

Occupation and adult onset of rhinitis in the general population

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ABSTRACT

Objectives: Occupational exposures have been associated with an increased risk of new-onset rhinitis in apprentices. However, population-based prospective data are scarce and do not cover new onset of rhinitis later in life. The authors studied the association between occupational exposure and adult onset of rhinitis prospectively.

Methods: The data of 4994 participants (age at follow-up 28–57 years) from 27 centres of the European Community Respiratory Health Survey II who were symptom-free at baseline were analysed. As outcome at follow-up self-reported (a) nasal allergies (“allergic rhinitis”) and (b) runny, blocked nose for 12 months a year (“perennial rhinitis”) were used. Occupational exposures at any time during follow-up were defined by job title.

Results: The cumulative incidence of allergic rhinitis, perennial rhinitis and both conditions was 12%, 11% and 3%, respectively. Compared to office workers, male medical professionals were at increased risk of new onset of allergic rhinitis (OR 3.0; 95% CI 1.4 to 6.4). Odds ratios were reduced in metal workers not involved in metal making or treating (0.3; 95% CI 0.1 to 0.7). For perennial rhinitis ORs were significantly increased in cleaners (1.4; 95% CI 1.0 to 2.1).

Conclusions: Cleaners and medical professionals may be at increased risk for adult-onset rhinitis.

Up to 21% of adults in Europe are affected by rhinitis^{1,2} making it one of the most common chronic diseases in adults.³ Even though it is not considered a severe disease the bothersome symptoms impact usual daily activities, quality of sleep, and work productivity of those affected.^{3–5} In addition, rhinitis is accompanied by asthma in up to 40% of patients.³

Symptoms of chronic rhinitis, an inflammation of the nasal mucosal membrane, may involve episodic nasal discharge, sneezing or congestion.⁴ Rhinitis is in general considered allergic when these symptoms are accompanied by allergen-specific IgE production. Therefore, the development of allergic rhinitis requires a period of exposure with sensitisation. The onset of symptoms of rhinitis due to irritation might be more rapid and the symptoms are transient at the beginning.⁶

Workplace exposures may contribute to the development of allergic and irritant rhinitis in adult life. Data from apprentices in high-risk industries, mainly with exposure to high-molecular weight agents,^{7–9} indicate a high incidence of allergic rhinitis with short latency periods. Few

studies on occupational rhinitis were done prospectively on a population base.^{10,11}

The aim of our analyses was to investigate the association between occupational exposure and adult onset of rhinitis within an international prospective cohort study on a general population sample of adults aged 20–44 years at baseline.

METHODS

Study design and population

Data were collected as part of the baseline study and the first follow-up of the European Community Respiratory Health Survey (ECRHS). The baseline study (ECRHS I) took place from 1991–5, the follow-up study (ECRHS II) was carried out in 28 study centres from 1998–2003. At baseline, participants were aged 20–44 years. Details of the study have been described previously.^{12,13}

For the present analyses data from the random population sample of 27 centres in 13 countries with occupational history data were used (n = 8540).

Occupational exposure assessment

At the face-to-face interview of ECRHS II all occupations and industries from jobs held during follow-up were coded according to the ISCO-88 system. The occupational codes were systematically checked by local experts after centralised training. Based on these codes 27 occupational groups were formed¹⁴ without a priori hypotheses.

In addition, occupational exposure to high molecular weight agents (HMW), low molecular weight agents (LMW), mixed environments, and low asthma risk agents (environmental tobacco smoke, exhaust, low risk irritants or jobs with low levels of exposure to asthmagens) was assigned based on the ISCO-88 codes using an asthma-specific job exposure matrix (JEM) proposed by Kennedy *et al.*¹⁵

Outcome definition

We excluded all subjects (n = 2674) who at baseline reported either nasal allergies (n = 2079), or asthma (asthma attack or having been woken by an attack of shortness of breath during last 12 months or currently taking asthma medication) (n = 436); or had missing information on one of these items (n = 159) from the analyses. We defined allergic rhinitis as an affirmative response to the question “Do you have any nasal allergies, including hay fever?”; and perennial rhinitis as

problems with sneezing or a runny or blocked nose without having the flu occurring in all 12 months before the second survey.

Serum samples were analysed for specific IgE against house dust mite, grass, cat and *Cladosporium* using the Pharmacia CAP System (Pharmacia Diagnostics, Uppsala, Sweden).¹⁶ Specific IgE at follow-up was considered present if at least one IgE level exceeded 0.35 kU/l.

Statistical methods

Of the 5866 participants at follow-up who did not report baseline symptoms of allergic rhinitis and asthma, subjects who did not report a complete occupational history ($n = 324$) or had missing information on any of the potential confounders ($n = 548$) were excluded, leaving 4994 subjects for the present analyses of allergic rhinitis, of whom 4853 also had information on perennial rhinitis.

All models were adjusted for:

- ▶ Age (years) used as continuous variable.
- ▶ Level of education as proxy of socioeconomic status: subjects who completed their full-time education earlier than age 19 years were considered to have a low level of education, the others were considered as having a high level of education.
- ▶ Smoking status at follow-up was categorised into never smokers, ex-smokers, and current smokers.
- ▶ Parental allergy was based on self-reported allergic diseases (asthma, rhinitis, eczema) of either father or mother.
- ▶ Country of residence.

Data were analysed for the total study population and stratified by sex using logistic regression models. Those employed in presumably non-exposed occupations (such as office workers) throughout the follow-up period were used as reference population. Each occupational group with at least 30 subjects was compared to this reference population in a separate model.

Subjects classified as exposed according to the asthma JEM were compared to those never exposed during follow-up to any of the exposures covered by the JEM. As subjects changed jobs during the follow-up they could be included in more than one job and exposure category (except the reference group).

In addition to the cross-sectional analyses, survival analyses were conducted and the net change in prevalence¹⁷ was calculated for allergic rhinitis. Finally, sensitivity analyses were performed stratifying the analyses by sensitisation to common allergens based on the results of specific IgE measurements.¹³ As the results of these analyses did not differ substantially, only results of the logistic regression model for the total population and stratified for sex are presented in the paper.

RESULTS

Descriptive data

The mean age of the population was 43 years, and about half the participants were females. Thirty one per cent were current smokers. The cumulative incidence of allergic rhinitis was 12%, and 11% reported symptoms of perennial rhinitis. Only 137 subjects (3%) reported both (fig 1).

New onset of allergic rhinitis during follow-up occurred significantly more often in females than in males (13% vs 10%), in never (13%) and ex-smokers (13%) than in current smokers (10%), in subjects whose parents had allergies (15% vs 11%), and subjects sensitised to common allergens (25% vs 9%) (table 1). Subjects with a higher level of education reported

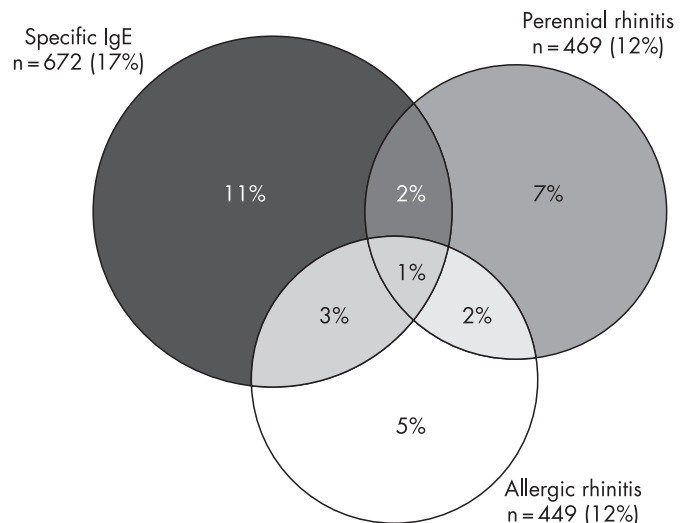


Figure 1 Venn diagram of allergic rhinitis, perennial rhinitis and specific IgE to common allergens at follow-up (ECRHS-II). Only subjects with neither symptoms of allergic rhinitis nor asthma at baseline ($n = 3963$) ($n = 1060$ missing due to missing data on specific IgE or perennial rhinitis).

significantly more often new onset of allergic rhinitis (13%) and perennial rhinitis (12%) than subjects with lower level of education (10%, respectively).

Occupational exposures

Based upon the classification of the JEM, 59% of the population were never exposed during the follow-up period. Overall, 20% of the population were ever employed in jobs associated with high asthma risk agents (HMW, LMW or mixed exposures). About 28% of the population were ever exposed to low asthma risk agents at any time during follow-up (table 2). This group included subjects working at least some time during follow-up as, for example, cleaners (50.7%), metal workers not involved in metal making or treating (35.5%), or other medical professions excluding nurses (11.0%).

In the multiple logistic regression models, none of the odds ratios for allergic rhinitis was significantly increased for any of the occupational exposures under study. Odds ratios for perennial rhinitis were slightly but not significantly increased only for those with exposure to agents with low asthma risks (OR 1.11; 95% CI 0.89 to 1.39). Stratifying for gender the increase in risk was confined to women (OR 1.50; 95% CI 1.06 to 2.12). However, the difference between men and women was not statistically significant different. Combining the outcome definition as having either allergic rhinitis or perennial rhinitis likewise did not change the results (data not shown).

Occupational groups

Throughout the follow-up period the majority of subjects always worked in offices (tables 3 and 4). Jobs in the medical sector were held at any time during follow-up by 9% of the population (nurses, dentists, veterinarians, personal care workers, medical assistants and other medical workers). About 6% of the population worked in cleaning during follow-up and 5% were metal workers. All other jobs were held by less than 5% of the population.

Table 1 Descriptive data of the study population at follow-up (ECRHS II)

Variable	Total, n = 4494	Allergic rhinitis ^{†‡} , n = 579 (11.6%)	Perennial rhinitis ^{†§} , n = 549 (11.0%)
	n (%)	n (%)	n (%)
Sex		***	
Female	2522 (50.5)	336 (13.3)	270 (11.1)
Male	2472 (49.5)	243 (9.9)	279 (11.6)
Educational level		**	*
High¶	2978 (59.6)	376 (12.7)	350 (12.1)
Low	2016 (40.4)	203 (10.1)	199 (10.2)
Smoking		**	
Never smokers	2105 (42.2)	265 (12.6)	216 (10.6)
Ex-smokers	1334 (26.7)	167 (12.6)	166 (12.8)
Current smokers	1555 (31.1)	147 (9.5)	167 (11.0)
Parental allergy		***	***
No	3338 (66.8)	350 (10.5)	325 (10.0)
Yes	1193 (23.9)	181 (15.2)	137 (12.0)
Don't know	463 (9.3)	48 (10.4)	87 (19.3)
Specific IgE to common allergens ^{††}		***	
No	3372 (82.9)	296 (8.8)	377 (11.5)
Yes	696 (17.1)	174 (25.1)	93 (13.8)

Only subjects neither asthma nor allergic rhinitis at baseline (n = 4994).

[†]Numbers do not add up to 100% as 137 subjects had symptoms of allergic and perennial rhinitis.

[‡]n = 10 missing.

[§]n = 141 missing.

[¶]Age at end of full-time education \geq 19 years.

^{††}n = 926 missing due to missing data on IgE.

*** χ^2 p < 0.001, ** χ^2 p < 0.01, * χ^2 p < 0.05 compared to subjects without symptoms.

With respect to the cumulative incidence of allergic rhinitis during follow-up, the odds ratio was significantly reduced for metal workers other than metal making or treating (OR 0.32; 95% CI 0.15 to 0.70, table 3). Stratifying for gender showed similar associations for men (OR 0.31; 95% CI 0.13 to 0.73) and women (OR 0.46; 95% CI 0.06 to 3.58) although confidence interval for women was wide due to small numbers. The only statistically significantly increased odds ratio was seen for men working in the medical sector in jobs other than nursing (OR

2.96; 95% CI 1.37 to 6.38). The odds ratio for women suggested an effect modification by gender (OR 0.64; 95% CI 0.40 to 1.03).

For perennial rhinitis, odds ratios were increased for cleaners (OR 1.43; 95% CI 0.99 to 2.06, table 4), in particular for women (OR 1.70; 95% CI 1.09 to 2.64). Additionally, male bakery workers showed a statistically significant elevated odds ratio (OR 3.46; 95% CI 1.02 to 11.8).

The other occupational groups did not differ significantly from the reference population with respect to either allergic

Table 2 Associations between occupational exposure and allergic as well as perennial rhinitis at follow-up for subjects with neither symptoms of allergic rhinitis nor asthma at baseline

	n (%) [†]	OR (95% CI)		
		Total*	Men	Women
<i>Allergic rhinitis</i>				
During follow-up				
Never exposed (ref)	2939 (58.9%)	1	1	1
Ever exposed to:				
High asthma risk agents				
HMW	525 (15.2%)	0.91 (0.67 to 1.23)	0.98 (0.52 to 1.86)	0.90 (0.64 to 1.26)
LMW	719 (19.7%)	0.99 (0.77 to 1.29)	1.06 (0.68 to 1.67)	0.98 (0.71 to 1.36)
Mixed	173 (5.6%)	1.10 (0.67 to 1.81)	0.77 (0.37 to 1.60)	1.72 (0.86 to 3.45)
Low asthma risk agents	1413 (32.5%)	1.00 (0.80 to 1.24)	1.05 (0.78 to 1.41)	0.95 (0.68 to 1.34)
<i>Perennial rhinitis</i>				
During follow-up				
Never exposed (ref)	2850 (58.7%)	1	1	1
Ever exposed to:				
High asthma risk agents				
HMW	505 (15.1%)	1.10 (0.81 to 1.49)	1.11 (0.62 to 1.96)	1.12 (0.77 to 1.62)
LMW	701 (19.7%)	1.01 (0.77 to 1.33)	1.07 (0.71 to 1.63)	1.02 (0.70 to 1.48)
Mixed	171 (5.7%)	0.91 (0.54 to 1.53)	0.99 (0.53 to 1.86)	0.85 (0.32 to 2.23)
Low asthma risk agents	1380 (32.6%)	1.11 (0.89 to 1.39)	0.94 (0.71 to 1.25)	1.50 (1.06 to 2.12)

*OR (95% CI) additionally adjusted for gender.

[†]Subjects might be categorised in more than one exposure category, therefore, numbers do not add up to 100%.

Odds ratio with 95% CI adjusted for country, age at first survey, smoking, parental allergies and level of education.

Table 3 Associations between occupational group and allergic rhinitis for subjects with neither symptoms of allergic rhinitis nor asthma at baseline.

	n (%)	Odds ratio (95% CI)		
		Total* (n = 4994)	Men (n = 2472)	Women (n = 2522)
During follow-up always employed as:				
Office worker (ref)	2843 (56.9)	1	1	1
During follow-up ever employed as:†				
Cleaners and caretakers	294 (5.9)	1.25 (0.86 to 1.81)	1.22 (0.59 to 2.55)	1.26 (0.81 to 1.95)
Hairdressers, barber, beautician and related	35 (0.7)	0.44 (0.10 to 1.85)	NA	0.51 (0.12 to 2.19)
Nurses	199 (4.0)	0.85 (0.54 to 1.34)	0.75 (0.17 to 3.27)	0.85 (0.52 to 1.37)
Other medical and pharmacy professions	260 (5.2)	0.88 (0.60 to 1.32)	2.96 (1.37 to 6.38)	0.64 (0.40 to 1.03)
Agriculture and forestry workers	109 (2.2)	1.38 (0.79 to 2.41)	1.58 (0.78 to 3.19)	1.11 (0.42 to 2.96)
Wood workers	72 (1.4)	0.79 (0.33 to 1.87)	0.70 (0.27 to 1.82)	7.27 (0.44 to 121)
Bakery workers	30 (0.6)	1.23 (0.42 to 3.61)	1.51 (0.33 to 6.98)	1.03 (0.23 to 4.72)
Food and tobacco processors	112 (2.2)	0.93 (0.49 to 1.78)	1.50 (0.65 to 3.48)	0.55 (0.19 to 1.56)
Metal making and treating	48 (1.0)	0.86 (0.31 to 2.51)	0.92 (0.31 to 2.68)	NA
Other metal workers	205 (4.1)	0.32 (0.15 to 0.70)	0.31 (0.13 to 0.73)	0.46 (0.06 to 3.58)
Electrical processors	128 (2.6)	1.22 (0.69 to 2.16)	1.12 (0.59 to 2.13)	2.73 (0.71 to 10.5)
Textile, leather and fur	50 (1.0)	1.77 (0.83 to 3.74)	0.76 (0.10 to 6.03)	2.12 (0.93 to 4.87)
Printing workers	43 (0.9)	1.17 (0.45 to 3.06)	1.87 (0.68 to 5.13)	NA
Construction and mining	188 (3.8)	0.96 (0.57 to 1.64)	0.96 (0.55 to 1.68)	NA
Drivers	175 (3.5)	1.06 (0.62 to 1.80)	1.07 (0.61 to 1.88)	0.96 (0.11 to 8.81)
Others‡	382 (7.6)	–	–	–

NA, not applicable due to small numbers.

Odds ratio with 95% CI adjusted for country, age at first survey, smoking, parental allergies and level of education.

*OR (95% CI) additionally adjusted for gender.

†Subjects might have held more than one job, therefore, numbers do not add up to 100%.

‡Others: occupational groups with fewer than 30 subjects (chemical technicians, plastic and rubber workers, chemical processors, welders and flame cutters, spray painters, paper, glass and ceramic workers) and groups with mixed exposures (remainder transport and storage, remainder blue collar, not classifiable). Odds ratios not calculated due to mixture of different exposures.

rhinitis or perennial rhinitis. Stratifying for sensitisation to common allergens did not change the results (data not shown). Combining the outcome definition as having either allergic rhinitis or perennial rhinitis did not affect the results (data not shown).

DISCUSSION

Principal findings

Within this population-based cohort study among subjects aged 28–57 years at follow-up, the cumulative incidence of allergic and perennial rhinitis was high. Overall, the associations

Table 4 Associations between occupational group and perennial rhinitis for subjects with neither symptoms of allergic rhinitis nor asthma at baseline.

	n (%)	Odds ratio (95% CI)		
		Total* (n = 4853)	Men (n = 2413)	Women (n = 2440)
During follow-up always employed as:				
Office worker (ref)	2762 (56.9)	1	1	1
During follow-up ever employed as:†				
Cleaners and caretakers	291 (6.0)	1.43 (0.99 to 2.06)	0.99 (0.49 to 2.02)	1.70 (1.09 to 2.64)
Hairdressers, barber, beautician and related	35 (0.7)	0.57 (0.13 to 2.42)	NA	0.70 (0.16 to 3.08)
Nurses	190 (3.9)	1.08 (0.67 to 1.73)	0.96 (0.28 to 3.30)	1.14 (0.68 to 1.92)
Other medical and pharmacy professions	248 (5.1)	1.05 (0.69 to 1.61)	1.46 (0.62 to 3.47)	0.95 (0.58 to 1.55)
Agriculture and forestry workers	108 (2.2)	0.88 (0.47 to 1.65)	0.97 (0.47 to 2.04)	0.77 (0.22 to 2.66)
Wood workers	69 (1.4)	1.12 (0.55 to 2.27)	1.10 (0.52 to 2.31)	11.2 (0.65 to 192)
Bakery workers	28 (0.6)	1.91 (0.73 to 5.02)	3.46 (1.02 to 11.8)	0.89 (0.18 to 4.59)
Food and tobacco processors	112 (2.2)	0.66 (0.32 to 1.35)	0.28 (0.07 to 1.19)	1.14 (0.48 to 2.69)
Metal making and treating	48 (1.0)	0.48 (0.14 to 1.63)	0.55 (0.16 to 1.87)	NA
Other metal workers	200 (4.1)	0.76 (0.45 to 1.27)	0.87 (0.50 to 1.51)	0.54 (0.07 to 4.47)
Electrical processors	126 (2.6)	0.99 (0.55 to 1.79)	1.11 (0.61 to 2.03)	NA
Textile, leather and fur	50 (1.0)	0.50 (0.15 to 1.65)	0.70 (0.09 to 5.59)	0.41 (0.09 to 1.79)
Printing workers	41 (0.8)	1.51 (0.61 to 3.74)	1.83 (0.67 to 5.01)	0.96 (0.10 to 9.11)
Construction and mining	183 (3.8)	0.76 (0.44 to 1.30)	0.86 (0.49 to 1.51)	NA
Drivers	169 (3.5)	0.84 (0.50 to 1.42)	0.91 (0.52 to 1.56)	1.28 (0.14 to 11.7)
Others‡	376 (7.7)	–	–	–

NA, not applicable due to small numbers.

Odds ratio with 95% CI adjusted for country, age at first survey, smoking, parental allergies and level of education.

*OR (95% CI) additionally adjusted for gender.

†Subjects might have held more than one job, therefore, numbers do not add up to 100%.

‡Others: occupational groups with fewer than 30 subjects (chemical technicians, plastic and rubber workers, chemical processors, welders and flame cutters, spray painters, paper, glass and ceramic workers) and groups with mixed exposures (remainder transport and storage, remainder blue collar, not classifiable). Odds ratios not calculated due to mixture of different exposures.

between occupational exposures and occupational groups were weak indicating that health-based selection out of exposed jobs might have occurred before first survey. Significantly increased odds ratios were seen for cleaners (perennial rhinitis) and male medical professionals (allergic rhinitis).

Strengths and weaknesses of the study

The strengths of our study include the prospective design, the large population-based sample from different countries, and the detailed job history for the time period between the two surveys.

Two outcome definitions of rhinitis have been used. Compared with perennial rhinitis, self-reported allergic rhinitis might more often be related to a physician diagnosis of allergic rhinitis and therefore be more specific. Although around 65% of subjects with rhinitis at both surveys were found to have positive specific IgE to at least one of the four allergens tested, only 30% of those with new onset of rhinitis were sensitised against common allergens. This might be related to a greater risk in adults with later onset of rhinitis of developing a “non-allergic” form of the disease. Another possibility might be that rhinitis with later onset in adulthood is associated with sensitisation to less common allergens, such as occupational allergens, which were not tested here. Restricting the analyses to those sensitised did not change the results substantially (data not shown).

As data on allergic rhinitis were available at baseline and at follow-up, we were able to assess the cumulative incidence of allergic rhinitis. In addition to the analyses presented in this paper, survival analyses were done and the net change in symptoms was calculated for allergic rhinitis. However, results did not change considerably (data not shown). In addition, cross-sectional analyses and analyses including only those who started employment between baseline and follow-up studies have been conducted. Results of these analyses were consistent with the findings presented in this paper (data not shown).

In contrast, the definition of perennial rhinitis was based on unspecific nasal symptoms that occur all year round. We used a stricter definition than suggested by the ARIA group for persistent rhinitis¹⁸ because allergic or irritant rhinitis from workplace exposures is expected to mostly result in perennial symptoms. In addition to a potentially lower specificity, the drawback of this definition is that the questionnaire items were only included in the follow-up survey. Therefore, we cannot be sure that only incident cases were taken into account.

We have to allow for the large number of statistical tests done. Therefore, the associations seen in our study might be mainly due to chance. Another drawback of our study is the low number of subjects in many of the job categories. This may have reduced the statistical power to detect associations between certain potentially relevant occupations and rhinitis. Occupational rhinitis is thought to start early after the beginning of exposure.⁷⁻⁹ Therefore, symptoms of rhinitis as a result of occupational exposures might already have occurred in many subjects at the time of the first survey. As we studied new onset of symptoms in later adulthood, associations reported here are either the result of a longer duration of exposure or occurred in subjects who changed job or started exposure between the first and second survey.

The latter might be one reason for the increased risk of allergic rhinitis in male medical professionals. About one quarter of the male medical professionals worked as a dentist or veterinarian at the second survey while only 4% of the female medical professionals did. Due to their long training their

Main messages

- ▶ New onset of rhinitis is common in adults.
- ▶ Only weak associations between profession and new onset of rhinitis could be shown.
- ▶ A health-based selection might have taken place before the study.

Policy implication

- ▶ Studies on the impact of occupation on rhinitis at the population level should start early on in occupational life.

exposure started later on and they might thus develop symptoms later in life. Earlier studies have indicated a high prevalence of allergic rhinitis in veterinarians^{19, 20} and dentists.^{21, 22} Because of the long training required for these jobs physicians and veterinarians might also be reluctant to change jobs because of symptoms. Finally, due to their training medical professionals might be more likely to report symptoms of allergic rhinitis. This is supported by the finding that the cumulative incidence of rhinitis was higher in subjects with a high level of education.

Our finding that cleaners are at increased risk of rhinitis confirms cross-sectional data from Hellgren and colleagues¹⁰ and is in line with recent studies on occupational asthma and chronic obstructive pulmonary disease, especially among female domestic cleaners.²³ Likewise, an increased risk of rhinitis among bakers is well established.^{7, 24-27} The low prevalence of new onset of symptoms among nurses might be attributed to a reduction of latex exposure in hospitals²⁸ in certain countries of the study or an onset of symptoms before the first survey.

Conclusions and implications for further research

In conclusion, our study indicates an increased risk of new onset of rhinitis during adulthood for certain occupations and exposures. The negative findings for other professions and exposures might partly be due to an early onset of symptoms. Overall, even in large population-based cohort studies it is difficult to identify associations between occupational exposures and multifactorial diseases like rhinitis. In order to assess the impact of occupation on new onset of rhinitis on a population level, population-based cohort studies are warranted starting at the beginning of working life.

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