

Exposures in the Painting Trades and Paint Manufacturing Industry and Risk of Cancer Among Men and Women in Sweden

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Using data from the 1960 and 1970 Swedish censuses and the Swedish Cancer Register for 1971 to 1989, this study investigated variations in cancer risk by gender associated with employment in painting trades and paint manufacturing. Among men, standardized incidence ratios were significantly increased for lung cancer among painters and lacquerers; bladder cancer among artists; and pancreas cancer, lung cancer, and nonlymphocytic leukemia among paint and varnish plant workers. Risks for women were elevated for cancers of the esophagus, larynx, and oral cavity among lacquerers and for oral cancer among glazers. These findings are consistent with the report of the International Agency for Research on Cancer that classified painting as an occupationally related cause of cancer and provide further evidence that the risk of certain cancers is increased by exposures in the paint manufacturing process. (J Occup Environ Med. 2002;44: 258-264)

In 1989, an International Agency for Research on Cancer Working Group reported that “there is *sufficient evidence* for the carcinogenicity of occupational exposure as a painter.”¹ Using a nationwide population-based record-linkage database in Sweden, we examined variations in cancer risk associated with employment in different painting trades among men and women. Because the Working Group also reported that “there is *inadequate evidence* for the carcinogenicity of occupational exposure in paint manufacture,”¹ we evaluated the cancer risk among workers in the paint and varnish industry.

Subjects and Methods

The source of data for this analysis is the Cancer Environment Register III (CERIII), which links data from the Swedish Cancer Register for 1971 to 1989,² the Swedish Register of Causes of Death for 1971 to 1989,³ and the national population censuses from both 1960 and 1970.⁴ Details of this linkage are described elsewhere.⁵ In brief, information for all individuals in Sweden was collected on place of birth, place of residence, employment status, job title, and industry by Statistics Sweden during the 1960 and 1970 Swedish National Population and Housing Censuses.⁶ For these individuals, mortality and cancer incidence during 1971 to 1989 were determined through linkage with the Swedish Register of Causes of Death² and the Swedish Cancer Register,³ respectively. Person-years of observation

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were calculated from January 1, 1971, until death or end of follow-up, December 31, 1989.

The cohorts for these analyses include men and women who were alive and free from cancer on January 1, 1971, and who, at either census, were employed as pictorial artists (Swedish occupational code 081), painters (code 781), lacquerers (code 782), glazers (code 814), or who worked in paint and varnish plants (code 314 in 1960 and 3521 in 1970). The lacquerers cohort was divided into those who worked in the wood industry and those in the metal industry. Employed men and women were classified as employed in either 1960 or 1970, or in both 1960 and 1970. This analysis focused primarily on subjects employed during either 1960 or 1970, because the larger cohorts provided greater stability. Results for those employed during both censuses are presented for specific findings of interest.

For each cohort, the expected number of cancers was calculated by multiplying the gender-specific national cancer incidence rates for persons employed in either 1960 or 1970 by 5-year-age and calendar-year group to the number of person-years in each cohort. Standardized incidence ratios (SIR), defined as the ratio of observed to expected number of cancers, were calculated to measure the risk of specific cancers and all cancers combined. Similar calculations were performed for individuals employed in the same occupation in both 1960 and 1970. The 95% confidence intervals (CI) were calculated assuming that the observed number of cases followed a Poisson distribution. All primary cancers (including second primary cancers) were included in both the observed and expected rates.³

Results

A total of 42,433 men classified as painters during either the 1960 or 1970 census contributed 611,544 person-years of observation and a total of 4475 tumors (Table 1). Risk

TABLE 1

SIRs of Selected Cancers Among Male Painters During 1960 or 1970, According to the Swedish Cancer Environment Register III*

Neoplasm	Painters		
	n	SIR	95% CI
All cancers	4,475	1.0	1.0-1.0
Oral cavity	122	1.0	0.8-1.1
Esophagus	63	1.1	0.9-1.4
Esophagus, adenocarcinoma	14	1.4	0.8-2.3
Stomach	276	1.0	0.9-1.1
Colon	320	1.0	0.9-1.1
Rectum	267	1.2	1.0-1.3
Liver	36	0.8	0.6-1.1
Gallbladder	26	1.1	0.7-1.6
Extrahepatic bile ducts	22	1.5	1.0-2.3
Pancreas	158	1.1	0.9-1.3
Larynx	62	1.2	0.9-1.6
Lung	548	1.2	1.1-1.3
Pleura/mesothelioma	19	1.6	0.9-2.4
Bone	10	1.4	0.7-2.5
Melanoma	95	0.9	0.7-1.1
Skin, nonmelanoma	145	0.8	0.7-0.9
Prostate	1,040	1.0	0.9-1.0
Bladder	344	1.1	1.0-1.2
Kidney	147	0.9	0.8-1.1
Brain	107	1.0	0.8-1.2
Thyroid	19	0.9	0.6-1.4
Non-Hodgkin's lymphoma	123	1.0	0.8-1.2
Hodgkin's lymphoma	25	1.0	0.6-1.4
Multiple myeloma	71	1.0	0.8-1.3
Leukemia	115	0.9	0.8-1.1

* SIR, standardized incidence ratio; CI, confidence interval.

was significantly increased for cancer of the lung (SIR, 1.2; CI, 1.1 to 1.3), of borderline significance for cancers of the rectum (SIR, 1.2; CI, 1.0 to 1.3) and extrahepatic bile ducts (SIR, 1.5; CI, 1.0 to 2.3), and nonsignificantly elevated for pleura/mesothelioma (SIR, 1.6; CI, 0.9 to 2.4). Rectal cancer was significantly elevated (SIR, 1.3; CI, 1.1 to 1.5; 165 observed) in men classified as painters during both the 1960 and 1970 censuses, whereas borderline or nonsignificant elevations in risk of 1.5 or greater were observed for adenocarcinoma of the esophagus (SIR, 1.6; CI, 0.7 to 3.0; 9 observed) and cancers of extrahepatic bile ducts (SIR, 1.6; CI, 0.8 to 2.8; 12 observed) and pleura/mesothelioma (SIR, 1.8; CI, 1.0 to 3.0; 13 observed).

For the cohort of 12,331 male lacquerers (198,661 person-years) employed during either the 1960 or 1970 census, risk was elevated sig-

nificantly for cancer of the lung (SIR, 1.3; CI, 1.1 to 1.6) and nonsignificantly for cancers of the pleura/mesothelioma (SIR, 2.0; CI, 0.7 to 4.4) and thyroid (SIR, 1.7, CI, 0.8 to 3.1) and for chronic nonlymphocytic leukemia (SIR, 1.9; CI, 0.8 to 4.0) (Table 2). Among the 2764 lacquerers employed during both the 1960 and 1970 censuses, the SIR remained elevated for cancers of the lung (SIR, 1.4; CI, 1.0 to 2.0; 37 observed) and thyroid (SIR, 2.1; CI, 0.8 to 4.3; 7 observed). Similar risk estimates were observed for the subset of 10,428 men employed during 1960 or 1970 as lacquerers in the metal industry. Among those employed during both censuses, the risk for lung cancer reached 1.5 (CI, 1.0 to 2.1; 34 observed) and the risk for cancer of the esophagus was nonsignificantly elevated (SIR, 1.8; CI, 0.6 to 4.3; 5 observed). For the 2021 lacquerers employed in the wood

TABLE 2
SIRs of Selected Cancers Among Male Lacquerers During 1960 or 1970, According to the Swedish Cancer Environment Register III*

Neoplasm	Any Lacquerer			Metal Lacquerer			Wood Lacquerer		
	n	SIR	95% CI	n	SIR	95% CI	n	SIR	95% CI
All cancers	933	1.0	1.0-1.1	784	1.0	1.0-1.1	158	1.1	0.9-1.2
Oral cavity	30	1.0	0.7-1.5	22	0.9	0.6-1.4	10	2.1	1.0-3.9
Esophagus	14	1.2	0.7-2.0	13	1.3	0.7-2.3	1	0.5	0.0-2.9
Stomach	46	0.9	0.6-1.2	41	0.9	0.7-1.2	6	0.7	0.2-1.5
Colon	56	0.9	0.7-1.1	43	0.8	0.6-1.1	9	0.9	0.4-1.7
Rectum	43	0.9	0.7-1.2	37	1.0	0.7-1.3	6	0.8	0.3-1.7
Liver and biliary tract	17	0.9	0.5-1.5	13	0.8	0.4-1.4	4	1.3	0.4-3.4
Pancreas	21	0.7	0.4-1.1	18	0.7	0.4-1.2	3	0.6	0.1-1.8
Larynx	11	1.0	0.5-1.7	11	1.1	0.6-2.0	0	0.0	0.0-2.0
Lung	128	1.3	1.1-1.6	116	1.4	1.2-1.7	13	0.8	0.4-1.4
Pleura/mesothelioma	6	2.0	0.7-4.4	5	2.0	0.6-4.6	1	2.0	0.0-11.3
Melanoma	30	1.0	0.6-1.4	25	0.9	0.6-1.4	5	1.0	0.3-2.3
Skin, nonmelanoma	33	1.0	0.7-1.4	24	0.9	0.6-1.3	9	1.7	0.8-3.2
Prostate	202	1.1	1.0-1.3	168	1.1	1.0-1.3	36	1.2	0.8-1.6
Bladder	78	1.2	0.9-1.4	68	1.2	0.9-1.5	12	1.1	0.6-1.9
Kidney	37	1.0	0.7-1.3	29	0.9	0.6-1.3	9	1.4	0.7-2.8
Brain	29	1.0	0.6-1.4	25	1.0	0.6-1.4	4	0.8	0.2-2.1
Thyroid	9	1.7	0.8-3.1	8	1.7	0.8-3.4	2	2.2	0.2-8.1
Non-Hodgkin's lymphoma	37	1.3	0.9-1.8	32	1.3	0.9-1.8	5	1.1	0.3-2.5
Hodgkin's lymphoma	7	1.0	0.4-2.1	6	1.0	0.4-2.2	1	0.9	0.0-4.9
Multiple myeloma	16	1.1	0.6-1.8	10	0.8	0.4-1.5	6	2.5	0.9-5.4
Nonlymphocytic leukemia	13	1.2	0.6-2.0	11	1.2	0.6-2.1	2	1.1	0.1-3.9
Chronic nonlymphocytic leukemia	7	1.9	0.8-4.0	5	1.6	0.5-3.8	2	3.3	0.4-12.1

* SIR, standardized incidence ratio; CI, confidence interval.

industry, risk was elevated for cancer of the oral cavity (SIR, 2.1; CI, 1.0 to 3.9) due to an excess reported during the 1970 census (SIR, 2.9; CI, 1.3 to 5.5; 9 observed). Nonsignificant elevations of 1.5 or greater were seen for nonmelanoma skin cancer (SIR, 1.7; CI, 0.8 to 3.2) and multiple myeloma (SIR, 2.5; CI, 0.9 to 5.4).

Male artists employed during either census comprised a cohort of 6662 men (99,737 person-years). Risk was significantly elevated for bladder cancer (SIR, 1.5; CI, 1.2 to 1.9) and of borderline significance for cancers of the oral cavity (SIR, 1.5; CI, 1.0 to 2.1) and renal pelvis (SIR, 2.5; CI, 1.0 to 5.1) (Table 3). Nonsignificant SIRs of 1.5 or greater were observed for cancers of the small intestine (SIR, 1.6; CI, 0.5 to 3.8) and testis (SIR, 1.7; CI, 0.6 to 3.7). Among the 2361 artists employed during both censuses, bladder cancer risk reached 1.9 (CI, 1.3 to 2.6; 39 observed), whereas the hepa-

tobiliary cancer risk was 1.6 (CI, 0.7 to 3.0; 9 observed). There were only 48 cancers among the 449 men employed as glazers during either census, with no significantly elevated risks for any form of cancer (data not shown). However, nonsignificant risks of 1.5 or greater were observed for cancer of the stomach (SIR, 1.7; CI, 0.5 to 3.9; 5 observed), specifically tumors not of the cardiac part of the stomach (SIR, 2.1; CI, 0.7 to 4.9; 5 observed).

A total of 618 cancers were observed among the cohort of 5741 men (85,401 person-years) employed during either the 1960 or 1970 census in paint and varnish plants (Table 4). Risks were significantly elevated for pancreatic cancer (SIR, 1.7; CI, 1.1 to 2.4), lung cancer (SIR, 1.5; CI, 1.2 to 1.9), and nonlymphocytic leukemia (SIR, 2.1; CI, 1.1 to 3.6). Risks of borderline significance were observed for cancers of the small intestine (SIR, 2.6; CI, 1.0 to 5.4)

and colon (SIR, 1.3; CI, 1.0 to 1.7), whereas nonsignificant risks of 1.5 or greater were seen for cancers of the esophagus (SIR, 1.5; CI, 0.8 to 2.7) and connective tissue (SIR, 1.6; CI, 0.6 to 3.4). Among the 1244 men employed in these plants during both censuses, a risk of borderline significance remained for cancer of the colon (SIR, 1.7; CI, 1.0 to 2.7; 18 observed), whereas nonsignificantly increased risks were seen for cancers of the pancreas (SIR, 1.6; CI, 0.7 to 3.2; 8 observed) and lung (SIR, 1.2; CI, 0.8 to 1.9; 20 observed). Among the subset of 2260 men with probable exposure to solvents but not other potential carcinogens (data not presented), risks were borderline or nonsignificantly elevated for cancers of the liver and biliary tract (SIR, 1.7; CI, 0.7 to 3.5; 7 observed) and for non-Hodgkin's lymphoma (SIR, 1.8; CI, 0.9 to 3.2; 11 observed) and multiple myeloma (SIR, 2.4; CI, 1.0 to 4.8; 8 observed).

TABLE 3
SIRs of Selected Cancers Among Male Pictorial Artists During 1960 or 1970, According to the Swedish Cancer Environment Register III*

Neoplasm	Artists		
	n	SIR	95% CI
All cancers	664	1.0	1.0-1.1
Oral cavity	29	1.5	1.0-2.1
Esophagus	11	1.4	0.7-2.4
Stomach	27	0.7	0.4-1.0
Small intestine	5	1.6	0.5-3.8
Colon	52	1.1	0.8-1.5
Rectum	30	0.9	0.6-1.3
Liver and biliary tract	18	1.4	0.8-2.2
Pancreas	25	1.2	0.8-1.8
Larynx	6	0.8	0.3-1.7
Lung	69	1.0	0.8-1.3
Melanoma	20	1.1	0.7-1.7
Skin, nonmelanoma	30	1.2	0.8-1.7
Prostate	129	0.9	0.8-1.1
Testis	6	1.7	0.6-3.7
Bladder	71	1.5	1.2-1.9
Kidney	26	1.0	0.7-1.5
Renal pelvis	7	2.5	1.0-5.1
Brain	19	1.1	0.7-1.7
Non-Hodgkin's lymphoma	21	1.1	0.7-1.7
Multiple myeloma	7	0.7	0.3-1.4
Leukemia	12	0.7	0.4-1.2

* SIR, standardized incidence ratio; CI, confidence interval.

Presented in Table 5 are risks for women employed as lacquerers, glazers, or pictorial artists during either the 1960 or 1970 census. In the cohort of 974 female lacquerers (16,022 person-years), there were 83 cancers observed. Although based on small numbers, significantly elevated risks were observed for cancers of the esophagus (SIR, 8.6; CI, 1.7 to 25.2) and larynx (SIR, 14.8; CI, 1.7 to 53.4), whereas a risk of borderline significance was seen for cancer of the oral cavity (SIR, 3.8; CI, 1.0 to 9.7). Nonsignificantly elevated risks of 1.5 or greater, with five or more cases, were observed for cancers of the pancreas (SIR, 2.2; CI, 0.7 to 5.1) and lung (SIR, 1.5; CI, 0.5 to 3.6). Risks were not significantly elevated among the 63 women (7 cancers) employed during both censuses. In the cohort of 882 female glazers (14,721 person-years and 68 cancers), a significantly elevated risk

TABLE 4
SIRs of Selected Cancers Among Male Workers in the Paint and Varnish Industry During 1960 or 1970, According to the Swedish Cancer Environment Register III*

Neoplasm	Paint and Varnish Workers		
	n	SIR	95% CI
All cancers	618	1.1	1.0-1.2
Oral cavity	13	0.8	0.4-1.3
Esophagus	11	1.5	0.8-2.7
Stomach	25	0.7	0.5-1.1
Small intestine	7	2.6	1.0-5.4
Colon	52	1.3	1.0-1.7
Rectum	27	0.9	0.6-1.4
Liver and biliary tract	13	1.1	0.6-1.9
Pancreas	30	1.7	1.1-2.4
Larynx	12	1.8	0.9-3.1
Lung	87	1.5	1.2-1.9
Melanoma	22	1.4	0.9-2.1
Skin, nonmelanoma	19	0.9	0.5-1.4
Prostate	117	1.0	0.8-1.1
Bladder	48	1.2	0.8-1.5
Kidney	16	0.7	0.4-1.2
Brain	10	0.7	0.3-1.2
Thyroid	5	1.8	0.6-4.2
Connective tissue	6	1.6	0.6-3.4
Non-Hodgkin's lymphoma	17	1.0	0.6-1.7
Hodgkin's lymphoma	5	1.5	0.5-3.5
Multiple myeloma	13	1.4	0.8-2.5
Nonlymphocytic leukemia	13	2.1	1.1-3.6
Acute nonlymphocytic leukemia	9	2.2	1.0-4.2

* SIR, standardized incidence ratio; CI, confidence interval.

(SIR, 4.6; CI, 1.2 to 11.8) was seen for oral cancer along with a nonsignificant risk (SIR, 2.3; CI, 0.7 to 5.3) for stomach cancer. No significantly increased risks were observed among the 103 women (11 cancers) employed during both the 1960 and 1970 censuses. In the cohort of 2136 female artists (34,271 person-years), there were 207 cancers observed, but only the SIR for cancer of the uterus (SIR, 1.6; CI, 1.1 to 2.3) was significantly elevated, due to borderline or nonsignificant risks for uterine cervix (SIR, 1.8; CI, 1.0 to 3.1) and corpus (SIR, 1.5; CI, 0.9 to 2.4). Among the 431 women employed during both 1960 and 1970, risks remained elevated for cancer of the uterus (SIR, 1.8; CI, 0.8 to 3.5; 9

observed), particularly the corpus (SIR, 2.4; CI, 1.0 to 4.9; 7 observed). In the cohort of 239 women (14 cancers) employed as painters or the cohort of 1897 women (157 cancers) employed in paint and varnish plants during either census, there were no significantly elevated risks (data not shown). No cancers occurred among the four women employed as painters during both censuses; however, the risk for ovarian cancer was significantly elevated among the 217 women employed in paint and varnish plants during both 1960 and 1970 (SIR, 3.8; CI, 1.4 to 8.2; 6 observed).

Discussion

In this study, we explored the cancer risks among Swedish men and women employed in 1960 and/or 1970 in various painting trades and the paint and varnish manufacturing industry. Increased risks may result at least partly from exposures to the basic components of paints, varnishes, enamels, and lacquers, including pigments (inorganic, organic, and earth), binders or resins (natural or synthetic), and solvents (eg, toluene, Xylene, and benzene).¹

Among both male painters and metal lacquerers, we found statistically significant but modest (less than 1.5-fold) increases for lung cancer and elevated but nonsignificant increases for cancer of the pleura/mesothelioma. These findings are consistent with several studies reviewed by the International Agency for Research on Cancer Working Group¹ and several recent studies.⁷⁻¹¹ Most painters in Sweden worked in the building construction industry and were exposed to high levels of organic solvents, paint dust containing a variety of pigments, including lead and zinc chromate, and a variety of other inorganic dusts. The elevated SIR for cancer of the pleura/mesothelioma suggests exposure to asbestos, which is often found in areas where painters work^{12,13} and which may contribute to the excess risk of lung cancer.

TABLE 5
SIRs of Selected Cancers Among Female Lacquerers, Glazers, and Pictorial Artists During 1960 or 1970, According to the Swedish Cancer Environment Register III*

Neoplasm	Lacquerers			Glazers			Artists		
	n	SIR	95% CI	n	SIR	95% CI	n	SIR	95% CI
All cancers	83	1.0	0.8-1.2	68	1.0	0.8-1.2	207	1.2	1.0-1.3
Oral cavity	4	3.8	1.0-9.7	4	4.6	1.2-11.8	2	0.9	0.1-3.2
Esophagus	3	8.6	1.7-25.2	2	7.0	0.8-25.4	1	1.3	0.0-7.1
Stomach	4	1.5	0.4-3.8	5	2.3	0.7-5.3	6	1.0	0.4-2.2
Colon/rectum	13	1.4	0.7-2.4	4	0.5	0.1-1.4	21	1.0	0.6-1.6
Pancreas	5	2.2	0.7-5.1	1	0.5	0.0-3.0	5	1.0	0.3-2.3
Larynx	2	14.8	1.7-53.4	0	0.0	0.0-35.3	0	0.0	0.0-13.9
Lung	5	1.5	0.5-3.6	2	0.8	0.1-2.8	6	0.9	0.3-2.0
Breast	17	0.7	0.4-1.1	21	1.1	0.7-1.6	54	1.1	0.8-1.4
Uterus (all)	11	1.1	0.6-2.0	6	0.8	0.3-1.7	31	1.6	1.1-2.3
Cervix uteri	5	1.4	0.5-3.4	4	1.3	0.4-3.4	13	1.8	1.0-3.1
Corpus uteri	4	0.7	0.2-1.8	2	0.5	0.0-1.7	16	1.5	0.9-2.4
Ovary	6	1.0	0.4-2.2	1	0.2	0.0-1.2	15	1.3	0.7-2.1
Bladder	2	1.0	0.1-3.5	0	0.0	0.0-2.2	6	1.4	0.5-3.0
Hemopoietic	0	0.0	0.0-0.8	5	1.3	0.4-2.9	10	1.0	0.5-1.8

* SIR, standardized incidence ratio; CI, confidence interval.

The excess risk of bladder cancer in some painting trades in our study has been reported in some but not all epidemiologic investigations.^{1,9,14-16} Although slight increases in risk were seen for bladder cancer among male painters and lacquerers (SIR, 1.1 and 1.2, respectively), there were significant elevations in risk for male artists employed in either 1960 or 1970 (SIR, 1.5) and in both censuses (SIR, 1.9). The excess in bladder cancer risk is consistent with an earlier report from Sweden¹⁷ and from several US studies.^{18,19} The borderline excess risk of renal pelvis cancer among artists is also consistent with previously reported risks among painters.²⁰

The elevated risks we observed for cancers of the oral cavity and multiple myeloma have been reported previously among painters.^{1,15,21-24} It is noteworthy that the excess risks for these cancers occurred among wood, but not metal, lacquerers and may reflect exposures related to the wood products industry, such as wood dust,²⁵ or to paint and varnish stripping.¹ A borderline elevated risk was also observed for cancer of the oral cavity among artists in our study.

Although the manufacture of paint and varnish may involve exposure to hundreds of chemicals through inha-

tion and skin contact,¹ few studies have looked at cancer risk among these workers. An earlier evaluation of these data based on employment in 1960 indicated an elevated risk of pancreatic cancer (SIR, 1.6),²⁶ which is consistent with the increased risk we observed among men employed in the industry during 1970 and during both 1960 and 1970. We also observed significantly elevated risks for lung cancer (SIR, 1.5), as reported among paint and varnish workers,¹ which may be due to solvents (which are ubiquitous in the paint manufacturing industry because of their high volatility),¹ dust from raw materials in paint (eg, chromium, lead, silica, talc),^{1,27-29} or other workplace exposures (eg, asbestos).^{12,13} Solvents, which may include benzene exposure,³⁰ likely account for the increased risk of nonlymphocytic leukemia in our study. We also found nonsignificantly elevated risks of 1.5 or greater for cancers of the esophagus and larynx and for Hodgkin's disease, which have been linked to painting in other studies.^{1,8,24,31} The nonsignificant excesses we observed for cancers of the small intestine, thyroid, and connective tissue have not

been associated previously with painting.

Although based on relatively small numbers, the results observed among women, especially for lacquerers and glazers, were considerably higher than those observed for men in the painting trades. As with other studies,^{1,24} we found significantly elevated risks for cancers of the upper aerodigestive tract among female lacquerers and for cancer of the oral cavity among female glazers. The reasons for the gender differences in risk are unclear, but exposure to solvents may be higher in women because of their greater fat depots available for storage³² or to variations in the ability to detoxify environmental carcinogens.^{33,34} In a Danish study, the ingestion of controlled amounts of soluble cobalt, a compound to which Danish pottery painters are exposed, resulted in significantly higher blood and urine cobalt concentrations in women than in men.³⁵ In addition, men and women in the painting trades may have different task-related exposures, with women tending to be glazers or fine-detail painters, whereas men are involved in construction trades. Not previously reported were the significantly elevated risks for uterine can-

cer (both cervical and endometrial) among female artists and for ovarian cancer among women with long-term employment in the paint and varnish industry. These findings may be due to chance and require further investigation.

Strengths of our study include the nearly 100% coverage of the Swedish working population.⁶ The cohorts contributed over 610,000 person-years of observation for male painters, over 198,000 for male lacquerers, 99,000 for male artists, and over 85,000 for men employed in paint and varnish manufacturing plants. Although the number of female workers was smaller, female artists contributed over 34,000 person-years of observation, female lacquerers over 16,000, and female glazers over 14,000. This large database allowed us to look at the risk of specific cancers for a variety of painting trades among men and women over two points in time, ie, 1960 and 1970.

Limitations of this study include the inability to control for possible confounding by tobacco or alcohol, incomplete job histories, and lack of knowledge about specific job exposures. Information on self-reported occupation and industry, but not specific job exposures or activities, was based on the 1960 and 1970 national censuses. Thus, we were unable to look at duration of employment or evaluate specific chemical exposures. However, subjects employed in both 1960 and 1970 were used as a surrogate for long-term employment. Although painters in Sweden were found in a nationwide survey to have rates of smoking higher than the national average,³⁶ studies in the United States and Germany have shown that adjustment for smoking does not account for the excess lung cancer risk consistently observed among painters.^{9,11,37,38} A study in Sweden found an excess of alcoholism-related diagnoses among men but not women employed as painters.³⁹ Because we did not observe elevated risks for liver cancer, major

confounding by alcohol seems unlikely, despite the excess risks seen for oral cancer. We also cannot exclude multiple comparisons and the play of chance as an explanation for some results, especially for the previously unreported associations noted in our study.

In conclusion, our results are consistent with the report of the International Agency for Research on Cancer that classified painting as an occupationally related cause of cancer, and they provide additional evidence that the risk of certain cancers is increased by exposures in the paint manufacturing process.

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