Acute Nonoccupational Pesticide-Related Illness and Injury — United States, 2007–2011

Gonza Namulanda, DrPH[1]
Michele M. Monti, MS, MPH[1]
Prakash Mulay, MPH[2]
Sheila Higgins, MPH[3]
Michelle Lackovic, MPH[4]
Abby Schwartz, MPH[5]
Joanne Bonnar Prado, MPH[6]
Justin Waltz, MPH[7]
Yvette Mitchell, MS[8]
Geoffrey M. Calvert, MD[9]

[1]*Division of Environmental Hazards and Health Effects, National Center for Environmental Health, CDC*
[2]*Florida Department of Health, Tallahassee, Florida*
[3]*North Carolina Department of Health and Human Services, Raleigh, North Carolina*
[4]*Louisiana Department of Health and Hospitals, New Orleans, Louisiana*
[5]*Division of Environmental Health, Michigan Department of Health and Human Services, Lansing, Michigan*
[6]*Office of Environmental Public Health Sciences, Washington State Department of Health, Olympia, Washington*
[7]*Environmental Public Health Section, Center for Health Protection, Oregon Public Health Division, Oregon Health Authority, Portland, Oregon*
[8]*Bureau of Occupational Health and Injury Prevention, New York State Department of Health, Albany, New York*
[9]*Division of Surveillance, Hazard Evaluations, and Field Studies, National Institute for Occupational Safety and Health, CDC*

Preface

CDC's National Institute for Occupational Safety and Health (NIOSH) collects data on acute pesticide-related illness and injury reported by 12 states (California, Florida, Iowa, Louisiana, Michigan, North Carolina, Nebraska, New Mexico, New York, Oregon, Texas, and Washington). This report summarizes the data on illnesses and injuries arising from nonoccupational exposure to conventional pesticides that were reported during 2007–2011. Conventional pesticides include insecticides, herbicides, fungicides, and fumigants. They exclude disinfectants (e.g., chlorine and hypochlorites) and biological pesticides (*1*). This report is a part of the *Summary of Notifiable Noninfectious Conditions and Disease Outbreaks — United States,* which encompasses various surveillance years but is being published in 2016 (*2*). The *Summary of Notifiable Noninfectious Conditions and Disease Outbreaks* appears in the same volume of *MMWR* as the annual *Summary of Notifiable Infectious Diseases* (*3*). In a separate report, data on illnesses and injuries from occupational exposure to conventional pesticides during 2007–2011 are summarized (*4*).

Corresponding author: Gonza Namulanda, Division of Environmental Hazards and Health Effects, National Center for Environmental Health, CDC. Telephone: 404-488-3831; E-mail: fos0@cdc.gov.

Background

A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating pests such as insects, mice and small animals, weeds, and fungi (*5*). Types of pesticides include insecticides, herbicides, and fungicides (*5*). In the United States, plant or insect growth regulators, defoliants, and desiccants also are referred to as pesticides (*5*). In 2007, approximately 5.1 billion pounds of pesticides were used in the United States; 17% (857 million pounds) were conventional pesticides. Of the conventional pesticides used in the United States during 2007, approximately 61% were herbicides, 15% were fumigants, 11% were insecticides, 9% were fungicides, and 3% were other conventional pesticides (*6*). During 2007, approximately 80% of conventional pesticide use in the United States was for agricultural use; 12% was for nonagricultural industry, commercial, or government use; and 8% was for home and garden use (*6*).

Pesticides are used in agricultural, residential, recreational, and other settings. Nonoccupational, unintentional exposure to pesticides can occur from any of those uses. Persons might be exposed to low levels of pesticides used commonly in a variety of settings including homes, schools, and hospitals. Exposure could occur from pesticide drift or overspray from an airplane, tractor, or home sprayer onto persons living or going to school near agricultural fields or other application sites. Exposure could occur from consumption of contaminated water or food. Exposure also could occur from improper use, storage, or application of household pesticides such as insect

repellents, foggers, rodent poisons, weed killers, and mosquito or flea and tick control products (*7*).

Pesticides are toxic substances, and exposure to them can cause acute or chronic adverse health effects. This report focuses on pesticide-related illnesses and injuries from acute exposure events (i.e., a single, repeated, or continuous exposure to one or more pesticides that generally occurs for ≤8 hours) (*8*,*9*). U.S. poison control centers collect data on pesticide-related illnesses and injuries from exposure calls, and upload them to the National Poison Data System (*8*). In 2013, of the approximately 2 million exposures that were reported to U.S. poison control centers, approximately 3% were attributed to acute exposures to pesticides (*8*). Pesticides were the eighth most frequent category of substances in poison exposures (intentional and unintentional combined) among children aged ≤5 years and the seventh most frequent category of poison exposures in persons aged ≥20 years (*8*). During 2013, a total of 15,430 pesticide-related illnesses or injuries were documented from 79,405 single substance pesticide exposure calls. Those results consisted of 13,313 minor health outcomes, 2,095 major and moderate health outcomes, and 22 deaths (*8*). Although 94% of the single substance pesticide exposures reported by poison control centers in 2013 were unintentional, 16 of the 22 deaths from pesticides were found to be either intentional suicide or the result of intentional misuse or abuse (*8*).

Surveillance of pesticide-related illness and injury instances can be used to monitor disease trends, detect disease outbreaks, design interventions for disease control and prevention, evaluate the effects of interventions, identify new pesticide-exposure problems, and identify research needs (*9*,*10*). Since 1987, NIOSH has provided financial and technical support for state-based acute pesticide-related illness and injury surveillance programs (i.e., the Sentinel Event Notification System for Occupational Risk [SENSOR]–Pesticides program) (*9*). The Environmental Protection Agency (EPA) also provides funding to NIOSH and three states (Florida, Louisiana, and North Carolina) that participate in the SENSOR-Pesticides program (*9*). All SENSOR-Pesticides program states report cases of acute pesticide-related illnesses and injury to NIOSH. However, not all of the state SENSOR-Pesticides programs collect data on nonoccupational exposures.

Data Sources

Among the 12 states that participate in the SENSOR-Pesticides program, seven states (Florida, Louisiana, Michigan, North Carolina, New York, Oregon, and Washington) routinely collect information on nonoccupational pesticide-related illness and injury. This report summarizes data from these seven SENSOR-Pesticides program states. More information on the SENSOR-Pesticides program is available at http://www.cdc.gov/niosh/topics/pesticides/overview.html.

State-level pesticide-related illness and injury surveillance programs receive case reports about pesticide-related illness and injury from hospitals and health care facilities, laboratories, regional or state poison control centers, agriculture departments, and affected persons or family members (*9*,*11*,*12*). Case ascertainment sources and the agencies to which cases are reported vary by state (*12*).

In Florida, health care practitioners and laboratories are required to report new cases of pesticide-related illness and injury within 24 hours of discovery (*13*). The Florida program also accepts reports from exposed person(s), witnesses, legal services, farmworker advocacy groups, other state agencies, news media representatives, and others willing to report (*14*). In Michigan, health care facilities, health care professionals, and Michigan's Poison Control Center are required to provide reports of chemical poisonings only by request, except in cases of intentional or medicinal poisonings (*15*). The Michigan Department of Health and Human Services (previously known as the Department of Community Health) makes routine and broad-based requests for all unintentional pesticide-related illness reports. Requested reports must be provided within 10 days. Data requests from the state to hospitals are made quarterly. Washington requires that physicians and other health professionals report pesticide-related illness and injury cases to the state health department. Serious or fatal poisonings in Washington must be reported immediately; all others must be reported within 3 days (*16*). In Louisiana, health care providers and poison control centers must report pesticide-related illness to the Louisiana Department of Health and Hospitals (*17*). New York operates a pesticide poisoning registry; physicians and other health care professionals are required to report suspected or confirmed pesticide-related illness and injury cases within 48 hours (*18*). In addition, the program receives reports from the two state poison control centers and pesticide product registrants. In North Carolina, health care providers must report cases of acute pesticide-related illness and injury resulting in death immediately to the state health department or state poison control center; other confirmed or suspicious cases must be reported within 48 hours of diagnosis (*19*). In Oregon, health care providers must report pesticide-related illness and injury cases to their local health department within 24 hours (*20*).

Case Definition

The SENSOR-Pesticides program case definitions for acute pesticide-related illness and injury and reporting details are described in detail elsewhere (*9*). A case of acute pesticide-related illness and injury is characterized by an acute onset of symptoms that are dependent on the formulation of the pesticide product and involve one or more of the following: 1) systemic signs or symptoms (including respiratory, gastrointestinal, allergic, and neurologic), 2) dermatologic lesions, and 3) ocular lesions (*9*). An illness and injury case is considered nonoccupational if the pesticide exposure occurred at some place other than the patient's place of work (*9*).

State SENSOR-Pesticides programs classify pesticide-related illness and injury cases as definite, probable, possible, suspicious, unlikely, insufficient information, asymptomatic, or unrelated. Only definite, probable, possible, or suspicious cases are reportable to NIOSH (*9*). Cases are considered definite if objective evidence (e.g., laboratory, clinical, or environmental evidence) confirms the occurrence of both an exposure and adverse health effects (*9*). A case is considered probable if there is objective evidence of either exposure or adverse health effects. A case is possible if only subjective information (e.g., self-reported information of exposure or adverse health effects) is available. With respect to identifying cases as definite, probable, and possible, the reported health effects must be consistent with the known toxicology of the pesticide to which the patient was exposed. A case is considered suspicious if available toxicologic information is not sufficient (e.g., the pesticide is relatively new and limited human toxicologic data are available) to confirm a causal relationship between the exposure and the adverse health effects (*9*).

The SENSOR-Pesticides program uses standardized criteria to categorize the severity of acute pesticide-related illnesses and injuries (*21*). The program has four categories of severity: death, high severity, moderate severity, and low severity. Death is reported if the outcome of a pesticide-related illness or injury is fatal (*21*). High-severity illness and injury means that the condition is life threatening and requires treatment, usually hospitalization, to prevent death (*21*). Under this category, time lost from work or leisure activity might exceed 5 days. Permanent or long-term disability might result from this level of exposure (*21*). Moderate severity means that the person has systemic signs or symptoms of pesticide-related illness and injury and might lose 3–5 days from work or leisure-time activity. Although adverse effects might be prolonged, no permanent disability or impairment results. In low-severity illnesses and injuries, the person might have signs and symptoms of exposure (e.g., skin, eye, or upper respiratory irritation; headache; fever; fatigue; or dizziness). However, these conditions might resolve without treatment, and <3 days are lost from work or other activities (*21*).

Data Processing and Analyses

During 2007–2011, a total of 5,795 reported cases met the criteria for inclusion in this report. Totals and incidence rates of acute nonoccupational pesticide-related illness and injury cases were calculated by state, sex, and year. U.S. Census Bureau population estimates were used to calculate the incidence rates of pesticide-related illnesses and injury per 100,000 population by state, gender, and year (*22*). Sums of acute nonoccupational pesticide-related illness and injury cases were calculated by pesticide functional classes (i.e., insecticides, herbicides, fungicides, fumigants, rodenticides, and repellents) for the total population. Data were stratified by three age groups: ≤5 years, 6 to <18 years, and ≥18 years. The analyses determined the pesticide categories most often implicated in acute nonoccupational pesticide-related illnesses and injuries for exposure to a single substance and exposure to multiple substances.

Interpreting Data

For several reasons, the data provided in this report (Table 1) (Table 2) are likely to be underestimates of the actual magnitude of acute nonoccupational pesticide-related illness and injury. First, nonoccupational exposure calls reported to poison control centers are self-reported. State surveillance systems rarely capture data on persons who neither call a poison control center nor seek medical care (*8*,*23*,*24*). In addition, an exposed person might not link symptoms to a pesticide exposure, and therefore might not report it (*23*). Second, pesticide-related illnesses and injuries can be difficult to diagnose. The signs and symptoms of pesticide-related illnesses and injuries are similar to other common illnesses (e.g., upper respiratory illness), and some physicians might not recognize and diagnose pesticide-related illnesses and injuries (*23*). Other challenges in diagnosing pesticide-related illnesses and injuries include lack of sufficient environmental data on the exposure and a general lack of clinical tools to diagnose pesticide exposures (*23*). Therefore, the counts and rates presented in this report likely underestimate the magnitude of acute nonoccupational pesticide-related illnesses and injuries.

The higher incident rates of acute nonoccupational pesticide-related illness and injury observed in Louisiana and North Carolina might reflect better case identification and follow-up

TABLE 1. Number and incidence per 100,000 population of acute nonoccupational pesticide-related illness and injury cases — Sentinel Event Notification System for Occupational Risk–Pesticides program, United States, 2007–2011

Characteristic	No.	Population*	Incidence rate†
State			
Florida	1,759	93,477,327	1.88
Louisiana	741	22,423,404	3.30
Michigan	594	49,600,502	1.20
North Carolina	1,547	47,087,962	3.29
New York	346	96,552,793	0.36
Oregon	379	19,004,910	1.99
Washington	429	33,254,981	1.29
Sex§			
Male	2,664	176,658,988	1.51
Female	3,108	184,742,891	1.68
Year			
2007	1,141	71,179,083	1.60
2008	1,220	71,762,644	1.70
2009	1,314	72,278,541	1.82
2010	1,083	72,804,820	1.49
2011	1,037	73,376,791	1.41

* U.S. Census population estimates, summed for the years 2007–2011.
† Per 100,000 population.
§ Information on sex was not available for 23 cases (0.4%) that were excluded from analyses.

TABLE 2. Number and percentage of acute nonoccupational pesticide-related illness and injury cases, by age group, pesticide functional class, and illness and injury severity — Sentinel Event Notification System for Occupational Risk–Pesticides program, United States,* 2007–2011

	Age group (yrs)			
Characteristic	≤5 years† No. (%)	6 to <18 years† No. (%)	≥18 years† No. (%)	All No. (%)
Functional class				
Insecticides	366 (10.0)	383 (10.5)	2,765 (75.9)	3,645 (62.9)
Herbicides	36 (6.0)	58 (9.7)	457 (76.3)	599 (10.3)
Insect repellents	183 (37.3)	106 (21.6)	191 (39.0)	490 (8.5)
Fumigants	14 (13.9)	8 (7.9)	77 ((76.2)	101 (1.7)
Rodenticides	23 (39.0)	3 (5.1)	33 (55.9)	59 (1.0)
Fungicides	0	4 (8.2)	38 (77.6)	49 (0.8)
Other§	47 (11.4)	46 (11.2)	301 (73.2)	411 (7.1)
Multiple	38 (8.6)	42 (9.5)	341 (77.3)	441 (7.6)
Total	707 (12.2)	650 (11.2)	4,203 (72.5)	5,795
Severity				
Low	632 (12.2)	604 (11.7)	3,716 (71.8)	5,173 (89.3)
Moderate	61 (11.2)	44 (8.1)	428 (78.5)	545 (9.4)
High	14 (19.4)	1 (1.4)	55 (76.4)	72 (1.2)
Death	0	1 (20.0)	4 (80.0)	5 (0.1)
Total	**707 (12.2)**	**650 (11.2)**	**4,203 (72.5)**	**5,795**

* Florida, Louisiana, Michigan, North Carolina, New York, Oregon, and Washington.
† Percentages might not total 100% because information on age was lacking for 235 cases (4%) that were excluded from analyses.
§ Includes insect growth regulators, antifouling agents, and other pesticides not otherwise categorized.

rather than a greater prevalence of illness and injuries. In addition, some cases not related to work might have been missed because NIOSH advises states to give priority to work-related cases when staffing limitations preclude follow-up of all cases. Furthermore, some persons might have been identified incorrectly as having acute, nonoccupational pesticide-related illness because the signs and symptoms of pesticide-related illnesses and injuries are similar to those of other causes. Some physicians might not be familiar with the effects of pesticide exposures and diagnostic tests might not be available or rarely performed (*23*).

The pesticides most often implicated in acute nonoccupational pesticide-related illness and injury are listed (Table 3). Data are stratified by whether the person was exposed to a single substance (i.e., the active ingredient). When a person is exposed to a single substance, that substance likely was responsible for illness or injury. This might not be so for persons exposed to multiple substances because any of the other substances in the mixture might have produced the illness or injury (*25*). Pesticide products also contain solvents and other nonactive ingredients, some of which can produce illness (*25*). Because inert ingredients in pesticide products are almost never identified, attribution of illness and injury to these ingredients is not possible (*25*). This report includes only illnesses and injuries caused by exposure to conventional pesticides. Illnesses and injuries caused by chlorine, hypochlorites, and other disinfectants were not included because not all states track such illnesses (often because of resource constraints in the state health department) and therefore including them would have made the rate estimates not comparable across the seven states.

Publication Criteria

This report is limited to cases of unintentional nonoccupational pesticide-related illness and injury, classified as definite, probable, possible, or suspicious. Disinfectant-related cases were excluded because not all state SENSOR-Pesticides programs report these cases.

Highlights

Among the 5,795 cases of acute nonoccupational pesticide-related illness and injury that were reported, 3,108 occurred among females and 2,664 occurred among males (Table 1). Most of cases (73%) occurred among persons aged ≥18 years, and 12% occurred in children aged ≤5 years (Table 2).

Florida had the highest number of cases (1,759), followed by North Carolina (1,547), and Louisiana (741). North Carolina and Louisiana had the highest incidence of cases per 100,000 population (3.29 and 3.30, respectively), followed by Oregon (1.99) (Table 1).

TABLE 3. Number of cases of acute nonoccupational pesticide-related illness and injury, by pesticides most often implicated —Sentinel Event Notification System for Occupational Risk–Pesticides program, United States,* 2007–2011

Pesticide category	Pesticide functional class	No. exposed to single substance†	No. exposed to multiple substances§	Total§
Pyrethroids	Insecticide	1,168	1,541	2,709
Pyrethrins	Insecticide	322	600	922
Organophosphates	Insecticide	282	280	562
Glyphosate	Herbicide	171	128	299
Carbamates	Insecticide	181	84	265
Naphthalene	Insect repellent	135	27	162
Triazines	Herbicides	37	18	55
Imidacloprid	Insecticide	0	88	88
Fipronil	Insecticide	16	95	111
Phosphorus	Fumigant	8	0	8
Thiocarbamates	Fumigant	27	5	32
Sulfur	Insecticide/ Fungicide	38	65	103
Dipyridyls	Herbicide	20	65	85
Pyraclostrtrobin	Fungicide	1	5	6
Chloropicrin	Fumigant	10	5	15
Organochlorines	Insecticides	13	18	31
All other		829	661	1,490
Total		**3,258**	**2,537**	**5,795**

* Florida, Louisiana, Michigan, North Carolina, New York, Oregon, and Washington
† Pesticide active ingredient.
§ Pesticide categories are not mutually exclusive for multiple exposures. Case counts for persons exposed to multiple substances are included in the totals of more than one pesticide category. Therefore, the sum of all case counts (6,943) exceeds the total number of exposed persons (5,795).

Insecticides were responsible for most of the cases (63%), followed by herbicides (10%), and insect repellents (9%) (Table 2). Children aged ≤5 years comprised 39% of all persons with rodenticide cases and 37% of all those with insect repellent cases. Pyrethroids, pyrethrins, and organophosphates were the pesticides most often implicated in single-substance or multiple-substance exposures (Table 3).

Approximately 1% of all cases were fatal or had a high severity of illness and injury. Among the high-severity illness and injury cases, 19% involved children aged ≤5 years, but no deaths were reported for that age group (Table 2).

Children aged ≤5 years accounted for 39% of all cases from exposure to rodenticides and 37% of all cases from exposure to insect repellents. Exposure to rodenticides might be more common in children because rodenticide baits, which are designed to be attractive to animals, might be attractive to children. Therefore, parents should exercise caution when using rodenticides (e.g., store them out of sight and use them out of the reach of children) (*26*). EPA recommends reading and following the usage recommendations on the product label of insect repellents (*27*). EPA also recommends that young children should not handle or spray insect repellents themselves. In addition, parents should not apply these products to children's hands because children frequently put their hands near their eyes or in their mouths (*27*).

Insecticides were responsible for most of the cases across all age groups. EPA recommends the following for the safe use of all pesticides, including insecticides: 1) read and follow the instructions on the label of the pesticide product, 2) keep pesticides in their original containers (do not transfer them to containers that someone might drink from by mistake), 3) use pesticides indoors only when necessary and with adequate ventilation, and 4) store pesticides in a locked cabinet out of reach of children (*28*).

The pesticides most often implicated in acute, nonoccupational pesticide-related illness and injury were pyrethroids and pyrethrins. When used as intended at low levels, the toxicity of these pesticides to humans is low (*29*). However, they can cause harm when not used as recommended (e.g., in larger amounts). Instructions on the product labels should be followed when using these pesticides.

Surveillance of acute nonoccupational pesticide-related illness and injury provides some information on pesticide-related mortality and morbidity incidence and on the pesticides primarily implicated in illness and injury. Obtaining a more in-depth occupational and environmental exposure history (e.g., occupation, name of pesticide product, intended use of pesticide, amount of pesticide exposed to, and route of exposure) in the several settings where these cases are identified could improve identification of pesticide-related illness and injury cases and the pesticide(s) implicated (*23*,*30*).

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