

# Children's Agricultural Health and Safety

## The Role of the Health Care Provider

Farming is one of the most hazardous occupational industries in the US and the farm environment poses numerous health risks for youth visiting, living, or working in the farm environment. This chapter is intended to familiarize health professionals with the context of farm health risks and the particular concerns for rural youth. The chapter is divided into four main areas, A) Problem Definition; B) Pathophysiology; Diagnosis and Treatment; C) Agricultural Factors; and D) Management Issues.

### Learning Objectives

At the completion of this chapter, the health care professional will be able to:

- Name at least five lead sources of agricultural morbidity among children in the Midwest;
- Describe the main agricultural factors that lead to agricultural morbidity for children in the Midwest;
- Identify health effects and management strategies for agriculture related injury and harmful exposures in children;
- Recommend at least three prevention strategies to reduce child agricultural injury and harmful exposures.

## Definition of the Problem

### Scope and Prevalence of Child Agricultural Mortality And Morbidity

Children experience fatal and nonfatal unintentional injuries associated with production agriculture in the United States. According to the National Agricultural Statistics Service, there were a total of over 2.19 million farms in the United States in 1999 and 4.6 million farm residents (USDA, 2000). Twenty-seven percent of these farm residents are youth less than 20 years old (Dacquel and Dahmann, 1993). Farm residents make up the largest population of youth exposed to farm safety hazards. Further, relatives and friends of farm families, hired farm workers, or migrant workers may also be present on farms and exposed to similar hazards. While children account for about 20 percent of all farm fatalities, studies have reported that they comprise a higher proportion of the total number of nonfatal farm injuries. An estimated 38,000 children under the age of 20 years who lived on, worked on, or visited farms and ranches were injured in 1998 (Myers, 2001) while approximately 100 unintentional injury deaths occur annually to children and adolescents on U.S. farms. Although the exact number of youth exposed to farm hazards annually is unknown, it has been estimated at more than two million (Adekoya and Pratt, 2001).

The primary agents of fatal and nonfatal injuries to children on farms include tractors, farm machinery, livestock, building structures, falls and bodies of water (AAP, 2001). Children are also exposed to many



of the same environmental exposures as those experienced by adult workers, including pesticides, volatile organic compounds (fuel), noxious gases, airborne irritants, noise, vibration, zoonoses, and stress. Youth may also be involved in non-work related recreational activities on farms that expose them to safety hazards. For the purposes of this discussion sources of work-related agricultural morbidity and mortality will be categorized into six broad categories corresponding to Healthy People 2010 Objectives (HHS, 2000): Fatal and Non-Fatal Injuries; Hazardous Organic and Inorganic Exposures; Trauma From Overexertion or Repetitive Motion; Occupational Skin Diseases or Disorders; Work-related Noise Induced Hearing Loss; and Stress.

Youth Farm Fatalities

Data from the 2001 National Institute for Occupational Health and Safety (NIOSH) National Youth Farm Fatality report show that between 1982 and 1996, there were 2,174 farm deaths among youth less than 20 years of age nationally (Adekoya and Pratt, 2001). About one out of every three farm deaths among youth occurred between the ages of 15 and 19. Males accounted for 85% of the fatal farm injuries to youth less than 20 years of age. Nearly 40% of the deaths among males were between the ages of 15 and 19, while nearly 40% of the deaths among females occurred before age 5. Farm machinery (including tractors), drowning, and firearm-related deaths represented 73% of fatal farm injuries to youth. Farm machinery-related deaths were the leading cause of death, accounting for 36% of deaths to youth less than 20. Thirty percent of farm machinery-related deaths were among children less than 5 years of age. Machinery was the leading cause of farm deaths in 29 states. For deaths attributed to machinery, drowning, and animals, the greatest numbers of deaths occurred among children under 5 years of age. The greatest numbers of deaths from mechanical suffocation occurred between ages 10 and 14, with firearms and electrocution deaths most common between ages 15 and 19. Two regions, the South Region and the Midwest Region, accounted for 79% of the fatal farm injuries. The greatest proportions of deaths in the Northeast Region and the West Region were among youth 0-4 years. In the Midwest Region and the South Region, the greatest proportions were among youth 15-19 years.

Table 1 shows leading cause data for farm youth fatalities specific to Wisconsin. A total of 105 deaths were recorded between 1982-1996 with machinery accounting for 67%, firearms accounting for 7% and mechanical suffocation accounting for 6% of all Wisconsin youth farm fatalities.

**Table 1. Leading causes of fatal farm injuries to persons less than 20 years, Wisconsin, 1982-1996**

Cause of Death	Frequency	Percent
Machinery	71	67
Firearms	8	7
Mechanical suffocation	6	6
Drowning	5	5
Struck by or against/caught in or between objects	5	5
Falls	4	4
All other causes	6	6
<b>All causes of death</b>	<b>105</b>	<b>100</b>

Source: (Adekoya and Pratt, 2001)



## Youth Non-fatal Disabling Injury

NIOSH recently reported the results of a national survey of non-fatal injuries occurring on farms during calendar year 1998 from a random sample of farms across the U.S. (Myers, 2001). Injury was defined as any condition that resulted in 4 hours or more of restricted activity (e.g., person could not perform work or other normal duties, missed work, missed school), or a condition that required professional medical treatment. There were an estimated 32,808 youth injuries on farms in 1998. The injury rate for all farm household youth was 1.87 injuries per 100 household youth. The region of the nation with the highest number of on-farm youth injuries was the Midwest (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin) with an estimated 16,443 injuries, followed by the South (8,810). The major sources of injury to youth on US Farming operations were floors, walkways, ground, or other surfaces (6,435), animals (2,932), and non-industrial off-road vehicles (1,963). The leading causes of these injuries were falls, off-road transportation incidents, and being struck by objects. The parts of the body most commonly injured were the hands, wrist, or fingers (7,096), the head (4,703) and the legs (3,833). These injuries most frequently resulted in lacerations, fractures or scrapes and abrasions.

Table 2 shows youth farm injury data specific to the Midwest region. In 1998 there were an estimated 16,443 injuries to youth on farms in the Midwest. Leading identifiable causes were non-highway accidents (14.7%) and falls to lower level (13.3%).

**Table 2. Midwest regional estimates of farm injuries to all youth less than 20 years of age by injury event: 1998**

<b>Injury Event</b>	<b>Frequency</b>	<b>Percent</b>
Contact with object	1425	8.7
Struck against object	1315	8.0
Struck by object	1315	8.0
Fall to lower level	2192	13.3
Non-highway accident, except rail, air, water	2412	14.7
Assaults by animals	1206	7.3
Other events	3509	21.3
Unknown	3069	18.7
<b>Total Injuries</b>	<b>16443</b>	<b>100.0</b>

## **Children at Risk**

In 1991, there were 923,000 children under 15 years of age and 346,000 children 15–19 years of age residing on US farms and ranches (Daquel and Dahmann, 1993). The exact number of adolescents working in agriculture in the United States is not known. The National Agricultural Worker's Survey estimates that about 128,000 14 to 17 year old farm workers were working in crop production from 1993-1996, composing approximately 7% of all hired farm workers working on crops (USDAL, 2000). Another 800,000 children lived in households of hired farm workers and many work on farms with their parents. Although more difficult to quantify, many children, whose parents are not farmers or farm workers, will visit and work on farms. The General Accounting Office recently cited an estimate of 300,000 15 to 17 year olds working in agriculture each year, while acknowledging that methodological problems likely resulted in an undercounting of the total number (USGAO, 1998). This estimate excludes those 14 and under; children younger than 14 are not included in any nationally



based surveys of farm workers. The United Farm Workers union estimates that there are 800,000 child farm workers in the United States. These estimates include both children working as hired laborers and children working on their parents’ farms. Farm safety protections and hazard surveillance must be designed to protect these nearly two million children regardless of their parents’ relationship to the farm.

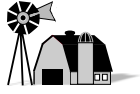
**Table 3. Categories and Estimates of Youth at Risk for Agricultural Injury in U.S.**

<b>Population at Risk*</b>	<b>Estimated Total Size</b>	<b>Potential Hazard Sources</b>
<u>Work-Related</u>		
Farm Owners’ Children	1,269,000	tractors, farm machinery, livestock, building structures, falls, bodies of water, pesticides, volatile organic compounds, noxious gases, airborne irritants, noise, repetitive motion, vibration, zoonoses, and stress (including heat exertion)
Farm Workers’ Children	800,000	
Child Farm Workers	800,000	
<u>Non Work-Related</u>		
Children Living on Farms	1,298,000	tractors, farm machinery, livestock, building structures, falls, bodies of water, pesticides, volatile organic compounds, noxious gases, airborne irritants, noise
Children Visiting Farms		
Children Living Near Farms	1,350,000	bodies of water, pesticides, volatile organic compounds, noxious gases, airborne irritants

\* categories are not independent

Taxonomy of Agricultural Morbidity for Youth

Table 3 identifies child populations at risk, size estimates, and types of hazard sources. The types of agricultural hazards children are exposed to depend on their work status and place of residence. Children of farm owners and farm workers often work on farms with their parents. However simply living in or visiting the farm environment also places children at risk for assorted environmental exposures. Living in close proximity to farms also increases children’s risk of inadvertent exposures to inorganic and organic substances. Hazards that child farm workers are at risk for correspond to Healthy People 2010 Objectives Occupational Categories: Fatal and Non-Fatal Injuries; Hazardous Organic and Inorganic Exposures; Trauma From Overexertion or Repetitive Motion; Occupational Skin Diseases or Disorders; Work-related Noise Induced Hearing Loss; and Stress.



**Pathophysiology, Diagnosis and Treatment**

**Developmental Considerations**

Health risks in agriculture arise from a variety of exposures, including toxins and physical and mechanical hazards. In lieu of actual pediatric data, identifying the major health problems experienced by adult agricultural workers gives clues to the health risks that farm children face. The major recognized or perceived problems, both acute and chronic, among adult farming populations include respiratory disorders, cancer, neurologic problems, injuries and traumatic deaths, skin diseases, hearing loss, and stress (Zejda et al., 1993).

Whereas chronicity of exposures are more relevant to adult workers who have been present in the farm environment for longer periods, vulnerability of developing organ systems is of particular concern for farm children. Human children differ from human adults not only in size but more importantly in the relative immaturity of biochemistry and physiological functions in major body systems; body composition in terms of proportions of water, fat protein and mineral mass, as well as the chemical constituents of these body components; the anatomic structure of organs; and the relative proportions of muscle, bone, solid organs, and brain. These structural and functional differences between adults and children can potentially influence the toxicity of chemicals, due to qualitative and quantitative alterations in the magnitude of systemic absorption, distribution, binding, metabolism, interaction of the chemical with cellular components of target organs, and excretion (NRC, 1993). Similarly musculoskeletal trauma and strain can have a qualitatively different effect on soft tissue in the developing body compared to one that is fully matured. These qualitative and quantitative differences result in more health risks for youth both working in and visiting farm settings.

Table 4 provides a general guide to health risks associated with agriculture that should be considered in the context of child health. Rather than complete, it is designed to highlight the principal exposures and possible symptoms that healthcare providers should be aware of when caring for rural youth. The original version of this guide was tailored to adult farmers and was based on prevalence estimates from prior clinical studies of adult farmers and farm workers (Zejda et al., 1993). Awareness of agricultural health risks to children has increased only recently and few data are available in the published literature on the prevalence of these conditions among youth or how frequently they present to healthcare facilities. This is particularly true for chronic conditions that may not be initially diagnosed as directly related to work or agriculture (e.g. asthma, emotional disturbance, memory problems etc.). The following sections review clinical characteristics of potential child agricultural health problems. Where available, pediatric data are presented. In most cases however only adult data are available and child implications must be extrapolated.



**Table 4. Rural Healthcare Providers' Guide to Health Risks in Agriculture \***

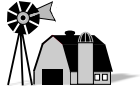
<b>Organ System or Disorder</b>	<b>Principal Exposures</b>	<b>Possible Medical Manifestations</b>	<b>Rural Healthcare Providers' Role</b>
Lungs	Organic dust, microbes, molds, fungi, endotoxins, allergens	Chronic bronchitis, asthma, hypersensitivity pneumonitis, organic-dust toxic syndrome	Recognition, environmental control, appropriate treatment, work practice changes
Neurologic disorders	Herbicides, insecticides, fungicides, solvents, fumes	Acute intoxication, peripheral neuritis, Parkinson's disease,+ acute and chronic+ encephalopathy	Immediate treatment, diagnosis, public health leadership
Accidents	Tractor rollovers, machine injuries, animal injuries, farmyard injuries	Suffocation, crushing, lacerations, amputations, eye injuries	Community action, emergency treatment public health leadership
Hearing loss	Motor noise, animal noise	Deafness	Hearing conservation, diagnosis, treatment
Skin	Pesticides, fuels, fungi, sun, mites, parasites	Dermatitis, dermatophyte infections, cancer+	Prevention, diagnosis, treatment
Cancer+	Herbicides, insecticides, fungicides, fumes, sunlight, diet, unknown	Non-Hodgkin's lymphoma; Hodgkin's disease; multiple myeloma; soft-tissue sarcoma; leukemias; skin cancer; cancer of prostate, stomach, pancreas, testicle; glioma	Early recognition, education, public health leadership

\*adapted from Zejda et al., 1993

+most likely to manifest in adulthood but may be attributable to chronic exposures initiating in adolescence

**Fatal and Non-Fatal Injuries**

Disabling injuries and accidental deaths represent one of the most disturbing aspects of child safety risks in agriculture. As described earlier, injuries on the farm involve tractor rollovers, machine injuries, animal injuries, and farmyard injuries. Farm machinery (including tractors) is the leading cause of fatality to youth less than 20 years of age. Thirty percent of farm machinery-related deaths are among children less than 5 years of age. Drowning is the second leading cause of death on farms with children less than 5 years of age accounting for 32% of the deaths. The most common injury resulting in death is to the head or brain, accounting for nearly two-thirds of the total (Rivara, 1997). The leading causes of nonfatal injuries are surfaces, animals and non-industrial off-road vehicles and the leading causes of these injuries are falls, off-road transportation accidents and being struck by



objects. The parts of the body most commonly injured are hands, head and legs and the most frequent types of injury are lacerations, fractures and scrapes or abrasions. Because rural health care providers are in the frontline for medical treatment for accidents they should be familiar with current trends in micro-surgery and amputated digit-limb reattachment (Zejda et al., 1993).

### **Hazardous Organic and Inorganic Exposures**

Potentially harmful exposures exist in a variety of forms in the farm environment including, solvents, pesticides, paints, welding and combustion fumes, plant toxins and animal bacteria and viruses.

#### Solvents

A solvent is a liquid used to dissolve other substances but the most toxic solvents are extracted or manufactured for chemical use (CEHN, 1999). Most solvents are colorless liquids at room temperature that volatilize easily and have strong odors. These compounds may be referred to as volatile organic compounds (VOCs) in reference to their physiochemical properties. Many commonly used solvents such as gasoline, kerosene and jet fuel are mixtures of solvents and other chemicals. They are widely used for manufacturing, degreasing and other cleaning, and as carrying agents (or “inert” ingredients) in products ranging from insecticides to glues and paints. The most common solvents and solvent mixtures found in the farm environment include pesticides, fuels, paints, and metal degreasers.

There is little information in animals or humans regarding the health effects of chronic low-dose exposure, which is more common than high-dose exposure in children and adults (Ott and Roberts, 1998). Solvents are most commonly inhaled in their volatilized form and absorbed via the respiratory track. Significant doses of solvents may occur through skin exposure and absorption. Most solvents are lipophilic but some are water-soluble. Animal studies in the toxicology literature emphasize the role of solvents as neurotoxins (Arlie-Soborg, 1992). The majority of solvents are central nervous system depressants and some have long-term neuropsychological effects, including chronic toxic encephalopathy. In adults, the following neurobehavioral problems resulting from chronic solvent exposure have been recorded in the literature (CHEN, 1999):

- Memory loss
- Decreased problem-solving ability
- Decreased attention span
- Impaired dexterity and hand-eye coordination
- Altered reaction time
- Reduced psychomotor function
- Altered personality or mood

In addition to neurotoxicologic effects, other documented health effects from solvent exposure in adults are pulmonary sensitization, bradycardia and ventricular fibrillation, defatting of the dermis and chemical burns.



### Pesticides

We would smell pesticides once in awhile in the fields. We would get headaches and rashes. Red and itchy rashes all over our hands and wrists. For two or three days the rash would stay. We would tell our supervisors, and they would say “it’s normal-it’s from the plants.” We know it’s not from the plants! But we’d have to keep working anyway.

-Dina V., 19 year old farm worker (HRW, 2000).

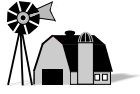
Exposure to pesticides is a serious risk to all farm workers. The Environmental Protection Agency estimates that as many as 300,000 farm workers suffer pesticide poisoning each year while the Natural Resources Defense Council estimates as many as 40,000 physician-diagnosed poisonings occur each year (NRDC, 1998). Only a small percentage of pesticide related illnesses are reported to government or health officials.

While acute pesticide health effects have been well documented and epidemiological investigations continue to evaluate chronic health effects, the current status of information regarding the health effects of pesticide exposures on infants and children is inconclusive at best (NRC, 1993). The toxicological and epidemiological data reviewed in this section largely originates from adult animal and adult human studies. Infants and children may be exceptionally vulnerable to health complications from exposures due to their developing neurological, immunological and reproductive systems and due to differences in their ability to metabolize and excrete toxicants. Only recently has research attention shifted to the potential health consequences of chemical exposure on this susceptible population. Consensus remains however that chemical exposures to infants and children should be prevented whenever possible (NRC, 1993; Lee and Marlenga, 1999).

There is evidence that farm families experience elevated levels of pesticide residues in their blood and urine. A recent investigation from the Agricultural Health Study reported that agricultural families could receive an absorbed dose of pesticides after application by a member of the family. The report used indoor air sampling, hand wipe sampling, serum, and urine monitoring to evaluate exposures to the family of a single farm applicator. The farmer applied carbaryl to pumpkins using a hand-cranked duster. His serum carbaryl levels rose by three-orders-of-magnitude following use of the pesticide, and the carbaryl metabolite was detectable in his urine. Urine metabolite measurements taken from his wife and two children showed a doubling of excretion of the carbaryl metabolite following application of the pesticide. These results were seen in the absence of a quantifiable increased carbaryl concentration in indoor air or house dust (Shealy et al., 1997).

Additional preliminary results from the Agricultural Health Study revealed that elevated blood serum pesticide levels were detected in some farm families. The very potent pesticide dieldrin, which has been banned in the US since 1987, was found at significantly elevated levels in the blood of all members of one of the six farm families sampled. Further investigation revealed persistently elevated levels of this pesticide in food samples on the farm, although all legal food uses of this pesticide were canceled in 1974. Other persistent pesticides identified in the blood of farm families included chlordane and trans-nonachlor (Brock et al., 1998).

Residents living near fields sprayed with organophosphate pesticides had small reductions in plasma and whole blood levels of the neurotransmitter enzyme cholinesterase during spraying season compared with residents living further from the fields, and with their own cholinesterase levels off-season. At the same time, infirmity records indicated a significant increase in visits for certain symptoms on days when organophosphate pesticides were sprayed. Symptoms included respiratory problems, headache,



and eye irritation (Richter et al., 1986). These data suggested that exposures to organophosphate pesticide drift might result in quantifiable cholinesterase inhibition in residents living nearby application fields.

Farm children under age six in a fruit growing region of Washington State were tested for urinary dimethylthiophosphate (DMTP), a metabolite associated with exposure to the organophosphates azinphos-methyl and phosmet, two highly potent agricultural pesticides not registered for use in the home. The testing compared 46 families with a member involved in pesticide application and whose residence was within 200 feet of an orchard with 13 families who had no members working in agriculture and who lived farther from orchards. DMTP was detected in 66 percent of the farm children at a median concentration four times higher than in the control children. However, DMTP was also detected in approximately 40 percent of non-farm children (Lowenherz et al., 1997). The non-farm children may have been exposed from dietary sources, pesticide drift, or contaminated soil and dust in this agricultural region.

In this same study, younger children tended to have higher pesticide concentrations in their urine than older children, consistent with expectations about disproportionate exposure. Children living closer to an orchard also tended to have slightly higher pesticide residues in their urine. Wearing work shoes inside the home also correlated with measured exposure among the children of pesticide applicators. Authors of the study cautioned that the methodology used might have tended to underestimate exposures due to the limited number of urinary metabolites evaluated. This study demonstrated that childhood exposure to agricultural pesticides in farm areas does occur and can be significant, but the limitations of the study make it difficult to apply to the actual quantification of total exposure.

### *Clinical Recognition of Solvent or Pesticide Poisoning*

The clinical presentation of solvent and pesticide poisonings are remarkably similar, adding to problems in differential diagnosis. The most common signs of solvent exposure are central nervous system depression, which can include such non-specific symptoms as headache, dizziness, irritability and fatigue. Eye, mucous membrane, and respiratory tract irritation, and nausea may also be present. Immediate signs of acute pesticide poisoning include nausea, vomiting, diarrhea, wheezing, rashes, headaches and dizziness. A patient or caretaker may note symptom onset in association with a chemical odor, but not all solvents or pesticides are detectable by odor at toxic thresholds. Chronic toxicity may be even more difficult to identify. The most important rule of thumb is to consider exposure to toxicants, including pesticides and solvents, in the differential diagnosis when evaluating children with puzzling symptoms (CEHN, 1999).

### Microbes and Their Toxins

Grain dusts, molds and fungi are among several plant-based irritants that abound in the agricultural environment and that cause a host of respiratory problems in adult farmers (Zejda et al., 1993). No data are available on the respiratory burden they may cause children and adolescents however the potential for harm is likely only compounded by vulnerabilities in immature respiratory systems. The clinical features of adult illnesses caused by these irritants should be considered with regard to the potential for child exposures. As with other chronic diseases, origins of chronic respiratory diseases are likely to begin during early exposures, with damage accumulating over time until eventual clinical



symptoms appear. Preventing such exposures early may be the key to reducing respiratory disease in adulthood. Additional clinical research is needed to identify the extent to which early symptoms are manifest and the extent to which farm youth are susceptible to acute forms of respiratory disease from airborne irritants.

Grain dust is a complex substance composed of plant debris, insect parts, silica, chemical residues, molds, fungi, and bacteria and their metabolites including endotoxins. Approximately 40% of its particles are less than 5  $\mu\text{m}$  in mean diameter and represent a respirable particle that can penetrate the terminal bronchioles (Yoshida and Maybank, 1980). Exposure to antigens from organic dusts may be responsible for hypersensitivity pneumonitis, which has a reported prevalence of 0.1% to 15% among adult farmers. Hypersensitivity pneumonitis is difficult to diagnose in adult farmers because it has an insidious course and appears as recurrent influenza-like episodes or nonspecific respiratory symptoms and may result in chronic respiratory problems that look like pulmonary fibrosis.

The organic-dust toxic syndrome is an acute response to inhaling organic dust, usually characterized by a delayed onset of fever, malaise, and chest tightness that does not evidence immunologic involvement and has an apparently benign course without long-term respiratory impairment (doPico, 1986). Possible mechanisms include a toxic reaction to endotoxins, mycotoxins, or proteinase enzymes of moldy plant materials. It is related to dust level and can be reproduced in laboratory subjects exposed to high concentrations of grain dust. The primary exposures responsible for extrinsic allergic alveolitis (farmer's lung) are actinomycetes such as *Micropolyspora faeni*, fungi, and animal proteins present in many agricultural environments.

### **Trauma From Overexertion or Repetitive Motion**

Early adolescence is a time of rapid growth, which makes teenage workers more vulnerable than adults to musculoskeletal disorders (NRC, 1998). Agricultural work in particular has been linked to musculoskeletal trauma, due to the stresses on the body of constant bending, lifting, twisting, and other awkward or punishing work (Bernard, 1997). Furthermore, because back pain is generally rare among adolescents as a whole and a history of back pain is a risk factor for new back injuries - a National Research Council Report recently concluded, "the long-term consequences of back strains among adolescent workers are of substantial concern." (NRC, 1998). How the physical demands of farm work activities differentially affect children and adolescents has yet to be examined, although it appears that youth, especially teenage boys, may not be exempted from heavy lifting and other strenuous activities. The North American Guidelines for Children's Agricultural Tasks (Lee and Marlenga, 1999) recommends safe work practices that can reduce musculoskeletal trauma. Lifting guidelines, for example, advise that children should not lift objects greater than 10-15% of his/her body weight and should not carry objects farther than 10-15 yards.

### **Skin Problems**

Data from studies of adult farmers indicate that skin irritation starts soon after employment commencement and increases to involve more than 60% of workers after four years' employment in the grain industry (Zejda et al., 1993). Skin cancers, dermatophyte infections, and pesticide-related skin diseases are common in farmers.

The impact of microscopic fungi on farmers' health seems to be greater than originally understood. The



infection may be transmitted from infected humans, animals, plants or soil. To date, little epidemiological data on fungal skin disease in farmers is available. Epidemiological studies from Poland suggest that mycoses are the most prevalent skin diseases in farmers, and may be present in over 20% of the population (Spiewak, 1998). Working conditions on farms directly contribute to the development of fungal infections. Farmers spend most of their working time in humid conditions and wearing rubber boots for long hours. Besides infection, fungi may also cause non-invasive forms of skin disease, as dermatomycotoxicosis professionalis or alternariosis. Most pesticide-related dermatoses are contact dermatitis, both allergic and irritant. Rare clinical forms also occur, including urticaria, erythema multiforme, ashy dermatosis, parakeratosis variegata, porphyria cutanea tarda, chloracne, skin hypopigmentation, nail and hair disorders (Spiewak, 2001).

### **Noise Induced Hearing Loss**

Although little population-based data are available, farmers older than 50 may have as much as 55% of hearing impairment (Ejercito et al., 1989). Hearing impairment related to noise generated by farm equipment develops early in life, as suggested by the finding that rural students have a 2? times greater hearing loss than urban students (Emanuel, 1990) and increases with age and number of years worked in farming (Marvel et al., 1991). Farmers and farm family members are exposed to excessive noise from equipment used on the farm, including tractors, grain dryers, combines, bush hogs, and chain saws. Noise-induced hearing loss occurs with continued exposure to high levels of noise; it is cumulative and irreversible (CDCP, 1988). Noise-induced hearing loss results from the destruction of the cochlear hair cells in the inner ear. There are two types of hearing damage caused by excessive noise. Acoustic trauma occurs when the ears are exposed to a single sudden sound above 140 dB(A) (decibels measured on the A scale, which incorporates weighting that takes into account the ear's varying response to sounds of different frequencies) and the sensory cells are permanently dislodged and destroyed. Gunshot blasts or explosions can cause acoustic trauma. Prolonged exposure to noises above 85 dB(A) can result in damage, though not necessarily permanent, to the cochlear nerve cells. Permanent damage to hearing occurs when exposure to excessive noise levels continues and the nerve cells are not given sufficient time to recover. There is no universal agreement on recovery duration. There is ample evidence that the damage is insidious, usually beginning at a young age, and in the long run, usually severe enough to affect a person's ability to hear and understand speech (Hwang et al., 2001a).

### **Stress**

There is little doubt that farming is one of the most stressful occupations in the United States (Haverstock, 1989). Both young farm workers and farm family members are exposed to the economic pressures of their family livelihood, the future of which remains precarious at best. The influence of stress is manifested by psychological or emotional disturbance among family members such as alcohol abuse, as well as by creating insecure working conditions. Being unmarried, having negative life events within the past year (legal problems, substantial income decline, and loss of something of sentimental value), and lower perceived general health status have been identified as significant risk factors for depressive symptoms for male farmers (Scarath et al., 2000).

Farm workers in general have high rates of depression (NCFH, 2001). Extreme poverty and hardship, the stress of job uncertainty and frequent moves, and social stigmatization and isolation are



contributing factors. This is true for children and youth as well. Studies have also linked depression in teenage workers to long hours of work in high-intensity, low-skilled jobs—precisely the kind of labor undertaken by farm workers.

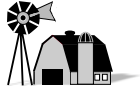
Identifying symptoms of psychosocial stress in farm adolescents requires history taking and consultation with farm parents to determine current social and economic conditions in the family. Depressive symptoms are expressed differently in youth and are frequently gender specific. Girls may be more likely to display internalizing symptoms such as lack of interest in social events, whereas boys may show externalizing behaviors such as antisocial or delinquent behavior. Knowing that adult farm owners and farm workers are at higher risk for psychological disturbance should alert the health care provider to potential risks for farm youth. Because health care providers are usually the first mental health contact for rural residents, they play an important role in the early identification of psychological distress in farm youth.

## **Agricultural Factors**

Agricultural production, which consistently ranks among the industries with the highest rates of work-related injuries and deaths in the US, is unique with respect to children and adolescents. This is the only industry in which the workplace is often also a home. Work by youth under 14 years of age is common and exposures to work hazards are not confined only to employed youth. Research is needed to expand the knowledge base for the development and implementation of effective intervention strategies. Farm tractors, farm machinery, stored grain, power lines, manure pits, ponds, and livestock are among the many injury hazards youth are exposed to in agricultural workplaces. Pesticides are particularly problematic because of their widespread use, their toxic potential, and because all members of farm communities can be exposed including individuals living near farmers.

### **Pesticide Exposure**

Pesticides surround all American children, although evidence suggests that farm children receive greater exposures from more sources than other children (NRDC, 1998). Agriculture is a workplace unlike many others in our country. Farm families often live in the middle of the work environment and actively participate on the job. As a result, children can come into close contact with toxic pesticides. Residues from 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. When exposures among farm family members have been evaluated, they frequently approach or exceed the safe reference dose for individual pesticides (NRDC, 1998). Children are often directly exposed to pesticides when they work in farm settings or accompany their parents in the fields and reports of acute exposures are accumulating in the agricultural health literature (Pollack et al., 1990). In 1980, 19 farm workers experienced acute organophosphate poisoning after working in a cauliflower field (Whorton & Obrinsky, 1983). Five of the workers were 18 years old or younger and three of those were between the ages of 9 and 15. Child workers may also be exposed to pesticides if they drink from, wash their hands, or bathe in irrigation canals or holding ponds, where pesticides can accumulate. Despite the fact that such practices are commonly reported by farm workers and are known to occur frequently, the pesticide level of irrigation canals and holding ponds is not monitored.



The herbicide atrazine, which is the most frequently used herbicide in the US, 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 (Camann et al., 1997). 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 (Bradman et al., 1997). 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 lived in the agricultural region but did not reside on a farm (Loewenherz, 1997). As the weight of evidence from empirical studies increases, greater attention must be given to pesticide protections, especially for the youngest members of farm communities.

### **Sanitation**

Drinking water, water for hand washing, and toilet facilities are the minimum sanitation requirements imposed by OSHA on farms. Even these minimal requirements, however, may be ignored by growers and by the farm labor contractors who bring in workers. Furthermore, Congress prohibits enforcement of these regulations on farms with ten employees or less, essentially exempting small farms. An estimated 95 percent of all United States farms fall under this exemption (HRW, 2000).

In studying the labor conditions of child farm workers, Human Rights Watch found that nearly all of the thirty farmworker children in Arizona interviewed for their report said they had worked in fields or orchards where one or more of these three basic requirements—drinking water, hand-washing facilities, and toilet facilities—was not met. Similar findings have been reported in other surveys in California and North Carolina (HRW, 2000).

Agricultural health clinicians have identified hygiene as being key in preventing bacterial infections from animals and dermatoses caused by chemical contamination. However farmers themselves may forego the minimum sanitation requirements when working in fields as a means of saving time and effort. These hygienic problems may be exacerbated for children who have a general tendency to skip basic hand washing unless reminded by an adult and who may also tend to have more hand to mouth contact. Health care providers should consider the multiple sources of contamination in the farm environment, consider hygiene as having a role in sources of infections especially of the skin, and take the opportunity to review household and farm hygienic practices with both pediatric patients and their parents.

### **Heat illnesses**

Heat illnesses can lead to death or brain damage and are an ever-present danger for field workers. The EPA and OSHA estimate approximately 500 deaths annually from heat illnesses in the United States and the EPA reports that children are more susceptible to heat stress than adults (USEPA, 1993a). Risk for heat stress during the growing season is particularly acute, especially during haying and harvesting. OSHA and EPA recommend that workers laboring under hot weather conditions drink a minimum of eight ounces of water every half-hour. Very high heat or humidity increases the amount of recommended water, so that, for example, a person working in 90-degree heat under a full sun should drink eight ounces of water every fifteen minutes. Ensuring sources of fresh water are abundant is critical to maintain children's hydration needs. Excessive sun exposure places children at risk for future skin malignancies, and must be prevented with proper head and body covering, which too can increase



the risk of heat stress from too much clothing. Keeping children hydrated, protected from the sun and insuring a minimum of 10 minutes of break time during each hour can reduce the risk of illnesses from overexposure to heat and sun.

### **Hazardous equipment and work-related injuries**

Children working in agriculture in the US make up only 8 percent of the population of working minors overall, yet account for 40 percent of work-related fatalities among minors. Minors working in agriculture have also been found to suffer a higher frequency of severe and disabling injuries than those working in all other occupations.

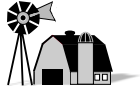
Tractors and other motorized farm equipment represent very serious hazards, and the FLSA prohibits their operation by children aged fifteen and younger. Abidance by this prohibition, and enforcement when it is violated, is another matter. A recent North American survey of tractor-related jobs assigned to farm children found that reports from 498 participating farms showed 360 children worked at least one farm tractor job. Some children operate tractors in field settings by 12-13 years of age. Males were more likely than females to be assigned to fieldwork with PTO-powered implements, 3-point implements, and trailed implements. Thirty-seven percent (104) of children below the recommended minimum age operated tractors and 24% (75) of underage children did fieldwork with PTO-powered implements (Marlenga et al., 2001). These data reinforce that children often use farm machinery at ages much younger than are developmentally possible for them to safely handle the machines.

For all workers, but especially for field workers, fatigue increases the risk of injury. Long hours, early morning hours, and work in very hot conditions all increase fatigue, as does the heavy physical labor entailed in most agricultural work. The relative inexperience of young workers also increases their risk of accidents and injury. Farmers identify stress and overwork as a main reason for forgoing pesticide safety practices (Perry and Bloom, 1998) and rushing is a well-established risk factor for machine-related injury in a variety of settings (Sorock et al., 2001). A recent study of farm injuries in over one thousand New York farmers showed that younger age, the presence of hearing loss or joint trouble, and working more hours per day were among the strongest predictors of severe injury (Hwang et al, 2001b).

## **Management Issues**

### **The Role of the Primary Health Care Provider in Agricultural Health**

Primary care providers work at the front lines of our health care system and therefore can have a significant impact in the diagnosis, treatment, and prevention of child agricultural health problems. Agents capable of having a direct impact on this pediatric problem include physicians, nurses, nurse practitioners and emergency medical technicians. Table 5 describes types of health care providers, the populations they serve, and an array of practice settings (USEPA, 2000).



**Table 5. Health Care Providers, Populations Served and Practice Settings**

<b>Agents</b>	<b>Populations Served</b>	<b>Practice Settings</b>
Nurses	farm owner families	hospitals and emergency departments
Nurse Practitioners	farm worker families	community clinics
Physicians	farm community residents	medical centers
Physician Assistants	migrant workers	independent practices
Nurse Midwives	pesticide applicators	public health departments
Community Health Workers	extension agents	poison control centers
Students in Training		schools
Emergency Medical Technicians		ag community health programs

A combination of knowledge and skills is needed for competency in pediatric agricultural health. Health care providers should have a basic understanding of epidemiology and the effect of agricultural hazards on various stages of human development. Health care providers must also learn the specifics of diagnosing, treating and preventing exposures to common agricultural health risks including environmental history taking/farm assessment; risk-communication; and advocating for health protections within the community (CEHN). The health care provider can serve as an:

### *Investigator*

Health care providers are the frontline investigators of agriculture-related illness within the clinical setting and the community. A careful health history and familiarity with agriculture-related symptoms are the keys to diagnosing farm-related illness in children. Health care providers can work with local farm health agencies to identify trends and contribute to clinical research on agricultural exposures of concern to the rural community.

### *Educator*

Knowledgeable providers are a credible source of information to patients, their families, and communities. Information shared by the provider can inform individuals and communities in their efforts to reduce or eliminate toxic or other hazardous exposures and create a safe home and work environment on the farm.

### *Advocate*

Providers who treat the adverse effects of agricultural health hazards in youth can be compelling advocates for more preventive and protective policies at the local, state and national levels.

### **Prevention**

Strategies recommended for preventing deaths associated with farm machinery include providing enclosed play spaces for young children away from work areas; checking a work area for the presence and location of children before starting to operate any machinery; evaluating youth's maturity, knowledge, and physical abilities to operate machinery before assigning a chore or work task; and ensuring that youth adhere to standard safety practices such as using seat belts on Rollover Over Protective Structure (ROPS)-equipped tractors. Elements of a drowning prevention program may include erecting barriers to separate children from ponds or other drowning hazards; supervising children at all times when they are near a body of water; and permitting youth to swim only when



another person is present (Adekoya and Pratt, 2001). A variety of agencies and organizations, including those listed in the section entitled “Additional Resources” at the end of this chapter, can provide further information about prevention of childhood injuries and fatalities on farms.

The American Academy of Pediatrics makes the following recommendations to pediatricians who care for children living or visiting farms (AAP, 2001):

1. Parents and patients should be asked about farm residence, farm work involving children, and visits to relatives on farms and should be informed about the risks of agricultural injury and effective preventive measures. Strategies for prevention might include the following:

- Separating young children from farm hazards by fencing in a play area
- Providing child care to assist farm families and farm workers or pooling family child care, especially at planting and harvesting times
- Prohibiting extra riders on tractors, mowers, and all-terrain vehicles (ATVs) (NRDC, 1998). Ensuring that there are rollover protective structures (ROPS) and seat belts on tractors and other farm equipment and that these are used at all times
- Limiting young children’s access to large animals
- Properly storing farm chemicals and cleaning agents
- Providing children who work on farms with personal hearing-protection equipment and training them on how to use it properly.

2. Parents should be educated about normal growth and development in adolescence and should be encouraged to consider the physical and emotional readiness of the child for work. Parents need to recognize that small adolescents on adult-sized machinery and large adolescents with immature cognitive and judgment skills are at high risk for farm injury. Consensus guidelines have been developed by the North American Guidelines for Children’s Agricultural Tasks project (Marlenga and Lee, 1999). These guidelines discuss skill sets for discrete tasks and skill acquisition necessary before advancing to a new task. They are available on the Internet to physicians, parents, and youth and may be helpful for counseling about developmentally and age-appropriate agricultural work for children 7 to 16 years old ([www.nagcat.org](http://www.nagcat.org)).

3. For any farm machinery work, parental supervision, task-specific education, and initial experiences in good weather on level terrain with visual contact by parents or other adults should be supported. Children should be taught to get help from adults if any difficulties are encountered. These behaviors should be supported not only for individual families but also in the schools and as community norms.

4. Pediatric training programs should increase teaching about the importance of childhood and adolescent agricultural health and safety issues, including regional epidemiology and effective prevention strategies. Pediatricians should then ensure that this information is shared with the community and schools. Community farm safety organizations such as 4-H, National FFA, and Farm Safety 4 Just Kids, as well as county extension agents taking leadership roles in agricultural health and



safety, should be supported. Also, community-based pediatric injury prevention organizations, such as SAFE KIDS coalitions and Safe Communities, should be encouraged to include education about prevention of agricultural injury in their rural-related activities. Especially where none of these efforts exist, rural pediatricians should themselves consider leading farm injury prevention efforts with local support and resources.

5. The emergency medical services system should be improved to provide the best possible emergency care, medical assessment, and access to tertiary care for children and adolescents residing in rural areas.

### Regulations

#### The Worker Protection Standard

Despite their greater vulnerability at work, children are afforded no more protection than adults. In actuality they receive less protection because health and safety standards now in place have been formulated with adults in mind. The Environmental Protection Agency's (EPA) pesticide reentry intervals (REIs) for example-which set the minimum period of time that workers must be kept out of a field after pesticides have been applied-are determined using the model of a 154 pound male (HRW, 2000).

Only about 5 percent of farms in this country are covered by safety regulations of the Occupational Safety and Health Act (OSHA). On the remaining 95 percent of farms, the owner/operator is responsible for assessing acceptable levels of risk for adults and children on that farm. Unfortunately, little scientific evidence is available to determine acceptable levels of hazardous exposure to children. Therefore, neither OSHA standards nor farm operators are prepared to provide children the same level of protection from occupational hazards in production agriculture as they receive in other occupations.

The 1992 Federal Worker Protection Standard (Code of Federal Regulations, Title 40, Part 170) issued by the Environmental Protection Agency to take full effect after April 15, 1994, details all of the compliances that pesticide applicators, dealers and commercial operation owners must comply with. However *owners of agricultural establishments and members of their immediate family* are exempt from many of the Worker Protection Standard (WPS) guidelines, including each of the following requirements: "information at a central location, pesticide safety training, decontamination sites, emergency assistance, notice about applications, monitoring handlers, specific handling instructions, equipment safety, all the specific duties related to the care of PPE and management of its use, and the following duties related to early entry: training and instructions, decontamination sites, and specific duties related to the care of PPE and management of its use" (USEPA, 1993b, p.93). These exceptions are made for private farmers to reduce undue safety operation burden. However, *it remains solely left to the individual responsibility of the private applicator to follow the many precautions necessary to prevent individual, family and environmental exposures.*

The WPS does not set any minimum age requirement for mixing or applying pesticides despite the heightened risk of juveniles to suffer pesticide-related illnesses or injuries.

The Fair Labor Standards Act enumerates "Exposure to agricultural chemicals classified as Category I or II of toxicity" as hazardous agricultural conditions. Accordingly, on a farm where the FLSA applies, children aged fifteen and under are prohibited from handling category I and category II pesticides.

They may still handle pesticides of lower toxicity, while juveniles aged sixteen and older work without any pesticide-related restrictions.



The Fair Labor Standards Act (FLSA) sets the federal minimum age for child labor. (Whichever legal standard—state or federal—is most stringent is the one that applies.) The Fair Labor Standards Act dates back to 1938 and reflects a radically different era in the United States, a time when “agriculture” was synonymous with “family farm,” and a quarter of all Americans still lived and worked on farms. Initially, farm workers were excluded entirely from the law’s protection, and restrictions on child labor in agriculture were not added until 1974.

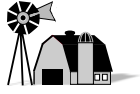
State laws regarding the minimum age of employment as a hired farmworker vary widely. According to a 1997 survey by the Child Labor Coalition, eighteen states have no minimum age requirement for children working in agriculture. In Oregon, the minimum age is nine; in Illinois it is ten. Fourteen states require a minimum age of twelve: Arkansas, Georgia, Idaho, Indiana, Kansas, Maryland, Minnesota, New Jersey, New York, South Carolina, Virginia, Washington, and Wisconsin; in nine states the minimum age is fourteen. Only one state, Nevada, has set sixteen as the minimum age for hired farmworkers (HRW, 2000).

For children working in agriculture, the FLSA is much less protective. Children younger than twelve may work unlimited hours outside of school, if this work takes place on a small farm with a parent’s written consent. Children aged twelve and thirteen may work unlimited hours outside of school on any farm with written parental consent, or without written consent on a farm where a parent is employed. Children aged fourteen and fifteen may work unlimited hours outside of school on any farm, without parental consent. There are no hourly restrictions on the agricultural work of children who are sixteen or older.

In addition to allowing agricultural employers to employ children for longer hours and at younger ages, the FLSA also permits sixteen and seventeen-year olds to engage in *hazardous* agricultural work. In other occupational settings, eighteen is the minimum age for hazardous work.

To reduce the undue burden of agricultural injury in farm children, protection regulations must be examined. The American Academy of Pediatrics makes the following recommendations regarding child protections from agricultural injury and illness:

1. Voluntary or legislated safety standards should be promoted, including the following:
  - Improved safety standards for farm equipment. All tractors should be equipped with seat belts and ROPS, and individuals younger than 18 years should be restricted from operating any tractor not so equipped.
  - Children younger than 16 years should not operate any farm vehicles, including ATVs. Individuals between 16 and 18 years of age should have a valid motor vehicle license and should also be a certified graduate of a state-approved tractor and farm vehicle safety training program, if available, to operate a farm vehicle on a public road. Such courses need to be developed, standardized, and evaluated.



- Children and adolescents should be restricted from riding on or in areas of machinery or motorized vehicles not approved for passengers (including the racks of ATVs, fenders of tractors, and cargo areas of pickup trucks).
- Safety and environmental guidelines to protect bystander children from agricultural hazards should be established.
- Child labor laws, including hazard orders, should be amended to apply uniformly to machinery and exposures in other settings and on farms to provide equal protection for all children.

2. Manufacturers of farm equipment and farm chemicals should be encouraged to apply existing technologies and invest research funds in the development of new technologies to decrease the number of agricultural injuries and poisonings.

### **Summary**

Agriculture remains one of the most dangerous industries in the US and children in the agricultural environment experience excess risk of injury and illness. Leading agricultural factors that directly contribute to mortality and morbidity among children include toxic exposures, physical, and mechanical hazards. In most instances accurate data on the prevalence and symptomatology specific to the pediatric population are not available. Health care providers should familiarize themselves with the contexts of farm injury and with the leading health problems among adult farmers in preparation for treating farm children. Rural clinicians should consider contributing to the clinical research literature on child agricultural health when practical. Prevention strategies include both engineering controls in the farm environment and active education with farm community members including farm owners, parents, and children. Regulations that require equipment safety standards and that limit underage children's access to hazardous machinery and harmful exposures should be actively supported by health care providers at the community, state and national levels.



## Additional Resources

Centers for Agricultural Disease and Injury Research, Education and Prevention  
National Institute for Occupational Safety and Health  
Phone: (304) 285-5749  
[www.cdc.gov/niosh/agctrhom.html](http://www.cdc.gov/niosh/agctrhom.html)

Farm Safety Program  
Cooperative State Research Education and Extension Service  
U.S. Department of Agriculture  
Phone: (202) 401-0151  
[www.reeusda.gov/pas/AGSYS/FARMSAFE/Farmsafe.htm](http://www.reeusda.gov/pas/AGSYS/FARMSAFE/Farmsafe.htm)

Employment Standards Administration, Wage and Hour Division  
U.S. Department of Labor  
Phone: (866) 487-9243  
[www.dol.gov/dol/esa](http://www.dol.gov/dol/esa)

Farm Safety 4 Just Kids  
Phone: (800) 423-5437 or (515) 758-2827  
[www.fs4jk.org](http://www.fs4jk.org)

National Center for Injury Prevention and Control  
Phone: (770) 488-1506  
[www.cdc.gov/ncipc/ncipchm.htm](http://www.cdc.gov/ncipc/ncipchm.htm)

National Children's Center for Rural and Agricultural Health and Safety  
Phone: (888) 924-SAFE (7233)  
[www.marshfieldclinic.org/research/children](http://www.marshfieldclinic.org/research/children)

National FFA Organization  
Phone: (317) 802-6060  
[www.ffa.org](http://www.ffa.org)

National Institute for Occupational Safety and Health  
Phone: (800) 356-7674  
[www.cdc.gov/niosh](http://www.cdc.gov/niosh)

National SAFE KIDS Campaign  
[www.safekids.org](http://www.safekids.org)

National Safety Council, Agriculture Division  
[www.nsc.org/mem/agri.htm](http://www.nsc.org/mem/agri.htm)

North American Guidelines for Children's Agricultural Tasks (NAGCAT)  
Phone: (888) 924-SAFE (7233)  
[www.nagcat.org](http://www.nagcat.org)

*The addresses above were correct as of June 2001. Internet addresses for Web sites change frequently, and address changes may have taken place since that time. Compiled by The National Children's Center for Rural and Agricultural Health and Safety.*



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