House Bill 584
Workers Compensation – Occupational Disease Presumptions – First Responders
(Caring for Public Safety Employees in the Safety Professions – CAPES ACT)

Fire Fighter Cancer Rates and Exposures: Thyroid, Colon, and Ovarian

Cancer in the Fire Service

Fire fighters are routinely and repeatedly exposed to environments filled with known and unknown chemicals. As a result, it has been proven that fire fighters are prone to cancer and certain other illnesses at rates greater than the general population.[1] In a study conducted on cancer incidence and mortality among a large cohort of US career fire fighters, it was found that fire fighters had a 9% increase in cancer incidence and a 14% increase in cancer mortality compared to the general population.[2] In 2022, the International Agency for Research on Cancer (IARC) reclassified the occupation of firefighting as carcinogenic to humans (Group 1), IARC's highest carcinogenic hazard classification.

Thyroid Cancer

There is scientific evidence that indicate that fire fighters are at an increased risk for thyroid cancer, given their exposure to chemical carcinogens in the line of duty. Fire fighters encounter combustion products of modern residential and commercial fires during fire suppression, overhaul, and salvage activities. They are also routinely exposed to carcinogens from the diesel exhaust from their fire apparatus every single shift, during routine and emergency operations. The smoke of combustion also contains a complex mixture of cancer-causing chemicals, some of which are causally linked to thyroid cancer. Combustion products of wood, coal, and diesel fuel are considered known or probable human carcinogens by IARC. Scientific research has proven relationships regarding the fact that fire fighter occupational exposures contribute to increased risk and rates of thyroid cancer. Known occupational physical and chemical exposures fire fighters encounter linked specifically to thyroid cancer include:

- Dioxin[3,4]
- Formaldehyde[5]
- Diesel exhaust[6,7,8,9,10,11]

- Lead/manganese/cadmium[12]
- Fine/ultrafine particulate PM2.5[12]
- Shift work[13]
- Benzene[14]
- PBDE flame retardants [15,16,17,18]
- PCBs, chlorinated naphthalenes, and solvents[19]

In a study of cancer risk among Florida fire fighters, Lee and colleagues identified thyroid cancers in 99 male fire fighters, resulting in a two-fold increased risk (2.17 with 95% confidence interval of 1.78 to 2.66).[20] Increased risk was also observed in female fire fighters. As the authors noted, this provides evidence that thyroid cancer risk in their population is not simply due to surveillance (medical screening) bias. In a meta-analysis of 35 epidemiological cohort studies, there was evidence of positive associations between occupational exposure as a fire fighter and cancer incidence for several sites, including bladder, testis, prostate, thyroid, and colon cancer.[21]

Colon Cancer

Several studies have examined cancer risk in fire fighters. Statistically significant elevations in various cancers have been reported in different studies using a range of research approaches. Three recent cohort studies provide valuable information on overall and specific cancer risks in fire fighters. Notably, colorectal cancer risk is elevated in fire fighters.[22] In 2019, male fire fighters in Florida were noted to be at increased risk of late-stage colon cancer. It is important to note that the terms colon cancer, rectal cancer, and colorectal cancer are all interchangeable for the purpose of pathology in fire fighters.[20] Rectal cancer shares with colon cancer almost all known risk factors.

Daniels and colleagues at the National Institute for Occupational Safety and Health (NIOSH) and National Cancer Institute (NCI) published findings in 2013 from a retrospective cohort study of 29,993 career fire fighters in three US cities. Standardized mortality ratios (SMR) and incidence ratios were calculated for different types of cancer. The study found excess colorectal cancer incidence in fire fighters, and the increased incidence was statistically significant (SIR=1.21, 95% CI 1.09-1.34). Mortality from colorectal cancer was also elevated in fire fighters (SMR=1.31, 95% CI 1.16-1.48).[23] The SMR of 1.31 means that fire fighters had an approximately 30% greater risk of dying from colorectal cancer compared to non-fire fighters in the general population.

Youakim and colleagues found that colon cancer mortality is 1.5 times higher than expected among fire fighters employed 30 or more years and increases to nearly 5 times higher than expected after a fire fighter has 40 or more years of employment; the risk for this malignancy is increased in the group with fewer than 10 years of employment, showing a dose-response relationship between firefighting and colon cancer.[24] Known occupational exposures fire fighters encounter linked specifically to colorectal cancer: [25,26,27,28]

- Arsenic and arsenic compounds
- Asbestos

- Formaldehyde
- Polychlorinated biphenyls (PCB)
- Tetrachloroethylene
- Diesel and gasoline engine exhaust

A report by LeMasters and colleagues summarized the results of 32 studies on cancer in fire fighters. This study was a meta-analysis, a research technique used to combine many smaller studies. The advantage of this analysis is that research with more participants is better able to detect true increases in risk. In the LeMasters study, the summary risk estimate for colorectal cancer was 1.21 (95% CI 1.03-1.41) based on 25 total studies with data on colon cancer. This risk estimate was statistically significant, indicating a 21% increased risk for colon cancer in fire fighters.[29] A similar meta-analysis was performed in 2019 by Jalilian et al. that synthesized the findings of 50 papers. This study found significantly elevated summary incidence risk estimates for colon cancer 1.14 (95% CI 1.06-1.21) and rectal cancer 1.09 (95% CI 1.00-1.20).[30]

Ovarian Cancer

Reproductive cancers are also of interest among the fire fighter population because elevated incidence and mortality may be associated with exposures to endocrine-disrupting chemicals. Endocrine-disrupting chemicals could result in elevated incidence and mortality for reproductive cancers for female fire fighters as well, specifically for ovarian cancer.

A recent Monographs Working Group of IARC concluded that there is sufficient evidence for a causal association between exposure to asbestos and ovarian cancer.[31] Fire fighters can routinely be exposed to asbestos while on the job, therefore increasing female fire fighters' risk of developing ovarian cancer. There are also several studies that have reported an increased risk of ovarian cancer in women occupationally exposed to asbestos.[32,33,34]

In a review of medical literature examining the risk for breast cancer, gynecologic malignancies, and lymphoma in the firefighting environment, there were 10 reviewed articles on the association between female reproductive cancers and occupational exposures or environment contaminants.[35] The investigators analyzed reports on the occupational exposures of fire fighters to known carcinogens. Six substances were recognized as significant occupational exposure for female fire fighters. This includes Benzene and 1,3-butadiene, which have been associated with ovarian cancer in animal studies.[35]

A study exploring how demographic characteristics, life experiences, and firefighting exposures impact cancer among female fire fighters described the types and biologic characteristics of cancers as reported by women in the fire service. The study reported 13 cases of ovarian cancer or precancer out of a total of 256 cases, making it the 8th most common malignancy in the study, whereas it occurs much less frequent among women in the general public.[36] This suggests that ovarian cancer may be more prevalent in the fire service than previously recognized. The study also noted that although ovarian and testicular cancer have different clinical courses, ovaries are derived from the same endodermal tissue as testicles, and testicular cancer is commonly elevated among male fire fighters and often covered under presumptive legislation. Additionally, some respondents noted that cancers specific to women, such as ovarian cancer, not being covered under presumptive legislation indicated a systemic barrier to supporting women in the fire service.

Cancer Coverage in the States

Below is a table that compares presumptive cancer benefits for firefighters. It displays states that cover one or all of the cancers (thyroid, colon, and ovarian.) Some states language is so broad that it encompasses all cancers.

STATE	COLON CANCER	OVARIAN CANCER	THYROID CANCER	ALL CANCERS
Alabama				**X**
Arizona	X			
Arkansas	Digestive tract		X	**X***
California				**X**
Colorado	Digestive system			
Connecticut	Digestive system	Reproductive system	Endocrine system	
Delaware			X	
District of Columbia	X	X	X	
Florida	X	X	X	
Georgia	Intestinal		X	
Hawaii	Intestines			
Idaho	Colorectal			
Illinois				**X**
Indiana				**X**
Iowa	Colorectal	X		
Kansas				**X**
Kentucky	X			
Louisiana	X	Reproductive tract		**X***
Michigan			X	
Minnesota				**X**
Mississippi	X	Reproductive tract		
Missouri	Digestive system			**X**
Montana	Colorectal			
Nebraska	Digestive system			
Nevada	X	X	X	
New Hampshire				**X**
New Jersey				**X**
New Mexico	Colorectal			
New York	Digestive system	Reproductive system		
North Carolina	Intestinal			
North Dakota				**X**
Ohio				**X**
Oklahoma				**X**
Oregon	X			
Pennsylvania				**X**
Rhode Island				**X**
South Carolina	Gastrointestinal		Endocrine system	
South Dakota				**X**
Tennessee	X			
Texas	X			
Vermont	X			
Virginia		X	X	
Washington	Colorectal			
Wisconsin	Digestive system	Reproductive system		
Wyoming				**X**

*Arkansas language states: cancer that has been found by research and statistics to show higher instances of occurrence in firefighters

*Louisiana language states: any other cancer for which firefighters are determined to have statistically significant increased risk over the general population

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