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EDITORIAL

Pesticides: Our Children in Jeopardy

The recently released Pesticide Action Network North America report "A Generation in Jeopardy" is replete with information and over 200 citations.[1] This is a synopsis of some of the points made in this report.

We use approximately 1.1 billion pounds of pesticides annually in the United States. If we were to include pesticides used in paints, plastics, and as wood preservatives, this number would rise to 5 billion pounds annually.[2-4] Numerous studies have shown how they can adversely affect children. These studies show that pesticide exposure in children contributes to the ever-increasing rate of autism, attention deficit/hyperactivity disorder (ADD/ADHD), and declining intelligence quotients (IQ); the alarming increase in childhood cancers, particularly leukemia and brain cancers; and early puberty and birth defects. Pesticide exposure contributes to rising rates of obesity, diabetes, and asthma in children.

Let us look at these pesticides. There are four main groups: organophosphates, pyrethroids, chlorpyrifos, and neonicotinoids. Organophosphates can block the neurotransmitter *acetylcholine*. Pyrethroids affect neurons by interfering with sodium channels. Chlorpyrifos adversely affect neural cell replication and differentiation. Neonicotinoids affect the entire plant; therefore, they cannot be washed off. More studies are needed on neonicotinoids. Many of the pesticides used in the home contain pyrethroids. In the yard and garden, Roundup is the most common—a glycophosphate.

The exposure starts in the womb where these chemicals cross the placenta, affecting the fetus. When a child is born, it explores the world at floor level, putting its hand and things it can grab into its mouth. Later, at daycare, kindergarten, schools, playgrounds, and the lawn outside, children are exposed to pesticides of different types. There are pesticides in our foods and residues on foods, and recent studies show that breast milk may be contaminated as well. Children grow rapidly and their development is delicately balanced, while at the same time they drink more fluids, eat more food, and breathe a greater volume of air than adults when compared by body surface and weight.

When comparing children to adults, there are several areas that play an important role in exposures to toxic substances. Starting with the fetus and up to 6 months of age, the blood-brain barrier is in development and does not provide the same protection from toxic substances as in an adult.[5] From birth to 6 months, babies take about 15 times more water than an adult.[6] A child up to age 12 will breathe about double the amount of air compared to an adult, doubling the dose and exposure from respirable droplets or airborne pesticides.[7]

Let us review this earliest exposure: the womb. A study by Whyatt et al showed that the breakdown of organophosphate pesticides were found in 100% of cord blood samples in newborns tested.[8] In another study by the same author, 80% of cord blood tested had pesticide metabolites.[9] Controversies about genetically modified foods continue both in the medical and scientific worlds as well as in the media and politics. A Canadian study looked for one herbicide in pregnant women who consumed genetically modified crops. These crops included potatoes, corn, and soybeans and the metabolites of the herbicide were found in cord blood in 100% of their newborn.[10]

Indoors in homes, without the effects of sun, rain, wind, temperature changes, and other factors, pesticides tend to remain for longer than 2 weeks. This was reported in a study that looked at insecticide residue on furniture, toys, pillows, and rugs after pesticide had been applied in the home.[11] This is also true of daycare centers and schools. In a 2010 review, Owens showed that of the 40 most commonly used pesticides in schools, 28 are possible or probable carcinogens, 26 damage the nervous system and cause reproductive defects, and 13 can cause birth defects.[12]

Children living in rural areas can be affected by pesticides from wind drift from agricultural fields contaminating outdoor play areas, as was found in a study conducted in

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Washington State.[13] According to federal law, children under 12 years old can work in agricultural fields after school where they can be exposed to pesticides, as long as the farm is where their parents work.[14]

A recent editorial in this journal reviewed a recent study in which organic foods were found to be no more nutritious than nonorganic foods.[15] In a study by Curl et al, when comparing children who ate organic foods to children who ate conventional foods, urine tests for metabolites of organophosphates were six times lower in the organic-consuming group.[16]

Cancers are increasing in children at an alarming rate: in children from 1 to 14 years of age, the number of invasive cancers has increased by 29% since 1975. Brain cancers and leukemias top the list. Using pesticides at home during pregnancy has been shown to increase the risk of acute lymphocytic leukemia, the most common type of leukemia in children.[17,18] Children whose parent used pesticides at home and in their garden had a higher risk of neuroblastoma, the most common cancer in infants.[19] In agricultural areas in the United States, children have a significantly higher risk of cancer from birth to age 15.[20]

If we look at birth defects, according to the CDC, about 1 in every 33 babies has some kind of birth defect. It is the leading cause of infant mortality in the United States.[21] Rocheleau et al found a significantly higher number of birth defects in the children of male pesticide applicators. Mothers exposed to pesticides at work had a 36% increased risk of hypospadia. This study was a meta-analysis involving the United States, Canada, Spain, Italy, Denmark, Sweden, and Norway.[22]

Pesticides can and do act as hormone disruptors. We have seen menarche developing at an earlier age in girls and we have had to change the normal age of onset of puberty. This was noted over 15 years ago in a study that showed that girls might be entering puberty before the age of 8.[23]

In the United States, we are dealing with a serious problem in schoolchildren: the increasing rate of neurobehavioral disorders, especially ADD/ADHD and autism. The National Academy of Sciences reported that approximately one-third of all neurobehavioral problems are due to pesticides.[24] ADD/ADHD affects 14% of school children in the United States.[25] In a study by Bouchard et al, 94% of the over 1000 children tested by the CDC had metabolites of organophosphates in their urine and these children had double the risk of having ADHD.[26] The data on autism is no less alarming: autism spectrum affects 1 in every 88 children born in the United States and, as autism affects boys more than girls, the rate is 1 in every 54. Landrigan showed that of the top five chemicals linked to autism, two were pesticides: organophosphate and organochlorine pesticides.[25] Brain development is also affected by pesticides: a study using magnetic resonance imaging (MRI) in infants exposed to chlorpirifos in utero showed abnormal areas of structural changes.[27]

Concerns about pesticides playing a role in the swell of obesity in children have been studied. The National Health and Nutrition Examination Survey (NHANES) showed that obese children are more likely to have elevated levels of pesticide metabolites in their urine.[28] Organochlorine pesticides have been implicated in type 2 diabetes as shown by Lee et al, who demonstrated that organochlorine serum levels correlate with the increased likelihood of developing diabetes in obese persons.

The incidence of asthma has more than tripled in the last 30 years, affecting over 7 million people and is the most common chronic disease in childhood. Salam et al showed that exposure to pesticides in the first year of life increased the risk of developing asthma by age 5 in over 4000 children in Southern California. Three pesticides are known to cause bronchial constriction in children; pyrethroid, carbamate, and organophosphate insecticide can trigger or exacerbate asthma in exposed children.[29-31]

Do the effects of pesticides on children have an impact on costs and our economy? For autism, the estimated cost of care over the lifetime of an autistic child is $3.2 million, according to a study by the Harvard School of Public Health.[32] ADHD costs in the United States are between $36 and $52 billion.[33,34] The cost of cancer per pediatric case is approximately $630 000 annually, or about $6.5 billion for the 10 400 new cases diagnosed each year.[35] Asthma cost the United States' economy almost $20 billion in 2007 according to the EPA.[36,37]

The answer lies in politics. Seventeen cities in the Northwest, including Seattle, have adopted plans to diminish the use of pesticides in parks and playgrounds. In New Jersey, legislators passed "The Child Safe Playing Field Act" whereby all municipal, county, and state playgrounds and playing fields, schools, and daycare centers will be pesticide-free. However, municipalities in 40 states have pre-emption laws, prohibiting them from passing local pesticide laws that are stricter than the ones at state level, where the pesticide industry is able to influence legislators. Canada has no such laws and now 65% of the population is protected from exposure to cosmetic pesticides.[37] It will take letters, calls, and e-mails to get our laws changed to protect our children and our future.

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Editor in Chief

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