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ATTACHMENT D

TROUBLE

ON THE

FARM

**GROWING UP
WITH PESTICIDES
IN AGRICULTURAL
COMMUNITIES**

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ENTER**

NRDC NATURAL
RESOURCES
DEFENSE
COUNCIL

OCTOBER 1998

TROUBLE ON THE FARM

Growing *Up with* Pesticides
in Agricultural Communities

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About NRDC

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I was astounded, when I went down there [to the San *Joaquin valley*], at the cavalier use OF these enormously toxic pesticides. These children are *literally* living among the chemicals.

Marion Moses, M.D., Pesticide Education Center
(Matt Crenson, Associated Press, December 9, 1997)

I believe that the EPA holds a unique and a central charge when it comes to the health and safety of *rural* communities . . . to safeguard the health and safety OF farm workers and their children who live, and often work side-by-side with them on farms across America.

Susan Bauer, Community Health Partnership of Illinois
Public Meeting in Tipton, IN, August 21, 1996)

The Food Quality Protection Act puts the safety of American children first. EPA is committed to higher standards of protection *FOR our* children, and I'm convinced we can meet those standards while providing a reasonable transition for agriculture.

Lynn Goldman, M.D., Assistant Administrator of the
Office of Prevention, Pesticides and Toxic Substances,
U.S. EPA (EPA Region 10 Press Release, May 26, 1998)

EXECUTIVE SUMMARY

Before World War II, growing up on the farm implied a healthy lifestyle—lots of clean air, fresh food, and physical activity. Today, with the pervasive use of highly toxic agricultural pesticides, growing up on, or even near, agricultural land means potentially being surrounded by a swirl of poisons—in the air, in water, on food, and on nearly everything a child touches, from a teddy bear to a parent's embrace.

Children are both more exposed to toxic substances in the environment than adults and more susceptible to many toxic chemicals. The National Academy of Sciences, in a pioneering 1993 report, clearly showed that children bear disproportionately high risks from our nation's use of pesticides on food. Their report focused on children's dietary exposure to pesticides but looked only at children living in non-agricultural areas. For many children, particularly those from agricultural families, food represents only a small portion of their total daily exposure to hazardous pesticides.

Children who live on or near agricultural land, or whose families work in the fields (called "farm children" in this report), come in contact with pesticides through residues from the parents' clothing, dust tracked into the house, contaminated soil in outdoor play areas, food brought directly from the fields to the table, and contaminated well water—making these children likely to be the most pesticide-exposed subgroup in the United States. Children often accompany their parents to work in the fields, raising their pesticide exposures even higher. Many of the children with the greatest pesticide exposures are from migrant farm worker families, who are poor and usually people of color or recent immigrants. There is an increasingly compelling body of scientific evidence indicating that farm children face particularly significant health risks. Levels of exposure, when measured, have often exceeded federal reference doses or "safe levels," as determined by the United States Environmental Protection Agency (U.S. EPA).

The impact of these exposures is far from trivial. There are nearly two million farms in the United States and over one billion acres of cropland.^{1*} An estimated five million agricultural workers labor on these farms.² There are more than 320,000 children under the age of six living on farms in the United States while hundreds of thousands more live adjacent to fields and have family members who work on farms.³ The overall costs of the human health effects from pesticide exposures are considerable. Economists have estimated that the nationwide health impacts from pesticide use total as much as \$786 million dollars per year.⁴ The large numbers of affected people and the monetary and social costs of exposure are seldom considered when evaluating the costs and benefits of pesticide use.

The federal Food Quality Protection Act of 1996 (FQPA) contains provisions that recognize the vulnerability of all children. Under the FQPA, the U.S. EPA must determine if all tolerances for pesticide residues fully protect children from the hazards of pesticides. The law also requires that all routes of pesticide exposure,

Children who live on or near agricultural land, or whose families work in the fields, are likely to be the most pesticide-exposed subgroup in the United States.

*Superscript numbers in this report correspond to specific reference materials, listed for each chapter in the References section following Chapter 7.

including non-dietary ingestion and dermal absorption, be considered in setting food tolerances. Pesticides that act through similar mechanisms of toxicity must be considered as having cumulative health impacts. Despite the clear provisions of the FQPA, the U.S. EPA has failed to consider all routes of exposure to pesticides, and has particularly failed to include the additional exposures faced by farm children when setting tolerances.

Similarly, EPA's federal regulation to protect farm workers, the Worker Protection Standard, does not consider that some of those workers may be children and it does not adequately protect even those children who do remain at home from pesticide residues on parents' skin, clothing, and shoes.

FINDINGS

NRDC has previously shown that pesticides should be considered one of the top five environmental threats to children's health.⁵ Multiple exposures to pesticides are not unique to farm children. The food on our tables carries residues of the same pesticides that may have poisoned farm children, and our water is increasingly contaminated from agricultural runoff. Some of the same pesticides used in the fields are used in homes, schools, and day care centers. In this report, we further explore the threats to children's health from pesticides and identify the increased risk to farm children.

Pesticides Around Us

- ▶ All children are disproportionately exposed to pesticides compared with adults. Due to their greater intake of food, water, and air per unit of body weight, their greater activity levels, narrower dietary choices, crawling, and hand-to-mouth behavior.

- ▶ Fetuses, infants, and children are particularly susceptible to pesticides compared with adults because their bodies cannot efficiently detoxify and eliminate chemicals, their organs are still growing and developing, and because they have a longer lifetime to develop health complications after an exposure.

- ▶ Pesticides can have numerous serious health effects, ranging from acute poisoning to cancers, neurological effects, and effects on reproduction and development.

- ▶ Many pesticides that are never used indoors are tracked into the home and accumulate there at concentrations up to 100 times higher than outdoor levels.⁶

- ▶ In non-agricultural urban or suburban households, an average of 12 different pesticides per home have been measured in carpet dust and an average of 11 different pesticide residues per household have been measured in indoor air in homes where pesticides are used.⁷

- ▶ In an early 1990s nationwide survey of urinary pesticide residues in the general population, metabolites of two organophosphate pesticides, chlorpyrifos and parathion, were detected in 82 percent and 41 percent, respectively, of the people tested.⁸

► In a rural community, all 197 children tested had urinary residues of the cancer-causing pesticide pentachlorophenol, all except six of the children had residues of the suspected carcinogen **p-dichlorobenzene**, and 20 percent had residues of the normally short-lived outdoor herbicide 2,4-D, which has been associated with **non-Hodgkins lymphoma**.⁹

Pesticides in Agricultural Areas

► Children living in farming areas or whose parents work in agriculture are exposed to pesticides to a greater degree, and from more sources than other children.

► The outdoor herbicide atrazine was detected inside all the houses of Iowa farm families sampled in a small study during the application season, and in only 4 percent of 362 non-farm homes.¹⁰

► Neurotoxic organophosphate pesticides have been detected on the hands of farm children at levels that could result in exposures above U.S. EPA designated "safe" levels.¹¹

► Metabolites of organophosphate pesticides used only in agriculture were detectable in the urine of two out of every three children of agricultural workers and in four out of every ten children who simply live in an agricultural region.¹²

► On farms, children as young as 10 can work legally, and younger children frequently work illegally or accompany their parents to the fields due to economic necessity and a lack of child care options. These practices can result in acute poisonings and deaths.

RECOMMENDATIONS

There are many actions we can take today to reduce the unjust exposure burden borne by farm children, and thereby protect all children from one of the five greatest environmental threats to their health. A summary of NRDC's recommendations follows, including several actions recommended by farm worker groups over the years. (See Chapter 7 of this report for a fuller description.)

Regulatory Protection

► Pesticide tolerance decisions under the FQPA should consider all the exposures faced by farm children and set food tolerances low enough to protect these children from cumulative health risks.

► U.S. EPA must use an additional safety factor of at least tenfold as required by FQPA to be sure to adequately protect farm children if there is uncertainty about their exposures, or about the toxicity of the pesticide to fetuses, infants, and children.

► The Farm Worker Protection Standard should be reevaluated to better protect children who accompany their parents to work in the fields, as recommended by the federal Children's Health Protection Advisory Committee.

► Phase out Category I acutely toxic pesticides, and phase out use of the most hazardous neurotoxic organophosphate and carbamate pesticides, endocrine

disrupters, and carcinogens, while developing and promoting alternative pest management practices.

Research Needed

- ▶ Improved reporting systems are necessary for tracking pesticide use and pesticide related illnesses as recommended by the American Medical Association.¹³

- ▶ Pesticides should not be registered for use unless there is an established sensitive and accurate scientific method for measuring residues of that pesticide and its metabolites in food, water, and human blood or urine.

- ▶ Regional public laboratories capable of precisely and accurately measuring low-levels of environmental toxicants in environmental media and human tissues should be established. Such laboratories would allow improved surveillance, exposure assessment in research studies, and the ability to respond rapidly to environmental disasters.

- ▶ Research should focus on the exposures and health status of farm children, with involvement of communities and farm worker groups in the study design. More data will allow more informed decision-making.

Practical Actions

- ▶ Subsidized day care should be provided for working families with young children. Farm workers must receive a living wage and benefits, so that their children are not forced to work in order to survive.

- ▶ Workers must be informed about the identity of chemicals they may be exposed to, and the known or potential health effects of these chemicals. Only with full knowledge can they take action to protect themselves and their families.

- ▶ Pesticide use in and around schools and day care centers should be reduced by requiring that all schools and day care centers have integrated pest management (IPM) programs and by creating buffer zones around schools located in agricultural areas. Parents and teachers must be informed about pesticide use. Hazardous pesticides should not be used in such facilities at all.

- ▶ Expanded integrated pest management (IPM) programs and organic farming will ultimately help most in reducing pesticide exposures for our children and grandchildren.

The food on *our* tables comes at a cost that remains hidden from many people.

If farm children are not protected from pesticides, then the U.S. EPA is failing to implement the law, and our society is failing to protect its future. The food on our tables comes at a cost that remains hidden from many people. Although farm children are on the front lines, bearing the brunt of pesticide exposures, other children are not far behind. If we adequately protect farm children, the most exposed children in our society, then we will better protect all children.

INTRODUCTION

"After the diagnosis of my son's cancer, I came home and wondered if there *was* anything that I was doing that might be implicated . . . I wanted to be able to face my son at some point, and just in case these chemicals were implicated I wanted to be able to say to him, 'Son, I did everything I could.' I didn't want, [in] ten years *for* them to find out, and my son on his death bed and I have to say, 'Oh well, now they found out that it was that and I was trying to protect the crop and, well I am *sorry* about that. I just did not know.' So I figured, let's err on the side of safety if we have to err at all. . . ."

Paul Buxman, Farmer, Dinuba, CA¹⁴

There are nearly 400,000 young children in the United States who actually live on farms, and an additional five million agricultural workers living near farms, many of whom have children.² These people are extraordinarily diverse, ranging from family farmers to professional pesticide applicators, to migrant farm workers. Other groups of people who do not farm may also have pesticide exposures similar to those discussed in this report. For example, urban landscapers, pet groomers, and urban pesticide applicators share at least one important **characteristic with farm families**: they may bring pesticide residues home to their children. Agricultural work is difficult and dangerous. Annual rates of work-related deaths among farm workers are two to four times greater than those for the general workforce. Migrant and seasonal farm workers have exceptionally difficult working and living conditions and may suffer particularly high pesticide exposures. Migrant farm workers are likely to be poor, members of minority groups, and often immigrants. They bear the brunt of the risks and are most likely to be overlooked by scientists and regulators.²

In addition to long workdays, injuries, and fatalities associated with agricultural work, pesticides pose a particularly serious threat to people living or working in the fields. Agriculture is a workplace unlike many others in our country. Farm families often live practically in the middle of the work environment and help out on the job. As a result, children can come into close contact with dangerous pesticides. Residues from the parents' clothing, dust tracked into the house, contaminated soil, food brought directly from the fields to the table, and contaminated water are significant sources of exposure for farm children. The 58 million children in the United States, most of whom live in urban and suburban areas, are also exposed to pesticides from numerous sources in their daily environment. Farm children, however, are likely to experience higher levels of exposure from more sources. Although farm children are a fairly small minority of the children in the nation, it is important to pay attention to their exposures and their health because of what they can tell us about risks to all children.

Farm children are like canaries in the coal mine. Canaries were placed inside mine shafts where they would breathe the first whiffs of poisonous gas. More susceptible than humans to these gases (in part because of their small body size and rapid respiratory rate), the birds would suffer health effects before the miners, providing an early warning of dangerous conditions. We are putting farm children in a

Agriculture is a workplace unlike many others in our country. Farm families often live practically in the middle of the work environment and help out on the job.



While this farmworker prepares to spray pesticide, his son looks on.

situation where they receive some of the highest pesticide exposures in our country. Children, like canaries, have greater susceptibility to the health effects than do adults. Yet in this case we cannot afford to wait and see if science proves conclusively that illnesses among these children are due to pesticides—particularly since many of the expected health effects occur years or even decades after the exposures.

Pesticide use in the United States is increasing. A recent report documented that pesticide use in California increased by 31 percent from 1991 to 1995, rising to nearly 212 million pounds annually in that state alone. Furthermore, the use of the most toxic pesticides is increasing even more significantly. For example, in the same time period, the use of pesticides classified as potential human carcinogens increased by 129 percent and the use of neurotoxic pesticides such as the organophosphates increased by 52 percent.¹⁶ California is the only state in the nation that requires commercial pesticide users to report the time, location, and amount of pesticides applied.

Despite the overall trend toward increasing use of toxic chemicals in agriculture, there are signs of a growing understanding among people ranging from scientists to farmers that pesticides may not be the lasting solution that they were initially

believed to be. A recent NRDC report, *Fields of Change*, interviewed nearly two dozen farmers who are moving away from reliance on pesticides while maintaining and in many cases improving the profitability of their operations.¹⁷ These examples are an inspiration and a roadmap to the future for those who wish to take action to prevent health risks to children and the generations to come.

Under the Food Quality Protection Act of 1996 (FQPA), U.S. EPA must determine that a pesticide tolerance is safe for children by evaluating exposure patterns, information about the susceptibility of infants and children, and information regarding cumulative effects of pesticide residues and other substances that have a common mechanism of toxicity. U.S. EPA must then ensure "that there is reasonable certainty that no harm will result to infants and children from aggregate exposure to the pesticide chemical residues."

The FQPA recognizes that children are not just exposed to pesticides through food. All environmental exposures must be considered together. This evaluation requires that children who have multiple routes of exposures to pesticides in their environment be adequately protected. For example, if a pesticide can be found in drinking water in certain geographic regions, any tolerance decision must protect those children who may be exposed to that pesticide in water. If a pesticide is licensed for use in the home or yard, these exposures must be included. If a pesticide can be tracked home from the fields, these exposures must also be considered in setting tolerances. The essential purposes of this innovative new law should not be lost in its implementation.

In passing this legislation we are ensuring that pesticides will present no **danger to our children**. *H.R. 1627* requires the Environmental Protection Agency when **establishing** safety tolerances that apply **to all** Americans to consider any special impacts a pesticide may have on infants and children and ensure that any aggregate exposure to **3** pesticide chemical residue presents a reasonable certainty of no harm. This provision cannot be waived for the purposes of considering economic benefits."

Rep. Henry A. Waxman, House of Representatives, July 23, 1996

In August 1996, Congress passed, and President Clinton signed into law, the Food Quality Protection Act (FQPA) of 1996. This law completely changes regulation of exposure to pesticide residues. The law focuses primarily on strategies for setting pesticide tolerances for food. A tolerance is an allowable residue concentration of a particular pesticide on a particular food at the time of sale to the consumer. In the past, tolerances were set by considering levels of pesticides that would be expected to remain on crops following normal agricultural use, consideration of public health risks, and consideration of economic benefits of pesticide use. Tolerances were set without any consideration of cumulative exposures. The FQPA changed the old way of doing business. There are three major innovative aspects of this new law that pertain to health risks to children.

1. EPA must evaluate all sources of exposure to a pesticide when constructing risk assessments. This includes food, drinking water, indoor and outdoor air exposures, exposures from dust and soil, and any other route of exposure that may be relevant to children, including "take-home" exposures from working parents.
2. EPA must consider the cumulative health impact of pesticides that are toxic via a similar mechanism. For example, the organophosphates all act via inhibition of the same enzyme, acetylcholinesterase. Thus these pesticides must all be considered together as posing a cumulative risk, rather than individually as separate chemicals.
3. In the case of "threshold" or non-cancer health effects, U.S. EPA must add an additional tenfold margin of safety to protect children, unless there are reliable data with respect to exposure and toxicity to infants and children.

The calculation of risk is different for health effects that do not appear to have a "safe" threshold of exposure (such as cancer) and those effects that may have a "safe" threshold of exposure below which no long-term health effects would be expected (such as liver toxicity). There is currently significant controversy about whether disruption of hormones and developmental toxicity to fetuses and children have a "safe" threshold of exposure. Many scientists believe that for effects on fetal or infant development, it is the timing rather than the dose of the exposure that is most critical. As a result, the current threshold model that assumes that a "safe" level of exposure exists may not adequately protect fetuses and children from certain toxicants.

NRDC aims to reshape public health guidelines to make children's health the standard for public policy and to incorporate multiple exposures and interactive effects into basic health policy assumptions.

This report is a critical element of NRDC's Children's Environmental Health Project. This Project seeks to prevent pollution and to protect the health of the entire population and particularly the most susceptible and most highly exposed people. Since 1989, NRDC has been working to identify the environmental hazards to children's health, and to minimize or eliminate the most severe threats. We aim to reshape public health guidelines to make children's health the standard for public policy and to incorporate multiple exposures and interactive effects into basic health policy assumptions. Through demonstrations of conventional risk assessment's failure to protect children, we hope to shift policymakers' opinions and actions toward more precautionary approaches.

Trouble on the *Farm* reviews the scientific evidence demonstrating that farm children are exposed to pesticides via numerous routes, and in disproportionate quantities. Precautionary action is required to protect farm children. Chapters 1 and 2 of the report focus on the health impacts of pesticides and scientific evidence of children's particular exposures and susceptibility. Chapters 3 and 4 highlight children who work in the fields and so-called "take home" exposures. Chapter 5 demonstrates how farm children are surrounded by pesticides and reviews evidence of exposure through water, food, outdoor air, indoor air, and dust. Chapter 6 illustrates how total exposures to pesticides from all sources can result in pesticide residues in children's urine or blood. The evidence to date indicates that farm children are exposed to numerous hazardous pesticides, from multiple sources, and at levels higher than those routinely encountered by the general population. This science should not be ignored, but rather must be used to inform prudent public policy.

HEALTH HAZARDS OF PESTICIDES

"Late in the afternoon of April 1, 1990, a three-year-old girl playing in front of her trailer home in California's San Joaquin Valley suddenly lost control of her body and began foaming at the mouth. By the time the girl arrived at the local emergency room, she was near death. She recovered eventually. A report filed with the California Department of Pesticide Regulation concluded the child had been poisoned by aldicarb, a highly toxic insecticide that works the same way on people as it does on bugs—like nerve gas. 'Somebody had parked a tractor with pesticide material on it right in front of the play area,' said Michael O'Malley, the author of the report and a physician at the University of California, Davis."

—Matt Crenson, Associated Press, December 9, 1997

Pesticides are specifically formulated to be toxic to living organisms, and as such, are usually hazardous to humans. Most pesticides used today are acutely toxic to humans. Pesticides cause poisonings and deaths every year and are responsible for about one out of every sixteen calls to poison control centers.¹⁸ Chronic health effects have also been reported from pesticides, including neurological effects, reproductive problems, interference with infant development, and cancer.

ACUTE IMPACTS

Acute pesticide poisonings frequently involve organophosphate pesticides, or sometimes their close relatives, the non-ethyl carbamates. These pesticides were originally derived from chemical warfare agents developed during World War II. Some common organophosphates in use today include chlorpyrifos (**Dursban**®), diazinon, azinphos-methyl (**Guthion**®), malathion, and methyl-parathion. Aldicarb (**Temik**®) and carbaryl (**Sevin**®) are common non-ethyl carbamates. They kill by blocking the enzyme that breaks down a critical nerve-impulse-transmitting chemical known as acetylcholine. The result is that certain nerve impulses are over-expressed, resulting in an array of acute toxic symptoms. Symptoms of organophosphate or carbamate poisoning include blurred vision, salivation, diarrhea, nausea, vomiting, wheezing, and sometimes seizures, coma, and death. Mild to

In one review of the medical records of 20 severely pesticide-poisoned infants and children transferred to a major medical center from other hospitals, 16 of the 20 children had been wrongly diagnosed at the time of the transfer.

moderate pesticide poisoning includes gastroenteritis, bronchitis, or intrinsic asthma, and even astute clinicians may not link these symptoms to pesticides.

The American Association of Poison Control Centers reported 97,278 calls about pesticide poisonings in 1996. Half of the reported poisonings involved children under six years of age.¹⁸ Occupational pesticide poisonings are required to be reported in California, and there are approximately 1,500 reported cases per year.^{19, 20} Efforts to extrapolate to national occupational pesticide poisonings result in estimates of anywhere between 10,000 and 40,000 physician-diagnosed pesticide illnesses and injuries annually among agricultural workers.²¹ These estimates do not include children of agricultural workers.

Research has shown that current estimates based on occupational surveillance or poison control centers may greatly underestimate the problem of pesticide poisonings. A study in California that involved active surveillance, with extensive physician education and recruitment, revealed that this intervention significantly increases the number of reports of pesticide illness. A follow-up evaluation of poisoned workers discovered that 40 percent of the exposure incidents also involved co-workers who did not seek medical treatment for various reasons, suggesting that the total burden of illness is grossly underreported.¹⁹ Poison control centers are commonly called after accidental ingestions or spills of pesticides in the home, but are less frequently called when illnesses occur after routine agricultural pesticide exposures.

Mild signs of acute pesticide poisoning, such as nausea, vomiting, diarrhea, or wheezing are often not recognized as being potentially linked to pesticide toxicity. Rashes and other skin reactions are another major manifestation of pesticide toxicity that is often misdiagnosed.²² Even Dr. Lynn Goldman, Assistant Administrator of the Office of Prevention, Pesticides and Toxic Substances of the U.S. EPA, has publicly admitted, "Medical problems caused by pesticide exposure are often overlooked or misdiagnosed by health care providers."²³

Even severe pesticide poisoning is frequently misdiagnosed. In one review of the medical records of 20 severely pesticide-poisoned infants and children transferred to a major medical center from other hospitals, 16 of the 20 children had been wrongly diagnosed at the time of the transfer. Diagnoses of the children's symptoms included brain hemorrhage, head trauma, diabetic acidosis, severe bacterial gastroenteritis, pneumonia, and whooping cough, although all of the children later turned out to have pesticide poisoning.²⁴ In this series, five of the children, all infants, were poisoned after home application of a pesticide. Another child was poisoned after mowing a lawn that had recently been sprayed with an organophosphate. Although these cases did not involve farm children, they demonstrate that all children can be overexposed to pesticides in their home environment. Among infants, only a small dose is required to have potentially devastating health consequences. Furthermore, there is some evidence from animal studies that undernourished individuals are more vulnerable to poisoning by organophosphates, implying that poor and undernourished children may be at greater risk.²⁵

CHRONIC IMPACTS

"Twenty-two years that I have been working in the fields, I've seen more illnesses, more children being born ill, more families that miss work because *every* day they have more problems, headaches. Sometimes their children are sick and they have to miss work. . . . We live in a depression. We don't know if it's because of the chemicals."

Laura Caballero, Lideres Campesinas (Salinas, CA
Public Meeting July 25, 1996)

Chronic effects of pesticide exposure may include adverse effects on neurological function, cancer, reproductive harm, reduced growth and development, and birth defects. Much of the evidence of chronic effects is based on studies of adult workers who are exposed to a mixture of chemicals every day, making it difficult to pinpoint specific pesticides. The effects of individual pesticides during specific periods of fetal life, infancy, and early development have been studied in laboratory animals. Little research on the chronic effects of pesticides has been done directly on children, and even less on farm children.

Neurological Effects

In adults, exposures to insecticides and herbicides have been reported to confer an approximately fourfold increased risk of early-onset Parkinson's disease.^{26, 27} Other long-term neurological problems, particularly shortened attention span and reduced coordination, have been reported in adults overexposed to organophosphate pesticides.²⁸ Although such studies have not been done in human children, animal studies have revealed that some pesticides appear to target the developing brain during the critical period of cell division, thereby leading to lasting behavioral aberrations.^{29, 30} Not only do organophosphate pesticides interfere with a critical nerve-impulse transmitter, but they also can permanently change the number of receptors in the brain for this neurotransmitter. This mechanism may explain the subtle, permanent effects observed in animals.³¹

Subtle neurological effects may also occur in human children. A recent study compared preschool children in two farming communities in Mexico, one with heavy pesticide use and one with little or no pesticide use. The children living in the area with heavy pesticide use had strikingly impaired hand-eye coordination, decreased physical stamina, short-term memory impairment, and difficulty drawing, compared with the less exposed children. Furthermore, observers of the exposed children noticed increased aggressive and anti-social behavior compared to their less exposed counterparts.³² Studies have shown that lead, a known neurotoxicant, has lasting effects on attention span, intelligence, and behavior. Infants and children are more susceptible to the toxic effects of lead than are adults, probably because their brains are still developing.³³⁻³⁵ Similarly, it appears that infants and children are also more susceptible to other neurotoxins, including pesticides.

The children living in the area with *heavy* pesticide use had strikingly impaired hand-eye coordination, decreased physical stamina, short-term memory impairment, and *difficulty* drawing.

Childhood Cancer

"There were three funerals in *a row* here *in* this neighborhood for children that died of cancer. There was *a* day when some of the children *got* together [across *from*] *our* house. They were playing with the Barbies. They were picking *flowers* . . . and they *were* buying the Barbie. *I* said 'What are you kids doing?' Cause they were buying the Barbie and they were *crying* and *crying* and *crying* . . . they said that Barbie died of cancer. *It* had cancer in the leg and it died. . . . *I* was always *wonderi*ng 'Is my daughter going to be next after having her so ill?' . . . When *I went* to the room, she was having another seizure and she kept saying, 'My dollies are dying of cancer m om, please help me, please help me.'"

Marta Salinas, Merced, CA¹⁴

Maternal occupational exposure to pesticides was associated with more than a doubling of the risk of stillbirth due to *congenital* anomalies, and a slightly increased overall risk of all types of stillbirth.

According to Dr. Lynn Goldman of the U.S. EPA, at least 101 pesticides in current use are probable or possible human carcinogens.³⁶ Examples of pesticides which are known carcinogens in animals and are still used around humans today include pentachlorophenol, 1,3-dichloropropene (Telone II®), and dichlorvos (DDVP).³⁷ Studies of farm populations indicate that adults exposed to pesticides may be at increased risk for cancers of the lymphatics and blood, stomach, prostate, testes, brain, and soft tissues.^{37, 38} Several human studies and studies of household dogs have consistently reported a particular association between exposure to the common herbicide 2,4-dichlorophenoxyacetic acid (2,4-D) and non-Hodgkin's lymphoma.³⁹⁻⁴¹

There is evidence of associations between parental or infant exposures to pesticides and childhood brain tumors, leukemia, non-Hodgkin's lymphoma, sarcoma, and Wilms tumor.⁴²⁻⁴⁶ In many of the reports, children's increased cancer risks were of greater magnitude than the risks reported in studies of adults.⁴⁷ Five of the nine human studies that evaluated the risk of childhood leukemia after parental exposures to pesticides found an increased risk, while four out of five studies looking at postnatal exposures to pesticides also found a link with acute leukemia.⁴⁸ In one California study, children with leukemia were three to nine times more likely to have a parent who reported using pesticides in the home or garden during pregnancy or lactation.⁴⁹ Eight of the nine studies evaluating the link between childhood brain tumors and pesticide use showed an association, with three reaching statistical significance.⁴⁸

Reproductive and Developmental Toxicity

Numerous pesticides are known or suspected reproductive toxicants. Examples include the fungicides benomyl (Benlate®) and vinclozolin (Ronilan®), as well as the fumigants methyl bromide and metam sodium.⁵⁰ People who live in agricultural regions or undergo occupational exposure to pesticides are at increased risk of a variety of adverse reproductive outcomes. An investigation of stillbirths and neonatal deaths in California reported that maternal occupational exposure to pesticides was associated with more than a doubling of the risk of stillbirth due to congenital anomalies, and a slightly increased overall risk of all types of stillbirth.⁵¹ Numerous types of birth defects, particularly limb-reduction defects, have been

associated with pesticide exposures in human studies.⁵²⁻⁵⁴ A Minnesota study indicated an association between paternal employment as a pesticide applicator and a variety of birth defects in offspring, including abnormalities of the lungs, heart, musculoskeletal system, and urogenital system. Furthermore, the general population of agricultural regions of the state had an increase of birth defects, with the peak incidence among children conceived in the spring, when spraying is most intense.⁵⁵

Endocrine Disruption

Many currently used pesticides are now known to interfere with normal hormonal function in animals. For example, vinclozolin and iprodione, popular fungicides, both break down into a metabolite that interferes with testosterone and other **androgens**.⁵⁶ Several organochlorine pesticides, including DDT, methoxychlor, endosulfan, and dicofol, mimic estrogen.^{57, 58} Lindane, which is sometimes used to treat head lice in children, acts as an anti-estrogen, and is also toxic to the nervous system.^{59, 60} A triazine, a popular herbicide, can disrupt ovarian function, cause mammary (breast) tumors in animals, and interferes with the binding of steroid hormones and the breakdown pathway of estrogen.^{61, 63} Although no human studies have been done involving the endocrine effects of these chemicals, the endocrine system in animals is nearly identical with the human, making it likely that effects observed may be relevant to human health. In humans and animals, the endocrine system is critical to life. Disruption of hormone function can permanently alter normal development of the fetus and child.⁶⁴ Some pesticides have also been reported to be toxic to the immune system in animals.⁶⁵

Disruption of hormone function can permanently alter normal development of the fetus and child.

Nearly all of the epidemiological studies on children's health and pesticide exposures were done on the general, non-farming population. These studies would likely underestimate the health impacts that would be expected for highly exposed subpopulations of children such as farm children. Some studies did look at children of parents who work in jobs that may involve pesticide exposure; however the child's exposure was almost never directly assessed, but was indirectly estimated based only on the parent's job title. Such a technique is likely to lead to misclassification of exposures and underestimation of the health impact. Thus health impacts among farm children are likely much greater than those described in most of the scientific research to date. Because of the health impacts of pesticides, it is important to identify the sources and levels of exposure to these chemicals in order to protect the most highly exposed children from these dangerous substances.

SUSCEPTIBILITY AND UNEQUAL EXPOSURE: CHILDREN AT RISK

"...while children from socio-economically disadvantaged communities may be disproportionately impacted by *our* public health and regulatory policies, it is important to emphasize that many toxicants represent greater threats to *all* children than to adults due to both biological and behavioral differences."

Dr. Kenneth Olden, Director, National Institute
of Environmental Health Sciences⁶⁶

Scientists and health professionals are finding that human exposure to toxic chemicals in the environment is highly variable, and that susceptibility to exposures also varies greatly. It is incorrect to assume that exposures are homogenous across the population, and that risk assessments performed for the typical study group, healthy adult males, will apply to other members of our society. Genetic variability, age, gender, overall nutritional and health status, and size and weight are all relevant to the risks that any individual faces from toxic chemicals in the environment. Good science requires that we look at population subgroups to quantify their exposures and their susceptibility in order to develop policies that adequately protect children's health.

ALL CHILDREN ARE AT GREATER RISK

There is growing understanding in the field of public health that children are disproportionately susceptible to toxic exposures in their environment.⁶⁷ A recent NRDC report entitled *Our Children at Risk* outlined the scientific evidence that children are particularly impacted by various environmental health threats, including pesticides.⁵ U.S. EPA has recognized this problem in their report "Environmental Health Risks to Children," released in the fall of 1996, and has followed up the report with the creation of a new Office of Children's Health Protection in February 1997.⁶⁸ The Administration also issued an Executive Order in April 1997 requiring that risks to children must be considered in all government decisions.⁶⁹

Children and infants are uniquely at risk from pesticides both because of physiological susceptibility and greater relative exposure. Three major factors are particularly important:

- ▶ Children often have greater contact with environmental contaminants because of activities that involve contact with dirt and floor surfaces, and because of hand-to-mouth behavior.

- ▶ Children drink more fluids, breathe more air, and eat more food per unit of body weight than adults; they also eat a more limited selection of foods.

- ▶ Children's bodies and brains are immature and still developing, they are more susceptible to certain cancers and reproductive problems, and they have a longer expected lifetime in which to develop illness after an exposure. Thus environmental toxicants can have more serious effects on children.

UNEQUAL DISTRIBUTION OF EXPOSURES TO ENVIRONMENTAL TOXICANTS

Scientific investigations of exposures in the environment have repeatedly found something quite curious about human exposures. If you measure the exposure of hundreds or thousands of people and plot their exposures along a line of increasing dose, no matter what the chemical, the distribution of the exposure intensity has a characteristic skewed shape. The curve rises steeply to a peak, and then has a long, slow decline at the high doses (see Figure 1). This signifies that some people are exposed at doses much greater than the 'average' person, sometimes more than a hundred times greater. Public health professionals look at those skewed exposure curves and ask, "who are those people at the upper end of the curve? Why are they exposed to so much more of this chemical compared with the rest of the population? What can we do to decrease their exposures?" In many cases, those people at the top end of the exposure curve are workers and poor people who, for example, rely on subsistence fishing for food (high exposures to mercury, PCBs), or who live in old, substandard housing (lead exposures). There is evidence that, for pesticides, farm children are near the top of the exposure curve. We need to investigate why that is true and what can be done about it.

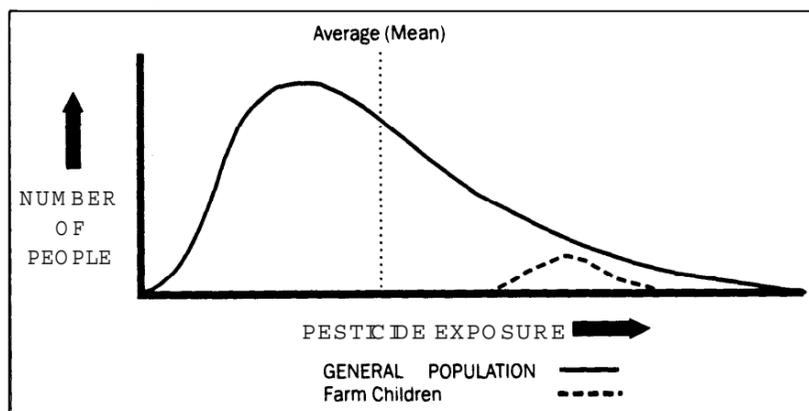


Figure 1. A Typical Exposure Distribution Curve.
 Source: Sexton et al. J. Exposure Analysis and Environ. Epidemiology 5(3): 233-256, 1995.

Children Are More Exposed

The National Academy of Science report, *Pesticides in the Diets of Infants and Children*, outlined how children's eating patterns and physiology place them at particular risk from pesticides in their diet.⁷⁰ The most important factor determining children's increased risk from pesticides is their greater exposure. Compared to adults, children, on a body-weight basis, consume more food and water, ingest more dust and soil, and breathe more air. The skin surface area of an infant per unit of body weight is double that of an adult.⁷⁰ The normal relative respiratory volume of a resting infant is twice that of a resting adult. Caloric consumption by infants per unit of body weight is approximately two-and-a-half times higher than for adults. Any contamination of food, water, air, soil, or dust will result in increased child exposures compared to adults.

A child's diet is far less varied than an adult's. In particular children consume large quantities of milk, fruit, and fruit juices. The average one-year-old drinks twenty-one times more apple juice, eleven times more grape juice, and nearly five times more orange juice per unit of body weight than the average adult.⁷¹ Infants and children also drink two-and-a-half times more water daily than adults do as a percentage of their body weights.⁷² Fruit, fruit juice, and water frequently contain pesticide residues.

Because of their higher rate of breathing, children are more highly exposed to pesticides that remain in indoor air. Children living in homes with indoor air contaminated with the pesticide pentachlorophenol (PCP) were found to have nearly twice as much PCP in their blood as their parents.⁷³ The breathing zone of young children is closer to the floor, and often contains higher pesticide levels than the breathing zone of adults.⁷⁴ Children have greater hand-to-mouth activity, increasing opportunities for direct ingestion of pesticide residues in dirt or dust.

Children Are More Susceptible

Human and experimental animal data suggest that children are more vulnerable than adults to the neurotoxic effects of pesticides. In several cases of human poisoning by organophosphate insecticides, fatality rates were higher in children than in adults.⁷⁰ Two decades of scientific research has demonstrated repeatedly that immature laboratory animals are more susceptible than adults to the neurotoxic effects of organophosphate insecticides.^{75, 76}

According to the National Academy of Sciences, concern about children's exposure to pesticides is valid because "exposure to neurotoxic compounds at levels believed to be safe for adults could result in permanent loss of brain function if it occurred during the prenatal and early childhood period of brain development."⁷⁰ In addition, children have a longer potential lifetime during which latent health effects from low-level exposures may be expressed.

Infants and children are sometimes less able to eliminate toxins from their bodies. Infant kidneys, for example, are immature and cannot excrete foreign compounds such as drugs as quickly as adult kidneys.⁷⁰ In immature animals, the lethal dose of some organophosphate compounds is only 1 percent of the lethal dose in adult

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animals.⁷⁷ In the infant rat, the maximum tolerated dose of chlorpyrifos was one-sixth the maximum tolerated dose in the adult.⁷⁸

Genetic differences are also a determinant of susceptibility to pesticides. For example, the activity of the enzyme paraoxonase affects the metabolism of organophosphate pesticides, thereby influencing the ultimate toxic response in an individual.⁷⁹ Researchers have documented that the body's ability to detoxify organophosphate insecticides is dependent upon adequate production of this enzyme, which differs within the human population by a factor of 15. Children in the first few months of life have very low levels of the enzyme.⁷⁹⁻⁸² Thus all infants, and those children and adults with genetically low production of paraoxonase, are likely more susceptible to the effects of organophosphates.

Many scientists agree that public health protection efforts should focus on those children who are most exposed and most susceptible, rather than on the average adult, or even the average child.⁸³ The children most exposed to pesticides are farm children.

FARM CHILDREN FACE EVEN HIGHER RISKS

Scientific data strongly suggest that children who live on, or adjacent to, agricultural land and children whose parents work in the fields have significantly greater pesticide exposure than non-farm children. Farm children have exposure to pesticides through the usual routes common to the general population and in addition, via routes particular to their location and the employment of their family members.

In California, less than 3 percent of all farms are inspected each year by the state and in many other states the inspections are even rarer.

Farm children are exposed to pesticides through food at levels similar to or higher than the general population. Higher levels of foodborne exposure in some agricultural areas may be due to the shorter transport time from field to table, which allows less time for degradation of residues on the food. Farm children also face potential exposures from "take home" residues on their parents' clothing, from contaminated water, from playing in contaminated soil on or near the fields, from pesticide drift, and from dust and indoor air in the home (see Figure 2). In addition, there is extensive evidence that many children accompany their families to the fields, where they may face exposures at occupational levels whether or not they are working.⁸⁴ The Children's Health Protection Advisory Committee (CHPAC) to the U.S. EPA recognized the disproportionate risks faced by farm children. The Committee's final report to EPA found that, "Children may be exposed to pesticides through employment in farm work, by eating fruits and vegetables directly from the fields while at work, or by drift from field applications to neighboring residential areas and schools. Pregnant and lactating women who work in farm fields or reside in neighboring areas can also expose fetuses and neonates to pesticides. The current Worker Protection Standard has not considered these pesticide exposures to children."⁸⁵ As a result, CHPAC recommended that the Worker Protection Standard be re-evaluated in order to make sure it adequately protects the health of farm children. CHPAC did not point out how little enforcement there currently is of the

EVERYTHING THEY TOUCH

Farm Children Face Pesticide Exposures from All Sides

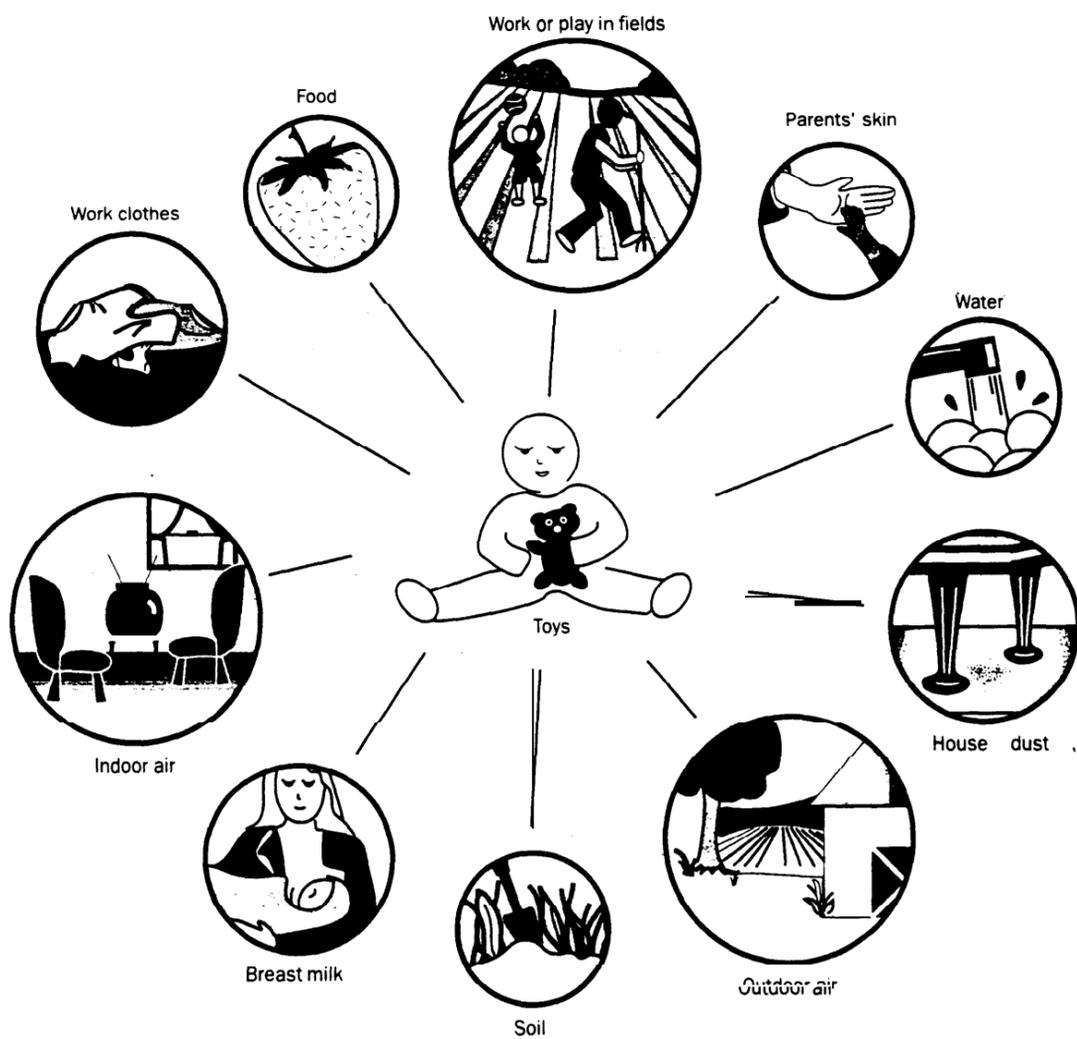


Figure 2. All children are exposed to pesticides in the foods they eat, but children who live on or near agricultural land, or whose families work in the fields, may come in contact with pesticide residues through all of the above pathways.

U.S. EPA has failed to adequately consider the extensive evidence that children are exposed to significant amounts of pesticides through sources other than food.

weak Worker Protection Standard's basic health and sanitation regulations. In California, less than 3 percent of all farms are inspected each year by the state and in many other states the inspections are even rarer. Without strong enforcement of existing standards, violations are likely to be common.

The Food Quality Protection Act (FQPA) recognizes the disproportionate susceptibility and exposures of children. This law requires U.S. EPA to consider children's vulnerability and exposure when setting tolerances for pesticides on foods. Unfortunately, as described in a recent NRDC report entitled *Putting Children First*, U.S. EPA's usual testing requirements for pesticides do not adequately quantify their particular impacts on the health of the fetus and infant, particularly the development of the brain.⁸⁶ Furthermore, the record shows that U.S. EPA has failed to adequately consider the extensive evidence that children are exposed to significant amounts of pesticides through sources other than food, and that farm children are exposed to agricultural pesticides in their environment. Thus U.S. EPA is flying blind when trying to protect children from pesticides. To account for these data gaps while awaiting more research, an additional safety factor should be added to pesticide tolerances to account for uncertainties about childhood susceptibility and exposure.

CHILDREN IN THE FIELDS

"The first field we visited could have been mistaken for a day care center. There were many *small* children in the field with their parents. Some were sitting in the dirt, just being near their families. Some were picking strawberries just like their parents and older siblings. We saw a baby stroller which was advanced a *few* feet occasionally to keep up with the progress of the picking. The families were together, but there wasn't much joy. At 12 cents a pound *FOR* the strawberries, minus room and board costs, this day care center was a part of survival."

Scott Pike, Optometrist (Testimonies *from* the Fields,

Pineros y Campesinos Unidos del Noroeste,
Woodburn, OR, 1997)

"Someday, I want my children to be treated like human beings, not like animals. *It's* not right *that* the children work. But we have to do it."

Pasqual Mares, Bowling Green, OH (Foster and Kramer,
Associated Press, December 14, 1997)

In the United States, children rarely enter most workplaces, such as factories, mines, and even offices. Yet children are frequently found in agricultural fields, even though heavy equipment and toxic chemicals are used in these workplaces.⁸⁴ According to the Fair Labor Standards Act (FLSA), children 14 and over may work unlimited hours in agricultural occupations outside school hours. Children as young as 10 may also work in agriculture if they have written parental consent.⁸⁷ Children under age 16 are prohibited from working with hazardous substances; however, according to federal regulations, agricultural occupations themselves are not considered to be particularly hazardous for children.⁸⁸ Children of farmers can work on their parents' farm at any age.

An estimated 300,000 children ages 15-17 work in U.S. agriculture at some point during the year, representing more than 7 percent of all hired farm workers working on crops.⁸⁹ The National Agricultural Workers' Survey of 1989 estimated there were 587,000 children of migrant workers age 21 or younger involved in seasonal agricultural services in the United States. Of these children, 65 percent were reported to travel with their parents but not do farm work; 6 percent traveled and participated in farm work; another 29 percent traveled on their own to do farm work.⁹⁰ The

Associated Press, in a recent investigative series on child labor in the U.S., visited several fields throughout the country over a 5-month period, and reported seeing 104 children, as young as 4, working in the fields.⁸⁴ The remarkable Associated Press articles brought national attention to the problem of child labor:

The poorest and most vulnerable among them start working before other children start kindergarten. Many earn wages below the legal minimum, often in exhausting, or even hazardous, jobs. These children live in a world apart from most Americans, hidden from consumers and even the companies that buy the products of their labor. Yet those products can sometimes be as close as the local mall or the corner grocery.⁸⁴

According to the U.S. General Accounting Office, in the period from 1992-1995, between 400 and 600 workers under age 18 reported work-related injuries each year, and about 140 children died doing agricultural work.⁸⁹ Other estimates of health impacts are higher, up to an estimate of 27,000 children under age 19 injured annually in U.S. agriculture, and 300 deaths per year.⁹¹ Yet in the face of these numbers, the director of governmental relations at the American Farm Bureau Federation, an agricultural lobbying group stated, "I've never seen anyone working on any farm anywhere who is under the age of 18."⁹²

A 1990 survey of 50 farm worker children in New York State revealed that despite legal prohibitions against working with hazardous substances, 10 percent of children under age 18 reported mixing or applying pesticides. One-third of the children had been injured at work within the past year, more than 40 percent had worked in fields still wet with pesticides, and 40 percent had been sprayed either by crop-dusters or by drift. In this survey, 15 percent of the children reported having experienced health symptoms consistent with organophosphate pesticide poisoning, but few had sought medical care for the symptoms.⁹³

Children, in addition to entering fields for work, often accompany their parents to the fields due to the lack of childcare. The frequency with which children are brought to the fields while their parents work is hard to quantify, yet several small surveys and numerous anecdotal reports indicate that young children are often in the fields. According to a survey in the mid-Atlantic states in 1994, 12.5 percent of migrant workers who have children reported bringing their children to the fields with them at least some of the time.⁹⁴ An EPA representative publicly acknowledged "... sometimes parents have to leave the kids resting inside the car or if the parents are working under the trees,

This migrant worker's child is one of thousands who work with their parents in the fields—or simply accompany them because the family cannot afford childcare.



Joelyn Sherman/USW

the kids sit down near them under a tree. The parents work from sunrise to sunset. . .” (Kay Rudolph, EPA Meeting with Farm workers, Fresno, CA, July 22, 1996). Documented health effects demonstrate that these concerns are not merely theoretical, but are a significant problem that needs to be addressed.

Addressing the problem of child labor in agriculture will not be easy, however. The reasons children work are primarily economic. Three out of four migrant families report earning less than \$5,000 per year, and according to an expert interviewed by the Associated Press, “If adults were paid a living wage, we wouldn’t have child labor.”⁹⁵ Furthermore, childcare is not available in many agricultural areas, leaving parents with few options. Ironically, in some agricultural areas where Head Start programs and day care centers do exist, they are located immediately adjacent to fields and are readily contaminated with over-spray from pesticide applications nearby.

Although children as young as 10 can legally work in the fields, and there is documentation of younger children accompanying their parents to the fields, reentry intervals (which stipulate how long growers must wait after pesticide applications before allowing workers back into sprayed fields) are calculated based on a theoretical 150-pound male. Children, who weigh much less and have a greater skin surface area than adults relative to their size, are likely not adequately protected by current reentry intervals.

Although children as young as 10 can legally work in the fields, reentry intervals are calculated based on a theoretical 150-pound male.

TAKE - HOME EXPOSURES

“... an instructor's assistant at a Sutter County preschool was trained in pesticide safety. She transmitted that information to her husband, who is a farm worker in that area. She emphasized to her husband the importance of avoiding contact with their only child after work because of the risk of contaminating the child with pesticide residue that might be present on his clothing. Before, the farm worker husband would arrive home *from* work and *greet* his spouse and child with hugs and other family gestures and eventually play with his child *for* a while and then, afterwards, shower.”

Eduardo Barriga (Public Meeting in Fresno, CA, July 23, 1996)

“Take-home” exposures to toxic workplace hazards have been reported for nearly a century in various settings. In the early 1900s, lead poisoning was reported in wives and children of lead workers.⁹⁶ The National Institute for Occupational Safety and Health (NIOSH) Workers' Home Contamination Study, released in 1995, revealed that home contamination is a worldwide problem, and identified incidents from 28 countries and 36 states. The report includes over 100 known deaths of family members from asbestos-related mesothelioma, numerous cases of poisoning by metals such as lead, mercury, and cadmium, exposures to radioactive, estrogenic, and infectious agents from the workplace, and pesticide poisonings.⁹⁷ Extensive experience with lead has demonstrated that working parents can bring this **toxicant** home on their clothing and skin and contaminate the home environment, directly resulting in elevated blood lead levels and even illness in their **children**.^{98, 99} This **route** of exposure can also occur with pesticides.

Pesticide exposures to family members have occurred due to contaminated skin, clothing, or shoes, contamination of the family car, and visiting the workplace. In addition, exposures can occur due to chemicals (primarily solvents which can be present in pesticide formulations) in the exhaled breath of a worker, or due to contaminated breast milk of a working mother.

Some extremely severe acute poisonings have occurred when agricultural workers have brought empty pesticide containers or pesticide-contaminated materials into the home where children have played with them. Reports in the medical literature describe numerous preventable illnesses and deaths from pesticide-contaminated equipment. A two-year-old boy died after playing near flattened pesticide storage

Extensive experience with lead has demonstrated that working parents can bring this **toxicant** home on their clothing and skin and contaminate the home environment. This route of exposure can also occur with pesticides.

drums contaminated with the pesticide toxaphene. A brother and sister died after playing in a swing that they made from a burlap sack contaminated with the organophosphate parathion. The four-year-old son of a farmer played with a bag of parathion stored in a barn and was admitted to the hospital near death.⁹⁷ A one-and-a-half-year-old girl was poisoned by dieldrin when her father, a crop sprayer, came home with contaminated shoes. He cleaned the shoes with paper towels, placed the towels in a wastebasket and left the shoes in the bathroom. The child contacted either the towels or the shoes and became unconscious. After treatment for organophosphate poisoning, she recovered.⁹⁷

CONTAMINATED CLOTHING

"... Not only were the family members who worked in the field poisoned, but their little toddler was also exposed when one of the parents picked him up after coming home from work. Three years later, the child is still experiencing severe skin problems."

Vikki Flores, Farm Worker Health and Safety Project at Texas Rural Legal Aid (Public Meeting in McAllen, TX, April 25, 1996)

Organophosphate and organochlorine insecticides have been identified as persisting on clothing; residues have also been transferred to clean fabrics washed in the same load.

Clothing contaminated with pesticides can be an important route of exposure for children of farm workers. Agricultural workers who spray pesticides or whose clothing brushes against contaminated vegetation may return home with these materials on their clothes. Hugging children or playing with them immediately after coming home is almost an instinct to most parents. Parents are unlikely to defer greeting their children until after they have showered and changed their clothes. However, hugging a child or holding a child may expose that child to pesticides. Direct contact with contaminated clothing on bare skin can be a route of exposure to children. A California survey of pesticide-exposed workers revealed that only 20 percent reported showering or changing clothes after work, and only half reported having received training about how to handle pesticides.¹⁹ Wearing pesticide-contaminated clothing and shoes into the family car and into the home can also contaminate the upholstery of the car, the carpets, and other surfaces inside the home.

In addition to contributing to concentrations of pesticides in house dust, residues may be a problem when clothes are washed. Numerous studies have identified spread of pesticide contamination to uncontaminated clothing laundered or stored with work clothing. Organophosphate and organochlorine insecticides have been identified as persisting on clothing, with greater persistence if clothing is washed with cold or warm water rather than hot.¹⁰² Residues of both organochlorine and organophosphate insecticides have also been transferred to clean fabrics washed in the same load. One study found that even three washings were not sufficient to remove all the residues of the three pesticides studied.¹⁰³ A Nebraska study on methyl parathion indicates that less than 20 percent was removed by one laundering. After 10 launderings, 34 percent of the original pesticide remained in the fabric. The level

of residue remaining was enough to kill insects, and to represent a health hazard to humans.¹⁰⁴

Three surveys of the families of pesticide applicators or farmers revealed that 40-90 percent of families report separating work clothes from uncontaminated clothes; however only 25-50 percent reported using hot water washes, and most did not report cleaning the washing machine after use or washing contaminated clothing

AGRICULTURAL PESTICIDE USE IN THE HOME: METHYL PARATHION

In 1996, a major environmental incident came to public attention. Thousands of homes in at least seven states were sprayed by unlicensed exterminators using the highly poisonous organophosphate pesticide methyl parathion. This pesticide is not licensed for indoor use, but is legal for use in agriculture, and is particularly common in cotton production. While this pesticide breaks down fairly rapidly in soil, it is persistent in indoor environments protected from the weathering effects of sun and soil microbes.

Due to lax enforcement, it was not difficult for individuals to purchase this farm pesticide and use it repeatedly in people's homes, day care centers, schools, and other buildings. Methyl parathion is highly effective against roaches and other household pests and very inexpensive, making it particularly attractive to low-income people, the main victims of the illegal spraying. The sprayers themselves were illiterate and claimed not to understand the health risks of what they were doing. Episodes of methyl parathion use in the home were reported to U.S. EPA for years, but steps were never taken to prevent recurrence of the problem. The government could not even persuade the pesticide manufacturer to put a strong odorant into the pesticide to discourage people from using it indoors. Finally, the 1995 outbreak, which was estimated to cost taxpayers over \$100 million in clean-up costs, got national press attention. In the aftermath of this environmental disaster, more than two thousand people were relocated from their homes, and more than 700 homes and businesses required extensive decontamination.¹⁰⁰

Numerous illnesses were reported in connection with these sprayings, particularly among young children and the elderly, and at least a half dozen deaths occurred shortly after pesticide applications to people's homes. Two girls, ages 4 and 11, are known to have died as a result of a previous episode of methyl parathion spraying indoors. Yet most local health care workers were not thinking about pesticide poisoning, so blood tests that would have made the diagnosis were rarely done on sick children. As a result, there are numerous reports of gastrointestinal symptoms, respiratory problems, and organ failure in the sprayed households, but no way to prove in hindsight that these symptoms and deaths were related to the pesticide. If it is difficult to link acute health effects to recent pesticide exposures, it is even harder to show an association between lower level exposures and such common symptoms as nausea, vomiting, diarrhea, dizziness, fatigue, headaches, and difficulty breathing or with cancers and reproductive problems years later.¹⁰¹

Illegal use of agricultural pesticides in the home is probably not uncommon, but most incidents are isolated or sporadic so they do not get widespread attention. Most episodes probably escape notice altogether. Yet use of these highly toxic pesticides indoors is a major risk to children, farmers and farm-workers have ready access to agricultural pesticides, and are therefore particularly likely to use them to control indoor pest problems.

In addition to the persistent *organo*-chlorine pesticides, some volatile organic solvents that can be used as "inert" ingredients in pesticides have been detected in breast milk.

promptly. In addition, only 6 percent of wives reported wearing rubber gloves when handling the work clothing.⁹⁷ No similar surveys have been done on farm worker populations, though anecdotal reports indicate that migrant farm workers often wear the same clothes repeatedly even though they may be contaminated. Migrant farm workers often wash their clothes at laundromats where they pay by the load and frequently wash the family's clothes together; in farm labor camps, clothes **are** often hand washed in buckets and line dried adjacent to fields where they can be re-contaminated by pesticide drift.

In the Worker Protection Standard promulgated by U.S. EPA, the Agency does not hold employers responsible for laundering "normal work attire." The Agency admits "Although it would be prudent for employers to clean... pesticide-contaminated work clothing for their employees, it is not a requirement of this final rule."¹⁰⁵ If U.S. EPA does not act to limit "take-home" exposure from contaminated clothing, then it must consider these exposures in any evaluation of cumulative risk to children from pesticides.

BREAST MILK

Breast milk can be considered a "take-home" exposure to a nursing infant. Mothers who are working in the fields and are exposed to pesticides can accumulate residues of some of these chemicals in their breast milk. The organochlorine pesticides such as DDT have long been reported to concentrate in breast milk. The residues are highest among non-white women and while nursing the first child.¹⁰⁶ The pesticide metabolites found most frequently in breast milk in one study of 942 women were *p,p'*-DDE (100 percent), oxychlorane (84 percent), trans-nonachlor (77 percent), heptachlor epoxide (74 percent) and beta-HCH, an isomer of lindane (27 percent).¹⁰⁷ Although the widespread presence of these persistent contaminants in breast milk is worrisome, the levels are gradually decreasing now that most of these chemicals are no longer used in the United States. Most experts agree that breast feeding is still the most healthy way to raise a child.^{108, 109} In addition to the persistent organochlorine pesticides, some volatile organic solvents that can be used as "inert" ingredients in pesticides have been detected in breast milk.¹¹⁰ Many pesticides have never been assessed to see whether or not they are present in breast milk. Pesticide exposures through breast milk should be better evaluated in order to protect nursing infants from pesticide exposures during breastfeeding.