Sprecher Institute for Comparative Cancer Research

Program on Breast Cancer & Environmental Risk Factors

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TOPICS

Understanding Breast Cancer Risk and Risk Factors Associated With Diet and Lifestyle

Breast cancer risk is the chance of getting breast cancer. Differences in risk provide the foundation for the epidemiological study of breast cancer. Many aspects of women's diets and lifestyle have been studied for their effect on increasing or decreasing the risk of breast cancer. The aspects that are linked to breast cancer risk are known as risk factors. Risk factors are significant for two reasons. First, their understanding can provide important clues to the causes of a disease. Second, they can define public health measures that can lead to decreases in the incidence of a disease.

This fact sheet examines the concept of risk, and how it is used in epidemiological studies to define risk factors. In addition, breast cancer risk factors are reviewed on the basis of the strength of the evidence supporting their association with breast cancer risk and the size of the associations.

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Cornell

What is risk and how is risk determined?

Risk can be defined as the chance that injury or harm will occur. Here, the injury or harm is breast cancer. Scientists estimate breast cancer risk by studying large groups of women. They assess how often breast cancer occurs in one group compared to another and then try to determine why the occurrence rates are different between the two groups. Two measures of risk are used to do this: absolute risk and relative risk.

Absolute breast cancer risk represents the chance of getting breast cancer for a large group of women. This is a statistical term and it defines the chance or probability of breast cancer for the whole group, not individuals within the group. Absolute risk represents a group average and not the breast cancer risk of any individual within the group. An individual woman's breast cancer risk cannot be determined. An example of absolute breast cancer risk is the statistic, that one in eight or 12.5% of women in the U.S. will ever get breast cancer.

The second measure of risk used in these studies is ***relative breast cancer risk***. Relative breast cancer risk is measured to assess potential factors or characteristics which may be linked to breast cancer. Relative risk is determined as a ratio or fraction; that of the absolute risk of a group of women who *have* the studied characteristic divided by the absolute risk of a second group of women who are ideally identical except that they *do not have* the studied characteristic. Thus, if the group with the studied characteristic has a greater absolute risk, it follows that the fraction defining relative risk will be greater than 1.0, indicating increased risk associated with the characteristic. If the group of women with the studied characteristic has a lower absolute risk of breast cancer, it follows that the relative risk will be less than 1.0, indicating association with decreased risk. If the absolute risk is the same for both groups, then the ratio will be 1.0 and no association with risk is indicated.

Risk of breast cancer is studied using representative groups of women. These groups can be chosen to represent as wide a group as all women in the United States or as narrow a group as women with exposure to a specific risk factor. Ideally, these studies choose comparison groups as similar as possible to the group of women to which they will be compared. For instance, a study of a group of women with the same ethnic/racial and age profile of women in the United States (U.S.) would be necessary for comparison to the general population of women in the U.S. Unfortunately, this ideal is often not possible. When reading studies of risk it is important to evaluate how similar the study subjects are to the general population of the women to which the resulting risk will be compared.

AN EXAMPLE OF RELATIVE RISK:

Drinking Alcohol

Studies have compared groups of women who drink to similar groups of women who do not drink. These studies have reported that drinking 2 to 5 drinks of alcohol daily is linked with a relative risk of breast cancer of 1.4 (the absolute risk of the drinkers is 1.4 times the absolute risk of the women who do not drink). 1.4 is greater than 1 and indicates an increase in risk; such a relative risk could also be described as a 40% increase in breast cancer risk was associated with having 2 to 5 drinks per day.

How is risk perceived?

Studies of the way people perceive risk have produced surprising findings. People are very good at determining what exposures or behaviors have higher or lower levels of risk. But when it comes to assigning a level of risk to a specific type of exposure or behavior people are not as good. Some exposures are evaluated more emotionally and associated with higher than actual risk levels. Exposures that are perceived as unrealistically large have several important characteristics. These are: not being within one's control, leading to a feared form of death; and having prevalent examples.

Breast cancer is a disease which has these characteristics. As such, it is a disease for which there is great dread.

What is the absolute risk of breast cancer in the U.S.?

Table 1 lists the risk of getting breast cancer for different age groups of U.S. women over three periods of time: ever in their lives, over the next 10 years and over the next 30 years. For example, looking at the 50 year old group of U.S. women, we see that women in this group have 123 chances out of a total of 1000 chances of ever getting breast cancer. The group also has a 28 out of 1000 chance of getting breast cancer in the next

10 years and a 98 out of 1000 chance of getting breast cancer in the next 30 years. Remembering that absolute risk represents the group average, the values in this table represent the average for all U.S. women.

The change in the risk of *ever* getting breast cancer for different age groups of women is not what would be initially expected. Since growing older is a well-known risk factor for breast cancer, one would expect the risk of ever getting breast cancer to be greatest for older women. But the opposite is true because the risk of ever getting breast cancer is averaged over the length of life remaining for these women. Young women have more years remaining in their lives and thus have higher risk of ever getting the disease.

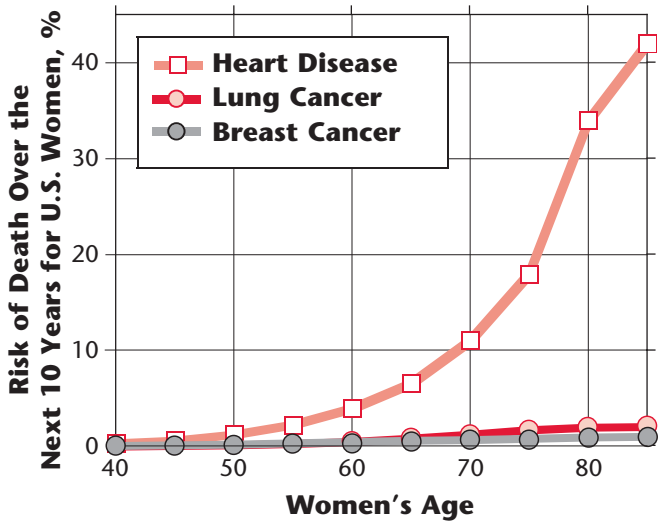
Some scientists have argued that viewing breast cancer risk over the remainder of life, especially for young women, misrepresents breast cancer risk for most women since it gives the largest possible estimates of risk. They suggest that a more reasonable approach is to view breast cancer risk over the next ten or more years of life. Such values are also presented in Table 1 as the average breast cancer risk over the next 10 and 30 years for women at different current ages.

How does the risk of dying from breast cancer compare to the risk of dying from other major diseases?

In the United States the leading causes of death among women in the year 2000 were as follows:

1. Heart disease . . . . . 255,000 deaths per year
2. Lung Cancer . . . . . 65,000 deaths per year
3. Breast Cancer . . . . . 42,000 deaths per year

Figure 1: Risk of death over the next 10 years for U.S. women. Of the three major causes of death, the risk for heart disease is greatest.



As women get older their risk of dying from any of these diseases goes up. But the increase in risk is most dramatic for heart disease. This is as shown in Figure 1. As this figure illustrates, the risk of death over the next 10 years from heart disease increases rapidly after age 50. It reaches a value of 11% (110 in 1000) at the 70 to 74 age period and climbs to 42% (420 in 1000) for women age 85 or older. The risk of death from breast or lung cancer remains much lower. Both breast and lung cancers reach values in the range of 1% (10 in 1000) from age 70 onward.

Table 1: Absolute breast cancer risk changes as women age

Women's Current Age	ABSOLUTE BREAST CANCER RISK FOR U.S. WOMEN: ***EVER*** in their lives	Over the ***NEXT 10 YEARS*** of their lives	Over the ***NEXT 30 YEARS*** of their lives
30 years	136 in 1000 *(13.6%)*	4 in 1000 *(0.4%)*	45 in 1000 *(4.5%)*
40 years	134 in 1000 *(13.4%)*	14 in 1000 *(1.45%)*	76 in 1000 *(7.6%)*
50 years	123 in 1000 *(12.3%)*	28 in 1000 *(2.8%)*	98 in 1000 *(9.8%)*
60 years	102 in 1000 *(10.2%)*	38 in 1000 *(3.8%)*	98 in 1000 *(9.8%)*
70 years	74 in 1000 *(7.4%)*	43 in 1000 *(4.3%)*	74 in 1000 *(7.4%)*

What are risk factors and how are they studied?

Risk factors are characteristics of people's lives that have been linked to increases or decreases in the relative risk of developing a specific disease. Risk factor studies have the goal of finding which aspects of sick and healthy people are different and possibly link these aspects to the causes of the disease. Types of risk factors that have been studied in relation to breast cancer include physical features (for example, weight, and height), reproductive history (for example, age at first birth and number of children), hereditary factors (for example family history and genetic syndromes), results of medical tests (for example, high breast density on mammograms), food intake (for example, amount of fruits and vegetables eaten), use of medications (for example, birth control pills and postmenopausal hormone treatment), and lifestyle choices (for example, smoking and alcohol use).

In most cases, risk factors do not cause the disease directly. Rather they typically act as indicators and are linked with a difference in the chance of the disease occurring in a group of women. For instance, many risk factors probably exert their effects by altering the levels and time of exposure of the breast to estrogen and other reproductive hormones which affect processes in the breast which are related to cancer formation.

What are the risk factors for breast cancer and how much do they affect breast cancer risk?

Tables 2 to 5 list risk factors which have been studied for a link to relative breast cancer risk.

The risk factor tables in this fact sheet are organized around two features of breast cancer risk factors: the strength of the evidence supporting them and the size of their associated risk.

Strength of the evidence. Strength of the evidence is based on how well the studies on a particular risk factor meet the following standards.

a) The studies on the topic are well-designed and well-executed.
b) Multiple studies have been done and have shown consistent results.
c) The studies show a "dose-response", which basically means that as the level of exposure to a risk factor goes up, the risk of disease goes up too.
d) There is a plausible biologic reason to explain how the risk factor affects the risk of disease.

Application of these quality standards results in three classes of breast cancer risk factors: convincing, possible, and under study.

- ***Convincing evidence of an association with breast cancer risk.*** These risk factors are well established, and the body of evidence supporting them would meet most of the above standards. Table 2 lists risk factors for which there is convincing evidence of an association with breast cancer risk.
- ***Possible association with breast cancer risk.*** The connection of these risk factors with breast cancer risk is less certain. The evidence supporting them meets only some of the above standards, and so additional research is needed. Table 3 lists risk factors for which there is a possible association with breast cancer risk.
- ***Under study for an association to breast cancer risk.*** Studies examining these risk factors do not meet any of the above standards. This may be due to a lack of evidence, a need for more study or the indecisiveness of existing studies in this area. It may also result from the lack of existence for a link to breast cancer risk. Table 4 lists risk factors which are under study for breast cancer risk.

It should also be mentioned that the low level of risk associated with most of the breast cancer risk factors makes it difficult for factors to become convincingly associated with breast cancer risk; this partially explains the presence of few factors in this category.

Size of the Associated Risk. Within the tables, the risk factors are categorized into three classes depending on the size of the associated risk (discussed in What is risk and how is it determined? above):

- ***VERY LARGE*** (for risk factors with a relative risk greater than 4.0)
- ***LARGE*** (for risk factors with a relative risk between 2.1 and 4.0)
- ***MODERATE*** (for risk factors with a relative risk between 1.1 and 2.0)

Most risk factors for breast cancer fall into the moderate category with a relative risk between 1.1 and 2.0. One can compare these values to those of other diseases

and their risk factors. The relative risk of lung cancer for heavy smokers compared to nonsmokers is 10 to 20. For coronary heart disease, the relative risk for high cholesterol compared to normal cholesterol is 2.0 to 2.5.

Two other aspects of risk factors are also important. First, the impact of a risk factor on the number of cases of the disease depends not only on the size of the risk that is associated with it but also how many people have the risk factor. For example, having a BRCA1 mutation is associated with a very large increase in breast cancer risk but these mutations are not very common and only 2 to 4 % of breast cancer cases result from them. Second, the strength of the evidence supporting a given risk factor does not have anything to do with the level of risk associated with it. For example, there is convincing evidence that beginning menstruating at a young age is a risk factor for breast cancer but the size of the risk associated with early menstruation is moderate.

Limitations of Relative Risk Studies. In most studies, relative risk is determined by comparing a group of women with a given risk factor to a group of women without the risk factor—and then determining which group of women was more likely to develop breast cancer. While this is a valid way to study breast cancer and estimate risk, it does have some limitations.

First, the results of the study will generally be applicable only to women who are similar to those who participated in the study. For example, most studies of breast cancer risk have been conducted among women and so may not be applicable to men, even though men do sometimes develop breast cancer.

Second, when studying a given risk factor, such as physical activity, researchers often compare women at the highest level of exposure (for example, those who exercise two hours a day) to women at the lowest level of exposure (for example, those who never leave the couch). While this approach can be revealing about how those specific levels of exposure affect breast cancer risk, it may not explain how intermediate level of exposure affect risk. This is an important limitation since the majority of women most likely fall somewhere between the two extremes of most exposures.

Finally, it is important to remember that risk is a concept of probability. Scientists can estimate how many women in a population group will develop breast cancer and can even identify the factors that might increase or decrease a woman's risk of the disease—but they cannot predict with any certainty which particular women will develop the disease. A woman who has many risk factors may never develop breast cancer, and a woman who has no risk factors may still develop it. Since no one knows where they'll fall, the best approach is to take steps to lower risk as much as possible.

What is the bottom line on using the risk factor tables for possibly lowering breast cancer risk?

Making life changes to lower breast cancer risk can have both personal and societal effects. If all women acted, where possible, to place put themselves on the low risk side of modifiable risk factors there would undoubtedly be a decrease in the number of breast cancer cases. Nonetheless, the effect on a personal basis is uncertain because which specific women benefit from these changes cannot be predicted. Yet choosing to make such changes is a reasonable approach as one may personally benefit and society will likely benefit. Because much of individual behavior is shaped by how other people act, lifestyle changes by individual women can cause changes in the social environment for food choices and physical activity.

Evaluation of the risk factors in the tables for such an approach should be focus on three characteristics of the risk factors: the strength of the evidence supporting them, the size of the associated risk and how accessible they are to change. Since the majority of the breast cancer risk factors are not under personal control, the ability to be modified becomes the limiting factor in many cases. In addition, a number of breast cancer risk factors are related to choice associated with childbearing (for example, having children and at what age) which is a major, individual choice which involves a number of aspect of a woman's life.

Several risk factors from the convincing evidence sections (Table 2 and Table 5) that are particularly suitable for change are regular alcohol consumption, use of postmenopausal hormone therapy, and maintaining a healthy weight. From the possible association and under study sections (Table 5), a reasonable approach might be to choose modifiable factors which have been associated with other health benefits. Such factors would be a diet high in whole grains, fiber, fruits and vegetables and getting frequent exercise.

Table 2: Factors With *CONVINCING EVIDENCE* Of An Association With Increased Breast Cancer Risk

Breast Cancer Risk Factor	Group at Increased Risk	Comparison Group at Low Risk	Comments
Factors For Which There Is *CONVINCING EVIDENCE* of an Association With A *VERY LARGE INCREASE* In Breast Cancer Risk (Relative Risk More Than 4.0)			
Older age	Women older than 50	Women younger than 50	Approximately 35% of women are currently older than 50 (in the increased risk group). More than 75% of breast cancers occur in women older than 50.
Female gender	Women	Men	Breast cancer is very rare in men. Six out of every thousand breast cancer cases are in men (0.6%).
Place of residence	Women living in North America or Northern Europe	Women living in Asia or Africa	Incidence rates for women living in North America and Western Europe are many times that of women living in Africa and Asia. Differences in incidence are thought to reflect differences in childbearing. See BCERF fact sheet #47 "Breast Cancer in Women From Different Racial/Ethnic Groups".
***CONVINCING EVIDENCE* of an Association With A *LARGE INCREASE* In Breast Cancer Risk (Relative Risk 2.1 to 4.0)**			
BRCA1 and BRCA2 gene mutations	Women with BRCA1 or BRCA2 mutations and a strong family history of breast cancer	Women without BRCA1 or BRCA2 mutations and breast cancer in their family history	The level of breast cancer risk for women with BRCA1 or BRCA2 mutations depends on how common mutation carriers are in women's families. See BCERF fact sheet #48 "Family History, Inheritance and Breast Cancer Risk".
High radiation exposure to the chest	Women with high radiation exposure to their chests	Women without radiation exposure	The highest radiation sensitivity is reported for girls and young women; possibly due to ongoing development of the breast. Breast cancer incidence is high in young atomic bomb survivors and women who received frequent X-rays when young (young women with scoliosis, tuberculosis, Hodgkin's disease and enlarged thymuses).
Atypical hyperplasia following breast biopsy	Women with breast biopsies with atypical hyperplasia	Women who had biopsies with no hyperplasia	Breast biopsies with atypical hyperplasia have a number of cancer-like characteristics and may later become cancerous.
Family history of breast cancer	Women with one or more close relatives with breast cancer	Women who did not have close relatives with breast cancer	Five to seven percent of all women with breast cancer have a family history of the disease. Size of risk depends on number of relatives with breast cancer and their age of diagnosis. See BCERF fact sheet #48 "Family History, Inheritance and Breast Cancer Risk".

Table 2 continued; CONVINCING

Breast Cancer Risk Factor	Group at Increased Risk	Comparison Group at Low Risk	Comments
CONVINCING EVIDENCE of an Association With A MODERATE INCREASE In Breast Cancer Risk (Relative Risk 1.1 - 2.0)			
Early menarche (younger age beginning regular menstrual periods)	Women who began menstruating regularly before age 12	Women who began menstruating regularly after age 14	Women who begin menstruating early may have higher lifetime estrogen levels and may be exposed to estrogen for longer periods of time. See BCERF fact sheet #9 "Estrogen and Breast Cancer Risk: What is the Relationship".
Late menopause (older age of menstruation ending)	Women who reached menopause at an age older than 55 years	Women who reached menopause at an age younger than 55 years	The ovaries stop producing estrogen and other reproductive hormones after menopause. Women who are older when they reach menopause may be exposed to estrogen for a longer period of time. The average age of menopause for U.S. women is 51. See BCERF fact sheet #40 "Hormone Treatments and the Risk of Breast Cancer".
Older age at time of first child's birth	Women older than 30 years when their first child was born	Women younger than 20 years when their first child was born	Pregnancy causes cell proliferation in the breast. Breast proliferation can increase breast cancer risk, especially for older women. 23% of all U.S. women have a child before age 20.
Not having children	Women without children	Women with one or more children	Pregnancy causes cell specialization in the breast. Cell specialization can decrease breast cancer risk.
Using post-menopausal hormone therapy	Women who used hormone treatment after menopause	Women who did not use hormone treatment after menopause	Postmenopausal hormone therapy increases breast cancer risk. Post-menopausal hormone therapy is also called Hormone "Replacement" therapy. See BCERF fact sheet #40 "Hormone Treatments and the Risk of Breast Cancer".
Using birth control pills	Women who used birth control pills	Women who did not use birth control pills	Use of birth control pills use is linked to a moderate increase in breast cancer risk in women who are currently or have recently used birth control pills. See BCERF fact sheet #40 "Hormone Treatments and the Risk of Breast Cancer".
Obesity after menopause	Women who were obese after menopause	Women who were not obese after menopause	Women who are obese after menopause have increased estrogen levels. Estrogen levels are linked to breast cancer risk. Recent studies, controlling for postmenopausal hormone therapy suggest even greater risk. See BCERF fact sheet #42 "A Woman's Body Type and the Risk of Breast Cancer".
Tall height	Women who are taller than 5 ft 9 inches	Women who are shorter than 5 ft 3 inches	Women who are taller may have more cells susceptible to becoming cancer. Size of risk increases with height. See BCERF fact sheet #42 "A Woman's Body Type and the Risk of Breast Cancer".
Regular alcohol consumption	Women who regularly consume alcoholic beverages	Women who do not consume alcoholic beverages	Regular use of alcohol leads to a moderate increase in breast cancer risk. The level of risk is linked to amount consumed daily. In women who consume more than one drink a day folic acid may decrease the extra risk linked to alcohol use. See BCERF fact sheet #13 "Alcohol and Breast Cancer Risk".

Table 3: Factors With A *POSSIBLE* Association With *INCREASED* In Breast Cancer Risk

Breast Cancer Risk Factor	Group Possibly at Increased Risk	Comparison Group at Possibly Low Risk	Comments
***POSSIBLE* Association With A *LARGE INCREASE* In Breast Cancer Risk (Relative Risk 2.1 to 4.0)**			
High density breasts on mammograms	Women with high density mammograms	Women with low density mammograms	Breasts which produce high density (dark) images on mammograms may have more cells susceptible to becoming cancer.
***POSSIBLE* Association With A *MODERATE INCREASE* in Breast Cancer Risk (Relative Risk 1.1 – 2.0)**			
High socioeconomic position	Women who have high socioeconomic position	Women who have low socioeconomic position	Proposed to be related to differences in reproductive behaviors (such as late age of or no childbirth). See BCERF fact sheet #47 "Breast Cancer in Women From Different Racial/Ethnic Groups".

Can risk factors interact to increase or decrease breast cancer risk to greater levels?

Since most women are in the higher risk category of at least one or two breast cancer risk factors, it is important to determine if certain risk factors interact to increase or decrease breast cancer risk. Most studies have not reported interactions between breast cancer risk factors. Yet, a number of individual studies have described specific risk factors acting together to produce an increase or decrease in risk that was larger than predicted for the factors acting alone. Few of these interactions have led to more than a moderate change in risk. More study will be needed to establish the interactions reported by these individual studies.

What proportion of the cases of breast cancer would theoretically be prevented if the established breast cancer risk factors were abolished?

Studies estimate that between 20 and 60 percent of all breast cancer cases could be prevented if major risk factors for this disease were removed from the population. The range of this estimate is wide and reflects the difficulty of this theoretical question. The very notion of eliminating risk factors for breast cancer is difficult to imagine and these values have been incorrectly interpreted to indicate the percentage of cases which are not explained by major risk factors. In addition, a number of the major risk factors, such as timing of childbirth, are very personal and depend on a woman's age and social circumstances and are thus far less than easy to change.

Are there factors that decrease breast cancer risk?

Factors that decrease relative breast cancer risk are listed in Table 6. This table is organized in a similar manner as the previous tables: by strength of evidence and size of the effect.

Are there other factors which are not associated with breast cancer risk or for which there is too little scientific information to evaluate their association with breast cancer risk?

Numerous factors have been found to have no association with breast cancer risk, meaning that they do not increase or decrease it. Examples of such include:

- Consumption of poultry and fish
- Use of vitamin supplements. An exception is folic acid, which may decrease breast cancer risk in women who drink alcohol regularly.
- Drinking beverages containing caffeine
- Use of antiperspirant deodorants

For some factors there is too little scientific data to evaluate their potential association with breast cancer risk. A prominent example is the consumption of dairy

products that were produced using bovine growth hormone. Bovine growth hormone itself has no effect on humans, but there is dispute over potential changes in the milk of cows treated with bovine growth hormone. Finally bovine growth hormone has only been used for this purpose since 1993, and this is too short a period of time for any effects to be detected by epidemiological studies (see BCERF fact sheet #37, "Consumer Concerns About Hormones in Food").

What is the relationship between the breast cancer risk factors and an individual woman's risk of getting breast cancer?

The relative risks associated with breast cancer risk factors are determined for large populations of women. They predict breast cancer risk for these *groups of women* well. Yet they are poor predictors of breast cancer risk for *individual women* within the group. Nonetheless, statistical models of breast cancer have been developed using relative risk values of several of the established risk factors for breast cancer. The goal of these models is to identify individual women who have a high risk of breast cancer and thus might benefit from some type of intervention.

One such model is the Gail model. This model is currently accepted by the U.S. Food and Drug Administration for use in determining if a woman's breast cancer risk is high enough to warrant intervention and preventive use of tamoxifen, an anti-estrogen drug used to treat breast cancer. A recent study

Table 4: Factors *UNDER STUDY* For An Association With An *INCREASE* In Breast Cancer Risk

Factor	Comments
High consumption of soy products	Results of studies are inconsistent. Concern raised from reports of high soy in the diet and estrogen-like effects on the breast. See BCERF fact sheet #1 "Phytoestrogens and Breast Cancer".
High consumption of dairy products	Results of studies are inconsistent. See BCERF fact sheet #33 "Dairy Foods and the Risk of Breast Cancer".
Heavy cigarette Smoking	Results are inconsistent depending whether comparison made to women who were never exposed to tobacco smoke or to women who did not smoke. See BCERF fact sheet #46 "Smoking and Breast Cancer Risk".
High exposure to tobacco smoke	Results are inconsistent depending whether comparison made to women who were never exposed to tobacco smoke or to women who did not smoke. See BCERF fact sheet #46 "Smoking and Breast Cancer Risk".
Working a late night shift	Several studies have demonstrated an increase in risk for women who regularly work a late night shift; effects may be related to decreased levels of the hormone, melatonin. More study is needed.
High exposure to electromagnetic fields	Studies have examined both occupational and home exposure. More occupational exposure studies are needed. Home exposure studies have been inconsistent.
Being a non-identical twin	Non-identical twin pregnancies have 2 placentas and mother's estrogen levels may be higher. Estrogen levels before birth may be linked to breast cancer risk for children. Also see pregnancies with preeclampsia in Table 6.
High red meat or cured meat consumption	Red meats are beef, pork and lamb. Cured meats include hot dogs, sausage, salami, bacon, lunchmeats and some types of ham. See BCERF fact sheet #39 "Meat, Poultry and Fish and the Risk of Breast Cancer".
High consumption of well-done meat	Cancer-causing chemicals can be formed to a larger extent when meat is cooked a long time. See BCERF fact sheet #39 "Meat, Poultry and Fish and the Risk of Breast Cancer".

Table 5: Factors With An Association With A *DECREASE* In Breast Cancer Risk

Breast Cancer Risk Factor	Group at Decreased Risk	Comparison Group at Increased Risk	Comments
CONVINCING EVIDENCE **Of An Association With A *MODERATE DECREASE* in Breast Cancer Risk (Relative Risk 0.5 – 0.8)**			
Young age at time of first child's birth	Women younger than 20 years when their first child was born	Women who did not have children	Pregnancy causes both cell proliferation and cell specialization in the breast. Cell specialization may decrease risk for remainder of life. Cell proliferation increases risk but the increase may be less for young women.
Having children	Women who had one or more children	Women who did not have children	Largest decrease in risk linked to first childbirth, subsequent childbirths decrease risk to lesser extent. Close spacing of childbirths may increase effect. Having children after age 35 may lead to a moderate increase in breast cancer risk.
Removal of both ovaries before menopause	Women whose ovaries were removed	Women with ovaries	Estrogen and other reproductive hormones are produced by the ovaries. These hormones are linked to increased breast cancer risk.
CONVINCING EVIDENCE **Of An Association With A *SMALL DECREASE* in Breast Cancer Risk (Relative Risk 0.8 – 0.99)**			
Breastfeeding	Women who breastfed a child	Women who had a child but never breastfed	Breastfeeding is linked with a small decrease (4% per year of breastfeeding) in breast cancer risk. Long term breast feeding may play a role in the lower incidence of breast cancer in 'developing' countries.
POSSIBLE ASSOCIATION **With A *MODERATE DECREASE* in Breast Cancer Risk (Relative Risk 0.5 – 0.8)**			
High consumption of whole grain products	Women who consume large amounts of whole grains	Women who consume small amounts of whole grains	High consumption of whole grains may decrease breast cancer risk. See BCERF fact sheet #36 "Whole Grains, Fiber and Breast Cancer Risk".
High folic acid in the diet of women who drink regularly	Women who drink alcoholic beverages regularly and have high folic acid levels in their diet	Women who drink alcoholic beverages regularly and have low folic acid levels in their diet	Folic acid may decrease breast cancer risk in women who drink regularly (1 or more drinks/day). Effect is uncertain in women who do not drink.
Frequent exercise	Women who exercise frequently	Women who get little exercise	Results of studies have been inconsistent. See BCERF fact sheet #19 "Exercise and Breast Cancer Risk".

evaluated this statistical model using the data from the Nurses Health Study group (a cohort study of 82,109 white women age 42 to 71). This study found that the model predicted breast cancer rates well for the *entire group of women* well but not for *individual women*. Most of the women who developed breast cancer in the study had a low risk, according to the Gail model. This result was not surprising. It has frequently been shown that most disease cases arise in people with presumably low risk.

If breast cancer risk factors are poor predictors of an individual woman's breast cancer risk, how can women use this information?

Women who modify their lifestyles to reduce their breast cancer risk are taking active steps toward a healthier life. But the size of the breast cancer risk factors makes them poor predictors of individual risk. Thus individuals who make personal changes in risk factors cannot be assured that their personal breast cancer risk will be affected. Nonetheless, such changes do make good sense from a societal point of view. Risk factors were derived from and are very good predictors of risk for groups of people; changes in risk factors within society will affect overall or absolute breast cancer risk. The way to achieve the greatest decrease in the total number of cases of breast cancer in the population is for all women to adopt such changes, encourage others to do likewise, and take community actions to encourage these healthful practices. Such actions can ultimately lead to the establishment of new and positive social standards for behavior such as have occurred with cigarette smoking in the U.S. Use of seatbelts in automobiles is another relevant example. The risk of a fatal accident in an automobile (like the risk of breast cancer) is low and use of seatbelts (like diet and lifestyle modifications) offers little protection to each individual that regularly 'buckles up' (or makes diet or lifestyle modifications). However, the adoption of seatbelt use by the majority of Americans is estimated to have decreased the number of traffic-related fatalities by one-fifth, saving 9,500 lives each year. It should also be noted that the diet and lifestyle modifications linked to decreased breast cancer risk have the added bonus that they are also linked to health benefits overall.

Effects such as these have been called the "Prevention Paradox". Illogically, preventive measures which give great benefit to the entire society provide little benefit to the individuals within society. Encouraging individual people to adopt preventive practices is one of the great challenges of public health as the potential rewards for society as a whole are great. For example, the recent study of postmenopausal hormone treatment by the Women's Health Initiative found a low individual risk associated with this treatment (an annual increase of 31 health related incidents for every 10,000 women using this treatment or 0.3% of users). Yet, this small increase in individual risk has major consequences for society. It is estimated that at least five million women in this country are using combination hormone therapy. From this number it would be predicted that each year more than 15,500 women would suffer serious adverse health effects related to this treatment. Unfortunately it is impossible to predict which women would be affected. Such a risk has been sufficient for the recommendation that postmenopausal treatment be used with reserve and in most cases for only a limited period of time (see *Balancing Risk and Benefit in an Environment of Emerging*

Table 6: Factors *UNDER STUDY* For An Association With A *DECREASE* In Breast Cancer Risk

Factor	Comments
High consumption of fruits and vegetables	High consumption of fruit and vegetables may decrease breast cancer risk. See BCERF fact sheet #18 "Fruits and Vegetables and the Risk of Breast Cancer".
Large amounts of fiber in the diet	Fiber in the diet may lead to decreases in estrogen levels. See BCERF fact sheet #36 "Whole Grains, Fiber and Breast Cancer Risk".
Mother had preeclampsia during woman's pregnancy	Preeclampsia is a serious disturbance in late pregnancy. Pregnancies with preeclampsia may have lower estrogen levels. Exposure to estrogen before birth may be linked to breast cancer risk.

and Shifting Understandings, *The Ribbon*, BCERF Newsletter, Volume 8, Number 2).

Most breast cancer risk factors cannot be modified. What can women do?

A reasonable approach is to act on the risk factors that are modifiable. Below are some steps women can take that will help lower the risk of breast cancer and improve their overall health.

- Maintain a healthy weight and prevent weight gain in adulthood.
- Be physically active.
- Eat a diet rich in whole grains, fruits and vegetables.
- Drink no more than one alcoholic drink per day.
- Avoid postmenopausal hormones.

In addition to these steps, it is also important for women over 50 to be screened regularly for breast cancer. If the disease does develop, screening tests can help find it early, when it is most treatable. ■

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A complete bibliography of references used in the preparation of this fact sheet is available on the BCERF web site at http://envirocancer.cornell.edu

We hope you find this fact sheet to be informative. We welcome your comments. (BCERF, Sprecher Institute for Comparative Cancer Research, Vet Box 31, Cornell University, Ithaca, NY 14853-6401; phone (607) 254-2893, FAX: (607) 254-4730, Email: breastcancer@cornell.edu).