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Occupational distribution of inflammatory bowel disease among German employees

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Abstract

Previous reports have shown that both Crohn's disease and ulcerative colitis affect people in white collar occupations associated with higher income and higher social class more frequently than other groups in the population. This study sought to carry these analyses one step further and investigate the distribution of inflammatory bowel disease by individual occupations. The German social security statistics for 'rehabilitation' were used to assess the occupational distribution of Crohn's disease and ulcerative colitis. From 1982 to 1988, a total of 12 014 people were granted rehabilitation as a result of inflammatory bowel disease. Low male prevalence of inflammatory bowel disease was found among bricklayers, road construction workers, unskilled workers in brick and stone, unskilled labourers, and security personnel. Low rates were found among women employed in cleaning and maintenance, and in those without occupation. In contrast, a high male prevalence was found among instrument makers, electricians, bakers, and technical assistants. Among female employees, inflammatory bowel disease was significantly associated with sales representatives, office workers, health occupations, and hairdressers. These associations were found in the complete data for 1982–8 as well as in the separate data for the two half periods 1982–5 and 1986–8. Highly significant correlations between the occupational distribution of Crohn's disease and ulcerative colitis were found among both male and female employees. It seems that occupations involving work in the open air and physical exercise are protective, while being exposed to airconditioned artificial working conditions or extended and irregular shift working confer a risk of contracting inflammatory bowel disease.

The social security system in West Germany covers over 20 million employees. According to German law, all employees must be members of a legal health insurance scheme. When they have a disease that interferes with their performance at work they may be provided with 'rehabilitation'. Rehabilitative measures include prolonged hospitalisation if necessary, prostheses or other expensive medical aids, and financial support if the patient is unable to continue his previous occupation and needs to be retrained for a work that suits his medical problem better. If rehabilitative measures fail and the patient is unable to work, a partial or complete disability pension may be granted.[1]

In a previous report, the disability statistics of the German social security system were used to analyse the distribution of inflammatory bowel disease among German employees by age, sex, and occupational status.[2] It was found that both Crohn's disease and ulcerative colitis affected white collar employees more frequently than blue collar employees. This report seeks to carry the previous analysis one step further and study the distribution of both inflammatory bowel disease by major occupational groups and individual occupations. To guarantee a large enough number of subjects in the individual occupations, the statistics of rehabilitation pertaining to seven consecutive years from 1982 until 1988 were analysed.

Methods

The statistics for rehabilitative measures for any legal insurance company in West Germany were collected centrally by the Verband Deutscher Rentenversicherungsträger (VDR), the Federation of German Insurance Companies. Cases were filed by disease code, sex, type of rehabilitation, and occupation. According to the 9th revision of the International Classification of Diseases (ICD), which was introduced to the VDR statistics in 1982, Crohn's disease and ulcerative colitis were assigned the ICD code numbers 555 and 556, respectively.[3] Individual occupations were recorded by the two digit code of the German classification of occupations.[4] For each year between 1982 and 1988, all records with the ICD codes 555 or 556 were taken from the complete VDR population and listed by their type of occupation. In addition, the overall frequency of each individual two digit occupational code in the complete VDR population was established. The frequency distribution of the occupational codes among the population of patients with inflammatory bowel disease was then compared with the frequency distribution in the complete VDR population. The comparison was carried out separately for men and women with Crohn's disease and ulcerative colitis, respectively. The occurrence of each occupational code in the inflammatory bowel disease population and in the complete VDR population was compared by calculating the odds ratio and its confidence limits according to Woolf's method.[5] An odds ratio was considered significant if its confidence limits do not include unity. To account for the number of 100 possible statistical comparisons, a significance level of $p=0{\cdot}0001$ was chosen when analysing the occupational distribution by two digit codes. In studying the 31 major occupational groups, a value of $p=0{\cdot}001$ was chosen. Table I illustrates how the individual odds ratios and their confidence limits were calculated. The relation

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TABLE I *Calculation of odds ratio and confidence limits*

	Agriculture	*Other occupations*	*Sum*
Crohn's disease	33	3570	3603
Other diagnoses	36235	2582676	2618911
Sum	36268	2586246	2622514

Odds ratio (OR): OR=33×2582676/3570×36325=0·659.
Standard error (SE) of ln OR: SE (ln OR)=(1/33+1/3570+1/36235+1/2582676)$^{1/2}$=0·1750.
Confidence limits (CL): CL=exp [ln OR±3·891×SE (ln OR)]=0·334 and 1·301.
For p<0·0001, p<0·001, and p<0·05: z=3·891, z=3·291, and z=1·960, respectively.

between the occupational distribution of Crohn's disease and ulcerative colitis was tested by least squares linear regression analysis.[6]

Results

From 1982 to 1988, a total of 12014 patients were awarded rehabilitative measures from Crohn's disease and ulcerative colitis. Table II shows the breakdown of these patients by type of inflammatory bowel disease, sex, and major occupational group. In men, the occurrence of inflammatory bowel disease was low among workers in building and construction, unskilled labourers, machinists, and transport workers. It was high among blacksmiths, locksmiths, mechanics, and kin occupations; workers in electricity; and workers in food industry. In women the occurrence of inflammatory bowel disease was low among unskilled labourers, housekeepers, cleaning and maintenance workers, and among those without a specified occupation. It was high among women in instrument making and similar occupations; trade, banking, and insurance; administration and general office work; and health care. Crohn's disease and ulcerative colitis showed a similar occupational distribution. In men, the correlation coefficient for the comparison of Crohn's disease with ulcerative colitis was r=0·50, n=31, p<0·005. In women, the correlation was restricted to those 24 out of 31 occupational groups with an odds ratio greater than 0 for both types of inflammatory bowel disease. The correlation coefficient was r=0·56, n=24, p<0·005.

Table III shows a further breakdown of Crohn's disease and ulcerative colitis by individual occupations. The presentation was restricted to those occupations which showed significant odds ratios or which contributed appreciably to a significant odds ratio in an occupational group as shown in Table II. Low odds ratios among men were associated with bricklayers, workers in road construction, unskilled workers in brick and stone, unskilled labourers, and security personnel. Low rates were also found among women employed in cleaning and maintenance, and those without occupation. In contrast, high odds ratios in men were found among instrument makers, electricians, bakers, and technical assistants. Among female employees, inflammatory bowel disease was significantly associated with sales representatives, office workers, health occupations, and hairdressers. To test the strength and validity of these associations, the data for the two half-periods 1982–5 and 1986–8 were analysed separately. All associations reported above for the total period of 1982–8 could also be confirmed in the data from both half periods, albeit with less conservative levels of significance such as p<0·001 or p<0·01.

The correlation between the occupational distribution of Crohn's disease and ulcerative colitis was r=0·43, n=79, p<0·0001 in men and r=0·40, n=53, p<0·005 in women. In the analysis

TABLE II *Distribution of inflammatory bowel disease by major occupational group*

		Men					*Women*				
Code	*Occupational group*	*Total*	*CD*	*OR*	*UC*	*OR*	*Total*	*CD*	*OR*	*UC*	*OR*
1–6	Agriculture, animal breeding, fishing	36268	33	0·7	27	0·7	7472	20	1·3	12	1·9*
7–9	Mining	49907	79	1·2	48	0·9	758	1	0·6	1	1·6
10–11	Quarrying, stone	4824	4	0·6	3	0·6	190	1	2·5	0	0·0
12–13	Pottery, glass	5395	3	0·4	7	1·2	1514	6	1·9	0	0·0
14–15	Chemical processing	35202	37	0·8	36	1·0	7804	16	1·0	8	1·2
16–17	Paper, printing	25632	54	1·5	26	0·9	8538	13	0·7	10	1·4
18	Wood processing	8486	11	0·9	6	0·7	623	0	0·0	0	0·0
19–24	Metal processing	94640	119	0·9	86	0·8	7203	13	0·9	3	0·5
25–30	Blacksmiths, locksmiths, mechanics	279163	485	1·3*	378	1·3*	6405	20	1·5	16	3·0*
31	Electricity	72315	161	1·7*	137	1·8*	1647	7	2·0	0	0·0
32	Assembly line	54391	65	0·9	53	0·9	27697	55	0·9	20	0·8
33–36	Textile, cloth	12551	6	0·3	16	1·2	64160	122	0·9	46	0·8
37	Leather processing	5950	5	0·6	2	0·3	4608	9	0·9	5	1·3
39–43	Food, beverages, tobacco	43364	95	1·6*	60	1·3	27000	38	0·7	21	0·9
44–47	Building, construction	144173	123	0·6*	132	0·8	447	1	1·1	0	0·0
48–49	Plasterers, tile layers, glazers	33369	54	1·2	41	1·2	987	2	1·0	0	0·0
50	Cabinet makers, carpenters	45746	58	0·9	68	1·4	461	3	3·1	0	0·0
51	Painting	41827	58	1·0	52	1·2	1689	4	1·1	4	2·8*
52	Warehouse, delivery	22136	29	1·0	17	0·7	22005	40	0·9	12	0·6
53	Unskilled labourers	150617	176	0·8	113	0·7*	114149	239	0·8*	99	0·8*
54	Machinists	70755	64	0·7*	64	0·8	5705	6	0·5	7	1·4
60–63	Engineers, technicians	272194	344	0·9	310	1·1	27275	75	1·3	39	1·7*
68–70	Trade, banking, insurance	141075	237	1·2	185	1·2	239370	643	1·3*	246	1·2*
71–74	Transport	259727	325	0·9	224	0·8*	49372	89	0·9	41	1·0
75–78	Administration, office	283446	407	1·1	297	1·0	536016	1271	1·2*	518	1·2*
79–81	Security	63156	56	0·6*	61	0·9	14894	14	0·4	6	0·5
82–83	Literature, art	16599	23	1·0	20	1·1	14309	26	0·9	17	1·4
84–85	Health care	22238	32	1·0	21	0·9	122810	326	1·3*	115	1·1
86–89	Social care, teaching	30730	52	1·2	33	1·0	73236	144	0·9	64	1·0
90–93	Hygiene, cleaning, maintenance	31837	33	0·8	26	0·8	194601	364	0·9	137	0·8*
97–99	No occupation named	264801	375	1·0	258	0·9	281594	423	0·7*	166	0·7*
1–99	All occupations	2622514	3603		2807		1894539	3991		1613	

Numbers in the Table reflect rehabilitation arising from all diagnoses (=Total), Crohn's disease (=CD), and ulcerative colitis (=UC) in every major occupational group. Odds ratios (=OR) were calculated as shown in Table I for the example of the first occupational order related to agriculture, animal breeding, and fishing.
*p<0·001 for OR>1·0 or OR<1·0.

TABLE III *Distribution of inflammatory bowel disease among individual occupations*

		Men					*Women*				
Code	*Occupational group*	*Total*	*CD*	*OR*	*UC*	*OR*	*Total*	*CD*	*OR*	*UC*	*OR*
5	Gardeners and florists	19152	19	0·7	14	0·7	4456	18	1·9*	10	2·6*
26	Plumbers	36718	70	1·4*	67	1·7†	114	1	4·2	0	0·0
28	Mechanics	61638	145	1·7†	91	1·4*	1850	2	0·5	4	2·5
29	Tool makers	19411	45	1·7*	27	1·3	266	1	1·8	0	0·0
30	Instrument makers	5959	17	2·1*	11	1·7	2395	12	2·4*	9	4·4†
31	Electricians	72315	161	1·7†	137	1·8†	1647	7	2·0	0	0·0
39	Bakers	12180	45	2·7†	22	1·7*	1851	9	2·3*	3	1·9
44	Bricklayers	79530	64	0·6†	77	0·9	232	1	2·1	0	0·0
46	Road constructors	16750	13	0·6*	14	0·8	65	0	0·0	0	0·0
47	Unskilled workers in brick and stone	15642	10	0·5*	13	0·8	82	0	0·0	0	0·0
53	Unskilled labourers	150617	176	0·8*	113	0·7*	144149	239	0·8*	99	0·8*
63	Technical assistants	19022	53	2·0†	35	1·7*	12871	51	1·9†	27	2·5†
68	Sales representatives	74571	128	1·3*	92	1·2	182218	510	1·4†	192	1·3*
69	Bankers	52323	89	1·2*	81	1·5*	50214	117	1·1	51	1·2
71	Ground transport	157425	188	0·9*	145	0·9	4563	10	1·0	4	1·0
78	Office workers, clerks	200311	309	1·1*	26	1·0	458400	1104	1·2†	455	1·2*
79	Security	51861	43	0·6*	43	0·8	11832	10	0·4*	4	0·4
85	Health occupations	19910	30	1·1	19	0·9	120550	321	1·3†	110	1·1
90	Barbers	2736	6	1·6	2	0·7	12576	110	4·3†	24	2·3†
93	Cleaning and housekeeping	13289	14	0·8	9	0·6	115294	117	0·5†	65	0·6*
99	Without specified occupation	250865	350	1·0	248	0·9	229360	401	0·8†	154	0·8*
1–99	All occupations	2622514	3603		2807		1894539	3991		1613	

Numbers in the Table reflect rehabilitation arising from all diagnoses (=Total), Crohn's disease (=CD), and ulcerative colitis (=UC) in individual 2 digit occupational codes. Odds ratios (=OR) were calculated as shown in Table I.
*p<0·05, †p<0·0001 for OR<1·0 or OR>1·0.

of inflammatory bowel disease distribution by occupational codes of two digits, multiple occupations with low case numbers were found. The odds ratios calculated for these smaller occupations were less likely to represent the true risk associated with the individual occupation. In subsequent analyses, therefore, the regression between Crohn's disease and ulcerative colitis was restricted to the largest occupations with most employees. A total of 10000 cases was arbitrarily chosen as cut off point. Figure 1 shows the results of the two separate regression analyses among male and female employees. Highly significant correlations between the occupational distribution of Crohn's disease and ulcerative colitis were found among both male and female employees. The significance of the two correlations remained unchanged if two outliers were omitted from both regression analyses (Fig 2).

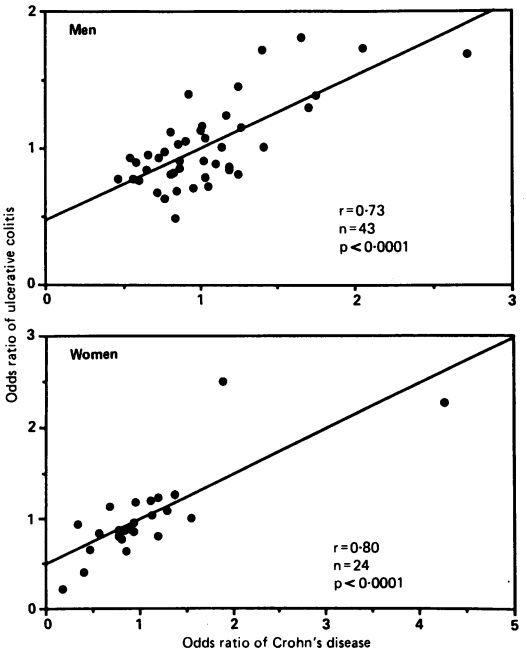

Figure 1: Correlation of Crohn's disease with ulcerative colitis among different occupations. The odds ratios shown on the x and y axis measure the risk of Crohn's disease and ulcerative colitis respectively, associated with individual occupations. Each point represents one occupation. Only occupational codes with a total of more than 10000 male or female patients are considered in the regression analysis.

Discussion

As shown by the present study, sedentary occupations and occupations which are performed indoors seem to be associated with a higher risk of inflammatory bowel disease. Similarly, and possibly by the same mechanisms, more prestigious and physically less demanding occupations are also associated with an increased risk. By contrast, physically demanding occupations and occupations with small educational and training requirements seem to be associated with a small risk only. In more general terms, being in the open air and having to exercise seem to be protective working conditions, while being con-

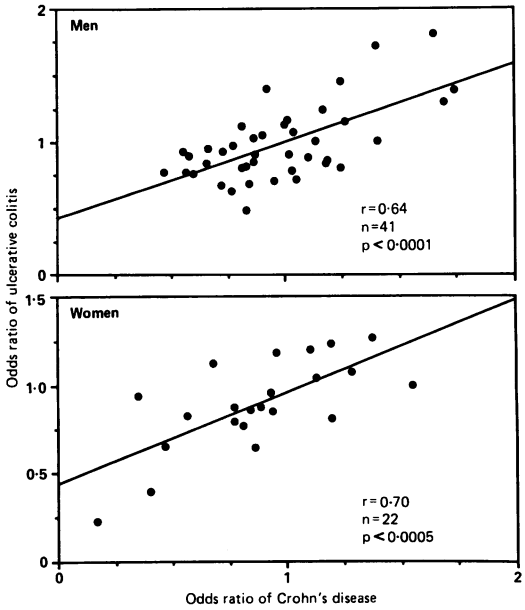

Figure 2: Correlation of the occupational variation of the odds ratio in Crohn's disease v ulcerative colitis. Figure 2 shows similar regression analyses as in Figure 1 with two outliers omitted from each regression.

fined to airconditioned or otherwise artificial working environments and having long or unusual working hours seem to be risky environmental conditions with regard to inflammatory bowel disease. With regard to individual occupations, the most consistent and most noticeable increases in the odds ratio were found among electricians, technical assistants, bakers, and female hairdressers. These occupations seem to exemplify the working environments characterised by artificial lights, extended and irregular shifts, and infringement of the normal diurnal rhythm. Another yet unnoticed common denominator, however, could also be responsible for the observed occupational patterns. For instance, it has been suggested that hypersensitivity to baker's yeast or related antigens may play a role in Crohn's disease.[7] Strains of this organism are used in a wide variety of foodstuffs and could explain the ubiquitous occurrence of Crohn's disease as well as its increased prevalence in bakers. The significant relation between the two inflammatory bowel diseases lends additional credibility to the observed occupational patterns. Previous studies have also revealed similarities in the epidemiologic behaviour of the two diseases.[8 9] Crohn's disease and ulcerative colitis show the same geographic distribution, and their temporal trends appear to be related.[10 11]

The German social security statistics of rehabilitation were used in the present analysis to assess the occupational distribution of Crohn's disease and ulcerative colitis. In previous studies, these statistics have been found to provide reliable data with which to analyse the epidemiology of inflammatory bowel disease and peptic ulcer disease.[2 12-14] They contain the records from all employees in West Germany and are based on diagnoses made by doctors. The large numbers allow estimation of the association of inflammatory bowel disease and individual occupations. In contrast with statistics dealing with occupational mortality, the information regarding occupation is based on data from both the employer and the employee. The system of social security does not cover civil servants and self-employed people with incomes above a certain threshold who are insured by the government and private insurance companies respectively, and who constitute seven per cent of the working population. Judging from previous epidemiologic reports, these two groups might be expected to show a high prevalence of inflammatory bowel disease.[15-18]

As with other types of occupational statistics, several biases could have entered and confounded the associations reported here.[19] Rather than reflecting increased exposure to hazardous characteristics of a working environment, occupational risks could be associated with socioeconomic factors, which influence the availability and desire to seek medical care and health seeking behaviour. A given occupation may show an unduly high risk not because of its hazardous influence but because of less demanding work conditions which attract a high proportion of chronically ill persons. Finally, the occupation recorded is that of the last employment, and hazards to health associated with previous occupations go unnoticed. Wyke *et al* found that during a period of six years, 57% of patients with inflammatory bowel disease continued in the same occupation for the same employer, and 10% were doing different work for the same employer. There were no major changes in the overall distribution of types of work undertaken by the patients as a whole.[20]

In conclusion, the present occupational statistics support and extend previous epidemiologic observations in showing a similar behaviour of both types of inflammatory bowel disease. Their characteristic dichotomous distribution with a low prevalence among physically demanding occupations with regular working hours and a high prevalence among sedentary indoor occupations could indicate the influence of a widely distributed risk factor associated with the influence of artificial working environments.

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