ORIGINAL ARTICLE

Smoking and occupation from the European Community Respiratory Health Survey

S A McCurdy, J Sunyer, J-P Zock, J M Antó, M Kogevinas, European Community Respiratory Health Survey Study Group

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See end of article for authors' affiliations

Correspondence to: Dr S A McCurdy, Department of Epidemiology and Preventive Medicine, University of California, Davis, One Shields Ave, Davis, CA 95616-8638, USA; samccurdy@ucdavis.edu

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Background: Smoking is among the most important personal and modifiable risk factors for adverse health outcomes. The workplace offers a potentially effective venue for tobacco prevention programmes; identifying occupational groups with high smoking prevalence may assist in targeting such programmes.
Aims: To examine smoking prevalence among occupational groups in the European Union.
Methods: The European Community Respiratory Health Survey (ECRHS), a cross sectional health survey conducted in 1992–93, was used to examine smoking prevalence by occupation among 14 565 subjects from 30 centres in 14 participating countries.
Results: There was an approximately twofold range in smoking prevalence by occupation. For occupational groups with at least 50 subjects, the highest smoking prevalence was seen in metal making and treating for men (54.3%) and cleaners for women (50.7%). Increased smoking prevalence by occupation persisted after adjustment for age, country, and age at completion of education. Smoking was also increased among occupations with high exposure to mineral dust and gas or fumes.
Conclusions: Smoking rates vary significantly by occupation. Prevention efforts in the workplace should focus on occupations with high smoking prevalence and large employment bases.

Smoking is widely recognised as the most important modifiable risk factor for numerous adverse health outcomes, including respiratory cancers, heart disease, and stroke.[1 2] In the USA, significant progress has been made over past decades in reducing adult smoking prevalence.[2] Methods for discouraging smoking include educational campaigns, taxation, and regulation. Tobacco control efforts often include workplace restrictions on smoking, which are generally well accepted by employees, even among those who smoke.[3] Although workplace restrictions have an important role for tobacco control, few data are available on smoking prevalence by occupation—information important for targeting worksite based tobacco control programmes. While such data are available for the USA,[4–7] there is little information on smoking by occupation for the European Union and associated countries, where smoking prevalence is significantly higher than in the USA.[8]

The European Community Respiratory Health Survey (ECRHS) has collected information relevant to respiratory health in nations of western European and other areas of the world since 1990.[9] The purpose of this article is to describe the smoking prevalence among study participants, with a focus on occupation and related exposures.

Main messages

- Smoking prevalence varied approximately twofold among occupations. Prevalence was highest for men among metal, construction, and mining workers and for women among cleaners and hairdressers.
- Smoking prevalence was lowest for men among persons with no stated occupation (including students) and for women among agricultural workers.
- Smoking prevalence increased directly with occupational exposure to mineral dust and gas or fumes.

Policy implications

- Anti-tobacco programmes should be focused on groups with high smoking prevalence and employee base. For men, these groups include metal, construction, and mining workers. For women, these groups include cleaners and hairdressers.
- Smoking prevalence studies should be conducted periodically to focus anti-tobacco efforts and monitor their effectiveness.

METHODS

Population

The ECHRS methodology has been described previously.[9] Briefly, it consists of a random sample of the general population, aged 20–44 years, in 33 centres in 11 countries of the European Union, seven centres in five countries of the Cooperation in Science and Technical Research Group of European States, and 15 centres in seven other nations. This report includes 14 714 randomly sampled subjects, aged 20–44 years, from 30 centres in 14 countries (11 countries of Western Europe, Australia, New Zealand, and the USA), in which occupational data were collected by cross sectional survey in 1992–93. The study was approved by the local institutional ethics committees, and all subjects gave informed consent.

Exposure assignment for smoking, occupation, and occupational exposures

Participating subjects completed a standardised respiratory health questionnaire including information on demographic

Abbreviations: CI, confidence interval; cpd, cigarettes per day; ECRHS, European Community Respiratory Health Survey

characteristics, smoking, and occupation. Current smoking was defined as: (a) lifetime consumption of at least 20 packs of cigarettes or at least one cigarette per day or one cigar a week for one year; and (b) affirmation of smoking within the past month.

Occupation was initially coded using 350 categories based on the Office of Population Censuses and Surveys classification scheme[10]; these were subsequently combined into a set of 30 occupational groups for analysis.[11] We further collapsed three painter categories (spray painters, other painters, and remainder painting) into a single category, yielding a total of 28 categories. A job-exposure matrix was developed by industrial hygienists to evaluate the likely exposures to biologic dust, mineral dust, and gas or fumes.[12] This categorisation was based on occupational designation (using the initial 350 categories) rather than specific exposure estimates provided by the subject. Exposure assignment for biologic dust, mineral dust, and gases or fumes was not mutually exclusive—that is, individuals could have high exposure to any combination of these agents. Each exposure was categorised as none, low, or high. Occupations associated with high levels of exposure to biologic dust, mineral dust, and gases or fumes are shown in the appendix (see *OEM* website; www.occenvmed.com).

Data management and analysis

Data were analysed using STATA 6.0 and 7.0 (STATA Corporation, College Station, TX, USA). Smoking prevalence and exact binomial 95% confidence intervals (95% CI) were calculated separately for each sex and by age, age at completion of education, country, occupational group, and occupational exposure to biologic dust, mineral dust, and gas or fumes.[11 12] The median is used for the central tendency for non-normally distributed variables such as daily cigarette consumption. Unadjusted group comparisons employed the χ^2 and Kruskal-Wallis tests as appropriate.[13] The Kruskal-Wallis test was utilised because of its robustness for non-normally distributed continuous data. Logistic modelling was employed to define the associations of various demographic characteristics with current smoking. Goodness of fit was assessed with the Hosmer-Lemeshow test.[14]

RESULTS

Demographic characteristics

Of the 14 714 subjects, 14 565 (99.0%) provided information on current smoking status. Of these, 7003 (48.1%) were male. Mean age of the study group was 32.7 years (standard deviation 6.9 years). There were 2072 (14.1%) subjects who completed their education before age 16, 5881 (40.0%) who completed education between ages 16 and 19 years of age (inclusive), and 4948 (33.6%) who completed education at 20 years of age or older. The remaining 1813 (12.3%) subjects did not respond to this question or had not yet completed their education. Current smoking was less prevalent among women than men (34.6 *v* 39.4%, $p < 0.0001$, χ^2 test) and was highest in the 30–39 year old age category for both men and women. Median daily cigarette consumption among current smokers was higher in men than in women (17 *v* 13 cigarettes per day, $p < 0.0001$, Kruskal-Wallis test). Smoking prevalence was highest among persons completing their education before age 16 (51.3% among men and 43.4% among women). There was an approximate twofold difference in smoking prevalence between countries.

Occupation and smoking

For men in occupational groups with at least 50 subjects, metal making and treating workers had the highest unadjusted current smoking prevalence (54.3%), followed by construction and mining (53.7%; table 1). Persons with no

Table 1 Smoking prevalence by current occupational group and sex in the European Community Respiratory Health Survey, 1992–93

	Men			Women		
Occupational group	Subjects (n)	Current smoking prevalence, % (95% CI)	Median cpd	Subjects (n)	Current smoking prevalence, % (95% CI)	Median cpd
Professional, administrative, clerical, service	3522	35.4 (33.8 to 37.0)	15	4879	33.6 (32.3 to 35.0)	13
Cleaners	77	48.1 (36.5 to 59.7)	16	288	50.7 (44.8 to 56.6)	15
Hairdressers	10	50.0 (18.7 to 81.3)	10	88	46.6 (35.9 to 57.5)	15
Nurses	38	36.8 (21.8 to 54.0)	13.5	383	30.3 (25.7 to 35.2)	10
Farmers, farm workers	38	26.3 (13.4 to 43.1)	18.5	19	26.3 (9.1 to 51.2)	20
Agricultural workers	105	43.8 (34.1 to 53.8)	15	61	26.2 (15.8 to 39.1)	15
Wood workers	157	33.8 (26.4 to 41.7)	15	7	71.4 (29.0 to 96.3)	10
Bakers	39	48.7 (32.4 to 65.2)	20	27	37.0 (19.4 to 57.6)	20
Other food processors	48	52.1 (37.2 to 66.7)	15	54	33.3 (21.1 to 47.5)	12.5
Laboratory technicians, assistants	45	17.8 (8.0 to 32.1)	15	96	28.1 (19.4 to 38.2)	10
Plastics and rubber workers	23	47.8 (26.8 to 69.4)	15	7	71.4 (29.0 to 96.3)	15
Chemical processors	57	45.6 (32.4 to 59.3)	16	7	28.6 (3.7 to 71.0)	9
Welders, solderers	62	32.3 (20.9 to 45.3)	20	2	50.0 (12.6 to 98.7)	10
Metal making and treating	127	54.3 (45.3 to 63.2)	20	8	50.0 (15.7 to 84.3)	7
Other metal workers	505	46.9 (42.5 to 51.4)	20	50	40.0 (26.4 to 54.8)	14.5
Electrical processors	323	39.3 (34.0 to 44.9)	18	38	26.3 (13.4 to 43.1)	12.5
Spray painters, other painters, and remainder painting	131	51.1 (42.3 to 60.0)	20	53	39.6 (26.5 to 54.0)	10
Leather workers	19	47.4 (24.4 to 71.1)	20	13	38.5 (13.9 to 68.4)	10
Textile and clothing	54	37.0 (24.3 to 51.3)	18.5	133	42.1 (33.6 to 51.0)	15
Paper workers	23	52.2 (30.6 to 73.2)	17.5	13	46.2 (19.2 to 74.9)	12.5
Printing workers	64	48.4 (35.8 to 61.3)	20	24	29.2 (12.6 to 51.1)	8
Glass and ceramics workers	24	58.3 (36.6 to 77.9)	19	9	44.4 (13.7 to 78.8)	20
Remainder non-metal/non-electrical processors	104	48.1 (38.2 to 58.1)	20	76	38.2 (27.2 to 50.0)	15
Construction, mining	246	53.7 (47.2 to 60.0)	20	9	44.4 (13.7 to 78.8)	12.5
Industrial drivers	312	51.0 (45.3 to 56.6)	20	25	52.0 (31.3 to 72.2)	20
Remainder transport and storage	151	51.0 (42.7 to 59.2)	20	58	44.8 (31.7 to 58.5)	20
Occupation not stated, including housewife/husband and student	141	30.5 (23.0 to 38.8)	15	560	34.6 (30.7 to 38.7)	12
Unclassified	99	47.5 (37.3 to 57.8)	20	73	41.1 (29.7 to 53.2)	10

cpd, cigarettes per day among current smokers.

Table 2 Smoking prevalence by current job exposures and sex in the European Community Respiratory Health Survey, 1992–93

	Men			Women		
Job exposure	Subjects (n)	Current smoking prevalence, % (95% CI)	cpd	Subjects (n)	Current smoking prevalence, % (95% CI)	cpd
Biologic dust						
None	5363	39.4 (38.1 to 40.8)	18	5994	33.7 (32.5 to 34.9)	12
Low	783	44.6 (41.1 to 48.1)	20	884	43.3 (40.0 to 46.7)	15
High	398	37.7 (32.9 to 42.7)	18	182	31.3 (24.7 to 38.6)	15
Mineral dust						
None	4145	36.9 (35.4 to 38.4)	17	6127	33.7 (32.6 to 34.9)	13
Low	1877	44.4 (42.2 to 46.7)	20	575	40.3 (36.3 to 44.5)	15
High	522	48.3 (43.9 to 52.7)	20	358	45.3 (40.0 to 50.6)	15
Gas or fumes						
None	3951	37.2 (35.7 to 38.7)	18	5276	33.5 (32.2 to 34.8)	13
Low	1900	42.4 (40.2 to 44.7)	20	1390	36.9 (34.4 to 39.5)	13
High	693	48.8 (45.0 to 52.6)	19.5	394	45.9 (40.9 to 51.0)	15

cpd, cigarettes per day among current smokers.

stated occupation, including students, had the lowest smoking prevalence among men (30.5%). For women in occupational groups with at least 50 subjects, cleaners had the highest unadjusted current smoking prevalence (50.7%), followed by hairdressers (46.6%). Agricultural workers had the lowest smoking prevalence among women (26.2%). Median daily cigarette consumption among current smokers in the 28 occupational groups was 10–20 for men and 7–20 for women.

Job exposures and smoking

The likelihood of current smoking increased directly with exposure to mineral dust and gas or fumes (table 2). This pattern held when adjusted for age category, sex, country, and age at completion of education. Because exposure status was assigned based on occupation rather than individual measurements, we did not include both occupational group and exposures in the same regression model to avoid multicollinearity. There was no clear pattern of current smoking prevalence for men or women according to biologic dust.

Multivariate modelling

Logistic regression models incorporating the main effects of occupational group, age group, age at completion of education category, and country were developed separately for each sex (table 3) and confirmed patterns evident in initial bivariate analyses, including associations with country and age. Professional/administrative and clerical workers served as the referent group because of the large number of subjects and relatively low smoking prevalence in this category. Other demographic factors associated with increased smoking included male sex and younger age at completion of education. Inclusion of age at completion of education resulted in reduction of the odds ratio for nearly all job categories, indicating its importance as a confounding factor.

Compared to the unadjusted job category specific smoking prevalence rankings and limiting consideration to job categories with at least 50 persons, multivariate adjustment did not alter the lowest prevalence job for men (occupation not stated, including housewife/husband and student, OR 0.39, 95% CI 0.24 to 0.62) or for women (agricultural workers, OR 0.73, 95% CI 0.40 to 1.34).

The highest adjusted odds ratio for smoking among men was in glass and ceramics workers (OR 3.89, 95% CI 1.43 to 10.60). This job category also had the highest unadjusted smoking prevalence (58.3%), but was not included in the unadjusted rankings reported above because there were fewer than 50 men in the job category. Excluding job categories with fewer than 50 male subjects, the five categories with the highest unadjusted prevalence of smoking (metal making and treating; construction, mining; spray painters, other painters, and remainder painting; industrial drivers; and remainder transport and storage) manifested increased odds ratios ranging from 1.32 (metal making and treating) to 1.82 (construction, mining). Odds ratios for all but metal making and treating were statistically significant.

The highest adjusted odds ratio for smoking among women was in plastics and rubber workers (OR 3.70, 95% CI 0.7 to 19.33). This job category also had the highest unadjusted smoking prevalence (71.4%), but was not included in the unadjusted rankings reported above because there were fewer than 50 women in the job category. Excluding job categories with fewer than 50 female subjects, the five categories with the highest unadjusted prevalence of smoking (cleaners; hairdressers; remainder transport and storage; textile and clothing; unclassified) manifested odds ratios ranging from 1.04 (textile and clothing) to 1.65 (unclassified). Only for cleaners was the odds ratio elevation statistically significant (OR 1.48, 95% CI 1.14 to 1.90).

DISCUSSION

We report here the results of our analysis of smoking prevalence in various occupations based on the ECRHS data. Increased smoking prevalence was associated with male sex and lower educational attainment as seen in other studies. In addition, significant variation occurred between countries, consistent with earlier observations.[15] We observed the highest smoking prevalences among metal workers, and construction and mining workers for men, and among cleaners and hairdressers for women. Lowest rates were seen among farmers and farm workers, welders and solderers, and those without a stated occupation, including housewives/husbands and students. Significant variation in prevalence among occupational groups persisted after multivariate adjustment for age, age at completion of education, and country.

Current smoking was increased among persons with jobs associated with higher exposures to mineral dusts or gases and fumes. Because occupational dust exposures may interact multiplicatively with smoking to cause adverse respiratory health outcomes,[16] this finding underscores the importance of tobacco control for groups with occupational dust exposures. Previous work has shown that persons with occupational airborne exposures may not be more likely than unexposed smokers to receive advice on smoking cessation.[17]

Studies of smoking among occupational groups in the USA have documented patterns similar to those seen here of increased prevalence among manual and trade occupations (for example, among "blue collar" workers such as transportation operators, labourers, craft workers) in comparison to

Table 3 Multivariate logistic model* for current smoking in the European Community Respiratory Health Survey, 1992–93

	Men		Women	
Factor	Odds ratio	95% CI	Odds ratio	95% CI
Age category (y)				
20–29	1.00	Referent	1.00	Referent
30–39	1.25	1.10 to 1.41	1.00	0.89 to 1.13
40–44	1.04	0.90 to 1.21	0.71	0.61 to 0.83
Age on completion of education (y)				
≥20	1.00	Referent	1.00	Referent
16–19	2.10	1.74 to 2.54	2.04	1.71 to 2.42
≤15	1.54	1.36 to 1.76	1.65	1.46 to 1.86
Country				
Sweden	1.00	Referent	1.00	Referent
Belgium	2.28	1.76 to 2.94	0.98	0.78 to 1.24
Germany	3.01	2.44 to 3.73	1.34	1.09 to 1.64
Spain	4.30	3.42 to 5.36	1.48	1.20 to 1.82
Ireland	1.83	1.31 to 2.55	1.40	1.01 to 1.94
Italy/Switzerland	2.06	1.57 to 2.69	0.77	0.58 to 1.02
Netherlands	2.79	2.20 to 3.53	1.32	1.05 to 1.65
United Kingdom	1.08	0.83 to 1.40	0.63	0.50 to 0.80
Iceland	2.66	1.93 to 3.66	1.43	1.05 to 1.94
Norway	3.20	2.38 to 4.29	1.87	1.41 to 2.48
New Zealand	0.77	0.59 to 1.02	0.57	0.44 to 0.73
USA	1.01	0.67 to 1.52	0.41	0.27 to 0.63
Australia	1.18	0.86 to 1.61	0.60	0.44 to 0.81
Occupational group				
Professional/administrative, clerical	1.00	Referent	1.00	Referent
Cleaners	1.60	0.97 to 2.64	1.48	1.14 to 1.90
Hairdressers	1.01	0.26 to 3.90	1.46	0.93 to 2.28
Nurses	1.06	0.49 to 2.29	0.86	0.67 to 1.12
Farmers, farm workers	0.76	0.35 to 1.62	0.67	0.21 to 2.12
Agricultural workers	1.44	0.93 to 2.22	0.73	0.40 to 1.34
Wood workers	0.82	0.57 to 1.20	3.59	0.62 to 20.76
Bakers	1.80	0.88 to 3.68	0.84	0.37 to 1.88
Other food processors	1.71	0.93 to 3.12	0.75	0.42 to 1.35
Laboratory technicians, assistants	0.45	0.18 to 1.11	0.87	0.52 to 1.45
Plastics and rubber workers	1.44	0.61 to 3.42	3.70	0.71 to 19.33
Chemical processors	0.95	0.54 to 1.65	0.59	0.11 to 3.11
Welders, solderers	0.72	0.41 to 1.28	2.20	0.14 to 35.52
Metal making and treating	1.32	0.90 to 1.93	1.19	0.29 to 4.84
Other metal workers	1.43	1.16 to 1.76	1.38	0.76 to 2.48
Electrical processors	1.03	0.80 to 1.33	0.51	0.24 to 1.10
Spray painters, other painters, and remainder painting	1.81	1.24 to 2.65	1.06	0.59 to 1.90
Leather workers	1.64	0.60 to 4.50	0.93	0.30 to 2.92
Textile and clothing	0.77	0.42 to 1.43	1.04	0.71 to 1.52
Paper workers	1.54	0.66 to 3.60	1.27	0.42 to 3.87
Printing workers	1.41	0.83 to 2.39	0.79	0.32 to 1.96
Glass and ceramics workers	3.89	1.43 to 10.60	1.07	0.18 to 6.26
Remainder non-metal/non-electrical processors	1.29	0.82 to 2.01	1.09	0.66 to 1.81
Construction, mining	1.82	1.36 to 2.43	1.17	0.27 to 5.05
Industrial drivers	1.71	1.33 to 2.21	1.54	0.65 to 3.67
Remainder transport and storage	1.79	1.25 to 2.55	1.46	0.73 to 2.91
Occupation not stated, including housewife/husband and student	0.39	0.24 to 0.62	0.85	0.69 to 1.05
Unclassified	1.86	1.20 to 2.87	1.65	0.98 to 2.76

*Model incorporates main effects for the factors shown; Hosmer to Lemeshow p=0.24 (men), p=0.26 (women).

professional or other "white collar" groups.[4 6 7] In general, the gap between blue collar and white collar groups in the USA has widened in recent decades.[7]

The public health importance of considering occupation in the context of smoking prevalence is evident in several areas. First, occupation is a strong correlate of smoking, exhibiting odds ratios comparable to those seen for age, sex, age at completion of education, and nationality. Occupational associations persist after adjustment for these demographic factors. Thus, knowledge of occupation is helpful in identifying high prevalence groups for prevention programmes.

Second, the workplace may play an important role as part of a comprehensive public health approach to tobacco control.[18] Workplace restrictions represent a barrier to smoking behaviour and may motivate employees to quit smoking. Workplace programmes should also include access to assistance programmes for persons wishing to quit smoking. Although recent efficacy studies have raised questions regarding the benefit of workplace smoking restrictions with respect to smoking cessation,[19 20] they are clearly successful when enforced in reducing occupational exposure to environmental tobacco smoke. Protection from involuntary exposure to environmental tobacco smoke at work and in public places has been the subject of World Health Organisation resolutions (for example, WHA39.14, 1986).[8]

A major strength of this study is that it provides to our knowledge the first comprehensive data on smoking prevalence and cigarette consumption by occupation for the European Union. The study utilised data from a large random sample of the populations in participating centres and countries. Thus, the results are likely to represent fairly the underlying smoking prevalence patterns in participating locales.

Limitations of the study include low numbers of subjects in some job categories, its cross sectional nature, and that the data represent subject reports rather than objectively validated data. Selection bias may also affect our results. In particular,

subjects with poor health may have been more likely than healthy persons to participate in this health research study. To the extent that poorer health is caused by smoking, one would expect to see a higher smoking prevalence in the study sample than in the population at large. This may explain why we observed somewhat higher national smoking prevalences than reported in other studies.[15]

Finally, the sample did not include persons older than 44 years of age or teenagers. The latter group is an important target for tobacco merchants, because addiction at an early age will provide long term customers. Public health advocates are also strongly focused on adolescents for similar reasons. Further research should examine tobacco use in this group because of the potential for adverse health outcomes—and their prevention—as the adolescent cohort ages.

Occupational and other patterns observed here may be affected by confounding. For example, age at completion of education was associated with current smoking prevalence, and adjustment for this factor reduced associations with occupation. Age at completion of education is a proxy for educational attainment, in that a young age of completion implies low educational attainment. High educational level has been associated with low prevalence of smoking and low occupational airborne exposures.[21]

Confounding with age at completion of education or other factors does not seriously affect the public health utility of the results. These data can be used to identify high smoking prevalence groups to target for anti-tobacco efforts; it is of lesser importance whether the high smoking prevalence is independently associated with the occupation or is in part caused by confounding by other variables. However, because age at completion of education was independently associated with smoking, this factor could also be used to identify groups for tobacco control efforts.

The results from this study can provide important information for targeting prevention programmes. In particular, occupations with high smoking prevalence and large numbers of employees are likely to yield the greatest population benefit with respect to reduction of smoking and workplace exposure to environmental tobacco smoke. Based on these data, such occupational groups include metal workers, construction workers, miners, and cleaners, among others. In addition, these data provide a valuable benchmark for assessing future efforts at tobacco control. As tobacco control efforts gain momentum in the European Union[15] subsequent surveys can document changes in smoking behaviour among the affected population.

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Coordination of the ECRHS: Department of Public Health Medicine, Guy's and St Thomas's medical and dental school, London, UK: P Burney, S Chinn, C Luczynska, D Jarvis, E Lai, J Potts.

Participating centres providing occupational information: *Australia*: M Abramson, J Kutin (Melbourne); *Belgium*: P Vermeire, F van Bastelaer (Antwerp South, Antwerp Central); *Germany*: H Magnussen, D Nowak (Hamburg); HE Wichmann, J Heinrich (Erfurt); *Iceland*: T Gislason, D Gislason (Reykjavik); *Ireland*: J Prichard, S Allwright, D MacLeod (Dublin); *Italy*: M Bugiani, C Bucca, C Romano (Turin); R de Marco lo Cascio, C Campello (Verona); A Marinoni, I Cerveri, L Casali, L Perfetti (Pavia); *Netherlands:* B Rijcken, JP Schouten, M Kerkhof, HM Boezen (Groningen, Bergen op Zoom, Geleen); *New Zealand*: J Crane, S Lewis, N Pearce (Wellington, Christchurch, Hawkes Bay); *Norway*: A Gulsvik, E Omenaas (Bergen); *Spain*: JM Antó, J Sunyer, J Soriano, M Kogevinas, A Tobías, J Roca (Barcelona); N Muniozguren, J Ramos González, A Capelastegui (Galdakao); J Martínez-Moratalla, E Almar (Albacete); J Maldonado Pérez, A Pereira, J Sánchez (Huelva); J Quirós, I Huerta (Oviedo); *Sweden*: G Boman, C Janson, E Björnsson (Uppsala); L Rosenhall, E Norrman B Lundbäck (Umea); N Lindholm, P Plaschke, K Torén (Göteborg); *Switzerland*: N Künzli (Basel); *United Kingdom*: R Hall (Ipswich), B Harrison (Norwich), J Stark (Cambridge); *USA*: S Buist, W Vollmer, M Osborne (Portland).

Job exposure matrix: H Kromhout, R Vermeulen (Utrecht, Netherlands).

The appendix can be viewed on the *OEM* website (www.occenvmed.com/supplemental)

Authors' affiliations
S A McCurdy, Department of Epidemiology and Preventive Medicine, University of California, Davis, USA
J Sunyer, J-P Zock, J M Antó, M Kogevinas, Respiratory and Environmental Health Research Unit, Institut Municipal d'Investigació Mèdica (IMIM), E08003 Barcelona, Spain

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