



## **Summary of *Environmental Pollutants and Breast Cancer: Epidemiologic Studies***

### **What human studies tell us about the connection between breast cancer and chemicals**

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### **Introduction**

Laboratory studies provide evidence that there may be a significant link between some environmental pollutants and breast cancer. Understanding these links is critical as it may help prevent the disease in many women.

Laboratory research shows that chemicals may contribute to breast cancer risk by damaging DNA, promoting tumor growth, or increasing susceptibility by altering how the mammary glands develop. Chemicals identified as causing breast cancer in animals or disrupting hormone systems are commonly found in people's bodies and in the environment, including in homes.

### **Methodology**

The authors searched PubMed, the US National Library of Medicine's database of medical literature, for peer-reviewed studies published through June 2006. Reviews of individual articles are accessible at [www.silentspring.org/sciencereview](http://www.silentspring.org/sciencereview) and at [www.komen.org/environment](http://www.komen.org/environment).

### **Results**

We identified 152 scientific articles on human studies of breast cancer and environmental pollutants. These studies focused on a small number of pollutants, and most chemicals identified as mammary carcinogens and/or hormone disruptors in laboratory studies have not been studied in human breast cancer research. Only seven studies looked at exposures in early life; 28 specifically analyzed risk among nonwhites. Despite the limited scope of previous studies on humans, research over the last five years has strengthened the evidence that environmental pollutants may play a role in women's breast cancer risk.

#### *PCBs – Current human exposure is primarily from fish*

Four recent studies show 2- to 4-times higher breast cancer risk in women with both higher than average exposures to polychlorinated biphenyls (PCBs) and an inherited

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gene variation that affects chemical metabolism in millions of Americans. The genetic variation associated with risk is present in 10-15% of the white population. These findings illustrate the potential of new human studies that take into account important interactions between genes and the environment.

PCBs were used in electrical equipment until their production was banned in the US in the 1970s. Because of contaminated rivers in industrial areas, fish are a primary source of exposure in general populations, although indoor sources can also be important since PCBs have been used in building materials such as paints and caulks. PCBs accumulate in fat, and high levels have been found in human breast milk.

Three recent studies of women with breast cancer have found that exposure to PCBs was linked to an increased chance that breast cancer was recurring, aggressive, or fatal. These findings suggest the possibility that exposures continue to be relevant today, even though PCBs were banned in 1978.

*PAHs – Human exposure from air pollution caused by cars, trucks, power plants, tobacco smoke, and diet*

Research in this area is rapidly evolving, but based on a relatively small number of studies done to date, the evidence generally supports a link between breast cancer and polycyclic aromatic hydrocarbons (PAHs). Inherited genes for poor DNA repair may interact with PAH exposure to increase risk. People are exposed to PAHs through air pollution from cars, trucks, and power plants; grilled and smoked foods; and tobacco smoke.

Some studies suggest that effects may be greater when exposure to PAHs occurs earlier in life. For example, breast cancer risk was more than three times higher in men who worked in exposed occupations such as jobs involving gasoline or vehicle exhaust before they were 40 years of age. In a Long Island breast cancer study, pre-menopausal women with DNA damage from PAHs had 58% higher breast cancer risk than those with no evidence of DNA damage from the chemical.

PAHs are products of combustion. PAH mixtures and some individual PAH chemicals are mammary carcinogens in laboratory animals. The recent State of California review of breast cancer and tobacco smoke supports an association between tobacco smoke, which contains PAHs and other chemicals of interest, and breast cancer in younger women. Given that exposure to PAHs is widespread and can be reduced, both further study and policies to reduce exposure should be public health priorities.

Studies of PAHs, air pollution, and breast cancer were conducted within Denmark, New York, Poland, and Texas, representing a limited geographic range for air pollution exposures that vary geographically.

*Dioxin – Human exposure is primarily from the fat in milk, fish and meat*

An important study of young women exposed to a chemical cloud released after a valve broke at a chemical factory in Seveso, Italy, in 1976, showed increased breast cancer risk associated with blood dioxin levels. Continued study of these women as they get older is important.

Primary sources of dioxin in the environment are waste incineration, pulp and paper manufacturing, and other industrial processes. Humans are most frequently exposed to

dioxin from consuming meat, fish, or milk, because dioxin accumulates in fat. Though not focused on breast cancer, a study estimated that nursing babies exceed the US and European standards for a safe level of dioxin in their first year of life.

*Organic Solvents – Human exposure is generally through the workplace (dry cleaners, beauty salons, machine shops) and in consumer products*

A few strong studies and numerous less detailed assessments of workers in exposed industries provide evidence of an association between breast cancer and organic solvents. Studies have found associations between breast cancer risk and working with solvents in machine shops, the food industry, dry cleaning, hairdressing, leather and fur processing, glass manufacturing, and aircraft maintenance, and in US Army enlisted women. Methodological limitations in these studies make it difficult to assess the overall balance of evidence, but worker exposures and exposures from air and water pollution and consumer products are priorities for further study.

## **Policy Implications**

A formal assessment of the fraction of breast cancers that may be due to environmental pollutants is premature because we lack estimates of parameters that contribute to this calculation. However, considering the examples of two exposures – PAHs and PCBs -- for which we now have meaningful evidence of an association with breast cancer, we do know that the patterns of exposure and the estimates of relative risk suggest substantial public health impact. In recent studies, the risks associated with PAHs and PCBs were comparable in magnitude to many risk factors that have received attention for breast cancer, including age at first full-term pregnancy, age at first period, age at menopause, body weight, hormone replacement therapy, and physical inactivity.

Because exposures to chemicals for which human studies provide meaningful evidence of links to breast cancer are both common and avoidable, reducing exposures should be a public health priority. In addition, because effects of chemicals have not been adequately studied in women, we must rely more on animal and cell studies as a basis for national chemicals policies that reduce exposure to chemicals that may cause breast cancer.