



# Breast Cancer and Environmental Risk Factors

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

## Estrogen and Breast Cancer Risk: What Factors Might Affect a Woman's Exposure to Estrogen?

*Estrogen is a hormone that is necessary for the normal development and growth of the breasts and organs important for childbearing. It helps control a woman's menstrual cycles and is essential for reproduction. Estrogen also helps maintain the heart and healthy bones. However, a woman's risk for breast cancer is associated with lifetime exposure to estrogen. Understanding how estrogen works in the body, knowing about how chemicals in the environment can affect body estrogen levels, and how diet and lifestyle factors affect estrogen exposure over a lifetime, may help women make more informed decisions about their bodies and their environment.*

### What is estrogen?

The hormone estrogen works as a chemical messenger in the body. It is essential for normal sexual development and functioning of female organs important for childbearing like the ovaries and uterus. Estrogen also helps regulate a woman's menstrual cycles. It is necessary for the normal development of the breast. It also helps maintain the heart and healthy bones.

### Is estrogen exposure related to a woman's risk for breast cancer?

Estrogen may be implicated in breast cancer risk because of: 1) its role in stimulating breast cell division; 2) its work during the critical periods of breast growth and development; 3) its effect on other hormones that stimulate breast cell division, and 4) its support of the growth of estrogen-responsive tumors. The BCERF fact sheet #9, *Estrogen and Breast Cancer Risk: What is the Relationship?*, explores how estrogen works and how it might affect the development of breast cancer in greater detail.

Because women with a high lifetime exposure to estrogen may be at higher risk for breast cancer, it is important to understand how lifestyle and environmental factors may affect the levels of estrogen in her body.

### How can lifestyle factors affect levels of estrogen in the body?

**Diet:** The foods that women eat can affect levels of estrogen in their bodies. Diets that are very low in fat, and high in fiber may decrease the levels of estrogen in the body. Certain dietary factors may increase breast cancer risk directly by increasing levels of estrogen in the blood, and indirectly by affecting obesity. Obesity is thought to increase the risk of postmenopausal breast cancer.

**Dietary phytoestrogens:** Phytoestrogens are plant estrogens found in foods like soybeans, tofu, whole grains, fruits and vegetables, and certain spices and herbs. The word "phyto" is from the Greek word for plant. A diet rich in phytoestrogens has been proposed as a way to decrease breast cancer risk. Some, but not all studies show that women with a diet high in phytoestrogens, including vegans (who eat no animal foods) and women who eat diets high in soy products, have lower rates of breast cancer.

Why is this so? Most phytoestrogens are not stored in the body, but are quickly broken down. Phytoestrogens are weak estrogens, and may prevent stronger human estrogens from binding to the estrogen receptor. If the weaker estrogens bind to the receptor instead of the stronger ones, there may be less breast cell division. Women with diets rich in phytoestrogens



also excrete more estrogens into their urine, and have lower blood estrogen levels. Some studies have shown that women with a diet rich in phytoestrogens have longer, and hence fewer, menstrual cycles. All of these factors may contribute to reduced breast cancer risk.

**Body weight:** Recent studies have suggested that adult weight gain, especially just before and after menopause, increases breast cancer risk. After menopause a woman's ovaries stop producing estrogen and the primary source for estrogen is a woman's body fat. Therefore, a woman with a higher level of body fat during the postmenopausal years would be expected to have a higher level of body estrogens than a comparatively lean woman. One change women can make in their lives to reduce their risk of breast cancer is to try to limit weight gain while getting older by eating a healthful diet, and making exercise a part of their daily routine.

**Exercise:** Studies have shown that women who exercise regularly have a lower risk of breast cancer. Some evidence suggests that circulating levels of estrogen are lower in women who exercise regularly. Body fat is often reduced in women who exercise and body estrogen levels may also be reduced. Exercise may extend the length of a woman's menstrual cycles. Longer menstrual cycles correspond with fewer cycles over a lifetime, and fewer menstrual cycles can result in less lifetime exposure to estrogen. Therefore, it is especially important for young girls to establish a pattern of regular exercise, since girls may carry these patterns into their adult years.

**Alcohol:** Research has suggested that drinking alcohol may increase breast cancer risk, and the increased risk is tied to the amount of alcohol consumed. One proposed explanation for the relationship between alcohol and breast cancer is that alcohol consumption may increase the amount of circulating estrogen in the bodies of women who drink, though some studies do not support this finding. Since many studies show a relationship between alcohol consumption and increased breast cancer risk, it is important to consider this when deciding whether or not, and how much to drink.

**Birth control pills:** There is considerable debate over whether the use of birth control pills may affect breast cancer risk. This may depend on the level of estrogen present in the birth control pill, the length of use, and the time in a woman's life when the pills were used. For

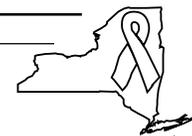
instance, the first birth control pills that were available to women in the 1960s had much higher levels of estrogen compared to those currently on the market.

A recent analysis of 54 studies of women who use(d) birth control pills found a small increased risk of breast cancer among those currently taking the pills, and this increased risk persisted in the 10 years after the use of the pills was stopped. However, there was no evidence for an increased risk of breast cancer more than 10 years after use of the pill was stopped. In addition, in another study, breast cancer diagnosed in women who had used birth control pills tended to be less advanced than in women who had never taken birth control pills.

**Postmenopausal hormone treatment (hormone 'replacement' therapy):** After menopause, a woman's ovaries no longer produce estrogen. This loss of estrogen has been associated with increases in the risk of heart and blood vessel disease, osteoporosis and a number of temporary discomforting symptoms associated with menopause. Hoping to counteract these effects treatment with estrogen has been used. This treatment was able to relieve the discomforting menopausal symptoms and decrease the risk of osteoporosis. However, it was found to increase the risk of uterine (endometrial) cancer and its effect on heart and blood vessel disease remains unresolved. Because of this increase in cancer risk, progesterone, which counteracts the cancer in the uterus, was added to the treatment in conjunction with estrogen. Postmenopausal hormone treatment with estrogen alone is currently only used in women who have had a hysterectomy and do not have a uterus. Recent clinical trials have examined postmenopausal treatment with estrogen and progesterone and found that it leads to an increase in the risk of breast cancer and is unlikely to prevent or benefit heart and blood vessel disease. Major health organizations have recommended discontinuation of its use for health promotion and most disease prevention purposes.

### **Is there a relationship between breast cancer risk, estrogen, and environmental chemicals?**

Since about half of breast cancer cases cannot be explained by known risk factors, some researchers suspect that chemicals in the environment may play a role in breast cancer risk. Though we still have many unanswered questions about whether environmental factors affect breast cancer risk, researchers have developed hypotheses about how



environmental chemicals may affect breast cancer risk. These include chemicals that either mimic the effect of estrogen or that affect the levels of estrogen in the body indirectly by disrupting the way estrogen is produced or used in the body.

### **What are environmental estrogens?**

Environmental estrogens are naturally occurring (e.g. phytoestrogens in plants) or synthetic chemicals that can act like human estrogen made by the ovary. Another term for an environmental estrogen is *xenoestrogen* (xeno is Greek for the word foreign). The greatest concern is over synthetic xenoestrogens that are not easily broken down, and that can accumulate and be stored in the body's fat cells, including breast fat. The strength of these xenoestrogens varies; some are ten times weaker than human estrogen, while others are a million times weaker. Xenoestrogens can mimic the effect of human estrogen because they have a chemical structure (like a "key") that allows them to fit into the estrogen receptor the way a key fits into a lock. Some xenoestrogens increase cell division and thus may contribute to breast cancer risk.

Many different chemicals have been identified as being weak environmental estrogens. These include several pesticides (including some forms of DDT), the food preservatives BHT and BHA, the industrial detergent by-products nonyl- and octaphenol, compounds used in plastics including bisphenol A and some phthalates, the food dye Red #3, and the solvent formaldehyde which was used in carpet manufacturing, and is still used in making plywood.

There are still many unanswered questions about xenoestrogens and breast cancer risk. Studies are needed to identify which environmental chemicals are xenoestrogens, and to determine the strength of the xenoestrogens, since very weak xenoestrogens may not stimulate breast cell division. Studies to determine the extent of exposure to xenoestrogens in the home, workplace, and environment are also needed. These are all important steps in assessing whether or not environmental chemicals can influence the risk of breast cancer.

### **Are there other chemicals that affect the levels of and types of estrogen in the body?**

Chemicals that are not environmental estrogens may still affect the levels of estrogen in the body. They may affect how quickly estrogen is broken down, or they may affect the levels of other hormones in the body that control the production and release of estrogen from the ovary.

In addition, researchers are concerned with whether synthetic chemicals can affect how the body makes different forms of

estrogen, and if these different forms of estrogen affect breast cancer risk in different ways. The strongest form of estrogen made by the body is called 17-beta estradiol. Estradiol can be changed into other forms of estrogen that are not as strong. For example, the form of estrogen called 2-hydroxyestrone (2-OHE) is a weak estrogen, while the form called 16-alpha-hydroxyestrone (16 $\alpha$ -OHE) is a stronger estrogen. Researchers are concerned that the 16 $\alpha$ -OHE form of estrogen can cause normal breast cells to form abnormal breast cells which may eventually become cancerous.

In some studies researchers have grown breast cancer cells in the laboratory, and have exposed them to different environmental contaminants to see if the cells make different amounts of the 16 $\alpha$ -OHE and the weaker 2-OHE forms of estrogen. Exposure to some chemicals, including the insecticide DDT and the herbicide atrazine, caused the cells to make comparatively more of the 16 $\alpha$ -OHE form of estrogen that may promote the formation of breast tumors.

Researchers are now examining the amounts of 16 $\alpha$ -OHE and the weaker 2-OHE forms of estrogen in the urine of women with and without breast cancer to see if there is any relationship to breast cancer risk. A recent study has shown that postmenopausal women with breast cancer have a significantly lower amount of the weaker 2-OHE estrogen versus the 16 $\alpha$ -OHE estrogen compared to postmenopausal women without breast cancer. Women with higher levels of the 16 $\alpha$ -OHE estrogen in their bodies were more at risk for developing breast cancer.

### **Conclusions**

Estrogen is essential for the normal functioning of a woman's reproductive system and for normal breast development. Lifetime exposure to estrogen is thought to increase a woman's risk for breast cancer. Understanding how estrogen works in the body, knowing that chemicals in the environment can mimic the effects of estrogen and/or disrupt normal estrogen metabolism in the body, understanding how hormone replacement therapy and birth control pills may be associated to estrogen exposure, and how diet and lifestyle choices affect lifetime exposure to estrogen, will help women make more informed decisions about their bodies and their environment.

For additional information on how estrogen works in a woman's body and whether there is a relationship between a woman's lifetime exposure to estrogen and risk of breast cancer, see BCERF fact sheet #9.



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An extensive bibliography on estrogen and breast cancer risk is available on the BCERF web page (<http://www.cfe.cornell.edu/bcerf/>).

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