



Firefighters & Breast Cancer

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GENERAL EPIDEMIOLOGY: BREAST CANCER

Outside of skin cancers, breast cancer is the most common cancer among women in the United States and accounts for 30% of new female cancer cases every year¹. The American Cancer Society estimated there would be almost 288,000 new cases of breast cancer in women, and over 43,000 women dying from breast cancer in 2022¹. Breast cancer mainly occurs in older women, as the median age at diagnosis is 62¹. Despite its common occurrence, deaths from breast cancer have decreased 43% since 1989 due to early screening and increased awareness¹. Aside from genetics, other risk factors associated with breast cancer include alcohol consumption, obesity, physical inactivity, and hormone therapy¹.

INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC)

In June 2022, IARC convened an international meeting of scientists to re-evaluate firefighting as an exposure related to cancer. They determined the literature supports reclassifying **firefighting to a Group 1 carcinogen (carcinogenic to humans) based on “sufficient” evidence**². This is the **highest** classification of exposure only assigned when there is scientific certainty.

Their statement indicated:

There was also “strong” mechanistic evidence that occupational exposure as a firefighter shows the following key characteristics of carcinogens in exposed humans: “is genotoxic”, “induces epigenetic alterations”, “induces oxidative stress”, “induces chronic inflammation”, and “modulates receptor-mediated effects”.

It should be noted that IARC criteria and classifications are focused on *scientific levels of certainty* which are more stringent than those focused on the “weight of the evidence”³ which is often used in cases of workers compensation.

OCCUPATIONAL EXPOSURES RELATED TO BREAST CANCER

Firefighters are exposed to a broad range of chemicals both in the firehouse and during emergency response. Recent research conducted with live burns has begun to identify and quantify the presence of carcinogens that are typically present on the fire ground. Most alarming are findings that, even when the air appears “clear” there are often ultra-fine respirable particles and gaseous chemicals of several known carcinogens present. Unfortunately, this time period when there is no visible smoke is typically the time when firefighters remove their personal protective equipment and self-contained breathing apparatus. Particularly noted in the research is the presence of carcinogens such as perfluorooctanoic and Perfluorooctanesulfonic acids (PFOA and PFOS), phthalates, dioxins, benzene, polybrominated diphenyl ethers (PBDEs), polychlorinated biphenyls (PCBs,) polycyclic aromatic hydrocarbons (PAHs), vinyl chloride and heavy metals⁴⁻¹¹. These same chemicals have recently been implicated as playing a central role in the development of breast cancers¹²⁻¹⁶. Firefighters face several routes of exposure to these carcinogens including inhalation, dermal absorption, secondary exposure through contaminated dust from particulates post incident, and potentially the semi-volatile off-gassing of gear.

While research is underway examining the exact mechanism of exposure and development of specific types of cancer, data on carcinogens and the development of breast cancer suggest several chemical exposures likely put firefighters at increased risk including:

Benzene. Evidence exists that suggests exposure to gasoline and its components, such as benzene, places people at increased risk for the development of breast cancer¹². Benzene is also a primary ingredient of several plastics and nylons. Benzene is not only present on the fire

ground as a product of combustion, but also at high rates in many fire stations as trucks and ambulances are housed in the bay areas. While efforts are being made to increase the use of exhaust mitigation devices in the firehouse, their introduction and use is relatively new to the fire service.

Polycyclic Aromatic Hydrocarbons (PAH). PAHs are a group of compounds present in the environment, food, and emissions that are stored in fat tissues, including breasts. These chemicals are products of the combustion of organic materials. While they are ubiquitous in the environment, exposure to high levels (such as those on the fire ground) have been found to be related to increased risk for breast cancer^{17,18}.

Endocrine Disrupting Chemicals

The Endocrine Society has released two statements over the past decade outlining what have been identified as endocrine disrupting chemicals. These synthetic chemicals include polychlorinated biphenyls (PCBs), plastics (bisphenol A), plasticizers (phthalates), dioxins, and some metals^{19,20}. Evidence suggests that these chemicals disrupt normal hormone functioning and interrupt normal homeostatic control and reproduction. The Endocrine Society concluded, "Collectively, these data support the notion that endocrine disruptors alter mammary gland morphogenesis and that the resulting dysgenic gland becomes more prone to neoplastic development."^{20, p.308}

Endocrine disruptors that have *also* been found to be present as products of combustion on the fire ground include:

- **Dioxins.** Dioxins are a group of chemicals that are present in chlorine containing chemicals and products (e.g. PVC pipes used as building materials). During incineration, dioxins are released. These chemicals have been found as products of combustion on the fire ground. Studies of dioxin exposure suggest a link between breast cancer and exposure^{21,22}
- **Phthalates.** These are a group of chemicals used to improve the durability, flexibility, and stability of plastics. These are commonly used in home building materials and home décor, such as flooring and blinds¹⁵. Exposures to these chemicals, which have been found to be present in the fire environment, are also related to breast cancer development through their disruption of the estrogen and androgen systems²³⁻²⁵.
- **Polychlorinated biphenyls (PCBs).** PCBs are man-made organic chemicals commonly used as coolants, lubricants in transformers, capacitors, and other electrical equipment. While the chemicals have been banned since the late 1970s due to the evidence that they are a probable human carcinogen, they remain in products manufactured prior to the ban and have been found in the fire environment as a product of combustion^{26,27}. These chemicals have been found to increase risk for breast cancer in the epidemiologic literature.^{28,29}
- **Polybrominated Diphenyl Ethers (PBDEs).** PBDEs are a complex grouping of chemicals present in polyurethane foam in furniture, electronics, plastics, and flame retardants. These chemicals exert effects on hormonal systems and the thyroid systems. Clearly, these products being burned account for the presence of PBDEs on the fire ground. While the link between PBDEs and breast cancer are hard to elucidate given their co-occurrence with other endocrine disrupting chemicals, there is sufficient evidence to support the suggestion of a link between PBDEs and breast cancer³⁰.

Shift Work

Shift work and being exposed to light at night interrupts the typical circadian rhythms of the body. Evidence about the impact of these interruptions has led the International Agency for Research on Cancer (IARC) to classify shift work as probably carcinogenic to humans. Evidence also supports an increased risk for breast cancer among women who engage in shift work or have jobs that require them to be awake at night.³¹⁻³³

FIREFIGHTING AND BREAST CANCER

Very limited data is available in the epidemiologic literature on breast cancer among firefighters. Most large-scale studies on firefighters and cancer do not include breast cancer, likely due to how rare the cancer is among the men who make up the majority of the study samples and the low numbers of women firefighters. Note that it has been the norm to exclude women firefighters from most of the larger epidemiological studies given that they typically represent less than 3-5% of career firefighters nationally.

In the study by Daniels and colleagues³⁴, the authors found that the majority of cancer deaths among women were the result of breast cancer. They reported an alarming 46% increase in breast cancer compared with the general population (SMR=1.46, 95% CI=0.30-4.26). The lack of statistical significance is explained by the low number (N < 1,000) of women firefighters in the study. A more recent cohort study³⁵ found similar results as female firefighters were at a greater risk of mortality related to breast cancer (SMR=1.41; 95% CI=0.46-3.30), although the study was plagued by a small sample size.

One study that did include breast cancer as an outcome was a cohort study of more than 36,000 Florida firefighters by Ma and colleagues³⁶. They found that male firefighters were more than 700% more likely (SMR=7.41, 95% CI=1.99-18.96) to develop breast cancer than non-firefighting males in the general population. Given the low rate of male breast cancer in the general population, this result suggests that exposure to chemicals common on the fire ground leads to dramatically higher rates of breast cancer in firefighters generally.

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