



Breast Cancer and Environmental Risk Factors

March 1998
FACT SHEET #15

Q & A's from the Cornell University Program on Breast Cancer
and Environmental Risk Factors in New York State

Pesticides and Breast Cancer Risk, An Evaluation of Lindane

What is lindane?

Lindane (gamma-hexachlorocyclohexane) is a synthetic chemical used to kill insects (insecticide). It kills insects on contact since it can be directly absorbed into the insects and their eggs. Lindane can also kill insects by acting as a stomach poison when eaten.

What is the history of lindane's use?

Lindane was first produced for commercial use in the United States (U.S.) in 1950. It was used in agriculture as a spray for foliage, to treat soil and seed grains, and in baits for rodent pests. Lindane can kill a broad range of insects including worms that eat leaves, insects that live in the soil, and human and animal parasites such as fleas, ticks and lice. It was also used in treatments for scabies and mange. Besides its agricultural uses, lindane was used in forestry for wood and timber protection, and as a household insecticide. Lindane has been used in small amounts (1%) in shampoos and lotions to control head lice and scabies for humans, and as an insecticide in dog dips and shampoos. Lindane was classified as a *Restricted Use Pesticide* by the U.S. Environmental Protection Agency (EPA) in 1985. Since then, insecticides containing lindane can be applied only by certified applicators, who are required to use protective equipment.

Why was lindane use restricted?

Use of lindane was restricted by the EPA due to concerns over its potential to cause cancer and birth defects in animals.

Is lindane still produced commercially?

Lindane is no longer produced in the U.S. However, it is still imported and formulated into products for use in the U.S. During the early 1990s, 61,189 pounds of lindane were used on cropland in the U.S., ranking it among the ten least-used insecticides in agriculture. Very small amounts of lindane are still used in treatments against head lice, which are only available when prescribed by a physician.

How do our federal agencies regulate lindane to protect the consumer?

The EPA placed several restrictions on the use of lindane in 1985. One of the restrictions was that lindane containing products be applied only by a certified applicator and with the use of protective equipment. Lindane's use in aquatic environments such as lakes and streams, and in vaporizers was canceled. New guidelines were required on the labels of all lindane containing products. The EPA made it a requirement that any spills or accidental discharges of one pound or more of lindane be reported.

The EPA sets the maximum level of lindane that is allowed in public drinking water supplies. This *maximum contaminant level* (MCL) for lindane has been set at no more than 0.2 micrograms of lindane in one liter of water (one microgram is one-millionth of a gram, one liter is approximately a quart). The EPA also sets *tolerances* which are the maximum levels of lindane allowed in different foods for humans, and for animal feed. The U.S. Food and Drug Administration (FDA) and the



U.S. Department of Agriculture (USDA) monitor the levels of lindane in domestic and imported foods. Foods that exceed the tolerances can be seized and destroyed by local or federal officials.

Who might have been exposed to lindane in the past?

People most likely to have been exposed to this chemical in the past are:

- Workers involved in the manufacture of lindane
- Pesticide applicators who treated buildings with lindane-containing products
- Farmers and agricultural workers who treated soil and seed with lindane, or worked with treated soil and seed
- Forestry and timber production workers who treated wood with lindane
- People who handled or laundered lindane-contaminated clothing
- Pet groomers, veterinary workers or pet owners who used lindane-containing products to treat animals for fleas, ticks or mange
- Home owners who treated their house or yard with lindane
- Children and adults who were treated for head lice or scabies with lindane-containing shampoos and lotions

How can we be exposed to lindane today?

Residues of lindane in U.S. diets have been decreasing steadily and are not considered to be a health concern. Children and adults can be exposed to lindane through the skin when a lotion or a shampoo containing lindane is applied to control head lice. Infants can be exposed to very small amounts of lindane through the breast milk of mothers who were exposed to lindane previously.

Does lindane cause cancer in experimental animals?

Mice that were fed lindane over a long period of time had a higher incidence of liver cancers than untreated mice. One study found a small increase in the incidence of thyroid cancer in female rats that were fed lindane.

Does lindane cause cancer in humans?

There are a few reports in which lindane exposures have been linked with cancer. But in all these reports, the people exposed to lindane were also exposed to many other chemicals. A study of male farmers in Iowa and Minnesota had reported an increase in the incidence of a type of cancer

called non-Hodgkin's lymphoma in farmers who had handled lindane and other pesticides. A later study of farmers from four Midwestern states looked at the relationship between exposure to different pesticides and the risk for this disease. This study reported that lindane did not play a major role in increasing the risk of non-Hodgkin's lymphoma in these Midwestern farmers.

One study reported that a higher number of families with cases of childhood brain cancer had acknowledged the use of pesticides, including products that had a small amount of lindane. This study did not indicate that lindane was the cause of brain cancer since many other pesticides were used and only a small number of families were interviewed. The study also relied on mothers to remember details about the pesticides that they had used several years ago. However, the results of this study suggest the need for further, larger-scale studies on cancer risk in children who were treated for head lice or scabies with lindane-containing products.

Does lindane cause breast cancer?

No studies were found that directly link lindane exposures with causing breast cancer in humans and animals. Only one study has been published that has evaluated breast cancer risk and body levels of lindane in women. The women with breast cancer had slightly, but not significantly higher levels of lindane in their breast tissue compared to women without the disease. This study had several limitations. It evaluated a very small number (14) of women and did not provide information on other breast cancer risk factors. Larger, more carefully designed studies are needed to further investigate whether higher body levels of lindane are associated with an increased risk of developing breast cancer. There is a study in progress that will evaluate the health effects in women who were exposed to lindane (described under "Is more research being done?").

No increase in incidence of breast cancer has been reported in animals that were fed lindane. However, many of the studies done so far have been criticized for not treating the animals with lindane for long enough periods of time to allow breast tumors to develop. Better designed studies need to be done on experimental animals to see if lindane can cause breast cancer.

How can lindane affect breast cancer risk?

The body makes a complex set of chemical messengers called *hormones*. Some hormones are released into the



blood and affect the growth and functioning of many different tissues. These kind of hormones are called *endocrine* hormones. Chemicals that disturb the way the body makes or uses these hormones are called *endocrine disruptors*. Lindane can act as an endocrine disruptor in experimental animals. However, current evidence suggests that the endocrine disruptions caused by lindane are not the kind that are suspected to increase breast cancer risk. Lifetime exposure to the female hormone estrogen has been linked to an increase in breast cancer risk. In laboratory tests, lindane does not act like estrogen. In fact, in experimental animals, there is some evidence that lindane can actually interfere with the effects of estrogen.

Specialized cells in the human body form its defense system called the immune system. The immune system plays an important role in the body's defense against cancer. One study has reported that lindane treatments over a long period of time can suppress (reduce the strength of) the immune system in mice. Whether these animals with suppressed immune systems develop more tumors has not been tested.

There is some evidence that lindane can act as a "tumor promoter." Lindane treatments increased the number of tumors that were detectable in the lung and liver of genetically altered mice. The significance of these results is not clear since studies have not adequately shown if lindane also causes "tumor promotion" in animals that were not genetically altered.

Is lindane present in breast milk?

Lindane levels have been declining steadily in the breast milk samples of women in countries where it is no longer widely used, including the U.S. Unlike other organochlorine insecticides like DDT and heptachlor epoxide, lindane does not stay in the breast fat and its levels have been found to decrease with age. Low levels of lindane were detected in human breast milk in women from North America and Europe. Higher levels of lindane can still be found in breast milk of women from countries in Asia where it is more widely used. The very small amounts of lindane that have been found in breast milk samples in the U.S. are not considered a health concern for infants that are breast-fed.

Conclusions

There is currently no evidence to show that lindane directly causes breast cancer in humans or animals. There is inadequate evidence to show that lindane exposures are associated with increased risk for breast cancer in humans. Studies of

experimental animals that were fed lindane over long periods of time have not shown an increase in breast tumors. While lindane is a hormone disruptor, there is no evidence that disruptions caused by lindane are the kind that increase breast cancer risk. Lindane does not act like estrogen.

Where is more research needed?

- Larger studies are needed on breast cancer rates among women who have been occupationally exposed to lindane in the past, including those who worked in manufacturing plants, as pet groomers, agricultural workers and pesticide applicators.
- Studies are needed to determine if those who were treated with lindane-products for head lice and scabies during childhood have higher rates of cancer later in life.
- Better studies are needed to determine if long-term treatments of experimental animals with lindane can increase the incidence of breast cancer.
- Further studies are needed to test if lindane can alter the immune system of experimental animals in a way that affects their ability to fight cancer.
- Lindane treatments in experimental animals caused a disruption of hormonal pathways. Further studies are needed to understand how lindane interferes with the action of estrogen.
- Lindane treatments were found to "promote" tumors in the lung and liver of genetically altered mice. Studies are needed to test if lindane acts as a breast "tumor promoter" in experimental animals treated with chemicals known to cause breast tumors.

Is more research being done?

The National Institutes of Health (NIH) have recently funded a study to examine if lindane has the ability to mimic estrogen. This study will also evaluate health effects in women who have been exposed to lindane, and in their children.

What should I do to minimize exposure to lindane?

- Instructions on prescriptions should be strictly followed when lindane containing products are prescribed against head lice.



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An extensive bibliography on *Lindane and Breast Cancer Risk* is available on the BCERF web site (<http://www.cfe.cornell.edu/bcerf/>).

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