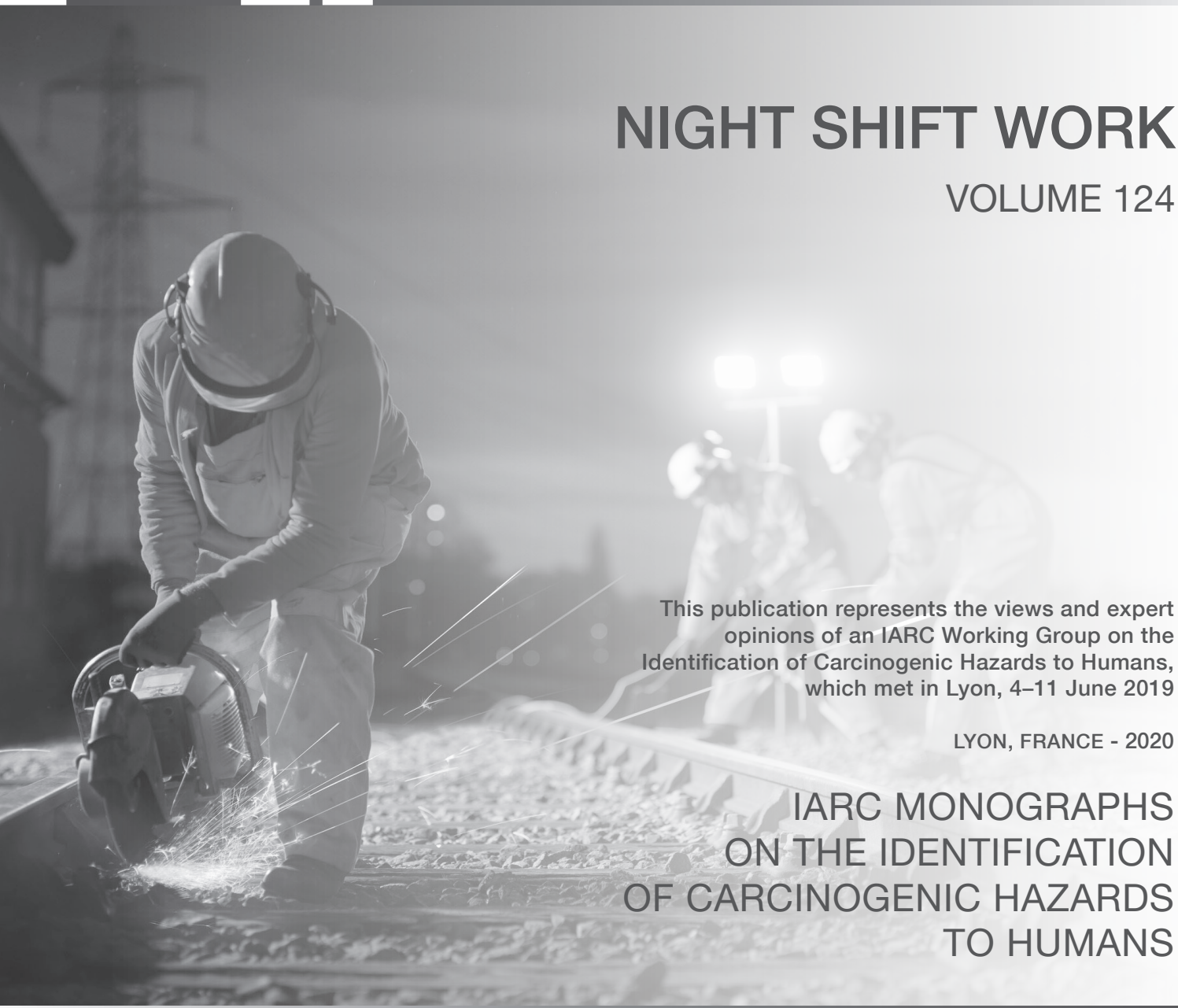
IARC MONOGRAPHS



NIGHT SHIFT WORK

VOLUME 124

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, 4–11 June 2019

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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 *limited evidence* in humans for the carcinogenicity of night shift work. Positive associations have been observed between night shift work and cancers of the breast, prostate, colon, and rectum.

6.2 Cancer in experimental animals

There is *sufficient evidence* in experimental animals for the carcinogenicity of alteration in the light–dark schedule.

6.3 Mechanistic evidence

There is *strong evidence* in experimental systems that alteration in the light–dark schedule exhibits key characteristics of carcinogens, based on evidence of effects consistent with immunosuppression, chronic inflammation, and cell proliferation.

6.4 Overall evaluation

Night shift work is *probably carcinogenic to humans* (Group 2A).

6.5 Rationale

In reaching the Group 2A evaluation, the Working Group considered the bodies of evidence related to exposure characterization, cancer in humans, cancer in experimental animals, and mechanistic evidence.

A large number of informative studies on cancer in humans were evaluated. A key aspect of the informativeness of the studies was the quality of the exposure assessment methods, which varied considerably, particularly across studies of different designs. In general, the case–control studies were given greater prominence in the overall evaluation due to their stronger exposure assessments. The largest and highest-quality case–control studies observed positive associations between night shift work and cancers of breast, prostate, colon, and rectum. However, results were inconsistent among cohort studies for these cancer types. Thus, the Working Group evaluated the evidence as *limited* for these cancers.

Based on reports of lifetime carcinogenicity bioassays from two laboratories, the Working Group concluded that there is *sufficient evidence* in experimental animals for the carcinogenicity of alteration in the light–dark schedule. In a first report, three mouse strains – including one wild-type strain – exposed to shifts in the light–dark schedule demonstrated significant increases in the incidence of hepatocellular carcinoma compared with strain-specific control groups exposed to a 12 hour light–12 hour dark cycle. In the second report, mice from a second wild-type strain exposed to continuous light demonstrated significant increases in the incidence of malignant lymphoma, lung adenocarcinoma,

and total tumours compared with a control group exposed to a 12 hour light–12 hour dark cycle. Several other studies supported the carcinogenicity of alterations in the light–dark schedule seen in the lifetime bioassays.

Studies of night shift work in humans and alteration in the light–dark schedule in experimental animals provided evidence relevant to key characteristics of carcinogens. Experimental designs and selection of end-points as they relate to each of these key characteristics varied for both streams of evidence. Findings for certain key characteristics were sometimes discordant, and this lack of coherence could not always be explained in both streams of evidence. The Working Group did find support for a conclusion of *strong evidence* in experimental systems, based on findings consistent with immunosuppression, chronic inflammation, and cell proliferation. There was suggestive evidence of alterations in estrogen homeostasis in female night shift workers.