

4. Summary of Data Reported and Evaluation

4.1 Exposures

Approximately 200 000 workers worldwide are employed in paint manufacture. The total number of painters is probably several millions, a major group being construction painters. Other industries in which large numbers of painters are employed include manufacture of transportation equipment and metal products, automotive and other refinishing operations and furniture manufacture.

Thousands of chemical compounds are used in paint products as pigments, extenders, binders, solvents and additives. Painters are commonly exposed by inhalation to solvents and other volatile paint components; inhalation of less volatile and nonvolatile components is common during spray painting. Dermal contact is the other major source of exposure. Painters may be exposed to other chemical agents that they or their coworkers use.

Painters are commonly exposed to solvents, the main ones being petroleum solvents, toluene, xylene, ketones, alcohols, esters and glycol ethers. Chlorinated hydrocarbons are used in paint strippers and less frequently in paint formulations. Benzene was used as a paint solvent in the past but is currently found in only small amounts in some petroleum solvent-based paints. Titanium dioxide and chromium and iron compounds are used widely as paint pigments, while lead was used commonly in the past. Asbestos has been used as a paint filler and may occur in spackling and taping compounds; painters in the construction industry and shipyards may also be exposed to asbestos. Exposure to silica may occur during the preparation of surfaces in construction and metal painting.

Workers in paint manufacture are potentially exposed to the chemicals that are found in paint products, although the patterns and levels of exposure to individual agents may differ from those of painters. Construction painters may be exposed to dusts and pyrolysis products during the preparation of surfaces and to solvents in paints, although water-based paints have become widely used recently. In metal and automobile painting, metal-based antirust paints and solvent-based paints are often applied by spraying; in addition, newer resin systems, such as epoxy and polyurethane, are commonly used. In contrast to other

painting trades, furniture finishing involves the use of more varnishes, which have evolved from cellulose-based to synthetic resin varnishes, including amino resins which may release formaldehyde.

4.2 Human carcinogenicity data

The reports most relevant for assessing the risk for cancer associated with occupational exposures in paint manufacture and painting are three large cohort studies of painters and collections of national statistics on cancer incidence and mortality in which data on cancer at many sites were presented for painters. These show a consistent excess of all cancers, at about 20% above the national average, and a consistent excess of lung cancers, at about 40% above the national average. The available evidence on the prevalence of smoking in painters, although limited, indicates that an excess risk for lung cancer of this magnitude cannot be explained by smoking alone. The risks for cancers of the oesophagus, stomach and bladder were raised in many of the studies, but the excesses were generally smaller and more variable than those for lung cancer. Some of the studies also reported excess risks for leukaemia and for cancers of the buccal cavity and larynx.

Several other small cohort and census-based studies in painters provided estimates of risk for cancer at one or several sites. The risk for lung cancer was reported to be raised in eight, that for stomach cancer in two, that for bladder cancer in two, that for leukaemia in four, that for malignancies of the lymphatic system in three, that for buccal cancer in three, that for laryngeal cancer in one, that for skin cancer in one, and that for prostatic cancer in three. In many studies, risks for cancer were reported only for sites for which the result was statistically significant.

In the three cohort studies of workers involved in the manufacture of paint, two of which were small, there was little to suggest an excess risk of lung cancer or of cancer at any other anatomical site.

Eleven case-control and related studies of lung cancer could be evaluated. All of the studies showed an increased risk for lung cancer among painters. The five studies in which smoking was taken into account showed an increase of 30% or more in risk for lung cancer. Two studies suggested increased risks among painters for laryngeal cancer, and one indicated an increased risk for mesothelioma.

Cancer of the urinary tract has been examined in relation to exposure to paint in 15 case-control and related studies. Eight showed an excess risk for bladder cancer in all painters. In certain studies, specific aspects of exposure to paint were examined: car painters were addressed in two studies, one indicating an excess risk; spray painters were evaluated in three studies, two of which showed an excess risk; and exposure to lacquer and chromium was associated with a risk in one study.

In a study of occupational histories of patients with oesophageal and stomach cancers, high risks were seen for painters. A further study also identified a risk for stomach cancer and another a risk for oesophageal cancer. One study of cancer of the gall-bladder and of the biliary tract showed associations with the occupation of painting. A study of pancreatic cancer reported a high risk for exposure to paint thinners.

Five studies of leukaemia mentioned painters. Two studies showed excess risks. Two small studies of Hodgkin's disease and three studies of multiple myeloma showed increased risks in association with the occupation of painter or with any exposure to paints, paint-related products or organic solvents.

A single study of prostatic cancer showed a significant excess risk for manufacturers of paints and varnishes, and one study reported a high risk for testicular cancer among spray painters.

Twelve studies of childhood cancer mentioned paternal exposure to paint and related substances; four of these also presented data on maternal exposure. Three studies showed an excess of childhood leukaemia in association with paternal exposure and one in association with maternal exposure. Two studies showed an excess risk for brain tumours in the children of male painters. One small study of children with Wilms' tumour showed an excess in those whose fathers were painters. All of these excesses are based on small numbers of children whose parents had been exposed, even in the larger studies. In the other studies, no association was seen between parental exposure to paint and childhood cancers. The type and timing of exposure varied among these studies.

4.3 Other relevant data

Painters may suffer from allergic and nonallergic contact dermatitis, chronic bronchitis and asthma, and adverse effects on the nervous system. There is also some indication of adverse effects in the liver, kidney, blood and blood-forming organs. Many of these effects are also seen in paint production workers.

Of three studies on the fertility of painters, two showed no adverse effect and the third a possible excess frequency of infertility in men. One study reported an excess frequency of spontaneous abortion in female painters, based on self-reported data. Studies of birth weight, perinatal mortality rates and congenital malformations in the offspring of male painters generally showed no adverse effects; few data on female painters were available.

No increase in the frequency of sister chromatid exchange in peripheral lymphocytes was found in one study of painters or in one study of paint manufacturing workers.

4.4 Evaluation¹

There is *sufficient evidence* for the carcinogenicity of occupational exposure as a painter.

There is *inadequate evidence* for the carcinogenicity of occupational exposure in paint manufacture.

Overall evaluation

Occupational exposure as a painter *is carcinogenic (Group 1)*.

¹For definitions of the italicized terms, see Preamble, pp. 27-30.

Occupational exposure in paint manufacture *is not classifiable as to its carcinogenicity (Group 3)*.