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Respiratory symptoms and occupation: a cross-sectional study of the general population

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Abstract

Background: This study focused on respiratory symptoms due to occupational exposures in a contemporary general population cohort. Subjects were from the Dutch Monitoring Project on Risk Factors for Chronic Diseases (MORGEN). The composition of this population enabled estimation of respiratory risks due to occupation from the recent past for both men and women.

Methods: The study subjects (aged 20–59) were all inhabitants of Doetinchem, a small industrial town, and came from a survey of a random sample of 1104 persons conducted in 1993. A total of 274 cases with respiratory symptoms (subdivided in asthma and bronchitis symptoms) and 274 controls without symptoms were matched for age and sex. Relations between industry and occupation and respiratory symptoms were explored and adjusted for smoking habits and social economic status.

Results: Employment in the 'construction' (OR = 3.38; 95%CI 1.02 – 11.27), 'metal' (OR = 3.17; 95%CI 0. 98 – 10.28), 'rubber, plastics and synthetics' (OR = 6.52; 95%CI 1.26 – 53.80), and 'printing' industry (OR = 3.96; 95%CI 0.85 – 18.48) were positively associated with chronic bronchitis symptoms. In addition, the 'metal' industry was found to be weakly associated with asthma symptoms (OR = 2.59; 95%CI 0.87 – 7.69). Duration of employment within these industries was also positively associated with respiratory symptoms.

Conclusion: Respiratory symptoms in the general population are traceable to employment in particular industries even in a contemporary cohort with relatively young individuals.

Introduction

Respiratory diseases such as asthma, bronchitis and emphysema form a major health problem in the general population in many western countries [1,2]. The evidence that these diseases are caused by exogenous factors other than tobacco smoke, and that occupational exposures are amongst these causes, is growing [3]. As the working population smokes less, the relative importance of occupational exposures causing respiratory diseases is likely to increase. The contribution of occupational exposure to respiratory diseases has been estimated at 11–19% for males and 4–5% for females [1,2,4,5].

The relationships between occupation and occupational exposures and respiratory symptoms in community-based studies have been studied since the late 1970s. In many of

these general population studies, an association with exposure to dust, gases and fumes has been found with odds ratios ranging from 1.3 to 2.5 for exposed versus non-exposed workers [4–14]. However, working conditions are continually changing, as are the characteristics of the workforce itself. Therefore, it is questionable whether the known results of the older population-based studies reflect the respiratory health risks in contemporary workforces. Hence, recent population based studies have shown that some not previously identified occupations and occupational exposures are possibly associated with asthma [2,5,15–17].

The aim of this study was to investigate relations between occupations and respiratory symptoms in a cross sectional study of the general population. The composition of the population, both male and female and its relatively young age could provide information on respiratory health risks due to occupational exposures from the present and recent past.

Material and methods

Data were collected as part of the Monitoring Project on Risk Factors for Chronic Diseases (MORGEN-Study). Its general purpose is to determine the prevalence of risk factors for chronic diseases as well as the prevalence of some specific chronic conditions in a general population sample.

Subjects

The present study is a nested case control study of the population of Doetinchem, one of the three cities included in the MORGEN study. Doetinchem is an old industrial town in the eastern part of the Netherlands with about 38,000 inhabitants.

A sample of 1104 subjects, aged 20–59 years were included. The study population originates from a random sample of the inhabitants of Doetinchem stratified by aged and sex drawn in 1987 who participated in an earlier survey (n = 1780). No inclusion or exclusion criteria were applied in the present study, but because a more extensive protocol had to be followed not everybody could be re-invited. Therefore a random sample of 1383 of this original study population was invited to participate in the present study. Of those, 1104 agreed to participate (response 80%). These subjects were asked to complete a self-administered shortened questionnaire on respiratory symptoms. The questionnaire contained also information on present smoking habits, socio-economic status (SES) and sectors of industry and occupation in which a respondent worked for more than one year. Asthma was defined as a positive answer to at least one of the following questions: 'Have you had an attack of shortness of breath while wheezing at any time in the last 12 months', 'Have you ever had an attack of asthma?'. Bronchitis was defined as a positive answer to at least one of the following questions: 'Do you cough daily for more than three months a year?', 'Do you bring up phlegm daily for more than three months a year?', 'Have you had episodes in the last three years in which you coughed and brought up phlegm which lasted for more than three weeks?', and 'Have you had attacks of shortness of breath while walking on a flat terrain at normal speed with other people?'.

A total of 274 subjects (24.8%) who reported one or more asthma or bronchitis related symptoms in the shortened questionnaire on respiratory symptoms were selected from the original sample (symptomatic). As controls, 274 subjects were selected among the 688 subjects, who reported no respiratory symptoms at all (asymptomatic) and were frequency matched for age (+/- 1 year) and sex at group level. The symptomatic sub sample was subsequently subdivided into two groups with symptoms of bronchitis (including chronic cough and chronic phlegm and shortness of breath) and asthma (including ever asthma, and wheezing), respectively.

Coding of industry and occupation

Information on type of industry (2-digits) and occupation (3-digits) was coded blindly by one of the authors (RV) based on the coding scheme by Hoar et al. [18]. When a specific company name was mentioned in the self-administered questionnaire additional information was gathered to confirm the classification of this industry from the local occupational health service, Chamber of Commerce and the local authorities.

Statistical analysis

The relation between occupation, based both on the complete occupational history and longest held occupation, and asthma and bronchitis symptoms was initially studied bivariately using the Cochran-Mantzel-Haenszel test. Associations between respiratory symptoms as outcome variables and risk factors such as 'industry', and 'occupation' were further investigated by means of multiple logistic regression analysis adjusting for SES and smoking. In the regression analyses the prevalence of respiratory symptoms of subjects who ever worked in a particular industry was contrasted to the prevalence of respiratory symptoms of subjects with exclusive employment in the category "occupations with few chemical exposures" (n = 97). This group comprises occupations such as business, law, communications, sales, etc. Smokers were categorised as never, ex and current smokers. SES was measured as a variable with three categories (high, intermediate and low) based on the status of the occupation of the subject. Analyses that involved only a part of the population and consequently departed from the matching criteria were also adjusted for age and sex.

Table 1: General characteristics of the study population (n = 547)

		SYMPTOMATIC GROUP (n = 273)		ASYMPTOMATIC GROUP (n = 274)	
		n	%	n	%
Smoking	never	70	25.6	100	36.5
	current	120	44.0	62	22.6
	ex	83	30.4	112	40.9
SES	low	174	63.7	156	56.9
	intermediate	57	20.8	54	19.7
	high	42	15.4	64	23.1
Sex	male	128	46.9	129	47.1
	female	145	53.1	145	52.9
Age	years (s.d.)	48.1 (10.4)		48.2 (10.5)	
Job duration	years (s.d.)	20.5 (12.1)		21 (12.0)	

Results

Table 1 gives an overview of the general characteristics of the study population for the symptomatic and asymptomatic group. Of the 548 cases and controls, 547 subjects reported a complete occupational history. One person refused to report his occupational history and was therefore excluded from the analyses. The population consisted of 47% men and 53% women. Of men and women, 38.5% and 28.6%, respectively, were current smokers and 38.5% and 33.1% were former smokers at the time of the survey. Of the 547 participants only 20 (3.7%) subjects never had a job. The mean number of jobs held by the subjects was 2.5 in 1.7 sectors of industry over an average working life of 20.8 (s.d. 12.0) years.

Table 2 shows the distribution of the population over the different sectors of industry for the complete job history and the longest held occupation. The distribution over the sectors of industry was very similar for the complete job history and the longest held job. Initial exploratory analyses were based on the longest held occupation (Table 3). Increased risks for bronchitis symptoms were observed for the 'construction' (OR = 3.38; 95% CI 1.02 – 11.27), 'metal' (OR = 3.17; 95% CI 0.98 – 10.28), 'rubber, plastics and synthetics' (OR = 6.52; 95% CI 1.26 – 53.80), and 'printing' industry (OR = 3.96; 95% CI 0.85 – 18.48). The 'metal' industry was also weakly associated with asthma symptoms (OR = 2.95; 95% CI 0.77 – 11.23).

For the industries with statistically significant associations with bronchitis and or asthma symptoms ($p < 0.10$), the regression analyses were repeated based on the total occupational histories with the inclusion of time-related variables such as duration and time since first employment. The median of the duration and time since first employment within a particular industry was used as cut-off point as no reasonable assumption could be made for the latency of chronic respiratory symptoms due to the diverse exposures in these industries. In the 'metal' and 'rubber, plastics and synthetics' industry the odds ratios increased significantly with increasing duration of employment (table 4). The results for the 'construction' and 'printing' industry were less pronounced but showed overall a similar pattern with increased risks with increasing duration of employment, however statistical significance was not reached. Time since first employment showed similar trends as observed with duration of employment with increased risks for more distant jobs (i.e., exposures). However, overall relations were less clear as those observed with the duration of employment indicating that the observed risks are most likely driven by the duration of exposure (i.e., cumulative exposure) and less by historical exposure levels or situations.

Discussion

Working in certain industries was positively associated with the occurrence of bronchitis and/or asthma symptoms. High-risk industries were the 'construction', 'rubber, plastics and synthetics products', 'metal', and 'printing' industry. The construction industry was found mainly to be associated with bronchitis-like symptoms. Other population-based studies have previously reported similar associations [9–11] with exposure to dust, silica, asbestos and (man-made) mineral fibres as well-known risk factors [20]. In the 'rubber, plastics and other synthetic products' industry, a significant elevated risk for asthma and bronchitis symptoms was found. The relation between working in the rubber industry and the occurrence of respiratory symptoms has been reported in several industry-specific studies [20–24] and in two population-based studies [2,5,15]. Interestingly, the majority of the study subjects were employed in one rubber bicycle tire

Table 2: Distribution of the symptomatic and asymptomatic population by industry based on total and longest held occupation.

	Complete occupational history			Longest held occupation		
Industry	Symptomatic (n)	Asymptomatic (n)	Total[1](%)	Symptomatic (n)	Asymptomatic (n)	Total[2](%)
Agriculture, forestry, fishing	13	18	3.3	4	8	2.2
Construction	25	17	4.4	18	10	5.1
Paper and wood	19	27	4.9	9	12	3.8
Glass, clay and stone	7	2	1.0	3	0	0.5
Metal	35	22	6.0	19	8	4.9
Machinery	25	24	5.2	14	15	5.3
Shipbuilding, motor vehicles, aircraft and other transportation methods	22	24	4.9	7	9	2.9
Food and tobacco	45	40	9.0	18	16	6.2
Textiles	33	32	6.9	18	18	6.6
Chemicals, drugs and paints	9	11	2.1	3	7	1.8
Rubber, plastics and synthetics	16	9	2.6	7	3	1.8
Fuel	3	6	1.0	2	3	0.9
Leather	7	8	1.6	3	4	1.3
Medicine and science	42	59	10.7	36	40	13.9
Entertainment and recreation	10	11	2.2	7	6	2.4
Printing	22	11	3.5	10	4	2.6
Occupations with few chemical exposures	126	147	28.8	81	101	33.3
Never employed	10	10	2.1	10	10	3.7

[1] calculated as proportion of the total number of jobs (n = 957); [2] calculated as proportion of the total number of longest held occupations (n = 547)

factory. This factory was also involved in a large-scale exposure assessment study of the rubber manufacturing industry at the end of the 1980's [25]. At that time, a mean inhalable dust concentration of 1.5 mg/m^3 was measured in this particular factory. Moreover, exposure to inhalable dust within the inner tube department and among technical services personnel was excessive at mean concentrations of 17.3 mg/m^3 and 4.2 mg/m^3, respectively. These high dust exposures were mainly caused by intensive use of talcum in the production process to prevent tacking of uncured profiles.

Working in the metal industry was also positively associated with the occurrence of asthma- and bronchitis-like symptoms. The relation between working in the metal industry and presence of respiratory symptoms has been reported frequently as a result of exposure to silica and metal dust, metal fumes, welding fumes and isocyanates [26–30]. In addition, a relation was found between working in the 'printing industry' and bronchitis like symptoms. Only a few studies have reported an increased risk for respiratory symptoms in this particular industry [11,31] and although exposures to irritative solvents and paper dust may occur it is unclear what the main risk factors are within this particular industry.

In industries with an elevated risk for respiratory symptoms, subjects occupationally exposed for a longer period or exposed a longer time ago, showed a higher risk for developing asthma and/or bronchitis symptoms. This was most clearly observed for the 'metal' and 'rubber, plastics and synthetics' industry. For the 'construction' industry this association was not detected, but additional analyses with cut-off points for the duration of employment of 5 and 10 years showed a more distinct difference between subjects longer employed with shorter employed subjects, although statistical significance was not reached (data not shown).

The prevalence of chronic respiratory symptoms (symptomatics) in this population was quite similar for males and females (128/512 = 0.25 and 145/592 = 0.24, respectively). However, the industries at high risk for asthma and bronchitis symptoms included only a small proportion of females. Stratified analyses by sex showed that the risks found for these industries could be attributed to males

Table 3: Relationships between asthma, and bronchitis symptoms and longest held occupation in a particular industry adjusted for age, sex, smoking and SES expressed as Odds Ratios (OR) with 95% confidence interval in parenthesis (95% CI) [1].

Industry	Asthma symptoms OR (95% CI)	Bronchitis symptoms OR (95% CI)
Agriculture, forestry, fishing	0.24 (0.07 – 2.38)	0.58 (0.14 – 2.43)
Construction	1.27 (0.28 – 5.81)	3.38 (1.02 – 11.27)*
Paper and wood	1.01 (0.28 – 3.67)	0.78 (0.24 – 2.57)
Glass, clay and stone	NC	NC
Metal	2.95 (0.77 – 11.23)#	3.17 (0.98 – 10.28)#
Machinery	0.99 (0.25 – 3.94)	1.58 (0.52 – 4.86)
Shipbuilding, motor vehicles, aircraft and other transportation methods	0.45 (0.08 – 2.53)	0.70 (0.20 – 2.40)
Food and tobacco	0.79 (0.24 – 2.55)	1.08 (0.41 – 2.84)
Textiles	0.51 (0.14 – 1.78)	1.02 (0.40 – 2.60)
Chemicals, drugs and paints	0.41 (0.04 – 4.03)	0.57 (0.12 – 2.64)
Rubber, plastics and synthetics	4.44 (0.69 – 28.59)	6.52 (1.26 – 53.80)*
Fuel	1.01 (0.08 – 13.19)	1.11 (0.14 – 9.07)
Leather	1.08 (0.17 – 7.04)	0.51 (0.08 – 3.35)
Medicine and science	0.81 (0.31 – 2.08)	0.73 (0.35 – 1.52)
Entertainment and recreation	0.82 (0.16 – 4.25)	1.26 (0.32 – 4.96)
Printing	1.30 (0.15 – 11.32)	3.96 (0.85 – 18.48) #

0.05<p 0.10 * p 0.05; [1] Compared to reference category "occupations with few chemical exposures" (n = 97) NC Not calculated due to limited number of subjects within this category

Table 4: Relationships between duration and time since first employment and asthma, and bronchitis symptoms adjusted for age, sex, smoking and SES expressed as Odds Ratios (OR) with 95% confidence interval in parenthesis (95% CI) [1].

Industry	Classification	Asthma symptoms OR (95% CI)	Bronchitis symptoms OR (95% CI)
Construction	Duration ≤ 20 yrs	0.75 (0.15–3.75)	1.84 (0.56–6.55)
	Duration >20 yrs	1.43 (0.34–6.09)	2.25 (0.69–7.38)
	Time since first employment ≤18 yrs	0.71 (0.15–3.34)	1.56 (0.47–5.23)
	Time since first employment >18 yrs	1.65 (0.36–7.52)	2.86 (0.78–10.51)
Metal	Duration ≤ 6 yrs	0.65 (0.18–2.40)	0.53 (0.18–1.59)
	Duration >6 yrs	3.85 (0.98–15.13)#	5.28 (1.53–18.25)**
	Time since first employment ≤ 20 yrs	0.95 (0.25–3.66)	0.80 (0.25–2.55)
	Time since first employment >20 yrs	2.03 (0.55–7.55)	2.54 (0.80–8.05)
Rubber, plastics, and synthetics	Duration ≤ 9 yrs	2.01 (0.31–13.21)	1.57 (0.28–8.98)
	Duration >9 yrs	5.81 (1.13–29.78)*	6.40 (1.51–27.20)*
	Time since first employment ≤ 23 yrs	3.71 (0.74–8.61)	2.92 (0.65–13.14)
	Time since first employment >23 yrs	3.80 (0.36–25.73)	5.21 (1.02–26.51)
Printing	Duration ≤ 4 yrs	1.14 (0.23–5.38)	1.47 (0.44–4.96)
	Duration >4 yrs	1.17 (0.19–7.11)	2.38 (0.62–9.05)
	Time since first employment ≤ 16 yrs	0.83 (0.14–5.11)	1.44 (0.38–5.50)
	Time since first employment >16 yrs	1.57 (0.27–8.95)	2.66 (0.76–9.27)

0.05<p 0.10 * 0.01<p 0.05 ** p 0.01; [1] Compared to reference category "occupations with few chemical exposures" (n = 97)

and not to females, probably caused by differences in actual jobs performed by males and females within these industries, production and administration, respectively. Another possible explanation lies in the fact that working in a particular industry was contrasted with 'Occupations with few chemical exposures'. This control group includes housewives who were recently shown to have a higher risk for developing asthma [2,5,33]. This may have masked possible other relations.

Although individuals from this population smoked less often than was common in the 1960s and 1970s, smoking remains an important risk factor. Adjusting for smoking (both pack years and current, never, ex smokers), age, sex and SES in this study had in general a minimal effect on

the risk estimates for industries and occupational exposures, suggesting that the observed effects could be related primarily to differences in industry or occupational exposures and that confounding by smoking was probably minimal.

The results of this epidemiological study indicate that, although the study population is relatively young, strong associations are present between certain occupations and asthma and bronchitis symptoms. It can be concluded that more detailed studies in the general population are needed and would be worthwhile to determine more precise attributable risks. These studies should include better exposure assessment strategies with an increased focus on women's occupational exposures as the risk factors for developing respiratory complaints in women due to occupational exposures remain unclear. It is concluded that respiratory symptoms in the general population are traceable to employment in particular industries even in a contemporary cohort with relatively young individuals.

Competing interests

None declared.

Authors' contributions

Roel Vermeulen performed the study, performed the statistical analyses and wrote the manuscript. Hans Kromhout and Dick Heederik participated in the study design and took part in the statistical analyses. Henriëtte Smit, principal investigator of the MORGEN study, took part in all phases of the study design and analyses. All authors contributed to and approved the final version of the manuscript.

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