Incidence and prognosis of ischaemic heart disease with respect to marital status and social class
A national record linkage study

MARKKU KOSKENVUO, JAAKKO KAPRIO, MATTI ROMO, AND HEIMO LANGINVAINIO
From the Department of Public Health Science, University of Helsinki

SUMMARY Increased mortality from ischaemic heart disease (IHD) has been found in previous studies among divorced, widowed, and unskilled middle-aged Finnish men. In this study all cases of IHD in men aged 40–64 during 1972 were analysed by linking death certificates and hospital records (7499 cases with 3136 deaths). Age-adjusted incidence, mortality, and survival rates of the first and third year were calculated by marital status and social class. The highest mortality rate was found among unskilled workers, the highest incidence among widowers and those in the lower professional classes, and the lowest survival rate among divorcees, single persons, and unskilled workers. The ratio of mortality by marital status (1.77) was in part due to survival (ratio 1.44) and in part due to incidence (ratio 1.32). The ratio of mortality by social class (1.44) seemed to be due more to differences in incidence (ratio 1.36) than to differences in survival (ratio 1.18). The distribution of conventional risk factors of IHD by marital status and social class seems to explain only part of the mortality differences.

Psychosocial factors such as social class and marital status are common determinants of illness and death. In England and Wales, widowed persons have the highest mortality rates in the younger age groups, while the rates of divorced persons do not differ from those of single persons. In Finland, on the other hand, the divorced have higher mortality rates than single people. The variation in mortality rates by social class is nearly twofold both in England and Finland. Psychosocial and behavioural factors are associated with morbidity and mortality from ischaemic heart disease (IHD). In Finland there are very high incidence and mortality rates for IHD. The prognosis of IHD seems also to be relatively poor in Finland. The variations in total mortality and IHD mortality rates are large by both marital status and social class. Because the incidence, prognosis, and mortality of IHD may have different risk factors, they were studied in the Finnish male population by marital status and social class.

Material and methods

Computer files were used of the death certificates and hospital discharge records for the years 1972–5 of all men born in Finland between 1908 and 1932. From the death certificates, men with IHD in 1972 (ICD category 410–414) were selected, and from hospital records men with acute myocardial infarction (ICD 410) or chronic coronary disease (ICD 412) as the principal diagnosis. Hospital records in Finland cover all hospitals including tuberculosis and mental hospitals. The records do not include patients who have spent less than 15 hours at the first aid department. The material comprised 7509 men, 3136 of whom died in 1972.

Record-linkage was carried out using the unique personal identification number (date of birth and a four-number code) included in the death certificates and hospital records. Lists of consecutive individual records were produced and the records were rechecked manually to avoid the possibility that a person's records had been erroneously recorded more than once. Records with incomplete date of birth were rejected and the error caused by incomplete identification numbers in hospital records was adjusted for by calculating incidence figures assuming that the proportion of missing records among survivors in a category was the same as the corresponding proportion of incomplete hospital records.

The proportion of complete personal identification numbers was over 99.9% on death certificates, but only 87.7% on hospital records. The latter
In the 1970 census returns by sex, five-year age groups, marital status, and social class. Direct standardised rates were computed by five-year age groups. The proportion of persons dying outside hospitals was also calculated to estimate the rate of sudden deaths. Hospital survivors were followed up for mortality to the end of 1975. One-year and three-year survival rates were computed for all cases of IHD.

Results

From the youngest to the oldest age group the mortality increased (from 0·15% to 1·19%) more than the incidence (0·46% to 2·58%) (Table 1), while the proportion of deaths outside hospitals was higher in the younger age groups (61% compared with 53%). Survival after one year was 67·1% in the 40–44-year-olds and 50·5% in those aged 60–64.

The variation of IHD incidence rates by marital status was 1·32-fold (Table 2). Widowed persons had the highest incidence and single and married persons the lowest. Divorcees had nearly as high incidence rate as widowers. The variation of IHD mortality rates was 1·77-fold. The highest mortality rate was found among divorced and the lowest among married men. The variation of first-year survival rates was 1·44-fold and the corresponding variation after three years was 1·47. The highest survival rates were found among married and widowed and the lowest among divorced and single persons. The variation of the proportion of deaths occurring outside hospitals was 1·21-fold. The highest proportion was found among men aged 40–64.

### Table 1

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Incidence per 100 000</th>
<th>Mortality per 100 000</th>
<th>One-year survival rate (%)</th>
<th>Proportion (%) of IHD deaths outside hospitals</th>
<th>No. with IHD</th>
</tr>
</thead>
<tbody>
<tr>
<td>40–44</td>
<td>462</td>
<td>145</td>
<td>67·1</td>
<td>60·8</td>
<td>622</td>
</tr>
<tr>
<td>45–49</td>
<td>962</td>
<td>292</td>
<td>67·2</td>
<td>62·7</td>
<td>1154</td>
</tr>
<tr>
<td>50–54</td>
<td>1526</td>
<td>535</td>
<td>62·9</td>
<td>54·2</td>
<td>1493</td>
</tr>
<tr>
<td>55–59</td>
<td>1836</td>
<td>711</td>
<td>58·6</td>
<td>54·8</td>
<td>1852</td>
</tr>
<tr>
<td>60–64</td>
<td>2579</td>
<td>1189</td>
<td>50·5</td>
<td>53·3</td>
<td>2388</td>
</tr>
<tr>
<td>Total</td>
<td>1377</td>
<td>529</td>
<td>62·2</td>
<td>57·7</td>
<td>7509</td>
</tr>
</tbody>
</table>

*Incidence and survival rates adjusted for the effect of incomplete identification numbers in hospital records.

### Table 2

<table>
<thead>
<tr>
<th>Marital status</th>
<th>Incidence per 100 000</th>
<th>Mortality per 100 000</th>
<th>One-year survival rate (%)</th>
<th>Proportion (%) of IHD deaths outside hospitals</th>
<th>No. with IHD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>1228</td>
<td>683</td>
<td>45·0</td>
<td>67·0</td>
<td>699</td>
</tr>
<tr>
<td>Married</td>
<td>1371</td>
<td>498</td>
<td>65·0</td>
<td>55·3</td>
<td>6218</td>
</tr>
<tr>
<td>Widowed</td>
<td>1623</td>
<td>641</td>
<td>61·9</td>
<td>61·5</td>
<td>352</td>
</tr>
<tr>
<td>Divorced</td>
<td>1566</td>
<td>881</td>
<td>45·0</td>
<td>56·3</td>
<td>257</td>
</tr>
<tr>
<td>Total</td>
<td>1377</td>
<td>529</td>
<td>62·2</td>
<td>57·7</td>
<td>7509</td>
</tr>
</tbody>
</table>

*Incidence and survival rates adjusted for the effect of incomplete identification numbers in hospital records.
The variation of IHD incidence rates by social class was 1.36-fold (Table 3). The highest incidence rate was found among those in the lower professional classes and unskilled workers, and the lowest rate among farmers and the higher professional classes. The variation of IHD mortality rates was 1.44-fold. The mortality was also highest among unskilled workers and the lower professional classes and lowest among the higher professional classes and farmers. The variation of first-year survival rates was 1.18-fold and the corresponding variation after three years was 1.23. The highest survival rates were among professionals and skilled workers and the lowest among unskilled workers and farmers. The variation of the proportion of deaths occurring outside hospitals was 1.53-fold. The highest proportion was among farmers and unskilled workers and the lowest among the higher professional classes.

**Discussion**

The reliability of the IHD diagnosis on death certificates in Finland has been found satisfactory for epidemiological purposes. Persons with a non-fatal silent infarction could not be included in the material. Nearly all diagnosed myocardial infarcts are treated in hospital in Finland. The adjusted IHD incidence figures based on hospital records seem to agree well with data from four coronary registries in Finland.

Differences in mortality rates may be attributable to two sets of factors: (1) determinants of selection by marital status or social class, or (2) risk factors, which are distributed unequally by marital status or social class. The role of selection in the increased mortality among widowers is probably minimal. Some longitudinal studies have shown that increased mortality among widowers occurs some time after the death of the spouse, but the mortality rate later returns to population levels. Selection by social class can happen if those with higher levels of risk factors for IHD tend to have lower abilities or possibilities for education than those with lower risk factor levels. The unmarried and unskilled include many persons seriously handicapped during early childhood. The meaning of this selection with respect to IHD is poorly known, because of the lack of longitudinal studies.

Both positive and negative life changes are predictive for IHD. The variation of IHD mortality by marital status seems to contain more than one component:
- the increased mortality of widowers was associated with increased incidence.
- the increased mortality of divorcees was associated with increased case fatality and with shorter survival.
- the incidence among single persons was low, but the case fatality was high and survival short.

The variation of risk factors of IHD by marital status has not been studied widely. Weiss found no consistent differences for serum cholesterol, blood pressure, and ponderal index. Manela found, on the other hand, an association between marital problems and blood pressure, and Haynes found an association between marital problems and IHD morbidity. In a Finnish population study married men smoked less than men in other categories and had lower blood pressure than widowed men. Serum cholesterol levels did not differ by marital status. In a population study of Finnish twins consumption of cigarettes and use of alcohol were significantly higher among divorced men, while their leisure time physical activity was less (Koskenuo et al., unpublished observations). Stopping smoking after myocardial infarction has been found to improve the prognosis.

So the differences in risk factor levels may partly explain the different incidence and mortality pattern at least in married and divorced men.

The proportion of deaths occurring outside hospital did not differ for married and divorced men. Thus the increased mortality of divorced men is probably not associated with a higher proportion of sudden deaths or delayed admission to hospital among the divorced compared with the married. On the other hand, the survival rate of single persons and

### Table 3: Ischaemic heart disease by social class among men aged 40–64 in 1972: age standardised figures*

<table>
<thead>
<tr>
<th>Social class</th>
<th>Incidence per 100 000</th>
<th>Mortality per 100 000</th>
<th>One-year survival rate (%)</th>
<th>Proportion (%) of IHD deaths outside hospitals</th>
<th>No. with IHD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher professional classes</td>
<td>1281</td>
<td>453</td>
<td>66-6</td>
<td>43:1</td>
<td>512</td>
</tr>
<tr>
<td>Lower professional classes</td>
<td>1579</td>
<td>605</td>
<td>63-7</td>
<td>56-8</td>
<td>1466</td>
</tr>
<tr>
<td>Skilled workers</td>
<td>1306</td>
<td>495</td>
<td>63-6</td>
<td>52-6</td>
<td>2480</td>
</tr>
<tr>
<td>Unskilled workers</td>
<td>1478</td>
<td>653</td>
<td>56-5</td>
<td>63-2</td>
<td>1150</td>
</tr>
<tr>
<td>Farmers</td>
<td>1160</td>
<td>474</td>
<td>59-0</td>
<td>65-8</td>
<td>1670</td>
</tr>
<tr>
<td>Total</td>
<td>1377</td>
<td>529</td>
<td>62-2</td>
<td>57-7</td>
<td>7509</td>
</tr>
</tbody>
</table>

* Incidence and survival rates adjusted for the effect of incomplete identification numbers in hospital records.
Incidence and prognosis of ischaemic heart disease with respect to marital status and social class

widowers was definitely lower than in the two other groups. The delay in admission to hospital, however, did not vary by marital status or social class in Helsinki (Pohjola S, unpublished observations).

The variation in IHD mortality by marital status seems principally due to differences in survival. There was no difference in coronary sclerosis between marital states in a consecutive series of 2553 violent deaths among men in Helsinki (Kaprio J et al, unpublished observations). The variation in survival rates may be explained by differences in susceptibility to various arrhythmias or to some other non-atherosclerotic mechanisms. Vegetative lability caused by marital problems may also be an independent factor. Men with IHD who live alone often may not have someone to advise and help when needed.

The variation of IHD mortality by social class seems to be more closely related to variations in incidence than to variation in prognosis:

- the highest incidence was found among the lower professional classes and the lowest incidence among farmers.
- the highest mortality and fatality was found among unskilled workers and the lowest among the higher professional classes.
- the highest proportion of deaths occurring outside hospitals was found among farmers and the lowest among the higher professional classes.

In a Finnish population study some significant differences in risk factor levels were found by social class: from the higher professional classes to unskilled workers there was a trend of increasing levels of serum cholesterol, systolic and diastolic blood pressure, and smoking. In an interview study on the nutritional habits of 4273 persons, there was a clearly increasing trend of lipid intake from the higher professional classes to farmers. These findings agree well with the results of this study except that farmers had the lowest mortality although their serum cholesterol level and lipid intake were the highest.

According to population studies farmers smoke less than industrial workers. In addition to the fact that farmers have the highest physical activity at work and different habits of alcohol and tobacco usage, their social work role is also different. This seems to indicate a complex interaction between risk factors. In the aforementioned prospective study the differences in IHD incidence by social class were not explained by differences in blood pressure, serum cholesterol level, and smoking habits (Aromaa et al, unpublished observations).

Thus marital status and social class may also be confounding factors in studies on IHD, because different categories of marital status and social class contain different patterns of risk factors. Secular changes in the distribution of risk factors may also confound conclusions when comparing risk factors and mortality data in different cohorts.

In some studies highly educated persons had a better prognosis after myocardial infarction. In this study the better educated white-collar and blue-collar workers had a lower incidence and mortality rates than their less educated counterparts. A-type behaviour has, however, been found to be more common among the well educated.

Unskilled workers and farmers had the highest proportion of deaths occurring outside hospitals. Possibly the admission of farmers to hospital may have been delayed. Unskilled workers may have had a more severe disease than farmers, because farmers had a higher proportion of deaths occurring outside hospitals but a better prognosis. It is also possible that some symptoms of IHD in farmers remained undiagnosed, resulting in a low incidence and low survival rate.

Marital status and social class seem to include factors which are associated with both processes leading to myocardial infarction and processes influencing survival. For a better understanding of these factors, longitudinal studies will be needed on the relationship of conventional risk factors to psychosocial factors in IHD.

Bereavement and divorce are crises that should be taken into account in the management of coronary patients.

This study was supported by a grant from the Finnish Heart Association.

Reprints from Dr. Markku Koskenvuoto, Department of Public Health Science, University of Helsinki, Haartmaninkatu 3, 00290 Helsinki 29, Finland.

References


Markku Koskenvuo, Jaakko Kaprio, Matti Romo, and Heimo Langinvainio

30 Aronmaa A et al. Social Institute Coronary Heart Disease Study (unpublished data).
37 Rimpelä M. Adult use of tobacco in Finland in the 1950s to 1970s. Tampere: Department of Public Health Science, University of Tampere, 1978.