



We hope this email finds you well. The First Responder Center for Excellence (FRCE) is pleased to provide this quarterly communication to keep you informed about the work of the Alliance.

Visit [the FRCE website](#) for cancer information related to the fire service, including links to the most up-to-date resources, research and best practices.

SPECIAL EDITION: The IARC Monograph Summary of the Final Evaluations

International Agency for Research on Cancer
World Health Organization

IARC MONOGRAPHS VOL. 132: OCCUPATIONAL EXPOSURE AS A FIREFIGHTER

Occupational exposure as a firefighter is **carcinogenic to humans (Group 1)** on the basis of **sufficient evidence for cancer in humans**

GROUP 1

GROUP 2A

GROUP 2B

GROUP 3

The IARC Monographs classification indicates the level of certainty that an agent can cause cancer (*hazard identification*)

Higher level of certainty ————— Lower level of certainty

Cancer types with **sufficient evidence for cancer in humans**:

Mesothelioma
 Bladder cancer

Cancer types with **limited evidence for cancer in humans**:

Colon cancer
 Prostate cancer
 Testicular cancer
 Melanoma of the skin
 Non-Hodgkin lymphoma

Strong mechanistic evidence in exposed firefighters

Genotoxicity
 Epigenetic alterations
 Oxidative stress
 Chronic inflammation
 Modulation of receptor-mediated effects

Exposures of firefighters include combustion products, diesel exhaust, building materials, asbestos, chemicals, shift work, ultraviolet radiation

Firefighters respond to various types of fire

Structure
 Wildland
 Vehicle

Important points of the summary and commentary

IARC Monographs evaluate the carcinogenicity of occupational exposure as a firefighter:

What follows is a breakdown of the important points for firefighters to understand based on the recently released summary of evaluations. After the release of the complete report in 2023 we will issue another update to help firefighters digest, understand and best utilize this information.

It is important to understand that the IARC working group evaluated scientific literature published up until June 2022. More than a decade has passed since the last IARC monograph. In that time, an enormous amount of scientific literature has been published on the health hazards including an elevated cancer risk to firefighters. The profession of firefighter was moved from group to 2B to group 1.

NOTE: Group 1: The agent is carcinogenic to humans.

This category is used when there is sufficient evidence for cancer in humans. In other words, there is convincing evidence that the agent causes cancer in humans. The evaluation is usually based on the results of epidemiological studies showing development of cancer in exposed humans. Agents can also be classified in Group 1 on the basis of sufficient evidence for cancer in experimental animals supported by strong evidence in exposed humans that the agent has mechanistic effects that are important for cancer development.

Additionally, and importantly - much more research is continuing.

In this summary, 7 cancers were elevated from their previous status. The Working Group concluded that there was “sufficient” evidence in humans for mesothelioma and bladder cancer and that there was “limited” evidence in humans for colon, prostate, and testicular cancers, and for melanoma and non-Hodgkin lymphoma. Lung and thyroid cancer are mentioned in this summary as “inadequate”. This may be due to a healthy worker hire bias for lung cancer and a surveillance bias was considered a probable explanation for the higher incidence rate of thyroid cancer observed in firefighters compared with the general population. There may also not be enough scientific literature on a specific cancer type, although research is continuing.

- A Working Group of 25 international experts, including 3 Invited Specialists, from 8 countries was convened by the International Agency for Research on Cancer (IARC) Monographs program for a meeting in Lyon France. After thoroughly reviewing the available scientific literature, the Working Group classified occupational exposure as a firefighter as carcinogenic to humans (Group 1), on the basis of sufficient evidence for cancer in humans.
- A summary of the final evaluations has now been published in The Lancet Oncology. (The detailed assessment will be published in 2023 as Volume 132 of the IARC Monographs).
- In June 2022, 25 scientists from eight countries met at the International Agency for Research on Cancer (IARC) in Lyon, France, to finalize their evaluation of the carcinogenicity of occupational exposure as a firefighter. Occupational exposure as a firefighter was classified as “carcinogenic to humans” (Group 1) based on “sufficient” evidence for cancer in humans.
- The Working Group concluded that there was “sufficient” evidence in humans for mesothelioma and bladder cancer. There was “limited” evidence in humans for colon, prostate, and testicular cancers, and for melanoma and non-Hodgkin lymphoma.
- 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”.
- The Group 1 evaluation for occupational exposure as a firefighter should be presumed to apply to all firefighters (including volunteers) and to both men and women.
- Firefighters can be exposed to combustion products from fires (eg, polycyclic aromatic hydrocarbons [PAHs] and particulates), building materials (eg, asbestos), chemicals in

firefighting foams (eg, perfluorinated and polyfluorinated substances [PFAS]), flame retardants, diesel exhaust, and other hazards (eg, night shift work and ultraviolet or other radiation).

- Uptake of fire effluents or other chemicals can occur via inhalation and dermal absorption and possibly via ingestion.
- Dermal absorption of chemicals can occur even in firefighters wearing PPE due to limitations of its design, fit, maintenance, or decontamination.
- Since the previous classification of firefighting (as “possibly carcinogenic to humans,” Group 2B) by the IARC Monographs in 2007, many new studies have investigated the association between occupational exposure as a firefighter and cancer risk in humans.
- A total of 52 cohort and case-control studies, 12 case reports, and seven meta-analyses were considered in the present evaluation as well as a meta-analysis that incorporated cohort studies of firefighters published up to June 2022.
- More than 30 non-overlapping cohort studies following firefighters for cancer over time were considered most informative for the evaluation and were conducted in Asia, Europe, North America, and Oceania.
- For these combined studies, the Working Group meta-analysis estimated a 58% higher risk for mesothelioma among firefighters compared with mostly general populations. Asbestos exposure in firefighting is a plausible causal agent to support the observed associations.
- 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%).
- 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.
- Credible positive associations were observed for colon, prostate, and testicular cancers, and for melanoma and non-Hodgkin lymphoma, based on estimates from the cohort studies included in the meta-analysis and consideration of the larger body of evidence.
- Several reasons (such as surveillance bias, inconsistent positive findings from informative studies, or little evidence for firefighting exposures known to be associated with these cancer types). reduced confidence in a casual conclusion and resulted in a determination of “limited” evidence for these five cancer types (colon, prostate, testicular, melanoma, and non-Hodgkin lymphoma).
- The human cancer evidence for all other cancer types was “inadequate”, including for lung and thyroid cancers. Lung cancer incidence and mortality rates were lower among firefighters than in the general population in most studies and in the meta-analysis; negative confounding by smoking and healthy worker hire bias were presumed to be likely. Surveillance bias was considered a probable explanation for the higher incidence rate of thyroid cancer observed in firefighters compared with the general population.
- Consistent and coherent evidence of genotoxic effects was observed in firefighters: an increase in the frequency of PAH-DNA adducts was found in blood; increases in urinary mutagenicity, DNA damage in blood, and micronucleus frequency in buccal cells were associated with firefighting-related exposures.
- Definition: Genotoxicity - the property of chemical agents that damage the genetic information within a cell causing mutations, which may lead to cancer.
- Definition: Buccal cells - The human body constantly sheds cheek, or squamous epithelial, cells. Samples can be easily obtained by swabbing the inside of the mouth. A noninvasive collection method. They have been used to detect cancer-associated changes in the oral cavity. Buccal cells have provided a source of DNA for analysis using PCR or other genotype tests.
- Definition: Monograph: A detailed written study of a single specialized subject or an

aspect of it.

Who is IARC?

- IARC's Mission: Cancer research for cancer prevention
- The International Agency for Research on Cancer (IARC) is the specialized cancer agency of the World Health Organization.

The objective of the IARC is to promote international collaboration in cancer research.

There was also strong mechanistic evidence in exposed humans that occupational exposure as a firefighter exhibits 5 of the 10 key characteristics of carcinogens:

- “is genotoxic” “induces epigenetic alterations” “induces oxidative stress” “induces chronic inflammation” and “modulates receptor-mediated effects”
- Occupational exposure as a firefighter was previously evaluated by the IARC Monographs program in 2007 and at that time was classified as possibly carcinogenic to humans (Group 2B) on the basis of limited evidence for cancer in humans (specifically, for non-Hodgkin lymphoma, prostate cancer, and testicular cancer).
- The Advisory Group to Recommend Priorities for the IARC Monographs during 2020–2024 recommended that occupational exposure as a firefighter should be re-evaluated with high priority by the IARC Monographs program.
- This recommendation was based on the publication of new large cohort studies in firefighters, with long-term follow-up for cancer incidence and/or mortality, and on the availability of new mechanistic evidence from epidemiological studies among firefighters.
- There was no single study that provided key evidence that was used to update the evaluation. Rather, there were more than 30 long-term studies of cancer among firefighters that provided new evidence to support the re-classification.
- The Working Group conducted a meta-analysis of all the evidence from the group of more than 20 non-overlapping cohort studies and found consistent evidence for an increased risk among firefighters for cancers at certain sites. Furthermore, the new mechanistic studies among firefighters found consistent and coherent evidence for five key characteristics of carcinogens, providing strong mechanistic support for the conclusions reached about elevations in cancer risk.
- There are more than 15 million firefighters worldwide. The term “firefighters” encompasses a heterogeneous group of paid and unpaid workers in industrial, municipal, and wildland settings, at the wildland–urban interface, and in other situations. In some settings, firefighting exposures have become more prevalent over time, because of the impacts of climate change.
- Firefighters respond to various types of fire, such as structure, wildland, and vehicle fires, as well as other events (e.g. vehicle accidents and building collapses).
- Firefighters are exposed to a complex mixture of combustion products from fires (e.g. polycyclic aromatic hydrocarbons, volatile organic compounds, metals, and particulates), diesel exhaust, building materials (e.g. asbestos), and other hazards (e.g. heat stress, shift work, and ultraviolet and other radiation). In addition, the use of flame retardants in textiles and of persistent organic pollutants (e.g. per- and polyfluorinated substances) in firefighting foams has increased over time.
- This mixture may include many agents already classified by the IARC Monographs program in Group 1 (carcinogenic to humans), Group 2A (probably carcinogenic to humans), and Group 2B (possibly carcinogenic to humans). Dermal exposure, inhalation, and ingestion are common routes of exposure, and biomarker studies among firefighters have found enhanced levels of markers of exposure to polycyclic aromatic hydrocarbons, flame retardants, and persistent organic pollutants.

Group 1: The agent is carcinogenic to humans.

This category is used when there is sufficient evidence for cancer in humans. In other

words, there is convincing evidence that the agent causes cancer in humans. The evaluation is usually based on the results of epidemiological studies showing development of cancer in exposed humans. Agents can also be classified in Group 1 on the basis of sufficient evidence for cancer in experimental animals supported by strong evidence in exposed humans that the agent has mechanistic effects that are important for cancer development.

The IARC Monographs classification indicates the strength of the evidence that a substance or agent can cause cancer. The IARC Monographs program seeks to identify cancer hazards, meaning the potential for the exposure to cause cancer. However, the classification does not indicate the level of cancer risk associated with exposure at different levels or in different scenarios. The cancer risk associated with substances or agents that are assigned the same classification may be very different, depending on factors such as the type and extent of exposure and the size of the effect of the agent at a given exposure level.

See Report [IARC Summary of Group 1 Classification for Carcinogenicity of Firefighting](#)

UPCOMING REGIONAL CANCER SEMINARS

New York 8.2022

Maryland 9.2022

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