Socioeconomic differences in risk of myocardial infarction 1971–1994 in Sweden: time trends, relative risks and population attributable risks

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Background The general trend in incidence of myocardial infarction (MI) in the Stockholm area changed from increasing to decreasing around 1980. The objective of this study is to examine time trends in incidence in major socioeconomic strata, relative risk between socioeconomic groups and population risk attributable to socioeconomic differences during this period.

Methods All cases of MI from 1971 to 1986 were identified from hospital discharge and cause-of-death registers. Person-years for each year of follow-up were calculated from the population register in the Stockholm region 1971–1986. Census registers were used for information on socioeconomic status. Register information was individually linked through the Swedish personal identification number. Supplementary information for 1992–1994 was taken from the case-control study SHEEP (Stockholm Heart Epidemiology Program).

Results The decline in MI risk among male high- and middle-level employees started in 1976 and in male manual workers in 1981. For women incidence increased from 1971 to 1986 among manual workers and decreased among high- and middle-level employees. The increase over time of the relative risk from low socioeconomic position continued into the 1990s. Despite the reduction of the category of manual workers, the population attributable risk from socioeconomic differences also increased over time. The process of social change influencing the size of the socioeconomic groups contributes to the change in time trends of MI morbidity.

Conclusions The increase over time of relative and population attributable risks of MI from low socioeconomic status add to the public health importance of social inequity.

Keywords Myocardial infarction, social class, incidence, trend

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The social dynamics of ischaemic heart disease risk is an important public health issue and has some known characteristics. In recent decades there has been an increase in age-specific mortality in some nations facing economic difficulties while more prosperous nations have experienced peaks followed by declines.1–2 These changes in mortality mainly reflect a change in disease risk but also in availability and effectiveness of new treatments, and possibly a change in the natural course and severity of the disease.3–4 The conclusions on changes in disease risk from time trends in mortality are supported by some available information on trends in incidence.4–7 Another important phenomenon is that despite the downward average trend in some countries there are increased social gradients within their populations with higher risks for lower socioeconomic or less educated groups.8–14 In Sweden the decline in age-specific mortality from MI (among men) started in the late 1970s and in age-specific incidence in the early 1980s among both men and women.15–21 An increasing relative risk among manual workers is also seen in this period.22

Some important questions have yet to be answered. Is incidence declining in all major socioeconomic groups among both men and women? Are there different timings for the peaks in different social strata? Is the social stratification a constant feature of the society or do the relative sizes of different social strata change over time? If so, what effect does the process of social change have on time trends in incidence, relative risk of low socioeconomic groups and risk that may be attributed to
prevaling socioeconomic differences? We will analyse these questions with data on incidence of MI from Sweden during the period 1971–1986 that includes the break in the overall trend. Information from a case-control study makes it possible to extend the trends in relative and population attributable risks into the 1990s.

Material and Methods

The source population includes all men and women aged 45–64 years, living each year in Stockholm County, a predominantly urban area, during the period 1971–1994, i.e. approximately 350 000 each year. From 1971 to 1986 all MI in this population were identified either as a discharge with diagnosis 410 (ICD-8) in the regional hospital discharge register, covering all hospitals in the region, or as a death with 410 (ICD-8) as the underlying or the contributory cause of death in the National Cause of Death register. Both first and recurrent MI were accepted as events. Two discharges, or one discharge later followed by death, recorded for the same individual were regarded as representing two MI only if the time between the events was more than 28 days. Altogether 15 785 male and 3728 female MI were identified. Person-years for 1971–1986 were estimated from a 10% random sample of the population defined as a dynamic cohort. Of those moving into the county each year 10% were included in the beginning of the year and subjects in the cohort who moved out or died were excluded by the end of each year.

Socioeconomic status (SES) is derived from self-reported job titles in the Swedish censuses. In the Census registers this information is available as occupational titles. After conversion into socioeconomic categories they were assigned individually to all cases and all members of the 10% random sample with the help of the unique personal 10-digit identification number. The census register and the hospital discharge register are based on the register of the total population from which the 10% sample was drawn and the three registers all contain the personal identification number. Missing information on occupation status due to non-participation in the census, and on discharge diagnosis in the hospital registers was less then 3% in the period examined. Both men and women were classified according to their own occupation. Each case and person-year was classified according to their SES 1–6 years before the year of follow-up. The 1970 Census register was used in the period 1971–1976, the 1975 Census register for 1977–1981 and the 1980 Census register for 1982–1986. The information on prevalence of socioeconomic groups in the source population was taken from the Census registers of the years 1970, 1975, 1980, 1985 and 1990 respectively.

The socioeconomic classification scheme is derived from Statistics Sweden to reflect the social stratification of the Swedish society. The two major categories of this classification, the manual workers and the non-manual employees or civil servants, were focused in this study and the small groups of self-employed and people not gainfully employed were excluded from the analysis. Manual workers can be further divided into skilled and unskilled but for reasons of statistical power they were kept together. The non-manual group can be subdivided into high, medium and low grade. As the low-grade employees often have an intermediary role, both socially and in terms of disease risk, they were analysed separately. In the male source population typical occupations among high- and middle-level employees are engineers, sales executives, senior civil servants, administrators and managers; among low-level employees attendants and caretakers; and in the category of manual workers there are drivers, craftsmen, skilled and unskilled workers. In the female source population typical occupations among high- and middle-level employees are teachers, nurses, qualified social workers and senior administrators; and among low-level employees clerks and telephone operators. In the female group of manual workers there are, for example, assistant nurses, day nursery assistants, shop assistants, waiters and cleaners.

To extend the trends into the 1990s we used information from a population based case-control study called Stockholm Heart Epidemiology Program (SHEEP). Cases, defined as first MI event, were identified through a special organization at all 10 emergency hospitals in the region or from discharges with a diagnosis of 410 (ICD-9) in the regional hospital discharge register. Fatal cases were also identified from death certificates with a diagnosis of 410 (ICD-9). There were 1047 male cases identified in 1992–1993 and 415 female cases in 1992–1994 in the 45–64 year age group. One control for each case was selected randomly from the source population after stratification for sex, age and hospital catchment area. Questions on occupational history similar to those found in the censuses were included in the questionnaire. For fatal cases they were answered by close relatives. To enhance comparability with the register cohort the socioeconomic categories of the SHEEP-subjects were based on job titles from the census year 1990. The analyses were restricted to the same socioeconomic categories as in the register cohort.

Incidence rates and rate ratios were age-standardized by weights in 5-year age groups from the 1990 age structure. Average yearly incidence rates for 3-year periods are reported. To quantify the annual change in incidence a linear regression line was fitted to a plot of yearly incidence rates and the per cent annual change was then calculated as the average of all yearly changes. Odds ratios for the period 1992–1994 were calculated by logistic regression in SAS 6.11. Population attributable risks were calculated as weighted by multiple-category exposures using the rate ratios and odds ratios for low-level employees and workers in Table 1 and the prevalences of socioeconomic groups in Figures 2 and 3. Interaction between gender and social stratification was analysed as proposed by Rothman with confidence limits as suggested by Hosmer and Lemeshow.

Results

In Figure 1 the incidence rate curves have a social gradient for both men and women during the entire period. Among male high- and middle-level employees the yearly incidence curve peaked in 1976 and the mean annual decline after that was −1.9% (95% confidence interval [CI]: −3.3 to −0.7). Male manual workers had their peak in 1981 followed by a mean annual decline of −3.2% (95% CI: −9.6 to 0.9). The choice of 1976 and 1981 as the moments of peak was verified from a 3-year sliding window and also the average for the period 1971–1986 and 1981–1994. Among women the period 1981–1994 contained the break in the overall trend. Information from a case-control study makes it possible to extend the trends in relative and population attributable risks into the 1990s.
Table 1 Relative risks for myocardial infarction in lower versus higher socioeconomic groups and population attributable risks due to socioeconomic differences among men and women 45–64 years old in Stockholm county 1971–1994. Direct age-standardized

<table>
<thead>
<tr>
<th>Relative risk</th>
<th>High- &amp; middle-level employees</th>
<th>Low-level employees</th>
<th>Manual workers</th>
<th>Population attributable risk %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1971–1974</td>
<td>1.0</td>
<td>1.13 (1.02–1.27)</td>
<td>1.17 (1.08–1.27)</td>
<td>0.08</td>
</tr>
<tr>
<td>1975–1978</td>
<td>1.0</td>
<td>1.12 (1.01–1.24)</td>
<td>1.17 (1.08–1.26)</td>
<td>0.07</td>
</tr>
<tr>
<td>1979–1982</td>
<td>1.0</td>
<td>1.15 (1.04–1.27)</td>
<td>1.34 (1.24–1.45)</td>
<td>0.12</td>
</tr>
<tr>
<td>1983–1986</td>
<td>1.0</td>
<td>1.31 (1.18–1.46)</td>
<td>1.38 (1.27–1.49)</td>
<td>0.14</td>
</tr>
<tr>
<td>1992–1993</td>
<td>1.0</td>
<td>1.17 (0.85–1.60)</td>
<td>1.99 (1.58–2.53)</td>
<td>0.17</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1971–1974</td>
<td>1.0</td>
<td>1.00 (0.73–1.37)</td>
<td>1.29 (0.97–1.72)</td>
<td>0.07</td>
</tr>
<tr>
<td>1975–1978</td>
<td>1.0</td>
<td>1.24 (0.93–1.65)</td>
<td>1.41 (1.08–1.85)</td>
<td>0.12</td>
</tr>
<tr>
<td>1979–1982</td>
<td>1.0</td>
<td>1.21 (0.94–1.57)</td>
<td>1.55 (1.22–1.98)</td>
<td>0.15</td>
</tr>
<tr>
<td>1983–1986</td>
<td>1.0</td>
<td>1.59 (1.22–2.08)</td>
<td>2.26 (1.75–2.92)</td>
<td>0.27</td>
</tr>
<tr>
<td>1992–1994</td>
<td>1.0</td>
<td>1.62 (1.06–2.48)</td>
<td>2.34 (1.52–3.61)</td>
<td>0.30</td>
</tr>
</tbody>
</table>

* The proportion of the total number of cases in these age-gender groups in the population that would be eliminated if manual workers and low-level employees had the same risk for MI as high- and middle-level employees.

b Information in these periods is based on odds ratios from the SHEEP case-control study. All other relative risk estimates are based on the register cohort.

Figure 1 Incidence of first and recurrent myocardial infarctions in socioeconomic groups, for men and women, in Stockholm county 1971–1986.
male population and 62% of the female population in 1970. The rest consists of housewives, early retired, unemployed and a small group of self-employed, mostly working on their own or in small businesses. In 1990 75% of the women had occupations associated with the three major socioeconomic categories and this increased proportion over time reflects mainly a rapid increase in gainful employment. The proportion of men in these three socioeconomic groups was 72% in 1990 and this downward trend reflects above all an increase in self-employment during the late 1980s.

**Discussion**

The decrease in age-specific incidence of MI in the total male population during the 1980s is seen in both major socioeconomic groups although with some lag time for manual workers. Further, this overall change in incidence trend among men is accelerated by the change in social structure. For women the same general pattern of decrease in age-specific incidence is dependent mainly on the change in social structure as incidence increases among manual workers and decreases among high- and middle-level employees. The population attributable risks show that in spite of the change in social structure (fewer manual workers) the proportion of cases in the total population that would disappear if the groups of manual workers and low-grade employees had the same risk as high- and middle-level employees has increased with time. The population attributable risks estimate this proportion of the cases in each period. As even the absolute number of cases that could be attributed to social inequity increase with time, the continuous fall in overall annual incidence is not large enough to compensate for the increase in population attributable risk. The trend in population attributable risk is also dependent on the caseload from non-employed groups. The trend for women is therefore partly due to the increase in gainful employment with a higher proportion of the reference category at low risk as the major feature. However, there is also among women an increasing trend in the absolute number of cases attributable to the socioeconomic stratification. The positive interaction effect found between gender and socioeconomic status is very small. We believe that the correct conclusion should be that the socioeconomic effect is equal among both men and women and that the sum of the mechanisms that make up the gender effect is independent of socioeconomic status.

The purpose of this study is to analyse the effect of social stratification on MI risk, i.e. the risk of MI among those having certain social positions at given times. Why an individual acquires a certain social position is another problem and it was not
in focus in this analysis. The change in the social structure with time (Figures 1 and 2) implies a change also in the composition of the different socioeconomic groups. This, however, is not a methodological problem, but rather a part of the phenomena we investigate. The stratification scheme reflects major aspects of the social stratification process, i.e. the work contract in relation to the means of production, the distribution of material resources, power and cultural norms in Swedish society and the relevance of this process during the period under study. We deliberately concentrate on the exposure contrasts between manual workers, low-grade employees, and high- and middle-level employees. For women (as well as for men) we chose to use their own occupation as the basis for the socioeconomic classification. Thus the substantial increase in gainful employment among women is a part of the socioeconomic trend we study, and the fact that only 62% are classified in the beginning is from this perspective not a problem of validity but something that is related to which question is answered. One may, for theoretical reasons, like to conceptualize social class differently and then use another basis for the classification. A frequently used alternative for women is the household socioeconomic group, implying that the occupation of the husband is more important for the socioeconomic position of a woman than her own. Such data were available and when used in the analysis they lead to a slightly higher and more stable proportion of women belonging to the three socioeconomic groups in focus. Nevertheless the incidence trends in these groups were essentially the same as in Figure 1.

From a European perspective unemployment may be suspected to be an important factor for the structural change of the labour force shown in Figures 2 and 3. Unemployment was, however, only around 2% of the total Swedish labour force in the age group 45–64 during the 1970s and 1980s except for a small increase to about 3.5% in 1982–1983. In the rest of Europe the rise in unemployment started in the mid-1970s and in Sweden not until 1991. In 1993 Sweden reached an unemployment level of 8%, which is similar to the rest of Europe. This means that the change in prevalence of the major socioeconomic groups during the period of investigation is not explained by socioeconomic differences in unemployment rate. Neither does unemployment interfere to any great extent with the socioeconomic classification of subjects.

Health-related selection into or out of the socioeconomic groups may bias the results on socioeconomic differentials for risk of MI. However, in this age group social position is rather stable from the individual's perspective and the proportion that has acquired a certain social position because of risk factors of MI or of early signs of the disease should be small. Some health-related selection out of the workforce is more likely. The incidence is higher in the group not gainfully employed who may not have reported any job titles in censuses and cannot, therefore, be classified into socioeconomic categories. Nevertheless, it is known that the proportion of people who previously had a low social position is higher in this group and therefore the socioeconomic differentials shown here could be slightly underestimated.

Sweden has a public health care system where ambulance transport and emergency hospital care is free of charge. Therefore, the identification of MI should not be dependent on socioeconomic status. Studies on the regional incidence register constructed in the same way as the case register used in this analysis show sufficient validity. The small amount of random misclassification of disease leads to some underestimation of the relative risks. It would have been preferable to use only first MI event also during the 1971–1986 period but this information was not available. However, from a comparison with the regional incidence register that uses earlier occurrences in the register to wash out recurrent infarctions we could estimate their proportion as 15–20%. There are no indications that this proportion has a time trend. Whether it varies between socioeconomic groups is not known. Treatment is one important prognostic factor and availability should be similar as the different socioeconomic groups are treated in the same general hospitals. The SLEEP study also shows that a similar proportion of the different socioeconomic groups are treated with thrombolysis, beta-blockade and angioplasty during the acute phase.

The cases are classified into socioeconomic categories from information on average 3 years before the disease occurs, which should reduce dependent misclassification. The specificity of job titles with regard to socioeconomic categories varies, implying some degree of random misclassification of exposure and possibly some underestimation of relative risks.

It is tempting but not easy to explain these socioeconomic trends in terms of risk factors. A full model presumes information on prevalence of several risk factors and the variation in exposure with time, induction times, excess risks from the exposures, time dependent effect modification etc. Smoking is often discussed and may certainly contribute to the trends in Stockholm. Among men aged 45–64 years the decline in daily smoking started earlier among employees but manual workers are catching up and the difference in prevalence is decreasing. Among women in the region daily smoking was more prevalent among employees in earlier cohorts. During the 1980s a higher proportion of female manual workers in this age group were smokers but since around 1990 a decline is seen among both female employees and female manual workers. An analysis like this should also include indicators of life circumstances and material resources. The changes in the income distribution in Sweden are interesting as the long-term trend towards greater equity reached a turning point in 1981 and from then on there has been a steady development towards a more uneven distribution. The Gini coefficient was 0.26 in 1967, 0.23 in 1975, and after reaching a low 0.20 in 1981 there has been a steady increase up to almost 0.30 in 1994. This increase in the Gini coefficient of income is quite consistent with the widening socioeconomic differentials in MI.

The recent dramatic increase in male cardiovascular mortality in Russia illustrates that living circumstances and lifestyle influence the risk of MI. The trends in gender specific socioeconomic groups shown here may be regarded as a parallel phenomenon, however of lesser magnitude. The socioeconomic differences in risk of MI is a public health problem in itself. Adverse trends in risk of MI are also sensitive indicators of social problems.

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References


