RESEARCH REPORT

Mortality from heart failure in an English population, 1979–2003: study of death certification

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Objective: It is widely held that there will be an epidemic of heart failure in Europe and North America as a result of increased survival from myocardial infarction and other coronary heart disease. The study objective was to discover if the decline in mortality from coronary heart disease has been accompanied by a rise in mortality from heart failure in the study population.
Design: Analysis of database of mortality records including all certified causes of death, not just the underlying cause, from 1979–2003.
Setting: Former Oxford NHS Region, England.
Patients: Data from death certificates of all who died in the population covered.
Main results: Mortality rates for heart failure fell at very similar rates as those from coronary heart disease. In men, the average annual fall in mortality from coronary heart disease was −2.7% (95% confidence intervals −2.8 to −2.5) and that from heart failure was −2.9% (−3.2 to −2.5). In women, the average annual fall in mortality from coronary heart disease was −2.3% (−2.6 to −2.1) and that from heart failure was −2.6% (−3.0 to −2.3).
Conclusions: The decline in mortality from coronary heart disease has not been accompanied by a rise in mortality from heart failure. A future epidemic of heart failure, as a consequence of the decline in mortality from coronary heart disease, seems unlikely.

It is widely held in both Europe and North America that over the next 20 years, as more people survive heart attacks and other severe forms of coronary heart disease, the number of people with heart failure due to damaged heart muscle may increase substantially.[1] It is argued that this will lead to an increase in mortality from and hospitalisation for heart failure.[2] However, the evidence to support these predictions is limited—it is "an epidemic of uncertain proportion".[3]

The use of mortality statistics to study heart failure is problematic. Until recently in England and in many other countries, official mortality statistics have been compiled on the basis of only one underlying cause for each death. However, the rules for death certification explicitly discourage the selection of heart failure as the underlying cause of death. The international form of the medical certificate of cause of death, in its annotation by the space for cause of death, specifies that "this does not mean the mode of dying, eg heart failure… it means the disease, injury, or complication which caused death".[4] Even when heart failure is certified as the underlying cause of death by the doctor, it may not be selected as such by the compilers of mortality statistics. This is because rule 3 of the International Classification of Diseases states that if the disease that is certified by the doctor as the underlying cause—in this example, heart failure—"can be considered a direct sequel of another reported condition, select this primary condition".[4] The application of this rule, in respect of heart failure, varies internationally according to the guidance used in the compilation of official statistics. It has also changed over time: it changed twice in England in the period covered by this study.[5 6] Accordingly, mortality data for all certified causes of death, not just the conventional data on underlying cause, are needed to study deaths attributed to heart failure.

METHOD

All certified causes of death for residents of the former Oxford National Health Service Region, covering a population of 2.5 million people, have been coded from 1979 to 2003. Following convention, in this paper we refer to certified causes—underlying cause and other contributing causes—as mentions. In each year, the underlying cause of death was selected and coded using the prevailing national rules.[6] We analysed the data for all records with certified mentions of heart failure (ICD9 code 428; ICD10 code I50) and for all certified mentions of coronary heart disease (410–414; I20–I25). Age standardised mortality rates for each time period were calculated by applying the age specific rates in five-year age groups to the European standard population. We then calculated the average annual percentage change over time in mortality rates, using data for each individual calendar year, by fitting linear regression models to the logarithms of the death rates.

RESULTS

Considering all mentions, from 1979 to 2003, for men the average annual fall in mortality from coronary heart disease was −2.7% (95% confidence intervals −2.8 to −2.5) and that from heart failure was −2.9% (−3.2 to −2.5). For women, the average annual fall in mortality from coronary heart disease was −2.3% (−2.6 to −2.1) and that from heart failure was −2.6% (−3.0 to −2.3).

Mortality rates for mentions of coronary heart disease and heart failure showed declines of very similar magnitude throughout the period (fig 1A). Their similarity is evident in the logged data (fig 1B), which show that the year on year rates of mentions of each condition declined more or less in parallel with the other.

The declines were consistent in both sexes and all age groups, within different categories of heart failure, and whether or not coronary heart disease was recorded on the same certificate as heart failure. The fall in mortality coded as congestive heart failure was −2.4% (−2.8, −1.9); that for left heart failure was −4.0% (−4.4, −3.6); and for heart failure without further specification −2.4% (−3.0, −1.7). The fall

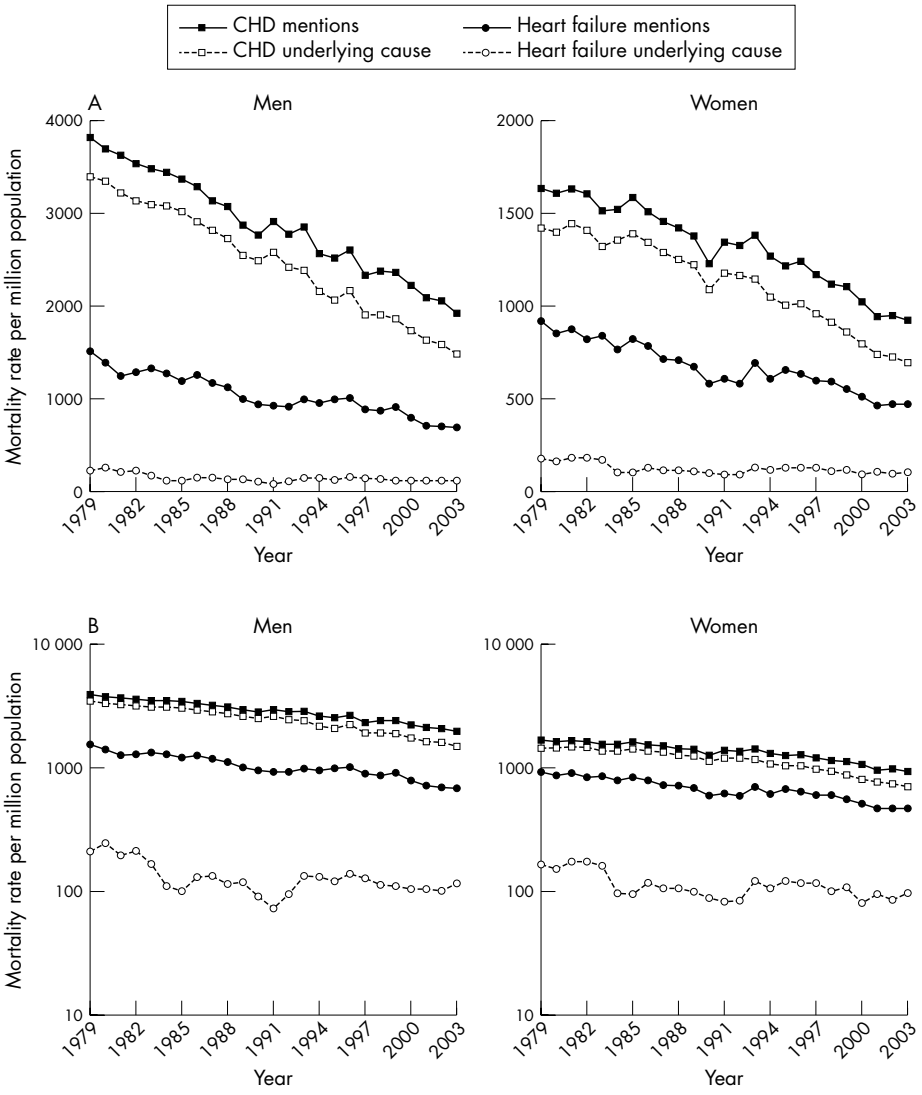

Figure 1 Age standardised rates for coronary heart disease (ICD 9 410–4, ICD 10 150) and heart failure (ICD 9 428, ICD 10 120–125). (A) Natural scale; (B) log scale.

was −2.4% (−2.8, −1.9) for heart failure in people who had coronary heart disease also recorded on the certificate; and −3.2% (−3.4, −2.9) for those with heart failure but without coronary heart disease on the certificate. The logged data illustrate the effect of the changes made to the rules for underlying cause coding of heart failure in 1984 and 1993. After the first rule change in 1984, the underlying cause mortality rate showed an artefactual decline. This was followed by an artefactual increase in 1993 after the second rule change.

What is already known

- It is widely held that there may be a substantial increase in heart failure in the developed world, as a result of increased survival after myocardial infarction and other coronary heart disease.
- Mortality rates in people with heart failure are high.
- However, the population based burden of heart failure mortality cannot be studied from conventional mortality statistics based on the underlying cause of death, because the death certification process explicitly discourages the recording of heart failure as the underlying cause of death.

DISCUSSION

Heart failure occurs when abnormalities of cardiac function cause the heart to fail to pump blood at a rate needed to meet metabolic requirements under normal cardiac filling pressure. Coronary artery disease, resulting in myocardial ischaemia, is its most common cause in western populations.[7] Other causes include hypertension. Those who survive myocardial infarction have an approximate threefold increased risk of developing left ventricular systolic dysfunction (systolic ejection fraction <45%)[8] and the likelihood of

What this paper adds

- In the English population studied, using all certified causes of death and not just the underlying cause, mortality rates from heart failure fell consistently and substantially over time.
- The fall in mortality from heart failure closely followed the fall in mortality from coronary heart disease.

Policy implication

A future epidemic of heart failure, as a consequence of the reduction in mortality from coronary heart disease, is very unlikely.

survival from myocardial infarction almost doubled in some countries between 1987 and 1999.[9] This is why an epidemic of heart failure, as a consequence of the decline in mortality rates from coronary heart disease, has been predicted by some commentators. Our study shows, however, that mortality rates from heart failure have fallen at very similar rates to those from coronary heart disease. The Oxford Region is a wealthier and healthier region than other parts of England, with lower standardised mortality ratios for coronary heart disease, but we have no reason to think that the relation between coronary heart disease and heart failure would be different from that in other parts of the country.

Our findings are in line with recently reported hospitalisation rates for heart failure in Sweden, where all men and women aged 45 to 84 years old, hospitalised for the first time for heart failure in 19 Swedish counties between 1988 and 2000, were studied.[10] In that population, a steady decline in hospitalisation rates for heart failure were seen from about 1993.

We acknowledge that there may be a lag time between infarction of heart tissue and onset of clinical heart failure, and therefore that there might be a lag between infarction and eventual death from heart failure, but our period of observation extends over 24 years. Heart failure has a poor prognosis: for example, data from the Hillingdon heart failure study in England show that around 40% of people die within a year of the initial diagnosis of heart failure[11] and mortality rates may be as high as 75% within five years.[12] If there had been a pronounced increase in the occurrence of heart failure in our study population, we think that it would have been reflected in an increase in mortality from heart failure during the study period.

We recognise that the population in economically developed countries is aging. For example, in the UK the population aged 75 years and over is projected to increase by over 40%, from 4.5 million to 6.5 million, between the present and the year 2026.[13] This in itself will tend to increase morbidity and hospitalisation rates from heart failure. We also recognise that patients may be surviving longer with heart failure—a 50% improvement in survival of hospitalised patients between 1993/94 and 2000/01 has been reported.[12] However, although aging and increased survival from heart failure may increase the prevalence of heart failure, our findings refute the prediction that increased survival from coronary heart disease itself will cause an epidemic of heart failure.

CONTRIBUTORS

MJG and DM planned the study and wrote the first draft. MG built the mortality dataset. MD analysed the data. All contributed to the final draft.

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