

Incidence and prognosis of ischaemic heart disease with respect to marital status and social class

A national record linkage study

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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,¹ 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.² The variation in mortality rates by social class is nearly twofold both in England and Finland.^{1,2} Psychosocial and behavioural factors are associated with morbidity and mortality from ischaemic heart disease (IHD).³ In Finland there are very high incidence and mortality rates for IHD.^{4–6} The prognosis of IHD seems also to be relatively poor in Finland.⁷ The variations in total mortality and IHD mortality rates are large by both marital status and social class.^{2,8,9} 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

proportion varied between 85.7–88.7% by marital status and between 86.3–91.6% by social class. The highest percentages were found among married persons and the higher professional classes and the lowest among single persons and unskilled workers.

Social class was based on the occupation reported by the patient or his relatives.^{8,9} This type of registration gives the last occupation of the patient and does not necessarily correspond to the lifelong occupational history. Errors in the determination of social class would probably reduce differences in mortality rates by social class,^{8,9} because a patient or his relatives might report an occupation belonging to a higher social class more often than one belonging to a lower social class.

The death certificate is sent to the local population registry, where the information is checked before processing at the Central Statistical Office. Hospital records are not rechecked in this way as hospitals are responsible for the information on the records, which are later collected by the National Board of Health. The proportion of missing data on marital status and social class was 0.1% and 3.9% on death certificates, 2.6% and 5.0% on hospital records and 0.1% and 1.0% on census returns. Married, divorced, and widowed persons on the 1972 hospital records were clarified as single in subsequent records in 0.5% of cases. In another study¹¹ the marital status recorded on death certificates was found to be incorrect in four out of 3549 records (0.1%).

The reference population was derived from 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

Table 1 *Ischaemic heart disease by age group among men aged 40–64 according to death certificates and hospital records**

Age group (years)	Incidence per 100 000	Mortality per 100 000	One-year survival rate (%)	Proportion (%) of IHD deaths outside hospitals	No. with IHD
40–44	462	145	67.1	60.8	622
45–49	962	292	67.2	62.7	1154
50–54	1526	535	62.9	54.2	1493
55–59	1836	711	58.6	54.8	1852
60–64	2579	1189	50.5	53.3	2388
Total	1377	529	62.2	57.7	7509

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

Table 2 *Ischaemic heart disease by marital status among men aged 40–64 in 1972: age standardised figures**

Marital status	Incidence per 100 000	Mortality per 100 000	One-year survival rate (%)	Proportion (%) of IHD deaths outside hospitals	No. with IHD
Single	1228	683	45.0	67.0	699
Married	1371	498	65.0	55.3	6218
Widowed	1623	641	61.9	61.5	352
Divorced	1566	881	45.0	56.3	257
Total	1377	529	62.2	57.7	7509

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

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

Social class	Incidence per 100 000	Mortality per 100 000	One-year survival rate (%)	Proportion (%) of IHD deaths outside hospitals	No. with IHD
Higher professional classes	1281	453	66.6	43.1	512
Lower professional classes	1579	605	63.7	56.8	1466
Skilled workers	1306	495	63.6	52.6	2480
Unskilled workers	1478	653	56.5	63.2	1150
Farmers	1160	474	59.0	65.8	1670
Total	1377	529	62.2	57.7	7509

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

single and the lowest among married and divorced men.

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.^{7,9} 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.⁵ The adjusted IHD incidence figures based on hospital records seem to agree well with data from four coronary registries in Finland.⁶

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.^{10,11} 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.¹² 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.^{13–15} 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,¹⁶ Weiss¹⁷ found no consistent differences for serum cholesterol, blood pressure, and ponderal index. Manela¹⁸ found, on the other hand, an association between marital problems and blood pressure, and Haynes¹⁹ found an association between marital problems and IHD morbidity. In a Finnish population study²⁰ 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 twins²¹ consumption of cigarettes and use of alcohol were significantly higher among divorced men, while their leisure time physical activity was less (Koskenvuo *et al*, unpublished observations). Stopping smoking after myocardial infarction has been found to improve the prognosis.^{22,23} 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

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 arrhythmias²⁴ or to some other non-atherosclerotic mechanisms. Vegetative lability caused by marital problems¹⁸ 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^{20 25 26} 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 study²⁶ 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^{25 27} 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 study²⁰ 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.^{28 29}

In some studies highly educated persons had a better prognosis after myocardial infarction.^{16 30} 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 behaviour¹⁶ has, however, been found to be more common among the well educated.^{1 16}

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 crises³¹ that should be taken into account in the management of coronary patients.

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References

- ¹Registrar General. *Occupational Mortality 1970-72. Decennial Supplement*. London: HMSO, 1978.
- ²Koskenvuo M, Sarna S, Kaprio J, Lönnqvist J. Cause-specific mortality by marital status and social class in Finland during 1969-71. *Soc Sci Med* 1979; **13A**: 691-7.
- ³Jenkins CD. Behavioral risk factors in coronary artery disease. *Annu Rev Med* 1978; **29**: 543-62.
- ⁴Keys A (ed). Coronary heart disease in seven countries. *Circulation* 1970; **41**, suppl 1: 1-199.
- ⁵World Health Organisation. *Myocardial infarction community registers. Public Health in Europe 5*. Copenhagen: WHO Regional Office for Europe, 1976.
- ⁶Pohjola S, Siltanen P, Romo M, Haapakoski J et al. Incidence and prognosis of myocardial infarction in Finland in 1973. Comparisons of registry data from Helsinki, North-Karelia, Tampere and Turku. (English summary). *Duodecim* 1980; **96**: 18-31.

- ⁷Pohjola S, Siltanen P, Romo M. Five-year survival of 728 patients after myocardial infarction, a community study. *Br Heart J* 1980; **43**: 176–83.
- ⁸Näyhä S. Social group and mortality in Finland. *Br J Prev Soc Med* 1977; **31**: 231–7.
- ⁹Koskenvuo M, Kaprio J, Kesäniemi A, Sarna S. Differences in mortality from ischaemic heart disease by marital status and social class. *J Chronic Dis* 1980; **33**: 95–106.
- ¹⁰Jacobs S. An epidemiological review of the mortality of bereavement. *Psychosom Med* 1977; **39**: 344–57.
- ¹¹Koskenvuo M. Mortality and causes of death among spouses (English summary) (MD thesis). Helsinki: Department of Public Health Science, University of Helsinki, 1978.
- ¹²Amnell G. *Mortalitet och kronisk morbiditet i barnäldern, En kohortundersökning av år 1955 födda Helsingforsbarn*. Helsingfors: Samfundet Folkhälsan, 1974.
- ¹³Rahe RH, Romo M, Bennett L, Siltanen P. Recent life changes, myocardial infarction and abrupt coronary death. Studies in Helsinki. *Arch Intern Med* 1974; **133**: 221–8.
- ¹⁴Siltanen P. Life changes and sudden coronary deaths. *Adv Cardiol* 1978; **25**: 47–60.
- ¹⁵Haney CA. Life events as precursors of coronary heart disease. *Soc Sci Med* 1980; **14A**: 119–26.
- ¹⁶Jenkins CD. Recent evidence supporting psychologic social risk factors for coronary disease. *N Engl J Med* 1976; **294**: 987–94, 1033–8.
- ¹⁷Weiss NS. Marital status and risk factors for coronary heart disease. *Br J Prev Soc Med* 1973; **27**: 41–3.
- ¹⁸Manela R, Harburg E, Wolfe R, Özgören F. Marital dissolution and blood pressure. (20th conference on cardiovascular disease epidemiology, San Diego, 1980). *CVD Epidemiology Newsletter* 1980; No. 28: 17.
- ¹⁹Haynes SG, Feinleib M, Levine S, Scotch N et al. The relationship of psychosocial factors to coronary heart disease in the Framingham study, II. prevalence of coronary heart disease. *Am J epidemiol* 1978; **107**: 284–402.
- ²⁰Aromaa A et al. Social Institute Coronary Heart Disease Study (unpublished data).
- ²¹Kaprio J, Sarna S, Koskenvuo M, Rantasalo I. The Finnish Twin Registry: Formation and compilation, questionnaire study, zygosity determination procedures and research program. In: Nance W (ed). *Twin Research: Biology and Epidemiology*. New York: Alan R Liss, 1978: 179–84.
- ²²Wilhelmsson C, Wedin J, Elmfeldt D et al. Smoking and myocardial infarction. *Lancet* 1975; **i**: 415–20.
- ²³Smith JW. Mortality after recovery from myocardial infarction. *J Chronic Dis* 1980; **33**: 1–4.
- ²⁴Corr PB, Sobel BE. Mechanisms contributing to dysrhythmias induced by ischemia and their therapeutic implications. *Adv Cardiol* 1978; **22**: 110–29.
- ²⁵Aromaa A, Reunanen A, Pyörälä K. Socioeconomic factors, conventional risk factors and coronary heart disease. Transactions of the European Society of Cardiology, Dublin, 1979: Abstract No. 95.
- ²⁶Seppänen R. Influence of socioeconomic factors on the dietary intake in a Finnish population study (IV European Nutrition Conference, Uppsala 1979). *Vår Föda* 1979; **31**, suppl 3: 210.
- ²⁷Rimpelä M. Adult use of tobacco in Finland in the 1950s to 1970s. Tampere: Department of Public Health Science, University of Tampere, 1978.
- ²⁸Marmot MG, Adelstein AM, Robinson N, Rose GA. Changing social class distribution of heart disease. *Br Med J* 1978; **ii**: 1109–12.
- ²⁹Morgenstern H. The changing association between social status and coronary heart disease in a rural population. *Soc Sci Med* 1980; **14A**: 191–201.
- ³⁰Weinblatt E, Ruberman W, Goldberg JD, Frank CW et al. Relation of education to sudden death after myocardial infarction. *N Engl J Med* 1978; **299**: 60–5.
- ³¹Walker KN, MacBride A, Vachon MLS. Social support networks and the crisis of bereavement. *Soc Sci Med* 1977; **11**: 35–41.