Respiratory Disease in Agricultural Workers: Mortality and Morbidity Statistics

February 2007

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

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Preface

Respiratory Disease in Agriculture: Mortality and Morbidity Statistics presents summary tables and figures of occupational respiratory disease surveillance data focusing on various occupationally relevant respiratory diseases for the Agriculture, Forestry, and Fishing industries. The report has seven major sections that provide the following data: (1) highlights and data usage limitations; (2) demographic statistics for agricultural workers; (3) mortality statistics for agricultural workers, including by sex and race/ethnicity; (4) morbidity statistics for agricultural workers, including by sex, race/ethnicity, smoking status, and source of data; (5) recommendations to fill research gaps for respiratory disease in agriculture; and (6) appendices with descriptions of data sources, methods, and other supplementary information.

Data contained in this report originate from various publications, reports, data files, and tabulations provided by the National Center for Health Statistics (NCHS) and the Bureau of Labor Statistics (BLS). Details on the major data sources and on the methods used to compute specific statistics can be found in Appendices A and B, respectively.

Interpreted with appropriate caution, the information contained in this report can help to establish priorities for research and respiratory disease prevention in agriculture. To increase the utility of future surveillance of occupational respiratory disease in agriculture, comments on the report, descriptions of how the information could be used, and suggestions of other data for inclusion in future reports are invited.

Send comments, suggestions, and other correspondence to:

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Drafts of this report were provided for review and comment to epidemiologists, physicians, industrial hygienists, agricultural health experts, and representatives of industry and labor associations. Their comments have been considered in preparing the final version of this report.

Abbreviations

BLS	Bureau of Labor Statistics
CDC	Centers for Disease Control and Prevention
DHHS	Department of Health and Human Services
FEV_1	forced expiratory volume in one second
FVC	forced vital capacity
ICD	International Classification of Diseases
L	liters
LCL	lower confidence limit
LLN	lower limit of normal
L/sec	liters per second
NCHS	National Center for Health Statistics
NHANES	National Health and Nutrition Examination Survey
NHIS	National Health Interview Survey
NIOSH	National Institute for Occupational Safety and Health
PEF	peak expiratory flow
PMR	proportionate mortality ratio
PR	prevalence ratio
SD	standard deviation
SOII	Survey of Occupational Injuries and Illnesses
UCL	upper confidence limit

List of Tables and Figures

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Highlights and Limitations

Highlights

These selected highlights summarize the major findings in the report, including a description of results that were statistically elevated. Mortality statistics were derived from deaths from 24 states for 1988–1998, while morbidity data came from two large population-based surveys of the U.S. undertaken in 1997–1999 and 1988–1994.

- Decedents whose death certificate indicated that they worked as *crop workers* had significantly elevated mortality for a number of respiratory conditions, including hypersensitivity pneumonitis (proportionate mortality more than 10 times higher than expected), asthma, bronchitis, histoplasmosis, tuberculosis, pneumonia, and influenza. (Tables H-1 and H-2)

- Decedents whose death certificate indicated that they worked as *livestock farm workers* had significantly elevated mortality for several respiratory conditions, including hypersensitivity pneumonitis (proportionate mortality more than 50 times higher than expected), asthma, tuberculosis, and influenza. (Tables H-1 and H-2)

- Decedents whose death certificate indicated that they worked as *landscape or horticultural workers* had significantly elevated mortality for chronic obstructive pulmonary diseases (COPD), including chronic airways obstruction, and for abscesses of the lung and mediastinum. (Tables H-1 and H-2)

- Decedents whose death certificate indicated that they worked as *forestry workers* had significantly elevated mortality for tuberculosis, COPD, including chronic airways obstruction, and for pneumonia. (Tables H-1 and H-2)

- Decedents whose death certificate indicated that they worked as *fishery workers* had significantly elevated mortality for COPD, including chronic airways obstruction. (Tables H-1 and H-2)

- At least two of the agricultural groups studied in this report were noted to have significantly elevated mortality for several respiratory diseases, including tuberculosis, hypersensitivity pneumonitis, asthma, COPD, pneumonia, and influenza. Significantly elevated COPD mortality was noted in three agricultural groups (*landscape and horticultural workers*, *forestry workers*, and *fishery workers*). (Table H-2)

- Individuals who reported that their longest job held was *farm worker* had elevated prevalence of phlegm production compared to all non-agricultural workers. Prevalence of wheeze was elevated for female *farm workers* and shortness of breath was elevated for *farm workers* who had 'ever smoked.' (Table H-3)

- *Farm workers* had a prevalence ratio (PR) of 173 for obstructive abnormality. (Table 3-22a)

Table H-1. Mortality: Significantly elevated proportionate mortality ratios (PMRs) by agricultural group

Disease (ICD-9 Code)	Number of Deaths	PMR	For more detail see: Table	Figure
Crop Farm Workers				
Hypersensitivity pneumonitis (495)	23	1,228	2-73	2-60
Blastomycotic infection (116)	14	245	2-43	2-39
Histoplasmosis (115)	27	183	2-43	2-38
Bronchitis, not specified as acute or chronic (490)	269	134	2-73	2-55
Abscess of lung and mediastinum (513)	153	120	2-85	2-71
Pulmonary congestion & hypostasis (514)	1,830	113	2-85	2-72
Asthma (493)	813	111	2-73	2-58
Tuberculosis (010–018)	522	148	2-1	2-1
Miliary tuberculosis (018)	35	196	2-37	2-36
Pulmonary tuberculosis (011)	437	152	2-37	7-31
Acute respiratory infections (460–466)	329	124	2-1	2-5
Acute upper respiratory infections of multiple or unspecified sites (465)	87	160	2-55	2-44
Acute bronchitis and bronchiolitis (466)	126	117	2-55	2-45
Pneumonia and influenza (480–487)	26,114	109	2-1	2-7
Influenza (487)	232	142	2-67	2-54
Other bacterial pneumonia (482)	955	120	2-67	2-50
Pneumonia, organism unspecified (486)	23,135	109	2-67	2-53
Livestock Farm Workers				
Hypersensitivity pneumonitis (495)	31	5,563	2-74	2-60
Other respiratory tuberculosis (012)	5	675	2-38	2-32
Tuberculosis of meninges and central nervous system (013)	5	546	2-38	2-33
Asthma (493)	276	150	2-74	2-58
Influenza (487)	73	150	2-68	2-54
Landscape and Horticulture Workers				
Abscess of lung and mediastinum (513)	13	190	2-88	2-71
Chronic obstructive pulmonary disease and allied conditions (COPD) (490–496)	799	109	2-4	2-8
Chronic airway obstruction, nec (496)	624	111	2-76	2-61
Forestry Workers				
Pulmonary tuberculosis (011)	41	143	2-41	2-31
Chronic obstructive pulmonary disease and allied conditions (COPD) (490–496)	2,318	122	2-5	2-8
Chronic airway obstruction, nec (496)	1,890	127	2-77	2-61
Pneumonia and influenza (480–487)	1,771	116	2-5	2-7
Pneumonia, organism unspecified (486)	1,564	117	2-71	2-53
Fishery Workers				
Chronic obstructive pulmonary disease and allied conditions (COPD) (490–496)	568	113	2-6	2-8
Chronic airway obstruction, nec (496)	455	116	2-78	2-61

nec - not elsewhere classified ICD - International Classification of Diseases
NOTE: PMRs are adjusted for age, sex, and race, U.S. residents age 15 and over, selected states (see Appendix D), 1988–1998. PMRs are significantly different from 100 ($p<0.05$).
SOURCE: National Center for Health Statistics multiple-cause-of-death data

Table H-2. Mortality: Disease and disease categories with significantly elevated proportionate mortality ratios (PMRs) in two or more agricultural groups

Disease (ICD-9 Code)	Crop Farm Workers	Livestock Farm Workers	Landscape and Horticulture Workers	Forestry Workers	Fishery Workers
Pulmonary tuberculosis (011)	✓			✓	
Abscess of lung and mediastinum (513)	✓		✓		
Pneumonia/influenza (480–487)	✓			✓	
Pneumonia, organism unspecified (486)	✓			✓	
Influenza (487)	✓	✓			
Chronic obstructive pulmonary disease (490–496)				✓	✓
Asthma (493)	✓	✓			
Hypersensitivity pneumonitis (495)	✓	✓			
Chronic airway obstruction, nec (496)			✓	✓	✓

nec - not elsewhere classified
NOTE: *Crop farm workers* had 10, *livestock farm workers* had 2, and *landscape and horticultural workers* had 1 other respiratory diseases or disease categories with significantly elevated PMRs. See Table H-1. PMRs are adjusted for age, sex, and race, U.S. residents age 15 and over, selected states (see Appendix D), 1988–1998. PMRs are significantly different from 100 ($p<0.05$).
SOURCE: National Center for Health Statistics multiple-cause-of-death data

Table H-3. Morbidity: Significantly elevated prevalence ratios (PRs) by agricultural group

Respiratory Condition	PR	*For more details see:* Table	Figure
Farm Workers			
Phlegm (current)	133	3-9	3-11
Females	226		3-14
Ever smoked	156		3-32
Wheezing (apart from a cold), females	155		3-20
Wheezing (past year), females	146		3-17
Shortness of breath (current), ever smoked	130		3-32

NOTE: PRs are adjusted for age, sex, race, and smoking (except for smoking-specific analyses), U.S. residents age 17 and over, 1988–1994. PRs are significantly different from 100 ($p<0.05$).
SOURCE: National Center for Health Statistics, Third National Health and Nutrition Examination Survey (NHANES III)

Limitations

In addition to the following cautions, readers should see Appendix A for other limitations relating to specific sources of data presented in this report.

General

- In this report, the data are drawn from the major existing databases. However, other data may exist that would improve the completeness and reliability of the findings presented in this report. Readers who are aware of other data that should be considered for inclusion in future editions are encouraged to make their suggestions known (see Preface for contact information).

- Statistics in many tables and figures in this report are based on small numbers. Readers are cautioned that these can be unstable. Hence, inferences should be drawn with care, and should take the numerical basis into account.

- A decedent's or survey respondent's usual or current industry/occupation is not always indicative of the industry and occupation associated with the exposure that may be responsible for that individual's disease even when that disease is work-related. Readers are therefore cautioned not to make definitive causative inferences about industries and occupations based solely on the various mortality and morbidity tables and figures presented in this report.

Mortality Data

- Data from only 24 states were used in the mortality analysis since reliable information on industry and occupation was not available for every state. These 24 states collectively account for 32 percent of the U.S. agricultural worker population (Table 1-2); they do not include the three states having the most agricultural employment (California, Texas, and Florida). Although the information presented is believed to be reasonably representative of health outcomes among all agricultural workers, it may not provide a fully accurate picture.

- Individuals affected by chronic diseases with long latency have much more time to change residences prior to death than individuals affected by acute diseases with short latency. Thus, state of residence at death does not necessarily represent the location of a decedent's occupational exposure, even for a death that results directly from occupational respiratory disease. However, unlike many other occupations, farmers often continue to work well beyond 65 years of age and 18% of the U.S. farm operators are over age 65[1], indicating that farmers are less likely to change residences before death than other occupation.

- Work-related respiratory diseases are often chronic, may also have long latencies, but often may not be reported as the underlying cause of death. This led to a decision to consider both underlying and contributing causes of death in the mortality summary tables and figures in this report.

- Certifying physicians typically do not list all of a decedent's diseases on the death certificate. Therefore, even though contributing causes of death are considered, the mortality data presented in this report probably underestimate the occurrence of some or most respiratory diseases.

- As with any analysis based on death certificate data, there is undoubtedly some misclassification of cause of death. A treating physician may not correctly diagnose a particular disease during a patient's life or, as mentioned above, a certifying physician may fail to list a correctly diagnosed disease on the death certificate, particularly if another disease was directly responsible for the individual's death. In addition, the diagnoses listed on the death certificate sometimes are miscoded.

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[1]U.S. Department of Commerce [1992]. Census of Agriculture. Washington, DC: U.S. Government Printing Office.

- Data that depend, either directly or indirectly, on physician reporting or recording of occupational disease diagnoses can be influenced significantly by the physician's ability or willingness to suspect and evaluate a relationship between work and health. These, in turn, are influenced by evolving medical and scientific information, and by the legal, political and social environment. Some factors may lead to increased diagnosis and recording and reporting whereas others may reduce occupational disease recognition or reporting by physicians.

- The PMRs in this report have not been adjusted for smoking or any other confounding exposure because of lack of these data. Note that PMRs are vulnerable to difficulties in interpretation in that an elevated PMR may reflect an excess in a particular disease mortality or may simply arise from deficits in mortality from other diseases. The PMRs in this report are derived from data reported by only 24 states and omit data from some of the major agricultural states (e.g., California). They therefore may not be representative of the mortality patterns for the whole country. In addition, they may fail to indicate risks for some agricultural operations and situations not, or poorly, represented in the 24 states.

Morbidity Data

- Data from both the NHIS and NHANES surveys are restricted to a sample of household-based respondents in the U.S. A typical round of NHIS or NHANES has about 30,000 respondents. Although weights reflecting the probability of selection for each survey respondent are provided (and were used in the analysis) to enable national estimates, the actual number of respondents is especially small when the data are disaggregated into groups (e.g., agricultural workers). For certain conditions such as emphysema and lung cancer, the numbers are especially small. Hence, the cautions given above for mortality data, against making broad inferences or generalizations from the data provided in this report, apply even more strongly here. In the case of the NHIS data, an attempt was made to compensate for small numbers by summing estimates from the most recent three years (1997–1999) for which survey data were available at the time of the analysis.

- Some of the conditions about which respondents were asked in these surveys relate to the individual's lifetime (e.g., has a doctor ever told you that you have asthma?), whereas others relate to a more recent period (e.g., during the past 12 months, have you had pneumonia?). Hence, the relationship between work and health may be conditional on the time frame of reference for the question, the individual's age, and whether the industry/occupation codes used in the analysis relate to the respondent's current or usual industry/occupation. For the NHANES data, the industry/occupation in which the respondent worked longest was used in the analysis, whereas for the NHIS data only the current industry/occupation was asked of the respondent.

- The questions asked about conditions in the NHANES and NHIS surveys are sensitive to the respondent's ability to recognize such conditions and to correctly answer the questions. Thus, there are potential reporting biases that may be associated, for example, with respondent age or socioeconomic status. The spirometric data from NHANES do not share this limitation, as they are objective measures of respiratory health derived from lung function tests.

- The method used to calculate confidence intervals for prevalence ratios assumes an underlying Poisson distribution and is strictly applicable to outcomes that are rare. Some of the outcomes reported in the survey (e.g., asthma) are not rare, and as a consequence the reported confidence intervals should be regarded as approximate.

- Unlike the NHIS and NHANES data, public-use data files were not available for the BLS injury and illness data. Only incidence rates summarized by industry for *dust diseases of the lung* and *respiratory conditions due to toxic agents* are publicly available, and it was not possible to adjust the survey results for factors such as age, sex, race/ethnicity, or smoking status. In the BLS data, work-related diseases are generally under-recognized and under-reported by employers. (Note: BLS confidential microdata for non-fatal injuries and illnesses is available for research, but users may access this data only at the BLS national office in Washington, D.C.)

- The agricultural occupation and industry coding systems for the source data employed in the presentation of the demographic, morbidity, and mortality data are broadly similar but differ in detail, preventing exact comparisons between them. See Appendices E, F, and G for descriptions of the industry and occupation codes relevant to this report.