Disability, mortality, and incidence of cancer among Geneva painters and electricians: a historical prospective study

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ABSTRACT The 1916 painters and the 1948 electricians who resided in the Canton of Geneva at the time of the 1970 census were identified and followed up to 1984. During the study period 121 disability pensions were awarded to painters and 59 to electricians. Age standardised incidence of disability per 1000 man-years at risk was higher among painters than among electricians for all neuropsychiatric causes (1.23/1000 and 0.68/1000, respectively) and for all other causes (5.50/1000 and 3.41/1000, respectively). No case of presenile dementia was diagnosed among painters. There was inadequate evidence to indicate that the higher risk of neuropsychiatric disability for painters might have been due to their occupational exposure to organic solvents. A possible toxic effect of these substances on the central nervous system was confounded with alcoholism which was associated with disability from neuropsychiatric disease in 12 of 20 painters and in only one of 10 electricians. Mortality and incidence of cancer were assessed among both cohorts and compared with the expected figures calculated from Geneva rates. Among painters there was a significant increase in overall mortality (O = 254, E = 218.5), in mortality from all cancers (O = 96, E = 75.4), and in incidence from all cancers (O = 159, E = 132.0). For the specific cancer sites, there was a significant excess risk for lung cancer (mortality: O = 40, E = 23.0), which was possibly related to occupational exposure to asbestos and to zinc chromate, although cigarette smoking was not controlled. The significant excesses of biliary tract cancer and of bladder cancer were in accordance with previous observations among painters from other countries. There was also a significant increase in incidence from testicular cancer (O = 5, E = 1.6), which has not been reported before. For causes of death other than cancer, the excesses for alcoholism (O = 5, E = 0.8), for liver cirrhosis (O = 14, E = 8.8), for motor vehicle accidents (O = 12, E = 5.9), and for cerebrovascular disease when allowing for ten years of latency (O = 8, E = 4.0), were consistent with a probable increased risk of alcohol abuse. Among electricians overall mortality was similar to that expected (O = 137, E = 139.0). No significant excess risk was found for all cancers or for any specific cancer site. Because of the small number of expected deaths the statistical power was low for the assessment of a possible risk for leukaemia or for brain tumour.

During the past ten years or so, several Scandinavian authors have reported non-specific neuropsychiatric disorders, attributed to a chronic toxic encephalopathy, among workers with long term exposure to solvents. In more severe cases "presenile dementia" and occasionally cerebral atrophy have been des-

cribed.¹ This syndrome has been recognised as an occupational disease in Nordic countries where it has been a frequent cause of premature retirement, especially in Denmark.² It is known as the "painters' syndrome" because it was first described among painters.³

The initial purpose of the present study was to examine the incidence of neuropsychiatric disability

among Geneva painters by comparison with that among Geneva electricians. Later on, the study was extended to the analysis of mortality and incidence of cancer among both groups.

Population and methods

The base cohorts were constituted by all painters ($n = 1993$) and all electricians ($n = 1992$) resident in the Canton of Geneva at the time of the 1970 census. The men were identified in the census files and traced through various registers according to methods previously described.⁴

From the base cohorts, 77 painters and 44 electricians were eliminated for the following reasons: (a) foreigners who did not appear in the records of the Population Office of Geneva (32 painters, 15 electricians); (b) men who died or emigrated before the start of the follow up (1 January 1971) (six painters, five electricians); (c) occupations wrongly classified as painters (six men) or electricians (two men); and (d) duplicate and other errors (33 painters, 22 electricians).

The remaining 1916 painters and 1948 electricians constituted the study cohorts. According to the classification of occupations used in the 1970 census, painters were distributed into 1338 building painters (wallpaper hangers included), 196 plasterer painters, 195 car painters, 68 other spray painters, and 119 sign painters and other painters. Electricians were distributed into 1833 "electricians" and 115 car electricians; the former category included: (a) electricity installers and repairmen, (b) telephone installers, and (c) linemen and cable jointers. It did not include electrical and electronics fitters and assemblers, or radio and television repairmen. About a third of the painters and half the electricians were certified professionals. The number of self employed was 258 painters (13.5%) and 68 electricians (3.5%).

The workers were followed up from 1 January 1971 to 31 December 1984, or to their death, or to the date at which their trace was lost. Of 763 foreign painters, 230 (30%) were lost to follow up when they left Switzerland and similarly 174 (27%) of the 649 foreign electricians. Thirteen of the 1153 Swiss painters and 31 of the 1299 Swiss electricians were known to have emigrated. Among them no painter and only one electrician were lost to follow up; the others were traced through Swiss Consulates, registers in their "Commune of origin,"⁴ population offices of neighbouring cities of France, or family members remaining in Geneva.

DISABILITY STUDY

In Switzerland a 100% disability pension is awarded to men under age 65 who have lost, due to disease or

accident, at least two thirds of their ability for a gainful employment in an equilibrated labour market. When the loss of ability is between half and two thirds, a 50% pension is awarded. The disability pension is paid whether the disease or accident is work related or not.

The workers of both cohorts who received a 50% or 100% disability pension during the study period (1 January 1971 to 31 December 1984) were identified in the files of the Geneva section of the Swiss "Assurance Invalidité." Men below age 30 were excluded because disability due to the "painters' syndrome" was not reported and seems unlikely among the younger age groups. Official coding of the cause of disability by the insurance board (only the main cause was coded) was used to classify the pensions in the selected categories of disability. Subsidiary diagnoses were extracted from the insurance records which contained medical forms completed by the treating physician(s) in all cases, and often reports of medical experts, especially from the outpatients or inpatients departments of the Geneva university hospital. In addition, hospital records of the 10 painters and the six electricians who had been admitted to the Geneva University psychiatric clinic were examined.

Only the date of the awarding of the pension and the official code number of disability were available for five painters and four electricians whose insurance records were not kept. For two other painters who both died from hepatic cirrhosis and one electrician who died from oesophageal cancer, it could not be ascertained if they had received a disability pension during a few months before death and these three cases were eliminated.

The cause specific disability incidence per 1000 man-years for 1971 to 1984, among painters and among electricians, was standardised for age using as standard population the two cohorts combined. The differences were tested using the method described by Berry.⁵

For convenience in the presentation of the results, the code number of the Swiss classification of disabilities was recoded by us in table 1 according to the 8th revision of the International Classification of Diseases (ICD).

No information was available about cause specific disability rates among the whole population. For comparison with the painters, occupations such as bricklayer, which was used as referent in Scandinavian studies,⁶ were considered. The proportion of foreign workers resident in the Canton of Geneva at the 1970 census was however much higher among bricklayers (86%) than among painters (41%), or electricians (34%), or among all Geneva industrial workers outside the construction industry (36%). The great majority of the electricians included in the cohort were working in housing and in industrial and commercial

Table 1 Number of pensions (1971-84) by official cause of disability and age standardised incidence† per 1000 man-years among painters and electricians. (Number of cases with the mention of alcoholism as a contributing cause of disability in parentheses)

Cause of disability (ICD code, 8th revision)	Painters		Electricians	
	No of pensions	Age adjusted incidence	No of pensions	Age adjusted incidence
Psychosis (290, 292-299)	1 (1)	0.07	1 (0)	0.06
Alcoholism (291, 303)	4	0.23	0	0.00
Neurosis, personality disorders (300-302, 304-307)	11 (7)	0.68	6 (1)	0.39
Nervous system (320-358)	4 (0)	0.25	3 (0)	0.23
Circulatory system (390-458)	31 (2)	1.62*	10 (1)	0.77
Respiratory system (460-519)	9 (2)	0.49	4 (2)	0.33
Musculoskeletal system (710-738)	26 (1)	1.42	11 (0)	0.75
Neoplasm (140-239)	11 (2)	0.58	7 (1)	0.46
Accident (800-949)	15 (1)	0.89	12 (0)	0.78
Other causes	9 (3)	0.50	5 (2)	0.32
All causes	121 (19)	6.72**	59 (7)	4.09

* $p < 0.05$; ** $p < 0.01$.

†Standard population = both cohorts combined.

establishments, similar to the painters. The socioeconomic levels of the two occupational groups were similar, as indicated by the minimum hourly wages in 1984: 17.1 Swiss francs for painters and 16.9 for electricians.⁶ Thus electricians were considered to be the best available comparison group of sufficient size.

MORTALITY AND CANCER INCIDENCE STUDY

The Swiss "Office fédéral de la statistique" supplied us with official death certificate codings for all men who died within the country. During the whole study period the ICD 8th revision was in force in Switzerland. Among the 10 deaths abroad (five painters and five electricians), the cause was obtained in four cases from a copy of the death certificates, in four cases from information from the wife, and from notices in Geneva newspapers for two men who died in the neighbouring region of France (one ski accident and one sudden cardiac death). The incident cancers were collected by the Geneva Cancer Registry.

Expected deaths and expected cases of cancer were calculated from regional rates as described previously.⁷ Expected deaths were based on 23 289 man-years of observation of painters and on 24 807 man-years of observation of electricians. The figures were a little less (22 398 and 23 387, respectively) for the incidence of cancer study because the periods of residence outside the Canton of Geneva should be excluded, due to the lack of a national cancer registry.

For the analysis of mortality from alcoholism we combined deaths from alcoholic psychosis (ICD-8: 291), alcoholism (303), and accidental poisoning by alcohol (E 860). The latter was included because in Switzerland most of the deaths allocated to this code are due to acute alcoholic intoxication.

The one sided significance of the excesses of observed deaths and of incident cancers was tested by the usual method based on the Poisson distribution.

Results

DISABILITY

Table 2 shows age specific incidence of disability per 1000 man-years and overall crude incidence for the whole study period 1971-84. The overall crude incidence of disability was twice as high among painters as among electricians. The age distribution of man-years, however, shows that the painters were on average older than the electricians. Age specific disability was always higher by about 50% among the painters except for the youngest age group (30-34).

There was higher age standardised incidence among painters than among electricians for all the selected categories of disability, although the difference was only significant for circulatory disease and for all causes (table 1).

For the four categories of neuropsychiatric disease, there were 20 pensions granted to painters and 10 to electricians. Age standardised incidence per 1000 man-years was respectively 1.23 and 0.68 (difference not significant), which gave a risk of disability among painters of 1.8 relative to the risk among electricians.

Among the 20 painters, alcoholism was the main cause of disability in four cases (one Korsakoff's syndrome) and a contributing cause in eight. Among the 10 electricians, alcoholism was a contributing cause for one case only.

There was no main or subsidiary diagnosis of presenile dementia or cerebral atrophy among painters. One electrician was granted a pension because cerebral atrophy was diagnosed on the CT scan. This was attributed to multiple cerebrovascular infarctions.

Considering all non-neuropsychiatric diagnoses together, the age standardised incidence of disability pensions was 5.50/1000 man-years among painters and 3.41/1000 among electricians (relative risk 1.6). The difference was significant at the 1% level.

Table 2 Number of disability pensions (1971–84) and incidence per 1000 man-years at risk among painters and electricians

Age	Painters			Electricians		
	No of pensions	Man-years	Incidence/1000 m-y	No of pensions	Man-years	Incidence/1000 m-y
30–34	4	2735	1.46	6	3746	1.60
35–39	8	2899	2.76	3	3394	0.88
40–44	13	2605	4.99	8	2826	2.83
45–49	10	2208	4.53	6	2244	2.67
50–54	16	1975	8.10	12	1725	6.96
55–59	39	1881	20.73	13	1278	10.17
60–64	31	1831	16.93	11	992	11.09
All ages	121	16134	7.50	59	16204	3.64

Among the selected categories of disability, incidence was significantly higher among painters for circulatory disease (table 1). More detailed analyses indicated that there were 18 pensions (incidence: 0.96/1000) among painters and eight (0.63/1000) among electricians for heart disease, eight (0.41/1000) and none, respectively, for cerebrovascular disease, and five (0.25/1000) and two (0.14/1000), respectively, for other vascular diseases.

Clinical data of the eight cases of cerebrovascular disease among painters indicated that there was a typical feature of stroke syndrome with a more or less severe hemiplegia in six men, a Wallenberg's syndrome in one, and a spontaneous haematoma of the left occipital lobe in the remaining one.

MORTALITY AND INCIDENCE OF CANCER

Among painters, mortality and incidence were significantly higher than expected from Geneva rates for gallbladder cancer, lung cancer, and all malignant

neoplasms (table 3). Incidence but not mortality from bladder cancer and from testicular cancer were also significantly increased. There was no significant excess for all malignant neoplasms or for any specific site among electricians (table 4).

Overall mortality and mortality from selected causes other than malignant neoplasm may be seen in table 5. There was a significant excess of observed deaths among painters for all causes, motor vehicle accident, and alcoholism. No significant excess of mortality was observed among electricians.

Table 6 gives the observed and expected deaths among painters during the first 10 years (1971–80), and the 11th to 14th years (1981–4), since the start of follow up. The SMRs from the leading causes of deaths increased with longer follow up. This was possibly due to the process of selection and survival described as the "healthy worker effect." The mortality excess during the last period was highly significant for all causes, malignant neoplasm, lung

Table 3 Cancer mortality and incidence among painters (1971–84)

Site (ICD code, 8th revision)	Deaths				Cases of cancer			
	Obs	Exp	SMR	90% CI	Obs	Exp	SIR	90% CI
All malignant neoplasms (140–209)	96	75.4	127**	107–151	159	132.0	120**	105–137
Buccal cavity, pharynx (140–149)	7	3.8	184	86–346	13	8.7	149	88–238
Oesophagus (150)	2	2.9	69	12–217	2	3.0	67	12–210
Stomach (151)	1	4.1	24	1–116	5	7.5	67	26–140
Intestine, rectum (152–154)	6	7.6	79	34–156	15	14.9	101	62–155
Liver (155)	5	3.2	156	55–292	5	3.6	139	55–292
Gallbladder (156)	3	0.7	429*	117–1108	3	0.8	375*	102–969
Pancreas (157)	1	3.5	29	1–136	1	3.0	33	2–158
Larynx (161)	2	1.9	105	19–331	5	4.4	114	45–239
Lung (162)	40	23.0	174***	131–226	40	27.3	147**	111–191
Skin (172–173)	0	1.5	—	0–200	21	18.3	115	77–165
Prostate (185)	5	6.0	83	33–175	13	12.3	106	63–168
Testis (186)	2	0.4	500	89–1574	5	1.6	313*	123–657
Bladder (188)	7	3.4	206	97–387	13	7.6	171*	101–272
Kidney (189)	3	2.0	150	41–388	4	3.4	118	40–269
Brain (191)	1	1.9	52	3–250	3	2.1	143	39–369
Hodgkin's disease (201)	0	0.9	—	0–333	0	1.0	—	0–300
Non-Hodgkin's lymphoma (200, 202)	1	1.4	71	4–339	2	2.5	80	14–252
Leukaemia (204–207)	1	2.0	50	23–237	1	2.3	43	2–206
Others and unknown	9	5.2	173	90–302	8	7.3	110	55–198

*p < 0.05; **p < 0.01; ***p < 0.001.

Table 4 Cancer mortality and incidence among electricians (1971–84)

Site (ICD code, 8th revision)	Deaths				Cases of cancer			
	Obs	Exp	SMR	90% CI	Obs	Exp	SIR	90% CI
All malignant neoplasms (140–209)	52	45.6	114	89–144	78	84.4	92	76–112
Buccal cavity, pharynx (140–149)	2	2.6	77	14–242	4	6.1	66	22–150
Oesophagus (150)	3	1.7	176	48–456	3	1.8	167	45–431
Stomach (151)	3	2.3	130	36–337	5	4.8	104	41–219
Intestine, rectum (152–154)	6	4.3	140	61–275	10	8.8	114	62–193
Liver (155)	1	1.9	53	3–250	1	2.1	48	2–226
Gallbladder (156)	0	0.4	—	0–749	0	0.5	—	0–599
Pancreas (157)	3	2.1	143	39–369	2	1.8	111	20–350
Larynx (161)	3	1.1	273	74–705	1	3.0	33	2–158
Lung (162)	13	13.7	95	56–151	16	16.6	96	60–146
Skin (172–173)	1	1.1	91	5–431	14	12.7	110	67–172
Prostate (185)	5	3.0	167	66–350	5	6.3	79	31–167
Testis (186)	0	0.5	—	0–599	2	2.0	100	18–315
Bladder (188)	0	1.9	—	0–158	3	4.5	67	18–172
Kidney (189)	1	1.2	83	4–395	1	2.1	48	2–226
Brain (191)	2	1.3	154	27–484	2	1.7	118	21–370
Hodgkin's disease (201)	2	0.8	250	44–787	1	1.1	91	5–431
Non-Hodgkin's lymphoma (200, 202)	1	1.0	100	5–474	1	1.9	53	3–250
Leukaemia (204–207)	2	1.4	143	25–450	2	1.6	125	22–393
Others and unknown	4	3.2	125	43–286	5	5.0	100	39–210

cancer, and circulatory disease. Analysis of the various categories of circulatory disease showed a significant excess for heart disease ($O = 32$, $E = 20.8$, $p < 0.01$), which was due to "other forms of heart disease" ($O = 17$, $E = 7.8$, $p < 0.01$) rather than to ischaemic heart disease ($O = 15$, $E = 13.0$). There was also an excess of borderline significance for cerebrovascular disease ($O = 8$, $E = 4.0$, $p = 0.05$).

By contrast, there was no increase in SMR with longer follow up among electricians. Within the last period (1981–84) the SMRs were 102 for all causes, 87 for malignant neoplasm, and 92 for circulatory disease.

No death certificate mentioned cerebral atrophy or presenile dementia as the underlying or a contributing cause in painters or in electricians.

The underlying cause of the five painters' deaths from alcoholism was delirium tremens for one, chronic

chronic alcoholism for three, and acute alcoholic intoxication for one.

Among the subgroup of building painters (70% of all painters), excesses were similar to those observed for the whole cohort, as expected. The increase in mortality from bladder cancer ($O = 6$, $E = 2.4$, $p < 0.05$) and from liver cirrhosis ($O = 12$, $E = 6.2$, $p < 0.05$) however, reached the conventional level of statistical significance, contrary to the increase among all painters.

Discussion

THE PAINTERS' SYNDROME

All painters living in Geneva canton at the time of the 1970 census were followed up for 14 years. Scrutiny of the causes of the 254 deaths and 121 disability pensions showed no case of presenile dementia. Never-

Table 5 Mortality from all causes and from non-malignant causes among painters and electricians (1971–84)

Cause of death (ICD code, 8th revision)	Painters				Electricians			
	Obs	Exp	SMR	90% CI	Obs	Exp	SMR	90% CI
All causes	254	218.5	116**	105–129	137	139.0	99	85–114
Circulatory disease (390–458):	81	74.9	108	89–130	34	42.7	80	59–106
Ischaemic heart disease (410–414)	34	35.7	95	69–126	16	21.0	76	48–116
Other heart diseases (390–398, 420–429)	25	20.4	123	85–171	13	11.5	113	67–180
Cerebrovascular disease (430–438)	16	11.0	145	91–221	3	5.9	51	14–131
Violent death (E 800–859, 861–999):	26	22.7	115	80–159	29	21.7	134	96–182
Motor vehicle accident (E 810–823)	12	5.9	203*	117–330	7	5.9	119	56–223
Other accidents and poisonings (E 800–807, 825–859, 861–949)	4	6.3	63	22–145	7	5.6	125	59–235
Suicide (E 950–959)	9	9.8	92	48–160	14	9.8	143	86–223
Other causes (0–136, 210–389, 460–796, E 860):	51	45.5	112	88–142	22	29.0	76	51–108
Alcoholism (291, 303, E 860)	5	0.8	625**	246–1314	0	0.5	—	0–599
Chronic bronchitis and emphysema (491, 492)	5	4.8	104	41–219	1	2.5	40	2–190
Cirrhosis of liver (571)	14	8.8	159†	96–249	4	5.9	68	23–155

* $p < 0.05$; ** $p < 0.01$.

† $p = 0.06$.

Table 6 Mortality among painters from the leading categories of deaths and from lung cancer for two periods of follow up

Cause of death (ICD code, 8th revision)	1971-80				1981-4			
	Obs	Exp	SMR	90% CI	Obs	Exp	SMR	90% CI
All causes	145	143.5	101	88-116	109	75.0	145***	123-170
Malignant neoplasm (140-209):	55	48.4	114	90-142	41	27.0	152**	115-197
Lung cancer (162)	23	15.1	152*	104-216	17	7.9	215**	137-323
Circulatory disease (390-458)	38	47.3	80	60-105	43	27.6	156**	119-202
Violent death (E 800-859, 861-999)	18	16.8	107	69-159	8	5.9	136	67-245
Other causes (0-136, 210-389, 460-796, E 860)	34	31.0	110	81-146	17	14.5	117	75-176

*p < 0.05; **p < 0.01; ***p < 0.001.

theless, a variety of less severe non-specific disorders of the central nervous system have been attributed to the chronic effects of solvents.⁸ This occupational hazard could conceivably account for the higher incidence of disability observed in this study among painters than among electricians for the four categories of neuropsychiatric disease taken together. Solvent exposure, however, was confounded with alcoholism, which was associated with neuropsychiatric disease in 12 of 20 painters and only one of 10 electricians.

It should be pointed out that the insurance board can reduce a pension by 50% in cases of alcoholism. We believe that Geneva physicians have taken this into account and have mentioned this diagnosis only when there was no doubt that their patient had a long history of alcohol related medical and social problems.

An increased risk for alcohol abuse among painters is supported by the mortality data which showed a significant excess of mortality from alcoholism and an excess of mortality from liver cirrhosis of borderline significance, although the latter excess was significant among the subgroup of building painters.

In conclusion, there was inadequate evidence to support a solvent related painters' syndrome from our 1971-84 analysis of disability among Geneva painters, despite the fact that hundreds of their Scandinavian fellow workers received compensation because of this syndrome during the same period.² There is no clear explanation for this discrepancy.

Mortality data were searched for suggestions. Observed mortality from all causes and from the leading causes of death among electricians was similar to that expected from Geneva rates. It is therefore unlikely that the relatively high incidence of disability among painters could be due to a better than average state of health of the occupational group selected for comparison.

In our previous cohort studies in Geneva there was no significant mortality excess from the main causes of death among hairdressers⁷ or among chemical workers who stayed at least one year,⁹ similar to the findings among electricians. Contrary to the concordant mortality experience of these three occupational cohorts, painters showed an increase in mortality which was

particularly pronounced (allowing for ten years of latency) for all causes, all malignant neoplasms, lung cancer, and circulatory disease.

Thus mortality and disability data are in agreement suggesting that Geneva painters are an unhealthy occupational group at higher risk from various diseases. It might be assumed that this is accountable for by a set of life style and occupational factors, some of which will be discussed below.

MORTALITY AND INCIDENCE OF CANCER AMONG PAINTERS

Lung cancer

The present study supports previous findings of an association between the occupation as a painter and lung cancer shown in two cohort studies of Swedish^{10,11} and United States painters^{12,13} and in "occupational disease surveillance studies" based on vital records¹⁴⁻¹⁷ and cancer registry data.^{18,19} Adjusting for cigarette smoking in two of these studies did not change the association.^{13,19}

In common with painters from other countries,²⁰ Geneva painters had in previous decades direct exposure to asbestos containing materials such as sealant and other compounds and indirect exposure to asbestos materials used by other trades in the building industry.

On the other hand, metal protective primers containing zinc chromate pigments were widely used by Geneva painters until recently. Zinc chromate has been shown to induce lung cancer in animals²¹ and has been assumed to be the main factor in the excess of lung cancer reported among chrome pigment makers²¹ and spray painters.²² Our inquiries indicated that Geneva building painters were exposed to zinc chromate during spray painting of non-ferrous metals and during removal of old primers often by sanding, before the application of a new coat of paint. But spray painters of machine tools, who constituted almost exclusively the subgroup of 68 "other spray painters," were certainly more regularly exposed to zinc chromate containing primers. Our mortality results suggest a high risk of lung cancer among these men

($O = 4$, $E = 1.0$, $p < 0.05$), although based on a small number of deaths.

In conclusion, the highly significant excess of lung cancer among Geneva painters was possibly related to occupational exposure to two lung carcinogens: asbestos and zinc chromate. Unfortunately, we have no data on the duration and level of exposure or on smoking habits. This precludes any tentative estimate of the proportion of the excess of lung cancer which may be ascribed to occupation.

Other cancers

The significantly increased risk for cancer of the biliary tract among Geneva painters was based on one cancer of the gallbladder and two cancers of the extrahepatic bile ducts. This observation is in agreement with the increased incidence from biliary cancer found among Swedish painters.^{10,23}

There were five cases of testicular cancer among Geneva painters (two seminomas, two teratomas, one lymphoma) when 1.6 were expected. No previous report has mentioned an association of testicular cancer with the occupation of painter and a chance excess should be considered.

Our finding of an excess of bladder cancer among painters supports the results of two case-control studies on bladder cancer,^{24,25} of a proportionate mortality study among artistic painters,²⁶ and of one of the above quoted occupational disease surveillance studies.¹⁸ Smoking or occupational exposure to unknown bladder carcinogen(s), or both, might be postulated to explain the excess among Geneva painters.

For alcohol related cancers (buccal cavity, pharynx, oesophagus, liver, and larynx) there was no significant excess risk. An increase in mortality and in incidence was nevertheless observed for cancer of the buccal cavity and pharynx ($SMR = 184$, $SIR = 149$) and for liver cancer ($SMR = 156$, $SIR = 139$) but as for cancers of the oesophagus and larynx the chances of detecting a significant excess were limited by the small numbers of expected deaths and cases of cancer.

Causes of death other than cancer

We have already discussed the probably higher than average alcohol consumption among Geneva painters and the related mortality from alcoholism and from hepatic cirrhosis. This risk factor is consistent with the significant excess of observed deaths from motor vehicle accident, and with the mortality excess of borderline significance from cerebrovascular disease when allowing for ten years of latency. As to this latter excess there is strong evidence of an association of heavy drinking with stroke²⁷⁻³⁰ and with hypertension,³¹ a well recognised risk factor for stroke.³²

It should be pointed out that the increased risk for

cerebrovascular disease is supported by the disability study which showed, as we have seen, eight cases among painters and none among electricians.

Mortality was significantly increased after a latency of ten years, for "other forms of heart disease." This category of deaths includes various heart disorders, especially cardiac insufficiency, a diagnosis often made by Swiss physicians, for ill defined causes of deaths. It cannot be ruled out that this mortality excess had some relation with the "alcoholic cardiomyopathy" described among chronic alcohol abusers.^{33,34} This latter diagnosis, however, could not be found on the relevant death certificates.

MORTALITY AND INCIDENCE OF CANCER AMONG ELECTRICIANS

Several reports have suggested an increased risk of leukaemia for various categories of electrical workers, although evidence is still controversial (reviews^{35,36}). Excess mortality or incidence were also reported for lung cancer,^{37,38} mesothelioma,^{39,40} brain tumours,⁴¹ malignant melanoma of the skin,^{42,43} and cancer of the pharynx.³⁸

In the present study there was no significant excess of cancer for any specific site. Observed and expected incidence of leukaemia ($O = 2$, $E = 1.6$), brain cancer ($O = 2$, $E = 1.7$), malignant melanoma ($O = 1$, $E = 2.1$), and cancer of the pharynx ($O = 1$, $E = 3.1$), however, were based on small numbers. There was no excess of lung cancer although in the past Geneva electricians have needed to pierce and saw asbestos plates that were set on the walls behind electrical boards for thermal insulation.

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