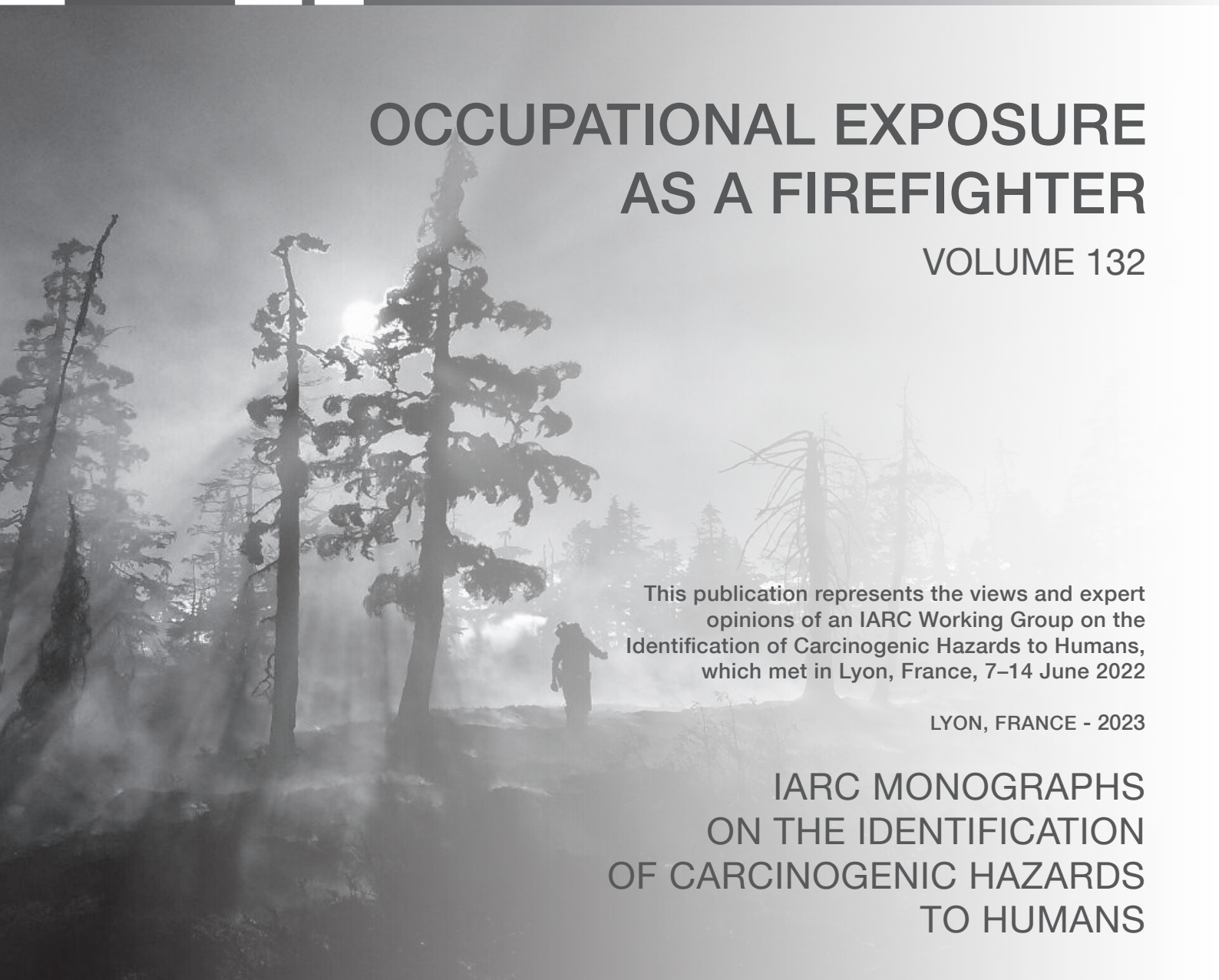
IARC MONOGRAPHS



OCCUPATIONAL EXPOSURE AS A FIREFIGHTER

VOLUME 132

This publication represents the views and expert opinions of an IARC Working Group on the Identification of Carcinogenic Hazards to Humans, which met in Lyon, France, 7–14 June 2022

LYON, FRANCE - 2023

IARC MONOGRAPHS ON THE IDENTIFICATION OF CARCINOGENIC HAZARDS TO HUMANS

International Agency for Research on Cancer

World Health Organization

6. EVALUATION AND RATIONALE

6.1 Cancer in humans

There is *sufficient* evidence in humans for the carcinogenicity of occupational exposure as a firefighter. Occupational exposure as a firefighter causes mesothelioma and cancer of the bladder. Positive associations have been observed between occupational exposure as a firefighter and cancers of the colon, prostate, and testis, and malignant melanoma of the skin and non-Hodgkin lymphoma.

6.2 Cancer in experimental animals

There is *inadequate* evidence in experimental animals regarding the carcinogenicity of occupational exposure as a firefighter.

6.3 Mechanistic evidence

There is *strong* evidence that occupational exposure as a firefighter exhibits key characteristics of carcinogens in exposed humans.

6.4 Overall evaluation

Occupational exposure as a firefighter is *carcinogenic to humans (Group 1).*

6.5 Rationale

The Group 1 determination for occupational exposure as a firefighter is based on *sufficient* evidence for cancer in humans. This *sufficient* evidence was observed for mesothelioma and cancer of the bladder, based on findings from many well-conducted cohort studies in multiple countries in Asia, Europe, North America, and Oceania comparing the cancer incidence or mortality experience of firefighters with that of the general population. The Working Group noted consistent positive associations for these cancers in the body of epidemiological evidence, including among the most informative studies based on consideration of exposure assessment quality, length of follow-up, and other study attributes. Furthermore, the positive findings were supported by the plausibility of exposure of firefighters to agents known to cause mesothelioma and bladder cancer (e.g. asbestos, and polycyclic aromatic hydrocarbons and other combustion products, respectively). For cancers of the colon, prostate, and testis, and for melanoma and non-Hodgkin lymphoma, the Working Group concluded that the evidence is *limited*: positive associations were observed in the body of evidence for firefighters, but chance, bias, and/or confounding could not be ruled out with reasonable confidence because of inconsistent associations, concerns about surveillance

bias (whereby firefighters might be subject to more frequent screening or medical examinations than are the general population), possible confounding, and/or the lack of exposure to known causes of these cancers. For other cancer sites, the evidence is *inadequate*.

There is also *strong* evidence that occupational exposure as a firefighter exhibits multiple key characteristics of carcinogens. Occupational exposure as a firefighter is genotoxic; it induces epigenetic alterations; it induces oxidative stress; it induces chronic inflammation; and it modulates receptor-mediated effects. A minority of the Working Group considered that the evidence for chronic inflammation was only suggestive; however, the majority opinion of the Working Group was that the evidence was consistent and coherent for this key characteristic. The evidence that occupational exposure as a firefighter exhibits these key characteristics came primarily from studies in humans exposed to different types of fire (i.e. structure, training, and wildland), as well as exposure measured as occupation (including volunteers) as a firefighter. Evidence regarding cancer in experimental animals is *inadequate* because no studies were available to the Working Group.

On the basis of the available evidence, the Group 1 evaluation for occupational exposure as a firefighter should be presumed to apply to all categories and types of firefighter, and to men and women.