



# Environmental Medicine Update

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## Can the Environment Cause Cancer? Myth versus Fact

As cancer rates continue to climb, the focus for patients and doctors is on prevention. The American Cancer Society estimates that more than 1 million people in the US get cancer each year. Early detection, diagnosis, and treatments have greatly improved a person's outcome. Today 2 in every 3 people diagnosed with cancer survive at least 5 years. In fact, the National Cancer Institute (NCI) states that there will be 18.1 million cancer survivors in 2020, 30% more than in 2010. The cost of cancer care has also increased along with survival rates. According to NCI, in 2010 the cost of cancer care was \$157 billion – yes, billion. Often times the unexpected expense that comes with a cancer diagnosis can create severe financial hardship. Prevention of cancer is the simplest way to decrease the cost of cancer. Cancer is a multifactorial disease with many possible causes. Genetics, lifestyle, and environmental factors have all been implicated. This column will explore the myths versus the facts.

### **Myth #1: Since There Is No Cancer in My Family, I Am Not at Risk**

Only 5% to 10% of all cancer is caused by genetics inherited from a parent.<sup>1</sup> The rest is caused by something else. Genes can give us information on what our risk is for getting a certain disease, but genetics does not equal fate. Many other causes come into play, such as external factors – lifestyle and the environment – as well as internal factors – hormones and the immune system. A study conducted in Utah to determine the frequency of cancer in the first-degree relatives (parents + siblings + offspring) yielded interesting results. It provided an age-adjusted risk ratio to first-degree relatives of cases compared with the general population.<sup>1</sup> It determined that genetics played a role in only about 7% of cancers and the family risk ratio for certain cancers was as follows: Thyroid: 8.5; Testicular: 8; Laryngeal: 8; Multiple melanoma: 4.3; Lung: 2.6; Colorectal and kidney: both 2.5; Prostate: 2.2; Melanoma: 2.1; Breast: 1.8.

Genetic mutations have been discovered that are linked to an increased risk for a specific cancer. It is possible to test for these mutations. For example someone with the BRCA1 and/or BRCA2 gene has an increased risk for breast and ovarian cancer. The SCLC1 gene is linked with risk for lung cancer, and the CDKN2 gene is linked to malignant melanoma. When people know that they have a family history of a certain type of cancer, they may request genetic testing to help determine their risk factors. Some people with a strong family history *and* a genetic mutation undergo surgery to prevent cancer, such as Angelina Jolie's choice to remove both breasts and ovaries. This is a personal decision made between patient and doctor.

But simply having the genetic mutation doesn't guarantee that a person will get that cancer. For example, the concordance between identical twins for breast cancer was found to be only 20%.<sup>2</sup> Again, genetics doesn't equal fate. Genetic testing can provide useful information in trying to motivate someone to make lifestyle and environmental changes, especially knowing the genetic mutation often gets activated by an environmental factor. Since over 90% of cancers are due to something other than genetics, we must look at these other factors when discussing prevention of cancer.<sup>1</sup>

### **Myth #2: Exercise Can't Prevent Cancer**

Exercise can lower the risk of developing certain types of cancer. This is an easy and inexpensive way to prevent cancer especially for people who have a family history or genetic mutation increasing their risk. Take colon cancer; as one example, a study that reviewed several observational trials found that moderate physical activity reduced colon cancer risk by 25% to 50%. One study showed that even just brisk walking 3 to 4 hours per week can lower colon cancer risk.<sup>3</sup>

There are numerous studies linking exercise to decreased risk of developing cancer. Some of the benefit may be in part due to body weight. People who exercise tend to maintain a normal body weight. Obesity is clearly linked to cancer. In fact, being overweight and inactive is known to increase the risk of breast, endometrial, kidney, colon, and esophageal cancer.<sup>4</sup>

### Myth #3: Diet Has Nothing to Do with Cancer

Consumption of red meat is linked to an increased risk of colorectal, prostate, bladder, breast, gastric, pancreatic, and oral cancers.<sup>5-12</sup> Alcohol consumption, even 1 drink a day, is linked to several types of cancer, including breast cancer. Of course tobacco smoke is a known cancer-causing agent as well.<sup>4</sup> These external lifestyle factors linked to cancer are easily modifiable.

What is it about red meat that makes it carcinogenic? It has to do with chemicals, also known as environmental toxicants. The heterocyclic amines produced during the cooking of meat are carcinogens. Charcoal cooking or smoke curing of meat produces harmful carbon compounds such as pyrolysates, which have a strong cancerous effect. Nitrites and nitrates are used in meat and are powerful carcinogens.<sup>4</sup>

We are exposed to chemicals from other food sources as well. Bisphenol from plastic food containers can migrate into food and may increase the risk of breast and prostate cancers. Arsenic and mercury are present in rice and fish, and both are linked to cancer. This brings us to consider chemicals in the environment and cancer.

### Myth #4: I Don't Work with Chemicals at My Job, So I Am Not at Risk

There is a clearly established link between occupational exposure to chemicals and cancer. According to the Agency for Toxic Substances and Disease Registry (ATSDR), being exposed to certain chemicals at work can cause specific cancers. This is considered high-dose exposure.<sup>13</sup>

However, nonoccupational or low-dose exposure to chemicals can also cause cancer. You don't have to work around chemicals to be exposed. Every day we come in contact with small amounts of chemicals in our air, water, food, and products. These chemicals are linked to cancer. For example, already mentioned above is the presence of cancer-causing chemicals in red meat. Another cancer-causing chemical produced when cooking meat is polycyclic aromatic hydrocarbons (PAHs).

**PAHs:** A number of studies show increased incidence of lung, skin, and urinary cancers when exposed to polycyclic aromatic hydrocarbons (PAHs). The primary source of PAHs is from burning carbon-containing compounds. PAHs in air are produced by burning wood and fuel for homes. They are also contained in gasoline and diesel exhaust, cola, cigar and cigarette smoke, and charcoal-broiled foods.<sup>4</sup> Foods that contain small amounts of PAHs include smoked, barbecued, or charcoal-broiled meats, roasted coffees, and sausages.

**Cadmium:** This is another chemical that we are exposed to daily in low doses through food, cigarette smoke, drinking water, and air. It is a known human carcinogen. Cadmium

is introduced to the food chain through agricultural soils or from anthropogenic sources, from cadmium-plated utensils and galvanized equipment used in food processing and preparation, enamel and pottery glazes with cadmium-based pigments, and stabilizers used in plastics. The highest levels of cadmium in food are typically found in leafy vegetables such as lettuce and spinach, potatoes, grains, peanuts, and organ meats such as liver and kidney.<sup>12</sup> Cadmium is linked to lung, kidney, breast, and prostate cancer.<sup>14</sup>

**Arsenic:** Another cancer-causing metal, arsenic is found in small amounts in air, water, and food. Food is the largest source of exposure. According to the American Cancer Society, the highest levels of arsenic (in all forms) can be found in seafood, rice, rice cereal (and other rice products), mushrooms, and poultry, although many other foods can contain low levels of arsenic. It is linked to lung cancer via inhalation, as well as skin, stomach, and kidney cancer; leukemias; and lymphomas.<sup>15</sup>

### Myth #5: The Air that I Breathe Can't Cause Cancer

**Air:** Many people believe that when they step outdoors to go for a walk, sit on the porch, or stand and talk to a neighbor, the air they breathe is safe. Since our federal and state governments regulate the outdoor air pollutants, it should be safe; unfortunately, this isn't the case everywhere. The International Agency for Research on Cancer (IARC),

Cancers Associated with Various Occupations or Occupational Exposure	Substances or Processes
Lung	Arsenic, asbestos, cadmium, coke oven fumes, chromium compounds, coal gasification, nickel refining, foundry substances, radon, soot, tars, oils, silica
Bladder	Aluminum production, rubber industry, leather industry, 4-aminobiphenyl, benzidine
Nasal cavity and sinuses	Formaldehyde, isopropyl alcohol manufacture, mustard gas, nickel refining, leather dust, wood dust
Larynx	Asbestos, isopropyl alcohol, mustard gas
Pharynx	Formaldehyde, mustard gas
Mesothelioma	Asbestos
Lymphatic and hematopoietic	Benzene, ethylene oxide, herbicides, X-radiation system
Skin	Arsenic, coal tars, mineral oils, sunlight
Soft-tissue sarcoma	Chlorophenols, chlorophenoxy herbicides
Liver	Arsenic, vinyl chloride
Lip	Sunlight

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part of the World Health Organization, has listed outdoor air pollution as carcinogenic to humans. There are many individual compounds and mixtures in outdoor air that are known cancer-causing agents, but in 2013 the IARC took the bold step to list *air* as a cancer-causing agent.<sup>16</sup> Outdoor air pollution consists of several chemicals, including diesel engine exhaust, solvents, metals, and dust. It also contains particulate matter, as a carcinogen on its own. Particulate matter is a combination of extremely small solid particles and liquid droplets and can include elements such as dust or smoke, as well as chemicals. The biggest risk from air pollution is lung and bladder cancer.

### Myth #6: My Food, Water Bottles, and Cosmetics Won't Hurt Me

**Bisphenol A:** BPA is a plasticizer found in baby bottles, hard plastic water bottles, the plastic lining of metal food cans, dental sealants, and the carbonless paper receipts that most cashiers hand out after a purchase at the store. It has been linked to breast cancer and prostate cancer in several studies.<sup>17-22</sup> BPA is being phased out voluntarily in some cases and by order in others. In 2012, the US Food and Drug Administration (FDA) banned the sale of baby bottles that contain BPA. However, it is being replaced by other bisphenols which are being found to have similar effects.<sup>23</sup>

**Phthalates:** These are a group of chemicals known as plasticizers and are found in cosmetics and personal care products, including perfume, hairspray, soap, shampoo, nail polish, and skin moisturizers. They are used in flexible plastic and vinyl toys, shower curtains, wallpaper, vinyl miniblinds, food packaging, and plastic wrap. Phthalates are also used in wood finishes, detergents, adhesives, plastic plumbing pipes, lubricants, medical tubing and fluid bags, solvents, insecticides, medical devices, building materials, and vinyl flooring. They are in literally hundreds of products, and we are exposed to them daily. Phthalates are linked to breast cancer.<sup>24</sup> The ATSDR lists phthalates as "Reasonably Anticipated to be a Human Carcinogen," meaning that it is just a matter of time.

**Parabens:** Parabens are among the most commonly used preservatives in cosmetic products. Chemically, parabens are esters of p-hydroxybenzoic acid. The most common parabens used in cosmetic products are methylparaben, propylparaben, and butylparaben. Cosmetics that may contain parabens include makeup, moisturizers, hair-care products, and shaving products. They are regulated by the FDA, which says that they are safe despite showing a link to breast cancer.<sup>25</sup> The FDA acknowledges the estrogenicity of parabens but states that low-dose exposure is safe. The FDA last updated its position on parabens in 2007.<sup>26</sup>

### Myth #7: These Are the Only Environmental Links to Cancer

Obviously, this list is barely scratching the surface. People are exposed to many low doses of chemicals in

the environment that are linked to cancer. Sometimes the exposure is enough to activate genetic predisposition for a specific cancer, turning on genetic mutation. This concept explains why some people exposed to low-dose chemicals get cancer and others don't. It is important for both doctors and patients to educate themselves about how to avoid environmental exposures to carcinogens.

Cancer is a multifactorial disease. Pinpointing a single cause is nearly impossible. Prevention really is the best medicine, especially in relation to cancer. It is important to identify genetic and heredity, lifestyle, and environmental factors. We can't change our genetics, but we can modify our lifestyle and minimize exposures to chemicals in order to decrease our risk of cancer.

### Notes

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