

## Link between Environmental Pollutants and Breast Cancer

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Breast cancer is the second leading cause of cancer among female and fifth most common cause of cancer death in the world.<sup>1</sup> Global burden of breast cancer in women, measured in terms of incidence, mortality and economic costs, is substantial and is on the increase. In the years ahead one in eight women will have the disease.<sup>2</sup> In Bangladesh as well breast cancer is the second commonest malignancy among women with estimated incidence being 17%.<sup>3</sup> The risk factors of breast cancer are varied and widely divergent. Although some risk factors for breast cancer like primary genetic mutations,<sup>4</sup> reproductive history<sup>5</sup> and lifestyle factors, such as, weight gain,<sup>6</sup> alcohol consumption<sup>7,8</sup> and lack of physical exercise<sup>9</sup> are widely recognized, yet it is conceded that these factors alone do not explain a considerable portion of the risk for breast cancer.<sup>10</sup> Recent descriptive epidemiological data suggest that, while there may be a genetic component to breast cancer risk, there is also strong evidence that environmental factors play an important role.<sup>11</sup> The scientific data generated from the studies relating female breast cancer with environmental chemical pollutants, human life style and ecology indicate that exposures to some common environmental chemicals and ionizing and non-ionizing radiations, either alone or in combination, may contribute to the unacceptably high incidence of breast cancer. Migrant studies suggest that much of these high incidences might be attributed to environmental chemicals rather than genetic predisposition. Migrants tend to acquire the breast cancer pattern of their new home, for example the Japanese in the United States assume the breast cancer of the United

States. This indicates that there may be ecological factors operating that determine breast cancer risks.<sup>11</sup>

More than 80,000 chemicals are registered for commerce in the US, and 1,000 new chemicals are being added to the market each year, although little is known about the toxicity of these chemicals to human beings exposed to their day-to-day lives.<sup>12</sup> Many of these chemicals persist in the environment,<sup>13,14</sup> accumulate in body fat and may remain in breast tissue for decades.<sup>15</sup> Even, majority of these chemicals have had little or no testing for their effects on human health.<sup>16</sup> Additionally, it is important to note that we are not being exposed to just one discrete chemical at a time, but to a mixture of chemicals, and the synergistic or additive effect of these chemicals is unknown as toxicological studies typically look at one chemical at a time. Although the state intends to regulate chemicals before and after they enter commerce through the Toxic Substances Control Act of 1976 (TSCA), studies by different Governmental and Non-Governmental Agencies have concluded that TSCA does not adequately help the public, industry or government to assess the hazards of chemicals in commerce or control those hitting the hardest.<sup>17</sup>

The Silent Spring Institute in 2007 published a comprehensive scientific review of environmental links to breast cancer, in which 216 chemicals have been found to be associated with increases in mammary gland tumors in animals.<sup>18</sup> Of those, 35 are air pollutants. The evidence gleaned from the review of human population studies conducted by the same Institute generally supports

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an association between breast cancer and ubiquitous air pollutants called polycyclic aromatic hydrocarbons (PAHs).<sup>19</sup>

Human population studies, although limited in number, point to an association between breast cancer and two other chemical families of air pollutants: dioxins and organic solvents. Animal studies have shown that prenatal exposures to the dioxin TCDD alter subsequent mammary gland development in ways that predispose rats to develop mammary cancers in adults.<sup>20</sup> Most of these air pollutants can be found in primary and second hand tobacco smoke, diesel exhaust and/or in specific occupational settings. The overall evidence collected by EPA (Environmental Protection Agency) in California is consistent with a causal association between environmental tobacco smoke exposure and breast cancer in younger, primarily premenopausal women.<sup>17</sup>

Some pesticides and herbicides, usually found in water supplies as well as in air and dust in homes, have been recognized as human or animal carcinogens. The triazine herbicides, atrazine, simazine and cyanazine, have all been shown to cause mammary cancer in rats. Atrazine, is of particular concern for breast cancer because it increases the activity of aromatase, which can lead to more estrogen in the body thereby increasing the risk of breast cancer.<sup>21</sup> Three other pesticides-heptachlor, dieldrin and aldrin-have also been shown to increase the estrogen levels and/or stimulate growth of breast cancer cells.<sup>17</sup> Each day, consumers use some products that contain chemicals untested for impacts on human health and the environment. Of them plastics are widely used in consumer products for packaging of all kinds. Most plastics are made from petroleum, a non-renewable resource. Everyday millions of bottles go to landfills, where they continue to leach chemicals into the environment for generations ahead. The three plastics that have been shown to leach toxic chemicals when heated, worn or put under pressure are polycarbonate (leaches bisphenol A), polystyrene (leaches styrene) and PVC (leaches phthalates).<sup>22</sup> Bisphenol A is used in the linings of cans, baby

bottles, sports water bottles and dental sealants. While studies funded by the chemical industry say bisphenol A is harmless, non-industry studies show it's a powerful hormone-disruptor linked to breast cancer.<sup>23</sup> Phthalates, another chemical family of concern, are found in many consumer products including children's toys and teething toys, and are used to soften plastics, especially PVC. Phthalates are endocrine disruptors that increase the risk of early puberty in girls and therefore, breast cancer.<sup>24,25</sup>

Modern food-production methods have introduced new environmental exposures to carcinogens and endocrine-disrupting compounds (EDCs). Crops consumed by the animals are not without pesticides. Similarly hormones are regularly used for growth of cattle, sheep and hogs and milk production. Animal fat retains these pesticides and other environmental toxicants consumed by the animal and data suggest that some of these exposures may increase breast cancer risk. Several studies have shown an association between dairy consumption and breast cancer in pre-menopausal women presumably because of potential carcinogenic effects of bovine growth hormone (rBGH/rBST).<sup>26,27</sup>

Cosmetics and Personal Care Products that consumers use every day contain chemicals linked to cancer and other serious health problems. The \$50 billion cosmetics industry in United States has put unlimited amounts of chemicals into personal care products with no required testing, no monitoring of health effects and woefully inadequate labeling requirements.<sup>17</sup>

Although there is law (Cosmetics Directive, 76/768/EEC) in the United States for prohibition of the sale of personal care products that contain any of the 1,100 carcinogens, mutagens or reproductive toxins (CMRs) classified as toxicants by the directive, there is no enforcement of those restrictions. Taken alone, the chemicals in a single consumer product are unlikely to cause health hazards. But the average American woman uses 12 personal care products a day, resulting in exposure to 126 unique chemicals.

As much as 70 percent of what women apply on their skin for personal care ends up inside their bodies—a huge concern for women of childbearing age. As a result, more than 200 chemicals have been detected in women's body fluids including breast which might have a link with increased incidence of breast cancer. Breast Cancer Fund is working with nine other funding organizations of the Campaign for Safe Cosmetics to make that happen with the ultimate aim of reducing the incidence of breast cancer.<sup>17</sup>

Most occupational research on women comes from Scandinavia and Canada, and much of it reports risk by job type or title, rather than by specific exposures, making the findings difficult to interpret. The evidence that does exist shows increased risk of breast cancer among two broad categories: (1) Those who work with toxic chemicals, such as chemists, dental hygienists, paper mill workers and microelectronics workers, and (2) Professionals in higher socioeconomic groups such as school teachers, social workers, physicians and journalists.<sup>17</sup>

Ionizing radiation is the best and the longest established environmental cause of breast cancer. There is no safe dose of radiation, and the genetic damage caused by radiation accumulates over a lifetime. Therefore, multiple exposures to low-dose radiation may cause the same harm as a single high-dose exposure. Radiation exposure in combination with exposure to certain synthetic chemicals—in different doses and during key developmental windows—can magnify the effect of radiation and/or result in greater susceptibility to chemical insults in the future. Ecological studies support the link between ionizing radiation and breast cancer as is evidenced by increases in breast cancer in women living in areas surrounding the Chernobyl Nuclear Power Plant in the former Soviet Union, which exploded in 1986 and caused massive radiation contamination. Likewise links between radiation exposure and breast cancer in women have been confirmed in atomic bomb survivors.<sup>28-30</sup> Rates of breast cancer were highest among women who were younger than

age 20 when the United States dropped atomic bombs on Hiroshima and Nagasaki.<sup>31</sup>

Exposure to ionizing radiation occurs during medical and dental X-rays, computed tomography (CT) scans, fluoroscopy and other imaging procedures. Diagnostic and therapeutic radiations are invaluable in the practice of medicine and dentistry today. Yet, not all equipment or procedures are subject to the same standards, even though legislation is prevailing in many countries.

Accumulating evidences suggest that continuous daily exposure to electromagnetic fields (EMF) is a fact of life for everyone living in the modern world. EMF includes extremely low frequency radiation (ELF-EMF) from electrical appliances and power lines and radiofrequency (RF) radiation from wireless technologies such as cell phones, cordless phones, personal data assistants, laptops, the towers and antennas that support these technologies and broadcast transmission towers. Decades of research indicate that exposure to EMF is associated with many adverse health effects including breast cancer (in both men and women).<sup>32</sup> Existing public exposure standards for EMF are inadequate to protect public health because they are based on a short-term (30-minute) thermal effect. An international scientific review in 2007 concluded that safety limits set for these types of radiation are 'thousands of times too lenient'.<sup>33</sup> Rapid expansion and deployment of wireless technologies are outpacing the policy decisions necessary to protect public health.

Taken together, these complex studies make clear that breast cancer causation is not simple to understand. Indeed, rather than looking for single, direct causes underlying the disease, it will be better to recognize the multiple and perhaps often interacting factors that may influence risk. It is time to go beyond looking for simple linear cause-effect relationships between risk factors and breast cancer, or even trying to think of a pie chart that we can slice up into proportions of risks accounted for by different types of factors. We instead begin to think of

breast cancer causation as a complex web of often interconnected factors, each exerting both direct and interactive effects on cellular and extracellular processes in mammary tissue.

The evidences presented so far convincingly demonstrates that there is a link between environmental pollutants and breast cancer and that our failure to adequately assess and regulate those chemicals is producing devastating effects on the health of humans and the environment. The rapid growth of the chemicals and their marketing without sufficient testing for their toxic properties adding new health hazards to the existing ones. These chemicals end up in the air we breathe, the food we eat, the water we drink, and even some of the fragrances and body products we use irrespective of geographical boundaries making the environment unsafe for human health and habitation. As Bangladesh is developing country, where environmental pollution is rampant and legislative measure to control air pollution is grossly lacking, it is a matter of great concern that breast cancer (including other cancers) soon might take a steeper turn from an insidious trend.

Given the situation prevailing, although it's essential to continue search for the best and most effective therapies to treat breast cancer, emphasis should be given to identify the environmental pollutants, changing ecology and human life-style contributing to the breast cancer epidemic for the primary prevention of the disease. The preliminary information presented in this paper will, therefore, be of immense significance in formulating guidelines for environmental safety measures and recommending future research directions with ultimate aim of reducing the risk of breast cancer.

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