



Firefighters & Bladder Cancer

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DetecTogether

Authors:

Sara A. Jahnke, Ph.D., FACE

Maria DH Koepfel, Ph.D.

Christopher K. Haddock, Ph.D., PStat®

Walker S. Carlos Poston, Ph.D., M.P.H., FACE

Center for Fire, Rescue & EMS Health Research

NDRI-USA, Inc.

New York, NY

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GENERAL EPIDEMIOLOGY: BLADDER CANCER

According to the American Cancer Society¹, there are approximately 80,000 new cases of bladder cancer annually and close to 18,000 deaths in the United States. The average annual incidence rate of bladder cancer was 20.3/100,000 between 2011 and 2015.

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.

IARC & BLADDER CANCER AMONG FIREFIGHTERS

In addition to the general classification of firefighting as a Group 1 carcinogen, the IARC committee also noted **sufficient evidence** for the relationship with bladder cancer specifically. According to their findings:

“Positive associations for bladder cancer incidence were observed consistently in several cohort studies of firefighters compared mostly with the general population. In the Working Group’s meta-analysis of ten studies, the increased risk estimate was small in magnitude (16%) but was statistically precise and had low heterogeneity (95% CI 8–26%, $P=0$). This estimate was consistent with two additional higher-quality cohort studies of cancer incidence that used a slightly expanded definition of bladder cancer, and with the results from studies of bladder cancer mortality. Further, negative confounding by smoking was deemed probable, because lower risks of lung cancer among firefighters were observed in most studies, and could have led to underestimated associations for bladder cancer in comparison with the general population. In one pooled US cohort study⁴, a positive association in exposure-response analyses with adjustment for employment duration suggested that healthy-worker survivor bias might have attenuated associations in other studies that had no such adjustment. Firefighters’ exposures to known and suspected human bladder carcinogens (eg, PAHs and soot) were considered plausible causal agents to support the observed associations for bladder cancer.”²

GENERAL RISK FACTORS FOR BLADDER CANCER

While scientists do not know the exact cause of bladder cancer, a number of risk factors have been found to be related to its development⁵.

- **Age.** Bladder cancer has been described as a disease of aging with the average age of diagnosis being 67 years old and incidence peaking at 75 years old.
- **Gender.** Men are between 3-4 times more likely to develop bladder cancer compared to women. This has been attributed in part to higher rates of smoking among men.
- **Smoking.** Cigarette smoking has been identified as one of the leading risk factors for developing bladder cancer. It is estimated that 50-65% of cases in men are attributable to cigarette smoking.
- **Location.** Incidence of bladder cancer is highest in Europe, followed by the United States, and then Egypt.
- **Occupational Exposures.** An estimated 18% of bladder cancers can be attributed to occupational exposures⁶. Most commonly researched exposures include aromatic amines and polycyclic aromatic hydrocarbons (PAHs) used in coal gasification, coal tars, and roofing. Increased risk also has been reported for those exposed to diesel exhaust (e.g. truck and bus drivers).
- **Arsenic.** Exposure to arsenic (typically through drinking water) has been identified as increasing risk for bladder cancer.
- **Genetics.** Having a family history of bladder cancer has been found to lead to increased risk.

CHEMICAL EXPOSURES AMONG FIREFIGHTERS

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 typically are present on the fire ground. Most alarming are findings that, even when the air appears “clear” there often are ultra-fine respirable particles and gaseous chemicals of several known carcinogens present. Unfortunately, this time period when there is no visible smoke is typically when firefighters remove their personal protective equipment (PPE) and self-contained breathing apparatus. Particularly noted in the research is the presence of carcinogens such as soot and arsenic⁷⁻¹¹ which have been classified as Group 1 carcinogens by the International Agency for Research on Cancer¹². These same chemicals have recently been implicated as playing a central role in the development of bladder cancer¹³. Firefighters face several routes of exposure to these carcinogens including inhalation, dermal absorption, and secondary exposure through contaminated dust from particulates post-incident.

Soot. Soot is the black particulate matter that is present as a by-product of combustion and has been classified as a known human carcinogen¹⁴. Originally, soot was most commonly studied as a risk factor for chimney sweeps but has more recently been identified as a risk for firefighters as well. This matter is the result of burning products such as wood, oil, coal, plastics and household items and has been found to contain such carcinogens as arsenic, cadmium, nickel, and several polycyclic aromatic hydrocarbons (PAH). Soot has been identified as a risk for firefighters and is thought to be one of the causes of bladder cancer².

Arsenic. Commonly found in treated wood used in home construction, arsenic is a common byproduct of combustion on the fire ground¹⁰. A growing body of evidence suggests that even

low levels of arsenic, such as those found in drinking water and well water, lead to increased risk of bladder cancer¹⁵.

RISK OF BLADDER CANCER AMONG FIREFIGHTERS

In the largest single study of U.S. career firefighters to date, Daniels and colleagues¹⁶ studied a pooled cohort of 29,993 firefighters from San Francisco, Philadelphia, and Chicago. They found that **firefighters were 18% more likely to be diagnosed with bladder cancer** as their first cancer than the general population (SIR=1.18, 95% CI=1.05-1.33). Meanwhile, Korean **firefighters were 60% more likely** to develop bladder cancer than the general population (SIR=1.60, 95% CI=1.01-2.56)¹⁷.

Most convincing is the evidence from two recent meta-analyses that have reported increased risk of bladder cancer among firefighters. Jalilian and colleagues¹⁸ found that **firefighters were 12% more likely to develop bladder cancer** than the general population (SIRE=1.12; 95% CI = 1.04 - 1.21). A second 2019 meta-analysis published by Soteriades and colleagues¹⁹ found a **28% increased risk (95% CI=1.05-1.56) of dying from bladder cancer** among firefighters when all studies were considered and an **18% increased risk (95% CI=1.01-1.36) of mortality and incidence combined** among firefighters.

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