Socioeconomic differences in the burden of disease in Sweden
Rickard Ljung,1 Stefan Peterson,2 Johan Hallqvist,3 Inger Heimerson,4 & Finn Diderichsen5

Objective We sought to analyse how much of the total burden of disease in Sweden, measured in disability-adjusted life years (DALYs), is a result of inequalities in health between socioeconomic groups. We also sought to determine how this unequal burden is distributed across different disease groups and socioeconomic groups.

Methods Our analysis used data from the Swedish Burden of Disease Study. We studied all Swedish men and women in three age groups (15–44, 45–64, 65–84) and five major socioeconomic groups. The 18 disease and injury groups that contributed to 65% of the total burden of disease were analysed using attributable fractions and the slope index of inequality and the relative index of inequality.

Findings About 30% of the burden of disease among women and 37% of the burden among men is a differential burden resulting from socioeconomic inequalities in health. A large part of this unequally distributed burden falls on unskilled manual workers. The largest contributors to inequalities in health for women are ischaemic heart disease, depression and neurosis, and stroke. For men, the largest contributors are ischaemic heart disease, alcohol addiction and self-inflicted injuries.

Conclusion This is the first study to use socioeconomic differences, measured by socioeconomic position, to assess the burden of disease using DALYs. We found that in Sweden one-third of the burden of the diseases we studied is unequally distributed. Studies of socioeconomic inequalities in the burden of disease that take both mortality and morbidity into account can help policy-makers understand the magnitude of inequalities in health for different disease groups.

Keywords Cost of illness; Socioeconomic factors; Disabled persons; Mental disorders/epidemiology; Cardiovascular diseases/epidemiology; Chronic disease/epidemiology; Quality-adjusted life years; Epidemiologic studies; Sweden (source: MeSH, NLM).

Mots clés Coût maladie; Facteur socioéconomique; Handicapé; Troubles mentaux/épidémiologie; Maladie chronique/épidémiologie; Rapport qualité vie-survie; Etude analytique (Épidémiologie); Suède (source: MeSH, INSERM).

Palabras clave Costo de la enfermedad; Factores socioeconómicos; Personas incapacitadas/epidemiología; Trastornos mentales/epidemiología; Enfermedad crónica/epidemiología; Calidad de acuerdo a los años de vida; Estudios epidemiológicos; Suecia (fuente: DeCS, BIREME).

Introduction
Burden of disease measurements that use disability-adjusted life years (DALYs) have been carried out at international, national and subnational levels in high-income, medium-income and low-income countries (1–5). The burden of disease has also been disaggregated by risk factors (6–8) as a basis for making projections about health gains from population interventions (9). DALYs have also been used to estimate the global burden of disease among the poor (10). There have also been recommendations that a more comprehensive list of both distal and proximal risk factors should undergo further analysis at the national level (6). A distal risk factor of key concern to policy-makers is socioeconomic position (11, 12). A vast body of literature exists on measuring health differentials across socioeconomic groups, and applicable methods have been summarized by Mackenbach & Kunst (13). However, the use of overall levels without causes or cause-specific comparisons does not lend itself to targeting interventions at diseases and risk factors that cause health differentials. Measuring the cause-specific burden of disease by socioeconomic group would fill this need.

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Therefore, using data from the Swedish Burden of Disease Study 1998 (14) we set out to analyse how much of the total burden of disease is due to inequalities in health between socioeconomic groups and how this unequal burden is distributed over different disease groups and socioeconomic groups. We also studied the absolute and relative differences in the burden of disease in Sweden by socioeconomic group.

Material and methods

The Swedish Burden of Disease Study

DALYs measure the combined burden of mortality and disability for different diseases. DALYs are composed of years of life lost (YLL) and years lived with disability (YLD) (15). The Swedish Burden of Disease Study aimed to document disease burden as a basis for formulating national health policy goals (14). The focus on the present burden of disease, together with the use of data from national health interview surveys and inpatient registers led to some methodological modifications of the standard DALY in the 1998 study. In calculating the burden for an average year during the period 1988–95, global disability weights were used but they were not discounted or age-weighted. The life expectancy at birth was set to 80 years for men and 82.5 years for women. The prevalence of conditions was used to calculate the mortality burden because the aim was to focus on the present burden of disease; the incidence of deaths was taken into account. The 20 disease and injury groups that contributed the most to the burden of disease in Sweden accounted for 70% of the total burden (Table 1) (14).

In our study, we analysed 18 of the 20 disease groups. Perinatal diseases and sudden infant death syndrome in both sexes were excluded. Prostate cancer and gynaecological cancers were also excluded because these do not occur in both sexes. The absolute values, YLLs and YLDs by sex, age group and disease and injury group are fixed in our study and are taken directly from the earlier study (14). The 18 diseases that we analysed accounted for 65% of the burden of disease in Sweden.

Study base

Data from the Swedish Burden of Disease Study form the basis for our analysis. We have restricted the analysis to all Swedish men and women in three age groups (15–44, 45–64 and 65–84) and five major socioeconomic groups for the study period 1988–95 (Table 2).

Table 1. The 20 disease and injury groups found by the Swedish Burden of Disease Study to contribute most to the burden of disease in Sweden. Total number of disability-adjusted life years (DALYs) and the percentage of the total for an average year are given for 1988–95

<table>
<thead>
<tr>
<th>Disease group and rank</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease group and rank</td>
<td>DALY</td>
<td>%</td>
</tr>
<tr>
<td>1. Ischaemic heart disease</td>
<td>200 277</td>
<td>19.2</td>
</tr>
<tr>
<td>2. Depression and neurosis</td>
<td>69 046</td>
<td>6.6</td>
</tr>
<tr>
<td>4. Alcohol addiction</td>
<td>46 939</td>
<td>4.5</td>
</tr>
<tr>
<td>5. Self-inflicted injuries</td>
<td>4 421</td>
<td>0.4</td>
</tr>
<tr>
<td>6. Dementia</td>
<td>32 801</td>
<td>3.1</td>
</tr>
<tr>
<td>7. Asthma and COPD</td>
<td>29 242</td>
<td>2.8</td>
</tr>
<tr>
<td>8. Bronchial and lung cancer</td>
<td>28 197</td>
<td>2.7</td>
</tr>
<tr>
<td>9. Traffic accidents</td>
<td>24 266</td>
<td>2.3</td>
</tr>
<tr>
<td>10. Psychosis excluding schizophrenia</td>
<td>24 140</td>
<td>2.3</td>
</tr>
<tr>
<td>11. Prostate cancer</td>
<td>23 734</td>
<td>2.3</td>
</tr>
<tr>
<td>12. Hearing disorder</td>
<td>22 132</td>
<td>2.1</td>
</tr>
<tr>
<td>13. Respiratory infections</td>
<td>21 059</td>
<td>2.0</td>
</tr>
<tr>
<td>15. Congenital malformations</td>
<td>18 696</td>
<td>1.8</td>
</tr>
<tr>
<td>16. Colorectal cancer</td>
<td>17 886</td>
<td>1.7</td>
</tr>
<tr>
<td>17. Diabetes</td>
<td>16 339</td>
<td>1.6</td>
</tr>
<tr>
<td>18. Falls</td>
<td>14 010</td>
<td>1.3</td>
</tr>
<tr>
<td>20. Perinatal disease and SIDS</td>
<td>13 502</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Subtotal | 741 198 | 71 | Subtotal | 667 560 | 68 |
| Others | 305 692 | 29 | Others | 309 834 | 32 |
| Total | 1 046 890 | 100 | Total | 977 394 | 100 |

Source: 14.

a COPD = chronic obstructive pulmonary disease.

b SIDS = sudden infant death syndrome.
DALYs

Total absolute YLLs and YLDs for each disease and injury group were distributed across socioeconomic groups. We took into account the size of each socioeconomic group as well as the specific relative risk of each disease and injury group for each socioeconomic group stratified by age and sex. Two sources of information were used to determine the relative risks by socioeconomic group. Our first source was the Social Database managed by the Swedish National Board of Health and Welfare; this database contains information on all deaths and patients being treated in hospital as well as information on socioeconomic and demographic data linked together by personal identification number. The socioeconomic information in this database is based on occupational information reported during national censuses; the most recent was performed in 1990 (18). Our second source was the Swedish Survey of Living Conditions, which is conducted yearly using a nationally representative sample. It contains information on self-reported illness, health-care utilization and socioeconomic factors (19).

Years of life lost (YLL)

Mortality rates for each of the 18 diseases studied were classified by socioeconomic group and stratified by age and sex using data from the above mentioned Social Database for the period 1988–95. Relative mortality risks were derived from these.

Years lived with disability (YLD)

The years lived with a disability were calculated as follows.

- For back and neck disease, asthma and chronic obstructive pulmonary disease disorder, depression and neurosis, hearing disorders, and diabetes, the prevalence ratio was derived from self-reports on long-standing illness from the Swedish Survey of Living Conditions (19).
- For alcohol addiction, dementia, psychosis (excluding schizophrenia), traffic accidents, falls and stroke, the prevalence ratio for the first three diseases and the incidence rate ratio for the latter three were based on data on patients treated in hospital between 1991 and 1994. These data were derived from the Social Database.
- For self-inflicted violence, ischaemic heart disease and respiratory infections the YLL accounted for more than 90% of the total DALY, therefore the relative risk used for mortality was also used for morbidity.
- For bronchial, lung, breast, and colorectal cancer, and blood malignancies it was assumed that the relative risk of morbidity was the same as the relative risk of mortality.
- For self-inflicted violence, ischaemic heart disease and respiratory infections the YLL accounted for more than 90% of the total DALY, therefore the relative risk used for mortality was also used for morbidity.
- For alcohol addiction, dementia, psychosis (excluding schizophrenia), traffic accidents, falls and stroke, the prevalence ratio for the first three diseases and the incidence rate ratio for the latter three were based on data on patients treated in hospital between 1991 and 1994. These data were derived from the Social Database.

Socioeconomic groups

The final analysis is restricted to the five major socioeconomic groups of unskilled manual workers, skilled manual workers, lower non-manual workers, intermediate non-manual workers and higher non-manual workers as defined by the socioeconomic classifications of Statistics Sweden (18). (See the Annex (web version only, available at: http://www.who.int/bulletin) for an explanation of these groups.)

People who were self-employed, farmers and those whose status was unclassified were omitted; they accounted for 34% of the person-years in men and 44% in women. Additionally, they accounted for 44% of the disease burden in men and 51% of the burden in women. The self-employed are a socioeconomically heterogeneous group. Sweden has few farmers. The largest group contains those whose status is unclassified; many of them are in the youngest age group and they had not yet entered the labour market at the time of the most recent census. They cannot therefore be categorized in the socioeconomic classification system (Table 2). The remainder of those who are unclassified are a mixture of people for whom information is missing, who retired early, those who have been excluded from the labour market and a small number of students and military conscripts. People who were ill with severe diseases, e.g. schizophrenia, and have never been in the labour market may also be unclassified. By restricting our analysis to 18 disease and injury groups and five socioeconomic groups we are able study one-third of the total measured burden of disease in Sweden.

Statistical analysis

We have studied the differential burden of disease by assuming the counterfactual distribution of exposure based on the principle of plausible minimal risk: that is, all socioeconomic groups have the same risk as the most affluent group. Previous studies have attributed the burden of disease to specific risk factors (6, 9, 10). We have used the same method to analyse the burden of disease attributable to socioeconomic position.

Table 2. Distribution of men and women by socioeconomic group and age during an average year in Sweden, 1988–95* (See the Annex (web version only, available at: http://www.who.int/bulletin) for information on the socioeconomic classifications)

<table>
<thead>
<tr>
<th>Socioeconomic category</th>
<th>Manual</th>
<th>Non-manual</th>
<th>Omitted groups</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unskilled</td>
<td>Skilled</td>
<td>Lower</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15–44</td>
<td>8.0</td>
<td>2.2</td>
<td>5.0</td>
<td>3.1</td>
</tr>
<tr>
<td>45–64</td>
<td>10.1</td>
<td>1.7</td>
<td>6.3</td>
<td>4.0</td>
</tr>
<tr>
<td>65–84</td>
<td>8.2</td>
<td>0.7</td>
<td>2.8</td>
<td>1.5</td>
</tr>
<tr>
<td>Total</td>
<td>26.3</td>
<td>4.5</td>
<td>14.1</td>
<td>8.5</td>
</tr>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15–44</td>
<td>8.1</td>
<td>6.9</td>
<td>2.2</td>
<td>3.0</td>
</tr>
<tr>
<td>45–64</td>
<td>7.5</td>
<td>6.9</td>
<td>3.2</td>
<td>6.5</td>
</tr>
<tr>
<td>65–84</td>
<td>5.1</td>
<td>3.9</td>
<td>2.2</td>
<td>4.0</td>
</tr>
<tr>
<td>Total</td>
<td>20.7</td>
<td>17.7</td>
<td>7.5</td>
<td>13.6</td>
</tr>
</tbody>
</table>

* Based on calculation of person-years during the period 1988–95.

† Totals do not sum exactly due to rounding of decimals.
In the analysis of attributable fractions in Fig. 1 and Fig. 2 the measure analysed is DALYs per socioeconomic group. The slope index of inequality is the slope of the regression line showing the relationship between a group’s health and its relative rank in the socioeconomic distribution; this can be interpreted as the absolute difference in health between the least-advantaged and most-advantaged groups (13, 20–22). The relative index of inequality (as modified by Mackenbach & Kunst) is the ratio of the estimated rate of health problems occurring among those in the least-advantaged group to that occurring among those in the most-advantaged group (13). The measure studied for the slope index of inequality and the relative index of inequality is DALY per 100 000 person-years. There is no standard method of calculating random bias for the slope index of inequality and the relative index of inequality. We have chosen to use the recommended equation in Kakwani et al. (23). All calculations have been made using Excel version 5 and SAS statistical software version 8.1.

Results

In women 30% of the burden of disease across socioeconomic groups is a differential burden resulting from socioeconomic inequalities (Fig. 1). Altogether 75% of this differential burden falls on unskilled workers. Ischaemic heart disease, depression and neurosis, and stroke account for more than half of the differential burden. For both sexes, ischaemic heart disease carries the largest burden of disease, and it is the second greatest contributor to the absolute inequality in the burden of disease. In contrast to other diseases, however, breast cancer has an inequality that favours those in the less-advantaged groups, with 338 more DALYs occurring per 100 000 person-years among women in the most-advantaged group compared with the least-advantaged. Alcohol addiction is the disease with the greatest relative inequality among women, followed by neck and back disease, ischaemic heart disease, diabetes and dementia.

Among men ischaemic heart disease is the largest contributor to inequalities in the burden of disease with a slope index of inequality more than double that of the second largest contributor (alcohol addiction). Self-inflicted injuries, depression and neurosis, neck and back disease, and stroke are other diseases with large relative inequalities. Alcohol addiction, neck and back disease, and self-inflicted injuries also show large relative inequalities. In contrast to the findings for women, large relative inequalities occur for traffic accidents and falls among men.

The composition of the burden due to mortality and morbidity differs between disease groups (Table 3). For ischaemic heart disease and self-inflicted injuries more than 90% of the burden results from mortality. For two other large contributors...
to absolute inequalities (depression and neurosis and neck and back disease) almost 100% of the burden results from morbidity. In women mortality accounts for 49% of the equally distributed burden and 54% of the differential burden; in men these figures are 63% and 60%, respectively (data not shown).

Precise calculations show that the unequal distribution is not the result of random bias. For the largest contributor to inequality, ischaemic heart disease among men, which has a slope index of inequality of 3616 DALYs per 100 000 person-years the 95% confidence interval (CI) is 2793–4439 DALYs per 100 000. For blood malignancies among women, a disease for which there are few cases and there is a much smaller inequality, the slope index of inequality is 48 DALYs per 100 000 (95% CI = –13–109 DALYs per 100 000).

**Discussion**

This is the first study to use socioeconomic differences, measured by socioeconomic position, to assess the burden of disease using DALYs. The results show that in Sweden one-third of the burden of the diseases studied is unequally distributed. The unequal distribution falls to a large extent on unskilled manual workers. A few disease groups account for more than half of the unequal distribution. The diseases that account for most of the total burden of disease are also those that have the largest differentials in burden. With the exception of breast cancer, which is a large contributor of disease burden in women, inequality in the burden of disease implies that there is less disease burden among more-advantaged groups. Had we included other determinants of inequality, e.g., ethnicity, the unequally distributed burden would have been even greater.

The burdens of mortality and morbidity occur in the same proportions in the differential burden as they do in the equally distributed burden. From this it is clear that people in manual groups not only die younger than those in non-manual groups but also suffer from more non-fatal diseases during their lifetime. Overall we found that among men there were greater absolute inequalities and greater relative inequalities in health than among women. The largest contributors to the burden of disease are similar for men and women. The exceptions were the larger contributors among men: alcohol addiction, self-inflicted injuries, bronchial and lung cancer, and traffic accidents.

We restricted our analysis to the 18 disease groups in the Swedish Burden of Disease Study that accounted for two-thirds of the total burden of disease. We suspect that if we were to analyse the entire burden of disease then the groups of rare diseases would have a more equal distribution across socioeconomic groups. This would increase the burden of equally distributed diseases and, as a consequence, decrease the differential burden. The Swedish Burden of Disease Study did not adjust for comorbidity. This is likely to affect diseases such as diabetes and ischaemic heart disease, thus increasing the differential burden. We studied the five major socioeconomic groups usually studied in Sweden (19). If the groups classified as self-employed, farmers and unclassified had been included, then the differential burden of disease resulting from socioeconomic distribution would be even larger, and both the slope index of inequality and the relative index of inequality would increase for each of the disease groups studied. Those who were classified as self-employed or as farmers have a burden of disease that is close to that found in the lower non-manual group (data not shown). The unclassified group has the highest burden for most of the diseases (data not shown). We suspect that this large group consists of relatively more manual than non-manual workers who are unemployed or who retired early because of illness or injury. This would lead to an underestimation of the social gradient for some of...
The DALY measure incorporates value judgements, e.g. disability weights, and can also incorporate discounting and age weighting. People in socioeconomic groups in the manual category die younger than those in the non-manual categories. Discounting would put proportionally less burden on future generations and give more weight to current deaths. The DALY measure is therefore more suitable for comparing countries with different age structures than the YLD measure.

The DALY measure will also do the most to reduce inequalities in health. It may be easier to make between-country comparisons of socioeconomic differences in the burden of disease than within a country. However, it will be impossible to make comparisons that include low-income countries using higher classifications of social stratification. Several European countries that are not industrialized or where a majority of the workforce is not employed in the formal sector. Several European countries have been shown to have larger absolute socioeconomic inequalities in mortality than Sweden (25, 26). Studying socioeconomic differences in the burden of disease would therefore likely demonstrate that there are larger inequalities in these countries than there are in Sweden. It may be easier to make comparisons within a country and then use the relevant social stratification measures for each setting. However, it will still be necessary for deaths to be registered and characterized socioeconomically. It may be easier to make between-country comparisons that include low-income countries using higher mortality and morbidity into account. This helps policy-makers understand overall and disease-specific inequalities in health and subsequently to target measures to address them. For example, the Swedish Parliament has decided on public health priorities and goals for the coming 10 years (24). Two of these goals are to reduce alcohol consumption and the incidence of smoking. There are large inequalities in the burden of disease associated with these lifestyle risk factors, and these inequalities fall disproportionately on people in less-advantaged groups. Other goals are to strengthen social capital and improve mental health; these correspond with our findings that the group depression and neurosis is one of the largest contributors to inequalities in disease burden. So far there have been no difficult choices: targeting the largest contributors to the overall burden of disease will also do the most to reduce inequalities in health.

To make between-country comparisons of socioeconomic differences in the burden of disease it is necessary to have a universal classification system for social stratification. This may be possible in western Europe but a global classification scheme would be impossible, especially if it were to include countries that are not industrialized or where a majority of the workforce is not employed in the formal sector. Several European countries have been shown to have larger absolute socioeconomic inequalities in mortality than Sweden (25, 26). Studying socioeconomic differences in the burden of disease would therefore likely demonstrate that there are larger inequalities in these countries than there are in Sweden. It may be easier to make comparisons within a country and then use the relevant social stratification measures for each setting. However, it will still be necessary for deaths to be registered and characterized socioeconomically. It may be easier to make between-country comparisons that include low-income countries using higher
non-manual workers as a reference group. In such comparisons we would expect low-income countries to have larger differential burdens than those found in our study. If the reference group higher non-manual workers, which is largely composed of civil servants, is used to make between-country comparisons it is possible that in low-income countries members of this group are more likely to suffer from diseases such as obesity and diabetes as these populations enter the epidemiological transition.

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Conflicts of interest: none declared.
References


Annex

The five major socioeconomic groups in Sweden

In Sweden the socioeconomic classification scheme is based on a person's occupation and the educational requirements of each occupational level.

The five categories are as follows.

• Unskilled manual workers: people in this category have normally had less than 2 years of post-comprehensive school education. (e.g. drivers, shop assistants).
• Skilled manual workers: people in this category have normally had 2 or more years of post-comprehensive school education. (e.g. bakers, mechanics, nursing assistants).
• Lower non-manual workers: people in this category normally have had 2, but not 3, years of post-comprehensive school education. (e.g. pharmacy assistants).
• Intermediate non-manual workers: people doing these jobs normally have had 3–5 years, but not 6, years of post-comprehensive school education. (e.g. registered nurses, mechanical engineers).
• Higher non-manual workers: people in these jobs normally have had at least 6 years of post-comprehensive school education. (e.g. teachers, government administrators).