Cancer risks in painters: study based on the New Zealand Cancer Registry

Peter B Bcthwaire, Neil Pearce, James Fraser

Abstract
Painters are exposed *to* a range **of** complex chemical mixtures which include organic solvents and dye products with **known** carcinogenic and mutagenic potential. Trade painters or those manufacturing paints and coatings have increased rates of non-malignant diseases and cancers; including lung cancer, acute leukaemia, bladder cancer, and cancers **of** the oesophagus, larynx, biliary system, liver, skin, and large bowel. A series **of** case-control studies of painters, based on the New Zealand Cancer Registry, are presented. These concerned 19904 male patients registered for the period 1980–4 who were aged 20 or older at the time of registration. For each cancer site studied, the registrants **for** all other cancer sites formed the control group. Three cancer sites were associated with work as a painter—namely, bladder tumours (odds ratio (OR) 1·52, **95%** confidence interval (**95%** CI) 1·00–2·31), kidney and other urothelial tumours (OR 1·45, **95%** CI 0·85–2·50), and multiple myeloma (OR 1·95, 95%, CI 1·05–3·65). **Risks** for multiple myeloma were greater **among** car or spray painters and signwriters (OR 2·81) compared with construction and general painters **(OR** 1.80). **No** increased risk was found **for** leukaemia or for respiratory. biliary, skin, or gastrointestinal cancers.

Persons engaged in the manufacture and Application of paint are potentially exposed to a heterogeneous group of substances. in particular a wide range of organic solvents and dye products. Several studies have investigated the occupational risks of work in the painting trade or in industries manufacturing pain: and coatings. Increased nsks have been shown to occur for lung cancer,[1–5] acute leukaemia,[2 6 7] multiple myeloma,[8–11] bladder cancer,[12–15] and cancers of the oesophagus, larynx, biliary system and liver,[16] skin, large bowel, and rectum.[16] Also, increased rates of non-malignant liver disease,[17] heart disease,[1] and respiratory and upper gastrointestinal tract disease[1] have been described, together with a form of chronic toxic encephalopathy known as "painters syndrome."[17 18]

We report here **on** the findings of a case-control study, based on the New Zealand Cancer Registry, undertaken to assess the risk of cancer for **New** Zealand men employed as painters and to generate hyporheses for further testing.

Department **of** Community Health. **Wellington School of Medicine.** Wellington. New Zealand
P B Bethwaite. N Pearce
National Health Statistics Centre, **Wellington, New** Zealand
J Fraser

Methods

Our cohorr comprised male patients who were registered with the New Zealand Cancer Registry for the period 1980–4, who were aged 20 or older **at** registration. The New Zealand Cancer Registry is population based and collects data from public and private hospitals throughout the counrry. with further information obtained from death certificates and incidental necropsy findings For the studv period under consideration registration **was** virtually complete.[6]

Occupation is defined as the patients' current or most recent occupation at the time of registration, and is coded in the New Zealand Cancer Registry using the New Zealand Standard Classification of Occupations NZSCO[7], this is a modification of the International Standard Classification of Occupations.[7] Of the total 24 762 male regiscranrs, occupational information **was** coded for 19 904 80% and dara analysis was confined to these. Table 1 shows the distribution of cancers in this group.

The NZSCO identifies two groups of painters. The firsr group consists of general painters. painter decorators. and steel and other construction painters. The second group comprises car painters. sprav painters. signwriters, and other unclassified painters. The classification does not allow for the identification of workers manufacturing paint and coarings.

The design consisted of a series of case-control studies using the over311 group of 19 904 registrants, to examine *the* association between diverse cancer sires and work as a painter. For each cancer sire **(see**

table 1' the regisrrants for the ocher cancer sites formed the control group. For example. in the analysis for cancers of the buccal cavity and pharynx ,International Ciassificacion of Disease ICD , 9th revision. codes 140–149[22] , the case group consisted of the 698 registrants with this type of cancer, and the ocher 19206 cancer registrants formed the control group table 1). The identical procedure was then applied to the other diverse sites. The analysis was conducted using the Statistical Analysis System.[23] Age adiusted odds ratios ORs were estimated by the Mantel-Haenszel method" using 10 year age groups. Confidence intervals 95% C! were calculated using Miettinen's approximate method."

Several previous case-control studies based on the New Zealand Cancer Registry have used "other cancers" to form the control group. The relevant issues in this design are described elsewhere.[26 27] The principle advantage of using other cancers as controls is the minimisation of information bias, together with a reduction in selection bias owing to incomplete cancer registration. A potential disadvantage is the possibility of selection bias if the exposure under consideration is associated with an increased risk for other cancer sites. Such bias is likely to be minimal in occupational studies. however. unless exposure is associated with a common cancer.[26] Even in this situation the direction of bias is towards the null value Generally this bias can be minimised by selective exclusion of exposure related cancers from the control group. although this may in certain situations actually lead to an increase in net bias.[27]

Table 1 Distribution of cancer cases. by site in New Zealand men aged 20 or older, 1980–4

Site of cancer	*ICD category*	*No of cases with occupation recorded %*	*Total cases*
Buccal cavity	140–149	583 82	*708*
Oesophagus	150	385 83	463
Stomach	151	1014 81	1258
Colon	153	2043 82	2500
Rectum	154	1376 82	1679
Liver	155	184 83	223
Gallbladder	156	120 87	138
Pancreas	157	571 82	695
Nasal cavity, sinus	160	46 79	58
Larynx	161	303 80	379
Lung	162	4224 84	5031
Soft tissue sarcoma	171	142 83	171
Malignant melanoma	172	1116 77	1448
Prostate	185	2135 73	3340
Testis	186	399 92	435
Bladder	188	912 72	1259
Kidney	189	542 81	666
Brain	191	431 90	481
Non-Hodgkin's lymphoma	200, 202	535 82	652
Hodgkin's lymphoma	201	170 91	186
Multiple myeloma	203	295 83	355
Leukaemia	204–209	534 82	649
Other	—	1544 78	1988
Total	140–209	19904 80	24762

Results

Table 3 shows the age adjusted ORs for the various cancer sites in New Zealand painters. The principal findings are the increased relative risk for urinary cancers and multiple myeloma. There was little evidence of an increased risk for other cancer sites; notably no excess risk occurred for lung, gastrointestinal, liver and bilary tumours, or leukaemia.

Table 3 shows char the excess risks pertain to both bladder (ICD, 9th revision, code 188) and to kidney and other urothelial tumours (ICD, 9th revision, code 189 , although the number of cases is small in the 189 group. Risks for bladder and urinary tumours were slightly higher in the car. spray. and signwriter painter group OR = 1 82, 95% CI 0·85–2·5' than among construction and general painters (OR = 1·47, 95% Ci 1·02–2·13 . A larger difference was found for multiple myeloma, with the car, spray. and signwriter group having a greater risk (OR = 2.81, 95% CI 0·73–10·7), than construcrion and general painters ,OR = 1·80, 95% CI 0·89–3·64).

Table 4 shows that the ORs for both the urological cancers and for multiple myeloma were particularly increased in younger persons.

Discussion

The finding of an increased risk of bladder cancer among painters is consistent with previous studies. An excess of bladder tumours was noted in a proportionate mortality study of artistic painters. A historical cohorr study conducted on 1910 Geneva trade painters. followed up from 1970 until 1984, showed a standardised mortality ratio SMR) for painters of ?Ob 95% CI 97–387) and a standardised incidence ratio of 171 95% CI 101–272) for bladder tumours.[5] No increased risk was noted for kidney tumours in this study Jensen *et al* in a case-control study undertaken in Copenhagen, found an increased risk for bladder cancer in trades undertaking painting (OR = 1·39, 95% CI 1·04–1·86) for 10 years duration of employment, with a significant trend for duration of employment." A German case-control study examining lifestyle and occupational risk factors for lower urinary rrac: cancer found an increased risk in spray painters 'OR = 4·67, 95% CI 2·10–10·39).[13] Olsen and Jensen. in an analysis of a linked data set from the Cancrr Registry and the Danish Supplementary Pensions Fund found a significant increase in cancers of the lower urinary tract among persons employed in paint and glue manufacrure and among persons working in paint shops." An increased risk of bladder cancer has also been described in painters in the United States.[15]

Increased risk of multiple myeloma has been associated with a number of occupational groups including farmers,[28–30] wood workers," [32] printers," workers in chemical manufacturing plants," and in

Table 3 Age adjusted ORs 95% CI for cancer in painters; New Zealand Cancer Registry 1980–4

Site of cancer	ICD category	Exposed cases	Exposed controls	OR 95% CI
Buccal cavity	140–149	10	343	0·78 (0·41–1·47)
Oesophagus	150	5	380	0·70 (0·29–1·71)
Stomach	151	19	995	1·04 (0·65–1·67)
Colon	153	28	2015	0·74 (0·50–1·09)
Rectum	154	25	1351	0·99 (0·66–1·50)
Liver	155	2	353	0·61 (0·15–2·41)
Gallbladder	156	3	117	1·41 (0·45–4·44)
Pancreas	157	6	565	0·57 (0·26–1·27)
Larynx	161	6	297	1·06 (0·47–2·41)
Lung	162	38	265	1·12 (0·93–1·52)
Soft tissue sarcoma	171	1	141	0·43 (0·06–2·88)
Malignant melanoma	172	14	1102	0·73 (0·43–1·25)
Prostate	185	43	2392	1·02 (0·73–1·41)
Testis	186	5	394	0·99 (0·37–2·66)
Urinary, bladder	188, 189	38	315	1·53 (1·10–2·14)
Brain, nervous system	191, 192	10	345	1·29 (0·68–2·46)
Non-Hodgkin s lymphoma	200.102	9	526	0·97 (0·50–1·90)
Hodgkin s lymphoma	201	1	169	0·38 (0·06–2·54)
Multiple myeloma	203	10	285	1·95 (1·05–3·65)
Leukaemia	204–209	5	348	0·54 (0·23–1·30)
Other	—	37	314	1·03 (0·73–1·45)

Table 3 Age adjusted ORs 95% CI for painters by subsite, New Zealand Cancer Registry 1980–4

Subsite	ICD category	Exposed cases	Exposed controls	OR 95% CI
Bladder	188	24	388	1·52 (1·00–2·31)
Kidney	189	14	528	1·45 (0·85–2·50)

workers exposed to petroleum products.[15] Several case-control studies have reponed small non-significant excess nsks of multiple myeloma among painters.[9,10,11] A cohort study based on Swedish death cerrificates of 416 paint industrv workers was undertaken by Lundberg and colleagues. Among 96 workers who died, three deaths cccurred from multiple myeloma against 0·6 deaths expected.[3] Our study found no excess risk for leukaemia among painrers, although this has been reported by other workers, 3 study based on New Zealand death certificates found an increased risk for all leukaemias in male painters SMR 234, 95%, CI 101–461.[3] A Swedish case-control study where painters with exposure io occupational organic solvents exhibited an OR of 13 (95% CI 2–554).[9]

Tine exposure of painters io chemical compounds is complex and the composition of paints and glues is likely to vary between countries. No specific study has been undertaken in New Zealand to document the various exposures among different groups of painters. Painters are exposed to various dye and pigment products, with one of the most common exposures being to organic solvents.[16,17] Painters are exposed to organic solvents either 3s vapours or by direct skin application through the regular use of cleaning solvents. A common solvent used by house painters is white spirit Sroddard's solvent), which is a mixture of around 20%, aromatic and 80% aliphatic hydrocarbons. Paints and lacquers also contain a mixture of aromatic solvents (C_9–C_{10}), toluene, and xylenes. Spray painters are also exposed to aerosols of paints, fillers. and catalysts.[17,18] Also, some painters use a range of adhesive and degreasing agents that are heterogeneous solvent producrs commonly containing trichloroethylene, n-hexane, and methylethyl ketone.[16,17] The use of benzene is prohibited as a pure solvent in most countries, but mal; be present in small quantities as an impurity in other solvents.[7] A range of organic solvencs has bern shown io have mutagenic properties but detailed knowledge on the specific risks posed by individual solvenrs is limited.[19–30]

Also, exposure to organic solvents has been linked to a number of haematopoietic malignancies, in particular. lymphomas, leukaemia, and multiple myeloma..[31]

Table 4 Age adjusted ORs 95% CI for cancer in painters by age group, New Zealand Cancer Registry 1980–4

	Age group (y)			
	20–59		≥60	
Site ICD	Exposed	OR 95% CI	Exposed	OR 95% CI
Bladder (188)	9	2·27 (1·15–4·48)	15	1·27 (0·75–2·15)
Kidney (189)	7	1·94 (0·91–4·19)	7	1·16 (0·54–2·48)
Multiple myeloma (203)	5	4·23 (1·80–9·91)	5	1·27 (0·52–3·10)

The interpretation of nnding a greater risk for urological cancers and multiple myeloma in younger male painters is uncertain. This rnay reflect a change over time in the composition of paints and glue products. together with a change in the work practices of painters or in other environmental confounding factors. Alternatively mortality among younger painters may reduce those at risk of developing cancer at an older age. Further. the difference may be a function of the use of a relative measure of effect rather than an absolute measure.[46]

Two main limitations of a registry based study of this type are the lack of valid information on exposure and the lack of information on potential confounding factors such as cigarette smoking. Knowledge of only the most recent occupation of registrants provides a crude occupational history, with no information on specific exposures. Secondary information on smoking behaviour is available from the 1981 census of population and dwellings, which showed that 46% of New Zealand male painters were regular cigarette smokers, compared with 38% of the total male workforce." The higher proportion of smoking behaviour among male painters rnay partially explain xcess of bladder cancer seen in this group. It is ncteworthy, however, that no other cancer sites strongly associated with cigarette smoking showed an s of cases among painters. Siemiatycki *et al* have assessed the degree of confounding bias related to smoking and socioeconomic state in estimates of occupational associations with bladder cancer. They concluded that relative risks in excess of 1·20 were unlikely to be attributable to confounding bias by these variables." Whether it is prudent to generalise from these results is uncertain, although similar results were reported from Finnish"' and American[50] studies.

In summary, this cancer registry based case control study has examined the cancer experience of male painters, who are known from previous work to have an excess of certain cancer types. Painters are exposed to a wide range of complex mixtures that include a number of known carcinogenic and mutagenic chemicals including organic solvents and dye products. The findings are consistent with previous work showing an increased risk for urological and haematic cancers among painters. The study found an excess of cases of multiple myeloma, however. among painters whereas other workers found an excess of leukaemia. These associations point to priorities for further research into the occupational exposures and cancer experience of New Zealand painters.

P Bethwaite is supported by the Medical Research Council of New Zealand under a Training Fe" vship in epidemiology. James Fraser thanks the Director General of Health for permission to publish the data.

Requests for reprints to. Peter B Bethwaite MB, Department of Community Health, Wellington School of Medicine. PO Bos 7613, Wellington, New Zealand.

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Accepted 11 June 1990

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