinorrhea. The difference in FEV₁ volumes remained after using a multiple linear regression model, and adjusting for age, sex, and smoking status. Reduced FEV₁ and the high prevalence of work-related respiratory symptoms in grape farmers could be explained by different occupational exposures, such as inorganic dust, organic agents, and pesticides. To evaluate the role of such exposures in lung function volumes, longitudinal studies with measurements of work site-specific respiratory hazards are needed.

The most striking finding in the present study is the high prevalence of atopy (64.2%) among grape farmers compared to control subjects (38.0%). These prevalence rates are higher than those reported in other crop-farming populations.^{12,24,25,28,29} A Greek study³⁰ showed that the prevalence of atopy in children living in rural areas of Crete was lower than that of children living in urban areas. The prevalence of atopy in our control group was slightly higher than that (31.5%) found by Grigoreas et al³¹ in a representative sample of Greek adults.

The most prevalent group of allergens for both groups was pollens, which is in accordance with the findings of Barnes et al,³⁰ for children living in rural areas of Crete. The most prevalent allergenic plants in Crete with known clinical significance are grasses, *Olea europaea* and Parietaria/nettle species.^{32,33} Pollens have been found to induce occupational allergy in several cases.^{12,25,28,29,34,35} In the present study, the most prevalent pollens in grape farmer group were from the Gramineae family (Gramineae mix, 25.0%; *C dactylon*, 20.8%) and the Compositae family (composite mix, 16.7%). A recent study on herbicides and weed control in vineyards in Portugal³⁶ showed that *C dactylon* and *Poa annua*, (which both belong to Gramineae family) are among the most predominant weeds in grape-growing regions. In Crete, there are no published reports on weed flora in vineyards. Garcia-Ortega et al,¹⁴ in a survey on occupational sensitization to *Diplotaxis erucoides*, found that workers in vineyards with rhinoconjunctivitis were sensitized to several pollens. Moreover, grape workers were found to be more likely to have skin disorders than were citrus or tomato workers,^{37,38} and these disorders may be causally associ-

ated with crop-specific exposures and lack of protective equipment.³⁷ Therefore, it is possible that the high prevalence of atopy in grape farmers could be associated with their exposure to different irritants found in their workplace (*ie*, open-field cultivation and exposure to a variety of inhaled agents such as pollens, molds, mites, bacteria, and pesticides), rather than grape growing itself.

We are well aware of the inherent limitations of the cross-sectional design of the present study. First, the study refers to a relatively small area of research in northern Crete. Furthermore, the cross-sectional methodology used in this study is not optimal for the assessment of causal relationships, but it suggests only the possibility of the association between the occupational exposure and the disease. Since we had statistically significant differences between the two groups in terms of age and smoking status, we used multivariate regression models to correct these imbalances.

Selection bias may have affected the results observed in this study. First, a possible bias might exist in the reporting of symptoms, so that those with respiratory symptoms would be more likely to respond to the questionnaire and participate in the study. For that reason, the nonresponders from both groups were contacted by telephone, and they were asked about self-reported allergic rhinitis and asthma. These prevalence rates were lower than the prevalence rates of allergic rhinitis and asthma found in responders, and they could indicate the presence of a possible selection bias in the study. However, these differences could also be explained by the difference in the definition of the cases (self-reported disease vs clinical diagnosis based on questionnaire and medical examinations). We cannot rule out that the individual, social, and educational status of each subject had an impact on the study findings. However, we have no indication from our data of differential selection bias in the compared groups.

The health worker effect does not seem to affect our results significantly. Only 1 of the 82 grape farmers who reported positive respiratory symptoms (1.2%) was likely to quit farming because of his symptoms. In Crete, grape farming is a family occupation. Farmers start cultivating grapes in their adolescence and continue until an advanced age, and their vineyards comprise their only asset so they rarely leave their farms for health reasons.

In conclusion, our study shows that grape farmers in the Malevisi region had a higher prevalence of allergic rhinitis, and work-related respiratory symptoms compared to control subjects. Grape farming was found to be associated with increased allergic sensitization to specific pollens, low baseline FEV₁, and increased bronchial hyper-responsiveness. Fur-

ther studies are needed to determine specific risk factors for these disorders and possible prevention measures.

ACKNOWLEDGMENTS: We are grateful to all of the residents of the Malevisi region for their participation. Furthermore, we wish to give our special thanks to Senior Lecturer Dr. Jean Peters and to Associate Professor Dr. Anna Kalantidi, for their professional advice.

REFERENCES

- 1 Respiratory health hazards in agriculture. *Am J Respir Crit Care Med* 1998; 158:S1-S76
- 2 Zejda JE, Dosman JA. Respiratory disorders in agriculture. *Tuber Lung Dis* 1993; 74:74-86
- 3 Linaker C, Smedley J. Respiratory illness in agricultural workers. *Occup Med (Lond)* 2002; 52:451-459
- 4 Kogevinas M, Anto JM, Sunyer J, et al. Occupational asthma in Europe and other industrialised areas: a population-based study; European Community Respiratory Health Survey Study Group. *Lancet* 1999; 353:1750-1754
- 5 Iversen M, Dahl R, Korsgaard J, et al. Respiratory symptoms in Danish farmers: an epidemiological study of risk factors. *Thorax* 1988; 43:872-877
- 6 Choudat D, Goehen M, Korobaef M, et al. Respiratory symptoms and bronchial reactivity among pig and dairy farmers. *Scand J Work Environ Health* 1994; 20:48-54
- 7 Radon K, Danuser B, Iversen M, et al. Respiratory symptoms in European animal farmers. *Eur Respir J* 2001; 17:747-754
- 8 Dalphin JC, Dubiez A, Monnet E, et al. Prevalence of asthma and respiratory symptoms in dairy farmers in the French province of the Doubs. *Am J Respir Crit Care Med* 1998; 158:1493-1498
- 9 Kronqvist M, Johansson E, Pershagen G, et al. Risk factors associated with asthma and rhinoconjunctivitis among Swedish farmers. *Allergy* 1999; 54:1142-1149
- 10 Radon K, Monso E, Weber C, et al. Prevalence and risk factors for airway diseases in farmers-summary of results of the European Farmers' Project. *Ann Agric Environ Med* 2002; 9:207-213
- 11 Monso E, Magarolas R, Radon K, et al. Respiratory symptoms of obstructive lung disease in European crop farmers. *Am J Respir Crit Care Med* 2000; 162:1246-1250
- 12 Monso E, Magarolas R, Badorrey I, et al. Occupational asthma in greenhouse flower and ornamental plant growers. *Am J Respir Crit Care Med* 2002; 165:954-960
- 13 Gamsky TE, McCurdy SA, Samuels SJ, et al. Reduced FVC among California grape workers. *Am Rev Respir Dis* 1992; 145:257-262
- 14 Garcia-Ortega P, Bartolome B, Enrique E, et al. Allergy to *Diplotaxis erucoides* pollen: occupational sensitization and cross-reactivity with other common pollens. *Allergy* 2001; 56:679-683
- 15 Burney PG, Luczynska C, Chinn S, et al. The European Community Respiratory Health Survey. *Eur Respir J* 1994; 7:954-960
- 16 Bachert C, van Cauwenberge P. The WHO ARIA (allergic rhinitis and its impact on asthma) initiative. *Chem Immunol Allergy* 2003; 82:119-126
- 17 Wang DY, Niti M, Smith JD, et al. Rhinitis: do diagnostic criteria affect the prevalence and treatment? *Allergy* 2002; 57:150-154
- 18 International Rhinitis Management Working Group. International consensus report on the diagnosis and management of rhinitis. *Allergy* 1994; 49:1-34
- 19 Bohadana AB, Teculescu DB, Megherbi SE, et al. Bronchial hyperresponsiveness in farmers: relation to respiratory symptoms, lung function, and atopy. *Lung* 1999; 177:191-201
- 20 Quanjer PH, Tammeling GJ, Cotes JE, et al. Lung volumes and forced ventilatory flows: Report Working Party Standardization of Lung Function Tests, European Community for Steel and Coal; official statement of the European Respiratory Society. *Eur Respir J Suppl* 1993; 16:5-40
- 21 Monso E, Schenker M, Radon K, et al. Region-related risk factors for respiratory symptoms in European and Californian farmers. *Eur Respir J* 2003; 21:323-331
- 22 Danuser B, Weber C, Kunzli N, et al. Respiratory symptoms in Swiss farmers: an epidemiological study of risk factors. *Am J Ind Med* 2001; 39:410-418
- 23 Kimbell-Dunn M, Bradshaw L, Slater T, et al. Asthma and allergy in New Zealand farmers. *Am J Ind Med* 1999; 35:51-57
- 24 Astarita C, Gargano D, Manguso F, et al. Epidemiology of allergic occupational diseases induced by *Tetranychus urticae* in greenhouse and open-field farmers living in a temperate climate area. *Allergy* 2001; 56:1157-1163
- 25 Atis S, Tutluoglu B, Sahin K, et al. Sensitization to sunflower pollen and lung functions in sunflower processing workers. *Allergy* 2002; 57:35-39
- 26 European Community Respiratory Health Survey. Variations in the prevalence of respiratory symptoms, self-reported asthma attacks, and use of asthma medication in the European Community Respiratory Health Survey (ECRHS). *Eur Respir J* 1996; 9:687-695
- 27 Papageorgiou N, Gaga M, Marossis C, et al. Prevalence of asthma and asthma-like symptoms in Athens, Greece. *Respir Med* 1997; 91:83-88
- 28 Groenewoud GC, de Jong NW, Burdorf A, et al. Prevalence of occupational allergy to Chrysanthemum pollen in greenhouses in the Netherlands. *Allergy* 2002; 57:835-840
- 29 Goldberg A, Confino-Cohen R, Waisel Y. Allergic responses to pollen of ornamental plants: high incidence in the general atopic population and especially among flower growers. *J Allergy Clin Immunol* 1998; 102:210-214
- 30 Barnes M, Cullinan P, Athanasaki P, et al. Crete: does farming explain urban and rural differences in atopy? *Clin Exp Allergy* 2001; 31:1822-1828
- 31 Grigoreas C, Pappas D, Galatas ID, et al. Serum total IgE levels in a representative sample of a Greek population: I. Correlation with age, sex, and skin reactivity to common aeroallergens. *Allergy* 1993; 48:142-146
- 32 Gioulekas D, Damialis A, Papakosta D, et al. 15-year aeroallergen records: their usefulness in Athens Olympics, 2004. *Allergy* 2003; 58:933-938
- 33 Papageorgiou PS. Particularities of pollen allergies in Greece. *Pediatr Pulmonol Suppl* 1999; 18:168-171
- 34 Demir AU, Karakaya G, Kalyoncu AF. Allergy symptoms and IgE immune response to rose: an occupational and an environmental disease. *Allergy* 2002; 57:936-939
- 35 Feo F, Martinez J, Martinez A, et al. Occupational allergy in saffron workers. *Allergy* 1997; 52:633-641
- 36 Monteiro A, Moreira I. Reduced rates of residual and post-emergence herbicides for weed control in vineyards. *Weed Res* 2004; 44:117-128
- 37 Gamsky TE, McCurdy SA, Wiggins P, et al. Epidemiology of dermatitis among California farm workers. *J Occup Med* 1992; 34:304-310
- 38 McCurdy SA, Wiggins P, Schenker MB, et al. Assessing dermatitis in epidemiologic studies: occupational skin disease among California grape and tomato harvesters. *Am J Ind Med* 1989; 16:147-157

Allergic Rhinitis, Asthma, and Atopy Among Grape Farmers in a Rural Population in Crete, Greece

Leda Chatzi, Emmanuel Prokopakis, Nikolaos Tzanakis, Athanasios Alegakis, Ioannis Bizakis, Nikolaos Siafakas and Christos Lionis

Chest 2005;127;372-378

DOI: 10.1378/chest.127.1.372

This information is current as of July 18, 2005

Updated Information & Services	Updated information and services, including high-resolution figures, can be found at: http://www.chestjournal.org/cgi/content/full/127/1/372
References	This article cites 38 articles, 9 of which you can access for free at: http://www.chestjournal.org/cgi/content/full/127/1/372#BIBL
Citations	This article has been cited by 1 HighWire-hosted articles: http://www.chestjournal.org/cgi/content/full/127/1/372#otherarticles
Permissions & Licensing	Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at: http://www.chestjournal.org/misc/reprints.shtml
Reprints	Information about ordering reprints can be found online: http://www.chestjournal.org/misc/reprints.shtml
Email alerting service	Receive free email alerts when new articles cite this article sign up in the box at the top right corner of the online article.
Images in PowerPoint format	Figures that appear in CHEST articles can be downloaded for teaching purposes in PowerPoint slide format. See any online article figure for directions.

