Journal of Epidemiology and Community Health 1993; **47**: 459–463

Reported incidence of occupational asthma in the United Kingdom, 1989–90

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Abstract

***Study objective*—To estimate the incidence of occupational asthma seen by respiratory and occupational physicians in the UK in 1989 and 1990.**

***Design*—New cases of occupational asthma were taken from a national reporting scheme, the Surveillance of Work-related and Occupational Respiratory Disease Project (SWORD). Estimates of the working population from the Labour Force Survey were used to calculate reported incidence by age group, sex, occupation, and region.**

***Setting*—The SWORD project is a scheme for the reporting of new cases of work-related respiratory disease by thoracic and occupational physicians from throughout the UK which began in 1989.**

***Patients*—In 1989 and 1990, of 4229 cases reported, 1085 (26%) were in patients with occupational asthma.**

***Main results*—Only half the reported cases were attributed to agents prescribed under the Industrial Injuries Scheme. There was considerable diversity in risk by occupation, with highest annual rates in welders, solderers, and electronic assemblers (175/million), laboratory workers (188/million), metal treaters (267/millon), bakers (334/million), plastics workers (337/million), chemical processors (364/million), and spray painters (658/million). Crude rates in men were higher than in women, but rates within occupations were similar in both sexes. Rates of disease rose with age; adjustment for occupation increased the gradient. Regional differences were only partly explained by diversity of industry and were probably mainly due to variation in levels of ascertainment and reporting.**

***Conclusions*—Asthma is the most commonly reported occupational lung disease in the UK. The incidence in the general population is unknown, but it was estimated that the incidence of new cases seen by respiratory and occupational physicians was about three times that reported. High relative risks were found in a number of occupations in which effective control of the work environment is urgently required.**

J Epidemiol Community Health 1993; **47**: 459–463

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Accepted for publication
June 1993

Occupational asthma is important because it is a preventable cause of serious long term disability, but the number of people affected is not known. Statistics based on disablement benefit awards underestimate the disease frequency and until very recently only cases attributed to certain agents were recognised for an award.[1] This report is an analysis of new cases of occupational asthma from throughout the United Kingdom notified in 1989 and 1990 to a confidential and voluntary scheme, the Surveillance of Work-related and Occupational Respiratory Disease project (SWORD). The analysis aimed to estimate the risk of reported disease by occupation, sex, age group, and region in the UK.

Methods

The SWORD project, its background, and methods have been described previously.[2] Briefly, new cases of work related respiratory disease seen by participating chest and occupational physicians from throughout the UK are reported on a regular basis. In 1989 and 1990, the first two years of the project, there were over 700 participating physicians equally divided between the two specialities. Chest physicians represented 83% of consultants listed in the handbook *Thoracic Medical Services in the United Kingdom*,[3] and included at least one physician in 90% of the country's chest clinics. Contributing and non-contributing clinics were fairly evenly distributed apart from a few areas of relatively poor participation, mainly in the south and east. The cases were newly diagnosed and were reported by most chest physicians in the UK, and so considered against estimates of the population at risk, rates for particular groups could be calculated.

Altogether 4229 cases of work related respiratory disease were reported in the first two years of the project, 1118 (26%) of which were of occupational asthma. After removal of 33 (3%) duplicates, 1085 cases remained—540 reported in 1989 and 545 in 1990; 824 (76%) were reported by chest physicians. Occupation was coded according to the Office of Population Censuses and Surveys (OPCS) 1980 classification,[4] and the place of residence according to the standard administrative regions. In 62 cases (5·7%) no place of residence was specified; these were allocated to the region in which the reporting physician worked.

The 404 occupation groups of the 1980 OPCS classification were aggregated in two ways (table I). The first was the standard grouping which combines occupations into 16 "orders"; the second, referred to as "occupational sets" we developed to study occupational rates in more detail while minimising misclassification. An occupational set covered all possible codes for the same occupation. For instance, someone described as a laboratory worker might be a

Table I Occupational classifications

Order[4]	*Set*	*Group code*[4]
(1) Professional & related supporting management	Remainder professional, clerical, & service	1 9
(2) Professional & related in education, welfare & health		
Nurses	Nurses	16
Remainder	Remainder professional, clerical, & service	10–15, 17–18
(3) Literary, artistic & sports	Remainder professional, clerical, & service	19–23
(4) Professional & related in science, engineering, & technology		
Laboratory technicians	in Laboratory technicians & assistants	30·1
Remainder	Remainder professional, clerical, & service	24–29, 30·2 33
(5) Managerial		
Farmers, horticulturalists & farm managers	in Farmers & farm workers	40
Remainder	Remainder professional, clerical & service	34–39, 41–44
(6) Clerical & related	Remainder professional, clerical & service	45–62
(7) Selling		
(8) Security & protective services		
(9) Catering, cleaning, hairdressing & other personal services		
Hairdressers	Hairdressers	73, 74
Cleaners	Cleaners	71·1–71·2, 72·1 72·2
Remainder	Remainder professional, clerical & service	63–75 excluding the above
(10) Farming, fishing, & related		
Farm and horticultural workers	in Farmers & farm workers	76·1–76·2, 77 78·1
Remainder	Remainder professional, clerical & service	76–83 excluding the above
(11) Materials processing, making, & repairing (excluding metal & electrical)		
Chemical processors	Chemical processors	88 89
Bakers	Bakers	90·1, 90·5, 91, 98·5
Other food processors	Other food processors	90·2 3, 90·6, 92·1 2, 98·7
Plastics workers	Plastics workers	95·5, 95·10, 97·2, 107·11
Wood workers	Wood workers	104 107·1, 107·6
Remainder	Remainder non-metal/electrical processors	84 107 excluding the above
(12) Processing, making, repairing & related (metal & electrical)		
Metal making & treating	Metal making & treating	108 110, 131·2 131·3
Welders	Welders, solderers & electronic assemblers	124·6, 128
Remainder	Remainder metal & electrical processors	104–131 excluding the above
(13) Painting, repetitive assembling etc		
Coach & other spray painters	Spray painters	132·2–3, 133·2 3
Other painters	Other painters	132·4, 133·4
Electronics assemblers	in Welders, solderers & electronic assemblers	134·1, 135·1
Laboratory assistants	in Laboratory technicians & assistants	136·8, 138·1
Remainder	Remainder painting, assembly & packaging	132–138 excluding the above
(14) Construction, mining & related	Construction & mining	139 146
(15) Transport operating, materials moving & storing	Transport & storage	147–158
(16) Miscellaneous labourers & unskilled workers		
Textiles, glass, ceramics & others	in Remainder non-metal electrical processors	159·1, 159·4, 159·8, 160·1, 160·4, 160·8
Chemicals, coke and gas works	in Chemical workers	159·2–3, 160·2 3
Foundries	in Metal making & treating	159·5, 160·5
Engineering and allied trades & boiler operators	in Remainder metal & electrical processors	159·6, 159·9, 160·6, 161·1
Mining	in Construction & mining	159·7, 160·7

technician, a laboratory assistant, or a foreman laboratory assistant, each of which has a different code; the three were therefore combined as a single occupational set.

Incidence rates were based on estimates of the working population derived from the 1989 and 1990 OPCS Labour Force Surveys (LFS) by region, sex, age group, and occupation (unpublished data). Most analyses were confined to the 995 cases (92%) in which age, sex, and occupation were specified by the reporting physician. All rates are expressed per million working persons per year.

Expected numbers in each sex and age group after adjustment for occupation were calculated by indirect standardisation using the crude rates by occupational order. A standardised rate ratio was then calculated, and rates by sex and age group adjusted for occupation were derived by multiplying the crude rate by the standardised rate ratio.

It was thought that regional variation in rates was probably the result of differences in ascertainment and reporting as well as differences in the distribution of the working population. To explore this, expected numbers in each region were calculated by indirect standardisation for sex, age group, and occupational order. Standardised rates were not estimated in the geographical analyses as these would simply have magnified the observed regional variation.

Results

SUSPECTED AGENTS

The suspected causal agents are shown in table II. For half the cases the suspected agent was one of the 14 officially prescribed at that time;[5 6] the nine additional agents recommended in October 1990 for prescription[7] accounted for a further 59 cases (5·4%), in 9% the cause was unknown or not specified, leaving 381 cases (35%) attributed to a wide variety of other agents. Some of these, such as the paints and glues, should perhaps have been classified with prescribed agents, but could not be because of inadequate information; others were clearly not included. Of note were the 52 cases attributed to organic materials such as spices (six cases), poultry (five cases), cotton (four cases), and wool (3 cases). Cases attributed to metals other than stainless steel welding fume formed another important group, in particular those associated with aluminium potroom emissions (16 cases).

Isocyanates were the most commonly suspected cause of occupational asthma and were implicated in many occupational sets. Of the 241 patients, 68 (28%) were painters, 40 (17%) plastic manufacturers, 11 (5%) chemical processors, and 81 (34%) were in other manufacturing occupations.

OCCUPATION, SEX, AND AGE

The crude annual incidence of occupational asthma reported to SWORD was 20 per million working populated (/mil). Three of the 16 occupational orders, which contain most of the manufacturing occupations and included 72% of cases, had the highest rates of disease: order 11—materials processing, making, and repairing (excluding metal and electrical), 319 cases (95/mil); Order 12—metal and electrical processing, making, and repairing, 217 cases (44/mil); and order 13—painting, assembly, and packaging, 181 cases (95/mil).

Table II Cases in relation to the agent suspected of causing their asthma

Agents	*Cases*	*(%)*
*Prescribed agents**		
Isocyanates	241	(22·2)
Platinum salts	7	(0·6)
Hardening agents	20	(1·8)
Soldering flux	69	(6·4)
Proteolytic enzymes	5	(0·5)
Laboratory animals insects	49	(4·5)
Flour grain	81	(7·5)
Antibiotics	15	(1·4)
Wood dusts	47	(4·3)
Azodicarbonamide	10	(0·9)
Agents not prescribed		
Organic:		
Soya bean†	2	(0·2)
Green coffee bean†	1	(0·1)
Other plant matter fungi	31	(2·9)
Crustaceans and fish†	19	(1·8)
Other animal antigens	18	(1·7)
Other organic origin not specified	3	(0·3)
Chemical:		
Glutaraldehyde†	20	(1·8)
Formaldehyde	12	(1·1)
Ethylene diamine	7	(0·6)
Chlorine	6	(0·6)
Ammonia	5	(0·5)
Styrene	4	(0·4)
Other chemicals	55	(5·1)
Metal:		
Stainless steel welding fume†	3	(0·3)
Other welding fume	20	(1·8)
Aluminium potroom emissions	16	(1·5)
Cobalt	8	(0·7)
Chrome	8	(0·7)
Nickel	4	(0·4)
Other metals	6	(0·6)
Miscellaneous:		
Other glues and resins	34	(3·1)
Paints	23	(2·1)
Cutting oils	18	(1·7)
Cleaning products & disinfectants	17	(1·6)
Persulphate salts and henna†	7	(0·6)
Other hair products	7	(0·6)
Reactive dyes†	7	(0·6)
Other inks and dyes	7	(0·6)
Insecticides & fungicides	7	(0·6)
Dust unspecified	8	(0·7)
Other specified agents	57	(5·3)
Agent not specified or unknown	101	(9·3)
Total	1085	(100)

* Agents recognised for compensation before 1991[5,6]
† Additional agents recommended for prescription in October 1990[7]

The crude incidence of occupational asthma in men (24/mil) was nearly twice that in women (13/mil). In both sexes the rate seemed to increase with age (table III). A similar trend was also apparent within occupational orders (data not tabulated here). The rates standardised for occupational order rose more steeply with age than the crude rates (table III) because young people of both sexes tended to work in jobs with higher rates of occupational asthma than those in older age groups.

Annual incidence rates by occupational set and sex (table IV) ranged from 3/mil for all those in orders one to 10 (excluding cleaners, hairdressers, farmers, and laboratory technicians) to 658/mil for coach and other spray painters, with little difference between men and women in the same occupational set. Therefore, the sex differences in crude rates were largely explained by differences in the distribution of occupations between men and women.

Table III Incidence rates of occupational asthma in relation to sex and age group—crude and standardised for occupational order*

Sex	*Age group (y)*	*Observed cases*	*Observed rate/mil/y*	*(95% CI)*	*Expected cases*	*Standardised rate ratio*	*Standardised rate/mil/y*
Female	16–29	84	11	(9, 13)	104·82	0·80	9
	30–44	98	12	(10, 15)	97·50	1·01	12
	≥45	104	15	(12, 18)	83·68	1·24	19
	All	286*	13	(11, 14)			
Male	16–29	167	17	(15, 20)	262·00	0·64	11
	30–44	249	23	(21, 26)	236·97	1·05	24
	≥45	293	31	(27, 34)	210·03	1·40	43
	All	709*	24	(22, 25)			

* Age and sex unknown in 90 cases

REGIONAL DIFFERENCES

Considerable geographical variation in incidence was apparent (table V), from 9/mil (95% CI 5, 14/mil) in West Yorkshire to 65/mil (95% CI 55, 76/mil) in the West Midlands Metropolitan County. Rates for Yorkshire and Humberside, the East Midlands, and the South East fell well below the national average of 20/mil, and those for the West Midlands, the North, and Scotland were clearly higher than elsewhere. The standardised rate ratios, which took age, sex, and occupation into account, were raised in the regions with high crude rates, and low in those with low rates, although the variability of the standardised rate ratios was less than that of the crude rates. Thus, the diversity in regional rates was only partially explained by differences in population distribution, which suggests that much of it was probably due to different levels of case ascertainment and reporting.

An intensive surveillance scheme for occupational asthma in the West Midlands Metropolitan County by Gannon and Burge[8] undoubtedly encouraged a high level of reporting to SWORD in that region. To provide an estimate based on a comparable level of ascertainment from other regions, rates by occupational order in the West Midlands Metropolitan County from SWORD were applied to the UK population. The estimated total number of cases was 2903 (55/mil), 2·7 times the number reported to the SWORD project in the same period.

Discussion

Once acquired, occupational asthma may cause respiratory illness for years to come, even after removal from the exposure that caused it.[9,11] Prevention therefore depends on the earliest possible identification of occupations at risk and of causal agents, and in the effective control of the work environment.

The number of people with occupational asthma awarded disablement benefit in 1989 and 1990 under the Industrial Injuries Scheme[1] was slightly lower than the number of cases attributed to prescribed agents reported to SWORD in the same period. Although any resemblance of the figures is to some extent coincidental because they are unlikely to include the same people, the distribution of cases by cause was broadly similar, apart from a larger number attributed to isocyanates and laboratory animals in SWORD. More importantly, the agents officially prescribed in 1989 and 1990 accounted for only half the cases in the present analysis. The legislative change which now permits occupational asthma from other causes to be compensated[7] is recognition of the much wider list of respiratory sensitisers, but the additional agents now specified cover only a further 5% of SWORD cases.

No systematic steps were taken to validate the diagnoses of occupational asthma. However, as these were made by specialists in respiratory or occupational medicine they are likely to have been reasonably reliable. Useful evidence on the question was obtained from a study of reported cases of asthma in workers in the chemical and plastics industry.[12] Of 95 cases studied, 85 had respiratory symptoms which improved on days away from

Table IV Incidence of occupational asthma in relation to occupational set and sex

Order	Occupational set	Women Cases	Women Rate (mil/y)	Men Cases	Men Rate (mil/y)	Sexes combined Rate (mil/y)	Sexes combined (95% CI)
1–10	Professional, clerical, & service work						
	Laboratory technicians & assistants	25	203	25	174	188	(139, 247)
	Cleaners	10	9	5	13	10	(5, 16)
	Nurses	22	17	0	0	16	(10, 24)
	Farmers and farm workers	7	43	16	24	28	(18, 41)
	Hairdressers	16	87	0	0	81	(46, 131)
	Remainder	45	3	52	3	3	(2, 4)
11	Material processors (excluding metal & electrical)						
	Wood workers	1	35	50	54	54	(40, 70)
	Food processors (excluding bakers)	15	146	20	90	108	(75, 150)
	Bakers	22	364	28	314	334	(248, 440)
	Plastics workers	5	163	42	386	337	(248, 448)
	Chemical processors	5	271	49	377	364	(274, 475)
	Remainder	31	41	63	53	49	(39, 60)
12	Metal & electrical processing and making						
	Welding, soldering & electronic assembly	44	268	34	120	175	(138, 218)
	Metal treatment	2	174	41	275	267	(194, 360)
	Remainder	10	48	122	28	29	(24, 35)
13	Painting, assembly and packing						
	Painters (excluding spray painters)	4	510	24	58	66	(44, 95)
	Coach and other spray painters	1	450	64	663	658	(508, 839)
	Remainder	18	31	23	41	36	(26, 49)
14	Construction & mining	1	64	21	11	11	(7, 17)
15	Transport and storage	0	0	23	8	8	(5, 11)

work, 45 had serial respiratory function tests, and in 11 bronchial challenge or specific IgE tests had been performed. In only two cases was there no corroboration of the diagnosis, in one of which the patient had left his job before any investigations could be undertaken. As this case series was selected only on industry these results may well be typical.

Correct identification of the causal agent may have been less reliable, however, as few chest physicians are able to investigate the work environment, and facilities for challenge tests are limited. There may, therefore, have been a tendency to blame agents known to cause asthma rather than other exposures in the work place.

The rates in this analysis provide the only measure of the relative frequency of work related asthma by occupation in the UK so far available. To our knowledge the only other national estimates of the risk of asthma by occupation are from Finland.[13] Although it is possible that in certain occupations work related asthma has a greater chance of being recognised, and so reported to SWORD, any such bias would only tend to underestimate the incidence in occupations in which the risk was less widely known. Despite underestimation, reporting schemes such as SWORD can draw attention to agents and occupations insufficiently recognised as a source of disease.

Some of the highest rates were in occupational sets well known to be associated with asthma such as laboratory animal workers,[14 15] solderers,[16] bakers,[17] chemical processors, plastics workers,[18] and spray painters.[19] The latter had a relative risk of occupational asthma that was over 30 times that of the general population; clearly preventive measures for this group are a matter of urgency. High rates were also found in more unexpected occupations such as food processors (other than bakers) and metal treatment workers. Most cases in the latter set were attributed to various metals, in particular aluminium potroom fume. Although a subject of controversy, aluminium smelting has been associated previously with asthma[20 21] as has foundry work.[22] However, the relative importance of metal treatment was surprising; although based on fairly small numbers, the set had the fifth highest risk.

The increasing incidence with age, made even greater by standardisation for occupation, was an unexpected finding. Part of the explanation may be patient selection: (i) patients may be more likely to be referred to a chest physician if they develop symptoms later on in life or if they have been ill for some time, and (ii) older employees may wish, despite symptoms, to stay in jobs where they have security and experience and so seek medical help only at a late stage, whereas younger people simply change jobs. On the other hand, susceptibility may increase with age, possibly because of previous occupational exposures or personal habits such as smoking.

The regional variation in rates could not be explained by geographical differences in the age, sex, and occupational distribution of the working population. The relatively small numbers reported from Yorkshire and Humberside, the East Midlands, and South East England were consistent with the areas of the country with fewer cooperating chest clinics, and the relatively large numbers reported from the West Midlands, the North and Scotland were probably due to more complete reporting.

Cases of occupational lung disease reported to SWORD are the "tip of an iceberg". To be

Table V Incidence of occupational asthma in relation to administrative region

Region	Cases	Rate/mil/y		(95% CI)	Standardised* rate ratio	(95% CI)
North—Tyne and Wear	28	31	}	34 (28, 43)	1·58	(1·28, 1·95)
—Remainder	62	37				
Yorkshire & Humberside—South Yorkshire	20	19	}	15 (12, 19)	0·67	(0·52, 0·86)
—West Yorkshire	17	9				
—Remainder	29	20				
East Midlands—All	51	13		13 (10,18)	0·60	(0·46, 0·79)
East Anglia—All	40	20		20 (14, 27)	1·05	(0·77, 1·43)
South East—Greater London	62	10	}	13 (11, 14)	0.73	(0.63, 0.84)
—Remainder	151	14				
South West—All	83	19		19 (15, 23)	0·97	(0·78, 1·21)
West Midlands—Metropolitan county	152	65	}	45 (39, 51)	1·76	(1·53, 2·02)
—Remainder	69	27				
North West—Greater Manchester	30	13	}	22 (18, 26)	1·04	(0·87, 1·24)
—Merseyside	29	25				
—Remainder	64	30				
Wales—All	54	22		22 (17, 29)	0·85	(0·63, 1·15)
Scotland—Central Clydeside Conurbation	35	26	}	28 (23, 33)	1·32	(1·09, 1·59)
—Remainder	90	29				
Northern Ireland—All	19	16		16 (10, 25)	0·86	(0·55, 1·35)
All UK	1085	20		(19, 22)		

* Observed/expected cases standardised for age, sex, and occupational order using national rates.

included in our statistics a patient must be seen by a participating physician who must not only recognise the occupational aetiology but remember to report the case. Many patients with respiratory symptoms do not seek medical advice, some for fear of losing their job. Others are seen by a general practitioner, but are not referred to a specialist. Those reported to SWORD represent only a fraction of the actual number of new cases of occupational asthma in the United Kingdom, and therefore all the incidence rates in this analysis are underestimated.

Although rates for the West Midlands Metropolitan County were no doubt underestimated for the reasons mentioned, the presence of a regional surveillance scheme[8] which increased local awareness of occupational asthma was probably responsible for the relatively high reported incidence from the region. If the same occupational rates had been achieved for the whole of the UK, the number of new cases seen by chest and occupational physicians during the two years would have been nearly three times that reported. This rough calculation gives only some indication of the degree of underascertainment, but it is the best estimate available.

I gratefully acknowledge contributions to this project by all participating physicians and in particular the members of our advisory panels: Drs P S Burge, I I Coutts, A G Davison, P G Harries, D J Hendrick, J Osman, M G Pearson, C A C Pickering, and J E Stark, and Professors P C Elmes, A J Newman Taylor, and A Seaton. Professor Corbett McDonald supervised the project and much help has been given by other unit staff (Linda Crombie, Elizabeth Paul, and Vivien Taylor).

The SWORD project is supported by a grant from the Health and Safety Executive.

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