

ORIGINAL ARTICLE

Occupational risk factors for asthma among nurses and related healthcare professionals in an international study

Maria C Mirabelli, Jan-Paul Zock, Estel Plana, Josep Maria Antó, Geza Benke, Paul D Blanc, Anna Dahlman-Höglund, Deborah L Jarvis, Hans Kromhout, Linnéa Lillienberg, Dan Norbäck, Mario Olivieri, Katja Radon, Jordi Sunyer, Kjell Torén, Marc van Sprundel, Simona Villani, Manolis Kogevinas

Occup Environ Med 2007;64:474–479. doi: 10.1136/oem.2006.031203

See end of article for authors' affiliations

Correspondence to:
Dr M C Mirabelli, Centre for Research in Environmental Epidemiology, Instituto Municipal de Investigación Médica, c/Dr Aiguader, 88, 08003 Barcelona, Spain; mmirabelli@imim.es

Accepted 16 February 2007
Published Online First
1 March 2007

Objective: The authors examined the relations between self-reported work tasks, use of cleaning products and latex glove use with new-onset asthma among nurses and other healthcare workers in the European Community Respiratory Health Survey (ECRHS II).

Methods: In a random population sample of adults from 22 European sites, 332 participants reported working in nursing and other related healthcare jobs during the nine-year ECRHS II follow-up period and responded to a supplemental questionnaire about their principal work settings, occupational tasks, products used at work and respiratory symptoms. Poisson regression models with robust error variances were used to compare the risk of new-onset asthma among healthcare workers with each exposure to that of respondents who reported professional or administrative occupations during the entire follow-up period (n = 2481).

Results: Twenty (6%) healthcare workers and 131 (5%) members of the referent population reported new-onset asthma. Compared to the referent group, the authors observed increased risks among hospital technicians (RR 4.63; 95% CI 1.87 to 11.5) and among those using ammonia and/or bleach at work (RR 2.16; 95% CI 1.03 to 4.53).

Conclusions: In the ECRHS II cohort, hospital technicians and other healthcare workers experience increased risks of new-onset current asthma, possibly due to specific products used at work.

Nursing and other related healthcare occupations are demanding professions. Men and women in these jobs are responsible for providing high-quality health care, but the environments in which they routinely work, including hospitals, clinics and laboratories, are increasingly recognised as hazardous workplaces.^{1–5} In particular, inhalation exposures and their potential respiratory health effects are of growing concern among workers in healthcare settings. Findings that describe the asthmagenic and allergenic properties of specific products (eg, natural rubber latex gloves) provided the basis for efforts to reduce such exposures in many healthcare settings, but continuing exposures to cleaning agents and latex products in the workplace remain important risk factors for adult-onset work-related asthma.^{6–8} Thus, further characterisation of these and other inhalation hazards in healthcare workplaces may facilitate the prevention of asthma in this important workforce.

The roles and responsibilities of nurses and other healthcare workers vary widely, as do the specific occupational tasks and products used. Nonetheless, certain aspects of medical workplaces are ubiquitous. For example, alkaline glutaraldehyde, a disinfectant used to sterilise medical instruments, has been associated with respiratory symptoms among nurses,^{9–11} hospital technicians¹¹ and respiratory therapists.¹² Recent surveillance data for cases of work-related asthma indicate that healthcare workers are the most commonly reported industry group (16%), among which cleaning products (eg, ammonia, bleach, disinfectants and other cleaning agents) (24%), latex (20%), glutaraldehyde (9%) and formaldehyde (5%) appear as common work-related exposures.⁶ The frequency with which latex was reported as one of the contributing exposures among workers in nursing occupations (33%) provides further evidence that latex is still a major concern for workers in healthcare settings,^{6, 13–14} where dermal and respiratory latex

exposures have been associated with symptoms among hospital personnel.^{15–17}

Data from the European Community Respiratory Health Survey (ECRHS) provide a unique opportunity to assess respiratory health effects among healthcare workers throughout Europe. Previous analysis of occupational exposures among workers in the ECRHS population suggests that occupational asthma may account for between 5% and 10% of asthma in young adults¹⁸ and that those working as nurses may experience notably increased asthma risks.¹⁹ Although a better understanding of the specific respiratory risks and exposures may lead to improvements in working conditions in this important workforce, the extent to which increased risks are attributable to specific exposures has not yet been investigated using baseline and follow-up ECRHS data. In addition, the longitudinal ECRHS study design provides a unique opportunity to assess the role of specific healthcare-related tasks and products in a previously symptom-free population. Therefore, with a primary aim of assessing the potential health effects of inhalation exposures in healthcare settings, we examined the risk of new-onset asthma among nurses and other healthcare workers who reported specific job-related tasks, use of cleaning products and latex gloves at work.

METHODS

European community respiratory health survey

The ECRHS is a prospective population-based cohort study of respiratory health among adults living near 28 study centres in 13 countries. The study design and methods have been described previously.^{20–23} Briefly, the ECRHS was a longitudinal

Abbreviations: ECRHS, European Community Respiratory Health Survey; ISCO, International Standard Classification of Occupations

study with a fixed cohort; initial survey of the population began in 1991 (ECRHS I) and in 1998–9 follow-up of a centre-stratified random sample of participants included an occupational survey component for 22 centres located in 10 European countries (ECRHS II). Each participant completed an interviewer-administered questionnaire, including a survey about respiratory symptoms and asthma therapies and a seven-item screening questionnaire to determine whether he/she would complete one or more of the seven occupational modules included in the follow-up survey. Participants whose responses to the screening questionnaire indicated that during the 9-year follow-up they performed one or more of a list of jobs (cleaning (professionally or at home), disinfecting, nursing, metal working, soldering or welding) responded to supplemental questionnaires about selected tasks and exposures for each relevant job held during follow-up. Institutional review boards of participating study centres approved the study protocol and instruments, and participants provided written informed consent.

Centre-specific participation rates for ECRHS I have been reported previously: ECRHS I screening questionnaire: median 78% (range 54%–100%),²⁴ ECRHS I main questionnaire: median 65% (range 12%–90%).²⁴ Centre-specific participation rates for ECRHS II are: screening questionnaire: median 79% (range 31%–93%) and main questionnaire: median 76% (range 45%–94%) (unpublished data). Participation in the ECRHS II random sample and in centres for which occupational survey modules were administered was 58% (unpublished data).

Study population

In the random sample of the ECRHS II population, 495 respondents reported having worked as a nurse or in a nursing-related job during the follow-up period. In this population, 408 were symptom-free at the time of ECRHS I, as identified using inclusion criteria defined for previous analysis of ECRHS data.²⁵ Using data from the baseline ECRHS I questionnaire, all individuals who gave negative answers to the questions: “Have you ever had asthma”, “Have you been woken by an attack of shortness of breath at any time in the last 12 months” and “Have you [had] wheezing or whistling when you did not have a cold [in the last 12 months]” were classified as symptom-free.²³ From the symptom-free population, we excluded respondents who provided incomplete data for the occupational module survey items ($n = 68$, 17%) and main ECRHS II survey items ($n = 8$, 2%) included in our data analysis. For comparison, we selected a population of ECRHS II respondents who reported in the screening survey that they had not performed the following work for at least three months during the follow-up period: professional cleaning, disinfecting, nursing, metal working, soldering, welding and whose jobs were classified as professional and/or administrative during the entire follow-up period ($n = 3054$). All jobs held for at least three months during the ECRHS follow-up period, including professional and/or administrative jobs and nursing and related healthcare jobs, were classified according to International Standard Classification of Occupations (ISCO-88) codes²⁶ using verbatim information provided in the occupational history portion of the ECRHS II survey. Classification of the occupational history text was performed by one experienced coder in each country and the coding was systematically checked by local experts using a common protocol. As with the nursing population, we excluded 530 respondents who were not symptom-free at the time they completed the ECRHS I questionnaire and 43 (2%) who provided incomplete data for the ECRHS II follow-up survey items included in our analysis. Our final study population included 332 nurses and a referent population of 2481 professional and/or administrative respondents.

Occupational survey modules

To identify participants who had worked in nursing and related healthcare occupations, the screening questionnaire included the question “Since the last survey, have you worked as a nurse?” The questionnaire specifically noted “We are interested in all types of nurses, including assistant nurses, midwives, dental hygienists, medical technicians and carers.” In this context, the term “carers” describes home health aides and others who provide health-related services, often, but not exclusively, in private homes. Participants who reported working as nurses, defined as such, at any time during the follow-up since ECRHS I completed a 36-item survey module about each nursing job held during this period. For each of these jobs, participants responded to a series of questions identifying principal work and work settings (yes/no) as well as the frequency of performing specific tasks and using specific types of products at work (never, >0 to <1 day/week, 1–3 days/week, 4–7 days/week). Respondents reported their use of latex gloves by responding to a series of questions about the type (powdered/non-powdered), frequency (never, >0 to <1 day/week, 1–3 days/week, 4–7 days/week) and number (none, 1–2 pairs/day, 3–5 pairs/day, 6–10 pairs/day, more than 10 pairs/day) of gloves used.

Occupational exposure assignment

We classified all individuals who completed a nursing survey module as nurses and/or healthcare workers (referred to henceforth as “nurses”) and used existing ISCO-88 categories to assign occupational categories to each of the jobs for which respondents completed nursing survey modules. To create module-based occupational exposure variables, we dichotomised questionnaire responses according to whether respondents reported each occupational work setting, task or product as part of any nursing job held during the ECRHS follow-up. As with previous analysis of ECRHS data, we dichotomised the frequency of cleaning product use (less than once/week vs 1–7 days/week).²³ We used three metrics to characterise occupational use of latex gloves: (1) frequency of powdered latex glove use (1–3 days/week, 4–7 days/week), (2) frequency of non-powdered latex glove use (1–3 days/week, 4–7 days/week) and (3) any use of powdered and/or non-powdered latex gloves (>0 days/week or 1+ pairs/day). When respondents reported holding more than one nursing job during the ECRHS follow-up period ($n = 18$), they completed one modular nursing questionnaire for each unique job; these individuals were categorised as positive for a given job, task or exposure when they provided a positive response to the corresponding job-, task- or exposure-related question in any of their completed modules. For each exposure about which a frequency was reported, the highest frequency response was assigned.

Asthma and atopy

New-onset asthma was based on the presence of current asthma at the end of the follow-up period and was assigned to participants with a positive response to any of the following questions: “Have you had an attack of asthma in the last 12 months?”, “Have you been woken by an attack of shortness of breath at any time in last 12 months?” and “Are you currently taking any medicine for asthma?” Respondents with a specific serum IgE level >0.35 kU/l to at least one of four common environmental allergens (dust mite, cat, Timothy grass, *Cladosporium herbarum*) measured at the time of the follow-up survey were categorised as atopic. These definitions are consistent with those used in previous analysis of the ECRHS data.^{18 22}

Statistical analysis

We estimated associations between occupational tasks and exposures and new-onset asthma using Poisson regression with

Table 1 Characteristics of nursing and healthcare workers and a referent population of professional and/or administrative ECRHS II participants who were symptom-free at the baseline ECRHS I survey, and the percentage of each population with new-onset asthma

Characteristic	Nursing population		Referent population	
	n	New-onset asthma n (row %)	n	New-onset asthma n (row %)
Total	332	20 (6.0%)	2481	131 (5.3%)
Age (years)				
27.7 to <36.6	93	7 (7.5%)	609	32 (5.3%)
≥36.6 to <42.9	87	5 (5.8%)	617	36 (5.8%)
≥42.9 to <48.9	96	6 (6.3%)	609	26 (4.3%)
≥48.9 to 55.8	56	2 (3.6%)	646	37 (5.7%)
Sex				
Female	289	18 (6.2%)	1420	77 (5.4%)
Male	43	2 (4.7%)	1061	54 (5.1%)
Smoking status at ECRHS II				
Lifetime non-smoker	143	8 (5.6%)	1142	58 (5.1%)
Ex-smoker	101	6 (5.9%)	683	33 (4.8%)
Current Smoker	88	6 (6.8%)	656	40 (6.1%)

robust error variances to compare the risk of new-onset asthma among nurses with each exposure to that of respondents in the comparison population. We conducted separate analyses to assess the sensitivity of our results to two decisions made in creating our final study population: inclusion of men (nurses, n = 48; referent population, n = 289) and exclusion of 433 referent group respondents who completed occupational survey modules about cleaning, disinfecting, metalworking, soldering and/or welding jobs. We also conducted separate analyses of the frequency of latex glove use and new-onset asthma in a population limited to atopic respondents. Measures of association are reported as relative risks (RRs) with 95% confidence intervals (95% CIs). Models were adjusted for age, country, sex and smoking status at ECRHS II (current smoker, ex-smoker, never smoker). Age was categorised using quartiles of the age distribution of our study population (27.7 to <36.6, ≥36.6 to <42.9, ≥42.9 to <48.9, ≥48.9 to 55.8). We performed all analyses using SAS version 9.1 (SAS Institute Inc, Cary, North Carolina, USA).

RESULTS

In the final study populations there were notable differences in the percentages of female respondents (nurses, 87%; referent population, 57%) and respondents in the ≥48.9 year age category (nurses, 17%; referent population, 26%) between the nursing and referent populations. Six per cent (20/332) of the professional nursing population reported experiencing an attack of asthma during the last 12 months, waking because of an attack of shortness of breath within the last 12 months or currently taking asthma medications (new-onset asthma), compared to 5% in the referent population. In both populations, the percentages of respondents with asthma were slightly higher among women and among current smokers (table 1). The distributions of years between the ECRHS I and ECRHS II surveys were similar for the two populations (nurses: mean (SD) 8.9 (0.8) years, median 8.9 years; referent population: mean (SD) 8.9 (0.8) years, median 8.9 years).

Overall, there was a <1% difference in the percentages of new-onset asthma in the nursing population and the referent population and the adjusted RR did not reach statistical significance (RR 1.16, 95% CI 0.72 to 1.87) (table 2). The magnitude and precision of this RR was similar to those generated using analyses limited to women (RR 1.21, 95% CI 0.72 to 2.04), when 433 respondents who completed occupational modules about their cleaning, metal working, soldering and/or welding jobs were included in our referent population

(RR 1.19; 95% CI 0.74 to 1.91) and when the model was adjusted for body mass index computed using height and weight measurements taken at ECRHS II (RR 1.22, 95% CI 0.76 to 1.99). When analyses were stratified using ISCO codes corresponding to job descriptions provided by survey respondents, a higher percentage of individuals in the ISCO category of nursing-associated professionals reported asthma relative to the referent population. Using questionnaire-based categories to identify nursing jobs, the percentage of respondents reporting asthma was greater among those who reported working as nursing technicians in hospital settings and among those who reported working as personal care providers in institutional environments, compared to the referent population.

Analysis of the occupational exposures included in the ECRHS II survey module suggests elevated relative risks of asthma among nurses who reported using ammonia and/or bleach cleaning products more than once per week (RR 2.16, 95% CI 1.03 to 4.53) (table 2). And, though no clear patterns emerged for the association between frequency of latex glove use and new-onset asthma, the point estimate was higher among users of powdered and/or non-powdered latex gloves compared to the referent population (RR 1.26, 95% CI 0.76 to 2.09) in the entire study population (table 2) and when the association was evaluated among atopic respondents (RR 1.74, 95% CI 0.85 to 3.58). When the exposed populations were limited to individuals who reported using only powdered latex gloves, the risk of new-onset asthma was increased among those in the entire population who reported using gloves 1–3 days/week, compared to the referent population (1–3 days/week: RR 2.83, 95% CI 1.03 to 7.81) (table 2), as well as in those categorised as atopic (1–3 days/week: RR 2.61, 95% CI 0.55 to 12.3).

DISCUSSION

In this analysis, we present risk factors for new-onset asthma among nurses and nursing-related healthcare workers in an international, population-based study. Despite the small number of healthcare professionals reporting each of the specific occupational tasks and exposures, we observed statistically significant increased adjusted RRs for new-onset asthma among hospital technicians, institutional-based personal care providers and users of specific cleaning products, as compared to a large population of administrative and professional workers. We also observed a positive association between new-onset asthma and use of powdered latex gloves, but only among

Table 2 Associations of selected job tasks and exposures with new-onset asthma among ECRHS II participants who were symptom-free at the baseline ECRHS I survey

	Exposed, n	New-onset asthma	
		n (%)	RR (95% CI)*
Professional, administrative occupations	2481	131 (5.3%)	1.00†
All nursing and related occupations	332	20 (6.0%)	1.16 (0.72 to 1.87)
ISCO-based occupational category‡			
Nursing and midwifery professionals	86	4 (4.7%)	0.90 (0.34 to 2.40)
Nursing-associated professionals	56	5 (8.9%)	1.85 (0.76 to 4.50)
Personal care workers, institution-based	85	3 (3.5%)	0.65 (0.20 to 2.06)
Other	107	8 (7.5%)	1.43 (0.70 to 2.91)
Job descriptions§			
Clinical nurse in a hospital	97	3 (3.1%)	0.60 (0.19 to 1.85)
General practice assistant†	36	2 (5.6%)	1.07 (0.27 to 4.24)
Nursing assistant in a hospital	53	1 (1.9%)	0.36 (0.05 to 2.60)
Personal care provider, home-based	32	1 (3.1%)	0.56 (0.08 to 3.92)
Personal care provider, institution-based	50	6 (12.0%)	2.30 (1.03 to 5.14)
Technician in a hospital	16	4 (25.0%)	4.63 (1.87 to 11.5)
Work tasks¶			
Disinfection	180	12 (6.7%)	1.29 (0.70 to 2.36)
Laboratory work	46	4 (8.7%)	1.62 (0.62 to 4.21)
Preparing and/or administering medications	187	8 (4.3%)	0.84 (0.41 to 1.74)
Products used at work			
Cleaning products‡			
Ammonia and/or bleach	60	7 (11.7%)	2.16 (1.03 to 4.53)
Liquid multi-use products	183	11 (6.0%)	1.16 (0.61 to 2.19)
Washing powders	78	7 (9.0%)	1.65 (0.77 to 3.53)
Any products in spray form	42	5 (11.9%)	2.36 (0.99 to 5.64)
Latex glove use			
Powdered and/or non-powdered latex**	258	17 (6.6%)	1.26 (0.76 to 2.09)
Powdered latex gloves only			
1–3 days/week	24	4 (16.7%)	2.83 (1.03 to 7.81)
4–7 days/week	53	2 (3.8%)	0.75 (0.18 to 3.07)
Non-powdered latex gloves only			
1–3 days/week	24	2 (8.3%)	1.58 (0.38 to 6.46)
4–7 days/week	36	2 (5.6%)	1.07 (0.26 to 4.43)

*Adjusted for age, country, sex and smoking status at ECRHS II.

†Referent category for all models shown in the table.

‡Two of the 18 respondents who completed more than one occupational module provided job descriptions for jobs in different ISCO categories, therefore the total number of jobs in the ISCO categories (n = 334) is greater than the number of respondents (n = 332).

§Exposures are not mutually exclusive. Work-related tasks and exposures were assessed using a series of non-nested questions, therefore the total number of participants in each category (job descriptions, work tasks, cleaning products) are not equal to the total number of participants.

¶Performed 1–7 days/week.

**Powdered and/or non-powdered latex gloves used >0 day/week or ≥1 pairs/day.

those with a reported use frequency of 1–3 days/week. These findings support the conclusions of previous ECRHS analyses reporting increased risks of asthma among nurses,¹⁹ cleaners^{18 22 27} and participants in occupations with substantial proportions of female workers.¹⁸ By using the occupational survey module as the basis of our exposure assessment, we were able to extend these findings to assess specific jobs, tasks and products used in healthcare settings. Our results suggest that men and women working in nursing and healthcare professions may routinely be exposed to respiratory hazards in the workplace and that these exposures may initiate or contribute to their adult-onset asthma-related symptoms.

We conducted our analyses using data from the ECRHS, a large, prospective population-based cohort study of adults in 10 European countries. The ECRHS II included an occupational health component designed specifically to address inhalation exposures relevant for nursing professionals. The major strengths of our analyses include the availability of survey-based occupational exposure data from a relatively large cohort of individuals in nursing and related healthcare occupations, standardised and comprehensive respiratory health symptom data, an international community-based sample and a nine-year follow-up of study participants.

We observed a statistically elevated risk of new-onset asthma among moderately frequent users of powdered latex

gloves—that is, among those using only powdered latex gloves and who reported using them 1–3 days per week—but not among those who reported more frequent use. This observation supports the hypothesis that healthcare workers with asthma-like symptoms or who previously experienced adverse reactions to latex gloves may limit their use of powdered latex gloves.²⁸ The absence of a significantly elevated risk among frequent users of powdered latex gloves or frequent users of non-powdered latex gloves suggests that the relevant latex exposure may not be measured in days of use per week or pairs of gloves per day (data not shown), that latex glove use is not a strong risk factor for new-onset current asthma as defined for our analyses, or that adverse reactions to latex exposure may have already affected the selection of health-related occupations among members of this population. Of note, 74 nursing or healthcare workers included in our analysis reported never using powdered or non-powdered latex gloves while working. Sixty one per cent of these non-glove users were participants from Sweden, a country from which 36% of the nurses included in our analysis participated. This disparity suggests that nursing practices and tasks vary between countries, and perhaps even by region within country, as 52% of the non-glove users arose from two participating ECRHS centres in Sweden. Further evaluation of this population indicates that cleaning (disinfecting: 46%; using washing powders: 28%; using liquid multi-use

cleaning products: 38%) and administering medications (46%) were common tasks among these 74 latex glove non-users.

Nursing and related healthcare professionals perform a wide array of tasks and a single job may involve work in multiple settings, in which case a job title or description of occupational tasks may not adequately reflect the potential range of workplace exposures. We were unable to categorise exposures with more specificity using survey-based ECRHS II data, but a more focused exposure assessment would reduce misclassification of exposure. Indeed, accurately describing the tasks, exposures, stressors and consequences of nursing and nursing-related jobs is difficult because of the vastly different jobs performed and because of the potential variation of work-related exposures and other factors between the countries involved in the ECRHS. Nonetheless, by assessing the risk of new-onset asthma within survey-based categories describing jobs and tasks we observed notably different risks than those generated when exposure was based on categories corresponding to nursing-related ISCO codes, thus suggesting that the questionnaire-based occupational exposure assessment provides more information, which can better characterise occupational risk categories than job title categories alone.

We selected new-onset asthma as an outcome to facilitate comparison of our findings with those of previous analyses of ECRHS data for which the same definition of asthma was used. In addition, this definition allows us to evaluate the onset of asthma among a previously symptom-free working population. However, our definition of new-onset asthma does not account for respondents who experienced asthma-related symptoms during the ECRHS follow-up period, but not within the past year. Among the population that was symptom-free at the time of the ECRHS I baseline survey, 6% (19/332) of nurses and 4% (86/2481) of the referent population gave positive responses to the ECRHS II survey question "Have you ever had asthma?", and these values of period prevalence provide alternative estimates of the cumulative incidence of asthma in these populations. Among these respondents who were symptom-free at the time of the baseline ECRHS survey, but who reported ever having asthma at the time of the ECRHS follow-up survey, 47% (9/19) of the nursing population and 40% (34/86) of the referent population were not categorised as having new-onset current asthma in our analysis. Excluding these individuals from our main analysis may reduce misclassification of new-onset asthma variable, but it reduces the comparability of our results to other analyses of ECRHS data for which the same definition was used and it results in negligible changes in the relative risks and confidence limit estimates (RR 1.17, 95% CI 0.72 to 1.89). And, although we are unable to fully explore the hypothesis using the small number of respondents who reported having asthma, but not during the previous 12 months, these data suggest that occupation exposures may be related to regression of symptoms in this population. Because our definition refers to symptoms experienced within the past 12 months, whereas our occupational exposures are based on jobs held during the entire ECRHS follow-up, we conducted additional analyses to include exposures reported in jobs held during the 12 months preceding participation in ECRHS II. Though too few individuals reported many of the specific occupational tasks and exposures during the past 12 months to assess the less common job tasks and exposures, results of analyses using this restricted definition of exposure are similar to those of our main analysis for the risk of new-onset asthma among individuals working in nursing and nursing-related occupations ($n = 257$, RR 1.18, 95% CI 0.70 to 1.98), working as hospital technicians ($n = 12$, RR 6.29, 95% CI 2.66 to 14.9), and performing disinfecting ($n = 139$, RR 1.23, 95% CI 0.62 to 2.44) during the past 12 months compared to that of the referent population.

Our analyses are limited by the small number of participants with new-onset asthma and with each specific work-related task and product. More thorough investigation of the elevated risks we observed in hospital technicians and among those performing cleaning and disinfecting tasks and using latex gloves would require a more focused study design, including additional information about job settings, exposures, use of personal protective equipment and other factors that would each reduce the potential for misclassification of inhalation exposures. Using our survey-based exposure categories, we were able to assess exposures and tasks across a range of occupations, but we cannot attribute the cumulative incidence of asthma-related symptoms in this population to specific or quantified exposure levels or to the duration of any work-related exposure. Occupational exposure assessment in community-based epidemiological studies continues to be a major challenge and an important area for improvement in epidemiological studies of health effects among workers.

Several additional limitations should be considered when interpreting our findings. In the ECRHS II, information about occupational exposures and asthma-related symptoms were collected in a single, retrospective, multipart survey, thus our findings may be biased by differential misclassification of exposure if respondents with asthma symptoms were more likely to recall or report specific exposures than were respondents without such symptoms. Statistical models in our analyses were adjusted for participants' countries of origin. The small number of nurses in each individual study centre limited our ability to use random-intercepts binary regression, which would have allowed us to take into account variations in new-onset asthma and in other unmeasured differences that exist between study centres. Such unmeasured factors are likely to include important between-country differences in health-care-related work, such as those observed in the use of latex gloves at work. We designated respondents as having new-onset asthma using self-reported symptoms. Symptomatic individuals may have reported asthma-like conditions that are actually related to chronic obstructive pulmonary disease, nocturnal dyspnoea or other similar health conditions. Although disorders such as chronic obstructive pulmonary disease are unlikely to be observed in a population of adults aged 27–56 years old, using the ECRHS data we are unable to evaluate the extent to which these conditions were identified as asthma. Furthermore, new onset asthma was most common among nurses in the youngest age category and declined across quartiles of age. In contrast, there was little difference by age in the referent group, raising the possibility that nurses develop symptoms early in their professional careers and change jobs due to their asthma-related symptoms. This hypothesis is supported by the declining number of nurses in the older age categories, although because occupational data are available at the time of the ECRHS II follow-up survey but not the ECRHS I baseline survey, we are unable to explore the degree to which this selection occurred. Despite these limitations, our results suggest that nursing and nursing-related healthcare occupations are not an exception to previous findings indicating the extent to which adult-onset asthma may be attributable to occupational exposures.^{18 29}

The increasing demand for healthcare workers and the working conditions provided for those already in these professions are major determinants of the current shortage of nursing and related healthcare professionals in the healthcare industry. Responsibilities of and tasks performed in the healthcare industry are changing rapidly and these changes may vary between and within the countries that participated in ECRHS. Use of high-risk products such as glutaraldehyde and powdered latex gloves may be declining in some places and for

Main messages

- Men and women working in nursing and nursing-related healthcare professions are routinely exposed to respiratory hazards in the workplace.
- Inhalation exposures in occupational settings may initiate or contribute to the onset of asthma-related symptoms among healthcare workers.

Policy implications

- Heightened awareness of respiratory and other occupational hazards that healthcare professionals encounter on the job is needed.
- Improving precautions designed to reduce inhalation exposures to respiratory irritants and sensitisers in healthcare settings may reduce asthma morbidity among nurses and other healthcare professionals.

some populations—for example, as aids and assistants perform more of the cleaning tasks, such exposures may be reduced for nurses in clinical and general practice roles. Nonetheless, identifying and addressing respiratory and other hazards in medical work settings is a timely public health issue of growing importance worldwide. Our findings present an overview of occupational exposures reported among healthcare workers who participated in ECRHS II and should be used to increase awareness about the use of disinfectants, latex gloves and other respiratory hazards to which this important working population and others working in healthcare environments may routinely be exposed.

Authors' affiliations

J M Antó, M Kogevinas, M C Mirabelli, E Plana, J Sunyer, J Zock, Centre for Research in Environmental Epidemiology, Municipal Institute of Medical Research, Barcelona, Spain

J M Antó, J Sunyer, Department of Experimental and Health Sciences, Universitat Pompeu Fabra, Barcelona, Spain

G Benke, Department of Epidemiology and Preventive Medicine, Monash University, Victoria, Australia

P D Blanc, Department of Medicine, University of California San Francisco, California, USA

A Dahlman-Höglund, L Lillienberg, K Torén, Department of Occupational and Environmental Medicine, Sahlgrenska University Hospital, Göteborg, Sweden

D L Jarvis, Respiratory Epidemiology and Public Health Group, National Heart and Lung Institute, Imperial College, London, UK

H Kromhout, Institute for Risk Assessment Sciences, Environmental Epidemiology Division, Utrecht University, Utrecht, the Netherlands

D Norbäck, Department of Medical Sciences, Occupational and Environmental Medicine, Uppsala University and University Hospital, Sweden

M Olivieri, Unit of Occupational Medicine, University of Verona, Italy

K Radon, Unit for Occupational and Environmental Epidemiology & NetTeaching, Institute for Occupational and Environmental Medicine, Ludwig-Maximilians-University, Munich, Germany

K Torén, Department of Allergology, Sahlgrenska University Hospital, Göteborg, Sweden

M van Sprundel, Department Epidemiology and Social Medicine, University of Antwerp, Belgium

S Villani, Section of Medical Statistics and Epidemiology, Department of Health Sciences, University of Pavia, Italy

M Kogevinas, Department of Social Medicine, Medical School, University of Crete, Heraklion, Greece

The authors received funding from the European Commission Quality of Life programme (QLK4-CT-1999-01237), the EU Framework programme for research (FOOD-CT-2004-506378), and the US National Institutes of Health (NIH) (1R01HL062633, 1F32ES014142). The contents of this manuscript are solely the responsibility of the authors and do not necessarily represent the official views of the European Commission Quality of Life programme, the EU Framework programme for research or NIH.

REFERENCES

- 1 **Merecz D**, Rymaszewska J, Moscicka A, *et al*. Violence at the workplace—a questionnaire survey of nurses. *European Psychiatry* 2006;**21**:442–50.
- 2 **Dement J**, Epling C, Østbye T, *et al*. Blood and body fluid exposure risks among health care workers: results from the Duke Health and Safety Surveillance System. *Am J Ind Med* 2004;**46**:637–48.
- 3 **Dement J**, Pompeii L, Østbye T, *et al*. An integrated comprehensive occupational surveillance system for health care workers. *Am J Ind Med* 2004;**45**:528–38.
- 4 **Loeb M**, McGeer A, Henry B, *et al*. SARS among critical care nurses, Toronto. *Emerg Infect Dis* 2004;**10**:251–5.
- 5 **Menzies D**, Fanning A, Yuan L, FitzGerald JM, the Canadian Collaborative Group in Nosocomial Transmission of TB. Hospital ventilation and risk for Tuberculous infection in Canadian health care workers. *Ann Intern Med* 2000;**133**:779–89.
- 6 **Pechter E**, Davis L, Tumpowsky C, *et al*. Work-related asthma among health care workers: Surveillance data from California, Massachusetts, Michigan, and New Jersey, 1993–1997. *Am J Ind Med* 2005;**47**:265–75.
- 7 **Shaffer MP**, Belsito DV. Allergic contact dermatitis from glutaraldehyde in health-care workers. *Contact Dermatitis* 2000;**43**:150–6.
- 8 **Zak H**, Kaste L, Schwarzenberger K, *et al*. Health-care workers and latex allergy. *Arch Envir Health* 2000;**55**:336–46.
- 9 **Waters A**, Beach J, Abramson M. Symptoms and lung function in health care personnel exposed to glutaraldehyde. *Am J Ind Med* 2003;**43**:196–203.
- 10 **Vyas A**, Pickering CA, Oldham LA, *et al*. Survey of symptoms, respiratory function, and immunology and their relation to glutaraldehyde and other occupational exposures among endoscopy nursing staff. *Occup Environ Med* 2000;**57**:752–9.
- 11 **Di Stefano F**, Siriruttanapruk S, McCoach J, *et al*. Glutaraldehyde: an occupational hazard in the hospital setting. *Allergy* 1999;**54**:1105–9.
- 12 **Dimich-Ward H**, Wymer ML, Chan-Yeung M. Respiratory health survey of respiratory therapists. *Chest* 2004;**126**:1048–53.
- 13 **Ranta PM**, Ownby DR. A review of natural-rubber latex allergy in health care workers. *Clin Infect Dis* 2004;**38**:252–6.
- 14 **Binkley HM**, Schroyer T, Catalfano J. Latex allergies: a review of recognition, evaluation, management, prevention, education, and alternative product use. *J Athl Train* 2003;**38**:133–40.
- 15 **Laresse Filon F**, Radman G. Latex allergy: a follow up study of 1040 healthcare workers. *Occup Environ Med* 2006;**63**:121–5.
- 16 **Laresse Filon F**, Bosco A, Fiorito A, *et al*. Latex symptoms and sensitisation in health care workers. *Int Arch Occup Environ Health* 2001;**74**:219–23.
- 17 **Nettis E**, Colanardi MC, Soccio AL, *et al*. Occupational irritant and allergic contact dermatitis among healthcare workers. *Contact Dermatitis* 2002;**46**:101–7.
- 18 **Kogevinas M**, Antó JM, Sunyer J, *et al*. Occupational asthma in Europe and other industrialised areas: a population-based study. European Community Respiratory Health Survey Study Group. *Lancet* 1999;**353**:1750–4.
- 19 **Kogevinas M**, Zock JP, Plana E, *et al*. New-onset occupational asthma in an international population study [abstract]. *Eur Respir J* 2004;**24**(Suppl 48):7S.
- 20 **Burney PG**, Luczynska C, Chinn S, *et al*. The European Community Respiratory Health Survey. *Eur Respir J* 1994;**7**:954–60.
- 21 **The European Community Respiratory Health Survey Steering Committee**. The European Community Respiratory Health Survey II. *Eur Respir J* 2002;**20**:1071–9.
- 22 **Zock JP**, Kogevinas M, Sunyer J, *et al*. Asthma characteristics in cleaning workers, workers in other risk jobs and office workers. *Eur Respir J* 2002;**20**:679–85.
- 23 **Zock J**, Plana E, Dahlman-Höglund A, Olivieri M, Kogevinas M, the ECRHS II occupational working group. Use of household cleaning sprays and new-onset asthma: a community based study in 10 European countries [abstract]. *Eur Respir J* 2005;**26**(Suppl 49):207S.
- 24 **Janson C**, Antó J, Burney P, *et al*. The European Community Respiratory Health Survey: what are the main results so far? European Community Respiratory Health Survey II. *Eur Respir J* 2001;**18**:598–611.
- 25 **Basagaña X**, Sunyer J, Zock JP, *et al*. Incidence of asthma and its determinants among adults in Spain. *Am J Respir Crit Care Med* 2001;**164**:1133–7.
- 26 **International Labour Organization**. International Standard Classification of Occupations, 1988 edition (ISCO 88). ILO, 1991.
- 27 **Zock JP**, Kogevinas M, Sunyer J, *et al*. Asthma risk, cleaning activities and use of specific cleaning products among Spanish indoor cleaners. *Scand J Work Environ Health* 2001;**27**:76–81.
- 28 **Grzybowski M**, Ownby DR, Peyser PA, *et al*. The prevalence of anti-latex IgE antibodies among registered nurses. *J Allergy Clin Immunol* 1996;**98**:535–44.
- 29 **Blanc PD**, Torén K. How much adult asthma can be attributed to occupational factors? *Am J Med* 1999;**107**:580–7.



Occupational risk factors for asthma among nurses and related healthcare professionals in an international study

Maria C Mirabelli, Jan-Paul Zock, Estel Plana, et al.

Occup Environ Med 2007 64: 474-479 originally published online March 1, 2007

doi: 10.1136/oem.2006.031203

Updated information and services can be found at:

<http://oem.bmj.com/content/64/7/474.full.html>

These include:

References

This article cites 28 articles, 8 of which can be accessed free at:

<http://oem.bmj.com/content/64/7/474.full.html#ref-list-1>

Article cited in:

<http://oem.bmj.com/content/64/7/474.full.html#related-urls>

Email alerting service

Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Notes

To request permissions go to:

<http://group.bmj.com/group/rights-licensing/permissions>

To order reprints go to:

<http://journals.bmj.com/cgi/reprintform>

To subscribe to BMJ go to:

<http://group.bmj.com/subscribe/>