Papers

Trends in rates of different forms of diagnosed coronary heart disease, 1978 to 2000: prospective, population based study of British men

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Abstract

Objective To examine trends over time in rates of different forms of diagnosed coronary heart disease among British men, during a period in which mortality due to coronary heart disease has been declining.

Design Prospective cohort study covering the period 1978-80 to 1998-2000.

Participants 7735 men, aged 40-59 at entry, randomly selected from one general practice in each of 24 British towns.

Main outcome measures Trends in the rates of major coronary events, first diagnosed angina and first diagnosed coronary heart disease (any fatal or non-fatal documented event or diagnosis). Events were ascertained from NHS central registers and reviews of medical records from general practices.

Results Over the 20 year period, 1561 major coronary events occurred; 1087 and 1816 men had new diagnoses of angina and coronary heart disease, respectively. The age adjusted annual relative changes were -3.6% (95% confidence interval -4.8% to -2.4%, $P < 0.001$) for all major coronary events, 2.6% (1.1% to 4.0%, $P < 0.001$) for first diagnosed angina and -0.8% (-1.8% to 0.3%, $P = 0.18$) for first diagnosed coronary heart disease. The fall in major coronary events occurred across all categories of event (fatal and non-fatal, first and recurrent). Similarly, first diagnosed angina increased for both uncomplicated angina and angina after myocardial infarction. The age adjusted annual relative change in case fatality at 28 days of first major coronary events was -1.4% (-3.1% to 0.4%, $P = 0.12$).

Conclusions Among British middle aged men, a substantial decline in the rate of major coronary events over the past two decades seems to have been largely offset by an increase in the incidence of diagnosed angina. Overall there was little change in the incidence of first diagnosed coronary heart disease. A continuing need exists for resources and services for coronary heart disease in general, and for new angina in particular.

Introduction

Since the late 1970s, rates of coronary heart disease death in the United Kingdom have fallen by more than 50%.[1] Data from the monitoring trends and determinants in cardiovascular disease (MONICA) studies[2] and a previous report from the British Regional Heart Study[3] showed that this trend has been due in part to a fall in the rate of occurrence of new major coronary events. However, despite increasing evidence of falling incidences of myocardial infarction in Britain and other countries, little is known about trends in rates of "lesser" diagnoses, particularly angina, a condition that makes a large contribution to the total incidence of diagnosed coronary heart disease.[4] In Britain, angina is commonly diagnosed and managed in primary care,[5 6] and studies based on cases in patients admitted to hospital may not present a complete picture of medically recognised disease in the population. Using information from general practice medical record reviews we examined trends in rates of different forms of diagnosed coronary heart disease in the British Regional Heart Study during 20 years of follow-up, from 1978-80 to 1998-2000. In particular we assessed whether trends in the incidence of diagnosed angina and diagnosed coronary heart disease overall have followed a similar pattern to trends observed for rates of major coronary events. Changes in rates of different forms of diagnosed coronary heart disease have implications for prevention policy and health provision.

Methods

The British Regional Heart Study is a prospective study of 7735 men aged 40-59 years at baseline (1978-80), who were randomly selected from one general practice in each of 24 British towns.[7] The sample includes all major geographical regions in Britain and is representative of the male population in terms of social class distribution. Information from participants' questionnaires at study entry was used to ascertain diagnoses of pre-existing coronary heart disease.[8] Participants were followed over 20 years through NHS central registers and regular reviews of medical records in general practices (including hospital and clinic correspondence) for death due to coronary heart disease, first and recurrent definite myocardial infarctions, first and recurrent possible myocardial infarctions, and first diagnosis of angina.[9] About 1% of men have been lost to follow-up.

End points

We examined trends in rates of diagnosed (medically recorded) coronary heart disease only. End points are defined in table 1. We considered three main categories: all major coronary events (subdivided into death due to coronary heart disease and non-fatal definite myocardial infarction, and also into first major coronary event and recurrent major coronary events); first diagnosed angina (subdivided into uncomplicated angina, and angina post myocardial infarction); and first diagnosed coronary heart disease (any fatal or non-fatal documented coronary event or diagnosis). Three end points—all major coronary events, non-fatal definite myocardial infarction, and recurrent major coronary events—include multiple recurrent events from

Table 1 Definitions of coronary end points and numbers of events occurring among 7735 men during 20 year follow-up

End point	No of events	Definition
All major coronary events:	1561	Death due to coronary heart disease or non-fatal definite myocardial infarction. Recurrent events for individual subjects included
Death due to coronary heart disease	751	Death with ICD-9 codes 410-414, according to underlying cause on death certificate
Non-fatal definite myocardial infarction	810	Medical record of acute coronary heart disease event with at least two of: history of severe prolonged chest pain, evidence of myocardial infarction on electrocardiography, cardiac enzymes abnormalities, with survival for ≥28 days after onset of symptoms. Recurrent events included
First major coronary events	1141	First occurrence of major coronary heart disease event. Subjects with pre-existing myocardial infarction diagnosis at study entry excluded
Recurrent major coronary events	420	Repeat occurrence of major coronary heart disease event. Recurrent events included
First diagnosed angina:	1087	First medical record of possible or definite angina according to clinical diagnosis (history of typical effort or stress related chest pain). Confirmation from investigative tests not required. Subjects with pre-existing angina diagnosis at study entry excluded
Uncomplicated angina	840	First diagnosed angina if it occurred without pre-existing definite myocardial infarction
Angina after myocardial infarction	247	First diagnosed angina if it occurred after a definite myocardial infarction
First diagnosed coronary heart disease	1816	First occurrence of any of: coronary heart disease death, non-fatal definite myocardial infarction, non-fatal possible myocardial infarction*, diagnosed angina. Subjects with pre-existing myocardial infarction or angina diagnosis at study entry excluded

*Possible myocardial infarction was defined as a medical record of an acute coronary heart disease event not fulfilling the criteria for definite myocardial infarction.

individual subjects, whereas the remainder are restricted to the first ever events only.

Statistical analysis

We ascertained numbers of events and person years at risk during four exact five year follow-up periods from each subject's baseline assessment date: 1978-80 to 1983-5, 1983-5 to 1988-90, 1988-90 to 1993-5, and 1993-5 to 1998-2000. We used Poisson regression to estimate trends in event rates, with date of follow-up period as a continuous covariate and person time of follow-up as an offset. We used quadratic or cubic polynomials as necessary to adjust for age, in order to account for the non-linear association over the age range included in analyses. We used generalised estimating equations with an autoregressive correlation structure to account for recurrent events from individual subjects (using SAS, release 8.02, SAS Institute, Cary, NC, USA). Accounting for clustering owing to initial town of selection had
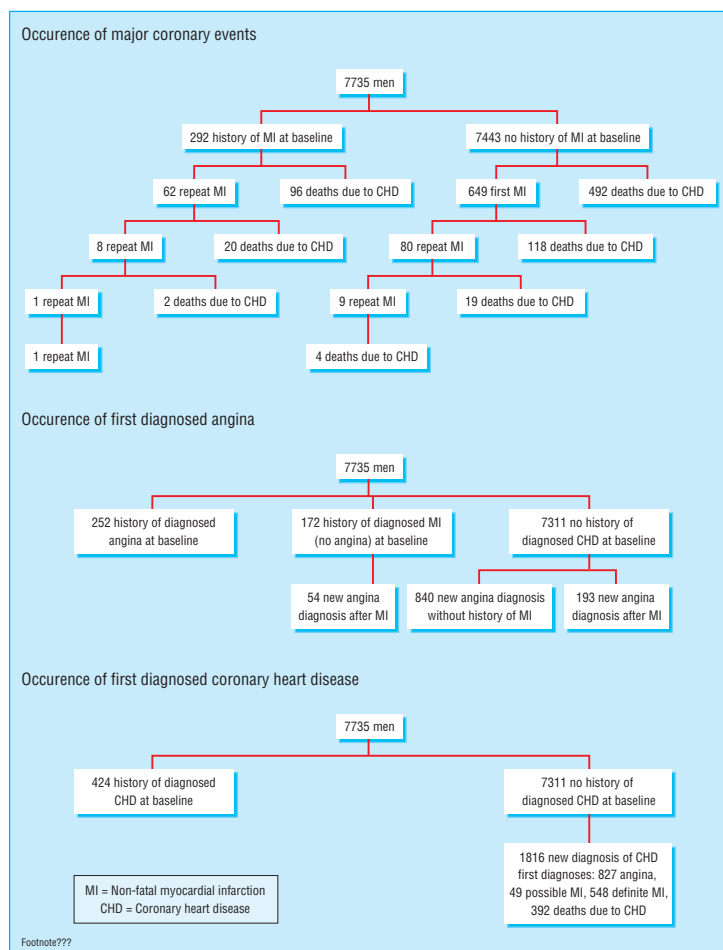

Fig 1 Occurrence of coronary events among 7735 men during 20 years of follow-up

Table 2 Age adjusted estimates of annual relative percentage changes in rates of coronary events

Event rate	Total person years at risk	No of events	Age adjusted annual relative percentage change (95% CI)*	
			Entire 20 year period (1978-80 to 1998-2000)	Final 10 year period (1988-90 to 1998-2000)
All major coronary events:	138 111	1561	−3.6 (−4.8 to −2.4, P<0.001)	−3.6 (−6.3 to −0.9)
Coronary heart disease death	138 111	751	−4.8 (−6.5 to −3.1, P<0.001)	
Non-fatal definite myocardial infarction	138 111	810	−3.0 (−4.6 to −1.4, P<0.001)	
First major coronary event	128 916	1141	−3.5 (−4.8 to −2.1, P<0.001)	
Recurrent major coronary events	9195	420	−3.9 (−6.1 to −1.7, P<0.001)	
First diagnosed angina:	126 228	1087	2.6 (1.1 to 4.0, P<0.001)	2.9 (−0.3 to 6.2)
Uncomplicated angina	121 332	840	2.4 (0.8 to 4.1, P=0.003)	
Angina after myocardial infarction	4896	247	5.1 (2.1 to 8.2, P<0.001)	
First diagnosed coronary heart disease	121 024	1816	−0.8 (−1.8 to 0.3, P=0.18)	−0.4 (−2.9 to 2.2)

*Estimates obtained using Poisson regression, with generalised estimating equation estimates for the following end points: all major coronary heart disease events, non-fatal myocardial infarction, recurrent major coronary events. Adjusted for age and age squared (all end points) and age cubed (all major coronary events, first major coronary event, and first diagnosed coronary heart disease for 20 year follow-up).

little effect on standard errors of trend estimates; we present unadjusted results. Trends are expressed as the average annual relative change in event rate with 95% confidence interval. For example, a rate ratio of 0.970 is presented as a relative rate change of −3.0%. We also examined trends in the case fatality of first major coronary events (percentage fatal within 28 days), using Poisson regression (as this provides the risk ratio rather than the odds ratio[10]), with date of event and age at event as covariates. We used tests of interaction to assess social class differences in trends, with each subject's social class classified as "non-manual" or "manual," according to occupation at entry into the study.

Results

Figure 1 shows the occurrence of coronary events and diagnoses among the 7735 men during 20 years of follow-up; total numbers of events in each category are given in table 1. Overall there were 1561 major coronary events; 1087 and 1816 men had new diagnoses of angina and coronary heart disease respectively. Figure 2 shows age specific trends for the three main end points. Table 2 gives age adjusted estimates of annual trends over the 20 year period, for all event rates, presented as relative percentage changes. The rate of major coronary events fell substantially over the period by an average of 3.6% per year. The decline occurred for both fatal and non-fatal major coronary events (although it was greater for fatal events), and for both first and recurrent major coronary events (being of similar magnitude in each case). In contrast to rates of major coronary events, the rate of first diagnosed angina increased during the 20 year period, by an average of 2.6% per year. This increase was apparent for uncomplicated angina and angina diagnosed after myocardial infarction, but it was larger for angina diagnosed after myocardial infarction. Because of the opposing trends in major coronary events and angina, the rate of first diagnosed coronary heart disease changed little over the 20 year period. Trend estimates for the last 10 year period of follow-up (1988-90 to 1998-2000) are also given in table 2 for the three main end points. These indicate the same pattern of opposing trends for major coronary events and angina, and no clear change in the rate of first diagnosed coronary heart disease. Of all 1141 first major coronary events, 492 were fatal within 28 days. The average annual decline in case fatality at 28 days of first major coronary events was moderate and non-significant (relative change in risk −1.4, 95% confidence interval −3.1 to 0.4, P=0.12 over the 20 year period).

The rate of major coronary events fell among men from both manual and non-manual social class groups (annual changes −3.3% for manual and −4.6% for non-manual), and the rate of diagnosed angina increased (annual changes 2.6% and 2.7%, respectively) over the 20 year period. We found no evidence that the magnitude of these trends differed according to social class group (interaction tests: P=0.31 for major coronary events and P=0.99 for diagnosed angina).

Discussion

From 1978 to 2000, while rates of all categories of major coronary events declined among British men, the incidence of diagnosed angina increased, resulting in no apparent change in the overall incidence of diagnosed coronary heart disease.

Strengths and limitations of the study
The strengths of this population based study include the geographically and socially representative nature of the study sample, the comprehensive ascertainment of coronary heart disease diagnoses from general practice, and the very high rate of follow-up. The limitations include the fact that trends are based on single measures of angina and other coronary heart disease from the medical record reviews. These measures may be subject to inaccuracies because of the original records and the review process. In this study, comparisons between medical record review and participants' self report for coronary heart disease diagnoses show good agreement,[11 12] giving support to the validity of these measures. Diagnoses of angina did not require fulfilment of specific objective criteria and therefore reflect diagnosis as it occurred in clinical practice, not necessarily certain confirmed coronary disease. We included "possible" documented cases of angina as the use of investigative tests has probably varied between practices and over time.[13] The trend in angina was at least as strong when "possible" cases (which comprised about 12% of the total cases) were removed (average annual change 3.7%, 95% confidence interval 2.1% to 5.3%). The trend estimates presented in this report are driven by data from the middle age groups, and are not necessarily generalisable to other age groups, or to women. The cohort design of the study prohibited investigation of age related heterogeneity in trends.

Trends in major coronary heart disease
We previously reported that among middle aged British men the rate of major coronary events fell from 1978-1995 by an average of 2.5% per year.[3] These results indicate that the decline in major coronary events has continued just as strongly from the mid 1990s onward. Substantial declines in rates of both first and recurrent myocardial infarction have contributed, indicating both a fall in incidence and an improvement in prognosis of myocardial infarction. These trends in acute event rates are likely

to be due both to changes in coronary risk factors in Britain and, perhaps to a lesser extent, improvements in treatment.[14–18] In this study, the fall in 28 day case fatality of first major coronary events was modest. A similar pattern of marked declines in both incidence and recurrence of myocardial infarction but a smaller decline in case fatality has been reported for the Finnish MONICA population during the period 1983-97.[19] This may indicate that, in these populations, changes in primary and secondary preventive treatments have had a greater role than changes in acute coronary care. However, unless case fatality is
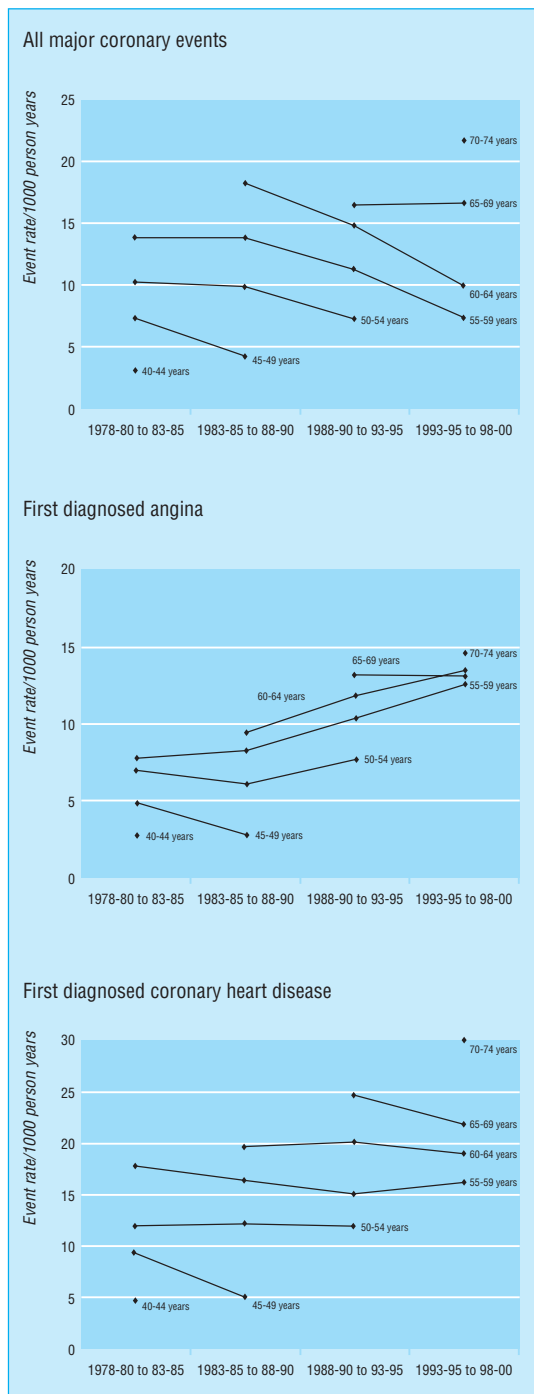
What is already known on this subject

Death rates due to coronary heart disease have been falling steadily in Britain since the late 1970s

Previous studies have shown that the incidence of major coronary heart disease has also fallen over this period

Much less is known about changes in the incidence of angina; previous studies have only included cases in patients who had been admitted to hospital

What this study adds

Although rates of major coronary events fell among British men from 1978 to 2000, the incidence of diagnosed angina (ascertained from general practice record reviews) seems to have increased over this period

The opposing trends in major coronary events and angina resulted in no apparent change in the overall incidence of diagnosed coronary heart disease

The increase in incidence of diagnosed angina may be a feature of changes in diagnostic practice rather than a real increase in disease incidence

These results have implications for resources and services for coronary heart disease, especially those for angina

Fig 2 Rates of coronary events (per 1000 person years) by calendar period and age group at start of period

restricted to cases in patients admitted to hospital, the impact of improvements in acute care is limited.[20 21]

Opposing trends in angina and major coronary heart disease

Although rates of all categories of major coronary events are continuing to fall among British men, a completely different trend is apparent for diagnosed angina. The rising incidence of diagnosed angina was apparent for uncomplicated angina as well as diagnoses occurring post myocardial infarction, implying that the trend was not solely due to increased survival from previous acute coronary disease. We know of no previous reports of angina incidence trends in Britain based on reviews of medical records from general practices. However, data from the England and Wales general practice morbidity surveys also indicated that secular trends differed for angina compared with myocardial infarction: the rate of consultation for angina increased among men and women in the 1990s compared with the 1980s, while the same statistic for myocardial infarction fell during this time.[22] In addition, a study based on emergency admissions to hospital in Scotland found that discharge rates for myocardial infarction fell during the 1990s, while those for acute (unstable) angina and other chest pain increased.[23] These results raise the possibility that the pattern of coronary heart disease is shifting from major events to less severe manifestations of disease.

Is angina increasing in Britain?

Does the increase in the rate of diagnosed angina seen in our study represent a genuine increase in the incidence of angina in Britain, or is it a feature of changes in diagnostic practice? Evidence from the British Regional Heart Study implies the latter explanation: the prevalence of angina symptoms (assessed by chest pain questionnaire on four occasions and irrespective of diagnosis) fell from 1978-1996, among men with and without a diagnosis of coronary heart disease.[3] This seems to imply a fall in

incidence, for angina defined in a standardised way according to symptoms. It is therefore possible that the incidence of angina in the population has genuinely fallen, but that a greater proportion of all angina cases are now formally diagnosed. Such an increase in ascertainment and diagnosis of angina is entirely plausible and may result from general practitioners prioritising the early identification and treatment of coronary heart disease, as well as from an increase in availability of diagnostic investigations for angina-like chest pain.[24]

Conclusions

The continued decline in the rate of major coronary events among British men is encouraging, and shows that favourable changes in both risk factors and treatment have affected the incidence and prognosis of myocardial infarction. Surprisingly, these changes do not seem to have resulted in a fall in the overall incidence of diagnosed coronary heart disease, because of the increase in the rate of new angina diagnoses. The trend in angina may well be due to diagnostic factors; possibly it will stabilise as diagnosis and investigation of coronary heart disease in Britain reaches a more "optimal" level and the burden of undiagnosed disease falls. Nevertheless, the trend raises concerns from a health service perspective, suggesting that even among middle aged men, resource requirements for angina are not falling. These results emphasise the ongoing need for treatments and services for coronary heart disease, particularly for new angina or suspected angina. They also highlight the need for continued emphasis on the primary prevention of coronary heart disease.

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