Breast Cancer and the Environment

Breast Cancer Statistics
Breast cancer is the most common cancer and cause of cancer-related death among women worldwide.¹ The American Cancer Society estimated 246,660 new cases of breast cancer in women in the United States in 2016, or about 29% of all new cancer cases in women, with about 14% of breast cancer cases resulting in death.² In Alaska alone, the estimates were 500 new female breast cancer cases in 2016, about 15% of estimated new cancer cases in the state.³ It is estimated that 1 in 8 women in the United States will be diagnosed with invasive breast cancer during their lifetime.⁴

Though breast cancer risk has known associations with genetics, family history, age, breast density, late or no childbirth, early puberty, late menopause, and radiation exposure, a growing body of scientific evidence shows that environmental exposures are also risk factors.⁵ Communities in northern regions are especially vulnerable to environmental toxic exposures, due to atmospheric currents that carry global contaminants to polar regions.⁶ Breast cancer is one of the most common cancers in the Circumpolar North. Athabaskans and circumpolar Inuit especially have a significantly increased risk of breast cancer compared to the world average.⁷ In Alaska, a study showed Alaska Native women aged 40 to 49 years were nearly twice as likely as white women of the same age range to die of breast cancer.⁸

This health bulletin provides a brief overview of environmental concerns related to breast cancer risk, recommends ways to minimize environmental exposures, points to sources of more information, and suggests additional ways to get involved in combating the breast cancer epidemic.

Environmental Links to Breast Cancer
Numerous environmental factors are now understood to be linked to breast cancer. Of the known chemicals present in our environment, 216 have been shown to increase the
presence of mammary gland tumors in animal studies, an indicator of carcinogenicity in humans.\textsuperscript{9} People come into contact with toxics via 1) air pollution, 2) contaminated food, 3) occupational exposures, 4) consumer products and pharmaceuticals, 5) legacy contaminants, 6) flame retardants, 7) diet and nutrition, and 8) other sources such as drinking water and heavy metals.

1) Air Pollution. Air pollution from vehicular exhaust, other forms of combustion, aerial pesticide spray, and other sources contains a multitude of chemicals that impact our health in various ways. There are more than 100 different forms of polycyclic aromatic hydrocarbons (PAHs) in the atmosphere, many of which are formed by the combustion of organic matter or carbon fuels.\textsuperscript{10} When exposed to high levels of PAHs during early life, women are more likely to develop postmenopausal breast cancer.\textsuperscript{11} 1,3-Butadiene and benzene, toxic components of vehicle exhaust and gasoline fumes are classified as possible and known human carcinogens, respectively, and are also released with the heating of cooking oils such as canola.\textsuperscript{12,13} Exposure to pesticides applied by aerial spraying is another form of air pollution for residents living near such applications, as shown in a study in Massachusetts that found a modest positive correlation between proximity to aerial pesticide application and an increased risk of breast cancer.\textsuperscript{14}

2) Food. The foods we eat may also contain chemicals of concern. Many food products contain pesticides, additives, bioaccumulated toxics, and other contaminants that may increase the risk of breast cancer and other health problems.

Atrazine, one of the most widely used herbicides, has been linked to increased incidence of breast cancer in residents living around Atrazine-treated agricultural area.\textsuperscript{15} Fourteen different organochlorine pesticides other than dichloro-diphenyl-trichloroethane (DDT) and dichlorodiphenyldichloroethylene (DDE) have been linked to increased breast cancer risk.\textsuperscript{16} Pesticides and other environmental toxics also bioaccumulate in the fats of animals, creating an exposure risk for people consuming certain meats and eggs.\textsuperscript{17}

Methylmercury also bioaccumulates in the muscle tissue of certain fish and marine mammals\textsuperscript{18} and is linked to growth of breast cancer cells.\textsuperscript{19} Methylmercury readily crosses the placenta and is excreted in breast milk. Pregnant women and nursing mothers may pass on their body burdens of mercury to their developing fetuses and breastfed children.\textsuperscript{20,21,22} Mercury contamination in Alaska fish compelled the State of Alaska to issue fish consumption advisories for the first time in 2007, restricting consumption of certain fish for women who are or can become pregnant, nursing mothers, and children age 12 and under.\textsuperscript{23} Arctic Indigenous Peoples who rely on traditional subsistence foods harvested from the land and sea are particularly vulnerable to exposure to mercury and other persistent organic pollutants (POPs), and
show levels of POPs concentrations in blood and breast milk that are among the highest of any population on Earth.\textsuperscript{24}

Certain foods cooked to a high heat may release toxic gases and may also form toxic ingredients that are then directly consumed with the food. Acrylamide, shown to cause both benign and malignant mammary tumors in rats and possible association with increased premenopausal breast cancer risk in humans, is formed when starch-rich foods such as French fries are heated to high temperatures.\textsuperscript{25,26} Food preservation additives such as BHA and BHT are known to cause tumors at high doses.\textsuperscript{27} Food may also be contaminated by packaging and containers with toxics that increase breast cancer risk, such as styrene from Styrofoam,\textsuperscript{28} bisphenol A (BPA) from can linings and certain hard plastic bottles,\textsuperscript{29} and vinylidene from plastic wrap.\textsuperscript{30} Foods packaged in plastic also have notable levels of BPA and phthalates, which may be avoided by choosing to eat fresh foods.\textsuperscript{31} Food cooked using non-stick cookware or stored in grease-resistant packaging may be contaminated by perfluorooctanoic acid (PFOA),\textsuperscript{32} which has been linked to endocrine disruption and breast maturation in young girls and altered mammary gland structure and function in laboratory animals.\textsuperscript{33}

3) Occupational Exposures. Women may also have a higher risk of breast cancer from working in settings with high occupational exposure to organic solvents and other carcinogens and endocrine disruptors. In one study, premenopausal breast cancer risk was highest among women working in the automotive plastics and food canning sectors, with noteworthy risk also in the agricultural, bars, gambling, and metalworking sectors.\textsuperscript{34} Women working in food canning are exposed to BHA, a confirmed carcinogen.\textsuperscript{35} Working in the nursing field increases exposure to nonylphenol, an environmental estrogen.\textsuperscript{36} Electronic workers are exposed to BPA, an endocrine disruptor.\textsuperscript{37} Dioxin (TCDD) is associated with increased breast cancer risk,\textsuperscript{38,39} with the greatest occupational exposure risk in the production of phenoxy herbicides and chlorophenols.\textsuperscript{40} Dry-cleaning, hairdressing, leather and fur processing, glass manufacturing, and aircraft maintenance are also notable occupations with increased breast cancer incidence.\textsuperscript{41} Any occupation with exposure to Freon, solder flux, isopropyl alcohol, Trichloroethane, toluene, methyl ethyl ketone, methylene chloride, and ethylene oxide may also lead to increased risk.\textsuperscript{42} Men working in motor vehicle mechanics and automotive industry, painting, papermaking, forestry, logging, and other industries exposing them to solvents, gasoline fumes and vehicle combustion products also have a significant increase in breast cancer risk.\textsuperscript{43}

4) Consumer Products. Many consumer products on the market contain toxic chemicals that may increase the risk and proliferation of breast cancer. Many cosmetics and personal care products contain endocrine-disrupting ingredients such as triclosan, octylphenol, parabens, phthalates, benzophenone, formaldehyde, homosalate, octyl-methoxycinnamate, PABA, and styrene, all of which have been shown to increase the
The word “fragrance” in a product ingredient list could mean any combination of 3,059 possible ingredients, some of which have known links to breast cancer. Phenols such as triclosan and 2,5-dichlorophenol have also been associated with early onset of puberty, another breast cancer risk factor. Oral contraceptives were linked with increased breast cancer risk in women with usage ranging from one year to lifetime (>= 15 years).

5) Legacy Contaminants. Some chemicals that have been banned for decades, such as DDT and polychlorinated biphenyls (PCBs), are still present in the environment today. DDT and PCBs are persistent and bioaccumulating chemicals, meaning they persist in the environment, remain in the body once absorbed and build up with continued exposure. PCBs from global sources travel on wind and ocean currents and build up in wildlife and people of the Circumpolar North, particularly Arctic Indigenous Peoples that rely on subsistence foods. People are exposed to PCBs by consuming fish, dairy products, marine mammals, and breast milk. Certain PCB congeners have been found in human breast tissue of women diagnosed with in situ or invasive breast cancer, indicating a link to increased breast cancer risk.

The pesticide DDT and its breakdown metabolite DDE have been linked to increased breast cancer risk in several studies. One study found that fetal exposure to DDT or DDE were associated with a fourfold increased risk of breast cancer in adulthood. Another study showed young girls exposed to DDT before the age of 14 had a fivefold increased risk of breast cancer compared to those not exposed or exposed later in life.

6) Flame Retardants. A class of chemicals used as flame retardants, polybrominated diphenyl ethers (PBDEs) is also associated with breast cancer. PBDEs are still present in old furniture and household dust at concerning levels, as are the newer replacement flame retardants such as Tris(2,3-dibromopropyl) phosphate (Tris or TDBPP) and others listed as carcinogens, despite the phase out of some PBDE congeners from manufacture and import into the United States in 2004. A case-control study at the Alaska Native Medical Center confirmed the correlation between serum concentrations of one PBDE congener and breast cancer in Alaska Native women.

7) Diet and Nutrition. Diet in early life influences lifelong health. Studies that measured circulating carotenoids in women found that higher levels were linked with protection against breast cancer. Diets high in omega-6 fatty acids (such as those from vegetable oils and processed foods) and low in omega-3s (found in wild fish, walnuts and flaxseeds) have been linked to higher risk of breast cancer. Studies also show that consumption of whole soy foods and fermented soy products (such as tempeh and miso, as found in traditional Asian diets; not to be confused with heavily processed soy products found in the United States), are linked with lowered risks of breast cancer. Diets lower in red meats during adolescence also show a decreased risk of later
development of breast cancer.\textsuperscript{64} It is especially important to aim for lean meats when eating meat, as environmental chemicals such as PCBs and DDT are stored in the fat of animals.\textsuperscript{65,66} Finally, there is strong evidence that consuming alcohol is linked to breast cancer risk, with numerous studies showing that each additional 10 grams of alcohol per day is linked to a 9\% increased risk.\textsuperscript{67}

8) Other Sources. Drinking water from the tap may also pose a potential hazard. Public water pipes lined with vinyl may leach perchloroethylene (PCE) into drinking water, which is associated with increased breast cancer risk.\textsuperscript{68} Heavy metals such as antimony, barium, chromium, lithium, lead, and cadmium have shown estrogenic effects, which may increase breast cancer risk.\textsuperscript{69} Iron, nickel, chromium, zinc, cadmium, mercury, and lead are present in breast cancer biopsies at higher levels than non-cancerous biopsies.\textsuperscript{70}

Ways to Minimize Risk

- Avoid products with toxic ingredients whenever possible. Environmental Working Group’s Skin Deep database is an excellent resource for information on the toxicity of specific consumer products: http://www.ewg.org/skindeep/. The Campaign for Safe Cosmetics also identifies ingredients to avoid: http://www.safecosmetics.org/.
- Cook using stainless steel or cast iron to avoid exposure to PFOAs in non-stick cookware. Avoid stain-resistant products for the same reason.
- Avoid storing, cooking and microwaving food in plastic whenever possible. Use glass, ceramic or stainless steel containers to store food.
- Ensure good ventilation using fans or open windows while cooking to avoid breathing toxic gases released when heating vegetable oils.
- Purify drinking water from the tap using a solid carbon block water filter.
- Parents are strongly encouraged to ensure their children have healthy diets consisting of an array of fruits and vegetables, organic whenever possible, especially in families with a history of breast cancer. Try to include sources of omega-3 fatty acids (such as fish, walnuts and flaxseeds), whole and fermented soy products, and limit consumption of red meat, vegetable oils, processed foods and alcohol.
- Just as important as a healthful diet is exercise. A good exercise regimen assists in maintaining a healthy weight, whereas being overweight is strongly linked to post-menopausal breast cancer development.\textsuperscript{71} If choosing to exercise outdoors, try to choose a location away from busy roads, highways and traffic congestion to avoid breathing chemicals from exhaust.

What Health Care Professionals Can Do

- Share case studies at medical meetings.
- Encourage further interdisciplinary research in breast cancer prevention.
- Review and share “State of the Evidence: The Connection between Breast Cancer
and the Environment” by Janet Gray, PhD, available at:
http://www.breastcancerfund.org/media/publications/state-of-the-evidence/

- Download materials to assist in discussing with patients ways they may lower their risk of developing breast cancer. The Breast Cancer and the Environment Research Program (BCERP) has guides that may be tailored to better suit local populations.
http://info.bcerp.org/health-professionals/materials-for-health-professionals

- Join Alaska’s Collaborative on Health and the Environment (CHE-Alaska), which was established by ACAT in 2006 to address growing concerns about the links between human health and environmental factors. CHE-Alaska sponsors monthly statewide teleconference seminars Alaskans and nationally-renowned scientists, health care professionals, and policy experts who are working on a range of environmental health concerns.” For more information, visit: http://www.akaction.org/

Additional Resources

http://www.healthandenvironment.org/breast_cancer/

http://saferchemicals.org/get-the-facts/chemicals-of-concern/


- Safer Chemicals, Healthy Families Coalition. Chemicals of Concern.
http://saferchemicals.org/get-the-facts/chemicals-of-concern/

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