America's Children and the Environment, Third Edition

DRAFT Indicators

Special Features: Contaminants in Schools and Child Care Facilities

EPA is preparing the third edition of *America's Children and the Environment* (ACE3), following the previous editions published in December 2000 and February 2003. ACE is EPA's compilation of children's environmental health indicators and related information, drawing on the best national data sources available for characterizing important aspects of the relationship between environmental contaminants and children's health. ACE includes four sections: Environments and Contaminants, Biomonitoring, Health, and Special Features.

EPA has prepared draft indicator documents for ACE3 representing 23 children's environmental health topics and presenting a total of 42 proposed children's environmental health indicators. This document presents the draft text, indicators, and documentation for the contaminants in schools and child care facilities topic in the Special Features section.

For more information on America's Children and the Environment, please visit www.epa.gov/ace. For instructions on how to submit comments on the draft ACE3 indicators, please visit www.epa.gov/ace/ace3drafts/.

Contaminants in Schools and Child Care Facilities

The indoor and outdoor environmental quality of schools and child care facilities has a great impact on children's health and educational wellbeing. Depending on the age, usage, maintenance, and type of facility, children may be exposed to contaminants from a variety of indoor and outdoor sources: building materials and furnishings, such as treated wood, paint, furniture, carpet, and fabrics; products used for maintenance of the building, such as cleaning products and pesticides; products used for hobbies, science projects, and arts and crafts projects; products used in learning environments, such as markers and correction fluid; and outdoor air pollution from nearby traffic and industry.

Children generally spend most of their active, awake time at schools and child care facilities, which face a set of environmental health challenges that differ from those of most residential homes and office buildings.[1] For example, on average, schools house four times the number of occupants as office buildings in the same amount of floor space.[2] Schools and child care facilities are also particularly vulnerable to pest problems due to their size; numbers of occupants; presence of food; and abundance of potential pest habitats, such as books, supplies, and other equipment.

Child care and school environments share many characteristics relevant to how children are exposed to indoor environmental contaminants, but there are also a number of important differences. Children in child care facilities are usually considerably younger than children in schools, sometimes as young as a few weeks old. The behaviors of very young children (e.g., crawling, hand-to-mouth activity) increase their exposure to contaminants in dust, in toys and other objects, and on surfaces.[3] Compared with schools, child care facilities can be located in a much wider variety of settings, including office buildings, individual homes, and religious buildings. Furthermore, child care facilities are more often operated independently, while schools are frequently part of a school district with centralized facilities management.

Contaminants in the indoor environment have been linked to various illnesses, including asthma, cancer, reproductive toxicity, and hormone disruption.[4-6] Children are especially sensitive to contamination, for several reasons. First, children are biologically more vulnerable than adults, due to their immature metabolic pathways and their sensitive developing processes and systems, such as the immune, endocrine, and neurological systems.[3,7,8] Children's intake of air and food is also proportionally greater than that of adults. On a body weight basis, a resting child breathes up to twice as much air as adults do.[1] For younger children, the inhalation and ingestion of contaminated dust is a major route of exposure due to their frequent and extensive contact with floors, carpets, and other surfaces where dust gathers, such as windowsills, as well as their high rate of hand-to-mouth activity.[1] Finally, children have many years of future life in which to develop disease associated with exposure.[8]

Indoor environmental contaminants, particularly indoor air pollutants, are associated with a variety of outcomes related to educational performance, possibly as the result of impaired health.[9] Exposure to indoor air pollutants has been associated with decreased concentration and poor testing outcomes.[10-12] Children exposed to indoor air pollution also miss more days of school due to illness.[13,14] A child's overall academic performance can suffer as a result of such an illness or absence.[15]

Certain groups of children are especially susceptible to indoor environmental contaminants. Children living in low-income urban or inner city environments suffer disproportionate effects from indoor environmental contaminants, because the buildings and homes in these areas are frequently old and in poor repair, have leaky roofs, water damage, mold contamination, rodent and cockroach infestation, and elevated levels of nitrogen dioxide and particulates.[16-22] Children with allergies, asthma, and other respiratory problems are also especially susceptible to the effects of indoor air pollution. Asthma attacks and allergies are often triggered by indoor allergens (pollen, dust, cockroaches), as well as by mold.[23]

Children may be exposed to a variety of contaminants in schools and child care facilities, including lead, polychlorinated biphenyls (PCBs), asbestos, pesticides, brominated flame retardants, phthalates, and perfluorinated chemicals. Exposure to indoor contaminants can occur via multiple routes, such as dermal (through the skin), inhalation, and direct and indirect ingestion. Children are exposed to a variety of chemicals as a result of the design, construction, and current state of schools and child care environments. Age, level of deterioration, and ventilation efficiency are key characteristics that determine a building's indoor environmental quality. Many hazardous substances that are either banned or in limited use, such as asbestos, lead, and PCBs, are still present in many schools and child care facilities. These substances are released into the indoor environment as a result of deterioration of the building from old age, or through improperly managed removal and renovation processes.

Lead

The most common sources of lead exposure in schools and child care environments are lead-based paint, lead dust, and lead-contaminated soil in outdoor play areas.[24] An estimated 14% of licensed child care facilities in the United States have significant lead-based paint hazards, with facilities in older buildings being more likely to have lead-based paint hazards than those in newer buildings.[25] Additional sources may include lead in drinking water, lead-contaminated products such as toys and books, and outdoor air from nearby industry.[26] The ingestion and inhalation of lead-contaminated dust are the primary pathways of childhood exposure to lead.[27] Children are at greater risk of exposure to lead-contaminated dust than are adults, due to their frequent and extensive contact with floors, carpets, and other surfaces where dust gathers, as well as their high rate of hand-to-mouth activity. Low-level exposure to lead has been associated with nervous system and kidney damage, learning disabilities,[28] attention-deficit/hyperactivity disorder, decreased intelligence, and planning and memory deficits.[29-35]

Polychlorinated Biphenyls (PCBs)

PCBs are a family of industrial chemicals used primarily as insulating fluids in capacitors, transformers, and other electrical equipment. While the manufacture of PCBs was banned in 1979, PCBs continue to be present in products and materials produced before the ban. Many schools in the United States have lighting systems containing PCBs. When contained in the lighting systems, PCBs pose very little health risk or environmental hazard.[36] However, lighting systems degrade as they age, increasing the risk of PCB leaks or even fires, which pose health and environmental hazards. In December 2010, EPA issued guidance recommending that schools take steps to reduce potential exposures to PCBs from these types of older lighting fixtures.[37] PCBs are also found in caulk, paint, and joint sealants used in building structures before 1980,[36] which may contribute significantly to PCB levels in indoor air and dust in schools.[38] Although there is some inconsistency in the epidemiological literature, the overall evidence supports a concern for effects of PCBs on children's neurological development.[39-41]

Asbestos

Asbestos is a naturally occurring mineral fiber that has been used in building materials as an insulator and fire retardant.[42] The production and use of building materials containing asbestos is currently limited by law in the United States,[43] but many older schools and other buildings may have asbestos-containing materials that were previously allowed in construction. If asbestos-containing materials are disturbed or begin to deteriorate, they can release hazardous fibers into the air and water, and long-term exposure to these fibers can lead to lung cancer, asbestosis (lung scarring), or mesothelioma (cancer of the lung cavity lining).[44,45] These diseases have a long latency period, putting children at greater risk because children have more years to develop the diseases. The Asbestos Hazard Emergency Response Act provides rules for the management of asbestos in schools. Sometimes asbestos-containing products are removed when they are found, but they are most often "managed-in-place."

Other Indoor Contaminants

Cleaning products and maintenance activities are a significant source of exposure to chemical contaminants. Many conventional cleaning supplies contain harmful chemicals that have been linked to various health effects, including asthma and cancer.[46] Additionally, maintenance activities, from routine cleaning to renovation, can cause dust and particulate matter to become airborne, leading to increased opportunity for such contaminants to be inhaled and ingested.[47]

Children also may be exposed to a variety of hazardous chemicals in school and child care environments, including benzene in tobacco smoke, glues, paints, and other art supplies; mercury from older thermometers; a range of chemicals in chemistry labs; lead acid in batteries and other automotive and trade shop supplies; formaldehyde in pressed wood furniture, flooring, carpets, curtains, and cleaning products; and methylene chloride in paints, aerosol sprays and fresheners, and insecticide propellents.[48] These and other chemicals commonly found in indoor air can cause a range of short-term effects, such as eye, lung, and skin irritation; headaches; nausea; fatigue; and a range of long-term health effects, from chronic lung irritation to cancer, depending on the specific chemical.

Inefficient or malfunctioning heating, ventilation, and air conditioning (HVAC) systems increase children's risk of exposure to indoor airborne contaminants, including chemicals and allergens, by failing to either provide sufficient circulation and filtration of fresh outdoor air or control moisture and temperature levels.[49] Airborne allergens commonly found in schools and child care centers include dust mites and mold, which thrive especially in damp, warm environments, as well as pest droppings (e.g., cockroach allergen), rodent dander, and pollen.[50] Temporary classroom structures, such as trailers and portable classrooms, are commonly associated with poor indoor air quality due to inadequate ventilation and toxic building materials. A large-scale, state-wide survey of traditional and portable classrooms in California found that, on average, temporary classrooms had worse indoor air quality than permanent buildings did, including less efficient or improperly functioning HVAC systems; higher levels of indoor air formaldehyde, particulate matter, polycyclic aromatic hydrocarbons (PAHs), and humidity; and temperatures above and below thermal comfort standards during warm and cool seasons, respectively.[51]

School Siting

The pollutants in the surrounding school environment have a significant impact on the current health of children. Currently, no federal guidelines exist to regulate the siting of new schools or the development of new industry surrounding schools; however, EPA is currently developing voluntary model guidelines for school siting.[52,53] If a school is built on top of or near contaminated lands, such as former industrial sites, chemicals in the soil can seep into the building structure via vapor intrusion. Radon, a naturally occurring gas, can also seep into buildings from the soil. A nationwide survey of radon levels in schools estimates that nearly one in five schools has at least one schoolroom with a short-term radon level above the level at which EPA recommends that schools take action.[54] Additionally, children attending schools near highways or industrial sources may be exposed to various hazardous products of combustion, including nitrogen oxides, carbon monoxide, VOCs, and fine particulate matter.

Pesticides in Schools and Child Care Facilities

Pesticides are used in the indoor and outdoor environment to prevent, destroy, repel, or mitigate pests such as rodents, insects, unwanted plants, and microorganisms. Pesticide products include insecticides, fungicides, rodenticides, herbicides, and antimicrobials. Application of pesticides in the indoor environment has been shown to contaminate untreated surfaces, including kitchen counters and toys,[55-61] indoor air,[55-57,61-67] and dust.[62,68-72]

Once applied, pesticide residues may take anywhere from a few hours to several months or years to completely break down. Pesticide residues in the indoor environment are removed from factors that enable degradation, such as sunlight, and therefore are more persistent than residues in the outdoor environment.[60,73,74] An assessment of pesticide residues in dust of inner city homes found a high prevalence of the pesticide chlorpyrifos two to three years after its indoor use was banned.[70] For example, DDT continues to be measured in indoor dust several decades after its use was banned in the United States.[71,72,75,76] The persistence of pesticides in the environment after application creates a reservoir for direct human exposure or migrate to untreated areas.[60,77] As a result, exposures may occur long after application and through a variety of routes such as inhalation and indirect ingestion of dust.[55]

Outdoor pesticide applications on school property, as well as on nearby agricultural fields, lawns, or house perimeters, may contaminate nearby schools and child care facilities.[55] Several studies demonstrate increased indoor air[60,78] and dust[75,78] levels following pesticide applications in an adjacent outdoor area. Pathways through which pesticides contaminate indoor dust and air following outdoor applications include track-in of pesticide residues indoors by building occupants and pets,[58,60,75,78] and drift-in or air intrusion into the indoor environment.[78,79]

Few studies have evaluated pesticide exposures in the school environment, although some states have conducted studies of pesticide occurrence in schools. A comprehensive survey of public K–

12 classrooms was conducted by the state of California between October 2001 and February 2002.[80] The California study found residues of both available and restricted-use pesticides in all floor dust samples, and concluded that pesticides enter classrooms either during application or by being tracked in on clothing or shoes from outdoors. Pesticides detected in more than 80% of the samples include *cis*- and *trans*-permethrin, chlorpyrifos, and piperonyl butoxide. The First National Environmental Health Survey of Child Care Centers evaluated potential pesticide exposures in child care facilities. The study detected numerous organophosphate and pyrethroid pesticides in indoor floor wipe samples. Chlorpyrifos, diazinon, and permethrin were detected in more than 67% of the tested centers.[77]

Several studies have reported associations between exposure to pesticides in early life and adverse health effects such as cancer and neurodevelopmental disorders. Childhood leukemia in particular has been associated with childhood exposures to pesticides.[81-85] Permethrin and resmethrin, which both belong to the commonly used class of pesticides known as pyrethroids, were recently classified by EPA as "likely to be carcinogenic to humans."[85] Childhood exposures to organophosphate pesticides have been associated with various adverse neurodevelopmental effects.[86-88] Exposure to herbicides and/or other pesticides in the first year of life has been associated with higher risk of asthma.[89]

The short- and long-term health effects of exposure to pesticides in the school environment are largely unknown, due to a lack of data. Between 1993 and 1996, there were 2,300 pesticide-related exposures reported to poison control centers that involved individuals at schools, resulting in 329 people seen in health care facilities, 15 hospitalized, and 4 treated in intensive care units.[90] Data on the long-term effects of pesticide exposure in schools are not available.[90]

Currently, there is no federal law on pesticide use in the school environment. However, at least 35 states have adopted laws on pesticide use in schools.[91] The state laws are generally focused on the adoption of certain types of practices that eliminate or minimize the use of hazardous pesticides: adoption of Integrated Pest Management (IPM) programs, prohibiting when and where pesticides can be applied, requiring signs before and after indoor and outdoor pesticide application, requiring prior written notification to parents and staff for pesticide use, and establishing restricted buffer zones to address chemicals drifting into school yards and buildings. Strategies such as restrictions on the use of pesticides and adoption of IPM have been shown to be effective at reducing human exposure.[65,66]

There is no national system for compiling data on the amount of pesticides used in schools.[90] Some states require reporting on pesticide use in schools. The state of Louisiana requires schools to submit a written record of "restricted use" pesticides used annually.[92] In the state of New York, commercial applicators are required by a 1996 law to report the amount of each specific pesticide used and the location where it was applied. Also, six states—Arizona, California, Connecticut, Massachusetts, New Hampshire, and New Mexico—require commercial applicators to report the amount of specific pesticides used.[90]

Indicators in This Section

Data on school or child care environmental exposures are not systematically collected. Over the years, some states have conducted surveys or assessments of schools to acquire information on specific contaminants such as pesticides and lead. The following two indicators provide data on the use or presence of pesticides and other chemicals of concern indoors in schools and child care facilities. Indicators Child Care1 and Child Care2 present data on detectable levels of pesticides and other contaminants in a regional and national sample of child care centers. Indicator Schools1 presents data on the amount of pesticides applied in schools in California.

Indicator Child Care1: Percentage of environmental and personal media samples with detectable pesticides in child care facilities, 2001

Indicator Child Care2: Percentage of environmental and personal media samples with detectable industrial chemicals in child care facilities, 2001

Overview

Indicators Child Care 1 and Child Care 2 present information about the types of contaminants that were detected in child care facilities. The data come from two different studies. One study collected information from selected child care facilities in Ohio and North Carolina, while the other study collected information from child care facilities throughout the United States. The indicators show how frequently different contaminants were detected in various media samples (e.g., indoor air, dust) taken at the testing locations.

CTEPP Study and the First National Environmental Health Survey of Child Care Centers

Indicators Child Care1 and 2 present data on the relative potential exposures of children to a variety of pesticides and other contaminants found in child care centers. The indicators are based on data from two different federal studies: the Children's Total Exposure to Persistent Pesticides and Other Persistent Organic Pollutants (CTEPP) Study and the First National Environmental Health Survey of Child Care Centers. Data shown in these indicators were obtained directly from these sources:

Tulve, N.S., P.A. Jones, M.G. Nishioka, R.C. Fortmann, C.W. Croghan, J.Y. Zhou, A. Fraser, C. Cave, and W. Friedman. 2006. Pesticide Measurements from the First National Environmental Health Survey of Child Care Centers Using a Multi-Residue GC/MS Analysis Method. *Environmental Science and Technology* 40(20) 6269-6274.

Morgan, M.K., L.S. Sheldon, C.W. Croghan, J.C. Chuang, R.A. Lordo, N.K. Wilson, C. Lyu, M. Brinkman, N. Morse, Y.L. Chou, C. Hamilton, J.K. Finegold, K. Hand, and S.M. Gordon. 2004. A Pilot Study of Children's Total Exposure to Persistent Pesticides and Other Persistent Organic Pollutants (CTEPP), Appendix I and Appendix J. Research Triangle Park, NC: U.S. Environmental Protection Agency. http://www.epa.gov/heasd/ctepp/.

The CTEPP study investigated the potential exposures of 257 preschool children, ages 1.5 to 5 years, and their primary adult child care providers to more than 50 anthropogenic chemicals, including pesticides, PAHs, PCBs, phthalates, and phenols. This regional study was conducted by EPA in North Carolina and Ohio in 2000–2001. Environmental (indoor and outdoor air, carpet house dust, and soil) and personal (hand wipe, solid and liquid food, drinking water, and urine) samples were collected for each child in the study at home and at the child care center over a 48-hour period.

The First National Environmental Health Survey of Child Care Centers was conducted by the U.S. Department of Housing and Urban Development, the Consumer Product Safety Commission, and EPA in 2001. Indoor and outdoor environmental media samples (surface wipes and soil samples) from a nationally representative sample of 168 child care centers were tested for lead, allergens, and pesticides. No personal samples were collected.

Data Presented in the Indicators

Indicator Child Care 1 presents the percentage of environmental and personal media samples (indoor air, hand wipe, dust, and floor wipe samples) taken from selected regional and national child care facilities with detectable pesticides. Indicator Child Care 2 presents the percentage of environmental and personal media samples (indoor air, hand wipe, dust, and floor wipe samples) taken from selected regional child care facilities with detectable industrial chemical. The "Regional Data" in the first graph and all data in the second graph are derived from the CTEPP study, and reflect the percentage of media samples with detectable pesticides and chemical residues. The "National Data" in the first graph are derived from The First National Environmental Health Survey of Child Care Centers, and reflect the percentage of media samples with detectable chemical residues. The level that is detectable is determined by the capabilities of the sampling and testing equipment used in a study; therefore, it cannot be completely ruled out that contaminants are present at lower levels in samples classified as being below the detection limit. Both indicators are based on whether the contaminant is detected or not detected, and thus provide an indication of potential for exposure, but they do not provide data on concentrations of the chemicals or levels of exposure.

The "indoor air" category reflects children's potential exposure to airborne chemicals through inhalation. The "hand wipes" category is based on sampling for the presence of chemicals on children's hands. Due to children's high levels of hand-to-mouth activity, hand wipe data indicate potential exposure via ingestion.[1] The "dust" category captures contaminants that accumulate in dust on various indoor surfaces, and reflects potential inhalation exposure to contaminants if dust is resuspended in the air, as well as indirect ingestion if dust contaminates items that children put in their mouths, such as food, toys, and their hands.

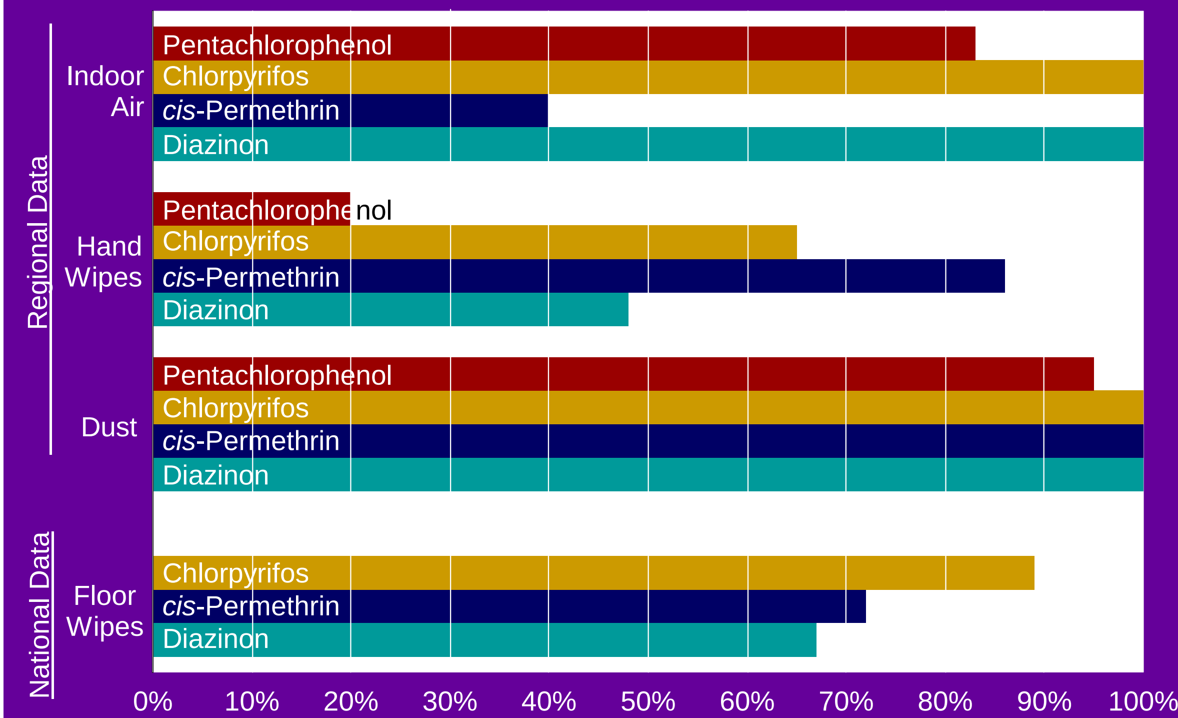
The specific pesticides shown in Indicator Child Care1 are pentachlorophenol, an organochlorine pesticide that has been used in the past in some paints, and in industrial and agricultural practices, but which is now limited to use in wood railroad ties and utility poles; chlorpyrifos, an organophosphate insecticide used previously indoors against cockroaches, fleas, and termites, and currently used on farms to control pests on animals and crops and in warehouses, factories, and food processing plants; *cis*-permethrin, a synthetic pyrethroid used to kill and repel domestic insects; and diazinon, an organophosphate pesticide with current agricultural uses and previous residential uses.

The industrial chemicals shown in Indicator Child Care2 are PCB-52, benzo[b]fluoranthene, dibutyl phthalate, and bisphenol A. While the manufacture of PCBs was banned in 1979, PCBs continue to be present in electrical equipment and some building materials, such as caulk, produced before the ban. Several PCBs were measured in the CTEPP study; data for PCB-52 are displayed in the graph because it is one of the PCBs most frequently detected in the study, and thus gives an indication of potential for exposure to PCBs in general. Benzo[b]fluoranthene is one of several polycyclic aromatic hydrocarbons (PAHs) measured in the CTEPP study. Mixtures of PAHs are produced when carbon-based fuels are burned. Benzo[b]fluoranthene is displayed in the graph because it is one of the PAHs most frequently detected in the study, and thus gives an indication of potential for exposure to PAHs in general. Dibutyl phthalate is a chemical commonly used in adhesives, plastics, and personal care products. Bisphenol A is a high-volume industrial chemical used in the production of epoxy resins and polycarbonate plastics. Polycarbonate plastics may be encountered in many products, notably food and drink containers, while epoxy resins are frequently used as inner liners of metallic food and drink containers to prevent corrosion.

Many of these pesticides and industrial chemicals are no longer available or have highly restricted uses. Manufacture of PCBs and PCB-containing equipment and materials was banned in 1979, though equipment and materials manufactured with PCBs prior to the ban remain in use. Pentachlorophenol has not been used other than as a wood preservative since 1987. Indoor application of chlorpyrifos, and any use at schools, was restricted beginning in 2001. All indoor uses of diazinon were banned in 2001.

Indicator Child Care1

Percentage of environmental and personal media samples with detectable pesticides in child care facilities, 2001



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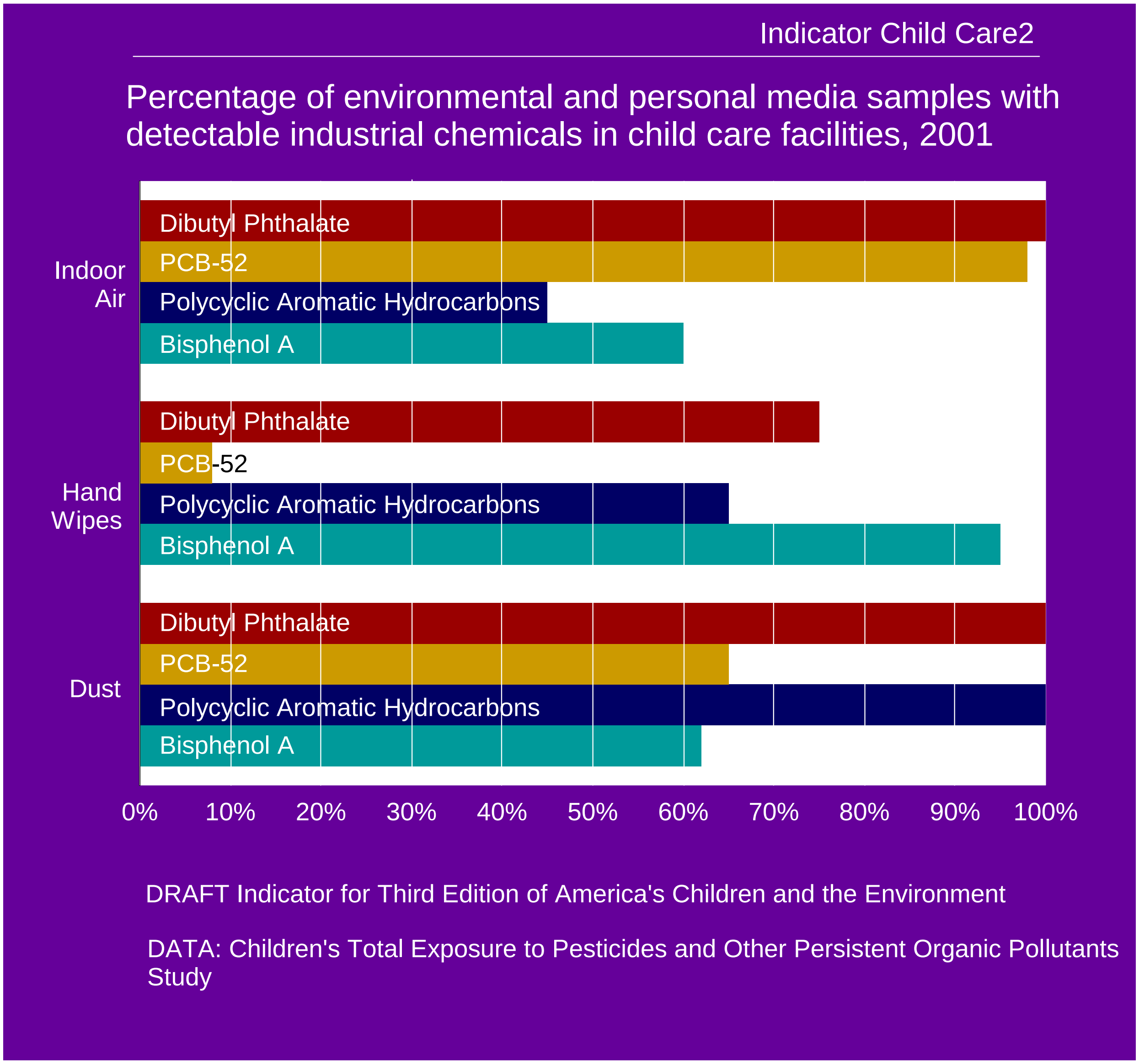
DATA: Children's Total Exposure to Pesticides and Other Persistent Organic Pollutants Study (Regional Data); First National Environmental Health Survey of Child Care Centers (National Data)

- Chlorpyrifos, *cis*-permethrin, and diazinon were detected in all of the dust samples taken at Ohio and North Carolina child care centers included in the CTEPP study. Chlorpyrifos and diazinon were also detected in all of the indoor air samples taken at these child care centers.

- Pesticide residues were detected least often in the hand wipe samples taken at Ohio and North Carolina child care centers, but chlorpyrifos and *cis*-permethrin were detected in more than half of the hand wipe samples.

- The national level floor wipe sampling found chlorpyrifos most frequently, in 89% of samples. *Cis*-permethrin and diazinon were also detected frequently, in 72% and 67% of floor wipe samples, respectively. Pentachlorophenol was not examined in the national study.



- Of the chemicals shown in this indicator, dibutyl phthalate was the most frequently detected in indoor air and dust samples taken at Ohio and North Carolina child care centers included in the CTEPP study.

- Dibutyl phthalate and PAHs were detected in 100% of the dust samples. PCB-52 and bisphenol A were detected in 65% and 62% or dust samples, respectively.

- Dibutyl phthalate, PAHs, and bisphenol A were detected in more than 60% of hand wipe samples, while PCB-52 was detected in less than 10% of these samples.

- Dibutyl phthalate was detected in all of the indoor air samples and PCB-52 was detected in almost all (98%) of the samples. PAHs (represented by benzo[b]fluoranthene) were detected in slightly less than half of the indoor air samples, while bisphenol A was detected in slightly more than half of the indoor air samples.

Indicator School1: Pesticides used inside California schools by commercial applicators, 2002–2007

Overview

Indicator School1 presents information about pesticides used inside California schools. The data for this indicator come from the California Department of Pesticide Regulation, which collects data on all commercial pesticide application in California schools. The indicator shows how the application amounts of different pesticide categories have changed over the years.

California Schools Pesticide Use Reporting Database

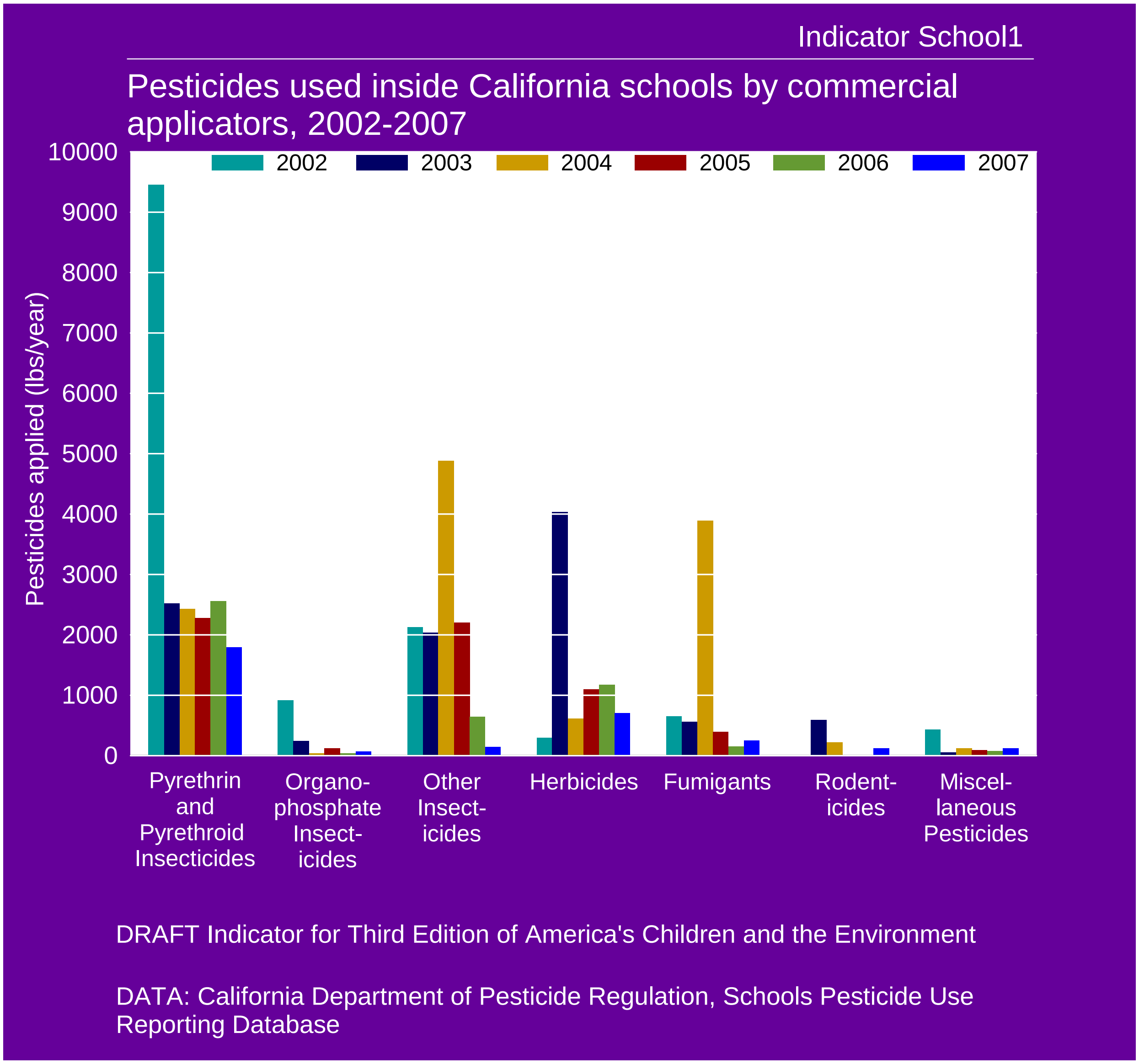
The data for this indicator come from the California Department of Pesticide Regulation. In the year 2000, California passed the Healthy Schools Act of 2000, which required all public child care facilities and school sites to report pesticide use on school sites by pest control businesses.[93] Schools are required to report pesticide use at least once per year, and all schools are required to maintain records of their reports on-site for four years. The California Healthy Schools Act requires reporting for application of pesticides to the buildings or structures (including attics and crawl spaces), playgrounds, athletic fields, school vehicles, or any other area of school property, indoors and outdoors, visited or used by pupils.[93] The law does not apply to products used as self-contained baits or traps; gels or pastes used as crack-and-crevice treatments; pesticides exempted from regulation by EPA; or antimicrobial pesticides, including sanitizers and disinfectants. All other pesticides must be reported.

Data Presented in the Indicator

Indicator School1 displays the mass of pesticides used inside California schools and child care facilities by commercial applicators. The indicator presents data for the indoor applications of pesticides for all years for which data are available: 2002–2007. Although the indicator presents data for schools and child care facilities, nearly all of the data reported are from schools.

The indicator presents the amount of pesticides applied in California schools and child care facilities, in pounds per year, with pesticides grouped into seven categories: pyrethrin and pyrethroid insecticides, organophosphate insecticides, other insecticides, herbicides, fumigants, rodenticides, and miscellaneous pesticides. Most use of the "other insecticides" category inside of California schools is accounted for by imidacloprid, which is marketed for indoor termite and cockroach control. Most of the "miscellaneous pesticides" category use inside of schools is accounted for by a borate compound used as a fungicide and insecticide.

Routinely collected pesticide use data can provide helpful information about the types of pesticides used and the extent of such use, including changes over time. However, these data do not indicate the extent of pesticide exposure experienced by children in California schools.



- Pyrethrin and pyrethroid insecticides accounted for the greatest volume of pesticide use in California schools overall from 2002 to 2007, although there was greater use of herbicides in 2003, and of the “other” insecticides category and fumigants in 2004.

- Generally, the application of pyrethrin and pyrethroid insecticides, organophosphate insecticides, and rodenticides inside California schools has decreased since 2002.

Data Tables

Table Child Care1: Percentage of environmental and personal media samples with detectable pesticides in child care facilities, 2001

	Pentachlorophenol	Chlorpyrifos	*cis*-Permethrin	Diazinon
Indoor Air (Regional Data)	83.2%	100.0%	40.3%	100.0%
Hand Wipes (Regional Data)	20.0%	65.0%	86.5%	48.3%
Dust (Regional Data)	95.2%	100.0%	100.0%	100.0%
Floor Wipes (National Data)	- - -	89.0%	72.0%	67.0%

DATA: Children's Total Exposure to Pesticides and Other Persistent Organic Pollutants Study (Regional Data); First National Environmental Health Survey of Child Care Centers (National Data)

Table Child Care2: Percentage of environmental and personal media samples with detectable industrial chemicals in child care facilities, 2001

	Dibutyl Phthalate	PCB-52	Polycyclic Aromatic Hydrocarbons	Bisphenol A
Indoor Air	100.0%	97.6%	45.3%	59.7%
Hand Wipes	75.0%	8.3%	65.0%	95.2%
Dust	100.0%	65.1%	45.3%	62.3%

DATA: Children's Total Exposure to Pesticides and Other Persistent Organic Pollutants Study

Table School1: Pesticides Used Inside California Schools by Commercial Applicators, 2002–2007

	Pounds of Pesticide Applied					
	2002	2003	2004	2005	2006	2007
Pyrethrin and Pyrethroid Insecticides	9,452	2,515	2,430	2,274	2,556	1,794
Organophosphate Insecticides	919	244	39	119	36	70
Other Insecticides	2,125	2,037	4,883	2,205	641	142
Herbicides	295	4,031	613	1,099	1,174	701
Fumigants	651	556	3,890	392	149	249
Rodenticides	1	589	219	0.4	0.7	120
Miscellaneous Pesticides	434	52	121	88	76	124

DATA: California Department of Pesticide Regulation, Schools Pesticide Use Reporting Database

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Metadata

Metadata for	California School Pesticide Use Reporting Database
Brief description of the data set	A California state-wide database containing the records of pesticide use in California schools and child day care facilities. The records include only pesticides applied by licensed commercial pest management services. Each record contains the name of the school, name of the pesticide product, registration number of the pesticide product, sites of application inside or outside the school, amount of product applied, unit of the measure, and the application date and time. A supplementary dataset giving the percentages of active ingredients in each pesticide product was also obtained from the California Department of Pesticide Regulation (DPR).
Who provides the data set?	California Department of Pesticide Regulation.
How are the data gathered?	As per California pesticide regulations, all businesses engaged in pest control are required to report pesticide use at school sites using a prescribed form to the DPR. More information is available at: http://www.cdpr.ca.gov/docs/legbills/6624fin.pdf.
What documentation is available describing data collection procedures?	The form that pest control companies use to report the pesticide use at school sites is available at: http://www.cdpr.ca.gov/docs/enforce/prenffrm/prenf117.pdf. The data reported by pest control companies are aggregated by the DPR and provided for the general public.
What types of data relevant for children's environmental health indicators are available from this database?	Amount and type of pesticides used at school sites in California by commercial applicators. This information is relevant to determine exposure of school children to pesticides during their time spent inside the school.
What is the spatial representation of the database (national or other)?	State (California).
Are raw data (individual measurements or survey responses) available?	Yes. The database contains all instances of pesticide use at school sites that are reported to the DPR. The raw data can be obtained directly from DPR. The supplementary data files with data on the contents of each pesticide product are available for download at: http://www.cdpr.ca.gov/docs/label/prodtables.htm.
How are database files obtained?	The database files are obtained from DPR through email correspondence.
Are there any known data quality or data analysis concerns?	The specific gravity for some pesticides is not reported. The amounts used in different school locations are not reported or reported as zero. The database excludes non-commercial pesticide applications such as by school staff.
What documentation is available describing QA procedures?	Not available.

Metadata for	California School Pesticide Use Reporting Database
For what years are data available?	2002 – 2007.
What is the frequency of data collection?	All instances of pesticide use at school and child day care sites by pest management companies need to be reported. The DPR aggregates these data on yearly basis.
What is the frequency of data release?	Yearly.
Are the data comparable across time and space?	Pesticide use can be compared between years or between schools.
Can the data be stratified by race/ethnicity, income, and location (region, state, county or other geographic unit)?	Data can be stratified only by county or at the individual school or child day care facility level. No demographic data are included in this database, although school ID codes are available so that these data can be matched with California or federal school population data.

Methods

Indicator

School1. Pesticides used inside California schools by commercial applicators, 2002-2007.

Summary

As per the Healthy Schools Act of 2000 (Assembly Bill 2260) enacted by the California legislature, all licensed pest management companies are required to maintain records of pesticide use at school and child day care facility sites and report such use to the California Department of Pesticide Regulation (DPR). The reporting requirements became effective January 1, 2002. The individual pesticide use reports are mandated to contain the following information: Name and address of the business that applied the pesticide; county where pest control was performed; date and time of pesticide use; name and address of the school or child day care facility site; location of application; pesticide, including the U.S. EPA or state registration number that is on the pesticide label; and finally, the amount used. The data contained in the individual reports of pesticide applications at school sites are aggregated by the DPR. Since each pesticide product may contain one or more active ingredients, and the use of active ingredients is of interest, the pesticide use data were combined with the data on active ingredients present in each commercially available pesticide product. These supporting data were obtained from the DPR, which maintains a database of all licensed pesticides along with names and proportion of active ingredients present in each pesticide. For each pesticide application, the pounds of each pesticide used were calculated by multiplying the amount of product used by the proportion of the active ingredient in the product and, for liquid volumes, by the density. The indicator School1 presents the annual total pounds of each pesticide group applied inside California schools and child day care facilities. Indicator School1 was computed by summing the pounds used across all schools and all pesticides in each pesticide group for each year.

Data Summary

Indicator	School1. Pesticides used inside California schools by commercial applicators, 2002-2007.					
Time Period	2002-2007.					
Data	School pesticide use reports.					
Year	2002	2003	2004	2005	2006	2007
Total Records	26,770	23,409	22,266	20,569	30,663	24,940
Records for Applications Inside Schools	16,523	14,342	13,732	12,840	20,989	14,989
Records for Applications Inside Schools in Liquid Form	600	255	104	96	61	226

Indicator	School1. Pesticides used inside California schools by commercial applicators, 2002-2007.					
With Unavailable Specific Gravity*						

*Specific gravity either missing or reported as zero.

Overview of Data Files

The following files are needed to calculate this indicator.

- XXXXSchoolPUR.xls: School pesticide use database for each year XXXX (MS Excel file for each year). The following variables were used: Product Name, Amount of Product Applied, Location Code, Unit of Measure, (Pesticide) Registration Number. The files were obtained directly from the California Department of Pesticide Regulation.[i]

- Pesticide product data. Product.dat. This ASCII file includes the Product Number (PRODNO), Product Name (PRODUCT_NAME), Registration Number (SHOW_REGNO), and the specific gravity (SPEC_GRAVITY).

- Pesticide product ingredient data. Prod_chem.dat. This ASCII file includes the Product Number (PRODNO), Chemical Code (CHEM_CODE), and the percentage of each active ingredient (PRODCHEM_PCT) in the product.

- Chemical code data. Chem_com.dat. This ASCII file contains the Chemical code (CHEM_CODE) and the Chemical Name (COMNAME).

School Pesticide Use Reporting Database

California regulations require reporting of pesticide use at school sites by pest management companies on a prescribed form. These forms are then submitted to the DPR. The prescribed form[ii] contains the following fields to be completed by the pest management company:

- Application year
- Business registration/license/certificate number, operator name and address
- School site and county
- Date and time of application
- Location code [iii]
- Pesticide product applied and the registration number from the label
- Amount used in either LB (pounds), OZ(ounces) PT (pint), QT (quart), or GA(gallons)

[i] Through email correspondence with Laurie Brajkovich (lbrajkovich@cdpr.ca.gov) and Basil Ibewiro (bibewiro@cdpr.ca.gov) of California DPR.
[ii] Available at http://www.cdpr.ca.gov/docs/enforce/prenffrm/prenf117.pdf.
[iii] There are 19 location codes, each coding denoting a specific site inside or outside the school or child day care facility. Some records list more than one location code.

The pesticide use reported using the above forms is aggregated into a database by the DPR. Each data field/record/row contains one instance of pesticide use at a school site containing all of the above fields. The pesticide use database is available for each year from the DPR.

A supplementary dataset maintained by the DPR was also obtained in order to calculate the indicator. This dataset contains the specific gravity of each pesticide product, and the percentages of each of the active ingredients present in each pesticide product.

Calculation of Indicator

Indicator School1 displays the mass of pesticides used inside California schools by commercial applicators from 2002-2007. The pesticides were classified into the following seven categories: Pyrethin and Pyrethroid Insecticides, Organophosphate Insecticides, Other Insecticides, Herbicides, Fumigants, Rodenticides, and Miscellaneous Pesticides.

Each instance of pesticide use in California schools or child day care facilities was first classified as an indoor or outdoor application, based on the location code. Some uses report multiple location codes; however, there are no data to apportion the total amount used for each location. Therefore, when multiple location codes are reported, the use was classified as an outdoor application only when all the location codes correspond to an outdoor location. This may result in an overestimate of the pesticides used at indoor locations. The following location codes are assumed to be outdoor applications: 2 (Athletic field), 4 (Building exterior), 8 (Hardscape—parking lot, sidewalk etc.), 10 (Outdoor landscape), and 14 (Playground). The analyses for this indicator used only the indoor application data.

After the location of the use is determined, the amount of pesticide product used was converted into the common mass unit of pounds for each record. If the pesticide was applied as a liquid and reported in volume units rather than mass units, the volume was multiplied by the density of the corresponding product (from the pesticide product data file) to obtain the pounds of pesticide product used. The density is the specific gravity (relative to distilled water) multiplied by the density of water at standard temperature and pressure, 8.34 pounds per gallon. For some pesticide products, the specific gravity data were not available or were reported as zero. In such cases, a specific gravity of 1 (for distilled water) was assumed.

The amounts of active ingredient applied for each use were determined using the pesticide product ingredient file that lists the active ingredients and their proportions in each pesticide product. The usage files, pesticide product data file, and pesticide product ingredient file were all matched using the registration code of the pesticide product. The total amount of pesticide applied was multiplied by the fractions of each active ingredient to obtain the amount of that particular active ingredient applied. The common chemical names of the active ingredients were obtained by matching the chemical codes to the chemical code data file. The total number of pounds of each active ingredient applied during the year was obtained by summing the amount applied over all pesticide use records. Finally, the total number of pounds applied for each pesticide category was obtained by summing the total pounds of all the pesticide active ingredients in that particular category.

Equations

The following equations give the mathematical calculations. Let w(x) denote the amount of the pesticide product x applied indoors at a school site. Assume that w(x) has been converted into pounds for products reported in mass units and has been converted into gallons for products reported in volume units. Let c(i) denote the percentage of active ingredient i present in the product x. Further, let d(x) be the specific gravity of the pesticide product x assuming it is in the liquid form and the reported unit is in volume units. The following calculations are applied to each year and pesticide category.

1. Sum over all pesticide use records (indoor applications only) to obtain the total amount of active ingredient i applied for products reported in mass units.

   $$M(i) = \Sigma\ w(x) \times c(i) / 100$$

2. Sum over all pesticide use records (indoor applications only) to obtain the total amount of active ingredient i applied for products reported in volume units. 8.34 pounds per gallon is the density of distilled water at standard temperature and pressure.

   $$V(i) = \Sigma\ w(x) \times d(x) \times 8.34 \times c(i) / 100$$

3. Sum the pounds of active ingredient used in solid and liquid form.

   $$A(i) = M(i) + V(i)$$

4. Sum over all active ingredients in the pesticide category P to obtain the total pounds of category P applied in each year.

   $P = \Sigma\ A(i)$, where the sum is over all pesticides in category P

Questions and Comments

Questions regarding these methods, and suggestions to improve the description of the methods, are welcome. Please use the “Contact Us” link at the bottom of any page in the America’s Children and the Environment website.