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Socioeconomic and occupational risk factors for epilepsy: a nationwide epidemiological study in Sweden

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Abstract

Objectives—The aim of this study is to investigate associations between hospitalization for epilepsy and two factors: socioeconomic status and occupation.

Design and Setting—A nationwide database was constructed in Sweden by linking the Swedish Census to the Hospital Discharge Register to obtain data on all first-time hospitalizations for epilepsy in adults in Sweden during the study period (1987 to 2004). Standardized incidence ratios (SIRs) were calculated by socioeconomic status and occupation.

Results—A total of 22 638 men and 16 871 women >30 years were hospitalized for epilepsy during the study period. Low education and low income (both men and women) and being an unskilled/skilled worker (only men) was associated with slightly but significantly increased risks. Among men, increased risk was noted for waiters, launderers and dry cleaners, clerical workers, other construction workers, sales agents and drivers. Among women, increased risk was observed among cooks and stewards and administrators and managers.

Conclusions—Socioeconomic status and occupation sometimes carry significantly increased risks of hospital admission for epilepsy.

Keywords

follow-up study; occupation; socioeconomic status; standardized incidence ratios

INTRODUCTION

Epilepsy is a common disabling condition, which affects approximately 3% of the world population during their lifetime [1]. There is a growing body of evidence implicating socioeconomic status as a risk factor for epilepsy in adults [2,3]. Socioeconomic factors may influence 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 socioeconomic status. Some studies have found increased risks of cerebrovascular disease, brain tumors, and neurodegenerative disease among people who have occupational exposure to chemicals [4–7], but few studies have reported on the association between specific occupations and incidence of epilepsy [8,9]. One such study reported a relationship between first epileptic seizure and occupational nickel poisoning [9]. Most studies to date have been case-control studies, and most of these have used prevalent cases and relied on self-reporting

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for exposure assessment, which may lead to self-report and recall bias. This study contributes to the increasing body of knowledge about socioeconomic and occupational risks and epilepsy since the focus on a total population represents a novel approach.

There is a lack of population-based data on the association between socioeconomic factors and epilepsy and occupations and epilepsy. Our aim was to increase insight into socioeconomic status and occupational risk factors for hospitalization for epilepsy in the economically active population of Sweden. Data were obtained from the latest update of the Swedish MigMed research database. Special aspects of this study include a large sample size and complete follow-up of all individuals.

MATERIAL AND METHODS

MigMed research database

Data used in this study were retrieved from the MigMed database, located at the Center for Family and Community Medicine at the Karolinska Institutet in Stockholm. MigMed is a single, comprehensive database that contains individual-level information on all people in Sweden, including age, sex, socioeconomic status, occupation, geographical region of residence, hospital diagnoses and dates of hospital admissions in Sweden (1987–2004), 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 the total population register, the multi-generation register, and the Swedish hospital discharge register (1987–2004) [10–12].

Using 1960, 1970, and 1980, and 1990 census data from this database, individuals were allocated to one of four census cohorts based on the time-span of their occupational history. The census cohorts were:

1960: individuals listed as economically active in the 1960 census;

1970–90: individuals listed as economically active in the 1970, 1980, and 1990 censuses;

1980–90: individuals listed as economically active in the 1980 and 1990 censuses; and 1990: individuals listed as economically active in the 1990 census.

Individuals were allocated to different occupational groups based on occupational title.

Information retrieved from the various registers in the MigMed database was linked at the individual level via the national 10-digit civic registration number assigned to each person in Sweden for his or her lifetime. Prior to inclusion in the MigMed database, civic 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 epilepsy appeared only once in the data set, for their first hospital diagnosis of epilepsy during the study period.

The follow-up period started on 1 January 1987 and proceeded until hospitalization for epilepsy, death from another cause, emigration, or the end of the study period on 31 December 2004. Information on hospitalizations prior to 1 January 1986 was unavailable.

Outcome variable

First-time hospital admission for epilepsy was defined as the first time one of three codes from the International Classification of Diseases (9^{th} and 10^{th} revisions) appeared in a patient's hospital record during the study period. These codes included ICD-9 code 345 and ICD-10 codes G40 and G41.

Individual variables controlled for in the analysis

Sex: **men and women—***Age at diagnosis* was categorized in 5-year groups starting at 30 years. We only included individuals over 30 years of age because many people do not have a stable occupation at younger ages.

Individuals were allocated to different occupational groups based on 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 labor market in 1970 than in 1960. In addition, for selected occupations, risks were analyzed 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 using the Nordic Occupational Classification (NYK). NYK is a common Nordic adaptation of the International Standard Classification of Occupation from 1958. Following a precedent set by Statistics Sweden [13], we combined the three-digit codes from the NYK into 53 NYK occupational groups and one economically inactive group. Occupational groups were combined based on similarities in the included occupations. People without paid employment were excluded.

Three different measures of socioeconomic status were used, i.e. education, occupational status, and income.

Education was categorized as completion of compulsory school or less (<=9 years), practical high school or some theoretical high school (10–11 years), or theoretical high school and/or university studies (>=12 years).

Occupational status was divided into five categories:

(1) unskilled/skilled workers, (2) white collar workers, (3) professionals, (4) farmers, and (5) self-employed.

Income was categorized in three groups: low, middle, and high.

Region of residence was divided into (1) large cities (cities with a population of more than 200,000, i.e., Stockholm, Gothenburg and Malmö), (2) Southern Sweden, and (3) Northern Sweden. Geographical region was included as an individual variable to adjust for possible differences between geographical regions in Sweden regarding hospital admissions for epilepsy.

Statistical analysis

Person-years were calculated from the start of follow-up on 1 January 1987 until hospitalization for epilepsy, death, emigration, or the end of the study on 31 December 2004. 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 the different socioeconomic status and occupational groups as the ratio of observed to expected number of cases [14]. We used all economically active individuals in the entire cohort as a reference. We assumed that various social classes and occupational groups should experience the same incidence as all workers in the entire cohort. The expected number of cases was calculated for age (5-year groups), sex, period (5-year groups), region, and socioeconomic status-specific standard incidence rates. Ninety-five percent confidence intervals (95%CI) were calculated assuming a Poisson distribution [14].

Ethical considerations

The Ethic Committee at the Karolinska Institutet, Stockholm, Sweden, approved this study.

RESULTS

From 1987 to 2004, a total of 22 638 men and 16 871 women over 30 years of age experienced first hospitalization for epilepsy in Sweden. Table 1 shows the SIRs for first-time hospital admission for epilepsy by the tree socioeconomic measures. The risks have been adjusted for age, time period, and region of residence. Low education and low income (both men and women) and being an unskilled/skilled worker (only men) was associated with slightly but significantly increased risks.

SIRs of first-time hospital admission for epilepsy by occupation in men and women are shown in Table 2. The risks in this table were adjusted for age, period, region of residence, and socioeconomic status. Data are shown if more than 50 cases were identified in the occupational group recorded in the census. Among men, significantly increased risks were observed in the following occupational groups: waiters (1.50); launderers and dry cleaners (1.27); clerical workers (1.14); other construction workers (1.14); and sales agents (1.10). Among women, significantly increased SIRs were noted for cooks and stewards (1.11).

Table 3 presents the SIRs of first-time hospital admission for epilepsy by occupation in persons who had the same occupational title in two consecutive censuses. Data are shown if more than 50 cases were identified in the occupational group recorded in the two continuous censuses. A significantly increased SIR was noted in male clerical workers (1.27), and drivers (1.11). Among women, a significantly increased SIR was noted in administrators and managers (1.69).

DISCUSSION

In the present study, SIR was used to ascertain the likelihood that an individual in a given socioeconomic status or occupational group would a have a raised risk of first-time hospital diagnosis of epilepsy. To our knowledge, this is the first large-scale study that has investigated socioeconomic groups and occupations as possible risk factors for epilepsy.

The main finding of this study is that socioeconomic status and occupation sometimes carry a significantly increased risk of hospitalization for epilepsy. For example, belonging to the socioeconomic status group “unskilled/skilled workers” carried an increased risk for men. Low income and low education was associated with an increased risk among both men and women. No increased risks were found for most occupational groups. However, risk was increased for men and women in certain occupational groups. Among men, these included waiters, launderers and dry cleaners, other construction workers, clerical workers, sales agents and drivers. Among women, they included cooks and stewards and administrators and managers.

This study has a number of strengths. For example, our study population included a well-defined open cohort of the entire population of Sweden. Thanks to the civic registration number assigned to each individual in Sweden (changed to a serial number to ensure anonymity), it was possible to track the records of every person for the whole follow-up period. Use of the anonymized civic registration number ensured that there was little or no loss to follow-up. Data about occupational status were almost 100% (99.2%) complete. Data in the Swedish Hospital Discharge Register were also highly complete. In 2001, the main diagnosis was missing in 0.9% and the national registration number in 0.4% of hospitalizations [10].

The present study also has some limitations. Although the national database includes data on the entire Swedish population, it only incorporates information about hospital admissions. Data

on out-patients are unavailable. However, in Sweden all hospital admissions are registered, and almost all people receive their official diagnosis of epilepsy from a hospital. Another limitation is that we were unable to test the validity of the epilepsy diagnoses. However, it seems likely that the diagnoses are valid as Sweden has complete nationwide medical coverage. Moreover, to help counter any potential validity problems, we only used main diagnoses of epilepsy recorded in the hospital registers, i.e., instances in which the main cause of hospitalization was epilepsy. This increased the possibility that the diagnoses of epilepsy were valid. In addition, we had no data on individual risk factors for epilepsy, like alcohol habits [15]. However, we did adjust for socioeconomic status, which is associated with several individual risk factors for cardiovascular disease [16] and Alzheimer's disease [17], many of which (like low education and socioeconomic deprivation) are also risk factors for epilepsy. A further potential limitation is that there have been large changes in the labor market in Sweden during the study period [18–20]. Lack of information on duration of employment was partly remedied by the analysis of individuals who maintained the same occupation through two consecutive censuses. The quality of data on occupational titles in the Swedish censuses has been assessed by Warnryd, Ostlin, and Thorslund [21]. The results showed that the proportion of concordant occupational titles was 72%, suggesting a reasonable quality for the census data. Moreover, it is important to compare consistency within this study and between studies, as well as biological plausibility, before inferring causality. In addition, early onset may influence a person's choice of occupation, which may in turn have influenced the results.

Low socioeconomic status is a risk factor for the development of epilepsy [2,3]. Low socioeconomic status is associated with social and economic deprivation, unemployment, and low income, which in turn are associated with risk factors like incidence of birth defects, trauma, infection, and poor nutrition. Low socioeconomic status may influence the risk of epilepsy through risk factors that are the same for epilepsy as for injury, cardiovascular disease, and Alzheimer's disease [16,17,22]. For unskilled workers, the increased risk of epilepsy might be traceable, at least in part, to short duration of employment and associated lifestyle factors [8].

Alcohol intake or abuse is a risk factor for epilepsy [23], so higher alcohol consumption in certain occupational groups may help explain raised risk of epilepsy in those groups. A study from Sweden that investigated the relationship between different occupational groups and mean consumption of alcohol found that men in many occupations, such as cleaners, waiters, and unskilled manual workers, had high consumption of alcohol [24]. In the present study, significantly increased SIRs of first-time hospital admission for epilepsy were found in male waiters, launderers and dry cleaners, other construction workers, clerical workers, sales agents and drivers. There is a striking similarity in the list of occupational groups with high prevalence of alcohol consumption and occupational groups with raised risk of epilepsy. It is also possible that drivers' higher risk of accident injuries may partly lie in the causal pathway: seizures are a common complication of head injuries [25].

It is noteworthy that increased risks were found for male launderers and dry cleaners. Chemical exposures occur frequently in these occupations; for example, exposure to solvents and chemical cleaning agents. Earlier epidemiological studies have reported that solvent exposure increases the risk of epilepsy [26,27]. We have no information about exposure to specific chemicals, so it is hard to identify which kind of chemical agent may have been causally associated with raised risk of epilepsy. Increased risks for these workers are not consistent in different sexes and cohorts. These inconsistencies may partly be explained by men and women working at different types of tasks and different sites, which may dilute the risk estimation.

In summary, this study shows that socioeconomic status and occupation sometimes carry significantly increased risks of first-time hospital admission for epilepsy. Pathways may

include exposure to organic solvents and other chemicals (such as that experienced by launderers and dry cleaners) and high alcohol consumption. However, our findings do not allow inferences about causal relationships, so the findings remain tentative.

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Table 1

SIRs of hospitalization for epilepsy by different socioeconomic measures in men and women

Socioeconomic status	Men				Women			
	O	SIR	95%CI		O	SIR	95%CI	
Education								
<=9 years	11040	**1.06**	**1.04**	**1.08**	8742	**1.06**	**1.04**	**1.08**
10–12 years	9156	0.98	0.96	1.00	6526	0.98	0.96	1.01
>12 years	2442	**0.86**	**0.82**	**0.89**	1603	**0.81**	**0.77**	**0.85**
Occupational status								
Farmers	1137	1.00	0.95	1.06	913	1.05	0.99	1.12
Self-employed	1792	**0.91**	**0.87**	**0.95**	881	1.00	0.93	1.07
Professionals	2035	**0.93**	**0.89**	**0.97**	775	0.95	0.88	1.01
White collar workers	5965	0.97	0.95	1.00	5737	0.99	0.96	1.01
Unskilled/Skilled workers	11709	**1.04**	**1.02**	**1.06**	8565	1.01	0.99	1.03
Income								
Low	10982	**1.13**	**1.11**	**1.15**	9308	**1.10**	**1.07**	**1.12**
Middle	7046	0.99	0.97	1.02	4651	0.98	0.95	1.01
High	4610	**0.79**	**0.77**	**0.81**	2912	**0.80**	**0.77**	**0.83**
All	22638	1.00	reference		16871	1.00	reference	

O = observed; SIR = standardized incidence ratio; CI = confidence interval.

Bold type: 95%CI does not include 1.00.

Table 2

SIRs of hospitalization for epilepsy in men and women by occupation

Occupation	Men				Women			
	O	SIR	95%CI		O	SIR	95%CI	
Technical, chemical, physical and biological workers	1107	0.97	0.91	1.03	99	1.07	0.87	1.30
Nurses	20	**0.63**	**0.38**	**0.97**	158	0.88	0.75	1.02
Assistant nurses	1	0.29	0.00	1.68	581	1.03	0.95	1.12
Other health and medical workers	27	1.26	0.83	1.84	119	0.98	0.81	1.17
Teachers	257	0.98	0.86	1.11	327	0.97	0.87	1.08
Religious, juridical and other social-science-related workers	166	1.01	0.86	1.18	103	0.93	0.76	1.13
Artistic workers	80	1.01	0.80	1.25	21	0.69	0.43	1.06
Administrators and managers	416	1.05	0.95	1.16	66	1.13	0.87	1.44
Clerical workers	650	**1.14**	**1.05**	**1.23**	1402	**0.92**	**0.87**	**0.97**
Sales agents	760	**1.10**	**1.03**	**1.18**	135	1.05	0.88	1.24
Shop managers and assistants	367	1.04	0.93	1.15	808	**0.92**	**0.86**	**0.99**
Farmers	1118	**0.93**	**0.87**	**0.98**	242	0.91	0.80	1.03
Gardeners and related workers	194	0.98	0.85	1.13	74	0.82	0.64	1.03
Forestry workers	277	0.94	0.84	1.06	2	0.40	0.04	1.47
Miners and quarry workers	66	0.82	0.64	1.05	1	1.00	0.00	5.71
Seamen	52	1.12	0.84	1.48				
Transport workers	177	1.16	0.99	1.34	7	1.71	0.68	3.54
Drivers	1014	1.02	0.95	1.08	48	0.95	0.70	1.26
Postal and communication workers	179	0.98	0.84	1.13	222	0.99	0.87	1.13
Textile workers	162	1.03	0.88	1.20	271	0.95	0.84	1.07
Smelters and metal foundry workers	233	0.94	0.82	1.07	11	0.87	0.43	1.57
Mechanics and iron and metalware workers	1400	0.96	0.91	1.01	121	0.97	0.81	1.16
Plumbers	174	1.09	0.94	1.27				
Welders	182	0.93	0.80	1.08	5	1.09	0.34	2.57
Electrical workers	450	0.94	0.85	1.03	62	0.91	0.70	1.16
Wood workers	612	0.92	0.85	1.00	18	0.69	0.41	1.09
Painters and wall paperhangers	216	0.96	0.84	1.10	9	1.66	0.75	3.16
Other construction workers	375	**1.14**	**1.03**	**1.26**				
Bricklayers	92	1.01	0.81	1.24				
Printers and related workers	185	1.07	0.92	1.24	40	0.91	0.65	1.24
Chemical process workers	171	1.04	0.89	1.21	27	0.87	0.57	1.26
Food manufacture workers	254	1.05	0.93	1.19	75	0.87	0.68	1.09
Glass, ceramic and tile workers	193	0.89	0.77	1.03	107	1.09	0.89	1.31
Packers, loaders and warehouse workers	680	1.07	0.99	1.16	146	0.92	0.77	1.08
Engine and motor operator workers	273	0.92	0.82	1.04	6	0.46	0.17	1.01
Public safety and protection workers	132	**0.81**	**0.68**	**0.96**	11	1.12	0.56	2.02
Cooks and stewards	26	1.03	0.67	1.51	332	**1.11**	**1.00**	**1.24**
Home helpers	1	2.22	0.00	12.72	558	1.04	0.96	1.13
Waiters	38	**1.50**	**1.06**	**2.06**	187	0.96	0.83	1.11
Building caretakers and cleaners	78	1.02	0.81	1.27	606	1.05	0.97	1.14
Hairdressers	34	0.89	0.62	1.25	97	1.01	0.82	1.23
Launderers and dry cleaners	99	**1.27**	**1.03**	**1.55**	109	1.02	0.84	1.23
Military personnel	101	0.86	0.70	1.04				

O = observed; SIR = standardized incidence ratio; CI = confidence interval.

Bold type: 95%CI does not include 1.00.

Table 3

SIRs of hospitalization for epilepsy in individuals with selected occupations who kept the same job title in two consecutive censuses

Occupation	Men (census 1960 and 1970)				Women (census 1970 and 1980)			
	O	SIR	95%CI		O	SIR	95%CI	
Technical, chemical, physical and biological workers	729	0.96	0.89	1.03	45	1.11	0.81	1.48
Nurses	14	0.79	0.43	1.32	101	0.84	0.68	1.02
Assistant nurses					277	1.03	0.91	1.16
Other health and medical workers	11	0.98	0.49	1.76	64	1.09	0.84	1.39
Teachers	196	1.00	0.87	1.15	230	0.99	0.86	1.12
Religious, juridical and other social-science-related workers	109	1.10	0.91	1.33	42	0.87	0.63	1.18
Administrators and managers	203	1.06	0.92	1.22	23	**1.69**	**1.07**	**2.54**
Clerical workers	280	**1.27**	**1.13**	**1.43**	760	0.98	0.91	1.05
Sales agents	380	1.09	0.99	1.21	31	1.05	0.71	1.49
Shop managers and assistants	123	0.99	0.82	1.18	285	0.93	0.82	1.04
Farmers	605	0.98	0.90	1.06	97	1.01	0.82	1.23
Gardeners and related workers	80	0.91	0.72	1.14	8	0.89	0.38	1.77
Forestry workers	84	0.91	0.73	1.13	1	1.51	0.00	8.66
Transport workers	55	1.18	0.89	1.53	1	1.21	0.00	6.94
Drivers	535	**1.11**	**1.02**	**1.21**	11	0.83	0.41	1.49
Postal and communication workers	82	0.96	0.77	1.20	90	0.95	0.77	1.17
Textile workers	70	1.05	0.82	1.33	78	1.01	0.80	1.26
Smelters and metal foundry workers	78	0.89	0.71	1.12	3	1.05	0.20	3.11
Mechanics and iron and metalware workers	685	0.98	0.91	1.06	29	0.99	0.66	1.42
Plumbers	103	1.11	0.91	1.35				
Welders	62	0.80	0.61	1.02				
Electrical workers	240	0.92	0.81	1.05	19	1.07	0.64	1.67
Wood workers	347	0.92	0.82	1.02	6	0.96	0.35	2.11
Painters and wall paperhangers	144	0.93	0.79	1.10	2	4.64	0.44	17.05
Other construction workers	166	1.16	0.99	1.34				
Bricklayers	62	1.03	0.79	1.32				
Printers and related workers	112	1.09	0.90	1.31	14	0.99	0.54	1.66
Chemical process workers	55	1.12	0.84	1.46	2	0.31	0.03	1.13
Food manufacture workers	111	1.07	0.88	1.29	19	1.14	0.68	1.78
Glass, ceramic and tile workers	55	0.79	0.60	1.03	31	1.43	0.97	2.03
Packers, loaders and warehouse workers	154	1.02	0.86	1.19	28	1.01	0.67	1.46
Engine and motor operator workers	86	0.84	0.67	1.03	2	0.58	0.06	2.15
Public safety and protection workers	86	**0.77**	**0.62**	**0.96**	3	1.04	0.20	3.09
Cooks and stewards	5	1.20	0.38	2.83	91	1.13	0.91	1.39
Home helpers					149	1.03	0.87	1.21
Waiters	13	1.57	0.83	2.69	47	0.99	0.73	1.32
Building caretakers and cleaners	40	1.02	0.73	1.39	202	1.11	0.96	1.27
Launderers and dry cleaners	35	1.04	0.72	1.45	24	1.14	0.73	1.70
Military personnel	65	0.88	0.68	1.12				

O = observed; SIR = standardized incidence ratio; CI = confidence interval.

Bold type: 95%CI does not include 1.00.