Chlorine, Human Health, and the Environment: The Breast Cancer Warning

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An emerging body of evidence suggests that contamination of the environment with chlorine-based synthetic chemicals may be an important factor in the epidemic of breast cancer taking place across the world.

These chemicals-called organochlorines-are building up absolutely everywhere on the planet-in the air and water, in the food chain, in the tissues of wildlife, and in our own bodies. Universal organochlorine contamination has already been implicated in regional and global disease epidemics in people and wildlife, including impaired reproduction, development, immune function and behavior. The new evidence that now links these chemicals to breast cancer reinforces the fact that organochlorines pose a serious threat to human health and the environment and should be phased out.

Organochlorines are by no means the only risk factor for breast cancer, and their role in incidence of the disease has not yet been proven, beyond a doubt, according to strict scientific standards. But the evidence is strongly suggestive, and it is not practical, responsible, or ethical to wait for proof before taking action to protect women´s health. Enough is known now about the effects of organochlorines on human health to justify preventive action now.

The Breast Cancer Epidemic

In virtually every nation in the world, breast cancer incidence is rising, especially among older women. Since about 1930, the disease has been increasing steadily at a rate of 1 to 2 percent annually in industrialized countries. These increases are mirrored by rising rates of many other cancers. More recently the breast cancer epidemic has spread to developing nations, as well.

In the last decade, breast cancer incidence in many nations has shot up even more rapidly, increasing by 4 percent annually in the U.S., making breast cancer now the most common of all cancers among women. In many developing nations, incidence rates of the disease have begun to increase, as well. By the year 2000, breast cancer is expected to kill 1 million women each year.

Breast Cancer Risk Factors

Recognized risk factors for breast cancer-genetic inheritance, reproductive and hormonal factors, and diet-account for an estimated 20 to 30 percent of all breast cancer incidence. Other factors, including alcohol consumption and exposure to radiation from nuclear tests and mammograms, also appear to play a role, but the majority of breast cancer remains unexplained.

There is clearly a relationship between sex hormones-especially elevated levels of estrogen-and increased breast cancer risk. Further, the types of breast cancer rising most rapidly are those that respond to estrogen. Changes in reproductive behavior and other hormonal factors-number of children and age at first and last childbirth, use of contraceptives and estrogen replacement

therapy, for example-account for a portion of breast cancer risk but do not explain changes in hormonal status that would lead to the large-scale increases in breast cancer that are taking place. Exposure to industrial chemicals, including organochlorines-some of which mimic or interfere with the action of natural hormones-may explain some of the increase.

The role of dietary fat in breast cancer risk is controversial. Nations with high per capita fat intake also have high breast cancer rates, and increased fat consumption seems to be associated with modest increases in breast cancer risk. But fat consumption tends to rise with the degree of industrialization, pollution, and other confounding factors; correlations of national fat intake and breast cancer rates may indicate an underlying cause other than the fat itself. And none of the epidemiological studies that have investigated the role of fat consumption in breast cancer have considered the role of chemical contaminants that concentrate in the fat, including organochlorines.

Just as identified risk factors account for only a small portion of breast cancer incidence, the epidemic increases in incidence of the disease are not explained by changes in these factors. Changes in diet, reproductive habits, and contraceptive use may have contributed but do not explain the entire increase.

Researchers have begun to suspect that exposure to ˆzeno-estrogens˜-industrial, agricultural, and pharmaceutical chemicals that mimic estrogen in the body-may play an important role in the increasing incidence rates of cancer of the breast and certain other sites and reproductive and development impairment. Environmental factors that cause genetic mutations or suppress the immune system may also be important.

Organochlorines: Priority Poisons

The evidence indicates that carcinogenic and hormonally-active chemicals in the environment may play a significant role in breast cancer. Among the suspects are the organochlorines, a class of industrial chemicals made from chlorine and carbon-based organic matter. Although these chemicals were first produced around the turn of the century, production did not reach a large scale until the decades following World War II. Now, the chemical industry produces about 40 million tons of chlorine annually.

Organochlorines include such highly persistent and toxic substances as dioxin, DDT, PCBs, the ozone-destroying chlorofluorocarbons (CFCs), plus thousands of lesser known chemicals. Almost 80 percent of all chlorine is used in the chemical industry to produce PVC (vinyl) and other plastics, pesticides, industrial solvents and other chemicals; use of chlorine bleach in the pulp and paper industry is another important use, while much smaller amounts are used to disinfect wastewater and drinking water. Incinerators that burn chlorine-containing trash and hazardous wastes are an additional source of organochlorine discharges to the environment.

Many organochlorines persist in the environment for decades or even centuries. Many also accumulate in the tissues of living things, multiplying in concentration as they move up the food chain. Over the decades, they have built to higher and higher levels in the ecosystem, in the food chain, and in the bodies of wildlife and people. Industrial organochlorines can now be found in ecosystems absolutely everywhere on the planet-in the deep oceans, in Arctic polar bears, in Antarctica.

Organochlorines also now contaminate the bodies of all people: 177 organochlorines have been found in the tissues and fluids of people in North America, including a wide range of pesticides, solvents, chemical by-products,

and other compounds. Hundreds more organochlorines are known to be present but have not yet been individually identified.

Organochlorines tend to be very toxic, often in tiny doses. Effects include reproductive and developmental impairment, hormonal disruptions, genetic mutations, cancer, birth defects, immune suppression, neurological and behavioral toxicity, and damage to the liver, kidneys, skin.

A growing body of evidence indicates that organochlorine pollution is already severe enough to be a major hazard to the health of people and wildlife. Organochlorines have been linked to large-scale hormonal disruptions, population declines, infertility and other reproductive problems, birth defects, impaired development, neurological and behavioral alteration, immune suppression and some types of cancer among people and wildlife.

Organochlorines are not the only widespread, toxic, or carcinogenic pollutants in the environment. Nor are they the only ones that may contribute to breast cancer. Organochlorines are a priority for phase-out, however, for two reasons. First, they tend to dominate officials lists of priority pollutants, typically making up half or more of chemicals of concern, precisely because they tend to be so persistent, bioaccumulative, toxic, and widespread.

Second, organochlorines are preventable: alternatives are available now for all major uses of chlorine. This report focuses on organochlorines not because they are the only cause of breast cancer, but because they may be an important one and they are highly preventable.

Organochlorines and Breast Cancer

Several lines of evidence suggest that organochlorines contribute to breast cancer among the general population.

Experimental evidence. Hundreds of organochlorines have been shown to cause cancer in laboratory animals and/or humans. Of the thousands that have not yet been tested, at least some are likely to turn out to be carcinogenic, as well. At least 16 organochlorines or groups of organochlorines have been found specifically to cause mammary cancers in laboratory animals, despite the fact that only a few have been tested for this effect. Some are pesticides-such as DDT, aldrin, dieldrin, and chlordane-that have already been restricted but remain common environmental contaminants and are still used in other nations. But other organochlorines identified as mammary carcinogens are still in common use, including the following:

- Atrazine: one of the most widely-used herbicides in North America and Europe and an extremely common contaminant of groundwater and surface water;

- Vinyl chloride, ethylene dichloride, and vinyledene chloride: feedstocks for the common plastics polyvinyl chloride (PVC, or vinyl) and polyvinylidene chloride (Saran wrap);

- Methylene chloride: a common solvent and paint-stripper;

- Dichlorobenzidines, dichloropropane and trichloro-propane: intermediates used in the chemical industry to produce dyes and other chemicals.

Most organochlorines have not been tested for a link to breast cancer; it is likely that some of these, particularly those that are structurally or toxicologically similar to those already identified as mammary carcinogens, will turn out to cause the same effect.

Biological mechanisms. Recent research into the behavior of organochlorines in the body shows how these chemicals could contribute to breast cancer in people. Organochlorines have been shown to cause genetic mutations, suppress the immune system, and disrupt the body´s natural controls on cell growth and replication. Some organochlorines are known to be ˆhormonally active˜: they mimic or otherwise disrupt the natural action of the body´s natural sex hormones, including estrogen. Since estrogen is a known risk factor for breast cancer, chemicals that act like estrogen are also likely to increase risk of the disease. Exposures to these chemicals during adulthood may cause estrogen-like effects and promote breast cancer. And in utero exposure to hormonally active chemicals can cause lifelong changes in the endocrine system that may lead to breast cancer risk many years later.
Breast cancer in women with high exposures. Women exposed to higher-than-normal levels of synthetic chemicals-including organochlorines-have been found to have significantly elevated rates of breast cancer. These groups include women chemical industry workers exposed to dioxin, women living near hazardous waste sites, women chemists, and women workers exposed to chlorinated and non-chlorinated solvents.

Tissue studies. Important new research has linked organochlorines to breast cancer risk among women from the general population-those with no unusual chemical exposures. Several studies have found a relationship between the levels of certain organochlorines in a woman´s blood, fat, or breast tissues and her risk of breast cancer. Women with the highest concentrations of certain organochlorine pesticides in their bodies have been found to have breast cancer risks 4 to 10 times higher than women with lower levels. If future research confirms that the effect of these chemicals is indeed that strong, organochlorines would be among the most important breast cancer risk factors ever identified.

The case of Israel. In Israel, national policies to ban organochlorines appear to have helped reduce breast cancer rates. Until the mid-1970s, both breast cancer rates and contamination levels by several organochlorine pesticides were among the very highest in the world. Following an aggressive phase-out program of those chemicals, contamination levels dropped to the levels found in other countries, and breast cancer mortality quickly followed, dropping to a rate similar to that in other nations. This decline, which was distributed across age groups in a ˆdose-response˜ pattern, is especially notable, given the rapid increases in breast cancer that were taking place in other nations during the same period. Further, all other dietary and reproductive risk factors in Israel actually grew worse during the period in question.

Related effects in people and wildlife. Emerging evidence implicates global organochlorine contamination in an array of other health effects among humans and wildlife. Current contaminants levels are in the range at which hormonal disruptions and other effects are known to occur. Exposure to these compounds has been linked to infertility, reproductive failure, developmental impairment, immune suppression, and possible other cancers-notably testicular cancer-among marine mammals, other species of fish and wildlife, and humans. If environmental levels of organochlorines are high enough to cause these effects, it is plausible that they are also high enough to cause breast cancer.

Trends in breast cancer incidence rates are consistent with increasing contamination by organochlorines. Industrialized nations, with more severe pollution, also tend to have much higher breast cancer rates than less

industrialized countries.

Proof or Precaution: When Do We Act?

Do these studies PROVE that organochlorines are causing increased breast cancer rates? If proof is defined as evidence, beyond any doubt, of a cause-effect link between individual chemicals and the disease, in which all possible confounding influences have been eliminated, the answer is no.

But this standard of proof will never be fulfilled, because of the complex reality of global chemical contamination and the limited tools available to epidemiologists and toxicologists. It is unethical, irresponsible and unrealistic to require strict proof, because such an approach takes preventative action only after irreversible damage to health and the environment have taken place.

We need a new standard of proof. In the fields of health and environmental protection, the Precautionary Principle should be the basis for evaluating scientific information and formulating public policy.

The Precautionary Principle requires preventive action and places the burden of proof on those who would cause pollution rather than on those who would prevent it. Because we cannot predict the precise impacts that chemicals will have on the environment and on human health, the Precautionary Principle requires that we err on the side of caution. We should not wait for scientific proof of harm before we take action: the use and discharge of chemicals that MAY cause harm should be avoided. The precautionary framework allows us to take action to prevent disease before it is too late.

Many National governments, including that of the U.S., have agreed in international fora, such as the United Nations Environmental Programme (UNEP), that precautionary, preventive action must be taken when there is reason to believe that harm may occur, without waiting for scientific proof of cause-effect relationships. Many governments that have committed to this approach, however, have yet to put action behind their words.

There is no reason to dismiss scientific evidence linking pollution to human health impacts simply because it does not reach the level of formal scientific proof. Rather, we should take a holistic approach to the data on the characteristics of chemical classes, and studies on laboratory animals, wildlife, and humans. The precautionary framework considers the effects of chemical mixtures, accepts the limits of epidemiological and toxicological studies to untangle cause-effect linkages, admits information that may be indirect or suggestive, and applies evidence from one species or disease to another, when appropriate. The Precautionary approach evolved from the recognition that even the most sophisticated environmental impact assessment models cannot cope with the diversity, quantity and complexity of chemical compounds and of environmental and human biological processes.

Seen in such a framework, the studies presented in this report indicate that organochlorines are likely to contribute to breast cancer rates in the general population. This does not mean that organochlorines play their role in isolation; presumably, they have acted in combination with other changing risk factors to produce the increasing breast cancer rates now apparent across the world. Nor does it mean that every single organochlorine contributes to breast cancer; current evidence implicates many individual organochlorines, and it is likely that at least some of the thousands more that have not yet been investigated will also turn out to be involved as well. Many organochlorines that do not contribute to breast cancer can cause other health effects in people and wildlife.

Research should continue to further identify the relationship between breast cancer, organochlorines, and other risk factors. But enough is known now to justify action to protect women´s health: no further organochlorine pollution should be permitted.

Recommendations: Phasing-Out Chlorine and Organochlorine

There is more than enough evidence to conclude that the class of organochlorines may pose serious hazards to health and the environment: members of this class tend to be toxic, persistent, and/or bioaccumulative and to produce even more dangerous organochlorine by-products at some point during their life-cycles. The Precautionary Principle-and common sense-thus requires that the burden of proof be reversed and that organochlorines be phased out. A phase-out of the production, use and discharge of these chemicals into the environment should begin immediately.

It would take centuries to phase-out the thousands of organochlorines in commerce on a chemical-by-chemical basis. Further, organochlorines are never made in isolation but are always formed in complex mixtures of products and by-products, so there is no effective way to regulate them one-by-one. Phase-outs should focus not on individual chemicals but on the major industrial sectors and processes that use and produce these compounds. Chlorine-free alternatives are available now for all major uses of chlorine, including PVC and other chlorinated plastics, chlorinated bleaches, pesticides, solvents, disinfectants, and chemical intermediates.

Several international bodies have already concluded that organochlorines should be phased-out as a class, including the International Joint Commission on the Great Lakes-a bi-national advisory body to the U.S. and Canadian governments-and the Paris Commission on Land Based Sources of Pollution to the North Atlantic, a ministerial convention of fifteen European nations. The IJC recommended that the U.S. and Canadian governments begin a scheduled phase-out of industrial processes that use chlorine and organochlorines begun in the U.S. and Canada. The parties to the Paris Commission agreed that discharges of organohalogens should be reduced with the aim of their elimination and that measures should be adopted to prohibit the use of organohalogens and substitute alternative processes and substances where those compounds are now produced and used.

The emerging evidence on the relationship between organochlorine contamination and breast cancer provides compelling new support for these calls to phase-out chlorine and related chemicals. A public health policy that emphasizes disease prevention must lead to environmental policies that prohibit environmental discharges of disease-causing chemicals, particularly organochlorines.

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ACE
P.O. Box 3063
Stowe, PA 19464
ace@acereport.org