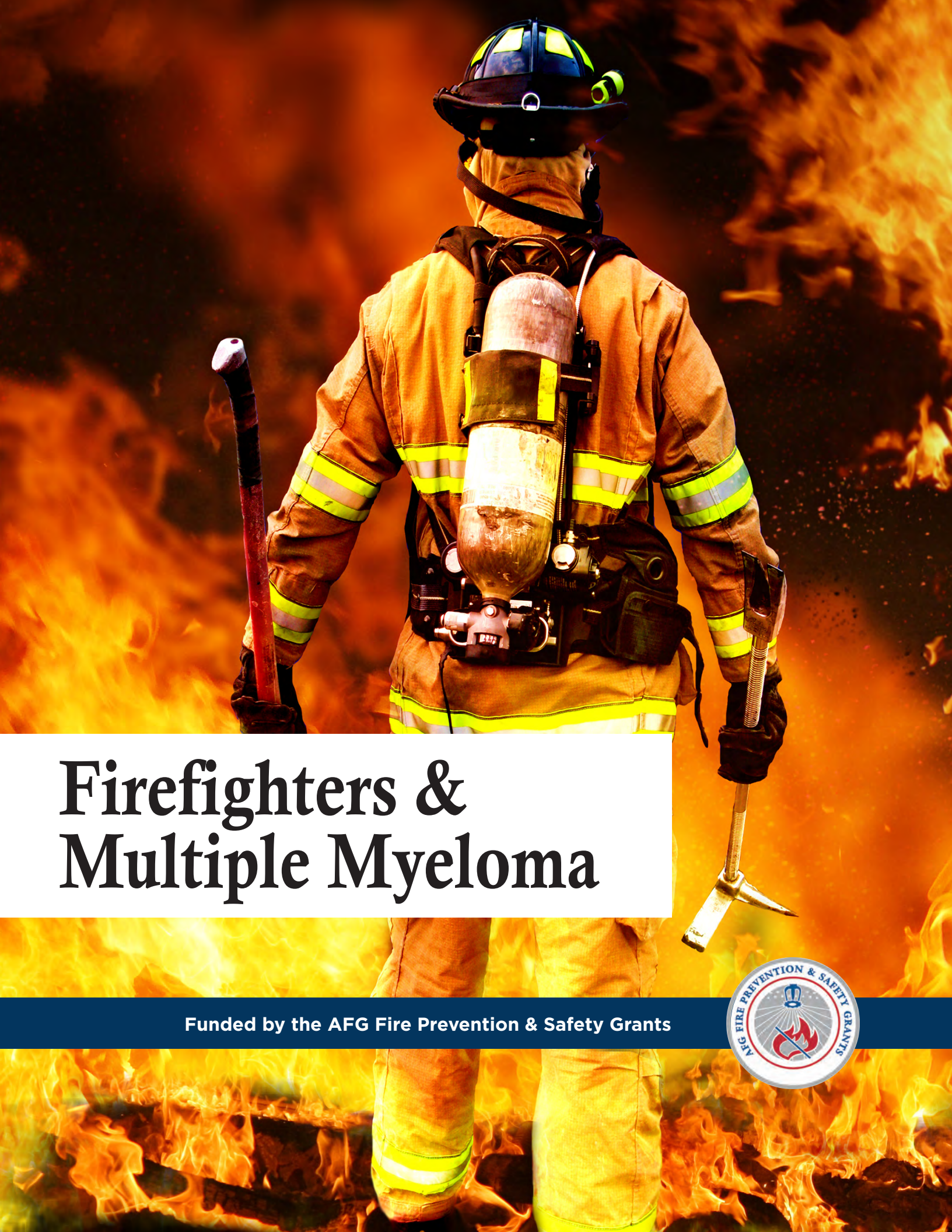

Firefighters & Multiple Myeloma

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GENERAL EPIDEMIOLOGY: MULTIPLE MYELOMA (MM)

The American Cancer Society (ACS)[1] estimates approximately 34,920 new cases of MM will be diagnosed and 12,410 deaths will occur from MM in the United States in 2021. As a relatively rare cancer, the estimated lifetime risk of MM is 1 in 143 (0.7%)[1]. Age adjusted incidence for MM in Western countries is estimated at 5.6 per 100,000 persons[2]. Ten year survival for MM is estimated to be 30% for those under the age of 60 years old[2].

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***[3]. 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"[4] which is often used in cases of workers compensation.

RISK FACTORS FOR MULTIPLE MYELOMA

Given the rarity of MM, the reasons some people develop the disease is not fully understood. However, a number of risk factors have been identified that seem to increase risk of disease development.

- **Age**: According to the ACS[1], less than 1% of people diagnosed with MM are under the age of 35 and 2% under the age of 40. Most people diagnosed with MM are at least 65 years old.
- **Race/Ethnicity**: African Americans are more than twice as likely as Caucasians to get MM[1].
- **Heredity**: Males are more likely to develop MM than females[1,5].
- **Family History**: Reviews of relevant literature suggest an increased risk of MM with a positive family history[5,6].
- **Obesity**: Compared to healthy weight peers, those who are overweight or obese have increased risk of developing MM[7].

OCCUPATIONAL EXPOSURES RELATED TO MULTIPLE MYELOMA

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 can be 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 asbestos, benzene, styrene, polycyclic aromatic hydrocarbons, and heavy metals[8–15]. Firefighters also face several routes of exposure including inhalation, dermal absorption, secondary exposure through contaminated dust from particulates post incident, and potentially the semi-volatile off-gassing of gear.

Benzene. Evidence exists that suggests exposure to benzene, a chemical in gasoline and a carcinogen consistently found to be a by-product of combustion[10], places people at increased risk for the development of multiple myeloma[16,17]. Benzene is not only present on the fire ground, 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.

FIREFIGHTING AND MULTIPLE MYELOMA

LeMasters et al.'s[18] meta-analysis of 32 firefighter cancer studies found support for the relationship between firefighting and multiple myeloma. ***Firefighters faced a 53% increased risk of multiple myeloma*** (SRE=1.53, 95% CI=1.31-1.73). Additionally, Tsai et al.[19] conducted a case-control study of cancer risk among firefighters in California from 1988-2007 using the California Cancer Registry (CCR). The study included 3,996 firefighters with cancer and 48,725 non-firefighter controls. The odds ratio comparing firefighters to controls, which was statistically adjusted for age of diagnosis, race, and year of diagnosis, was 1.35 (95% CI: 1.00-1.82). ***Firefighters faced a 35% higher risk of developing multiple myeloma.***

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