Socioeconomic Inequalities in Risk of Hospitalization for Community-Acquired Bacteremia: A Danish Population-Based Case-Control Study

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In a Danish population-based case-control study, we examined the association between socioeconomic status (SES) and risk of community-acquired bacteremia, as well as the contribution of chronic diseases and substance abuse to differences in bacteremia risk. Analyses were based on 4,117 patients aged 30–65 years who were hospitalized with first-time community-acquired bacteremia during 2000–2008 and 41,170 population controls matched by sex, age, and region of residence. Individual-level information on SES (education and income), chronic diseases, and substance abuse was retrieved from public and medical registries. Conditional logistic regression was used to compute odds ratios for bacteremia. Persons of low SES had a substantially higher risk of bacteremia than those of high SES (for short duration of education vs. long duration, odds ratio = 2.30 (95% confidence interval: 2.10, 2.52); for low income vs. high income, odds ratio = 2.77 (95% confidence interval: 2.54, 3.02)). A higher prevalence of chronic diseases and substance abuse in low-SES individuals versus high-SES individuals explained 43%–48% of the socioeconomic differences in bacteremia risk. In a country with a universal welfare system, differences in the burden of chronic diseases and substance abuse seem to have major importance in explaining inequalities in bacteremia risk.


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Original Contribution

Abbreviations: CAB, community-acquired bacteremia; CI, confidence interval; DACOBAN, Danish Collaborative Bacteremia Network; PR, prevalence ratio; SES, socioeconomic status.

Community-acquired bacteremia (CAB) is a severe infection and a common cause of hospitalization in Western countries. According to recent population-based studies, the incidence of CAB has increased during the last several decades and now averages 80–90 cases per 100,000 person-years (1–3). The 30-day mortality from bacteremia remains above 15%, which places bacteremia among the top 8 causes of death in Western populations (1, 4, 5). Socioeconomic disparities in the incidence of severe bacterial infection, including bacteremia, are of public health concern and may even exist in countries with universal welfare systems (6). To reduce disparities in bacteremia risk, we need an understanding of the risk factors that contribute to these differences.

Several factors may increase the risk of infections among persons of lower socioeconomic status (SES). Crowding, poorer housing conditions, and poorer hygienic practices may increase exposure to infection in persons of lower SES (6–8). Decreased resistance to infection in lower-SES individuals may be caused by less use of vaccination programs, more smoking, and poorer nutrition (9, 10). Furthermore, several chronic diseases, including chronic heart disease (11, 12), chronic pulmonary disease (11, 13), liver disease (14), diabetes (13, 15), cancer (11, 16), human immunodeficiency virus infection (17), and conditions related to substance abuse (11, 13, 18), are associated with increased risk of bacterial infection and are more prevalent among persons...
of lower SES. Thus, variations in the prevalence of chronic diseases may mediate the association between SES and risk of bacterial infection (19). However, to our knowledge, no previous study has estimated the contribution of preexisting chronic diseases to socioeconomic differences in the incidence of bacterial infection.

A few previous studies have shown an increased risk of bacteremia among persons of lower SES compared with those of higher SES. These studies were limited by either not being population-based (20, 21), using area-based measures of SES (20–23), or having a high percentage of nonresponders when using self-reported information on SES (21). Moreover, preventive efforts are hampered by uncertainty if the increased risk pertains to specific infectious agents. Previous studies have suggested increased susceptibility among persons of lower SES for pneumococcal and Haemophilus influenzae pneumonia (21, 22), Staphylococcus aureus-associated skin and soft-tissue infections (24, 25), and meningococcal and pneumococcal meningitis (26).

Therefore, we conducted a population-based case-control study, using detailed individual-level markers of SES, to examine the association between SES and risk of hospitalization for CAB, and to examine whether this association varied by type of infectious agent. Furthermore, we evaluated the extent to which the burden of chronic diseases and substance abuse contribute to socioeconomic differences in the incidence of CAB.

METHODS

Setting

We conducted this population-based case-control study in 2 regions of Denmark (North Denmark and the Capital Region) with both rural and urban areas and a population of 1.7 million people. The population was predominantly Caucasian, and fewer than 10% were immigrants or descendants of recent immigrants.

The Danish National Health Service provides tax-supported health care for all residents of Denmark, including free access to primary care and public hospitals. Only 1% of hospital beds are in the private sector, and all patients treated for severe infections are admitted to public hospitals. Since April 1, 1968, all permanent residents of Denmark have been assigned a unique civil registration number. These civil registration numbers are included in all Danish medical and public registries, which allowed us to perform electronic linkage between registries (27).

Identification of bacteremia cases

We obtained data from the population-based bacteremia research database established by the Danish Collaborative Bacteremia Network (DACOBAN). DACOBAN was formed to allow coordinated surveillance of bacteremia cases and to study risk factors and prognostic factors for bacteremia. The DACOBAN research database has been described in detail elsewhere (28, 29). All patients with a first-time hospitalization for CAB during the period 2000–2008 were identified in the database. All bacteremia episodes were physician-diagnosed, and blood culture isolates regarded as contaminants were excluded. We did not include patients with blood cultures obtained more than 48 hours after hospital admission, because we considered these infections to have been hospital-acquired. Patients who had been discharged from a hospital within 30 days before the bacteremia episode were also excluded, since these episodes were considered to be health-care-associated.

Selection of population controls

The Danish Civil Registration System is updated daily. It contains civil registration numbers, data on changes in residence, migration, and vital status (dead or alive), and dates of death for all Danish residents from 1968 to the present (27). We used the Civil Registration System to randomly select 10 population controls for each bacteremia case. We matched population controls by age, sex, and region of residence. Controls were selected through incidence density sampling (i.e., eligible population controls had to be alive and at risk of a first hospitalization for CAB on the date of sampling).

Data on SES

Registries administered by the government agency Statistics Denmark are updated yearly and contain detailed individual-level socioeconomic information on all Danish citizens (30–32). We obtained information on educational attainment and annual personal income from these registries as markers of SES. These 2 markers of SES were selected to measure different aspects of socioeconomic stratification. Education is generally acquired in young adulthood and will to some extent measure early-life SES. In contrast, income can change over the life course but may better capture adult SES (33, 34).

Because we used education and income as markers of SES, we restricted the study to adults aged 30–65 years, assuming that most persons in this age group had completed their education and were in their earning years. During the study period, optional retirement with a public pension was possible from the age of 65 onward. The study was restricted to persons below this age, because education and income are considered to be less reliable markers of SES in older, retired persons (33, 35).

Information on highest completed level of education was drawn from the Population Education Register, which consists of data generated from administrative records of educational institutions and from surveys (31). We categorized education into primary/lower secondary education (short), upper secondary education (medium), and tertiary education (long) according to the International Standard Classification of Education 1997 (36).

Personal annual income was drawn from the Income Statistics Register and was defined as all income subject to income taxation (wages, salaries, and all types of benefits and pensions). The income data are primarily supplied by tax authorities and are assumed to reflect real income (32). We adjusted income for inflation according to the year 2000 value of the Danish krone and grouped it into tertiles: low income (first tertile), middle income (second tertile), and high income (third tertile).
Additionally, we obtained information on employment status, immigrant status, cohabitation status, and marital status. Employment status was grouped into 3 categories: employed/self-employed; unemployed/employment subsidized by labor market arrangement; and early retirement pensioner. Cohabitation status was categorized as living either alone or in a relationship. For all variables, we used data from the year preceding the index date of the bacteremia diagnosis.

Identification of chronic diseases

In order to evaluate the contribution of chronic diseases and substance abuse to the association between SES and CAB risk, we obtained data from the Danish National Registry of Patients on any previous hospital diagnosis prior to current admission. The registry contains data on all nonpsychiatric hospitalizations that have taken place since 1977 and all visits to emergency departments and outpatient clinics that have occurred since 1995 (37). The following conditions were considered to be associated with increased risk of CAB: cardiovascular disease, including previous myocardial infarction or congestive cardiac insufficiency; peripheral vascular disease; cerebrovascular disease; dementia; hemiplegia; chronic pulmonary disease; connective tissue disease; peptic ulcer disease; liver disease; diabetes mellitus; moderate or severe chronic kidney disease; solid cancer; leukemia; lymphoma; human immunodeficiency virus infection/acquired immunodeficiency syndrome; and disorders related to alcohol and drug abuse. Associated International Classification of Diseases codes are provided in Appendix Table 1.

Statistical analysis

We calculated frequencies and proportions of cases and controls within categories of SES and for sex, immigrant status, employment status, cohabitation status, marital status, and each chronic disease. Log-binomial regression analysis was used to calculate age- and sex-adjusted prevalence ratios and 95% confidence intervals for the association between SES and chronic diseases and substance abuse. Odds ratios for risk of CAB hospitalization according to each marker of SES were calculated using conditional logistic regression. Because we used incidence density sampling of population controls, the odds ratios estimated incidence rate ratios for risk of CAB hospitalization according to each marker of SES and chronic diseases and substance abuse. To determine the contribution of chronic diseases and substance abuse to the association between SES and bacteremia risk, we calculated the percentage reduction in the \( \beta \) coefficient after adjustment, using the formula:

\[
100 \times \left( \frac{\beta_{unadjusted} - \beta_{adjusted}}{\beta_{unadjusted}} \right)
\]

This method has been used previously by Stringhini et al. (39). We calculated 95% confidence intervals for the percentage of attenuation using a bootstrap method with 1,000 resamplings. To examine whether the association between SES and risk of CAB was consistent in different subgroups, we performed stratified analyses according to age group, sex, and number of chronic diseases. We also performed stratified analyses according to infectious agent. To examine the association between income and risk of CAB independently of educational attainment, we also performed analyses in subgroups of persons with different levels of education.

All statistical analyses were performed with Stata statistical software, version 11.2 (StataCorp LP, College Station, Texas). The study was approved by the Danish Data Protection Agency.

RESULTS

Descriptive data

We identified 4,117 persons aged 30–65 years with a first hospitalization for CAB and 41,170 matched population controls (Table 1). The overall number of bacteremia cases corresponded to an incidence of 55 per 100,000 person-years in our middle-aged study population. The median age of the bacteremia cases and population controls was 54 years (inter-quartile range, 44–60 years), and 52.8% were males. The proportion of immigrants was 10% among both cases and controls. On average, substantially more bacteremia cases than matched controls had a short education (40.1% vs. 27.3%) or a low income (50.4% vs. 31.6%). In addition, cases were more likely to be out of the workforce, to live alone, and be unemployed. The prevalence of chronic disease was also substantially higher among cases than among controls. Among the cases, 51.2% had been diagnosed with 1 or more chronic diseases, compared with 17.5% of the controls. Among the cases, there was also a greater prevalence of alcohol abuse (16.4% vs. 2.5%) and drug abuse (6.6% vs. 0.7%).

Table 2 shows age- and sex-adjusted prevalence ratios for the association between SES and preexisting chronic diseases and substance abuse. Cases with short education and cases in the lowest income tertile were more likely to have 1 or more preexisting chronic diseases than those with long education and those in the highest income tertile (for short education vs. long education, adjusted prevalence ratio (PR) = 1.39 (95% confidence interval (CI): 1.27, 1.53); for low income vs. high income, PR = 1.52 (95% CI: 1.39, 1.66)). They were also much more likely to be substance abusers (short education vs. long: PR = 2.58 (95% CI: 2.07, 3.22); low income vs. high: PR = 5.41 (95% CI: 4.14, 7.05)). The same patterns were observed among population controls, where the prevalence ratio for 1 or more preexisting chronic diseases was 1.50 (95% CI: 1.42, 1.59) for short education versus long education and 1.59 (95% CI: 1.51, 1.68) for low income versus high income. Compared with controls with the highest SES, those with the lowest SES were also much more likely to be substance abusers (short education vs. long: PR = 2.99 (95% CI: 2.52, 3.56); low income vs. high: PR = 6.33 (95% CI: 5.31, 7.54)).

Risk of CAB hospitalization according to SES

The risk of CAB hospitalization increased gradually with decreasing SES (Table 3). This finding was consistent for both markers of SES, with unadjusted odds ratios of 2.30 (95% CI: 2.10, 2.52) for short education versus long education and 2.77 (95% CI: 2.54, 3.02) for low income versus high income. Adjustment for preexisting chronic diseases and conditions related to alcohol and drug abuse greatly

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A higher prevalence of chronic diseases and substance abuse in low-SES individuals compared with high-SES individuals could explain approximately half (43%–48%) of the association between SES and risk of CAB. Nonetheless, after adjustment for chronic diseases and substance abuse, the risk of CAB was still 1.6- to 1.7-fold higher for persons of low SES compared with persons of high SES.

Stratified analyses showed that the increased risk of CAB in persons of low SES was a robust finding across age groups, sex, and number of chronic diseases. More pronounced associations between the 2 markers of SES and risk of CAB were found for persons aged 40–49 years (short education vs. long: unadjusted odds ratio = 3.12 (95% CI: 2.58, 3.77); low income vs. high: unadjusted odds ratio = 4.14 (95% CI: 3.48, 4.93)). Furthermore, income remained a predictor of CAB risk independently of educational level (Table 4).

### Analyses stratified by infectious agent

*Escherichia coli* was the most commonly isolated bacterium, identified in 1,167 (28%) of the cases, followed by...
Our findings of a higher incidence of bacteremia among persons of lower SES are consistent with previous studies. A population-based New Zealand study of 779 incident cases of *S. aureus* bacteremia revealed a lower incidence of bacteremia among persons living in nondeprived areas compared with those living in the most deprived areas (age- and sex-adjusted rate ratio = 0.74, 95% CI: 0.56, 0.98) (23). Two recent US studies found an increased risk of bacteremic pneumonia among persons of lower SES and persons living in impoverished areas (21, 22). Flory et al. (21) used self-reported information on individual-level SES and found that persons without a high school education were 2.7 (95% CI: 2.0, 3.7) times more likely to be admitted to a hospital with bacteremic pneumococcal pneumonia than persons who had attained a college degree. Moreover, persons with an annual income less than $6,000 had a 10-fold increased risk of bacteremic pneumococcal pneumonia compared with those with an income higher than $50,000. The study was hampered by a high percentage of nonresponders to educational (54% missing) and income (67% missing) questions among the 609 individuals with pneumonia. In the second US study, Burton et al. (22) used area-based socioeconomic measures to examine disparities in the incidence of microbiologically verified bacteremic pneumonia among 4,870 adults in 9 states. They found that the incidence of bacteremic pneumonia was more than 2-fold higher (incidence rate ratio = 2.39, 95% CI: 2.16, 2.64) among residents of the most impoverished census tracts (>20% of residents living in poverty) than among residents of the least impoverished census tracts (<5% of residents living in poverty) (22).

Our study supports previous findings of increased susceptibility to infections caused by *S. aureus*, pneumococci, meningococci, and *H. influenzae* among persons of lower SES, which may be partly mediated by overcrowding, poor housing conditions, poor hygienic practices, and smoking (21, 22, 24–26). Evidence is limited, however, with regard to an association between SES and an increased risk of invasive infections caused by enterobacteria, which often originate in the urinary tract. Previous studies have found an increased prevalence of bacteriuria, which is a risk factor for development of acute pyelonephritis, in lower-SES women (40, 41). Furthermore, diabetes is associated with increased risk of enterobacterial bacteremia (42) and is more prevalent in persons of lower SES; this may partly explain our finding of an inverse association between SES and risk of enterobacterial bacteremia.

Several factors may contribute to the association between SES and CAB risk that remained after accounting for differences in chronic diseases and substance abuse. We lacked information on vaccination status at the individual level. However, overall coverage for pneumococcal and meningococcal vaccines is extremely low in our working-age study population compared with other Western populations, including the US population (43). The polysaccharide pneumococcal vaccine is recommended only for persons aged 65 years or older and for persons aged 2–64 years with certain chronic conditions (44). The estimated coverage for pneumococcal vaccine was less than 0.1% in persons aged 30–65 years during our study period (15). The meningococcal group C vaccine and the meningococcal conjugate vaccine...
against serogroups A, C, W-135, and Y are only recommended for travelers to high-risk countries. It is therefore unlikely that socioeconomic differences in vaccination coverage explain the observed disparities in the incidence of pneumococcal and meningococcal bacteremia. Furthermore, the *H. influenzae* type b vaccine was introduced for routine childhood vaccination in 1993, with a coverage rate that has reached almost 90%. After introduction of the vaccine, there was near-elimination of invasive *H. influenzae* type b disease in Denmark (45).

Several lifestyle factors are associated with SES. Persons of lower SES tend to smoke more and to eat more unhealthy foods (46). Previous studies have suggested that both smoking and poor nutrition are risk factors for severe bacterial infection, particularly lower respiratory tract infection (47, 48). We adjusted for several chronic diseases related to unhealthy lifestyles, including chronic obstructive pulmonary disease, diabetes, and cardiovascular disease. Still, we find it likely that the residual association between SES and risk of CAB could be partly related to differences in lifestyle factors. Overcrowding and poor housing conditions may also mediate some of the risk differences in our setting (7, 49), and further studies should assess the potential role of these factors. Finally, studies by Cohen et al. (9, 50) have also suggested that physiological responses to chronic stress associated with lower SES can impair immune function. The observed disparities in the risk of bacterial infection may therefore be partly explained by differences in exposure to psychosocial stress (9, 50).

Our study had 2 major strengths. First, our study design, within the setting of a free tax-supported universal health-care

### Table 3. Association Between Socioeconomic Status and Risk of Hospitalization for Community-Acquired Bacteremia, Before and After Adjustment for Chronic Diseases and Substance Abuse, Denmark, 2000–2008

<table>
<thead>
<tr>
<th>Socioeconomic Marker</th>
<th>Unadjusted</th>
<th>Adjusted</th>
<th>% of Attenuation</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>95% CI</td>
<td>OR</td>
<td>95% CI</td>
</tr>
<tr>
<td>Educational attainment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short</td>
<td>2.30</td>
<td>2.10, 2.52</td>
<td>1.60</td>
<td>1.45, 1.77</td>
</tr>
<tr>
<td>Medium</td>
<td>1.39</td>
<td>1.27, 1.52</td>
<td>1.18</td>
<td>1.07, 1.29</td>
</tr>
<tr>
<td>Long</td>
<td>1.00</td>
<td>Referent</td>
<td>1.00</td>
<td>Referent</td>
</tr>
<tr>
<td>Income category</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low (first tertile)</td>
<td>2.77</td>
<td>2.54, 3.02</td>
<td>1.69</td>
<td>1.54, 1.86</td>
</tr>
<tr>
<td>Middle (second tertile)</td>
<td>1.41</td>
<td>1.28, 1.55</td>
<td>1.20</td>
<td>1.09, 1.32</td>
</tr>
<tr>
<td>High (third tertile)</td>
<td>1.00</td>
<td>Referent</td>
<td>1.00</td>
<td>Referent</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; OR, odds ratio.

* Odds ratios were adjusted for preexisting chronic diseases and for conditions related to alcohol and drug abuse (see Table 1).

* P-trend < 0.001 for both socioeconomic status markers.

* Percentage of attenuation = 100 × (β_unadjusted − β_adjusted)/(β_unadjusted).

* Educational attainment was defined in accordance with the *International Standard Classification of Education 1997* (36): short (primary/ lower secondary education), medium (upper secondary education), or long (tertiary education). Information on educational attainment was available for 96.7% of the cases; therefore, only 3,983 cases were included in the analysis.

* Income categories were based on tertiles. Information on income was available for 99.8% of the cases; therefore, only 4,107 cases were included in the analysis.

### Table 4. Association Between Income and Risk of Hospitalization for Community-Acquired Bacteremia, by Educational Attainment, Denmark, 2000–2008

<table>
<thead>
<tr>
<th>Income Category</th>
<th>Short Education</th>
<th>Educational Attainment</th>
<th>Long Education</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unadjusted</td>
<td>Adjusted</td>
<td>Unadjusted</td>
</tr>
<tr>
<td></td>
<td>OR</td>
<td>95% CI</td>
<td>OR</td>
</tr>
<tr>
<td>Low (first tertile)</td>
<td>2.66</td>
<td>2.15, 3.29</td>
<td>1.59</td>
</tr>
<tr>
<td>Middle (second tertile)</td>
<td>1.42</td>
<td>1.14, 1.78</td>
<td>1.23</td>
</tr>
<tr>
<td>High (third tertile)</td>
<td>1.00</td>
<td>Referent</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; OR, odds ratio.

* Income categories were based on tertiles.

* Educational attainment was defined in accordance with the *International Standard Classification of Education 1997* (36): short (primary/ lower secondary education), medium (upper secondary education), or long (tertiary education).

* Odds ratios were adjusted for preexisting chronic diseases and for conditions related to alcohol and drug abuse (see Table 1).
system, allowed us to conduct a population-based study with little concern about selection bias. Second, we were able to obtain individual-level SES data of high validity and on almost all study subjects (31, 32). Moreover, SES data were collected independently of our study; thus, our study had no influence on the validity of the SES data.

Figure 1. Odds ratios (ORs) for hospitalization for community-acquired bacteremia according to educational level, by infectious agent, Denmark, 2000–2008. Educational level was defined in accordance with the International Standard Classification of Education 1997 (36): short (primary/lower secondary education), medium (upper secondary education), or long (tertiary education). Bars, 95% confidence intervals (CIs).
There were certain limitations of our study that also merit comment. Even though we studied more than 4,000 cases of CAB, analyses stratified by bacteremia type still had low precision. Furthermore, we included only hospitalized patients and did not know the percentage of CAB cases that was captured in our study population. We assume that most

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**Figure 2.** Odds ratios (ORs) for hospitalization for community-acquired bacteremia according to income category, by infectious agent, Denmark, 2000–2008. Income categories were based on tertiles: low (first tertile), middle (second tertile), and high (third tertile). Bars, 95% confidence intervals (CIs).
cases of bacteremia in the age group studied here would result in hospitalization, because of the severity of the symptoms. Still, physicians may be more likely to hospitalize persons of low SES versus persons of high SES, including those with less severe bacteremia, because of concerns about poor self-care, treatment compliance, and lack of social support. The possible surveillance bias could have led to over-estimation of the risk of CAB in persons of lower SES compared with persons of higher SES. In addition, physicians probably have a lower threshold for admitting persons with the coexisting chronic diseases that were associated with low SES in our study. However, our finding of a consistent inverse association between SES and CAB risk in subgroups of persons with different levels of chronic disease suggests a lack of major bias.

An important step in the prevention of severe infections is the identification of persons at increased risk. In this study, we found that persons of lower SES were at increased risk of hospitalization for CAB compared with those of higher SES. The mediating factors that contribute to this increased risk of severe infection among lower-SES individuals are complex and interwoven. In our setting within a universal welfare system, we found that differences in the prevalence of preexisting chronic conditions and substance abuse had a major role in explaining inequalities in bacteremia risk. Therefore, improvement in prevention, treatment, and management of chronic diseases among persons of lower SES could reduce inequalities in risk of CAB, along with reducing inequalities in overall health. Still, about 50% of the inequalities in CAB risk in this population remained unexplained. Therefore, the role of other potential mediating factors, including smoking, poor nutrition, overcrowding, and housing conditions, needs further investigation.

The inverse association between SES and CAB risk was consistent for all infective agents. Nonetheless, efforts targeted toward prevention of the most prevalent agents, including *E. coli* and *S. pneumoniae*, would have the largest impact on reducing inequalities in the incidence of CAB.

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## Appendix Table 1. Diagnosis codes for chronic disease conditions included in a study of socioeconomic status and risk of community-acquired bacteremia, Denmark, 2000–2008\(^a\)

<table>
<thead>
<tr>
<th>Condition</th>
<th>ICD-8 Description</th>
<th>ICD Version and Code(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular disease(^b)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peripheral vascular disease</td>
<td>440–445</td>
<td>I70–I74 and I77</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>430–438</td>
<td>I60–I69, G45, and G46</td>
</tr>
<tr>
<td>Dementia</td>
<td>290.09–290.19 and 293.09</td>
<td>F00–F03, F05.1, and G30</td>
</tr>
<tr>
<td>Hemiplegia</td>
<td>344</td>
<td>G81 and G82</td>
</tr>
<tr>
<td>Chronic pulmonary disease</td>
<td>491–493 and 515–518</td>
<td>J41–J47, J60–J67, J68.4, J70.1, J70.3, J84.1, J92.0, J96.1, J98.2, and J98.3</td>
</tr>
<tr>
<td>Connective tissue disease</td>
<td>135.99, 446, 712, 716, and 734</td>
<td>M05, M06, M08, M09, M30–M36, and D86</td>
</tr>
<tr>
<td>Peptic ulcer disease</td>
<td>530.91, 530.98, and 531–534</td>
<td>K22.1 and K25–K28</td>
</tr>
<tr>
<td>Liver disease</td>
<td>070.00, 070.02, 070.04, 070.06, 070.08, 456.00–456.09, 571, 573.00, 573.01, and 573.04</td>
<td>B15.0, B16.0, B16.2, B18, B19.0, K70.0–K70.4, K70.08, K71–K74, K76.0, K76.6, I86</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>249 and 250</td>
<td>E10, E11, and E14</td>
</tr>
<tr>
<td>Moderate or severe chronic kidney disease</td>
<td>403, 404, 580–584, 590.09, 593.19, 753.10–753.19, and 792</td>
<td>I12, I13, N00–N05, N07, N11, N14, N17–N19, and Q61</td>
</tr>
<tr>
<td>Solid cancer</td>
<td>140–199</td>
<td>C00–C80</td>
</tr>
<tr>
<td>Leukemia</td>
<td>204–207</td>
<td>C91–C95</td>
</tr>
<tr>
<td>Lymphoma</td>
<td>200–203 and 275.59</td>
<td>C81–C85, C88, C90, and C96</td>
</tr>
<tr>
<td>HIV/AIDS</td>
<td>079.83</td>
<td>B20–B24</td>
</tr>
<tr>
<td>Disorders related to alcohol abuse</td>
<td>291, 303.19, 303.20, 303.28, 303.29, 303.91, 979, and 577.10</td>
<td>F10.2–F10.9, G31.2, G62.1, G72.1, I42.8, K29.2, and K86.0</td>
</tr>
<tr>
<td>Disorders related to drug abuse</td>
<td>294.39 and 304</td>
<td>F11–F16, F18, F19, and T40</td>
</tr>
</tbody>
</table>

Abbreviations: AIDS, acquired immunodeficiency syndrome; HIV, human immunodeficiency virus; ICD, International Classification of Diseases.

\(^a\) The Danish version of the Eighth Revision of the ICD (ICD-8) was used until the end of 1993; the Tenth Revision (ICD-10) was used thereafter.

\(^b\) Includes previous myocardial infarction or congestive cardiac insufficiency.