



Health & Safety Programs Annual Publication  
Volume 1, 2011

# The Fields

## DANGEROUS EXPOSURE: FARMWORKER CHILDREN AND PESTICIDES

**The Association of Farmworker Opportunity Programs' (AFOP)** mission is to improve the quality of life for migrant and seasonal farmworkers and their families by providing advocacy for the member organizations that serve them. The thread that binds the Association is the concept that training and education can provide the launching pad to a better and more stable life for the workers who plant, tend, and harvest the crops that Americans consume at their tables.

### **Health & Safety Programs**

To address the needs of workers in one of the most dangerous jobs in the country, AFOP's Health & Safety Programs strive to empower farmworkers to protect themselves against pesticides and heat stress through health and safety education. Our programs utilize bilingual, interactive, low-literacy training techniques and materials.

### **Programs**

**Project HOPE** (Health Outreach through Pesticide Education)  
**SAFE AmeriCorps Program** (Serving America's Farmworkers Everywhere)  
**Project LEAF** (Limiting Exposures Around Families)  
**Projecto Sol** (Heat stress education)

### **Publications**

**¡Salud!** (Newsletter)  
**The Fields** (Annual Publication)

For more information, contact Levy Schroeder, Director of Health & Safety Programs at [schroeder@afop.org](mailto:schroeder@afop.org) or (202) 828-6006 ex. 130

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**David Strauss**  
Executive Director

Health & Safety Programs

**Levy Schroeder**  
Director, Health & Safety Programs

**Jessica Werder**  
Senior Program Manager

**Melanie Forti**  
Program Coordinator

**Amanda Jordan**  
Program Associate

**Valentina Stackl**  
Program Associate  
Editor ¡SALUD! and The Fields



**Association of Farmworker Opportunity Programs**  
1726 M St NW, Suite 602, Washington, DC 20036 (202) 828-6006  
**Twitter:** @AFOPHealth **Facebook:** AFOP Health and Safety **Website:**  
[www.afop.org](http://www.afop.org)





*All the things with the way they are, I still hope that there will be change. Just like what we're doing right here, we're letting people know and be aware. There's also the government that has laws and things in place. As long as they keep applying those laws and inspecting, I think that there'll be a change eventually*

-Duperval Frantz (States: Maryland, Florida Crop: Tomatoes, Oranges)

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*This publication is dedicated to the millions of people living all over the country who work hard to bring food to the tables of the rich and poor alike, as well as the tireless efforts of the scientists, service providers, and advocates that make concrete the evidence of their struggles.*

## A Letter From the President of AFOP:



What would possess a person to **choose** to work in agriculture? In a job that has them outdoors often in extreme heat or cold? Working in sweltering temperatures above 100 degrees, without drinking water or shade, or in numbing cold and frost? A job that often requires up to 10 to 12 hours of back breaking, bone racking standing, bending, lifting and stooping? In an occupation that can both rob you of your youth and, considering the high rates of fatalities among children in agriculture, send you to an early grave?

A job that requires that you work in fields or orchards saturated with poisonous chemicals that can cause debilitating skin diseases, neurological disorders and cancers of various kinds. A job that may often have you come in physical contact with those same deadly chemicals because proper safety procedures were not followed or were purposely ignored. And then you are terrified to go home because the last thing you want to do is to contaminate your loved ones and you are not certain that you have washed properly or sufficiently?

To work in not only one of the most dangerous occupations on earth, but in a job that often subjects you to treatment that is humiliating and can rob you of your dignity. A job that provides little to no protections against workplace abuse and that scorns you and castigates you if you ask for common decency in the way you are treated on the job?

Why would someone **choose** to work under these conditions? The short answer to that question is that most of the 157 million working persons in these United States do not choose, **would never choose**, to subject themselves to those conditions. Yet the work of harvesting the field and row crops that feed us and a good part of the world, has to be done, doesn't it? If it wasn't done, people would starve and farmers and a good portion of our economy would go bankrupt.

The longer answer to that question is a little more complicated, but should be easy to comprehend. It is about a parent's love for their children and how they would give their very lives to provide for them, to make sure they are fed, clothed and educated. It is about enduring all types of indignity and physical and mental abuse to provide their family with a better life. It speaks to a hunger for independence and self-respect.

I think that a big part of that long answer is love. Farmworkers love their families. They love America, being free and working very hard to earn their share of the "dream" for themselves and their families. They love to sing, dance and to celebrate the fruits of their labor. And yes, they even love their jobs in agriculture, even with the hardships that are part of those jobs.

I think that America should love them back, don't you?

**Ernie Flores, President**

# Reviewers



**Esperanza Gonzalez**  
*Director of Minority Health Programs, Illinois Migrant Council*

## Esperanza Gonzalez

Since 1979 Esperanza Gonzalez has been employed with the Illinois Migrant Council in various positions and capacities. Esperanza is currently the Director of the Minority Health Programs where she administers a wide range of health outreach and educational programs that address health disparities for farmworker and Latino communities throughout Illinois, such as breast, cervical and prostate cancers, H1N1, HIV/AIDS prevention, diabetes, obesity, healthy living/nutrition, pesticide safety training, heat stress and other issues.

She is also an experienced clinical counselor and therapist. She has developed and administered several mental health programs providing services to at risk farmworker and Latino youth and their families. Esperanza was the Regional Director for the Illinois Migrant Council's Northern Region (13 Northern Counties) for 20 years providing a variety of services and programs for the farmworker and Latino communities before moving to the administration office in Chicago.

Along with having extensive experience on these programs she is also the President of the Illinois Association of Agencies and Community Organizations for Migrant Advocacy (IAACOMA). IAACOMA is a committee of state agencies and community organizations created in 1977 to provide services and advocacy on behalf of migrant and seasonal farmworkers in Illinois. Esperanza has been IAACOMA's President for more than 20 years. Recently Governor Pat Quinn appointed Esperanza as a member of the Illinois Commission to End Hunger. Esperanza was born in Racine, Wisconsin to farmworker parents. A Farmworker herself she grew up in Cotulla, Texas. She migrated with her parents until her high school years. In 1979 she moved to Illinois to work for the Illinois Migrant Council and has been there ever since.



**Thomas A. Arcury, Ph.D**  
*Professor and Vice Chair at Wake Forest School of Medicine*

## Thomas A. Arcury, PhD

Thomas A. Arcury, Ph.D., is Professor and Vice Chair for Research in the Department of Family and Community Medicine, Wake Forest School of Medicine. He is Director of the Center for Worker Health, and he is Director of the Program in Community Engagement and Implementation.

He received his PhD in Cultural Anthropology in 1983 from the University of Kentucky. Arcury is a medical anthropologist and public health scientist with a research program focused on improving the health of rural and minority populations.

Since 1996, he has collaborated in a program of community-based participatory research with immigrant farmworkers and poultry processing workers and their families focused on occupational and environmental health and justice. He has authored over 250 referenced articles, and he is the co-editor of a volume published in 2009 on the health, safety, and justice of farmworkers in the eastern United States. He has participated in the development of diverse educational materials intended to return research results to immigrant worker communities. He has also used research results to affect policy change.

# Focus Groups

Thank you to the focus group participants, who shared their experiences, concerns, and wisdom in hopes their children can be further protected from the effects of pesticides. Thank you also to the individuals and organizations that made the focus groups possible.

## California

The five participants wished to remain anonymous

## Florida

Jesus Aguilar, Orfanelia Velazquez, Floriberta Mirade and the other three participants who wished to remain anonymous

## Maryland

Cynthia Nicklow, Simon Augustus, Duperval Frantz, Lesly Lissade, Samuel David Avila

## New York

Nicole Terry

## North Carolina

Hilda Acosta, Teresa Aguilar, Graciela Pérez

## Texas

Olga S. Hernández, Arturo Peñafiel, Pascuala Puentes, María Ramos, Juana Salazar, María del Carmen Valenzuela, Isabel Magallanes, and the other two participants who wished to remain anonymous

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*"As long as people keep accepting certain conditions that are not ideal, then they're going to keep on being taken advantage of, or it's going to continue the way it is... Although we have this conversation here, or this type of meeting, sometimes it doesn't go to the right person that can help make that change. So now that we've had this conversation...we want to make sure that this information goes to the right person that can do something about it."*

*(Lesley Lissade, Maryland)*

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# I. Introduction



**Children of farmworkers** bear a disproportionate burden of health effects from pesticide use in our country. Birth defects, neurological complications, respiratory illness, and cancers have all been linked by peer-reviewed research to pesticide exposure in children. This publication reviews research found on the effects of pesticides on these four areas related to children's health. The information compiled here is a tool for consumers, policy-makers, health and safety trainers, advocates, those who serve farmworkers, and those who benefit daily from their hard work.

Pesticide exposure occurs at work in the fields and also at home. Farmworkers may bring their families into contact with pesticides inadvertently through their clothes or unsafe storage of chemicals. However, thousands of children all over the country are more directly exposed to pesticide residues while they labor in fruit, vegetable, and flower crops. Discriminatory laws exempting farmworker youth from safe working conditions as they harvest on farms put them at particular risk for contact with these chemicals. Parents in farm work, who largely earn below a living wage, often opt for their children to work with them in the fields in order to provide the basics for the family. Whether exposed through parents' field work or their own, children who develop illnesses as a result of pesticide exposure pay the price for our demands for cheap food. Coupled with the concerns of farmworker parents in their own voices about pesticide exposure, the following findings demonstrate that the health of these children is at stake.



-Nicole Terry (State: New York; Crop: Apples)

*...think of it like if it was one of your family members. Would you want them to be out there...spraying the pesticide, bringing it home to their kids, your grandkids? I think it should be fair where they should just really investigate the stuff that they're using on that crop.... I don't really think that that's fair. I really don't...I'm telling you right now, I don't buy apples at all...and yes, I do think about, who cut this watermelon, who harvests this corn,...because I remember the days of me, with that apple sack on my shoulder, coming home dead tired...*

## II. Background



Farmworkers endure some of the most grueling working conditions of any occupation in the United States. These women, men, and children work in fields, orchards, tree farms, and greenhouses, contributing daily to the country's food supply. Low pay, frequent wage theft, 12 to 14 hour work-days in extreme weather, and tasks that are physically destructive to their bodies are constant realities for workers. They often labor without access to drinking water, toilets, or hand washing facilities. In addition, most people in this line of work have no health insurance. Housing that is provided by their employers is often sub-standard and crowded. The average farmworker family earns less than \$17,000 annually [1], well below the poverty guidelines for a family of four or more people. Farmworkers may not seek medical help because of lack of insurance, limited access to appropriate facilities, hostilities based on immigration status, or fear of retribution from their employers. Yet, in spite of poverty and unsafe working conditions, including pesticide exposure, they work daily to put food on our tables. Of the many tribulations farmworkers and their families face, the serious effects of pesticide exposure are simultaneously an environmental justice issue and a public health concern.

### Farmworker Children

It is estimated that there are 2.5 million migrant and seasonal farmworkers in the United States, with as many as 400,000 to 500,000 children working in the fields alongside their parents. In 2006, the Childhood Agricultural Injury Survey found 307,000 youth under the age of 20 employed in the agricultural industry [2]. No studies have been done on the number of child farmworkers under age 12; however, the Association of Farmworker Opportunity Programs has documented children as young as 6 exposed to pesticides while working in the fields. There is also growing concern among farmworker advocates about the increased presence of unaccompanied minors, even younger than 14, migrating alone to the U.S. to earn money in agricultural jobs. Children in farmworker families who do not participate in the harvest also face hardships related to their parents' occupation. Due to lack of childcare, parents may take infants to the fields.



-Maria del Carmen Valenzuela (States: New Mexico, Texas' Crop: Chilies, Onions)

*It's not allowed to bring children to the fields, but in vacations, they go. We take all of the kids during school vacations to where we work.... But it's dangerous for them.*

In addition, the National Agricultural Workers Survey (2001-2002) found that a large number of farmworker parents have their children living with them [3], making them unintentionally subject to chemical exposure through traces of pesticides brought home from work.

### Pesticides

Pesticides are "intended for preventing, destroying, repelling, or mitigating any pest" [4]. These chemicals include insecticides,

herbicides, and other substances that are used to control unwanted insects, weeds, or fungi. Pesticides also regulate plant growth or fruit maturity, often used as defoliants or desiccants. Although used in homes around the country, they are most heavily used in agriculture.

The Environmental Protection Agency (EPA) estimates that one billion pounds of pesticide active ingredient are used annually in the United States, of which nearly three quarters are used in agriculture [5]. There are currently over 1,400 pesticides approved and registered by the EPA with about 18 new pesticide registrations per year [6]. With over 16,000 pesticide products on the market, the U.S. spent over \$12.5 billion on pesticides in 2007[7][8].

## Occupational Exposure to Pesticides

Exposure to agricultural pesticides occurs in a number of ways: pesticides are ingested through food or water, consumed directly by accident, inhaled or absorbed through the skin. Farmworkers, including children, are at high risk for occupational pesticide exposure, as they come into contact with these chemicals every day. They also are exposed to pesticide residues on crops as they plant, cultivate, and harvest. They are exposed when they load, unload, move, mix, store, and apply pesticides.

*Directly they used the by-planes. I know they're not just flyin' around just for an OV (overhead view)...I don't know if they got any laws that dictate when. From what I understand, no workers are supposed to be in the field while the plane be goin' up and down and actually spraying, spraying something. Yeah, I've been directly involved with this. And I get sneezes and stuff, too, so I know...but I don't know what the medical part of it is later on...*



-Simon Augustus (States: Florida, Georgia, S. Carolina, N. Carolina, Virginia, Delaware; Crop: Watermelons)

## Residential Exposure

Migrant farmworker housing is frequently old, in severe state of disrepair, and not well maintained by the landlords or the employers who provide the facilities. Pesticides accumulate in these ramshackle conditions through drift from pesticide applications in the fields nearby. It also occurs from take-home exposure when residues on farmworkers' boots, clothing, and work gear are transferred to the floor, furniture, and pillows.

Farmworkers and their children are also exposed to pesticides when they use products to combat nuisance pests in their dwellings. In a study of 41 farmworker homes in western North Carolina, researchers detected traces of pesticides inside the homes. They collected wipe samples of the floor, children's toys, and children's hands, and tested the samples for the presence of specific classes of pesticides. Pesticides were present in 39 of the 41 samples and included "organochlorine insecticides in at least 17 of the dwellings, organophosphorus insecticides in at least 32 of these dwellings, carbamate insecticides in at least 15 of these dwellings, and pyrethroid insecticides in 38 of these dwellings." The study then examined the exposure pathway to the children. The wipe samples were traced from the 39 floor samples (95% of the homes) to children's toys in 29 of the homes (71%), and from the toys to the children's hands in 24 houses (55%) [9].

In conjunction with the aforementioned research, Arcury and his colleagues collected urine samples from the adults and children of nine of the houses where the wipe samples were taken [10]. The urine was analyzed for pesticide metabolites, which signal pesticide exposure. Farmworkers living in those houses had high levels of these metabolites as compared with National Health and Nutrition Examination Survey's findings on the general U.S. population. As a follow-up, the investigators analyzed urine samples of 60 farmworker children age 1-6 years old, all of whom lived in farmworker housing in eastern North Carolina [11]. All of the children had detectable pesticide metabolites in their urine—including agricultural insecticides and herbicides, non-agricultural pesticides, pesticides used for livestock, and in some instances pesticides that had been banned since 1986 [12].

A similar study has been done in the Salinas Valley in California, the so-called grocery cart of America because of its intense agriculture production of vegetables and fruits. Using the wipe sample technique on floors of farmworker residences, it was found that the presence of agricultural toxins was 10-200 times higher than in the air indoors or the soil around the home [13]. These studies are important because they document the occurrence of in-home exposure to farmworkers and their families. They tell us that in early childhood, farmworker children are likely to be directly exposed to a number of toxic pesticides every day. There is compelling evidence that the risk for childhood diseases could be elevated by these exposures.

### Children's Vulnerability

Physiologically, children are at increased risk from pesticide exposure. The World Health Organization describes this vulnerability:

*Children's bodies metabolize, detoxify and eliminate substances differently than adults' bodies do. The central nervous system undergoes its period of most rapid development from the fetal stage through the first six years of life, so young children are especially vulnerable to pesticides that act as neurotoxins. The dermal area of an infant per unit of body weight is greater than that of an adult, allowing for greater vulnerability to dermal absorption. Children's breathing zones are closer to the ground, exposing them to inhalation of pesticides that linger at floor level [14].*

Children have special vulnerability to health effects because of exposure through their behaviors. Crawling and playing on the floor put them at risk for residue absorption through their skin. Additionally, children are quick to put hands, toys, and other objects in their mouth increasing the opportunity for residue ingestion.

### Health Risks of Exposure

The International Agency for Research on Cancer (IARC) has identified 400 chemicals that are known, probable, or possible carcinogens. A startling number of these are compounds found in many commonly used pesticides. Others, particularly the organophosphates, are endocrine disruptors, which mimic or block reproductive and thyroid hormones. Furthermore, pesticide manufacturers are not required to register inactive ingredients in their products, so it is impossible to ascertain even an estimate of the total amount of these chemicals being used, or the danger they may pose. For example, *xylene*, which is associated with increased risk of brain tumors, rectal cancer, and leukemia, is an inactive ingredient in 900 different pesticides [15].



-Lesly Lissade (States: Maryland, Florida; Crops: Oranges, Tomatoes)

*Organs, as an adult, are more resistant than they would be for a child. It depends on the quantity or the level of pesticides, where the child is weaker than an adult. The child's organs will be affected more.*

An increasing body of research suggests relationships between pesticides and serious illnesses, particularly among children. The risk of these diseases is dependent on the intensity of the dosage, timing, and the length of exposure or repeated exposures. Measurements of exposure are difficult to assess, yet researchers have attempted to form the links between pesticide exposure and childhood illnesses, including reproductive, neurological, and respiratory disease outcomes, in addition to several types of cancers.



### III. Methodology

Primary scientific research from accredited journals, such as the *American Journal of Epidemiology* and *Environmental Health Perspectives*, as well as first-hand narratives from farmworkers working in more than seven states were utilized for this publication. The conclusions drawn from research on children and pesticides permit evidence-based descriptions of the risks these chemicals pose to growing bodies. In addition, farmworker parents' personal experiences with pesticides illustrate the serious concerns people working in the field have for their children's health. Experts in farmworker advocacy and pesticide science have also reviewed this publication, lending their unique expertise on the issue of farmworker health and safety.

This publication largely focuses on the effects of agricultural pesticides on children. However, studies highlighting residential exposure were also utilized. Many pesticides used in the home contain similar compounds to those used in agriculture, putting farmworker children doubly at risk for negative health outcomes. Where used, studies examining long-term effects of pesticides on children's health also took precedence over acute poisoning incidents. No studies researching exposure to pesticides through food consumption are referenced in the text. Farmworker children, like any other children in the country, face exposure to pesticides through food. Toddlers and youth who work or accompany working parents in the fields may pick fruits and vegetables to eat right away, even without washing them first. However, it was important to highlight often overlooked dangers inherent in the distinctive pathways of take-home and field exposure the children experience as a unique and vulnerable population.

Challenges of the publication include the limited nature of the data available on the health effects of pesticide exposure on children, specifically farmworker children. The variability in research methodologies and measurements of exposure at times made it difficult to draw concrete conclusions. We noted these instances in our review. In addition, while extensive, our review of studies relating children's illnesses to pesticide exposure was not exhaustive. Every effort was made to use a convincing amount of the most relevant and scientifically sound research available. Finally, recognizing ourselves as advocates for farmworker health and safety, we still made every effort to present information in an accurate manner.



-Hilda Acosta (States:  
North Carolina and Maryland)

*When he comes home from work, I tell my husband to take off his shoes, the ones he takes to work, and to leave them outside...Because those shoes carry pesticides and it's not good for him to enter. Also, with my husband's work clothes, I wash them separately...and I don't let him bring it inside either. I just wash his clothing apart. Because I know that it has pesticides. I've heard that, in the Center, and also at the school they talked to us about it. We already had a meeting. It was, a woman, I don't remember her name, and she was talking to us about pesticides and all that, and so from there I learned a little.*

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## IV. Health Effects



## Long-term Health Effects of Pesticide Exposure in Children

There is a body of research connecting farmworker children's exposure pathways, including parental occupational exposure, household pesticide use, and residence near agricultural production, with serious health effects capable of creating lasting damage in a growing child. Birth defects, problems related to neurological functioning, respiratory illnesses, and childhood cancers have all been associated with pesticide exposure

### **Birth Defects**

The birth of a child is generally an occasion for celebration and reflection as parents and family share in the experience of a new life. Unfortunately for some parents, that sense of awe is overshadowed by a deep sadness as they receive news that their child is born with a serious or potentially life-threatening condition. Complications in the development of physical or neurological system are often not recognized until birth. Such conditions are known as congenital malformations or birth defects.



-Graciela Pérez (States: North Carolina; Crops: Sweet Potatoes, Tobacco, Chillies, Cucumbers, Oranges, Tomatoes)

*Well, you feel bad because you think that, you try to take care as much as you can so that they don't get sick because of us, because of all that we bring in terms of sicknesses because of our work. So that's what we want to avoid, that they get sick because of our lack of responsibility in taking care of ourselves in order to take care of them too, so they don't get sick. After that...we do all that and when we go to pick them up, we try to go with other clothes...And that's why we do that, so that our kids are okay. We're okay if they're okay, too.*

Making the link between pesticides and congenital malformations is a complex task. Yet, in spite of the obstacles, evidence does exist. Studies conducted in the United States suggest that children conceived during the spring have higher rates of birth defects than children conceived during any other season [16], especially in agriculturally productive regions of the country [17, 18]. This same effect has also been found internationally, suggesting a possible link between the season in which pesticides are most heavily used and resulting birth defects [19]. General studies have also associated paternal employment as a pesticide applicator [18] and maternal employment in agriculture [20] with higher rates of malformations.

Birth defects generally result from one of two situations: 1) genetic damage before conception or; 2) direct interference with the developing embryo or fetus [4]. A variety of factors can produce either of these scenarios, though environmental causes are often suspect. In the case of farmworker parents, the nature of the job begs the question: could pesticide exposure be the cause of certain birth defects, including those of the limbs, neural tubes, and the urogenital tract?

### **Limb Defects**

Efforts to more carefully characterize the relationship between pesticide exposure and specific birth defects have resulted in a significant amount of epidemiologic evidence. Research on limb defects, in which a child is born with missing or malformed arms or legs, suggests an association between maternal employment in agriculture and higher than normal incidence of this particular birth defect [21]. Additional evidence also links limb defects with maternal residence in counties having high agricultural productivity or high pesticide use [22]. Results from Norway suggest an increased risk of limb defects among the children of grain farmers who purchased large amounts of pesticides [19].

### **Neural Tube Defects**

While limb defects are devastating for parents of a newborn, there are another set of life threatening conditions linked to pesticide exposure, known as neural tube defects. These malformations are characterized by abnormalities in the development of the spinal cord or brain. Well-known neural tube defects include spina bifida, which can result in lifelong paralysis, and anencephaly, which usually leads to death within the first hours of life. Studies have found links between neural tube defects and home use of pesticides [23], living near cultivated fields [23], paternal occupational exposure to agrochemicals [24], and maternal agricultural occupation during early pregnancy [25]. Others have associated neural tube defects with maternal residence within 1000 meters of pesticide application [26] and being born to parents whose farm has tractor spraying equipment [19].

### **Male Urogenital Malformations**

Developing male embryos face a unique vulnerability to parental chemical exposure. Significant amounts of research have addressed two congenital conditions of the male urinary and reproductive systems: hypospadias and cryptorchidism. Hypospadias is a condition in which the urethral opening is abnormally placed on the penis; cryptorchidism refers to a situation in which the testes remain inside of the abdominal cavity instead of dropping into the scrotum. The possible link between these conditions and pesticides was first proposed in the 1990s. It was then that scientists began to hypothesize that “environmental estrogens” could be negatively affecting the formation of the male reproductive tract during development, due to its sensitivity to hormone balance [27].

Environmental estrogens are also known as endocrine disruptors because they interfere with the normal function of the human endocrine (hormone) system. These chemicals resemble the hormone estrogen and mimic it during crucial developmental stages, such as the formation of male urogenital tract. Many currently-used pesticide compounds are endocrine disruptors. A number of studies in Europe have linked high incidence of hypospadias and/or cryptorchidism with exposure to agricultural pesticides [28] [29] [30] or a parent’s employment in agriculture [31-33].

### **Spontaneous Abortion**

Spontaneous abortion, commonly known as a miscarriage, may be the result of a severe birth defect preventing a fetus from continuing to develop fully. As such, spontaneous abortion could be viewed as a symptom of malformation in the womb. A number of studies have linked pesticide exposure to spontaneous abortion [34-36].

## Discussion

Birth defects are rare conditions, therefore limiting researchers' data collection and the strength of their studies. In addition, measuring actual exposure is both complicated and expensive. Nevertheless, significant evidence points to a link between birth defects and parents' exposure to pesticides.

## Neurological and Behavioral Health

The brain is the center for all physical and cognitive human activity. Any disorder of the brain or related nervous system has long-term, negative consequences for the physical, psychological or social health of a developing person. Children are still in the process of growing, and as such, their neurological development is especially vulnerable to the effects of pesticides.

While in the womb, a fetus' exposure to chemicals used in agriculture may contribute to lasting neurotoxic damage, including visible effects on reflexes and working memory after babies are born[37]. The placenta naturally provides a certain amount of protection for the developing fetus, yet certain chemicals in pesticides have been shown to cross the placenta [38]. Because many pesticides are lipophilic, or attracted to fat, the brain is especially sensitive because of its high fat content[39]. This may result in concentrations of these chemicals in the fetal nervous system [38]. Here, these toxins can have severe effects on development, inhibiting the normal function of sensitive processes. Data suggest that prenatal, infantile, and childhood exposure to pesticides may permanently alter the development of cognitive faculty and motor skills.

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*Many pesticides say, "Do not enter for two days." Yet, we enter the fields one day later. That is the problem, that the liquid is still there. It depends on the supervisor. It's the supervisor's negligence. When we are picking we say "my clothes are so itchy!" Oh, it's because they were spraying and you don't realize until later. Then you feel...warm. And sometimes I even feel something that feels like bumps on my skin, and I think it's because of the orchard.*



-Jesus Aguilar (States: Florida, Michigan; Crops: Apples, Tobacco, Blueberries, Oranges)

## Thyroid Functioning

For those families living in agricultural communities, pesticide exposure is a constant danger. Fetuses exposed in the womb may face continual exposure, both before and after being born, leading to complications in thyroid function and other aspects of brain development. Infants' small, growing brains are sensitive to any outside influence.

In fact, the blood barrier protecting the brain from toxic agents is not completely formed until at least six months after birth [40]. Certain environmental toxins harm thyroid functioning, pivotal to normal neurological development from the womb through the early years of a child's life. Even low levels of pesticides blocking thyroid hormones during brain development are dangerous[41], yet they have been found in the cord serum of exposed pregnant mothers and later affecting thyroids in their same children at four years of age[42].

## Problem Solving and Mental Flexibility

Damage to neurological development at the most vulnerable stages of life creates continuous difficulties for a child in school, presents challenges in his or her social life, and impedes general cognitive capabilities. Children exposed to pesticides have faced disproportionate challenges in problem solving and general mental flexibility [43,44]. In a particular instance, the use of methyl parathion (a chemical normally used in agriculture) around homes in Ohio and Mississippi was associated with short-term memory problems [45]. Children born and raised in an agricultural community with heavy pesticide application have also been observed with debilitated short term memory and the capacity to draw a person clearly when compared to children in a nearby region not exposed to pesticides [46].

*It can also poison us sometimes not just through our clothing, but also by breathing it. It's more dangerous.*



-Teresa Aguilar with her daughter Lisani (States: North Carolina, Florida; Crops: Cabbage, Strawberries, Sweet Potatoes)

## Motor Control and Response Time

Inhibited motor control and response time in children has been associated with possible exposure to pesticides [43, 46-48]. Indicative of prenatal exposure, certain studies have found significant traces of organophosphate pesticides in the urine samples of some pregnant women.

A preoccupying number of children born to mothers in two studies of prenatal exposure had three or more abnormal reflexes, including higher-than-average difficulties in walking, which is considered clinically significant [49, 50].

## Attention-Hyper Deficit and Autism Spectrum Disorders

Both for pregnant women working in the fields and those coming into contact with pesticides in the home, heavy prenatal exposure subtly invades the intricate process unfolding in their wombs. Continual exposure to pesticides may also increase the risk of these neurological problems, prompting many researchers to test for pesticide presence in the womb and later when the infants have grown. Children who were found with high levels of pesticides in their bodies prenatally and throughout the first years of their lives, have been observed with various attention and response delays, some of which relate to Attention-Deficit/Hyperactivity Disorder (ADHD) and Autism Spectrum Disorder [51, 52]. Additional evidence suggests the risk of children developing Autism Spectrum Disorder, characterized by impaired social interaction and restricted communication, may be affected by prenatal exposure to agricultural pesticides, especially for parents living close to fields where crops are grown[53]. Use of excessive insecticides within and around the home has been linked to higher rates of autism in children in the United States as compared to Italy, where domestic pesticide use is less common [54].

## Cholinesterase Depression

As children grow, there are many ways they can be exposed to pesticides, whether it is through drift and take-home exposure in agricultural communities or domestic use of pesticides. More seriously, aside from exposure in and around the home, children come into contact with pesticides through their own work in the fields.

A certain enzyme (cholinesterase) needed for normal nerve functioning is inhibited by organophosphate and carbamate pesticides, commonly used to kill insects in agricultural settings [55]. Chronic effects of pesticides have been repeatedly linked to high levels of cholinesterase inhibition in children. Exposed children harvesting cotton in Egypt, tobacco in Mexico, green vegetables in Brazil, and various crops in the United States have all exhibited significant neurobehavioral impairment in the performance of simple tasks [56-59].

## **Discussion**

Clinically diagnosed disorders related to brain functioning, and their many symptoms, are not easily linked to one, specific cause. While evidence is apparent in many parts of the world, pesticide exposure may not necessarily be the sole link in inhibited thyroid function or damaged motor and cognitive skills. Neurobehavioral issues are difficult to detect and measure because they are not easily distinguished from normal variation in child development. A looming concern is the misdiagnosis of neurological and behavioral problems among ethnic minorities due to systemic disparities in language and material resources. In addition, certain neurodevelopment problems may only be observed as the child matures, making early intervention, timely diagnosis, and causal links to pesticide exposure difficult [50]. As with other health issues facing children in farmworker communities, studies delineating type and level of exposure, control for other environmental neurotoxins, and longitudinal studies which follow children's development over time are necessary to more fully understand how children's brains are affected by these chemicals. Finally, population-appropriate testing of neurological health would increase the strength of these studies, including the use of tools that are sensitive to a participant's culture, education, and technical level.

## **Respiratory Health**

Respiratory illnesses inhibit some of the best times of childhood, and unfortunately, many times carry their biting symptoms into adulthood. A body of research links pesticides to chronic respiratory illnesses. Children whose parents perform field work have more frequent exposures to dangerous pesticides, and many parents worry about their risk of developing respiratory issues, including allergies, as compared to other children their age.



*As far as me, I might have a rash or you know, an itch or something, but my daughter, she's more sensitive. Like her lungs, more of coughing, sneezing, more like a cold, she get more of that, you know, of that affect. As to where I might just have an itch and I can go take a bath and I'm okay. But for children, I think it effect more of their breathing...the respiratory system. She's five right now.*

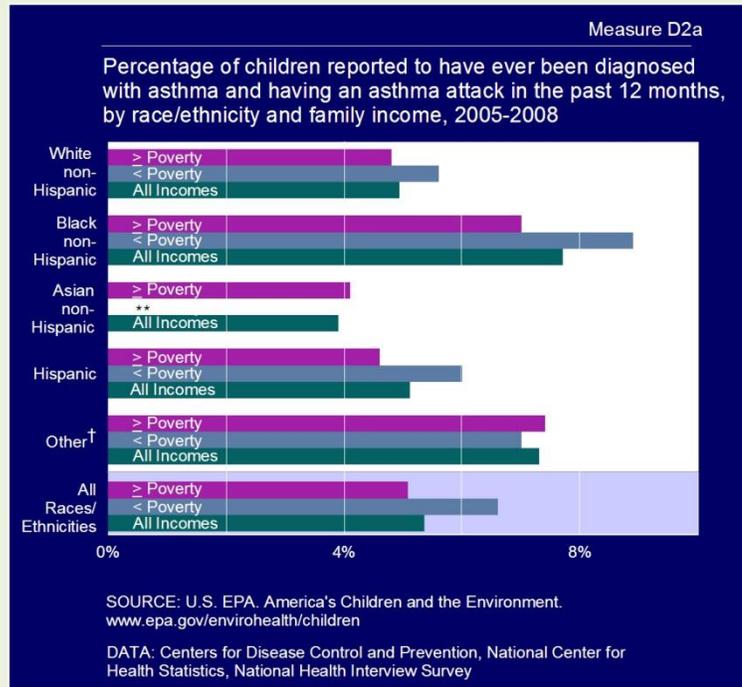
-Cynthia Nicklow (States: Florida, Gerogia, S. Carolina, N. Carolina, Virginia, Delaware, Maryland; Crops: Beans, Peas, Apples, Christmas Trees, Watermelons)

## Chronic Respiratory Illnesses

Data suggest that children who have been exposed to pesticides during their first year of life have a higher risk of suffering from chronic respiratory illnesses, like asthma, than those who have not been exposed. Children growing up in agricultural communities with high-pesticide use are particularly at risk [60]. The two most sensitive stages for pesticides to damage infants' fragile respiratory systems are while they develop in the womb and in the first year of life [61]. Chronic respiratory complications, including persistent wheezing (signaled by a high-pitched whistling sound in the chest and labored breathing) and chronic phlegm, mar the lives of small children who were exposed through their parents' occupational and domestic pesticide use [62]. Data suggests that chronic cough or wheezing is negatively influenced by prenatal exposure to pyrethroids (a common class of pesticides)[63].

## Atopic Asthma

Atopic (or allergic) asthma, complicating the normal functions of the nose and lungs, has a high prevalence among people who have grown up on farms around pesticides. Exposure to the presence of more than one chemical has been shown to augment this risk [64,65]. While consistent, low-intensity exposure throughout a person's adult life may be linked to atopic asthma, early and consistent childhood exposure to pesticides likely increases the risk of adulthood respiratory illnesses.



## Discussion

Focused studies of long term respiratory complications among children in agricultural communities are lacking. Children spending time in or near the fields often complain about sneezing and other symptoms of respiratory ailments—both acute and chronic. As the agricultural sector becomes increasingly industrialized, these problems will persist with growing demands for pesticides.

Many variables confound the link between pesticide exposure and respiratory illness including exposure to tobacco smoke, dust and exhaust present in truck driving routes, dioxins produced through industry, and pollen[66]. For children who already have asthma, more data is needed to characterize the possible aggravating effects that pesticides might have on pre-existing respiratory conditions[67]. Studies intent on identifying the types of pesticides, including those with an organochlorine or carbamate base, and the frequency of exposure, would prove beneficial in understanding these persistent respiratory illnesses.

## Cancer

Cancer is a life threatening disease that is feared universally. When an adult is diagnosed with cancer, the news is devastating; when a child is struck with it, it is heartbreaking. The American Cancer Society reports that there were 10,700 new cases of childhood cancer (children 0-14 years old) in 2009. While cancer deaths among children are declining, it remains the second leading cause of death among children, following accidents. Leukemia is the most commonly diagnosed cancer among children, accounting for nearly one third of all childhood cancers. Other common childhood cancers include lymphomas, brain tumors and Wilms tumor, a specific type of kidney cancer unique to children.

Decades of scientific research point to two general causes of cancer: genetic and environmental. Relatively few childhood cancers are attributed to genetic causes. In fact, according to the American Cancer Society, 75-80% of all incidences of cancer are caused by environmental factors [68]. The President's Cancer Panel 2008-2009 Report expresses profound concern about environmental causes of the dread disease, and makes a persuasive plea for concentrated efforts to be directed toward mitigating environmental risks for cancer [69].

An increasing body of research is pointing toward pesticides as a contributing factor to childhood cancers. In a 2002 case-controlled review of 162 child leukemia patients, there is evidence that timing of exposure is a critical factor in increased risk. Focusing on indoor residential insecticide exposure, this study indicates such exposures very early on, from before conception to three years after birth, "appear to be more significant than later exposures", with the most vulnerable time occurring during pregnancy [70].

When discussing pesticide exposures and a child's increased cancer risk, two scenarios generally emerge: prenatal exposure and post-natal exposure. Pre-natal exposures, or exposures to a developing fetus, result from a mother's exposure during pregnancy or, of increasing concern, a father's occupational exposure before conception or birth of the child. Postnatal exposures, or childhood exposure, can occur as the result of take-home exposure, use of residential pesticides, or children's direct contact with pesticides while working in the fields.



*I would say that for a child it's more impactful. Well, for example, for my own daughter. I took my daughter and I had to leave her inside...And I didn't want to take her for the same reason that when...she smelled [the air] she started to sneeze. So it's stronger for them than for you.*

*-Olga Hernandez (States: Oklahoma, New Mexico, Texas; Crops: Onions, Cotton, Corn)*

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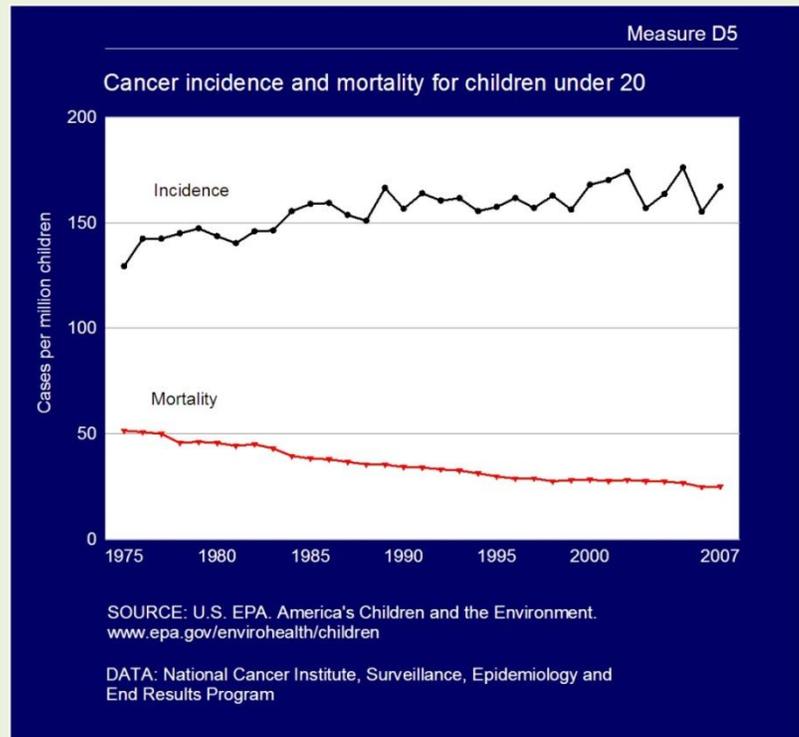
### Parental Occupational Exposure

Prenatal exposure may cause genetic changes in the sperm or ovum when either parent is exposed to a toxic agent, or may interfere with the child's development in the womb. There is a large body of research linking parental occupational exposure to toxic substances, pesticides included, with elevated risks for childhood cancer in their offspring,

Speaking generally about children's cancers, the Agricultural Health Study (AHS), which looks at the health of agricultural pesticide applicators and their families, examined the cases of 21,375 children of study participants in Iowa and North Carolina. The children of parents who did not use appropriate protective gloves had twice the risk of developing childhood cancers compared to those whose parents did use the gloves [71].

### Leukemia

Maternal occupational exposure to pesticides before and during pregnancy has been associated with an increased risk for childhood acute nonlymphocytic leukemia (ANLL) [72, 73]. Paternal occupational exposure to pesticides has also been linked with childhood acute lymphoblastic leukemia, especially when fathers are exposed to fungicides [74]. Similar associations have been found between parental pesticide exposure and children suffering from a rare form of leukemia, called Acute Myelogenous Leukemia (AML). In one study, postnatal occupational exposure to either parent was positively associated with AML [75]. Among a number of environmental variables, the study also cited parental occupational exposure as the highest risk factor for childhood leukemia.



### Lymphoma

Data suggest that children of parents employed as agricultural pesticide applicators, have an increased risk for lymphoma, including Hodgkin's lymphoma [71]. Additionally, parental occupational exposure to pesticides has been linked with increased risk for Burkitt lymphoma [76].

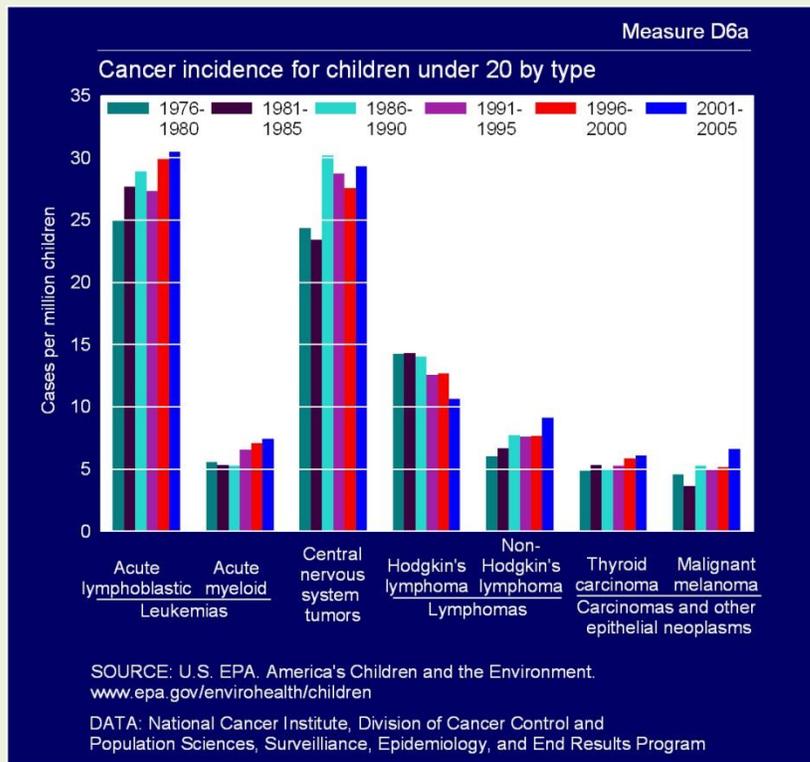
### Additional Cancers

An international study on brain tumors has linked maternal exposure to agricultural pesticides within five years of a child's birth with risk of developing brain tumors [77, 78]. Another study links paternal occupational exposure to pesticides with tumors of the nervous system [79]. Other studies examine specifically the paternal occupational exposure to toxins and cancer in children. Once such study of Ewing's Sarcoma (a bone cancer) showed an increased risk for children who had been born to fathers working in agriculture six months prior to conception. The researchers suggested a relationship between Ewing's Sarcoma and children whose fathers had worked with herbicides, insecticides and fertilizers [80].

One group of researchers presents an intriguing set of data, suggesting that certain children may be more likely to develop brain cancer when exposed to organophosphate or carbamate pesticides due to a certain genetic mutation which prevents them from “detoxifying” these dangerous chemicals once they have been introduced to their bodies [81].

### *Residential and Take Home Exposure*

A large number of studies indicate a positive association with residential pesticide exposure and various types of cancer in young children such as childhood leukemia, brain tumors and non-Hodgkin’s lymphomas.



### **Leukemia**

Findings demonstrate significant associations between household exposures to pesticides and leukemia [70, 82-85]. Several studies suggest a strong relationship between childhood leukemia and critical windows of exposure to residential pesticides, most predominantly during pregnancy. One particular study on childhood leukemia warns of the potential danger of prenatal exposure to pesticides, with the strongest evidence pointing toward household insecticides, particularly professional pesticide applications in the home, no-pest strips, house bombs and flea and tick products for pets. The study looked at a number of toxic sources, including solvents, plastics, petroleum products, and lead, and reports that “the most significant maternal exposure was to pesticides.” The same research group cited direct exposure to pesticides in the home as a strong risk factor for leukemia in children [72]

Additional data further link the use of home insecticides or use of professional pest control services during pregnancy to this class of cancers [70, 72]. Mother's postnatal occupational exposure to pesticides has also been linked to acute nonlymphocytic leukemia [72], indicating possible take-home exposure. Exposure to certain pesticides during childhood, such as garden insecticides, fungicides and lice shampoo, also may increase a child's risk of acute leukemia [82]. Some researchers believe the elevated risk of pregnant women is significant enough to call for a concerted public information campaign to raise awareness about the potential harm from pesticide exposure for children.

### **Lymphoma**

In an investigation on pesticides and non-Hodgkin's lymphoma (NHL) in children, significant findings were shown when mothers reported using household pesticides during pregnancy, with the exposure risk increasing with the frequency in which the mothers had used the products [86]. The use of professional pesticide applications was also shown to be strongly associated with NHL [76].

### **Childhood Brain Tumors**

In studies of childhood brain tumors (CBT), some researchers contend that the highest risks occur with exposure to household pesticide products. Mothers having direct contact with these chemicals while preparing, applying, or cleaning with them, place their unborn children at risk for pediatric brain tumors [87].



*If I was the boss...I would take preventive measures. I would put an area where the children can be better, and not smell the fertilizer. I would put everything. I would put more bathrooms...*

-Pascuala Puentes (States: Texas and others  
Crops: Onions, Chillies, Pecans)

Prenatal exposure to these products point toward a higher risk for cancer than postnatal exposure. In a very large international investigation of farmworkers (2,223 subjects), from seven countries, yet again the prenatal and preconception exposure to pesticides lead to an association with CBT [88].

### **Discussion**

Given that agricultural pesticide residues are present in farmworker housing, that farmworkers likely use household pesticide products, and that farmworker children are exposed to parental occupational residues, we can see that farmworker children come in contact with these toxins at every turn. While it is a challenge for researchers to pinpoint exact causalities of cancer, there is sound evidence that draws associations between pesticides and these devastating diseases.

Further evidence exists in a University of North Carolina-Chapel Hill review of literature noting, "Collectively these studies suggest an increase in brain cancer, leukemia, Wilms tumor, Ewing Sarcoma, and germ cell tumors associated with paternal occupational exposure to pesticides prior to and during pregnancy" [89].



V. Conclusion

Based on the evidence reviewed, pesticide exposure is likely linked to a host of children's health problems. Strong evidence suggests links between parental pesticide exposure and certain birth defects, including cryptorchidism, hypospadias, and limb defects. Additional evidence associates parental pesticide exposure with certain neural tube defects and spontaneous abortion. Neurological and behavioral development may also be negatively impacted by pesticide exposure. Children with prenatal exposure to pesticides have been observed with abnormal reflexes, and evidence suggests a higher risk of exposed children developing Autism Spectrum Disorder. Postnatal exposure is connected to inhibited thyroid functioning, ADHD, impeded motor control, and short-term memory problems. While not as extensive, continued evidence suggests pesticide exposure affects the development of asthma and other respiratory ailments. Lastly, studies have shown that parental occupational exposure and exposure in the home are connected with childhood cancers, including leukemia and brain tumors.

### **Weaknesses and Opportunities in Current Body of Research**

While there is strong evidence from the research we reviewed, we recognize that there are a number of weaknesses in the literature on farmworker children and pesticide exposure. First and foremost, more in depth, large-scale data on farmworker children and pesticide exposure is necessary. An example of a large-scale longitudinal study is the Agricultural Health Study (AHS), which has followed over 89,000 agricultural workers since 1996. While this study has provided some quality data on health of families working on their own farms, unfortunately it has no counterpart focusing on children born to migrant and seasonal farmworkers.

Some of the studies we encountered in our research were disappointing from a design perspective. An overwhelming majority of the research was retrospective in nature, putting into question the validity of exposure assessments. In addition, cross-sectional studies and inappropriate control groups tainted some studies' findings, therefore excluding them from our collection. Community-based participatory research, which would be especially appropriate for this population, was also found to be sparse. The work of several research groups form a promising base for increased farmworker involvement in formulating research related to pesticide exposure [90]

Finally, one of the biggest challenges in investigating causal links between pesticides and child health effects is exposure assessment. Few studies we reviewed measured exposure directly, instead relying on geographical proximity or parental occupation as an indicator of exposure. Additionally, many studies lumped together various environmental exposures, making it impossible to extrapolate chemical specific exposures. A host of environmental and social factors, including food insecurity, poverty, lack of access to healthcare, and industrial toxins can complicate the causal relationship between pesticide exposure and childhood illness. Some studies successfully accounted for these factors in their research, but many did not.

Although there is ample opportunity to expand the body of data available on children and pesticide exposure, particularly with farmworker children, the evidence we do have speaks with urgency. Children are exposed to pesticides through multiple pathways, such as well and irrigation water, soil in the fields and near their homes, indoor and outdoor air, dust, food residues, and skin contact with contaminated surfaces. Farmworkers bear an unjust burden of the chemical pollutants produced by the farming industry. Therefore, it is not safe to wait any longer for absolute scientific proof while known dangerous exposures continue unabated. Plenty of evidence exists demonstrating the severe public health problem of pesticide exposure. This evidence should justify and encourage immediate action to protect the most vulnerable among us, children.

## VI. Recommendations



In light of the quantity of research suggesting a link between agricultural pesticide exposure and negative health effects in children, the Association of Farmworker Opportunity Programs recommends a number of immediate actions to mitigate the danger of pesticides on children on an individual, community and policy level:

### **For individuals working in agriculture:**

Reduce take-home exposure by refraining from bringing home any contaminated chemical containers or pesticides, removing work clothing and boots before entering your house, and washing work clothes separate from the family's clothes. Know your rights; your employer is legally required to teach you about the health effects of pesticides and how to protect yourself.

### **For growers and field work supervisors:**

Protect yourself and your own families from the effects of pesticides. Comply with the Worker Protection Standard, which is designed to maximize worker safety with pesticides in the fields. This includes mandatory training, with information more effectively communicated through interactive, culturally and linguistically appropriate educational sessions rather than video-only training.

### **For farmworker supporters:**

Know where your food comes from; research labor practices of the companies you support and prioritize efforts to deliver organic and fairly traded agricultural products. When given the opportunity, thank farmworkers for their necessary and important labor. Use natural alternatives to pesticides in the home and taking precautionary steps to keep food away from bugs. Additionally, you can support children's labor rights by keeping them out of the fields (see AFOP's *Children in the Fields Campaign*) and worker safety through training (see AFOP's Health & Safety Programs). Continue to support policies and programs that improve the lives of farmworkers and their families.

### **Program Recommendations:**

Develop educational programs that inform farmworker families about the risks of pesticide exposure to children's health, involving families and children in the design and distribution of health and safety materials [90]. Build an alliance of health educators and advocates in your region to promote social change. Contact AFOP for information about project LEAF which educates parents about take home exposure.



*I, for example, and my husband went to the orange (grove) to see if we could find out what they were spraying. My husband is very careful about those things. When we get home he says, "take off your clothes," because he is afraid that we will bring something in and infect our children, sometimes. But like I said, it's our work, and there is no other way out. It is the work that we have to do.*

- Floriberta Mirade with her daughter Evette (States: Georgia, N. Carolina, S. Carolina, Virginia, Florida; Crops: Watermelons, Cantaloupes, Pumpkin, Corn, Oranges)

## Policy Recommendations:

Policy, programs, and regulatory decisions should be based on the recognition of the potential dangers of pesticides, rather than on the absence of evidence. Make efforts to continue to phase out the most hazardous neurotoxic organophosphate and carbamate pesticides, including those found to be endocrine disruptors and carcinogens. Alternative pest management forms, such as non-pesticide alternatives or organic farming practices, should be promoted to reduce the use of these toxic chemicals.

Create program access to affordable, accessible day care for all working families with young children so children do not have to come into the fields with their parents. Increase buffer zones between fields and labor housing, schools, and community centers to mitigate the dangers of exposure through drift. Living wages are fundamental to decreasing the presence of children in the fields as well as the country's reliance on child labor.

Increase educational and outreach efforts for farmworker health and safety, with more resources allocated to the enforcement of existing health and safety labor practices.

Finally, more support should be given to studies and programs with sound methodological designs. National, periodic, up-to-date studies, collection of data, and easy accessibility of pesticide information for the public should be supported. Examples include the Agricultural Health Study model, the cited Spanish birth cohort studies, and the Center for health Assessment of Mothers and Children of Salinas (CHAMACOS) project in California. The Agricultural Health Study should be expanded to include farmworkers.



*(You feel) helpless in a way because sometimes you can't protest or complain. Why don't they tell you beforehand so that you know [that the fields were sprayed with pesticides]? It's just that kids are around close. I mean, it's always the one above who has more power, right, than the one who's here below.*

-Claudia Ramírez (State: Texas; Crop: Pecans)

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