

## **IARC MONOGRAPHS PROGRAMME FINDS CANCER HAZARDS ASSOCIATED WITH SHIFTWORK, PAINTING, AND FIREFIGHTING**

After a thorough review and discussion of the published scientific evidence, an [expert Working Group](#) convened by the IARC Monographs programme has concluded that

- Shiftwork that involves circadian disruption is [probably carcinogenic to humans](#) (Group 2A).
- Occupational exposure as a painter is [carcinogenic to humans](#) (Group 1).
- Occupational exposure as a firefighter is [possibly carcinogenic to humans](#) (Group 2B).

These three occupations involve complex exposure patterns that make it difficult to attribute risk to specific factors. [The Working Group, comprising 24 scientists from 10 countries](#), met at the [International Agency for Research on Cancer \(IARC\)](#), the cancer research agency of the [World Health Organization](#).

A summary of these conclusions is being published in the December issue of [The Lancet Oncology](#). Full results will be published next year as [volume 98 of the IARC Monographs](#).

### **Shiftwork that involves circadian disruption is “probably carcinogenic to humans”**

Epidemiological studies have found that long-term nightworkers have a higher risk of breast cancer risk than women who do not work at night. These studies have involved mainly nurses and flight attendants. The studies are consistent with animal studies that demonstrate that constant light, dim light at night, or simulated chronic jet lag can substantially increase tumour development. Other experimental studies show that reducing melatonin levels at night increases the incidence or growth of tumours.

These results may be explained by the disruption of the circadian system that is caused by exposure to light at night. This can alter sleep-activity patterns, suppress melatonin production, and disregulate genes involved in tumour development. Among the many different patterns of shiftwork, those that include nightwork are most disruptive to the circadian system.

"Nearly 20% of the working population in Europe and North America is engaged in shiftwork, which is most prevalent in the health-care, industrial, transportation, communications, and hospitality sectors: To date, most studies have focussed on breast cancer in nurses and flight attendants. Now more studies are needed to examine this potential risk in other professions and for other cancers," noted [Dr Cogliano, Head of the IARC Monographs Programme](#).

### **Occupational exposure as a painter is “carcinogenic to humans”**

Epidemiological studies of painters have consistently found small but significant increases in the risk of lung cancer and bladder cancer. In addition, several studies of painters have found increased levels of genetic damage.

Four of five case-control studies found significant increases in childhood leukaemia associated with maternal exposure before or during pregnancy, although findings were inconsistent for lymphatic and haematopoietic cancers in the painters themselves.

Painters are exposed to numerous chemical solvents, pigments, and additives. They can also be exposed to other workplace hazards such as asbestos and crystalline silica. The available information is not specific enough to identify particular agents as the cause of the excess lung or bladder cancers. It also cannot be determined whether the cancer risks have increased or decreased with changes in the solvents, pigments, and additives used in paints.

### **Occupational exposure as a firefighter is “possibly carcinogenic to humans”**

Epidemiologic studies of firefighters have noted excess cancer risks compared with the general population. Consistent patterns are difficult to discern due to the large variations in exposure across different types of fires and different groups of firefighters. Relative risks were consistently increased, however, for three types of cancer: testicular cancer, prostate cancer, and non-Hodgkin lymphoma.

Acute and chronic inflammatory respiratory effects have been noted in firefighters, and this would provide a plausible mechanism for respiratory carcinogenesis. Firefighters are exposed to numerous toxic chemicals, including many known or suspected carcinogens. These intermittent exposures can be intense, and short-term exposure levels can be high for respirable particulate matter and for several carcinogens, notably benzene, benzo[a]pyrene, 1,3-butadiene, and formaldehyde.

### **What is new, and what do these results mean to me?**

"These are IARC's first evaluations of shiftwork and firefighting. Because there is credible evidence linking these occupations with increased risks of cancer, it is important that further studies be conducted to better identify what it is about such occupations that may increase the risk of cancer so that preventive measures can be implemented to avoid such risks", concluded Dr Peter Boyle, Director of the International Agency for Research on Cancer.

Occupational exposure as a painter has been classified since 1989 as carcinogenic to humans, and this new evaluation has linked painting to lung cancer and bladder cancer. The new evaluation also suggests that maternal exposure may be associated with childhood leukaemia. It is important that further studies be conducted in this area to confirm whether this risk is real and to identify precautionary measures that are appropriate to consider.

## **ABOUT THE IARC MONOGRAPHS**

### **What are the IARC Monographs?**

The IARC Monographs identify environmental factors that can increase the risk of human cancer. These include chemicals, complex mixtures, occupational exposures, physical and biological agents, and lifestyle factors. National health agencies use this information as scientific support for their actions to prevent exposure to potential carcinogens. Interdisciplinary working groups of expert scientists review the published studies and evaluate the weight of the evidence that an agent can increase the risk of cancer. The principles, procedures, and scientific criteria that guide the evaluations are described in the Preamble to the IARC Monographs.

Since 1971, more than 900 agents have been evaluated, of which approximately 400 have been identified as carcinogenic or potentially carcinogenic to humans.

### **Definitions**

#### **Group 1: The agent is carcinogenic to humans.**

This category is used when there is *sufficient evidence of carcinogenicity* in humans. Exceptionally, an agent may be placed in this category when evidence of carcinogenicity in humans is less than *sufficient* but there is *sufficient evidence of carcinogenicity* in experimental animals and strong evidence in exposed humans that the agent acts through a relevant mechanism of carcinogenicity.

#### **Group 2.**

This category includes agents for which, at one extreme, the degree of evidence of carcinogenicity in humans is almost *sufficient*, as well as those for which, at the other extreme, there are no human data but for which there is evidence of carcinogenicity in experimental animals. Agents are assigned to either Group 2A (*probably carcinogenic to humans*) or Group 2B (*possibly carcinogenic to humans*) on the basis of epidemiological and experimental evidence of carcinogenicity and mechanistic and other relevant data. The terms *probably carcinogenic* and *possibly carcinogenic* have no quantitative significance and are used simply as descriptors of different levels of evidence of human carcinogenicity, with *probably carcinogenic* signifying a higher level of evidence than *possibly carcinogenic*.

#### **Group 2A: The agent is probably carcinogenic to humans.**

This category is used when there is *limited evidence of carcinogenicity* in humans and *sufficient evidence of carcinogenicity* in experimental animals. In some cases, an agent may be classified in this category when there is *inadequate evidence of carcinogenicity* in humans and *sufficient evidence of carcinogenicity* in experimental animals and strong evidence that the carcinogenesis is mediated by a mechanism that also operates in humans. Exceptionally, an agent may be classified in this category solely on the basis of *limited evidence of carcinogenicity* in humans. An agent may be assigned to this category if it clearly belongs, based on mechanistic considerations, to a class of agents for which one or more members have been classified in Group 1 or Group 2A.

### **Group 2B: The agent is possibly carcinogenic to humans.**

This category is used for agents for which there is *limited evidence of carcinogenicity* in humans and less than *sufficient evidence of carcinogenicity* in experimental animals. It may also be used when there is *inadequate evidence of carcinogenicity* in humans but there is *sufficient evidence of carcinogenicity* in experimental animals. In some instances, an agent for which there is *inadequate evidence of carcinogenicity* in humans and less than *sufficient evidence of carcinogenicity* in experimental animals together with supporting evidence from mechanistic and other relevant data may be placed in this group. An agent may be classified in this category solely on the basis of strong evidence from mechanistic and other relevant data.

### **Group 3: The agent is not classifiable as to its carcinogenicity to humans.**

This category is used most commonly for agents for which the evidence of carcinogenicity is *inadequate* in humans and *inadequate* or *limited* in experimental animals.

Exceptionally, agents for which the evidence of carcinogenicity is *inadequate* in humans but *sufficient* in experimental animals may be placed in this category when there is strong evidence that the mechanism of carcinogenicity in experimental animals does not operate in humans.

Agents that do not fall into any other group are also placed in this category.

An evaluation in Group 3 is not a determination of non-carcinogenicity or overall safety. It often means that further research is needed, especially when exposures are widespread or the cancer data are consistent with differing interpretations.

### **Group 4: The agent is probably not carcinogenic to humans.**

This category is used for agents for which there is *evidence suggesting lack of carcinogenicity* in humans and in experimental animals. In some instances, agents for which there is *inadequate evidence of carcinogenicity* in humans but *evidence suggesting lack of carcinogenicity* in experimental animals, consistently and strongly supported by a broad range of mechanistic and other relevant data, may be classified in this group.

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