In this nationwide population-based cohort study using national Danish registries, our aim was to study employment and receipt of disability pension after central nervous system infections. All patients diagnosed between 20 and 55 years of age with meningococcal ($n=451$), pneumococcal ($n=553$), or viral ($n=1,433$) meningitis or with herpes simplex encephalitis ($n=115$), who were alive 1 year after diagnosis, were identified. Comparison cohorts were drawn from the general population, and their members were individually matched on age and sex to patients. Five years after diagnosis, the differences in probability of being employed as a former patient with pneumococcal meningitis or herpes simplex encephalitis versus being a member of the comparison cohorts were $-19.9\%$ (95% confidence interval (CI): $-24.7$, $-15.1$) and $-21.1\%$ (95% CI: $-33.0$, $-9.3$), respectively, and the corresponding differences in probability of receiving disability pension were $20.2\%$ (95% CI: $13.7$, $26.7$) and $16.2\%$ (95% CI: $6.2$, $26.3$). The differences in probability of being employed or receiving disability pension in former meningococcal or viral meningitis patients versus members of the comparison cohorts were small. In conclusion, pneumococcal meningitis and herpes simplex encephalitis were associated with substantially decreased employment and increased need for disability pension. These associations did not seem to apply to meningococcal meningitis or viral meningitis.
Table 1. Characteristics of Meningococcal, Pneumococcal, or Viral Meningitis or Herpes Simplex Encephalitis Patients Aged 20–55 Years, Members of the Comparison Cohorts, and Siblings of These Cohorts, Denmark, 1980–2008

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Patients</th>
<th>Comparison Cohorts</th>
<th>Siblings of Patients</th>
<th>Siblings of Members of the Comparison Cohorts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. %</td>
<td>Median (IQR)</td>
<td>No. %</td>
<td>Median (IQR)</td>
</tr>
<tr>
<td>Overall</td>
<td>2,552</td>
<td>10,208</td>
<td>1,748</td>
<td>6,989</td>
</tr>
<tr>
<td>Male</td>
<td>1,290</td>
<td>50.5</td>
<td>5,160</td>
<td>50.5</td>
</tr>
</tbody>
</table>

CNS Infection Etiology

| Meningococcal meningitis               | 451      | 18.04              | 258      | 96.5             |
| Pneumococcal meningitis               | 553      | 2,212              | 225      | 943              |
| Viral meningitis                      | 1,433    | 5,732              | 1,192    | 4,798            |
| Herpes simplex encephalitis           | 115      | 460                | 73       | 283              |

Age at Time of CNS Infection, Years

| Meningococcal meningitis               | 34.5 (24.6–45.3) | 34.5 (24.6–45.3) | 26.0 (22.1–31.8) | 25.8 (22.5–32.7) |
| Pneumococcal meningitis               | 43.4 (33.9–50.1) | 43.4 (33.9–50.1) | 34.8 (27.0–40.9) | 34.7 (27.7–41.7) |
| Viral meningitis                      | 32.5 (27.9–38.2) | 32.5 (27.9–38.2) | 32.6 (27.9–37.6) | 32.3 (27.8–37.1) |
| Herpes simplex encephalitis           | 39.8 (32.4–47.8) | 39.8 (32.4–47.8) | 36.3 (30.9–42.7) | 33.7 (28.4–39.3) |

Calendar Period of CNS Infection

| 1990–1999                              | 994      | 38.9               |
| 2000–2008                              | 1,184    | 46.4               |

Higher Education at Time of CNS Infection

| Meningococcal meningitis               | 57       | 12.6               | 21       | 8.1              | 96       | 9.9              |
| Pneumococcal meningitis               | 66       | 11.9               | 36       | 16.0             | 161      | 17.1             |
| Viral meningitis                      | 249      | 17.4               | 209      | 17.5             | 800      | 16.7             |
| Herpes simplex encephalitis           | 20       | 17.4               | 14       | 19.2             | 67       | 23.7             |

Charlson Comorbidity Index Score ≥1 at Time of CNS Infection

| Meningococcal meningitis               | 33       | 7.3                | 5        | 1.9              | 26       | 2.7              |
| Pneumococcal meningitis               | 90       | 19.3               | 19       | 8.4              | 35       | 3.7              |
| Viral meningitis                      | 129      | 9.0                | 55       | 4.6              | 210      | 4.4              |
| Herpes simplex encephalitis           | 10       | 8.7                | 5        | 6.9              | 19       | 6.7              |

Diagnosed with a Disease Associated with Work Incapacity at Time of CNS Infection

| Meningococcal meningitis               | 70       | 15.5               | 19       | 7.4              | 67       | 6.9              |
| Pneumococcal meningitis               | 150      | 27.1               | 33       | 14.7             | 88       | 9.3              |
| Viral meningitis                      | 273      | 19.1               | 144      | 12.1             | 442      | 9.2              |
| Herpes simplex encephalitis           | 28       | 24.4               | 7        | 9.6              | 30       | 10.6             |
during the period 1980–2008, or viral meningitis or herpes simplex encephalitis during the period 1994–2008, and alive 1 year after diagnosis; 2) a comparison cohort drawn from the general population whose members were individually matched with the patients on date of birth and sex; 3) full siblings of members of the patient cohort; and 4) full siblings of members of the comparison cohort.

The cohorts were followed for 4 years, starting 1 year after CNS infection. The primary outcomes were employment, personal income for those employed, and receipt of a disability pension.

**Setting**

In 2012, Denmark had an estimated population of 2.6 million in the age group 20–55 years, of whom 76.6% were employed and 5.0% received a disability pension. In 2012, the mean monthly income for people aged 20–55 years was US $4,799, according to Statistics Denmark (http://www.dst.dk/en). Throughout the study period, tax-supported medical care was provided free of charge to all Danish residents.

**Data sources**

We used the unique 10-digit personal identification number assigned to all Danish citizens at birth or upon immigration, in order to avoid multiple registrations and to track individuals identified in the following registries (refer to Web Appendix 1, available at http://aje.oxfordjournals.org/, for further description of the registries):

- The Danish National Registry of Patients (DNRP) covering all Danish hospitals was used to identify the first date of all meningococcal, pneumococcal, or viral meningitis or herpes simplex encephalitis diagnoses for each patient. Meningococcal and pneumococcal meningitis diagnoses have been recorded in the DNRP since 1977, while viral meningitis and herpes simplex encephalitis diagnoses have been recorded only since 1994. The DNRP provided data on inpatient admissions and hospital outpatient services (10).
- The Danish Civil Registration System was used to identify members of the general population comparison cohort and their siblings, as well as siblings of the patients. This registry also provided data on sex and date of birth, immigration/emigration, loss to follow-up, and death of all study participants (11).
- The Employment Classification Module, Statistics Denmark, provided data on the employment status of study participants in each calendar year during the study period. It also provided data on receipt of disability pension starting on January 1, 1994 (12).
- Personal Income Statistics, administered by Statistics Denmark, provided data on the personal income of the study participants in each calendar year during the study period.
- The Danish Educational Attainment Registry, also administered by Statistics Denmark, provided data on the highest educational level attained by all members of the study population as of the year when a CNS infection was diagnosed among members of the patient cohort (13).
Study population

Cohort of patients with CNS infection. We used the DNRP to identify all patients meeting the following criteria: 1) diagnosed with meningococcal, pneumococcal, or viral meningitis or with herpes simplex encephalitis (refer to Web Appendix 2 for International Classification of Diseases, Eighth Revision (ICD-8) and Tenth Revision (ICD-10), codes) for the first time during the period from January 1, 1980 (January 1, 1994, for viral meningitis and herpes simplex encephalitis patients), to January 1, 2008; 2) diagnosed with these infections between the ages of 20 and 55 years; 3) born in Denmark; and 4) not diagnosed with any other CNS infections (as specified in Web Appendix 3) before the diagnosis of meningitis or encephalitis. Patients were excluded from the study if they died, emigrated, or were lost to follow-up within the first year after their diagnosis with a CNS infection. The date of study inclusion was 1 year after the diagnosis date of the CNS infection. In Denmark, pneumococcal vaccination is recommended for people at increased risk of invasive pneumococcal disease. There is no general recommendation for use of the meningococcal vaccine (14).

General population comparison cohort. We constructed comparison cohorts of individually matched persons identified from the Danish Civil Registration System. We first identified all Danish citizens meeting the following criteria: 1) same birth date and sex as the patient; 2) born and residing in Denmark and not diagnosed with a CNS infection at the time of the corresponding patient’s CNS infection diagnosis date; and 3) alive and living in Denmark 1 year after the corresponding patient’s diagnosis date for CNS infection. From this population, we randomly chose 4 individuals for the comparison cohort. The date of their study inclusion was 1 year after the diagnosis date of the matched CNS infection patient.

Sibling cohorts. To estimate potential confounding from familial factors, either inherited or environmental, such as alcohol consumption and smoking, we also contrasted employment status and receipt of disability pension between the full siblings of the patients and the full siblings of the comparison cohort members. The siblings were identified from the Danish Civil Registration System. To limit differences in age, siblings had to be born within 5 years of their corresponding patient or comparison cohort member. Registration of siblings in the registry is incomplete for individuals born before 1953, which explains why the average age at study inclusion is lower in the sibling cohorts than in the patient and comparison cohorts.

Comorbidity

A modified Charlson Comorbidity Index score derived from DNRP discharge diagnoses before the time of CNS infection was used as a measurement of comorbidity (15, 16). A score of 1, 2, 3, or 6 was assigned to a range of comorbid conditions, and 3 levels of comorbidity were defined: none (Charlson score = 0), low (Charlson score = 1–2), or high (Charlson score ≥3).

The prevalence of common diseases associated with work disability was calculated on the basis of discharge diagnoses and diagnoses given at hospital outpatient services 3 months before the CNS infection diagnosis date of members of all cohorts (refer to Web Appendix 4 for diseases included in this category, references, and International Classification of Diseases, Eighth Revision and Tenth Revision, codes).

Study outcomes

Employment status, personal income for those employed, and receipt of disability pension were compared between the patient and comparison cohorts and between the 2 sibling cohorts.

Less than 2% of the patients and members of the comparison cohorts and less than 3% of the siblings lacked annual information on employment status, personal income, and receipt of disability pension. Persons without this information for a given calendar year were omitted from the analyses for that year.

Statistical analysis

Employment status, personal income for those employed, and receipt of disability pension were determined at the time of CNS infection and 1 and 2 years before, as well as annually for each following year, until the earliest of 5 years after CNS infection, the end of 2008, or the year before the person died, emigrated, or became lost to follow-up. The calendar year of CNS infection diagnosis was designated as year 0, and the following calendar years were given values relative to year 0.

We calculated the differences in probability of being employed and of receiving a disability pension in patients versus members of the comparison cohort, taking the individual matching into account using the Mantel-Haenszel method for risk difference (17, 18). Comparisons were made 2 years before the time of CNS infection, at the time of CNS infection, and 2 and 5 years after CNS infection. Separate analyses were performed for patients with meningococcal, pneumococcal, or viral meningitis or with herpes simplex encephalitis and members of their comparison cohorts and sibling cohorts. We repeated the analyses in a study sample, model 1, excluding individuals with comorbid conditions defined by the Charlson Comorbidity Index, diagnosed before the time of CNS infection and in a study sample, model 2, excluding individuals diagnosed as having a disease associated with work disability before the time of CNS infection. We also repeated the analyses restricting the study sample, model 3, to individuals who had been employed and who had not received a disability pension in the 2 years before CNS infection.

To determine whether patients employed after the CNS infection had decreased work capacity, we calculated the mean monthly income for employed patients and compared it with the income for employed members of their respective comparison cohorts. Comparisons were made 2 years before the time of CNS infection, at the time of CNS infection, and 2 and 5 years after CNS infection. During the study period, mean monthly income was estimated in US dollars in 2012 prices. This entailed deflating the mean monthly income by multiplying it by the Consumer Price Index of 2012 and dividing by the actual year’s price index (http://www.statistikbanken.dk/PRIS).

In a cross-sectional analysis, the educational status of members of all cohorts was assessed in the year of CNS infection.

We compared the proportions employed and the proportions receiving a disability pension among siblings of patients versus siblings of members of the comparison cohorts and repeated the analyses stratifying by sex and age.

SPSS Statistics, version 19, software (SPSS, Inc., Chicago, Illinois) was used for data analysis.

Ethics

The study was approved by the Danish Data Protection Agency (record no. 2008-41-2467). Ethics approval and individual consent are not required by Danish legislation governing this type of registry study.

RESULTS

Descriptive data

Of the 2,742 patients who met the inclusion criteria, 485 patients had meningococcal meningitis, 695 had pneumococcal meningitis, 1,442 had viral meningitis, and 120 had herpes simplex encephalitis. Thirty-four (7.0%) patients with meningococcal meningitis, 142 (20.4%) with pneumococcal meningitis, 8 (0.6%) with viral meningitis, and 4 (3.3%) with herpes simplex encephalitis died, 2 patients emigrated, and none was lost to follow-up within the first year after the CNS infection diagnosis, leaving a total of 2,552 patients and 10,208 comparison cohort members in the study (Table 1). During the study period, 28 (1.1%) patients emigrated, and none was lost to follow-up.

Employment

Employment of the patients and members of the comparison cohort in the period from 2 years before to 5 years after the CNS infection diagnosis is shown in Web Tables 1 and 2 and in Figure 1. Among meningococcal meningitis patients, the difference in probability of being employed 2 years before their diagnosis date versus that among members of the comparison cohort was $-10.1\%$ (95% confidence interval (CI): $-14.6, -5.6$) (Table 2). No substantial change in this disparity was observed after diagnosis of the meningococcal meningitis.

The difference in probability of being employed in pneumococcal meningitis patients versus that in members of the comparison cohort was $-11.5\%$ (95% CI: $-15.6, -7.4$) 2 years before the CNS infection. This disparity increased markedly after diagnosis, with a difference in probability of being employed of $-19.9\%$ (95% CI: $-24.7, -15.1$) in pneumococcal meningitis patients versus the probability of being employed in members of the comparison cohort 5 years after the CNS infection.

No substantial differences in employment for viral meningitis patients versus that for members of the comparison cohort were observed during follow-up (Table 2). For herpes simplex encephalitis patients versus members of the comparison cohort, the difference in the probability of being employed was $-4.8\%$ (95% CI: $-13.2, 3.7$) 2 years before the CNS infections. This disparity increased markedly by 5 years after the diagnosis date, with a difference in the probability of being employed of $-21.1\%$ (95% CI: $-33.0, -9.3$).

![Figure 1. Proportions employed among meningococcal meningitis (A), pneumococcal meningitis (B), viral meningitis (C), and herpes simplex encephalitis (D) patients (dashed lines) and comparison cohorts (solid lines), Denmark, 1980–2008.](https://academic.oup.com/aje/article-abstract/181/10/789/158771)
Tables 1 and 2 and in Figure 2. Throughout the study period, years after the CNS infection diagnosis is shown in Web Table 4 and 5, Web Figures 4 and 5; Tables 2 and 3). This was also the case in model 3 restricting the comparison cohort during follow-up were small (Table 3).

Subanalysis

When we excluded individuals with a comorbid condition defined by the Charlson Comorbidity Index (model 1) or with a disease associated with work incapacity (model 2) before the CNS infection (Web Tables 4 and 5), we observed almost the same changes in the differences as obtained in the analyses including all study participants (Web Figures 2 and 3; Tables 2 and 3). This was also the case in model 3 restricting the study sample to individuals who had been employed in the same changes in the differences as obtained in the analysis (Web Tables 4 and 5), we observed almost the same changes in the differences as obtained in the analyses including all study participants (Web Figures 2 and 3; Tables 2 and 3).

Sibling cohorts

No substantial differences in the proportions employed or in receipt of a disability pension were observed between the

cohorts of siblings of CNS infection patients and the siblings of the comparison cohorts (Web Table 6). This finding held for all CNS infection cohorts and when stratified by sex and age (Web Tables 7–10).

DISCUSSION

This study investigated the degree to which the most common CNS infections in a developed country are associated with subsequent work disability (5–7, 19). We found that pneumococcal meningitis and herpes simplex encephalitis were associated with substantially decreased employment and increased need of a disability pension. This pattern did not hold for patients with meningococcal meningitis or viral meningitis. Cerebral infarction and hemorrhage have been shown to be particularly common in pneumococcal compared with meningococcal meningitis (20–22) and, in accordance with our findings, patients with pneumococcal meningitis are known to carry a higher risk of disabling sequelae than patients with meningococcal meningitis (3). Our observations are consistent with those of investigations reported by van de Beek et al. (23) on cognitive impairment in adults with otherwise good recovery after bacterial meningitis. In that study, subjects were aged between 16 and 65 years and expected to be able to resume their daily life as it was before the meningitis episode. At the time of neuropsychological evaluation 6–24 months after discharge, a cognitive disorder was diagnosed in 27% of pneumococcal meningitis patients, in 4% of meningococcal patients, and in 4% of controls who were recruited from partners, siblings, and close friends. The main cognitive impairment in meningitis patients was loss of cognitive speed (23).

Compared with the general population, the pneumococcal meningitis patients in our study had a substantially decreased employment rate and increased receipt of a disability pension during follow-up. This finding held when we excluded individuals who, before their episode of pneumococcal meningitis, had been diagnosed with diseases known to be associated with work incapacity. Other risk factors, such as unmeasured alcohol dependence, may have contributed to this association (24). Nonetheless, siblings of the pneumococcal meningitis patients and comparison cohort members had almost equal levels of employment. For this reason, social factors shared by the patients and their siblings do not seem to explain our findings.

In an earlier study, we found that meningococcal meningitis and pneumococcal meningitis in childhood were associated with lower educational achievements in adulthood (4). The observed association proved to be particularly relevant for children with pneumococcal meningitis. Both siblings and parents of children with meningococcal meningitis. Both siblings and parents of children with meningococcal meningitis achieved lower educational levels compared with those of the general population. In contrast, siblings and parents of children with pneumococcal meningitis attained educational levels similar to those of the general population. Given this background (4, 20–23), it appears that the incapacity for continued work among survivors of pneumococcal meningitis might be related to neurocognitive deficits induced by the CNS infection.

Patients with meningococcal meningitis were less likely to be employed than were members of the comparison cohort 2
Table 3. Mantel-Haenszel Difference in Probability of Receiving Disability Pension in Meningococcal, Pneumococcal, or Viral Meningitis and Herpes Simplex Encephalitis Patients Versus Members of the Comparison Cohorts, Denmark, 1994–2008

<table>
<thead>
<tr>
<th>Difference in Probability of Receiving Disability Pension in Patients Versus Comparison Cohorts</th>
<th>All</th>
<th>Model 1*</th>
<th>Model 2b</th>
<th>Model 3c</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>95% CI</td>
<td>%</td>
<td>95% CI</td>
</tr>
<tr>
<td>Meningococcal meningitis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 years before diagnosis</td>
<td>5.6</td>
<td>0.8, 10.5</td>
<td>3.5</td>
<td>−0.7, 7.7</td>
</tr>
<tr>
<td>Year of diagnosis</td>
<td>5.8</td>
<td>1.5, 10.1</td>
<td>4.4</td>
<td>0.4, 8.3</td>
</tr>
<tr>
<td>2 years after diagnosis</td>
<td>6.3</td>
<td>1.8, 10.7</td>
<td>5.2</td>
<td>1.1, 9.4</td>
</tr>
<tr>
<td>5 years after diagnosis</td>
<td>5.1</td>
<td>0.1, 10.2</td>
<td>3.7</td>
<td>−0.9, 8.4</td>
</tr>
<tr>
<td>Pneumococcal meningitis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 years before diagnosis</td>
<td>6.1</td>
<td>2.2, 10.1</td>
<td>4.5</td>
<td>0.9, 8.2</td>
</tr>
<tr>
<td>Year of diagnosis</td>
<td>8.5</td>
<td>4.5, 12.6</td>
<td>6.2</td>
<td>2.4, 10.0</td>
</tr>
<tr>
<td>2 years after diagnosis</td>
<td>18.2</td>
<td>12.9, 23.6</td>
<td>16.7</td>
<td>11.1, 22.2</td>
</tr>
<tr>
<td>5 years after diagnosis</td>
<td>20.2</td>
<td>13.7, 26.7</td>
<td>17.5</td>
<td>10.9, 24.2</td>
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<tr>
<td>Viral meningitis</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2 years before diagnosis</td>
<td>−0.4</td>
<td>−1.3, 0.6</td>
<td>−0.7</td>
<td>−1.5, 0.1</td>
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<tr>
<td>Year of diagnosis</td>
<td>−0.3</td>
<td>−1.2, 0.7</td>
<td>−0.7</td>
<td>−1.5, 0.1</td>
</tr>
<tr>
<td>2 years after diagnosis</td>
<td>−0.4</td>
<td>−1.5, 0.7</td>
<td>−0.6</td>
<td>−1.6, 0.4</td>
</tr>
<tr>
<td>5 years after diagnosis</td>
<td>−0.7</td>
<td>−2.0, 0.6</td>
<td>−0.5</td>
<td>−1.8, 0.8</td>
</tr>
<tr>
<td>Herpes simplex encephalitis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 years before diagnosis</td>
<td>7.1</td>
<td>0.5, 13.8</td>
<td>6.5</td>
<td>−0.4, 13.4</td>
</tr>
<tr>
<td>Year of diagnosis</td>
<td>7.0</td>
<td>0.9, 13.0</td>
<td>6.5</td>
<td>0.5, 12.4</td>
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<td>2 years after diagnosis</td>
<td>13.8</td>
<td>6.1, 21.5</td>
<td>13.7</td>
<td>5.6, 21.7</td>
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<tr>
<td>5 years after diagnosis</td>
<td>16.2</td>
<td>6.2, 26.3</td>
<td>16.2</td>
<td>5.7, 26.7</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; CNS, central nervous system.

* Individuals without comorbid conditions defined by the Charlson Comorbidity Index before CNS infection.

b Individuals not diagnosed with a disease associated with work incapacity before CNS infection.

c Individuals employed 2 years before CNS infection and not having received disability pension.

years before the diagnosis, and this disparity remained throughout the study. This finding may reflect that decreased employment in the meningococcal meningitis patients stems from factors not directly related to the meningitis episode. This possibility is consistent with known environmental risk factors for meningococcal disease, which include social deprivation and cigarette smoking (25–28). The observation that meningococcal meningitis patients did not have an increased need of a disability pension during follow-up implies that the possible long-term neurocognitive deficits induced by a meningococcal meningitis episode are mild. This observation is also supported by the above-cited study on cognitive impairment after bacterial meningitis in adults and by our earlier findings on adult functioning after meningococcal meningitis in childhood (4, 23).

Viral meningitis is considered to have the lowest risk of neurological sequelae among the CNS infections we studied. Nevertheless, studies have indicated that cognitive impairment may follow an episode of viral meningitis (29, 30). A follow-up study of 24 patients with viral meningitis revealed mild cognitive impairments by neuropsychological testing 25 ± 12 months after the infection (29). The patients performed worse in cognitive speed and visual memory compared with controls. All patients except for 2 worked again in their former profession at follow-up. Likewise, a cohort study of 59 viral meningitis patients reported that patients’ learning and memory functions were affected (30). Nevertheless, none of the patients in that cohort had to retire as a consequence of the infection. This result accords with our finding that a viral meningitis episode did not appear to be associated with decreased employment or increased need for a disability pension. As well, the personal income for employed viral meningitis patients remained slightly higher than that for employed comparison cohort members during the follow-up period, implying that the viral meningitis patients did not accept employment in less demanding jobs as a consequence of their illness.

In patients diagnosed with herpes simplex encephalitis, general and focal signs of brain parenchymal involvement are present, and thereby these patients differ clinically from patients with viral meningitis. Severe memory impairment, personality change, aphasia, and epilepsy are well-described sequelae of herpes simplex encephalitis (31–34), with 6 of 22 (27%) of acyclovir-treated survivors reported to have no neuropsychological impairment, 13 of 22 (59%) to have mild, and 3 of 22 (14%) to have moderate/severe neuropsychological impairment after an average of 3 years of follow-up (35). These
severe sequelae accord with our findings of lower employment rate and increased receipt of a disability pension in herpes simplex encephalitis patients compared with the general population.

The prospect of returning to work has been shown to be one of the most critical factors leading to successful rehabilitation (8). With respect to identifying individuals affected by CNS infections who could potentially benefit from medical and vocational rehabilitation, our findings imply that close follow-up of patients with pneumococcal meningitis or herpes simplex encephalitis might be useful.

The economic costs associated with work disability after pneumococcal meningitis constitute a further reason to support existing preventive measures against pneumococcal disease. Following the implementation of pneumococcal conjugate vaccines in childhood, a correlated decline has been observed in adult cases of invasive pneumococcal disease caused by vaccine serotypes (36). Chronic illness and high-risk behaviors, such as cigarette smoking and alcohol consumption, are known conditions associated with pneumococcal disease, with cigarette smoking found to be the strongest independent risk factor for invasive pneumococcal disease among immunocompetent, nonelderly adults (37). According to data from the American Lung Association, 85% of adult smokers began smoking before 22 years of age, implying that public health interventions engaging younger adults through social media might have some benefit in modifying health behaviors (38–40).

As for the herpes simplex virus, currently there are no approved vaccines available. In order to improve the quality of life of those affected by herpes simplex encephalitis, high clinical suspicion and prompt initiation of treatment with intravenous acyclovir are of utmost importance.

We relied on registry-based discharge diagnoses, which may be inaccurate. The registries maintained by Statistics Denmark provided access to almost complete annual data on employment status and personal income during 1980–2009 and complete annual data on disability pension during 1994–2009, allowing us to determine whether CNS infections were associated with adverse socioeconomic outcomes. The registration of meningococcal meningitis in the DNRP has been shown to be highly sensitive and specific (41, 42), making it reasonable to assume similarly high sensitivities and specificities for the other CNS infections. A limitation of the viral meningitis analyses was lack of stratification by viral etiology. We also did not have access to clinical and laboratory data or CNS imaging results during hospitalizations. In conclusion, in a Danish population, pneumococcal meningitis and herpes simplex encephalitis were associated with substantially decreased employment and increased need for a disability pension. These associations did not seem to apply to meningococcal meningitis or viral meningitis.

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REFERENCES


