

Socioeconomic and occupational groups and risk of asthma in Sweden

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Aim	To investigate possible associations between hospitalization for asthma and socioeconomic status and occupation.
Methods	A nationwide database was constructed by linking Swedish Census data to the Hospital Discharge Register (1987–2004). The hospital diagnoses of asthma were based on the International Classification of Diseases. Standardized incidence ratios were calculated for different socioeconomic and occupational groups. Ninety-five per cent confidence intervals were calculated assuming a Poisson distribution.
Results	A total of 13 202 male and 11 876 female hospitalizations for asthma were retrieved at ages >30 years. The socioeconomic groups with <9 years of education were associated with a significantly increased risk of hospitalization for asthma. Among male occupations, increased risks were noted for farmers, mechanics and iron and metal workers, welders, bricklayers, workers in food manufacture, packers, loaders and warehouse workers, waiters and chimney sweeps with prolonged exposures in two censuses. For female occupations, increased risks were observed among assistant nurses, religious, juridical and other social science-related workers, drivers, mechanics and iron and metalware workers and wood workers.
Conclusions	The present study suggests that socioeconomic status (low educational level) and occupation have an effect on the population's risk of hospitalization for asthma.
Key words	Asthma; follow-up study; occupational exposure; socioeconomic status.

Introduction

There is a growing body of evidence implicating socioeconomic status as a risk factor for asthma in adults [1–6]. Socioeconomic factors may increase the risk of the disease in many ways. For example, exposure to harmful agents may be related to occupational, residential and lifestyle factors, which may depend on social class [1]. Some epidemiological studies have investigated the relationships between long-term occupational exposures and risk of asthma [7–13]. However, most of those studies used prevalent cases and relied on self-reports for exposure assessments, and thus the studies are potentially skewed due to survival and recall bias. Due to the lack of large-scale follow-up studies of the possible associations between asthma and socioeconomic status or occupation, we conducted a follow-up study of the entire economi-

cally active Swedish population. The aim of this study was to investigate the association between socioeconomic status (education), occupation and hospitalization for asthma among men and women >30 years of age.

Methods

Data used in this study were retrieved from the MigMed database, located at the Centre for Family and Community Medicine at the Karolinska Institute in Stockholm. MigMed is a single, comprehensive database that contains individual-level information on all people in Sweden, including age, sex, occupation, geographic region of residence, hospital diagnoses and dates of hospital admissions in Sweden, date of emigration and date and cause of death. This unique database was constructed using several national Swedish data registers including, but not limited to, Census data (1960–90), the Total Population Register and the Swedish Hospital Discharge Register [14,15].

Individuals in the MigMed database were allocated to at least one of four census cohorts (1990, 1980, 1970 and

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1960), based on their occupation at the time of the census. In addition, we identified persons who had the same occupation in two (1960–70 or 1970–80) censuses. The aim was to ensure that the person's occupation had not changed and that the risk estimates were constant in two censuses.

Information retrieved from the various registers in the MigMed database was linked at the individual level via the national 10-digit registration number assigned to each person in Sweden for his or her lifetime. Prior to inclusion in the MigMed database, national registration numbers were replaced by serial numbers to ensure the anonymity of all individuals. In addition to using the serial numbers to track all records in the database at the individual level, these numbers were used to check that individuals with hospital diagnoses of asthma appeared once in the data set for their first hospital diagnosis of asthma during the study period.

First hospitalizations for asthma during the study period were retrieved from the Hospital Discharge Register (1987–2004). This register naturally does not include hospital outpatients or health care centre patients. The diagnosis of asthma was based on the International Classification of Diseases. The 9th version was used between 1987 and 1996 (code 493), and the 10th version between 1997 and 2004 (code J45 and J46).

The individual variables are listed below.

'Gender': Male and female.

'Age' at diagnosis was categorized in 5-year groups >30 years. We only included individuals >30 years of age because many people do not have a stable occupation at younger ages.

Individuals were allocated to different occupational groups according to their occupational title as recorded in the Swedish censuses in 1960 (men) and 1970 (women). The later census was used for women because substantially more women were active in the labour market in 1970 than in 1960. In addition, for selected occupations, risks were analysed among individuals who had the same occupational title in two consecutive censuses, i.e. 1960 and 1970 for men and 1970 and 1980 for women.

'Occupation' was coded according to national adaptations of the Nordic Occupational Classification (NYK). The NYK is a common Nordic adaptation of the International Standard Classification of Occupations from 1958. Three-digit codes were combined into 53 NYK occupational groups and one economically inactive group [16]. Occupational groups were combined based on similarities. People without paid employment were excluded.

'Socioeconomic status' was based on educational level and categorized into three groups: ≤ 9 years, 10–12 years and >12 years. Educational level was chosen as a marker for socioeconomic status, because education could be regarded as a stable measure of socioeconomic status.

'Geographic region' was defined as (i) large cities (cities with a population of more than 200 000, i.e. Stockholm, Gothenburg and Malmö), (ii) Southern Sweden and (iii) Northern Sweden. Large cities were defined in a separate category because it is likely that individuals living in large cities have better access to health care. In addition, they are more exposed to air pollution. Sweden is divided into 25 counties. The border between Northern and Southern Sweden has traditionally been drawn at the Dalälven River, which was used to define the geographic boundaries between Southern and Northern Sweden. Geographic region was included as an individual variable to adjust for possible differences between geographic regions in Sweden regarding hospital admissions for asthma.

Person-years were calculated from the start of follow-up on 1 January 1987 and continued until hospitalization for asthma, death, emigration or the end of the study period on 31 December 2004. Information on hospitalizations prior to 1 January 1987 was not available. For continuous census analysis, the follow-up was started at immigration or on January 1 following the last included census, i.e. 1970 or 1980. Age-specific incidence rates were calculated for the whole follow-up period, divided into five 5-year periods. Standardized incidence ratios (SIRs) were calculated for different socioeconomic and occupational groups as the ratio of the observed to the expected number of cases [17]. The expected number of cases was based on the actual number of cases in the corresponding cohort of all economically active individuals and was calculated for age (5-year groups), sex, period (5-year groups), region and socioeconomic status. Ninety-five per cent confidence intervals were calculated assuming a Poisson distribution [17].

This study was approved by the Ethics Committee of the Karolinska Institute, Stockholm, Sweden.

Results

There were a total of 13 202 male and 11 876 female first hospitalizations for asthma during the study period. Table 1 shows the SIRs of hospitalization for asthma by socioeconomic status (level of education) and geographical regions of residence. Statistically significant differences appeared between some socioeconomic groups and the reference group. For example, men and women with a high level of education were less likely to be hospitalized for asthma than the reference group. People living in Northern Sweden had an increased risk of hospitalization for asthma.

Table 2 shows the SIRs by occupation after adjustment for age, period, region and socioeconomic status. Data are shown if more than 15 cases were identified in the occupational group recorded in the census. Significant risk was found for male waiters (1.80), chimney sweeps

Table 1. SIRs for hospitalization for asthma by educational level and geographical region among men and women

Education/region	Men				Women			
	O	SIR	95% CI		O	SIR	95% CI	
Education								
<9 years	11 432	1.03	1.01	1.05	8570	1.05	1.03	1.08
9–12 years	1383	0.94	0.89	0.99	2574	1.00	0.96	1.04
>12 years	387	0.63	0.57	0.70	732	0.63	0.59	0.68
Region								
Big cities	3880	0.92	0.89	0.95	4330	0.99	0.96	1.02
Northern Sweden	2690	1.08	1.04	1.12	2200	1.13	1.08	1.17
Southern Sweden	6632	1.02	1.00	1.05	5346	0.96	0.94	0.99
All	13 202	1.00	Reference		11 876	1.00	Reference	

O = observed. Bold type: 95% CI does not include 1.00.

(1.80), cooks and stewards (1.76), shoe and leather workers (1.34), bricklayers (1.28), miners and quarry workers (1.24), smelters and metal foundry workers (1.21), workers in food manufacture (1.19), packers, loaders and warehouse workers (1.18), welders (1.16), other construction workers (1.15), farmers (1.14), engine and motor operators (1.14) and drivers (1.09). For women, smelters and metal foundry workers (1.59), public safety and protection workers (1.54), engine and motor operators (1.49), mechanics and iron and metalware workers (1.43), drivers (1.38), chemical process workers (1.31), cooks and stewards (1.24), waiters (1.16), building caretakers and cleaners (1.13), assistant nurses (1.13) and home helpers (1.08) had a significantly higher risk of hospitalization for asthma than the reference group.

Table 3 shows the SIRs for hospitalization for asthma in men and women who had the same occupational title in two consecutive censuses, after adjustments for age, period, region and socioeconomic status. Male building caretakers and cleaners (2.08), chimney sweeps (1.99), bricklayers (1.46), welders (1.35), workers in food manufacture (1.29), farmers (1.26), packers, loaders and warehouse workers (1.21) and mechanics and iron and metalware workers (1.08) had a significantly higher risk of hospitalization for asthma than the reference group. Female wood workers (2.01), drivers (1.86), mechanics and iron and metal workers (1.51), religious, juridical and other social science-related workers (1.28) and assistant nurses (1.24) had a significantly higher risk of hospitalization for asthma than the reference group.

Discussion

The main findings of this study were that socioeconomic status (education) and occupation carried significantly increased or decreased risks of hospitalization for asthma. For example, for the male and female occupations mentioned in Table 2 and Table 3, individuals who had the

same occupational title in these groups had a substantially higher risk of hospitalization for asthma than the reference group. To our knowledge, this is the first large-scale study that has investigated the socioeconomic and occupational risks of hospitalization for asthma.

This study has a number of strengths. Our study population included a well-defined cohort of the entire Swedish population, and because of the national registration number assigned to each individual in Sweden, it was possible to track the records of every person for the whole follow-up period. Data on occupational status were almost 100% (99.2%) complete (1980 and 1990 censuses). Swedish socioeconomic and occupational data derived from the national censuses have been used extensively in the study of cancer [18,19]. In addition, we examined the risks among men and women who had the same occupational title in two consecutive censuses, i.e. a period of at least 10 years. However, it is possible that some jobs are more likely to predispose individuals to the risks and disabilities associated with asthma.

The present study also has several limitations. First, although the national database includes data on the entire Swedish population, it only incorporates information about hospital admissions for asthma. Data on outpatients were not available to us, which is a limitation because most asthma patients are treated as outpatients. It is possible that older persons or those with more severe asthma were more likely to be admitted to hospital. Other factors are also likely to be associated with an increased risk of hospital admission. Examples of such factors are smoking, reduced access to primary health care, reduced awareness and poor understanding about symptoms of the disease, failure to comply with therapy, lack of family support, poor housing and lack of transportation. Thus, the time of first admission for asthma may differ from the time of onset for the disease. The use of hospitalizations to calculate the incidence of asthma as a chronic disorder could therefore have led to an underestimation of the actual incidence of the disease. The nature of these

Table 2. SIRs for hospitalization for asthma in different male and female occupations

Occupation	O	SIR	95% CI		O	SIR	95% CI	
Technical, chemical, physical and biological workers	938	0.82	0.76	0.87	121	0.89	0.74	1.06
Physicians	17	0.43	0.25	0.70	4	0.36	0.09	0.92
Nurses	31	1.00	0.68	1.42	242	0.83	0.73	0.94
Assistant nurses	0				1012	1.13	1.06	1.20
Other health and medical workers	19	0.84	0.51	1.32	153	0.83	0.70	0.97
Teachers	165	0.69	0.59	0.81	389	0.82	0.74	0.91
Religious, juridical and other social science-related workers	97	0.60	0.48	0.73	185	1.13	0.97	1.30
Artistic workers	63	0.96	0.73	1.22	35	0.86	0.60	1.20
Journalists	27	0.94	0.62	1.36	19	0.95	0.57	1.48
Administrators and managers	324	0.77	0.69	0.86	82	0.87	0.69	1.08
Clerical workers	437	0.82	0.74	0.90	2018	0.86	0.83	0.90
Sales agents	657	0.93	0.86	1.01	228	1.07	0.93	1.22
Shop managers and assistants	285	0.88	0.78	0.99	1377	0.97	0.92	1.02
Farmers	1601	1.14	1.09	1.20	392	0.82	0.74	0.90
Gardeners and related workers	212	1.01	0.88	1.16	127	0.81	0.67	0.96
Fishermen, whalers and sealers	32	0.68	0.46	0.96	2	1.08	0.10	3.98
Forestry workers	346	1.03	0.93	1.15	11	1.28	0.63	2.30
Miners and quarry workers	112	1.24	1.02	1.49	3	1.50	0.28	4.44
Seamen	53	1.26	0.94	1.65	0			
Transport workers	137	1.03	0.86	1.21	4	0.64	0.17	1.65
Drivers	1029	1.09	1.02	1.15	112	1.38	1.14	1.66
Postal and communication workers	103	0.69	0.56	0.83	358	1.00	0.90	1.11
Textile workers	166	1.07	0.91	1.25	414	0.94	0.85	1.03
Shoe and leather workers	61	1.34	1.03	1.73	28	0.82	0.54	1.19
Smelters and metal foundry workers	308	1.21	1.08	1.36	32	1.59	1.09	2.25
Mechanics and iron and metalware workers	1301	1.00	0.95	1.06	262	1.43	1.26	1.61
Plumbers	141	0.94	0.79	1.11	0			
Welders	205	1.16	1.01	1.33	5	0.75	0.24	1.77
Electrical workers	411	0.93	0.84	1.03	107	1.09	0.89	1.32
Wood workers	739	1.04	0.96	1.11	52	1.23	0.92	1.61
Painters and wallpaper hangers	233	1.03	0.90	1.17	6	0.72	0.26	1.59
Other construction workers	406	1.15	1.04	1.27	0			
Bricklayers	125	1.28	1.06	1.52	0			
Printers and related workers	119	0.88	0.73	1.05	66	1.04	0.80	1.32
Chemical process workers	179	1.02	0.88	1.18	65	1.31	1.01	1.68
Food manufacture workers	262	1.19	1.05	1.34	147	1.08	0.91	1.27
Glass, ceramic and tile workers	221	1.09	0.96	1.25	161	1.09	0.93	1.27
Packers, loaders and warehouse workers	736	1.18	1.10	1.27	272	1.11	0.98	1.25
Engine and motor operators	345	1.14	1.03	1.27	30	1.49	1.01	2.14
Public safety and protection workers	139	0.88	0.74	1.04	25	1.54	1.00	2.28
Cooks and stewards	21	1.76	1.09	2.69	596	1.24	1.15	1.35
Home helpers	2	5.66	0.53	20.82	941	1.08	1.01	1.15
Waiters	27	1.80	1.18	2.62	358	1.16	1.04	1.28
Building caretakers and cleaners	106	1.18	0.97	1.43	1128	1.13	1.07	1.20
Chimney sweeps	24	1.80	1.15	2.68	0			
Hairdressers	35	0.90	0.63	1.25	118	0.88	0.73	1.05
Launderers and dry cleaners	82	1.19	0.94	1.47	173	1.00	0.86	1.16
Military personnel	100	0.76	0.62	0.92	0			

O = observed. Bold type: 95% CI does not include 1.00.

limitations implies that the increased admission rates in certain occupational groups are not necessarily due to their occupational status.

Second, we had no data on most individual risk factors for hospitalization for asthma. In a register that includes an entire population, it is not feasible to include individual data on weight, height, smoking, drinking and other individual risk factors. However, we adjusted our results

for socioeconomic status and geographical region [20]. In addition, we were not able to test for the validity of asthma diagnoses since our data were based on the entire population. However, we only used main diagnoses for asthma recorded in the hospital registers, i.e. all patients were hospitalized mainly for asthma, which increases the possibility that the asthma diagnoses are valid. However, the inability to test for validity constitutes a bias that is

Table 3. SIRs for hospitalization for asthma in selected occupations for individuals who had the same job title in two consecutive censuses

Occupation	O	SIR	95% CI		O	SIR	95% CI	
Technical, chemical, physical and biological workers	594	0.80	0.73	0.86	59	1.05	0.80	1.35
Physicians	17	0.49	0.29	0.79	4	0.50	0.13	1.28
Nurses	15	0.84	0.47	1.39	146	0.92	0.77	1.08
Assistant nurses	0				467	1.24	1.13	1.35
Other health and medical workers	14	1.16	0.63	1.96	72	0.89	0.70	1.12
Teachers	129	0.74	0.62	0.88	255	0.94	0.83	1.06
Religious, juridical and other social science-related workers	66	0.68	0.52	0.86	80	1.28	1.01	1.59
Artistic workers	30	0.81	0.55	1.16	15	1.00	0.56	1.65
Journalists	20	1.13	0.69	1.75	8	0.94	0.40	1.87
Administrators and managers	154	0.79	0.67	0.93	18	0.86	0.51	1.37
Clerical workers	172	0.83	0.71	0.96	1065	0.93	0.88	0.99
Sales agents	333	0.95	0.85	1.06	39	0.90	0.64	1.24
Shop managers and assistants	89	0.75	0.60	0.92	409	0.91	0.82	1.00
Farmers	969	1.26	1.18	1.34	154	0.91	0.77	1.06
Gardeners and related workers	111	1.14	0.94	1.38	8	0.60	0.26	1.19
Fishermen, whalers and sealers	11	0.45	0.22	0.81	0			
Forestry workers	108	0.94	0.77	1.14	2	1.81	0.17	6.67
Miners and quarry workers	37	1.20	0.85	1.66	0			
Seamen	30	1.35	0.91	1.93	0			
Transport workers	47	1.04	0.76	1.38	0			
Drivers	504	1.05	0.96	1.15	37	1.86	1.31	2.57
Postal and communication workers	60	0.78	0.60	1.01	158	1.09	0.93	1.27
Textile workers	61	0.87	0.66	1.12	87	0.81	0.65	1.00
Shoe and leather workers	18	1.09	0.65	1.73	4	0.64	0.17	1.66
Smelters and metal foundry workers	98	0.98	0.79	1.19	6	1.39	0.50	3.04
Mechanics and iron and metalware workers	690	1.08	1.00	1.16	62	1.51	1.16	1.94
Plumbers	84	0.97	0.77	1.20	0			
Welders	99	1.35	1.10	1.65	0			
Electrical workers	206	0.85	0.74	0.98	29	1.16	0.78	1.67
Wood workers	437	1.06	0.96	1.16	18	2.01	1.19	3.19
Painters and wallpaper hangers	162	1.04	0.89	1.21	0			
Other construction workers	175	1.14	0.98	1.32	0			
Bricklayers	92	1.46	1.17	1.79	0			
Printers and related workers	70	0.85	0.66	1.07	17	0.91	0.53	1.47
Chemical process workers	61	1.02	0.78	1.32	11	1.17	0.58	2.10
Food manufacture workers	131	1.29	1.08	1.53	17	0.72	0.42	1.15
Glass, ceramic and tile workers	64	0.90	0.69	1.15	35	1.14	0.80	1.59
Packers, loaders and warehouse workers	199	1.21	1.05	1.39	40	1.00	0.72	1.37
Engine and motor operators	122	1.14	0.95	1.36	6	1.16	0.42	2.54
Public safety and protection workers	86	0.83	0.66	1.03	5	1.24	0.39	2.91
Cooks and stewards	4	1.66	0.43	4.28	135	1.18	0.99	1.40
Home helpers	0				211	1.04	0.91	1.19
Waiters	13	2.08	1.10	3.56	75	1.08	0.85	1.36
Building caretakers and cleaners	53	1.15	0.86	1.50	300	1.10	0.98	1.23
Chimney sweeps	17	1.99	1.15	3.19	0			
Hairdressers	30	0.98	0.66	1.40	45	0.82	0.60	1.09
Launderers and dry cleaners	42	1.30	0.94	1.76	25	0.81	0.52	1.19
Military personnel	57	0.76	0.58	0.99	0			

O = observed. Bold type: 95% CI does not include 1.00.

present in all occupational groups, including the reference group. We have no reason to believe that the magnitude of this bias differed between the occupational groups, which implies that the magnitude of the risk ratios would be affected to only a small extent.

Furthermore, the Swedish labour market underwent great changes during the study period [21–23]. A lack of information on the duration of employment was partly remedied by the analysis of individuals who maintained the same occupation in two consecutive censuses. In

addition, the quality of data on occupational titles has been assessed by Warnryd *et al.* [24]. The results showed that the proportion of concordant occupational titles was 72%, suggesting a reasonable level of quality in the census data. The large number of comparisons is another point worthy of consideration. Some associations might undoubtedly have been due to chance, and any similarity between this study and others should be assessed for causal inference, as should the biological plausibility. In addition, early onset may influence a person's choice of education and profession, which may in turn influence the results.

Our results are in agreement with the earlier European Community Respiratory Health Survey, which found a positive association between lower socioeconomic status and an increased risk of asthma [1,6]. Studies from Chile, the United States and Sweden also revealed that low socioeconomic status was related to a higher risk of asthma [2,4,5]. Both men and women living in Northern Sweden had a higher risk of hospitalization for asthma. This could be due to the cold outdoor climate affecting their health [25]. Because of the long winters in the North, people spend more time at home. As a result, they are more exposed to chemical pollution from new building materials, smoking, poor ventilation and indoor dampness and mould, i.e. factors that have been found to be associated with adult asthma [26].

Occupational exposures have been reported to have caused ~10% of the cases of asthma among young men and women [12,27] and 0.2–0.5% of young adults become asthmatics or have their asthma exacerbated due to their occupations [12]. The association between occupation and proximity to specific agents was assessed according to job title. A job-exposure matrix in three groups of biological dusts, mineral dusts and gases or fumes was constructed [12]. A similar excess risk was shown in a case-control study in Sweden, where the occupational exposures for the risk of asthma were summarized as follows: welding fumes, man-made mineral fibres and solvents for men and paper dust and textile dust for women [28]. Consistent with these studies, the risk of asthma was increased among several occupational groups in the present study. For men, this applied to the following occupations: miners and quarry workers, shoe and leather workers, smelters and metal foundry workers, mechanics and iron and metal workers, welders, wood workers, other construction workers, bricklayers and chemical process workers. In women, mechanics, iron and metal workers and engine and motor operators had an increased risk of hospitalization for asthma. The main exposures in these groups are cutting and engine oils, metal, exhaust fumes and asbestos.

Our finding of an increased risk of hospitalization for asthma among male farmers is consistent with findings from earlier Swedish [29] and Swiss [30] studies. In Sweden, farming tasks are performed mainly by men. The

risk factors for asthma in the farming environment seem to involve pig farming and the handling of hay, which generates respiratory irritants and sensitizers, mostly comprising exposure to mites and pollens that are associated with the risk of asthma. An increased risk of hospitalization for asthma was observed for male and female drivers. Female drivers subjected to long-term exposures were at even higher risk. Drivers are exposed to low concentrations of engine exhausts. They are particularly exposed to diesel exhaust particles in traffic-related pollutants, which enhance T-cell activation in severe asthmatics [31].

Significantly increased risks of hospitalization for asthma were observed among female launderers and dry cleaners and assistant nurses with possible exposure to various irritant gases, organic solvents from cleaning materials, detergents and other indoor allergens or air pollutants. The results were consistent with some earlier studies [7,12].

Increased risks for hospitalization for asthma were found for many male and female occupations, including engine and motor operators, cooks and stewards and chimney sweeps. Chemical exposure, for example to solvents, occurs frequently in these occupations. Earlier epidemiological studies have reported that solvent exposure results in an increased risk for asthma [28]. In our population-based database, information is not available on detailed job tasks or on exposure to potential chemicals inside or outside the workplace. Hence these factors cannot be distinguished from the effects of other risk factors, such as smoking.

Smoking and second-hand smoke exposure are risk factors for asthma. In the present study, it was not possible to differentiate the contributions of tobacco smoking from occupational exposures, because no data on smoking were available. It was, however, possible to compare occupations with a high asthma risk for those with a high lung cancer risk [18] in order to ascertain the effect of smoking, bearing in mind that in some occupations the risk of lung cancer may be increased due to carcinogenic exposure. In the present study, significantly increased SIRs of asthma were found for male food manufacture workers and waiters, particularly those with long-term exposure (two consecutive censuses). Increased risks of lung cancer for food manufacture workers and waiters have been found in earlier studies [32], which is in accordance with the high prevalence of smokers reported in these groups [33]. The increased risk of asthma in waiters has also been reported in a Finnish population-based case-control study [10].

Additionally, a novel contribution of our study is that the data revealed occupations with a significantly decreased SIR, such as physicians, those working in the area of religion, teachers, fishermen, whalers and sealers and administrators and managers. Some of these occupations imply a higher socioeconomic status and/or not being

exposed to an unhealthy environment. In addition, the decreased risk in fishermen, whalers and sealers could be explained by their sometimes long stay at sea.

The present study showed that socioeconomic status (education) and occupation carried significantly increased or decreased risks of hospitalization for asthma. For example, men and women with a high educational level had a slightly lower risk of hospitalization for asthma, whereas waiters, chimney sweeps, bricklayers, welders, food manufacture workers, farmers, packers, loaders and warehouse workers, female postal and communication workers, mechanics and iron and metal workers and assistant nurses, all with the same occupational titles in two consecutive censuses, had substantially higher risks of hospitalization for asthma than the reference group.

Key points

- Socioeconomic status and occupation had an effect on the population's risk of hospitalization for asthma.
- Some occupations had an increased risk whereas others were associated with a decreased risk of hospitalization for asthma.
- Future studies should investigate specific agents in those occupations that were associated with an increased risk of hospitalization for asthma.

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Conflicts of interest

None declared.

References

1. Basagana X, Sunyer J, Kogevinas M *et al.* Socioeconomic status and asthma prevalence in young adults: the European Community Respiratory Health Survey. *Am J Epidemiol* 2004;**160**:178–188.
2. Corvalan C, Amigo H, Bustos P, Rona RJ. Socioeconomic risk factors for asthma in Chilean young adults. *Am J Public Health* 2005;**95**:1375–1381.
3. Littlejohns P, Macdonald LD. The relationship between severe asthma and social class. *Respir Med* 1993;**87**:139–143.
4. Claudio L, Tulton L, Doucette J, Landrigan PJ. Socioeconomic factors and asthma hospitalization rates in New York City. *J Asthma* 1999;**36**:343–350.
5. Braback L, Hjern A, Rasmussen F. Social class in asthma and allergic rhinitis: a national cohort study over three decades. *Eur Respir J* 2005;**26**:1064–1068.
6. Ellison-Loschmann L, Sunyer J, Plana E *et al.* Socioeconomic status, asthma and chronic bronchitis in a large community-based study. *Eur Respir J* 2007;**29**:897–905.
7. Mirabelli MC, Zock JP, Plana E *et al.* Occupational risk factors for asthma among nurses and related health care professionals in an international study. *Occup Environ Med* 2007;**64**:474–479.
8. Bakke PS, Hanao R, Gulsvik A. Relation of occupational exposure to respiratory symptoms and asthma in a general population sample: self-reported versus interview-based exposure data. *Am J Epidemiol* 2001;**154**:477–483.
9. Eagan TM, Gulsvik A, Eide GE, Bakke PS. Occupational airborne exposure and the incidence of respiratory symptoms and asthma. *Am J Respir Crit Care Med* 2002;**166**:933–938.
10. Jaakkola JJ, Piipari R, Jaakkola MS. Occupation and asthma: a population-based incident case-control study. *Am J Epidemiol* 2003;**158**:981–987.
11. Johnson A, Toelle BG, Yates D *et al.* Occupational asthma in New South Wales (NSW): a population-based study. *Occup Med (Lond)* 2006;**56**:258–262.
12. Kogevinas M, Anto JM, Sunyer J, Tobias A, Kromhout H, Burney P. Occupational asthma in Europe and other industrialised areas: a population-based study. European Community Respiratory Health Survey Study Group. *Lancet* 1999;**353**:1750–1754.
13. Le Moual N, Kennedy SM, Kauffmann F. Occupational exposures and asthma in 14,000 adults from the general population. *Am J Epidemiol* 2004;**160**:1108–1116.
14. Statistics Sweden. *The Swedish Multi Generation Register (1960–1990)*. http://www.scb.se/templates/Standard_22842.asp [in Swedish: Registret över totalbefolkningen/RTB] (2005, date last accessed).
15. The National Board of Health and Welfare. *The Swedish Hospital Discharge Register and the Cause of Death Register (1961–2001)*. <http://www.sos.se/epc/english/ParEng.htm> (2004, date last accessed).
16. Statistics S.N.C.B.o. *Socioeconomic Classification. Report on Statistical Coordination*. Stockholm, Sweden: Swedish National Central Bureau of Statistics, 1982.
17. Rothman KJ, Greenland S. *Modern Epidemiology*, 2nd edn. Philadelphia, PA: Lippincott-Raven, 1998.
18. Hemminki K, Li X. Time trends and occupational risk factors for pleural mesothelioma in Sweden. *J Occup Environ Med* 2003;**45**:456–461.
19. Hemminki K, Zhang H, Czene K. Socioeconomic factors in cancer in Sweden. *Int J Cancer* 2003;**105**:692–700.
20. Eldeirawi K, McConnell R, Freels S, Persky VW. Associations of place of birth with asthma and wheezing in Mexican American children. *J Allergy Clin Immunol* 2005;**116**:42–48.
21. Hemminki K, Li X. Cancer risks in second-generation immigrants to Sweden. *Int J Cancer* 2002;**99**:229–237.
22. Hemminki K, Li X. Cancer risks in Nordic immigrants and their offspring in Sweden. *Eur J Cancer* 2002;**38**:2428–2434.
23. Hemminki K, Li X, Czene K. Cancer risks in first-generation immigrants to Sweden. *Int J Cancer* 2002;**99**:218–228.
24. Warrnryd B, Ostlin P, Thorslund M. *Living Conditions. Appendix 11. Quality in Retrospective Questions on Previous Occupational Exposures: An Evaluation of Occupational*

- Histories in the Investigation on Living Conditions*. Stockholm, Sweden: Statistics Sweden, 1989.
25. Aberg N. Asthma and allergic rhinitis in Swedish conscripts. *Clin Exp Allergy* 1989;**19**:59–63.
 26. Jaakkola MS, Nordman H, Piipari R *et al*. Indoor dampness and molds and development of adult-onset asthma: a population-based incident case-control study. *Environ Health Perspect* 2002;**110**:543–547.
 27. Blanc PD, Toren K. How much adult asthma can be attributed to occupational factors? *Am J Med* 1999;**107**:580–587.
 28. Toren K, Balder B, Brisman J *et al*. The risk of asthma in relation to occupational exposures: a case-control study from a Swedish city. *Eur Respir J* 1999;**13**:496–501.
 29. Kronqvist M, Johansson E, Pershagen G, Johansson SG, van Hage-Hamsten M. Risk factors associated with asthma and rhinoconjunctivitis among Swedish farmers. *Allergy* 1999;**54**:1142–1149.
 30. Danuser B, Weber C, Kunzli N, Schindler C, Nowak D. Respiratory symptoms in Swiss farmers: an epidemiological study of risk factors. *Am J Ind Med* 2001;**39**:410–418.
 31. Mamessier E, Nieves A, Vervloet D, Magnan A. Diesel exhaust particles enhance T-cell activation in severe asthmatics. *Allergy* 2006;**61**:581–588.
 32. Ji J, Hemminki K. Occupation and upper aerodigestive tract cancers: a follow-up study in Sweden. *J Occup Environ Med* 2005;**47**:785–795.
 33. Jaakkola MS, Jaakkola JJ. Effects of environmental tobacco smoke on the respiratory health of adults. *Scand J Work Environ Health* 2002;**28**(Suppl. 2):52–70.