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Heat-Related Deaths Among Crop Workers — United States, 1992–2006

Workers employed in outdoor occupations such as farming are exposed to hot and humid environments that put them at risk for heat-related illness or death. This report describes one such death and summarizes heat-related fatalities among crop production workers in the United States during 1992–2006. During this 15-year period, 423 workers in agricultural and nonagricultural industries were reported to have died from exposure to environmental heat; 68 (16%) of these workers were engaged in crop production or support activities for crop production. The heat-related average annual death rate for these crop workers was 0.39 per 100,000 workers, compared with 0.02 for all U.S. civilian workers. Data aggregated into 5-year periods indicated that heat-related death rates among crop workers might be increasing; however, trend analysis did not indicate a statistically significant increase. Prevention of heat-related deaths among crop workers requires educating employers and workers on the hazards of working in hot environments, including recognition of heat-related illness symptoms, and implementing appropriate heat stress management measures.

Information for the illustrative case described in this report was collected by the Agricultural Safety and Health Bureau of the North Carolina Department of Labor. For the nationwide analysis, fatality data were obtained from the Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI) (*1*).* A heat-related death was identified in CFOI as an exposure to environmental heat (BLS Occupational Injury and Illness Classification System [OIICS] event/exposure code 321), with the nature of injury attributed to effects of heat and light (OIICS nature code 072). A crop worker death was indicated where the industry in which the decedent worked was crop production or support activities for crop production.† Fatality rates were calculated as an average annualized rate per 100,000 workers during the 15-year study period for civilian noninstitutionalized workers aged ≥15 years. The numerator was the total of all fatalities during the 15-year period; the denominator was the total of the annual average worker population during the same period. Estimates of the number of workers employed were derived from the U.S. Current Population Survey (CPS) (*2*).§ To examine trends in fatality rates during the study period, data were aggregated in 5-year periods because the numbers of fatalities for several individual years in the study period were too low to

* For this report, CDC used a CFOI research file provided by BLS, which excluded deaths in New York City. Because of confidentiality restrictions, individual case information from the CFOI data cannot be reported; information for the case described in this report was obtained solely from the North Carolina Department of Labor field investigation.

† Because of changes to the industry classification system in 2003, two comparable, though not identical, classification systems were used: the Standard Industrial Classification (major group 01 and 07, excluding industry group 078) for 1992–2002 and the North American Industry Classification System (NAICS) (industry codes 111 and 11511) for 2003–2006.

§ CPS labor counts included workers in crop production industries (NAICS code 111) and support activities for agriculture and forestry (code 115). The latter industry category includes some workers who do not specifically support crop production activities. However, the inclusion of a small number of animal production and forestry support workers in the denominator value should have little influence on the crop worker fatality rate.

INSIDE

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meet BLS publishing criteria. Poisson regression was used to estimate confidence intervals for these aggregate rates.

Case Report

In mid-July 2005, a male Hispanic worker with an H-2A work visa (i.e., a temporary, nonimmigrant foreign worker hired under contract to perform farm work) aged 56 years was hand-harvesting ripe tobacco leaves on a North Carolina farm. He had arrived from Mexico 4 days earlier and was on his third day on the job. The man began work at approximately 6:00 a.m. and took a short mid-morning break and a 90-minute lunch break. At approximately 2:45 p.m., the employer's son observed the man working slowly and reportedly instructed him to rest, but the man continued working. Shortly thereafter, the man's coworkers noticed that he appeared confused. Although the man was combative, his coworkers carried him to the shade and tried unsuccessfully to get him to drink water. At approximately 3:50 p.m., coworkers notified the employer of the man's condition. At 4:25 p.m., the man was taken by ambulance to an emergency department, where his core body temperature was recorded at 108°F (42°C) and, despite treatment, he died. The cause of death was heat stroke. On the day of the incident, the local high temperature was approximately 93°F (34°C) with 44% relative humidity and clear skies. The heat index was in the range of 86°–101°F (30°–38°C) at mid-morning and 97°–112°F (36°–44°C) at mid-afternoon.[¶] Similar conditions had occurred during the preceding 2 days.

The man had been given safety and health training on pesticides but nothing that addressed the hazards and prevention of heat-related stress. He reportedly only spoke Spanish. Fluids, such as water and soda, were always available to the workers in the field; however, whether the man drank any of these fluids is unknown.

Heat-Related Fatalities, 1992–2006

During 1992–2006, a total of 423 worker deaths from exposure to environmental heat were reported in the United States, resulting in an average annual fatality rate of 0.02 deaths per 100,000 workers. Of these 423 deaths, 102 (24%) occurred in workers employed in the agriculture, forestry, fishing, and hunting industries (rate: 0.16 per

[¶] The heat index, an indicator of the combined physiologic effect of air temperature and relative humidity, is presented in this report as a range, which is estimated by using the temperature and humidity to calculate the minimum value and then adding 15°F. This method better reflects exposure conditions in the field under clear skies. Additional information available at http://www.nws.noaa.gov/om/heat/heat_wave.shtml.

100,000 workers), and of these, 68 (67%) occurred in workers employed in the crop production or support activities for crop production sectors, resulting in an average annual fatality rate of 0.39 deaths per 100,000 crop workers (Table). Analysis of fatality rates by 5-year periods suggests an increase in rates over time; however, those rates were based on small numbers of deaths, and the increase over time was not statistically significant (Figure).

During 1992–2006, nearly all deceased crop workers were male,** and 78% were aged 20–54 years (Table). During 1992–2006, the birth country was unknown for 46% of the decedents; however, during 2003–2006, approximately 20 (71%) of the 28 deceased crop workers were from Mexico or Central and South America. Nearly 60% of all heat-related deaths among crop workers occurred in July, and most deaths occurred in the afternoon. Although 21 states reported heat-related deaths among crop workers, California, Florida, and North Carolina accounted for 57% of all deaths, with North Carolina having the highest annualized rate.

** Data are not reported by sex because they do not meet BLS publication criteria.

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Editorial Note: During 1992–2006, a total of 68 crop workers died from heat stroke, representing a rate nearly 20 times greater than for all U.S. civilian workers. The majority of these deaths were in adults aged 20–54 years, a population not typically considered to be at high risk for heat illnesses (*3*). In addition, the majority of these deaths were among foreign-born workers.

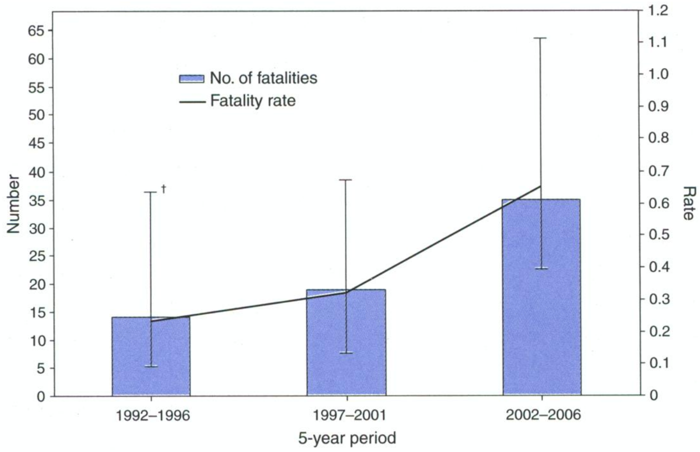
Persons who work outside in hot and humid conditions are at risk for heat-related mortality and morbidity. Heat-related illnesses range from minor heat cramps or rash to heat exhaustion, which is more serious and can lead to heat stroke, which can result in death if medical attention is not provided immediately. Heat stroke is characterized by a body temperature of >103°F (>39°C); red, hot, and dry skin (with no sweating); rapid, strong pulse; throbbing headache; dizziness; nausea; confusion; and unconsciousness. Crop workers might be at increased risk for heat stroke because they often wear extra clothing and personal protective equipment to protect against pesticide poisoning or green tobacco illness (transdermal nicotine poisoning). Employers and workers must be aware that heat-related illness, which can have symptoms similar to pesticide poisoning and green tobacco illness, requires immediate attention. The high proportion of heat-related deaths among foreign-born workers indicates that training and communications regarding the risk for heat-related illnesses should be provided in the workers' native language.

TABLE. Number, percentage, and estimated average annualized rate* of occupational heat-related deaths among crop workers, by selected characteristics — United States, 1992–2006

Characteristic	No.	(%)†	Total no. of workers§	Rate
Total	**68**	**(100)**	**17,227,000**	**0.39**
Industry category				
Crop production	52	(76)	14,454,000	0.36
Vegetable and melon farming	15	(22)	—¶	—
Fruit and tree nut farming	11	(16)	—	—
Other crops**	19	(28)	—	—
Other/Unspecified	7	(10)	—	—
Support activities	16	(24)	2,716,000	0.59
Age group (yrs)				
20–34	16	(24)	4,616,000	0.35
35–54	37	(54)	6,907,000	0.54
≥55	15	(22)	4,589,000	0.33
Region of birth				
Mexico/Central and South America	27	(40)	—	—
Other regions outside United States	10	(15)	—	—
Unknown	31	(46)	—	—
Month of injury				
June	11	(16)	19,487,000	0.06
July	40	(59)	20,143,000	0.20
August	12	(18)	19,964,000	0.06
Other months	5	(7)	—	—
Time of incident				
Before 1:00 p.m.	13	(19)	17,227,000	0.08
After 1:00 p.m.	46	(68)	17,227,000	0.27
Unknown	9	(13)	—	—
State of injury				
California	20	(29)	4,041,000	0.49
Florida	6	(9)	809,000	0.74
North Carolina	13	(19)	551,000	2.36
Other states	29	(43)	—	—

* Per 100,000 workers.
† Percentages for certain characteristics might not add to 100 because of rounding.
§ Annual national average estimates (totaled for 15 years) of employed civilians aged ≥15 years, based on the Current Population Survey. Monthly total number of workers are monthly national average estimates. State total number of workers are annual state average estimates. Numbers are rounded to thousands.
¶ Labor force data not available.
** Includes crops such as cotton, tobacco, sugarcane, and hay; excludes oilseeds and grains.

FIGURE. Number and rate* of heat-related deaths among crop workers, by 5-year period — United States, 1992–2006



* Per 100,000 workers. Rates calculated using annual national average estimates of employed civilians aged ≥15 years based on the Current Population Survey.
† 95% confidence interval for fatality rate.

Guidance to help agricultural employers establish a heat-illness prevention program is available from CDC and the U.S. Environmental Protection Agency (*4,5*). In addition, the Department of the Army and Air Force has published a technical bulletin that provides strategies for employers to control heat stress (*6*). Heat-related safety materials in English and Spanish are available from several other sources, including the California Division of Occupational Safety and Health[††] and the North Carolina Department of Labor.[§§] California and Washington state have recently enacted regulations requiring that employers take action to prevent heat-related illnesses and deaths among their workers, including providing training to supervisors and workers and ensuring the availability of fluids (*7,8*). These regulations were prompted by deaths and illnesses in both states in recent years.

The findings in this report are subject to at least four limitations. First, certain fatality rates had to be calculated as average annualized rates for the entire 15-year study period because small numbers prevented publication according to BLS publishing criteria. This aggregation obscured variability between years. Second, CPS estimates likely underestimated the number of crop workers because of the seasonal nature of the work and because the CPS relies on stable residences for sequential interviews. An underestimate of the worker population would have resulted in an overestimation of the fatality rates. Third, heat-related deaths were likely underreported because heat stroke was not recognized at the time of death, was not indicated as a contributing factor on the death certificate (*3*), or was not recognized by the state agencies as meeting the case definition for an injury-related death in CFOI. Finally, the fatality rates for 5-year periods were based on small numbers with large confidence intervals, and the data do not allow an assessment of whether increased numbers over time might be a reflection of increased awareness and reporting.

The illustrative case described in this report and another case previously reported by CDC (*9*) suggest that some employers might not have heat stress management programs in place. Agricultural employers should develop and implement heat stress management measures that include 1) training for field supervisors and employees to prevent, recognize, and treat heat illness, 2) implementing a heat acclimatization program, 3) encouraging proper hydration with proper amounts and types of fluids, 4) establishing work/rest schedules appropriate for the current heat indices, 5) ensuring access to shade or cooling areas, 6) monitoring the environment and workers during hot conditions, and 7) providing prompt medical attention to workers who show signs of heat illness (*5,6,10*). Employers and workers should be vigilant for signs of heat illness, not only in themselves but in their coworkers, and be prepared to provide and seek medical assistance.

Acknowledgments

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Influenza Vaccination Coverage Among Persons with Asthma — United States, 2005–06 Influenza Season

During 2006, approximately 6.8 million (9.3%) U.S. children and 16.1 million (7.3%) U.S. adults were reported to have asthma (*1,2*). Since 1964, the Advisory Committee on Immunization Practices (ACIP) has recommended influenza vaccination of all persons with asthma because of the higher risk for medical complications from influenza for those persons (*3,4*). Influenza vaccination coverage of persons with asthma varies by age group and remains below *Healthy People 2010* targets of 60% coverage of persons aged 18–64 years with high-risk conditions (14-29c) and 90% of all persons aged ≥65 years (14-29a) (*5–7*). Influenza vaccination rates of children and older adults with asthma have not been well studied. Using 2006 National Health Interview Survey (NHIS) data, this report provides the first examination of influenza vaccination rates and related factors across a national sample of persons with asthma aged ≥2 years. The results indicated that 36.2% received influenza vaccination during the 2005–06 influenza season. Vaccination rates remained below target levels among all subgroups examined, including those reporting the greatest number of health-care visits in the past 12 months. The results of this study indicate that influenza vaccination coverage of all persons with asthma can be improved by increasing access to health care and using opportunities for vaccination during health-care visits.

NHIS is an ongoing, nationally representative, in-person household interview survey of the civilian, noninstitutionalized population of the United States. Beginning with the 2004–05 influenza season, influenza vaccination questions were included in the child questionnaire portion of the NHIS. Because of an influenza vaccine shortage during the 2004–05 season, 2005–06 was the first influenza season for which the NHIS was able to provide an estimate of influenza vaccination rates among children with asthma in a nonshortage season. This report examines NHIS data on influenza vaccination among all persons with asthma aged ≥2 years during the 2004–05 and 2005–06 influenza seasons and identifies characteristics associated with vaccination coverage. Age subgroups were chosen for convenient comparison with previously published Behavioral Risk Factor Surveillance System and NHIS results (*5*). Because diagnoses of asthma in children aged <2 years are considered unreliable, and to be consistent with other reports, the <2 years age group was excluded from this report (*6*).

To ensure that included respondents had equal opportunity for vaccination, only responses for persons who were within the stated age range for the entire influenza season (September 2005–February 2006) were included; furthermore, only responses from interviews that occurred following the influenza season (i.e., interviews conducted during March–August 2006) were included in the analysis to ensure that only vaccinations given for the 2005–06 season were counted. In addition, only persons who reported the month of their most recent vaccination to be in the period September 2005–February 2006 were considered vaccinated for the 2005–06 season. The same inclusion criteria were applied to 2004–05 influenza season data.

For the 2004–05 and 2005–06 seasons, influenza vaccination status was stratified by characteristics reported to influence likelihood of vaccination, including age group, race/ethnicity, income, health insurance coverage, number of health-care visits, and possession of a usual place of health care (*5,6*). Differences in coverage were compared by chi-square test for within-year comparisons and z-test for comparisons in coverage across influenza seasons, with statistical significance defined as $p<0.05$.

Of the 15,295 survey participants aged ≥2 years for the entire 2005–06 influenza season, 1,277 (8.3%) reported current asthma, of whom 29 (2.2%) were excluded from further analysis because of incomplete answers regarding vaccination. Of the remaining 1,248 participants with asthma, 455 reported receiving influenza vaccinations, but 24 (5.3%) had received their vaccination before September 2005 or after February 2006 and were counted as unvaccinated for the 2005–06 season. Influenza vaccination coverage of persons aged ≥2 years with asthma in the 2005–06 influenza season was 36.2%, compared with