



Cornell University Program on Breast Cancer and Environmental Risk Factors in New York State (BCERF)

Smoking and Breast Cancer Risk

Tobacco smoke is highly addictive and has been linked to 20 percent of all deaths in the United States. It contains many cancer-causing chemicals, and almost one third of all cancer deaths are related to tobacco use. Tobacco smoking has generally been considered to have little or no association with breast cancer risk. Newer studies have challenged this conclusion and suggested a connection between smoking and an increased risk of breast cancer, but more investigation is needed to resolve this issue. Passive smoking has been linked with an increased risk of lung cancer and heart disease. Studies have also indicated a possible linkage between passive smoking and breast cancer risk, but settling this concern will require more study. Understanding the potential association of active and passive smoking with breast cancer risk is important, because women have some control over their exposure to tobacco smoke, unlike many other breast cancer risk factors.

Is smoking related to breast cancer risk?

The relationship between cigarette smoking and breast cancer risk is uncertain. Many studies have examined this relationship, and cigarette smoking has been considered to have little or no association with breast cancer risk. But recent studies of women who did not smoke but who lived or worked in environments where other people smoked (they were exposed to passive or second-hand smoke) have questioned the design and results of these earlier studies. Four studies have compared women who smoked to women who had no exposure to tobacco smoke (they had neither smoked nor had ever been passively exposed to tobacco smoke). In contrast, earlier studies had compared smokers to women who had never smoked or did not currently smoke but whose passive smoke exposure was unknown. All four of the newer studies reported increased breast cancer risk among the women who smoked cigarettes. They were all small case-control studies, and only one reported an increase in risk among women who smoked longer. Nonetheless, three of the studies reported that smokers had a statistically significant increased breast cancer risk of two to four times that of women who neither smoked nor were ever passively exposed to tobacco smoke. This is an area of research with considerable disagreement. Recent review of this area of research by the International Agency for Research on Cancer (IARC) dismissed a linkage between smoking and breast cancer risk. A large number of women smoke or have smoked and resolution of this issue is important.

Is passive smoking related to breast cancer risk?

Although passive exposure to tobacco smoke has been linked to a number of health problems, it is unresolved whether it alters breast cancer risk. Most, but not all, studies that compared women who were passively exposed to tobacco smoke to women with no exposure to tobacco smoke reported an association of passive smoking with an increased risk of breast cancer. Only two of these studies showed a “dose-relationship”, where an increase in breast cancer risk was related to more tobacco smoke exposure. Other studies, which compared the risk of breast cancer of women exposed to passive smoke to women with less clearly defined passive smoke exposure (nonsmokers or those who have never smoked), have reported conflicting associations with breast cancer risk; some studies reported increases in risk, some reported decreases in risk and some reported no association with risk. All of these studies were also recently reviewed by the IARC. They found that it was unlikely that passive smoking increased breast cancer risk.

Several studies have found similar increases in breast cancer risk for both active and passive smoke exposures. These results have been criticized by some researchers. These researchers argue that this is an unlikely result as smokers have much greater exposure since they are exposed to smoke both actively and passively, but further investigation will be required to resolve this issue. Possible reasons for the differences in the results of these studies are discussed below (see: “Why are



there differences in the results of the human epidemiological studies examining breast cancer risk and passive exposure to tobacco smoke?”).

Is the smoke inhaled during active smoking different from the smoke inhaled during passive smoking?

The tobacco smoke a smoker inhales is different from the smoke inhaled by those nearby. The major source of passive smoke is from the burning of the cigarette rather than what is exhaled by smokers. Both types of smoke contain thousands of chemicals. The chemicals present in both these types of smoke are similar, but the concentrations of the chemicals are different. Many of the toxic chemicals in tobacco smoke are found in higher concentrations in the tobacco smoke as it leaves the cigarette compared to inhaled smoke; in some cases, the concentrations are far higher. This smoke is largely produced from the lower temperature burning of cigarettes between inhalations and the chemicals are less degraded than in the smokers’ inhalations. However many factors, such room size and air flow, can affect the dilution of the smoke and the resulting exposure can differ greatly.

How common is passive exposure to environmental tobacco smoke?

Passive exposure to tobacco smoke is very common. The most recent studies of the number of nonsmokers in the United States who are exposed to tobacco smoke were conducted in 1991. These studies used a break-down product of nicotine, cotinine, in the blood of nonsmokers as a marker for tobacco smoke exposure. They reported that 90% of nonsmokers over 4 years old had measurable levels of cotinine. Due to changes in smoking policies since 1991, the prevalence of environmental tobacco smoke exposure may have decreased. Measurements made in 1999 of the typical levels of this marker in nonsmokers’ blood were substantially lower than levels reported in 1991. Because the typical levels of cotinine have decreased it is also likely that a smaller percentage of people have detectable levels.

Why are there differences in the results of the human epidemiological studies examining breast cancer risk and passive exposure to tobacco smoke?

The inconsistencies in the results of these studies arise from differences in their methodologies, the way they were

carried out. The first difference is in the choice of women who served as the reference group, the women whose breast cancer risk was used as the level for risk comparison. Ideally, the women in the reference group and the women under study would differ only in their active or passive exposure to tobacco smoke. This ideal is seldom reached, and some of the differences in the results come from the extent to which these groups of women differ from this ideal.

Recent studies have used as a reference group women who had no exposure to tobacco smoke - that is, they have never actively or passively smoked. These studies in most cases have reported increases in breast cancer risk for women who smoked or were passively exposed to tobacco smoke compared to reference women who were never exposed. Critics of this approach cite studies that indicate the reference women who have never been exposed to tobacco smoke are healthier, in general. They argue that the difference in risk is due to the better health of these women used as references for risk. Older studies used as a reference group women who had never actively smoked or who were not current smokers but whose exposure to environmental smoke was unknown. These studies have largely reported no link between any exposure to tobacco smoke and breast cancer risk. Critics of this approach cite the potential for passive smoking and previous smoking to increase risk in control women and mask effects on the women under study.

A second potential source of the discrepancies may come from how the exposure or lack of exposure to environmental tobacco smoke is determined. Studies have shown that people can recall recent exposure very well but that remembering the duration and degree of distant exposure (such as whether their grandparents or baby-sitter smoked) is difficult. Yet one study examined this issue and found that women tended to underestimate their exposure, an effect which would decrease the observed risk. Thus, the information used in these studies may be inaccurate which could influence the reported breast cancer risk association. More work is needed to resolve these issues.

How might smoking increase the risk of cancer in the breast, an organ that is not exposed to smoke?

It is biologically possible for active cigarette smoking or passive exposure to tobacco smoke to affect a woman’s



breast cancer risk. There is direct documentation that breasts are exposed to chemicals within tobacco smoke in active smokers. Study of the fluid in the ducts of the breast of smoking women has shown the presence of tobacco chemicals at higher concentrations than were found in blood. Women passively exposed to tobacco smoke have tobacco chemicals in their blood too, but examinations of their breast fluid have not been carried out.

Both active and passive tobacco smoke exposure have been linked to non-respiratory cancers. Active cigarette smoking has been associated with cancer of the bladder, cervix, stomach, pancreas, and kidney. The effects of passive exposure to tobacco smoke have been studied much less, but associations with cervical cancer in adult women, as well as leukemia and brain cancer in children, have been reported.

Does smoking at a young age or being passively exposed to tobacco smoke at a young age affect a woman's breast cancer risk?

Exposure to tobacco smoke at a young age either by smoking or by being around people who smoke may be related to an increased breast cancer risk. Sixteen studies have examined smoking at a young age. These studies compared women who smoked at a young age to women who had never smoked or who were not currently smokers. Most studies reported a small increase in breast cancer risk associated with starting smoking under age 17. Two studies used women who were never passively exposed to tobacco smoke as the comparison group and found about a doubling of breast cancer risk among young smokers; one of the studies reported this effect only for premenopausal breast cancer.

The association of exposure to passive smoke at a young age with breast cancer risk has been examined in five studies. These studies typically looked at exposure up to age 19. Four of these studies used women with no exposure to tobacco smoke as controls and reported approximately a doubling of breast cancer risk among women who were exposed to passive smoke. The remaining study used women who never smoked as the comparison and found no association between tobacco smoke exposure and breast cancer risk.

The breast undergoes a major period of development during adolescence, and studies in animals have demonstrated that this is a period of great susceptibility to cancer-causing agents. More study is needed in this area.

Does the number of years a woman has been smoking or the amount she smokes affect her breast cancer risk?

Increases in breast cancer risk, relative to how long a woman has smoked or the number of cigarettes she smoked a day, have been found in several studies. However, the relationship between breast cancer and the level of smoking exposure is not as clear as it is for lung cancer. For example, people who smoke the least (or for the shortest time) have the lowest risk of lung cancer, while people who smoke the most (or for the longest time) have the highest risk. People who smoke amounts between these two extremes, have risks that fall between the two extremes. This is called a "dose-relationship" between lung cancer risk and smoking; the risk of lung cancer increases with the dose or amount a person smokes. Most breast cancer studies have not seen a dose relationship between smoking and breast cancer risk. A possible explanation would be that there is a exposure level that must be exceeded for risk to increase; such a level is called a threshold. A threshold effect is possible but has not been described for other smoking-related diseases.

Why did some earlier studies report an association of active smoking and decreased breast cancer risk?

Most of the epidemiological studies which compared breast cancer risk of active smokers to women who were not smokers (regardless of their passive smoke exposure) have found no association of smoking and breast cancer risk. But several studies found that women who smoked had a decreased breast cancer risk. It is not uncommon for epidemiological studies to come to different assessments of health risk, especially when, as in these studies, the associated risk is not large. Epidemiological studies differ in many ways, such as the groups of women being studied, how information is obtained and what other exposures and risk factors are taken into consideration. These differences can affect the study's outcome. For this reason, many epidemiological studies must be conducted and evaluated before there is an agreement on the relationship between a potential risk factor and a disease.

The clarity of these studies' results is also affected by the very complicated relationship between tobacco smoke exposure and breast cancer risk - which could support associations with either increased or decreased risk.



Smoking has effects that can both increase and decrease breast cancer risk. On one hand, tobacco smoke contains chemicals that can cause breast cancer in animals and could thus be associated with an increase in breast cancer risk. On the other hand, smoking has been shown to have many effects which suggest an opposition of the effects of estrogen and could decrease breast cancer risk. The interplay between the effects of the cancer-causing chemicals and the apparent opposition of estrogen is critical to breast cancer risk. The nature of this interplay is poorly understood.

Does quitting smoking affect breast cancer risk?

Quitting smoking may lead to a temporary increase in breast cancer risk. Most of the studies that have examined the breast cancer risk of women who have quit smoking have reported an increase in breast cancer risk. In many of these studies, breast cancer risk was highest shortly after the women stopped smoking and gradually decreased over 5 years to 20 years depending on the study.

It is possible that the interplay between the effects of toxic tobacco chemicals and the effects that may oppose estrogen matter here. Opposition of estrogen's effects is lost in women who quit smoking and this may allow the expression of the accumulated toxic effects of cigarette smoke.

The increase in breast cancer risk associated with quitting smoking should be considered in the context of overall health. After quitting smoking, a woman's risk of breast cancer temporarily increases between 25 and 450 percent (depending on the study examined). This is in sharp contrast to the high risks for other health problems associated with continued smoking. For example, there is a well established 1,000 to 2,000 percent increase in lung cancer risk associated with smoking. Without question, the effects of quitting smoking on overall health are beneficial.

Does smoking marijuana affect breast cancer risk?

The relationship between smoking marijuana and breast cancer risk has not been studied. Marijuana smoke has

been shown to contain many of the toxic substances found in tobacco smoke. Unfortunately, there has not been enough study to evaluate a possible link of marijuana smoking with breast or even lung cancer.

Are some women more susceptible to tobacco smoke?

Studies have shown that people differ in how their bodies process different chemicals, including the toxic chemicals in tobacco. Examinations of the connection between breast cancer risk and differences in the processing of these toxic tobacco chemicals have produced conflicting results. This is an active area of research that may allow the identification of women who are more susceptible to the cancer-causing chemicals in tobacco smoke.

Does smoking affect the survival of women with breast cancer?

The effect of smoking on the survival of women with breast cancer is unclear. Some studies have reported an association between smoking and an increase in the risk of death, while others found no association with the risk of death from breast cancer. Smokers may be at increased risk for metastasis (the spread of cancer). Two studies have reported an increase in the spread of tumors from the breast to the lungs in women who smoked. The survival of women with breast cancer who stopped smoking has been examined in one study. Their survival was found to be similar to that of women with breast cancer who never smoked.

What can women do now?

Quitting smoking and avoiding passive exposure to tobacco smoke makes good sense. Although it is unclear if smoking and passive exposure to tobacco smoke are associated with breast cancer risk, women can control their exposure to these potential risk factors. There are also many other health benefits to be gained by decreasing or eliminating either of these exposures.

Quitting smoking is difficult, but a number of drug and behavioral programs have been shown to increase the likelihood of success. Quitting smoking will not only make one ultimately feel better, but will decrease the risk of many diseases including heart disease, stroke, many respiratory diseases, and cancer of the lung, mouth, larynx, kidney, pancreas, stomach, and some types of leukemia.




The effects of passive exposure to tobacco smoke are just beginning to be understood. Until more is known, decreasing exposure is desirable. Minimizing tobacco smoke exposure is particularly important for children, who appear to be more sensitive to its toxic effects.

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**An Extensive bibliography on “Smoking and Breast Cancer Risk” is available on the BCERF web site:
<http://www.cfe.cornell.edu/bcerf/>**

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