

# Stomach cancer and occupation in Sweden: 1971–89

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**Objectives:** To examine the relation between gastric cancer and occupation among men and women gainfully employed in 1970 in Sweden for the period 1971–89 and, more specifically, to evaluate whether any excess of incidence of gastric cancer had also occurred among the subcohort of people reporting the same occupation in 1960 and 1970.

**Methods:** In both sexes and cohorts, relative risks adjusted for age, period of diagnosis, and geographical risk area were computed for occupational codes specified at one, two, or three level (occupational sector, occupational group, and occupation, respectively). Relative risks were calculated with all other occupations as reference and then, to take socioeconomic status into account, solely other occupations within the same occupational sector were used.

**Results:** Among men, occupations with increased risk included miners and quarrymen, construction and metal processing workers, supporting the possible causative role of dusty environments in stomach cancer. In men, the results also provide support for increased risks among electrical and mechanical engineers, fishermen, petrol station workers, motor vehicle drivers, butchers and meat preparers, dockers, freight handlers, launderers and dry cleaners. Furthermore, it is worth noting interesting results for women, whose occupational risks have been studied less. Excess risks were found for practical nurses, cashiers, bank employees, engineering and electronic industry workers, food industry, housekeeping and cleaning workers. Due to the many occupations studied, several significant associations may be expected by chance.

**Conclusions:** The study is explorative but provides support for the relations suggested previously between occupational exposure to dusty environments and stomach cancer, together with some new high risk occupations which should be further studied.

Incidence and mortality from gastric cancer have been declining throughout Europe during the past decades.<sup>1–5</sup> The major risk factors associated with the occurrence of this tumour are environmental exposures, especially diet and infection for *Helicobacter pylori*.<sup>6–11</sup> Aetiological models have been proposed to explain the development of gastric cancer.<sup>12–13</sup> Even though occupation is said to play a small part in its aetiology, occupational exposures may interact with numerous non-occupational factors at various stages in the development of gastric cancer.<sup>14</sup>

According to epidemiological studies, occupational exposures reported to increase the risk of stomach cancer include dusts, nitrogen oxides, *n*-nitroso compounds, and ionising radiation.<sup>14</sup> Excess risks have been found for several occupational groups, including miners and quarrymen,<sup>15–18</sup> farmers,<sup>15–19–21</sup> fishermen,<sup>15–22</sup> masonry and concrete workers,<sup>15–17–19–23</sup> machine operators,<sup>15–21–24</sup> and to a lesser extent metal workers,<sup>25</sup> chemical and rubber workers,<sup>15–26–27</sup> carpenters,<sup>28–29</sup> transport workers,<sup>19–22–30</sup> and sailors.<sup>31</sup> Rates of gastric cancer are higher in areas and groups with a lower socioeconomic status,<sup>24–32</sup> and the increased risks may partially be explained by these differences, as social class and occupation are interrelated.

This study seeks to analyse the relation between gastric cancer and occupation among men and women gainfully employed in 1970 in Sweden for the period 1971–89. Although other studies of a more general and explorative character reporting risks for many combinations of cancer sites and occupations have been based on the same material,<sup>33–34</sup> this paper is focused entirely on stomach cancer, and risk estimators have been computed allowing for the geographical variation in incidence of gastric cancer. Chow *et al* also studied the relation between occupation and stomach cancer in the cohort of Swedish men gainfully employed in 1960 for the period 1961–79, partially overlapping our study.<sup>15</sup> However, there are

some important differences between this and that study: (a) the female working population is also studied; (b) our work includes the period 1971–89, and; (c) the availability of the 1960 occupational codes gives the opportunity of a more specific evaluation using the subcohort of people reporting the same occupation in both the 1960 and 1970 censuses. Also, comparisons within sectors have been carried out with the aim of contrasting people with a more homogeneous socioeconomic status, something that has not been covered in previous reports.

## MATERIALS AND METHODS

The base population for this historical cohort comprised all Swedish men and women who were gainfully employed at the time of the 1970 census, had also been recorded in the 1960 census and were still alive and in the age range of 25–59 on 1 January 1971. A historical cohort was formed by all Swedish people by occupation according to the census of 1970, 1 779 646 men and 1 066 346 women, and inside it a subcohort including only those referring the same occupation in both the 1960 and 1970 censuses (comprising 693 501 men and 231 858). The occupational cohorts were followed up from 1971 to the end of 1989. Death was the only cause of censoring considered. People not reported as dead during the follow up were considered to be alive at the end of follow up.

Information was drawn from two data sets. Firstly, the Swedish cancer environment register, providing information on incident cancer cases, occupation, and demographic variables such as age and residency from the 1960 and 1970 censuses; this register was used to compute specific rate

**Abbreviations:** RR, relative risks; SIR, standardised incidence ratio; PCBs, polychlorinated biphenyls

**Table 1** Relative risks for gastric cancer among men and women by occupational sector (1 digit), 1971–89

Code	Occupational sector	General cohort			Same occupation in 1960–70		
		Cases	RR*	95% CI	Cases	RR*	95% CI
<b>Men:</b>							
0	Professional and technical work	1089	0.77	0.73 to 0.82	522	0.76	0.70 to 0.84
1	Administrative and managerial	242	0.70	0.61 to 0.79	91	0.70	0.57 to 0.86
2	Bookkeeping and clerical work	344	0.93	0.83 to 1.03	85	0.91	0.73 to 1.13
3	Sales work	546	0.89	0.81 to 0.97	217	0.83	0.73 to 0.95
4	Agricultural, forestry and fishing	1199	1.04	0.98 to 1.11	875	1.05	0.97 to 1.13
5	Mining and quarrying	83	1.55	1.25 to 1.93	40	1.91	1.40 to 2.61
6	Transport and communications	718	1.03	0.95 to 1.11	433	1.04	0.94 to 1.14
7–8	Production I or II	4063	1.18	1.13 to 1.23	1887	1.15	1.08 to 1.22
9	Services and military work	479	1.04	0.95 to 1.14	240	1.05	0.93 to 1.20
<b>Women:</b>							
0	Professional and technical work	435	0.85	0.77 to 0.95	162	0.85	0.71 to 1.01
1	Administrative and managerial	24	0.80	0.53 to 1.19	5	1.28	0.53 to 3.09
2	Bookkeeping and clerical work	429	0.96	0.87 to 1.07	93	1.02	0.82 to 1.27
3	Sales work	316	0.85	0.75 to 0.95	91	0.73	0.59 to 0.91
4	Agricultural, forestry and fishing	179	1.09	0.94 to 1.27	23	1.30	0.86 to 1.97
5	Mining and quarrying	0	–	–	0	–	–
6	Transport and communications	87	0.97	0.79 to 1.21	33	1.08	0.76 to 1.54
7–8	Production I or II	380	1.12	1.01 to 1.25	103	1.12	0.90 to 1.38
9	Services and military work	875	1.15	1.06 to 1.25	193	1.25	1.06 to 1.48

\*Adjusted for age, period, and geographical risk area.

numerators, with gastric cancer taken to be any case with code 151 of the seventh revision of the international classification of diseases (ICD-7). The Swedish cancer registry provides valuable information on cancer incidence, with high reporting rates: 95%–98% of all tumours are estimated to be reported.<sup>35, 36</sup> Secondly, a background population register, comprising all people in the 1970 census, with information on occupation and residence in 1970, occupation in 1960, and date of death; this register was used to compute specific rate denominators.

In the 1970 census, occupations were coded according to the Nordic classification of occupations.<sup>37</sup> Similar codes were used in the 1960 census and translations were made to the 1970 code when necessary. Every occupation is represented by a three digit number. The first digit refers to one of 10 major occupational sectors (0–9), where higher numbers indicate manual occupations, and lower numbers non-manual occupations often requiring longer education associated with a higher socioeconomic status.

The exact number of person-years was calculated with Clayton's algorithm<sup>38</sup> by sex, age group (25–29, 30–34, ..., 75–79), occupation coded as in the Nordic classification of occupations<sup>37</sup> on a three digit basis, calendar period (1971–5, 1976–80, 1981–5 y 1986–9) and county for the general cohort as well as the subgroup of people reporting the same occupation in both censuses, henceforth called the subcohort.

On the assumption that the number of cases in each age group, sex, and calendar period would be distributed as a Poisson variable, log linear Poisson models were fitted in both sexes and cohorts for the calculation of occupational relative risks (RRs), comparing occupations against others in the cohort. In this model, the number of expected cases was introduced as an offset.<sup>38</sup> Given that the expected number was computed on the basis of the age and period specific reference rates, the RR for each occupation was likewise adjusted for age and period. The RRs were estimated for occupational codes by one, two, and three digit (occupational sector, occupational group, and occupation, respectively) taking all other occupations as the reference rate.

In view of the fact that gastric cancer risk shows a geographical variation, the RRs were adjusted for geographical risk area. As occupations are not uniformly distributed geographically, we decided to group counties according to

geographical risk areas (based on their standardised incidence ratio (SIR)). The SIR is the ratio of the observed to the expected number of cases in a specific area. Sweden is divided into 24 counties that were consequently grouped into five categories depending on the observed SIR value: (a) less than 0.85, (b) between 0.85 and 0.95, (c) between 0.95 and 1.05, (d) between 1.05 and 1.15, and (e) more than 1.15. These five categories were represented by dummy variables in the regression.

Finally, as a means of assessing the influence from factors associated with social class—for example, dietary habits—the same analysis was further run with other occupations in the same sector as the reference rate (namely, the corresponding one digit category according to the Nordic classification of occupations, except for production sectors I and II that were considered together). However, people in the same occupational sector may also share relevant occupational exposures and in this case the second analysis would underestimate their risk. For this reason both RRs are presented. Because of the many occupational categories, only those with 1000 or more people and at least 10 cases of gastric cancer in the general cohort were evaluated.

## RESULTS

There were 8763 cases of gastric cancer among men and 2725 among women in the study population. Significant excesses of stomach cancer were found for men in the occupational sectors (one digit) mining and quarrying and production (table 1), the overall cohort was used to provide reference rates. For women, a significant excess was found among service workers.

### Men

Table 2 shows the RR for Swedish men by occupational groups (two digit). People in professional and technical, administrative and managerial, bookkeeping, clerical, and the sale sectors generally showed reductions in risk of gastric cancer compared with the whole cohort combined. In the case of engineering workers, when taking as reference those occupations in the same sector (those with the same first digit) engineering work registered a significant excess risk of 25% for people in the general cohort and of 36% in those reporting

**Table 2** Relative risks for gastric cancer among male Swedish workers by occupational group (2 digit), 1971–89

Code, occupational group*	General cohort					Same occupation in 1960–70				
	Cases	RR†	95% CI	Adjusted RR‡	95% CI	Cases	RR†	95% CI	Adjusted RR‡	95% CI
Sector 0, professional and technical work:										
00 Engineering	703	0.86	0.80 to 0.93	1.25	1.10 to 1.41	349	0.88	0.78 to 0.98	1.36	1.13 to 1.63
01 Chemical or physical	31	0.90	0.63 to 1.28	1.12	0.78 to 1.60	5	0.70	0.29 to 1.67	0.87	0.36 to 2.10
02 Biological	11	0.65	0.36 to 1.17	0.81	0.45 to 1.47	11	1.09	0.60 to 1.97	1.40	0.77 to 2.55
03 Medical	15	0.33	0.20 to 0.54	0.40	0.24 to 0.67	12	0.30	0.17 to 0.53	0.37	0.21 to 0.66
04 Health or nursing	44	0.87	0.65 to 1.18	1.10	0.82 to 1.49	19	0.77	0.49 to 1.20	0.98	0.62 to 1.55
05 Educational	120	0.64	0.53 to 0.76	0.78	0.65 to 0.94	57	0.62	0.48 to 0.81	0.77	0.59 to 1.02
06 Religious	17	0.60	0.37 to 0.96	0.74	0.46 to 1.20	16	0.68	0.41 to 1.10	0.86	0.52 to 1.42
07 Legal	12	0.58	0.33 to 1.03	0.72	0.41 to 1.27	4	0.28	0.11 to 0.75	0.35	0.13 to 0.94
08 Literary or artistic	57	0.87	0.67 to 1.13	1.08	0.82 to 1.41	30	0.77	0.54 to 1.10	0.96	0.66 to 1.39
09 Other professional	79	0.76	0.61 to 0.95	0.95	0.75 to 1.19	19	1.12	0.72 to 1.76	1.42	0.90 to 2.25
Sector 1, administrative and managerial:										
10 Government	51	0.74	0.56 to 0.97	1.03	0.76 to 1.41	14	0.58	0.34 to 0.98	0.79	0.44 to 1.40
11 Business administr.	191	0.69	0.60 to 0.80	0.97	0.71 to 1.32	77	0.73	0.58 to 0.91	1.27	0.71 to 2.25
Sector 2, bookkeeping and clerical work:										
20 Bookkeeping or cashier	63	0.99	0.78 to 1.27	1.08	0.82 to 1.42	19	0.85	0.54 to 1.33	0.94	0.56 to 1.57
29 Clerical	281	0.92	0.81 to 1.03	0.93	0.70 to 1.22	66	0.93	0.73 to 1.18	1.06	0.64 to 1.78
Sector 3, sales work:										
30 Wholesale or retail	142	0.90	0.76 to 1.06	0.99	0.82 to 1.20	74	0.84	0.67 to 1.06	0.98	0.74 to 1.30
31 Insurance or security	21	0.55	0.36 to 0.85	0.62	0.40 to 0.96	10	0.77	0.41 to 1.43	0.94	0.50 to 1.78
32 Travelling agents	46	0.75	0.56 to 1.00	0.82	0.61 to 1.11	22	0.74	0.49 to 1.13	0.87	0.56 to 1.36
33 Other sales	337	0.95	0.85 to 1.06	1.19	1.00 to 1.41	111	0.86	0.71 to 1.04	1.08	0.83 to 1.41
Sector 4, agriculture, forestry, and fishing:										
40 Agricultural or forestry	762	1.01	0.94 to 1.09	0.93	0.83 to 1.05	649	1.05	0.97 to 1.14	1.02	0.88 to 1.19
41 Agricultural or livestock	196	1.10	0.96 to 1.27	1.08	0.93 to 1.26	88	0.98	0.79 to 1.21	0.94	0.75 to 1.17
43 Fishing	37	1.38	1.00 to 1.91	1.35	0.98 to 1.88	30	1.37	0.96 to 1.97	1.33	0.92 to 1.91
44 Forestry	204	1.04	0.90 to 1.19	0.99	0.85 to 1.16	108	0.99	0.82 to 1.20	0.94	0.77 to 1.16
Sector 5, mining and quarrying:										
50 Mining or quarrying	83	1.55	1.25 to 1.93	–	–	40	1.91	1.40 to 2.61	–	–
Sector 6, transport and communications:										
60 Ships' officers	25	0.93	0.63 to 1.38	0.89	0.59 to 1.32	18	0.91	0.57 to 1.44	0.83	0.52 to 1.34
61 Ships' crew	16	1.38	0.85 to 2.26	1.35	0.82 to 2.22	9	1.65	0.86 to 3.18	1.59	0.82 to 3.08
63 Rail or road transport	494	1.10	1.00 to 1.20	1.20	1.03 to 1.41	350	1.11	1.00 to 1.24	1.37	1.08 to 1.75
64 Traffic supervisors	64	0.83	0.65 to 1.06	0.79	0.61 to 1.02	15	0.73	0.44 to 1.22	0.71	0.42 to 1.18
65 Post or telecommunication	16	0.70	0.43 to 1.14	0.67	0.41 to 1.11	8	0.75	0.37 to 1.49	0.73	0.36 to 1.46
66 Mail distribution	70	0.85	0.67 to 1.08	0.81	0.63 to 1.04	26	0.68	0.46 to 0.99	0.63	0.43 to 0.94
67 Other transport or telec.	24	1.57	1.05 to 2.34	1.55	1.03 to 2.33	4	0.89	0.33 to 2.36	0.85	0.32 to 2.27
Sectors 7 and 8, production I or II:										
70 Textile	41	1.35	0.99 to 1.84	1.27	0.93 to 1.73	27	1.40	0.96 to 2.06	1.31	0.89 to 1.93
71 Sewing	57	1.10	0.85 to 1.43	1.00	0.77 to 1.31	38	1.18	0.86 to 1.63	1.09	0.79 to 1.50
72 Shoe or leather goods	27	1.24	0.85 to 1.81	1.14	0.78 to 1.66	13	0.88	0.51 to 1.52	0.81	0.47 to 1.40
73 Metal processing	171	1.13	0.97 to 1.32	1.03	0.89 to 1.21	81	1.24	1.00 to 1.55	1.15	0.92 to 1.43
74 Fine mechanical	36	0.80	0.58 to 1.11	0.72	0.52 to 1.01	18	0.72	0.45 to 1.14	0.65	0.41 to 1.04
75 Engineering industry	961	1.06	0.99 to 1.13	0.95	0.88 to 1.02	444	1.02	0.93 to 1.13	0.93	0.83 to 1.03
76 Electronics	232	1.01	0.89 to 1.15	0.92	0.80 to 1.05	121	0.98	0.81 to 1.17	0.89	0.74 to 1.07
77 Wood	585	1.00	0.92 to 1.08	0.90	0.82 to 0.98	267	0.97	0.86 to 1.10	0.88	0.77 to 1.00
78 Painting	136	0.90	0.76 to 1.07	0.82	0.69 to 0.97	102	0.87	0.71 to 1.06	0.79	0.65 to 0.97
79 Masonry or concrete	477	1.32	1.21 to 1.45	1.22	1.11 to 1.34	260	1.37	1.21 to 1.55	1.28	1.12 to 1.46
80 Graphic	78	1.03	0.82 to 1.29	0.92	0.74 to 1.16	54	1.01	0.78 to 1.33	0.93	0.71 to 1.21
81 Glass or ceramic	37	1.26	0.91 to 1.74	1.15	0.83 to 1.59	14	1.34	0.79 to 2.26	1.25	0.74 to 2.12
82 Food industry	141	1.14	0.97 to 1.35	1.04	0.88 to 1.23	94	1.26	1.02 to 1.54	1.16	0.94 to 1.43
83 Chemical or cellulose	120	1.02	0.85 to 1.22	0.94	0.78 to 1.12	41	1.13	0.83 to 1.53	1.03	0.76 to 1.41
85 Other fabrication	148	1.20	1.02 to 1.41	1.09	0.93 to 1.29	52	1.27	0.97 to 1.68	1.18	0.90 to 1.56
86 Heavy labour	230	1.19	1.04 to 1.35	1.09	0.95 to 1.24	66	1.05	0.83 to 1.34	0.96	0.75 to 1.23
87 Machine maintenance	234	1.13	1.00 to 1.29	1.04	0.91 to 1.18	66	1.00	0.79 to 1.28	0.92	0.72 to 1.18
88 Warehouse or packaging	351	1.20	1.08 to 1.34	1.10	0.98 to 1.22	129	1.38	1.15 to 1.64	1.28	1.07 to 1.53
Sector 9, services and military work:										
90 Civilian protection	125	1.04	0.88 to 1.25	1.00	0.82 to 1.23	77	1.06	0.85 to 1.33	0.99	0.76 to 1.30
91 Housekeeping	32	1.12	0.79 to 1.59	1.07	0.75 to 1.53	13	1.43	0.83 to 2.46	1.31	0.75 to 2.29
92 Waiters	13	1.53	0.89 to 2.63	1.44	0.83 to 2.50	9	1.80	0.94 to 3.46	1.61	0.82 to 3.13
93 Caretaking or cleaning	184	1.07	0.93 to 1.24	1.05	0.88 to 1.27	57	1.15	0.88 to 1.49	1.12	0.83 to 1.51
94 Other	67	1.02	0.80 to 1.30	0.97	0.75 to 1.25	50	1.09	0.82 to 1.44	1.01	0.74 to 1.38
98 Armed forces	45	0.80	0.60 to 1.07	0.77	0.56 to 1.04	34	0.74	0.53 to 1.04	0.71	0.49 to 1.02
99 Unidentifiable	13	1.25	0.73 to 2.16	1.20	0.69 to 2.08	0	–	–	–	–

\*Only those occupational groups with 1000 or more people in the general cohort at the onset of the follow up and at least 10 cases; †adjusted for age, period, and geographical risk area; ‡adjusted for age, period, geographical risk area, and occupational sector.

**Table 3** Relative risks for gastric cancer among male Swedish workers for those specific occupations (three digit) with a minimum of 10% excess risk, 1971–89

Code, occupation*	General cohort					Same occupation in 1960–70				
	Cases	RR†	95% CI	Adjusted RR‡	95% CI	Cases	RR†	95% CI	Adjusted RR‡	95% CI
Sector 0, professional and technical work:										
002 Electrical engineers	132	1.04	0.87 to 1.23	1.32	1.10 to 1.59	57	0.96	0.74 to 1.25	1.23	0.93 to 1.62
003 Mechanical engineers	261	0.91	0.80 to 1.02	1.17	1.02 to 1.35	129	0.89	0.74 to 1.05	1.16	0.95 to 1.42
005 Metallurgist engineers	30	0.93	0.65 to 1.33	1.17	0.82 to 1.69	11	0.90	0.50 to 1.62	1.15	0.63 to 2.10
014 Laboratory technicians	14	0.98	0.58 to 1.66	1.24	0.73 to 2.09	0	–	–	–	–
043 Practical nurses	16	1.16	0.71 to 1.89	1.46	0.89 to 2.39	4	0.99	0.37 to 2.65	1.26	0.47 to 3.38
081 Sculptor or painter or artists	15	0.89	0.54 to 1.48	1.10	0.66 to 1.84	8	0.75	0.37 to 1.50	0.93	0.46 to 1.88
093 Librarian or archivist	13	1.14	0.66 to 1.96	1.42	0.82 to 2.45	6	1.60	0.72 to 3.56	2.03	0.91 to 4.54
Sector 2, bookkeeping and clerical work:										
295 Property or store managers	111	0.99	0.82 to 1.20	1.10	0.88 to 1.38	35	0.94	0.67 to 1.31	1.10	0.72 to 1.70
Sector 3, sales work:										
333 Shop assistants	92	1.16	0.95 to 1.43	1.35	1.08 to 1.69	29	0.99	0.69 to 1.43	1.20	0.81 to 1.78
338 Petrol station workers	33	1.35	0.96 to 1.90	1.52	1.07 to 2.16	14	1.39	0.82 to 2.35	1.67	0.97 to 2.87
Sector 4, agriculture, forestry, and fishing:										
412 Horticultural workers	78	1.12	0.89 to 1.40	1.09	0.87 to 1.37	23	0.93	0.62 to 1.40	0.90	0.59 to 1.36
413 Livestock workers	19	1.29	0.82 to 2.02	1.26	0.80 to 1.98	8	1.08	0.54 to 2.17	1.05	0.52 to 2.10
431 Fishermen	37	1.41	1.02 to 1.94	1.38	0.99 to 1.92	30	1.38	0.97 to 1.98	1.34	0.93 to 1.93
Sector 5, mining and quarrying:										
501 Miners or quarrymen	59	1.78	1.37 to 2.29	1.48	0.92 to 2.39	32	1.97	1.39 to 2.79	1.20	0.54 to 2.65
504 Other mining work	17	1.52	0.94 to 2.45	1.00	0.58 to 1.70	3	1.78	0.57 to 5.52	0.96	0.29 to 3.20
Sector 6, transport and communications:										
611 Ship deck or engine crew	16	1.38	0.85 to 2.26	1.35	0.82 to 2.22	9	1.65	0.86 to 3.18	1.59	0.82 to 3.08
633 Motor vehicle drivers	400	1.13	1.02 to 1.25	1.21	1.05 to 1.40	272	1.12	0.99 to 1.27	1.22	1.00 to 1.48
678 Railway linesmen	13	1.33	0.77 to 2.28	1.30	0.75 to 2.26	0	–	–	–	–
Sectors 7 and 8, production I or II:										
701 Textile worker	41	1.35	0.99 to 1.84	1.27	0.93 to 1.73	27	1.40	0.96 to 2.06	1.31	0.89 to 1.93
714 Upholsterer	27	1.38	0.95 to 2.01	1.26	0.86 to 1.84	19	1.43	0.91 to 2.25	1.32	0.84 to 2.08
722 Shoe cutters or sewers	10	1.37	0.73 to 2.54	1.26	0.69 to 2.35	6	1.20	0.54 to 2.68	1.09	0.49 to 2.43
731 Furnaceman	45	1.20	0.90 to 1.61	1.11	0.83 to 1.49	21	1.59	1.03 to 2.44	1.44	0.94 to 2.22
733 Rolling-mill worker	22	1.15	0.76 to 1.75	1.06	0.70 to 1.61	10	1.51	0.81 to 2.81	1.40	0.75 to 2.60
735 Black smiths or forgers	39	1.29	0.94 to 1.76	1.17	0.85 to 1.60	21	1.15	0.75 to 1.76	1.06	0.69 to 1.63
738 Other metal processes	17	1.18	0.73 to 1.90	1.08	0.67 to 1.74	5	1.50	0.62 to 3.60	1.38	0.57 to 3.32
753 Sheet metal workers	69	1.30	1.03 to 1.65	1.19	0.94 to 1.51	40	1.28	0.94 to 1.75	1.18	0.86 to 1.62
755 Welders or flame cutters	105	1.17	0.96 to 1.41	1.07	0.88 to 1.30	62	1.22	0.95 to 1.57	1.13	0.88 to 1.46
757 Metal platers or coaters	14	1.42	0.84 to 2.40	1.29	0.76 to 2.18	6	1.56	0.70 to 3.47	1.44	0.65 to 3.21
758 Other engineering work	83	1.10	0.88 to 1.36	1.00	0.81 to 1.24	13	0.60	0.35 to 1.03	0.55	0.32 to 0.96
767 Line workers	36	1.11	0.80 to 1.54	1.02	0.73 to 1.42	14	0.89	0.52 to 1.50	0.81	0.48 to 1.37
768 Other electronic work	24	1.36	0.91 to 2.03	1.23	0.82 to 1.83	1	0.30	0.04 to 2.14	0.27	0.04 to 1.93
774 Frame or circular sawyers	49	1.20	0.91 to 1.59	1.10	0.83 to 1.46	7	0.84	0.40 to 1.77	0.77	0.37 to 1.62
779 Non-specific wood work	56	1.29	0.99 to 1.68	1.18	0.91 to 1.54	7	1.03	0.49 to 2.16	0.95	0.45 to 1.99
791 Bricklayers	74	1.15	0.92 to 1.45	1.05	0.83 to 1.32	60	1.18	0.91 to 1.52	1.08	0.84 to 1.40
793 Concrete or construction	321	1.30	1.16 to 1.46	1.19	1.06 to 1.34	170	1.39	1.20 to 1.63	1.29	1.10 to 1.51
798 Other construction work	67	1.84	1.44 to 2.33	1.68	1.32 to 2.14	19	2.20	1.40 to 3.45	2.05	1.30 to 3.22
806 Bookbinders	11	1.15	0.63 to 2.07	1.03	0.57 to 1.87	4	0.82	0.31 to 2.18	0.75	0.28 to 2.00
822 Baker or pastry cooks	47	1.13	0.85 to 1.51	1.03	0.77 to 1.38	44	1.26	0.94 to 1.70	1.16	0.86 to 1.56
824 Beverages plant workers	10	1.36	0.73 to 2.54	1.24	0.67 to 2.31	2	0.79	0.20 to 3.16	0.73	0.18 to 2.92
826 Butchers or meat preparers	47	1.33	1.00 to 1.77	1.21	0.91 to 1.61	29	1.53	1.06 to 2.21	1.41	0.98 to 2.04
851 Rubber products workers	26	1.20	0.82 to 1.76	1.08	0.73 to 1.59	16	1.48	0.91 to 2.42	1.36	0.83 to 2.23
852 Plastic products workers	29	1.14	0.79 to 1.64	1.05	0.73 to 1.51	4	1.11	0.41 to 2.95	1.03	0.39 to 2.75
858 Other production work	68	1.47	1.16 to 1.86	1.34	1.06 to 1.70	19	1.48	0.94 to 2.33	1.37	0.87 to 2.15
861 Unskilled manual workers	230	1.19	1.04 to 1.35	1.09	0.95 to 1.24	66	1.05	0.83 to 1.34	0.96	0.75 to 1.23
872 Crane or hoist operators	40	1.38	1.01 to 1.88	1.27	0.93 to 1.73	12	1.02	0.58 to 1.80	0.95	0.54 to 1.67
875 Truck or conveyor operators	94	1.26	1.03 to 1.54	1.16	0.94 to 1.42	19	1.11	0.71 to 1.75	1.03	0.65 to 1.62
882 Docker or freight handler	61	1.72	1.34 to 2.21	1.58	1.23 to 2.04	36	2.19	1.58 to 3.04	2.04	1.47 to 2.84
883 Store or warehouses	262	1.14	1.01 to 1.29	1.04	0.92 to 1.18	87	1.20	0.97 to 1.48	1.11	0.89 to 1.37
Sector 9, services and military work:										
901 Fire fighters	20	1.42	0.91 to 2.20	1.38	0.88 to 2.16	17	1.55	0.96 to 2.49	1.49	0.91 to 2.44
908 Other protective work	50	1.24	0.94 to 1.64	1.21	0.90 to 1.62	12	1.55	0.88 to 2.73	1.46	0.82 to 2.61
921 Waiters	13	1.53	0.89 to 2.63	1.44	0.83 to 2.50	9	1.80	0.94 to 3.46	1.61	0.82 to 3.13
931 Building caretakers	156	1.12	0.96 to 1.32	1.12	0.92 to 1.36	46	1.13	0.85 to 1.52	1.11	0.81 to 1.53
943 Laundry or dry cleaning	19	1.79	1.14 to 2.80	1.74	1.10 to 2.75	12	2.12	1.20 to 3.74	2.02	1.13 to 3.62
999 Unidentifiable	13	1.25	0.73 to 2.16	1.20	0.69 to 2.08	0	–	–	–	–

\*Only those occupations with 1000 or more people in the general cohort at the onset of the follow up and at least 10 cases; †adjusted for age, period, and geographical risk area (reference, all other occupations); ‡adjusted for age, period, and geographical risk area (reference, other occupations in same sector).



**Table 4** Relative risks for gastric cancer among female Swedish workers by occupational group (two digit), 1971–89

Code, occupational group*	General cohort					Same occupation in 1960–70				
	Cases	RR†	95% CI	Adjusted RR‡	95% CI	Cases	RR†	95% CI	Adjusted RR‡	95% CI
Sector 0, professional and technical work:										
00 Engineering	10	0.80	0.43 to 1.50	0.94	0.50 to 1.75	0	–	–	–	–
04 Health or nursing	288	1.03	0.91 to 1.16	1.49	1.22 to 1.81	106	1.10	0.90 to 1.36	1.66	1.20 to 2.29
05 Educational	80	0.64	0.51 to 0.80	0.68	0.53 to 0.87	39	0.62	0.45 to 0.86	0.63	0.44 to 0.91
08 Literary or artistic	10	0.70	0.38 to 1.31	0.82	0.44 to 1.54	5	1.11	0.46 to 2.68	1.31	0.53 to 3.19
09 Other professional	38	0.87	0.63 to 1.20	1.01	0.72 to 1.40	8	0.82	0.41 to 1.64	0.93	0.45 to 1.88
Sector 1, administrative and managerial:										
10 Government	10	0.93	0.50 to 1.73	1.27	0.56 to 2.87	2	1.34	0.34 to 5.39	1.13	0.18 to 7.08
11 Business administr.	14	0.73	0.43 to 1.23	0.79	0.35 to 1.78	3	1.24	0.40 to 3.87	0.88	0.14 to 5.50
Sector 2, bookkeeping and clerical work:										
20 Bookkeeping or cashier	127	1.12	0.94 to 1.34	1.21	0.98 to 1.49	39	1.29	0.94 to 1.79	1.42	0.94 to 2.15
29 Clerical	302	0.91	0.81 to 1.03	0.83	0.67 to 1.02	54	0.87	0.66 to 1.15	0.70	0.46 to 1.06
Sector 3, sales work:										
30 Wholesale or retail	31	1.01	0.71 to 1.44	1.19	0.82 to 1.72	12	1.04	0.59 to 1.84	1.43	0.78 to 2.62
33 Other sales	282	0.84	0.74 to 0.95	0.87	0.61 to 1.24	78	0.70	0.55 to 0.88	0.67	0.37 to 1.20
Sector 4, agriculture, forestry, and fishing:										
40 Agricultural or forestry	18	1.30	0.82 to 2.06	1.22	0.75 to 1.99	4	1.22	0.46 to 3.26	0.92	0.31 to 2.73
41 Agricultural or livestock	156	1.05	0.89 to 1.24	0.74	0.48 to 1.15	17	1.19	0.73 to 1.92	0.68	0.27 to 1.75
Sector 6, transport and communications:										
63 Rail or road transport	18	1.14	0.71 to 1.81	1.19	0.71 to 2.00	1	0.45	0.06 to 3.18	0.40	0.05 to 2.94
65 Post or telecommunication	54	0.90	0.69 to 1.18	0.81	0.53 to 1.26	31	1.15	0.80 to 1.64	1.98	0.47 to 8.28
66 Mail distribution	13	1.07	0.62 to 1.85	1.12	0.62 to 2.01	1	0.92	0.13 to 6.52	0.79	0.11 to 5.78
Sectors 7 and 8, production I or II:										
70 Textile	25	1.16	0.78 to 1.73	1.04	0.69 to 1.57	10	0.96	0.51 to 1.81	0.81	0.42 to 1.57
71 Sewing	84	0.89	0.71 to 1.11	0.75	0.58 to 0.96	41	1.09	0.79 to 1.51	0.95	0.63 to 1.43
72 Shoe or leather goods	10	1.22	0.65 to 2.27	1.14	0.61 to 2.13	7	2.09	0.99 to 4.40	2.08	0.96 to 4.51
75 Engineering industry	49	1.34	1.01 to 1.78	1.23	0.91 to 1.66	7	1.46	0.69 to 3.08	1.44	0.66 to 3.15
76 Electronics	26	1.52	1.03 to 2.23	1.41	0.94 to 2.10	5	1.15	0.48 to 2.78	1.11	0.45 to 2.75
77 Wood	14	1.64	0.97 to 2.78	1.47	0.86 to 2.51	1	1.76	0.25 to 12.5	1.59	0.22 to 11.4
80 Graphic	12	0.83	0.47 to 1.45	0.75	0.42 to 1.34	5	1.20	0.50 to 2.90	1.15	0.46 to 2.84
82 Food industry	46	1.34	1.00 to 1.80	1.24	0.91 to 1.69	14	1.48	0.87 to 2.51	1.45	0.82 to 2.57
83 Chemical or cellulose	12	1.10	0.62 to 1.94	0.98	0.55 to 1.74	2	0.73	0.18 to 2.92	0.62	0.15 to 2.55
85 Other fabrication	31	1.21	0.85 to 1.73	1.14	0.79 to 1.65	4	0.82	0.31 to 2.19	0.76	0.28 to 2.08
88 Warehouse or packaging	51	1.00	0.75 to 1.31	0.89	0.66 to 1.19	6	0.79	0.36 to 1.77	0.70	0.31 to 1.60
Sector 9, services and military work:										
91 Housekeeping	431	1.12	1.01 to 1.24	1.00	0.88 to 1.14	77	1.29	1.02 to 1.64	1.12	0.84 to 1.49
92 Waiters	82	0.98	0.79 to 1.23	0.88	0.70 to 1.10	28	1.12	0.77 to 1.64	0.93	0.62 to 1.39
93 Caretaking or cleaning	293	1.21	1.07 to 1.36	1.11	0.97 to 1.28	59	1.20	0.92 to 1.57	1.00	0.73 to 1.36
94 Other	67	1.06	0.83 to 1.35	0.95	0.74 to 1.21	29	1.07	0.74 to 1.56	0.90	0.60 to 1.33

\*Only those occupational groups with 1000 or more people in the general cohort at the onset of the follow up; †adjusted for age, period, and geographical risk area; ‡adjusted for age, period, geographical risk area, and occupational sector.

such occupations in 1960 and 1970. By contrast, the incidence was markedly decreased among medical workers even when only other occupations in the same main group were taken as reference.

For agricultural, forestry, and fishing sector, fishing work showed an excess risk in both the general cohort and those in the same occupations in 1960 and 1970, with similar increases of more than 30% when people of the same occupational sectors were used as reference. Miners and quarrymen employed for 10 or more years in this occupational group ran the highest risk of gastric cancer (RR 1.91). For this group, it is not possible to calculate RRs within the sector, given that it is the only occupational group in this sector. Within the transport and communication sector, the title rail and road transport work showed significant excess in both cohorts, whereas ships' crew presented non-significant increased risk in all analyses.

For the production sector, significant excess risks were found in the general cohort for masonry and concrete work, heavy labour, and warehouse and packaging work. We also found non-significantly increased risks for textile work, sewing, shoe and leather goods work, metal processing work, and glass, ceramic, and food industries when the overall cohort provided the reference rates, although risks were attenuated when people of the same occupational sector were used as reference. The analysis of all people who reported the same occu-

pation in 1960 and 1970 gave a more specific selection of occupational groups with high risk, this time textile, metal processing, masonry and concrete, glass or ceramics, and warehouse or packaging work stood out. Among service occupations, incidence of gastric cancer was increased for housekeeping workers and waiters.

Table 3 examines three digit occupations for those codes with an RR greater than 1.10 in men. Significant increases in gastric cancer risk appeared in the general cohort among fishermen (RR 1.41), miners and quarrymen (RR 1.78), motor vehicle drivers (RR 1.13), sheet metal workers (RR 1.30), concrete and construction workers (RR 1.30), butcher and meat preparers (RR 1.33), crane or hoist operators (RR 1.38), truck or conveyor operators (RR 1.26), docker and freight handlers (RR 1.78), and launderers or dry cleaners (RR 1.79). In general, these associations were stronger among those in the same occupations in 1960 and 1970 and remained after adjusting for occupational sector. We also found increased risks for petrol station workers, textile workers, upholsterers, furnacemen, metal platers, coaters, and waiters among others.

### Women

The RRs for Swedish women by two digit occupational groups are shown in table 4. In professional and technical occupational groups, significant excesses were found for health and

**Table 5** Relative risks for gastric cancer among female Swedish workers for those specific occupations (three digit) with a minimum of 10% excess risk, 1971–89

Code, occupation*	General cohort					Same occupation in 1960–70				
	Cases	RR†	95% CI	Adjusted RR‡	95% CI	Cases	RR†	95% CI	Adjusted RR‡	95% CI
Sector 0, professional and technical work:										
042 Psychiatric attendants	17	1.08	0.67 to 1.73	1.24	0.76 to 2.02	8	1.20	0.60 to 2.41	1.37	0.67 to 2.79
043 Practical nurses	193	1.11	0.96 to 1.28	1.44	1.19 to 1.75	62	1.38	1.06 to 1.79	1.83	1.34 to 2.52
044 Dental nurses	11	1.20	0.66 to 2.17	1.39	0.76 to 2.53	6	1.26	0.56 to 2.82	1.45	0.64 to 3.28
092 Social workers	19	0.96	0.61 to 1.51	1.11	0.70 to 1.75	5	0.80	0.33 to 1.93	0.90	0.37 to 2.19
093 Librarians or archivists	11	0.98	0.54 to 1.77	1.13	0.62 to 2.07	2	0.70	0.18 to 2.82	0.81	0.20 to 3.27
Sector 1, administrative and managerial:										
101 Government workers	10	0.93	0.50 to 1.73	1.27	0.56 to 2.87	0	–	–	–	–
Sector 2, bookkeeping and clerical work:										
204 Cashiers	40	1.33	0.97 to 1.81	1.41	1.02 to 1.96	7	1.38	0.65 to 2.90	1.37	0.64 to 2.97
292 Bank employees	21	1.60	1.04 to 2.46	1.69	1.09 to 2.62	4	1.55	0.58 to 4.14	1.52	0.56 to 4.15
296 Insurance raters	10	1.15	0.62 to 2.14	1.15	0.61 to 2.15	6	1.68	0.75 to 3.75	1.73	0.75 to 3.98
Sector 3, sales work:										
302 Working proprietor or retail	31	1.03	0.72 to 1.47	1.22	0.84 to 1.76	12	1.04	0.59 to 1.84	1.43	0.78 to 2.63
333 Shop assistants	256	0.87	0.76 to 0.99	1.10	0.83 to 1.46	77	0.74	0.58 to 0.93	0.99	0.56 to 1.74
Sector 4, agriculture, forestry, and fishing:										
401 Agriculture enterprises	16	1.28	0.78 to 2.08	1.20	0.72 to 2.01	0	–	–	–	–
412 Horticultural workers	22	1.28	0.84 to 1.94	1.24	0.79 to 1.95	0	–	–	–	–
413 Livestock workers	21	1.12	0.73 to 1.72	0.95	0.60 to 1.51	0	–	–	–	–
Sector 6, transport and communications:										
635 Delivery women	10	1.16	0.62 to 2.15	1.18	0.61 to 2.29	–	–	–	–	–
653 Telephone operators	14	1.43	0.85 to 2.42	1.58	0.89 to 2.80	11	1.46	0.80 to 2.65	1.52	0.74 to 3.15
Sectors 7 and 8, production I or II:										
701 Spinners or weavers or knitters	25	1.16	0.78 to 1.73	1.04	0.69 to 1.57	10	0.96	0.51 to 1.81	0.81	0.42 to 1.57
758 Other engineering work	30	1.67	1.17 to 2.40	1.55	1.06 to 2.25	5	1.42	0.59 to 3.42	1.37	0.55 to 3.42
768 Other electronic work	26	1.58	1.08 to 2.33	1.48	0.99 to 2.20	5	1.15	0.48 to 2.78	1.12	0.45 to 2.76
822 Bakers and pastry cooks	16	1.31	0.80 to 2.13	1.16	0.70 to 1.91	6	1.40	0.63 to 3.13	1.33	0.58 to 3.04
825 Canning workers	15	1.70	1.02 to 2.82	1.64	0.97 to 2.75	6	2.28	1.02 to 5.10	2.24	0.97 to 5.18
852 Plastic product workers	17	1.81	1.13 to 2.92	1.70	1.05 to 2.77	0	–	–	–	–
881 Packers	33	1.16	0.83 to 1.64	1.05	0.73 to 1.50	3	0.69	0.22 to 2.16	0.60	0.19 to 1.91
Sector 9, services and military work:										
912 Cooks	48	1.25	0.94 to 1.66	1.14	0.85 to 1.53	23	1.81	1.19 to 2.74	1.58	1.02 to 2.44
913 Kitchen maids	121	1.22	1.01 to 1.46	1.12	0.92 to 1.35	16	1.26	0.77 to 2.06	1.07	0.64 to 1.79
931 Building caretakers	12	1.25	0.71 to 2.21	1.13	0.64 to 2.00	0	–	–	–	–
932 Cleaners	281	1.20	1.06 to 1.36	1.11	0.96 to 1.28	59	1.24	0.95 to 1.61	1.03	0.76 to 1.40
943 Laundry or dry cleaning	26	1.30	0.89 to 1.92	1.18	0.80 to 1.75	10	1.57	0.84 to 2.93	1.36	0.72 to 2.56
948 Other service work	10	1.35	0.73 to 2.51	1.21	0.65 to 2.27	0	–	–	–	–

\*Only those occupations with 1000 or more people in the general cohort at the onset of the follow up and at least 10 cases; †adjusted for age, period, and geographical risk area (reference, all other occupations); ‡adjusted for age, period, and geographical risk area (reference, other occupations in same sector).

nursing work taking as reference the same occupational sector, and non-significant excesses were found for bookkeeping and cashier's work. The RR was also increased among women employed in the production sectors, including engineering, electronics, wood, and food industries. Among service and related occupations, significant increases in risk were found for housekeeping work and caretaking and cleaning work.

Table 5 shows RRs for those specific occupations (three digit) with a minimum of 10% excess risk in women. For practical nurses, a nearly significant RR of 1.11 was found in the general cohort, whereas the comparison of these women with the rest of professionals and technicals yielded a 44% excess risk. Furthermore, the subcohort of women with this occupation in both the 1960 and 1970 censuses clearly confirmed this association. Other occupations that registered significant increases for gastric cancer were cashiers, bank employees, other engineering work, other electronic work, canning workers, plastic product workers, cooks, kitchen maids, and cleaners.

## DISCUSSION

We have studied the relation between incidence of gastric cancer and occupation in a historical cohort of Swedish male

and female workers gainfully employed in 1970. Risks were also estimated for the subcohort of these people who reported the same occupation in 1960 and 1970. Thus, we obtained a subgroup of long term employed workers, increasing the specificity of risk estimators.

As was expected, in the general cohort there were substantial differences in risk across occupational sectors. High risks of stomach cancer were identified among blue collar workers, whereas low risks were noted among professional and technical workers and in the administrative and managerial sector. Previous studies have shown that mortality from gastric cancer is greater in men of low social class.<sup>24,32</sup> Social class and educational level are strongly correlated with occupation, and it is thus difficult to disentangle the effects of occupational exposures from other lifestyle risk factors such as diet or hygiene standards.

As a way of allowing for socioeconomic status, analyses within sectors were also conducted—namely, using only workers of the same occupational sector as reference. The reduction in the risks for most of the blue collar occupations was a logical consequence of this correction. We were unable to take into account diet and other potential risk factors that could act as confounders. Some of these factors might be distributed following a geographical pattern, as incidence of gastric cancer presented a twofold variation among Swedish

counties, with higher incidence in the north and lower incidence in the central part of the country. To take this variability into account, RRs were adjusted for geographical risk area.

A major problem of this type of study is that the many comparisons could produce some spurious significant results, the so called mass significance phenomenon. It is possible to calculate the number of significant results expected by chance. For this tumour, among men chance would explain three of the increased RRs that reached significance by specific occupations (three digit) and one by occupational group (two digit), whereas among women chance would account for two of the increased RRs in both three and two digit analyses.

In our data, after adjusting for age, period of diagnosis, and geographical area, a marked and consistent excess of stomach cancer was noted among workers exposed to mineral dust in the mining and masonry industries. Miners and quarrymen registered an important excess risk, something already described in Sweden.<sup>15</sup> Interestingly, men reporting such occupation in both censuses showed a higher risk. Miners and quarrymen in this cohort have been exposed to mineral dusts of various kinds, as there are no coal mines in Sweden. The increased RRs among masonry and concrete workers reported previously,<sup>15 17 19 23 39</sup> were also found in our cohort. People in these occupations have been exposed to various chemicals and dusts. Taken together, these results speak in favour of the suggested association between gastric cancer and exposure to dust.<sup>27 40-42</sup>

After being inhaled, dust could be cleared by the lung and then swallowed, allowing potential carcinogenic compounds to take part in the precursor lesions of gastric cancer. Specifically, coal miners have been reported to have an increased mortality from gastric cancer.<sup>16</sup> Ames found a risk excess in miners who had prolonged exposure to both coal mine dust and cigarette smoke, suggesting the interaction between these factors.<sup>43</sup> Coal miners have been exposed to very high concentrations of coal dust during their work that often are high enough to exceed the clearing capacity of the lung. More recently, a review of the risks of gastric cancer undertaken by Cocco gathered evidence around the potential carcinogenic mechanisms for coal dust and nitrogen oxides.<sup>14</sup>

Occupations associated with exposure to metal dust also showed an excess risk of gastric cancer in our study. Associations tended to be increased in the subcohort of those people who reported the same occupation in 1960 and 1970, which is consistent with previous reports.<sup>25 41 44 45</sup> Among men, a high risk was found for furnacemen, rolling mill workers, sheet metal workers, welders, flame cutters, metal platers, and coat-ers. In women, other engineering industry workers had a 50% significant excess risk in the general cohort. Exposures to several metals classified as carcinogenic to humans, hexavalent chromium, nickel, and cadmium, and to combustion products, including polycyclic aromatic hydrocarbon compounds are common in several of these occupations, and may play a part in the increased risks found.

Although male engineers did not present an increased incidence of gastric cancer when the general cohort was taken as reference, a significant excess risk was found among electrical and mechanical engineers compared with other professional and technical workers. Recently, a case-control study by Ekström *et al* also found non-significant increased risks for technicians and engineers when adjusting for socioeconomic status.<sup>25</sup> Parent *et al*<sup>19</sup> reported an increased incidence of gastric cancer among male electrical workers who had been employed for at least 10 years as electric or electronic workers, although other studies in the United States, England, and Sweden failed to support this association.<sup>46-48</sup> We have also found an excess risk among women electronic workers and telephone operators. Potential exposures among these workers included electromagnetic fields and polychlorinated biphenyls (PCBs), although there is no evidence about their influence on the development of gastric cancer.<sup>49</sup>

The relation between the rubber industry and gastric cancer is well documented.<sup>27 31 50 51</sup> The relevant exposures include nitrosamines and polycyclic aromatic compounds, both related to gastric cancer. In our case, a high although non-significant risk was found in the rubber industry only in men.

A high risk of gastric cancer was found for motor vehicle drivers. Excess risks have been reported for transport workers in previous studies<sup>19 22</sup> and recent evidence from work in Swedish men exposed to diesel engine emissions showed an increased risk of stomach cancer.<sup>30</sup> We also found an increased risk of gastric cancer among petrol station workers. Lynge *et al* studied the relation between cancer and exposure to gasoline vapours in the Nordic countries using the occupation registered at the census on 1970, and they found a non-significant excess risk in both sexes for stomach cancer.<sup>52</sup>

Exposure to wood dust has been shown to be carcinogenic to humans, increasing the risk of nasal adenocarcinoma. Previous studies have reported a high risk of stomach cancer among these workers in Canada,<sup>28</sup> the United States,<sup>29</sup> and New Zealand.<sup>53</sup> Our data do not support this association in men, although in women wood work had a non-significant excess. In the Nordic countries, the results reported by Andersen *et al* were also negative.<sup>33</sup>

A high risk of stomach cancer was found in Swedish fishermen as has been previously noted in Nordic countries.<sup>15 33</sup> High incidence and mortality from gastric cancer have been reported among Icelandic seamen and fishermen,<sup>54 55</sup> and Italian sailors and seamen.<sup>31</sup> In Hong Kong, fishermen showed a high risk not only for stomach cancer but also for digestive cancers,<sup>22</sup> suggesting the importance of dietary habits in this group. The exposures involved could be related to a high intake of fish, preserved, smoked, and cured foods, and lower consumption of fruits and vegetables.

Cancers among farmers have been widely investigated, and different studies have described an association between risk of gastric cancer and agricultural work,<sup>15 19-21 56 57</sup> although neither our results nor those of some other studies supported such an association in the Nordic countries.<sup>33 58</sup> Differences in agricultural practices may account for these discrepancies.

Men employed in the two digit title warehouse and packaging work presented significant increases of incidence of gastric cancer, but the greater excesses appeared for its corresponding three digit category docker and freight handler. These workers are exposed to various mixed dusts and polycyclic aromatic compounds. Although not large, this association was previously described in Sweden<sup>15</sup> and the Nordic countries as a whole.<sup>33</sup>

Several studies have found an excess risk of stomach cancer in employees in the food industry.<sup>19 21 59</sup> In general, we found an increased risk of gastric cancer among them. It was significant for male butchers and meat preparers and female canning workers. The analysis for the subcohort reporting the same occupation in 1960 and 1970 confirmed the presence of an increased risk. Recently, Boffetta *et al* suggested that the excess of gastric cancer among butchers could be due to effect modification by lifestyle or socioeconomic factors.<sup>59</sup> However, in our study, when RRs were calculated with only other occupations in the same sector as reference, the excess risk, although reduced, remained increased. This results are, however, difficult to interpret, as several different factors could be involved.

In service occupations, for men significant excess risks were found among launderers and dry cleaners whereas non-significant increased risks were found among fire fighters and waiters. Among women the risk of gastric cancer was increased for cooks, launderers, and dry cleaners. Female cleaners seemed to be a high risk group in an Italian study as well as our own.<sup>31</sup>

In summary, the high risk among miners, construction industry, and metal processing workers would support a dust



### Main messages

- Dusty occupations, such as mining and jobs related to construction present an increased risk of gastric cancer.
- Fishermen show an increased incidence of gastric cancer.
- Among women, it is worth noting the risk excess found for practical nurses, food industry workers, cooks, and launderers and dry cleaners.
- Socioeconomic status is strongly related to gastric cancer and should be taken into account in occupational studies.

### Policy implications

- There seem to be a preventable portion in the incidence of gastric cancer related to specific occupational exposures—such as mineral and metal dust.
- Possible risk factors associated with excesses of gastric cancer in women should be further investigated.

theory, as well as the increased risk among women wood workers and other engineering industry workers. The results also corroborate the strong risk among fishermen and may indicate an area that warrants further research, which could include study of the presence of toxic substances in their diet and other lifestyle factors. This study also provides support for increased risks of stomach cancer among dockers. Furthermore, there were interesting increased risks in women, for whom occupational risks have been less studied—such as practical nurses, food industry workers, cooks, and launderers and dry cleaners.

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## ECHO.....

## Asthma and agriculture



Please visit the Occupational and Environmental Medicine website [www.occenvmed.com] for link to this full article.

Whether environmental exposure to bacterial endotoxin protects against asthma is questionable. According to a recent review in *Thorax*, the evidence is equivocal. Endotoxin is common in the environment—in homes, especially those with pets, and in occupational, especially agricultural, environments. Recent studies indicate that exposure to it might reduce atopy and asthma in farmers' children.

Direct evidence for protection against atopy—that is, involving IgE sensitisation and eosinophils—rests on a single study of infants with a high risk of asthma in whom endotoxin stimulated a non-atopic immunological pathway. Atopy probably accounts for only half of asthma cases, at most.

However, endotoxin can provoke asthma too. Its recognition as a cause of occupational lung disease—including asthma—comes from inhalation experiments and field studies in farmers and other occupations, among them cotton mill, pig farm, and grain workers, and its ability to exacerbate existing asthma in adults and children comes from several indoor studies. But this is non-allergic asthma, involving inflammation and activation of neutrophils and alveolar macrophages.

The relation between endotoxin, asthma, and farming is complex and the evidence contradictory. For now it seems that endotoxin marginally protects children and adolescents but increases risk in adult farmers.

Endotoxin might prevent primary development of allergic asthma but may itself be a primary and secondary cause of non-allergic asthma. This could be explained, the authors suggest, if endotoxin differs in effect depending on exposure—during the prenatal or neonatal period versus child and adult phases—and dose. Prospective studies in progress may clarify the picture.

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