A POPULATION-BASED COHORT STUDY OF CORONARY HEART DISEASE AFTER A MYOCARDIAL INFARCTION: SIX-YEAR FOLLOW-UP

By

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Abstract

Background: Despite well-documented improvements in short-term prognosis after a myocardial infarction, longer-term outcomes and health service costs are poorly defined.

Aim: To provide a comprehensive account of the progression of coronary heart disease (CHD) after a myocardial infarction in the subsequent six to seven years. The long-term consequences and associated factors were examined in several separate but interrelated follow-up studies focusing on the following areas:
(i) Mortality; (ii) socioeconomic status as a predictor of mortality; (iii) non-fatal CHD progression and preventive treatment; (iv) psychological health; and (v) health service use and cost.

Methods: The patient cohort consisted of 1118 Oxfordshire residents aged 30 to 79 years diagnosed with a myocardial infarction in 1994-95 identified by the Oxford Myocardial Infarction Incidence Study (OXMIS). Studies undertaken:
(1) Analyses of OXMIS databases, adding data from 1995 to 2001, with emphasis on 613 long-term survivors.
(2) Review of hospital and general practice casenotes for 606 survivors.
(3) Postal questionnaire study of 266 seven-year survivors.

Main Results: By six years, amongst 28-day survivors:
(1) 13% had died of CHD with no significant gender or socioeconomic differences.
(2) 51% had experienced another non-fatal coronary event, of which 37% occurred within the first year. Subsequent annual rates reduced substantially, but continued at 4% per year. Most coronary preventive medications were initiated at either hospital discharge or within the first year. After hospital discharge, CHD health service costs for the first year were £1700 per patient. From the third year onwards, these annual costs reduced to £600.
(3) At seven years, the prevalence of poor psychological health was 15%. Patients with current angina symptoms were twice as likely to be emotionally distressed as those with no angina.

Conclusion: In 28-day infarct survivors, the first year was the time of highest risk for subsequent CHD events and associated health service costs. Nevertheless, risk of CHD mortality in the cohort was higher than that of the general population over the following five years.

Acknowledgements

This section has been the most difficult to write. Words can scarcely describe the sentiments I feel and the sincere gratitude I wish to show for the enormous amount of support and encouragement that I have received during the preparation of this thesis.

My research career began as a research nurse for the Southampton-based SHIP study in 1995. I became curious about the long-term consequences of coronary disease while conducting one-year follow-up assessments in patients diagnosed with myocardial infarction. This curiosity was further fueled by my involvement with the Warwickshire-based ASSIST Study, as a joint study coordinator with Dr Mike Moher, between 1998 and 2000. I thank both Professor Andrew Neil and Professor David Mant for encouraging and supporting me to develop my ideas that arose from these experiences. The outcome was the award of an NHS R&D Research Training Fellowship from the South East Region in 2000 and the opportunity to do this thesis.

Serious personal health problems, on which I do not wish to dwell, caused an unavoidable delay in the completion of this thesis. I am grateful for the financial support at the conclusion of this fellowship, from Andrew, David on behalf of the Department of Primary Health Care, Dr Martin Francis on behalf of the Wolfson College Hardship Fund and the University of Oxford Hardship Committee.

During the entirety of my work, the most important thanks must go to my supervisors, Professor Andrew Neil and Dr Patricia Yudkin. They encouraged and supported me during this roller coaster ride. I have had the good fortune of having two supervisors whose wide-ranging knowledge and skills have complemented each other and been invaluable to me. Andrew, by keeping an eye on the bigger picture, allowed me to work to my strengths and concentrate on the detail. Pat patiently and generously took the time to guide me through the challenging world of statistics and epidemiology, which might have remained relatively incomprehensible without her. Furthermore, they have both been responsible for my adoption of a better usage of the English language!

I'd like to thank the following people for sharing their data and / or expertise, which resulted in the comprehensiveness of this thesis: Dr Mike Murphy, Dr John Newton, Dr Adrian Banning, Professor Richard Mayou and Professor Alastair Gray. I am grateful to Ian Miller in OUCS for helping me to create the masterpiece that is the hospital database and Jack Cowley in San Francisco for putting the finishing touches on the general practice database. The labour-intensive data collection could not have been completed on schedule without the help of Maeve O'Donnell, Pauline Marshall and Catherine Green. The completeness of hospital records is due to the persistence of Usha Shohan in the Oxford Radcliffe Hospital Trust Medical Records Department. She searched for and found records in the most obscure places. I am indebted to Janet Justice and Philippa and Christopher

Rose for data entry. Tina Hammond's assistance with the psychological data collection and entry was invaluable as was Alice Fuller's help with data cleaning and its conversion from an ACCESS database to SPSS for analysis.

A number of friends and colleagues have shared the laughter and the tears. They include Dr Mike Moher, Mr. Chris Price, Dr Satinder Kumar, Dr Krina Zondervan, Dr Rebecca Reynolds, Dr Rachel Huxley, Dr Alisha Wade, Emma Meats, Mary Selwood, Anthea Craven, Dot Powers and soon to be Drs. Clare Bankhead and Janine Hartweg.

Despite the number of people involved, I experienced the usual solitary existence of a doctoral student. To counteract this, I attended a beginners' course and became a cox for the novice men's squad at the City of Oxford Rowing Club (CORC). This experience gave me a sense of group belonging and an essential balance between 'town and gown'. Thank you to CORC for supplying me with a crew who needed me as much as I needed them. In the summer of 2002, we had many shared experiences on the river and a record number of winning races. They became know as 'my boys' and are Dom Cheater, Giles Chalk, Gav Allinson, Ross Elder, Paul Hammond, Pete Taylor, Dave Lait, Ashley Latham and Nick Yeeles. Our dedicated coach, Andy Drohan, was so right when he said that rowing can teach you a lot about life! This effective distraction therapy resulted in many thrills, which peaked when we qualified for and raced at the 2003 Henley Royal Regatta.

Another benefit of CORC membership was the opportunity of meeting my partner, John Hill. A relationship was not in the original thesis timetable. However, he has compensated for this many times over by his support and unconditional love. He has also earned my undying appreciation, respect and an occasional treat by proofing most of the thesis chapters.

Last, but not least, thank you to my brother, Daniel. In 1999, he introduced me to an American touring band from Colorado called String Cheese Incident (www.stringcheeseincident.com). Since then he has sent me a regular supply of their live CDs and gave me the best 40th birthday present - tickets to their first London show in June 2003. Their music has inspired and kept me company during the long lonely hours of writing up.

Role of the Candidate

This work in this thesis capitalised on the availability of baseline incidence and mortality data from an earlier study, the Oxford Myocardial Infarction Incidence Study (OXMIS), and used this as a foundation for follow-up studies. The candidate's role in the acquisition and preparation of the data is detailed below. The candidate performed all statistical analyses reported.

OXMIS Baseline Data:
i) Using the existing electronic baseline OXMIS mortality database, I prepared the data for mortality and survival analyses. I created a new variable for underlying cause of death, which was based on ICD codes from death certificates, thereby creating necessary variables for Kaplan-Meier analyses. I analysed baseline data to describe baseline characteristics of the patient cohort.
ii) I analysed individual assigned socioeconomic status for the cohort using existing social class data and allocated area-based socioeconomic status using a Townsend Index score.

Casenote Review
The baseline database had been prepared to meet the earlier OXMIS project objectives. To augment the data and obtain follow-up data, I conducted a retrospective review of hospital and general practice casenotes focusing on subsequent coronary events, occurrences of congestive heart failure, and their treatment, over the six years after the original myocardial infarction.
i) I created and piloted the follow-up data collection forms.
ii) I collected hospital and general practice data, while supervising and coordinating a research nurse team in the same activity.
iii) I created the new databases about hospital and general practice care. I supervised and coordinated a data entry team.
iv) I prepared the morbidity database, resource use and costs databases for analysis, including data cleaning and merging of relevant variables from the baseline database.

Psychological questionnaire
Psychological data were collected by a postal questionnaire sent to seven-year survivors.
i) I constructed a postal questionnaire that, among other items, included the same validated instruments as the baseline and one-year psychological study of OXMIS patients.
ii) I organised the locating of survivors using the Office of National Statistics patient flagging system.
iii) I organised and supervised the posting and receipt of questionnaires, coding of completed questionnaires, data entry and data cleaning.
iv) I prepared the seven-year database for analysis and merged it with the existing electronic psychological OXMIS patient database to provide the means to undertake the longitudinal analyses. I undertook the analyses and interpreted the findings.

Contents

Chapter 1

Background

1.1 Introduction

For over 50 years, researchers have studied coronary heart disease (CHD). Whilst reductions in CHD mortality and incidence were reported in many countries, increases occurred in others.[1 2 3 4 5]

The Framingham Heart Study was the first major epidemiological study of CHD. It was initiated in 1948 as a response to an observed epidemic of CHD mortality in the USA. This community-based cohort study examined 20 year trends in CHD mortality, incidence and risk factors in men and women living in Framingham, Massachusetts aged 50 to 59 years at baselines in 1950, 1960 and 1970. Coronary disease mortality and incidence after 20 years declined, with the greatest decline occurring between the 1950 and 1960 cohorts.[6]

From the 1970s onwards, a number of other studies investigated CHD, based on other American or international populations. A review of those published before 1990 found conflicting trends between the 1970s and 1980s.[1] Most studies reported decreases in both CHD mortality and incidence.[7 8 9] However, others found a decrease in coronary mortality and no change in incidence[10 11] or an increase in coronary mortality and no change in incidence.[12] Comparisons between the 1980s and 1990s from other single country studies found similar discrepancies with some reports of declines in CHD mortality and incidence[13 14 15 16] and others of declines in CHD mortality but stable rates of incidence.[17 18]

The international World Health Organisation (WHO) MONICA Project was designed to answer questions about the observed, but controversial decline in CHD mortality and relate them to changes in coronary risk factors and medical care. Incidence rates were found to follow mortality rates, so in countries where

mortality reduced over time so did incidence and if CHD mortality increased, so did CHD incidence.[5]

The relative contributions of coronary risk factors and medical care on coronary mortality and incidence were hotly debated in the 1980s as explanations for the conflicting findings.[19] The Framingham investigators were the first to identify the coronary risk factors of hypertension, hypercholesteraemia and cigarette smoking. In their report, mentioned above, it was concluded that more than half of the 51% decline in coronary mortality in women and between a third and a half of the 44% decline in coronary mortality in men between 1950 and 1989 could be attributed to improvements in these risk factors in the 1970 cohort.[6] Methodological factors in each study complicated the arguments about the determinants of CHD. These included different case ascertainment methods (hospital vs. community), different definitions of CHD (clinical vs epidemiological) and changes in death classification systems during the decades of interest. Nevertheless, it is now generally accepted that declines in CHD incidence were driven by declines in coronary risk factors and that declines in CHD mortality (in-hospital, 28-day and long-term) were driven by improvements in medical care.

Coronary heart disease (CHD) remains the leading cause of death globally and accounts for an estimated seven million deaths a year world-wide.[20] In the United Kingdom (UK), CHD is the most common cause of death and accounts for one in four male deaths and one in six female deaths annually.[21]

In the UK general population, CHD mortality rates are higher in Scotland, Northern Ireland and the north of England than in Wales and the south of England.[21] Similar geographical variations have also been reported for coronary event rates, which included fatal and non-fatal events.[22]

The risk of developing CHD is multi-factorial and complex. Established biological and lifestyle factors include male gender, raised plasma low density lipoprotein

cholesterol, decreased plasma high density lipoprotein cholesterol, hypertension, smoking, increased plasma glucose concentrations, physical inactivity, obesity and advanced age. There is also emerging evidence that, in people lacking the established coronary risk factors, serum markers of inflammation or of thrombosis may indicate a susceptibility to atherosclerosis, the underlying pathophysiology of CHD.[23] In addition, CHD risk is higher for people with psychological problems[24] and for those in lower socioeconomic groups.[25]

In the UK general population, there has been a substantial decline in deaths from coronary heart disease over the last 30 years.[21] Likewise, the prognosis following diagnosis of a myocardial infarction has also improved for both short and long term survival during the same time period.[22] [16] Despite this, the associated costs of living with CHD, rather than dying from it, are high. In 2003, costs to the health service for CHD totalled over £3.5 billion, which equated to £61 per capita.[2]

Better survival for myocardial infarction patients over the last three decades has been attributed to changes in acute treatment with the routine use of thrombolysis, aspirin and ACE-inhibitors. In addition, long-term treatment with aspirin, beta-blockers, ACE-inhibitors and statins has contributed to improved prognosis in the survivors of the acute phase. However, infarct survivors remain at risk of subsequent fatal and non-fatal coronary events, as the disease continues to progress.

The work presented in this thesis is an attempt to provide a comprehensive account of the progression of coronary heart disease in the six years after a myocardial infarction by investigating the long term consequences and associated factors.

1.1.1 Chapter Overview

In this chapter, each topic area is addressed separately. Relevant UK studies are examined in detail and a brief summary of selected non-UK studies is also presented. In section 1.7, the rationale and objectives of the thesis are summarised.

1.1.2 Literature Search

Specific details about the aims of each search are described in the relevant section together with search terms used.

For each of the five subject areas, the electronic database MEDLINE was searched from 1990 to March 2005 for studies of patients diagnosed with myocardial infarction. References for relevant articles were examined. Only studies of patients identified in the 1990s were reviewed in detail, since the prognosis of patients identified in earlier decades is unlikely to be generalisable due to improvements in routine acute treatment. In the 1980s, pharmacological reperfusion therapy based on thrombolytic, antiplatelet and anticoagulant agents were gradually introduced. By the 1990s, it had become firmly established in routine treatment for the acute care of myocardial infarction.

1.2 Mortality

International differences in mortality within one month of a myocardial infarction have been studied extensively by the World Health Organization (WHO) Monitoring Trends and Determinants of Cardiovascular Disease (MONICA) project.[5] In the UK, a number of population-based studies (including the Glasgow MONICA centre) have shown that between 45% and 52% of patients die within one month of a myocardial infarction.[26 27 22]

1.2.1 Literature Review

The aim of the literature review was to identify studies of long-term coronary mortality for myocardial infarction survivors. Different combinations of the following search terms were used: after myocardial infarction, survival, mortality and cohort or follow-up studies.

1.2.2 Subsequent Mortality in Myocardial Infarction Survivors

1.2.2.1 Previous UK Studies

Four cohorts of patients diagnosed with myocardial infarction in the 1990s were investigated. Details are summarised in Table 1.1. The cohorts consisted of patients from the Scottish Record Linkage Study,[16 28] Yorkshire,[29] the Nottingham Heart Attack Register[30] and East London.[31 32] For all four cohorts, all-cause mortality was the primary outcome. Follow-up periods ranged from one year to 10 years after the index event.

There were varied findings for all-cause mortality after a myocardial infarction. Generally, no differences between men and women were found, but an age-related influence was evident. For 30-day survivors in the Scottish Record Linkage Study, ten-year all-cause mortality was 40% for men and 44% for women. In Yorkshire, two-year mortality was 17% for male and 27% for female hospital survivors. For the Nottingham Heart Attack Register hospital survivors, four-year all-cause mortality (men and women combined) was 29% and coronary mortality in the same period was 20%. For East London 30-day survivors, three-year mortality was 14% for men and 12% for women.

1.2.2.2 Previous Non-UK Studies

Outside the UK, studies of long-term all-cause mortality in infarct survivors identified in the 1990s from Ireland,[33] America,[34] and Sweden[35] reported some similar findings to those in the UK. There was general agreement that advancing age was associated with higher death rates and overall disagreement about

gender differences. Only the Swedish study reported coronary mortality separately from other causes, and after one year, no differences between men and women were found.

Table 1.1 UK Studies of Subsequent Mortality in Myocardial Infarction Survivors

Lead author	Study Aim	Methods Study type; year(s) of recruitment; 1st or all MIs; age limit; patient numbers	Findings
Scottish Record Linkage Study			
Capewell 2000[16]	To assess factors associated with long-term all-cause mortality.	Retrospective record linkage study; 1986-1995; 1st MIs only; no age limit; 55,810 men & 35,785 women diagnosed with fatal or non-fatal MI in Scotland	Amongst 30-day survivors: 5-year mortality was 27% for men & 31% for women & 10-year mortality was 40% for men & 44% for women. Mortality after 1st 30 days almost doubled for each increasing decade of age for men & women.
MacIntyre 2001[28]	To determine whether gender-based differences exist in 1-year all-cause mortality.	Same as above	For 30-day survivors: 1-year age-adjusted case fatality was similar for men & women. (Odds ratio 0.97, [95% CI 0.93 to 1.01]). Mortality rates were not reported.
Yorkshire Cohort			
Hanratty 2000[29]	To investigate the extent of sex differences in 2-year all-cause mortality.	Prospective observational study; 1995; all MIs; 35-85 years; 1055 men & 595 women admitted to hospital.	For 1683 hospital survivors: 2-year mortality was 17% for men & 27% for women. After adjustment for age & other risk factors, there was no significant difference found between men & women. (Odds Ratio 1.22 [0.95 to 1.67])
Nottingham Heart Attack Register			
Melville 1999[30]	To report 4-year all-cause & coronary mortality.	Prospective observational study; 1992; all MIs; no age limit; 695 hospital survivors	For hospital survivors: 4-year all-cause mortality was 29% & coronary mortality was 20%. Findings were not reported separately for men & women.
East London Cohort			
Wilkinson 1994[31]	To examine the influence of female gender on 6-month all-cause mortality.	Prospective observational study; 1988-1992; all MIs; no age limits; 607 men & 216 women admitted to CCU	For 30-day survivors: 6-month mortality was 4% for men & 5% for women. No significant gender differences were found.
Stevenson 1993[32]	To investigate gender differences in 3-year all cause mortality.	Same as above, except recruitment occurred in 1988-1991 & identified 447 women & 161 men.	For 30-day survivors: 1-year mortality was 6% for men and 5% for women. 3-year mortality 14% for men & 12% for women. For 6-month survivors, sex was not associated with 3-year mortality.

MI: myocardial infarction; CCU: coronary care unit

1.3 Socioeconomic Status and Coronary Disease

1.3.1 Introduction

Socioeconomic status and coronary heart disease (CHD) have been extensively studied for more than 40 years. Overall, an inverse association between socioeconomic status and the incidence of, prevalence of and mortality from coronary disease has been reported, using either individually assigned or area-based socioeconomic status measures. In the UK, the most common sources of data about the relationship between socioeconomic status and CHD are national statistics[25 21] or follow-up studies of healthy people in the general population.[36 37 38]

1.3.2 Literature Review

The aim of this literature review was to identify studies of patients diagnosed with myocardial infarction during the 1990s that investigated the relationship between socioeconomic status and mortality following the diagnosis of a myocardial infarction (fatal or non-fatal). The following search terms were used in different combinations: social class, socioeconomic factors, myocardial infarction, survival and mortality.

1.3.3 Socioeconomic Status and One-month Case Fatality

1.3.3.1 Previous UK Studies

Previous UK studies of the relationship between socioeconomic status and one-month case fatality after a myocardial infarction included reports from the Scottish Record Linkage Study,[16 39] the East London cohort[40] and the Glasgow cohort of the MONICA Project.[41] All relied on a residential area measure of socioeconomic status. In the Scottish Record Linkage Study and East London cohort, one-month case fatality following a myocardial infarction was between 10% and 62% higher in patients from areas of deprivation compared to those from affluent areas. However, no such relationship was found in the Glasgow patients.

1.3.3.2 Previous Non-UK Studies

Amongst studies outside the UK, mortality within the first month of a myocardial infarction was higher in patients from lower social classes in Sweden,[42] Finland,[43] France[44] and Italy.[45] These studies used data from WHO MONICA cohorts and none used area-based socioeconomic measures.

1.3.4 Socioeconomic Status and Mortality after the First Month

1.3.4.1 Previous UK studies

Like one-month case fatality, there were conflicting findings about the relationship between area-based socioeconomic status and subsequent mortality in one-month UK infarct survivors. The report from the East London cohort (included an additional 594 patients from 1992 and 1996) found no relationship between residential area deprivation and subsequent all-cause one-year mortality for 30-day survivors.[40] In contrast, long-term mortality (adjusted for age and co-morbidities) was higher in patients living in areas of greater deprivation compared to those from least deprived areas (27% higher for men and 15% for women) in the Scottish Record Linkage Study.[16] Outcomes for the Glasgow MONICA did not extend beyond 28 days.

1.3.4.2 Previous Non-UK Studies

Higher one-year all-cause mortality was associated with lower individual socioeconomic status in myocardial infarction patients in the cohorts from Sweden[42] and Finland[43], but deaths within the first 28 days were included. Another Swedish study reported higher all-cause five-year mortality rates for hospital survivors from residential areas with high levels of deprivation compared to those from affluent areas.[46]

1.4 Non-fatal CHD Progression and Preventive Treatment

During the hospital admission for the index myocardial infarction, patients are at risk of cardiac complications. These can include reinfarction, unstable angina or congestive heart failure.[47 48] Furthermore, myocardial infarction survivors continue to be at risk for recurrent coronary events and congestive heart failure due to the progressive nature of the underlying disease. Preventive treatment for patients diagnosed with myocardial infarction includes prescribing coronary preventive medications, providing a cardiac rehabilitation programme and recommending and supporting lifestyle changes. The aim of these interventions is to reduce the risk of these subsequent coronary events (fatal and non-fatal) and improve patients' physical and psychological recovery.

1.4.1 Literature Review

The aims of the literature review were to identify studies of CHD progression or of congestive heart failure after hospital discharge for the index myocardial infarction. In addition, treatment with coronary preventive medication prescriptions after a myocardial infarction and the treatment of congestive heart failure with ACE-inhibitors for infarct survivors were ascertained. Different combinations of the following search terms were used: after myocardial infarction, surviv*, angina, isch*emi*, recurren* myocardial infarction, reinfarction, heart failure, secondary prevention or ACE-inhibitors (*used in search strategy to allow for different endings or spellings). Literature about the provision of cardiac rehabilitation and lifestyle advice to post-infarct patients was not reviewed, since it was not studied in this thesis. (see section 5.3.3 for more details)

1.4.2 CHD Progression after a Myocardial Infarction

1.4.2.1 Previous UK studies

Subsequent CHD progression in infarct survivors has been reported for two UK patient cohorts, and details are shown in Table 7.2. In East London amongst 30-

day survivors, 20% had died of any cause or had been admitted with a non-fatal ischaemic event (unstable angina, recurrent MI or revascularisation) by one year and 32% by three years.[32] In Nottingham, the proportion of hospital survivors with at least one hospital admission for a coronary reason varied between 11% and 16% at four years.[30] However, it was unclear whether fatal admissions were included in the Nottingham results.

1.4.2.2 Non-UK Studies

Follow-up studies beyond the UK were only found of patients diagnosed prior to the 1990s.[49 50] Amongst these studies identified, patient samples were restricted to those diagnosed with a first myocardial infarction and those diagnosed prior to 1990, when prognosis was poorer than in the 1990s.

Table 1.2 Previous UK studies of coronary heart disease progression after a myocardial infarction

Lead Author	Study Aim	Methods Year(s) of recruitment; 1st or all MIs; age limit; patient numbers	Findings
East London Cohort			
Stevenson 1993[32]	To report annual probability of event-free survival. (event = hospital admission for reinfarction, unstable angina or revascularisation, or all-cause death)	1988-91; all MIs; no age limit 604 men & women admitted to CCU; 30-day survivors	In 30-day survivors, the proportion still alive & event-free was: 80% at 1 year & 68% at 3 years.
Nottingham Heart Attack Register			
Melville 1999[30]	To describe the proportion of patients with hospital admissions for subsequent CHD by 4 years.	1992; all MIs; no age limit 695 hospital survivors	At 4 years, the proportion of hospital survivors with at least 1 admission for CHD progression was: 11% (75) for definite reinfarction 11% (78) for revascularisation procedures 15% (104) for angiography 16% (108) for unstable coronary syndrome

MI myocardial infarction, CCU coronary care unit, CHD coronary heart disease

1.4.3 Congestive Heart Failure after a Myocardial Infarction and its Treatment with ACE-inhibitors

1.4.3.1 Previous UK Studies

Table 1.3 shows the two recent UK studies of infarct survivors diagnosed with congestive heart failure. In the Nottingham Heart Attack Register, 10% of hospital survivors were readmitted at least once for congestive heart failure or left ventricular failure over the following four years after hospital discharge.[30] In another study of 461 London myocardial infarction patients, 72% had been diagnosed with congestive heart failure by one year, but it was unclear whether this figure included diagnoses made during the index admission. Of those diagnosed, 50% had been prescribed an ACE-inhibitor.[51]

1.4.3.2 Previous Non-UK Studies

Outside the UK, the occurrence of congestive heart failure in 1455 American hospital survivors of myocardial infarction was 43% in the subsequent seven years.[52] Treatment of congestive heart failure with ACE-inhibitors was reported for American and Canadian myocardial infarction patients. Like the London patients, the proportion of patients with prescriptions was less than adequate.[53 54 55]

Table 1.3 UK studies of congestive heart failure after myocardial infarction and its treatment with ACE-inhibitors

Lead author	Study aim	Methods Year(s) of recruitment; 1st or all MIs; age limit; patient numbers; source of diagnosis	Findings
Nottingham Heart Attack Register			
Melville 1999[30]	To report 4-year occurrence of CHF in infarct survivors.	1992; all MIs; no age limit 695 hospital survivors; hospital clinical records	By 4 years, 10% (72) had been admitted for CHF or left ventricular dysfunction.
London DGH Register			
Blackman 2003[51]	To determine the use of ACE-I for AMI with or without CHF.	1996-1997; all MIs; no age limit; 461 one-year infarct survivors; hospital clinical records	At 1 year, 72% (330) of infarct patients had evidence of CHF & of these, 51% (169) of were prescribed an ACE-I. Only 41% (53) of infarct patients with no evidence of CHF received an ACE-I prescription.

CHF congestive heart failure, MI myocardial infarction; ACE-I ACE-Inhibitor

1.4.3.3 Preventive Treatment after a Myocardial Infarction

One element of preventive treatment for post-myocardial infarction patients is to prescribe low-dose aspirin, beta-blockers, ACE-inhibitors and lipid lowering agents (primarily statins). In 2000, the Department of Health published the National Service Framework (NSF) for CHD with the aim of improving the quality of acute and long-term care for patients diagnosed with myocardial infarction.[56] It included recommendations that all patients diagnosed with myocardial infarction receive prescriptions at hospital discharge for medications from the four groups mentioned above. For those patients diagnosed prior to 2000, general practice was given the responsibility of ensuring these preventive medications were offered.

1.4.3.4 Previous UK Studies

Most UK studies of coronary preventive medications after a myocardial infarction consisted either of cross-sectional studies of hospital discharge prescriptions,[57] of reports from six-month infarct survivors[58] or of general practice records for one-year survivors[59] or for two-year survivors.[60] The findings are summarised in Table 1.4. The proportion of patients on preventive medications ranged from 71% to 96% for aspirin, 32% to 48% for beta-blockers, 26% to 36% for ACE-inhibitors and 2% to 27% for lipid lowering medications. Additionally, improvements in hospital discharge prescriptions were noted for East London myocardial infarction patients diagnosed in the late 1990s compared to the early or mid-1990s.[57]

The EUROASPIRE-I study examined trends in lipid lowering medication prescribing in general practice in England and Wales between 1994 and 2001 in patients with established CHD. Prescribing had increased substantially over time, which was entirely due to an increase in statins. In 2001, 56% of men and 41% of women received prescriptions for lipid lowering medications compared to 12% of men and 10% of women in 1995.[61]

Table 1.4 Preventive medications prescribed for myocardial infarction survivors

Lead author	Study aim	Methods Year(s) of identification; age limit; patient numbers & source; prescription source	Findings
East London Cohort			
Baraket 2001[57]	To describe the proportion of patients prescribed coronary preventive medication.	1993-97; no age limit 892 hospital survivors after admission to CCU; Hospital discharge records	At hospital discharge, the proportion of patients on Aspirin was 96% A beta-blocker was 32% An ACE-inhibitor was 36%.
ASPIRE 1996[58]	To examine coronary preventive medication taking 6 months after hospital discharge.	1994-95: aged ≤ 70 years; 489 consecutive hospital infarct survivors from a stratified random sample of 24 UK hospitals Interview 6 months after hospital discharge	At 6 months, the proportion of patients on: Aspirin was 86% A beta-blocker was 38% An ACE-inhibitor was 26% A lipid lowering drug was 8%
Bradley 1997[60]	To report coronary preventive medication prescribing in general practice 2 years after the index event.	1995; no age limit 266 2-year survivors from discharge lists of 13 hospitals in southern England who were registered with 65 practices from Wessex Research Network; General practice records	Amongst 2-year survivors, the proportion of patients with prescriptions for: Aspirin was 71% A beta-blocker or an ACE-inhibitor was 30% A lipid lowering drug was 2%.
Wright 2001[59]	To report coronary preventive medication prescribing in general practice 1 year after an infarct.	1994-95; aged ≤ 80 years 565 1-year survivors from OXMIS register General practice records	At 1 year, the proportion of patients with prescriptions for: Aspirin was 85% A beta-blocker was 48% An ACE-inhibitor was 36% A lipid lowering drug was 27%.

CCU coronary care unit

1.4.3.5 Previous Non-UK Studies

One study examined preventive medication prescribing within two years of hospital discharge for myocardial infarction patients identified in the mid-1990s in nine European countries.[62] Compared to UK study findings, similar levels of prescribing for aspirin (85%) and ACE-inhibitors (39%), but higher prescription rates for beta-blockers (58%) and lipid lowering medication (31%) were reported. Like the East London comparison, improvements in hospital discharge prescriptions were also found for myocardial infarction patients diagnosed in the late 1990s compared to the early or mid-1990s in Europe,[63], Canada[55] and Norway.[64]

1.5 Psychological Health and Coronary Heart Disease

Poor psychological health (depression or anxiety) is recognised as a risk factor for the development of CHD.[24 65 66] However once a myocardial infarction has been diagnosed, there is less certainty about the relationship between psychological difficulties and subsequent coronary problems.

1.5.1 Literature Search

The aim of reviewing the psychological literature was to identify follow-up studies of infarct survivors that reported subsequent non-fatal CHD events and the relationship with psychological health. Different combinations of the following search terms were used: myocardial infarction, depression, anxiety, psychology and emotional distress.

1.5.2 Psychological Health after a Myocardial Infarction

1.5.2.1 Previous UK Studies

There were two UK cohorts of myocardial infarction patients for which the relationship between psychological health (depression, anxiety or emotional distress) at the time of the index event and subsequent outcomes had been

investigated. Patient cohorts were identified in Birmingham and Oxfordshire and study findings are shown in Table 1.5. In both cohorts, no relationship was found between baseline psychological health and subsequent one-year coronary events (fatal and non-fatal),[67] eighteen month all-cause mortality[68] or three-year all-cause or coronary mortality.[69]

Table 1.5 Previous UK studies of psychological health and subsequent events in myocardial infarction survivors

Lead Author	Study Aim	Methods Year(s) of recruitment; age limit; patient numbers; psychological health instrument	Findings
Birmingham Cohort			
Lane 2000[67]	To examine the association between baseline depression & anxiety and recurrent fatal or non-fatal CHD events in 1st year.	1997-1998; all MIs; no age limit 288 men & women; hospital survivors; Depression = BDI score >10 Anxiety = STAI score >40	At 1 year, 30% (82) of patients had at least 1 recurrent fatal or non-fatal CHD event. Baseline depression or anxiety was not associated with CHD event rates at 1 year.
Lane 2002[69]	To examine the relationship between depression & anxiety following an MI & 3 year survival status.	As above; cardiac deaths included congestive heart failure.	At 3 years, 13% (38) of patients had died of all cause & 11% (33) died of cardiac causes. In-hospital depression or anxiety was not associated with 3-year all-cause or cardiac mortality.
OXMIS Cohort			
Mayou 2000[68]	To investigate emotional distress immediately after an MI & its relationship with subsequent 6 & 18 month all-cause mortality.	1994-1995; all MIs; aged < 80 years; 344 hospital survivors; emotional distress = total HADS score >19	At 6 months, 4% (14) of patients had died & at 18 months the proportion was 8% (28). Amongst hospital survivors, baseline emotional distress was not associated with 6- or 18-month all-cause mortality. Non-fatal events were not reported.

BDI Beck Depression Inventory, STAI state-trait anxiety inventory, HADS hospital anxiety & depression scale

1.5.2.2 Previous Non-UK Studies

A number of other studies outside the UK have explored the relationship between psychological health and outcomes following hospital discharge in myocardial infarction survivors. In contrast to the UK studies, there were conflicting findings about the relationship between baseline depression and subsequent mortality. A Montreal cohort of infarct survivors has been investigated extensively, with consistent reports of baseline depression being independently associated with subsequent cardiac mortality at one year[70] and at five years.[71] Similar findings were reported for four month all-cause mortality in American infarct survivors[72] and for ten-year cardiac mortality in Swedish patients.[73] However, two other studies found no relationship between depression and one-year cardiac mortality in Quebec, Canada[74] and Japan.[75]

Amongst infarct survivors, a relationship has also been found between depression and subsequent cardiac events in the studies from Quebec[74] and Japan,[75] both of which included fatal events. The Montreal study was the only one to report non-fatal cardiac events separately from deaths and no relationship was found with depression.[71]

1.6 Health Service Resource Use and Costs after a Myocardial Infarction

1.6.1 Introduction

In 2003, the UK spent the largest percentage (18%) of health care expenditure on cardiovascular disease within the European Union.[2] CHD alone cost over £3.5 billion, which equated to the highest cost per capita in Europe at £61. The proportion of CHD health care expenses spent was 80% for inpatient care, 16% for medications, 3% for primary care, 2% for outpatient care and 1% for accident and emergency care.

1.6.2 Literature Review

The aim of the literature review was to identify studies of health service resource use and economic costs subsequent to hospital discharge for myocardial infarction survivors. The search was conducted in both the MEDLINE database and the NHS Economic Evaluation database at the University of York. A combination of the terms myocardial infarction, cost* and resource* were used.

1.6.3 Resource Use and Cost for CHD after Hospital Discharge

1.6.3.1 Previous UK Studies

The Nottingham Heart Attack Register was the only UK study to report CHD hospital resource use for myocardial infarction survivors after hospital discharge. Readmission rates for CHD ranged from 12% for reinfarction to 29% for unstable coronary syndrome (angina).[30] Follow-up studies of health service economic costs incurred by infarct survivors were not found.

1.6.3.2 Previous Non-UK Studies

Among the non-UK studies, one North American study compared one-year resource use after hospital discharge between American and Canadian patients diagnosed with myocardial infarction.[76] Differences between the two countries' health care systems accounted for most of the variation observed and made it difficult to extrapolate to the UK. In another study from the Duke Medical Centre in North Carolina USA, hospital costs from 30 days to 10 years after a myocardial infarction were estimated as $19,840 per patient.[77]

1.7 Thesis Rationale

There have been relatively few UK studies investigating the long-term outcomes and associated factors in patients diagnosed with myocardial infarction. Furthermore, the progression of CHD after hospital discharge, using a comprehensive set of measures, has not been fully documented in a single cohort

of infarct survivors. Despite the decline in CHD deaths and the improvement in survival rates, a myocardial infarction remains a major life-affecting event from a clinical and psychological perspective. It therefore seemed timely to assess the subsequent course of coronary disease and its impact on infarct survivors after hospital discharge.

Amongst the existing UK studies, there were a number of methodological limitations. These are described below for each of the five topic areas: mortality, socioeconomic status, non-fatal CHD progression, psychological health and health service use and costs.

1.7.1 Previous Studies of Mortality

There were relatively few UK studies of long term mortality in a cohort of infarct survivors and only one investigated coronary mortality, so the progression of fatal coronary disease after initial survival is unclear. In addition, two of the patient samples were not likely to have been representative of patients found in routine clinical practice. The Scottish cohort only included patients with a first myocardial infarction and the East London cohort only included those admitted to a coronary care unit in one hospital. This limits the generalisability of their findings to infarct patients in routine clinical practice.

1.7.2 Previous Studies of Socioeconomic Status and CHD

For patients diagnosed with a myocardial infarction, the relationship between individual socioeconomic status and long-term mortality has not been reported separately from 28-day mortality. Furthermore, there have been no recent studies of the relationship between individual socioeconomic status and coronary outcomes in infarct survivors from an English population. In two of the three UK cohorts, patients lived in highly deprived areas compared to the national population, which may limit the generalisability of findings.

1.7.3 Previous Studies of Non-fatal CHD Progression and Preventive Treatment

No studies have used a single composite measure of non-fatal CHD progression for each patient. In addition, fatal and non-fatal events were not differentiated and as a result, non-fatal progression of CHD post-infarction remains unclear. Study outcomes also excluded CHD diagnoses made during outpatient clinic visits, which may have led to an underestimate of CHD progression. The one UK study of congestive heart failure did not specify whether diagnoses were limited to those occurring after hospital discharge. In addition, it was not clear whether the prescription of ACE-inhibitors to treat congestive heart failure was initiated subsequent to hospital discharge. No follow-up studies of preventive medication prescribing beyond one year were found.

1.7.4 Previous Studies of Psychological Health and CHD

Reports of the two UK cohorts of infarct survivors that explored the association between baseline psychological health and subsequent outcomes were limited to deaths or deaths combined with non-fatal coronary events. The relationship between baseline psychological problems and subsequent non-fatal coronary events, investigated separately from deaths, has not been explored. In addition, the Birmingham study measured psychological health using the Beck Depression Inventory, an instrument designed for detecting problems in psychiatric not medically ill patients.

1.7.5 Previous Studies of CHD Health Service Resource Use and Costs

For infarct survivors, annual rates of hospital and general practice contacts after hospital discharge have not been reported. Neither have associated costs to the health service for CHD been reported.

1.7.6 Thesis Aim and Objectives

Given these limitations of the UK literature, the overall aim of this thesis was to provide a comprehensive account of the progression of CHD and associated factors over the subsequent six years. This was possible in an unselected cohort of Oxfordshire residents diagnosed with fatal or non-fatal myocardial infarction in the mid-1990s previously identified by the Oxford Myocardial Infarction Incidence Study (OXMIS). The work presented in this thesis started from the premise that, despite well-documented reductions in the incidence of myocardial infarction and the improvement in short-term prognosis, longer term outcomes and costs to the health service are poorly explored. Several separate but interrelated studies were designed to investigate the long-term consequences and focused on the following topic areas: mortality, socioeconomic status, non-fatal coronary events, psychological health and health service use and costs.

The title of this thesis is 'A Population-Based Cohort Study of Coronary Heart Disease after a Myocardial Infarction: Six-year Follow-up' and three main studies were undertaken to address specific objectives, as follows.

1. Retrospective analyses of the existing OXMIS databases were undertaken, with emphasis on 28-day infarct survivors, in order to:
i) Determine six-year mortality, both all-cause and mortality from CHD.
ii) Examine the relationship between baseline socioeconomic status and coronary outcomes up to six years after the index event.
The methods and results are presented in Chapters 3 and 4 respectively.

2. Hospital and general practice casenotes were studied, extracted and analysed, in order to:
i) Document the progression of non-fatal CHD and its treatment, over the six years following the index event.
ii) Determine associated health service use and economic costs during the six years.

The methods and results are presented in Chapters 5 and 7 respectively.

3. A cross-sectional survey of psychological health in long-term survivors was undertaken in order to:

i) Examine psychological health and its relationship with CHD, at seven years and during the previous seven years in 28-day survivors.

ii) Combine the seven-year data with the baseline OXMIS psychological database to construct a longitudinal study of psychological health over the seven years.

The methods and results are presented in Chapter 6.

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Chapter 2

Patient Cohort

2.1 Introduction

This chapter gives a description of the methods used to identify a cohort of patients who sustained a myocardial infarction in 1994-95. The follow-up of this patient cohort is the subject of this thesis and consists of several separate, but interrelated studies to provide a comprehensive account of the natural history and long term consequences of coronary heart disease following a myocardial infarction. The detailed methods for each study are described in individual chapters.

2.2 Study Population

Patients were identified by the Oxford Myocardial Infarction Incidence Study (OXMIS),[1] which was conducted in Oxfordshire, a mixed rural and urban county covering an area of 258,261 hectare in central England. This was a twelve month prospective case finding survey which aimed to identify all cases of myocardial infarction occurring between November 14 1994 and November 13 1995 among the Oxfordshire population. Permanent Oxfordshire residents were selected for registration in the study, whether the event occurred in the area or not. Cases were excluded if the onset of an event was outside the study period or within 28 days of any preceding event in the same patient. A copy of the paper reporting OXMIS coronary events and case fatality is given in Appendix A.

2.3 Case Ascertainment

Multiple overlapping sources of case ascertainment were used to register suspected cases of myocardial infarction. Most non-fatal events were identified prospectively within hours or days of the onset of the attack using the method also

known as 'hot pursuit'.[2] Prospective case identification methods are illustrated in Figure 2.1 and were employed in the two hospitals, the John Radcliffe Hospital, Oxford and the Horton General Hospital, Banbury, where most Oxfordshire residents with a suspected myocardial infarction were treated. The computerised admission system of these two Oxfordshire hospitals was searched daily and enquiry from staff in coronary care units and other medical wards identified potential cases admitted during the previous 24 hours. The results of serum cardiac enzymes estimations were examined daily, and results of electrocardiograms (ECGs) carried out in hospital were obtained monthly. General practitioners (GPs) were also asked to notify the study team, by telephone, of suspected cases of myocardial infarction admitted to a hospital outside Oxfordshire or treated at home and of all suspected coronary deaths.

Eligibility for the study was confirmed by casenote review of all suspected cases of myocardial infarction. Patients with a presenting problem suggestive of myocardial infarction admitted to hospital from the accident and emergency department were usually located in the coronary care unit or on a general medical ward and hospital casenotes were reviewed. Those with serum cardiac enzyme levels raised above the normal laboratory limits or with an ECG suggestive of myocardial infarction were also found and followed up. Potential cases of infarction identified by general practitioners were registered in the study, whether hospitalised or treated at home, and for the latter, general practice casenotes were reviewed to confirm eligibility.

Cases that died outside hospital and survivors who were treated outside Oxfordshire were identified retrospectively, using 'cold pursuit'. Contract minimum datasets compiled by the Oxfordshire Health Authority were searched to detect patients discharged with a diagnosis of myocardial infarction from hospitals within the county as well as hospitals with whom extra-contractual arrangements existed. This method was important for identifying Oxfordshire residents treated outside Oxfordshire. Death certificates for Oxfordshire residents were also reviewed and those with International Classification of Diseases (ICD), ninth revision, codes 410

to 414 were registered.[3] Additionally necropsy reports were examined to identify deaths caused by coronary heart disease (CHD) and cause-specific mortality statistics from the Office of National Statistics (ONS) were scrutinised.

2.4 Sources of Case Ascertainment

The use of multiple overlapping sources aimed to maximise the completeness of case ascertainment. The greatest yield of non-fatal events was from the accident and emergency department with 567 events, the biochemistry laboratory with 461 events and hospital discharge statistics (Contract minimum datasets) with 436 events. For fatal events the principal source was the ONS death statistics from which 574 events were ascertained. Review of death certificates and Coroner's reports provided 488 and 257 events respectively. A total of 33 non-fatal and 18 fatal events were identified by GPs.

The number of eligible events exclusively ascertained from each source is shown in Table 2.1. This provides an indication, for each ascertainment source, of the number of cases that would have been missed had the source not been included in the study. Prospective methods, using accident and emergency and biochemistry records, provided a substantial number of nonfatal cases (89) that would not have been detected using only discharge data. On the other hand, discharge data provided unique information on 44 patients, most of who had been treated at hospitals outside of Oxfordshire. A number of deaths (24) were detected from the ONS that were not detected from screening death certificates. However, only a few cases (3) were found through screening of death certificates that were not identified from ONS data.

Table 2.1 Number of coronary events ascertained exclusively from each source

	Number of events ascertained			
Source	Definite MI	Possible MI	Unclassifiable Death	Total
Accident & Emergency	21	45	0	66
Biochemistry	15	8	0	23
Coronary Care Unit	1	0	0	1
ECG Department	0	3	0	3
Death Certificates	2	1	0	3
Coroner's Office	0	2	1	3
Routine Post-mortems	3	1	0	4
General Practitioners	2	3	0	5
Minimum Contract Datasets	34	10	0	44
Office of National Statistics	6	14	4	24
Total	84	87	5	176

MI: myocardial infarction

2.5 Diagnostic Criteria

The diagnosis of myocardial infarction was validated using WHO MONICA project criteria, which were based primarily on symptoms, electrocardiograph (ECG) findings, cardiac enzymes and necropsy reports.[4] ECGs were coded by trained staff at the Glasgow MONICA centre using a combination of MONICA protocol criteria and the Minnesota code manual of ECG findings.[5] Each coronary event was classified to one of five categories: definite myocardial infarction, possible myocardial infarction, ischaemic cardiac arrest, fatal case with insufficient data (also termed unclassifiable death) or no acute myocardial infarction. These diagnostic categories are defined below.

2.5.1 Definite Acute Myocardial Infarction

a) Definite ECG, or

b) Symptoms typical or atypical or inadequately described, together with probable ECG and abnormal enzymes, or

c) Symptoms typical and abnormal enzymes with ECG ischaemic, or non-codable or not available, or

d) Fatal case, whether sudden or not, with naked-eye appearance of fresh myocardial infarction and/or recent coronary occlusion found at necropsy.

2.5.2 Possible Acute Myocardial Infarction

a) Living patient with typical symptoms whose ECG and enzymes results do not place them in 'definite myocardial infarction' category and in whom there is no good evidence for another diagnosis for the symptoms, or

b) Fatal case, whether sudden or not (not in 'definite myocardial infarction' category), where there is no good evidence for another cause of death, clinically or at necropsy:

i) with symptoms typical or atypical or inadequately described, or

ii) without typical or atypical or inadequately described symptoms but with evidence of chronic coronary occlusion or stenosis or old myocardial scarring at necropsy, or

iii) with a history of chronic ischaemic heart disease such as definite or possible myocardial infarction, or coronary insufficiency or angina pectoris in the absence of significant valvular disease or cardiomyopathy.

2.5.3 Ischaemic Cardiac Arrest

Twenty-eight day survivors not fulfilling criteria for 'definite myocardial infarction' or 'possible myocardial infarction' categories, who have been resuscitated from cardiac arrest. The cardiac arrest should have been from presumed primary ventricular fibrillation secondary to ischaemic heart disease, in the absence of significant valvular disease or cardiomyopathy, not provoked by medical intervention, electrocution, or other physical insult.

2.5.4 Fatal Case with Insufficient Data

Cases with no necropsy, no history of typical or atypical or inadequately described symptoms, no previous history of chronic ischaemic heart disease, and with no other diagnosis were classified as a fatal case with insufficient data.

2.5.5 No Acute Myocardial Infarction

a) Living patient not in 'definite myocardial infarction' category:

i) with symptoms or tests that do not qualify for 'definite myocardial' infarction or 'possible myocardial infarction', or

ii) where the illness has been explained by another diagnosis, or

b) Fatal case, whether sudden or not, not in 'definite myocardial infarction' category where another diagnosis has been made (clinically or at necropsy).

2.6 Data Collection

A trained research nurse completed a separate data collection form for each event registered in the study (Appendix B). For those events identified prospectively, hospital case notes, GP referral letter and ambulance patient report of hospitalised patients with suspected myocardial infarction were examined to obtain information on event details and past medical history. Information on clinical indicators of infarct severity in the first 24 hours of the event was also recorded. Complications, medications and procedures during the admission, and diagnoses and medications at discharge were also extracted. Levels of cholesterol and cardiac enzymes measured during the hospital stay were obtained from the computer in the departments of Clinical Biochemistry. Copies of all ECGs taken during the event were sent to the Glasgow MONICA Centre for coding.

Case notes of Oxfordshire residents treated at hospitals out of county or at home were examined for event details, past medical history and coronary risk factors. For those patients treated outside Oxfordshire, hospitals were visited for case note review, when feasible, or medical record departments were asked to send

photocopied admission details. For those patients who received domiciliary care, general practice notes were reviewed. If GPs had completed diagnostic investigations, copies of ECGs and cardiac enzyme levels were obtained.

When possible, patients with non-fatal events were interviewed to obtain details of the acute event, coronary risk factors and social history. Hospitalised patients were interviewed when the attending doctors or nurses considered it appropriate. Patients who received care from their GP or out of county hospitals were interviewed at home as soon as possible after notification. However, in two cases, GPs refused permission to interview such patients (one was an alcoholic and the other had suffered a stroke).

In cases where the patient died prior to an interview, permission was sought from the GP to interview the nearest relative. A minimum period of three weeks was allowed before writing to the relative of the deceased. If he or she agreed, they were interviewed either by telephone or at home. Additional data on fatal cases were also provided by GPs. However on many occasions, by the time GPs were approached for information, records were no longer available at the surgery and these were obtained through the Family Health Services Association.

Survival status at 28 days was determined for all patients by reviewing death certificates and coroners' reports and through notifications received from the ONS. All 28-day survivors were flagged through the ONS for subsequent mortality.

2.7 Data Quality

Rigorously standardised study procedures were used to ensure data quality. A manual of operations provided a policy for the interpretation and coding of questionnaire items. All diagnostic data (symptoms, ECGs, enzymes and necropsies) were coded independently by two trained coders. Disagreements were resolved by discussion with the principal investigator, or in the case of Minnesota

coding, with a third coder at the MONICA Centre in Glasgow. Double key data entry using DBASE IV for DOS version 2.0[6] was undertaken, with the incorporation of range and consistency checks into the data entry procedure.

2.8 Patient Cohort

Between 14 November 1994 and 13 November 1995, a total of 1,343 suspected cases of myocardial infarction were identified which met the criteria for registration in the study. After exclusion of the 187 events classified as 'no myocardial infarction' and five classified as 'ischaemic arrests' using the WHO MONICA diagnostic criteria, there were 1151 events in Oxfordshire residents under the age of 80 years. These events occurred in 1120 individuals – 1091 suffered a single event, 27 experienced two events and two people had three separate events (all separated by more than 28 days) during the study period. By 28 days after the index event, 615 patients had survived.

Some patients were identified in the acute Oxfordshire hospitals: 555 patients at the John Radcliffe Hospital and 103 at the Horton General Hospital. Ninety-two patients were treated at hospitals outside the county or were already admitted to non-acute Oxfordshire hospitals (the Radcliffe Infirmary or Churchill Hospital) at the time of the index event. Five patients were in a community hospital and 37 patients were treated at home by their GP. The remaining 328 people died outside hospital, either before they could be seen by a doctor or ambulance staff, or before treatment could be initiated.

The cohort of 1120 consisted of 756 men and 364 women. Table 2.2 shows the MONICA diagnostic classification of the first coronary events for men and women. Based on available diagnostic data, 96.4% (1080) of events were classified as definite or possible myocardial infarction. Of the 632 cases which met the MONICA criteria for definite myocardial infarction, 73.4% (464) were non-fatal (28-day

survivors). One third (151) of the 448 events classified as possible myocardial infarction were non-fatal (28-day survivors)

Table 2.2 MONICA classification of first coronary events by 28-day survival status for men and women

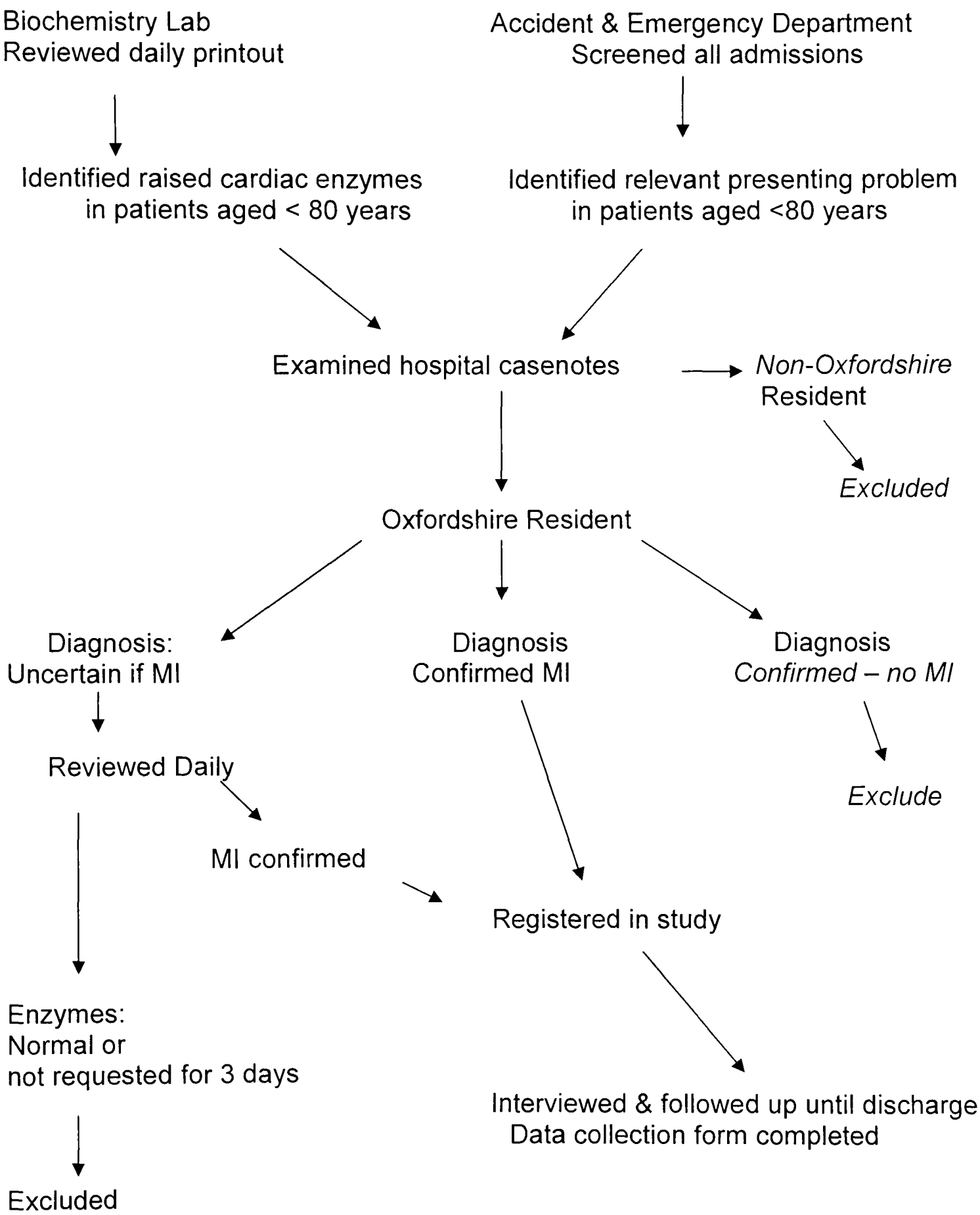
		Non-fatal coronary event (28-day survivors)		Fatal coronary event		
	N	Definite MI % (n)	Probable MI % (n)	Definite MI % (n)	Probable MI % (n)	Unclassifiable % (n)
Men	756	44.3 (335)	12.6 (95)	14.3 (108)	26.3 (199)	2.5 (19)
Women	364	35.4 (129)	15.4 (56)	16.5 (60)	26.9 (98)	5.8 (21)
Total	1120	41.1 (464)	13.5 (151)	15.0 (168)	26.5 (297)	3.6 (40)

2.8.1 28-Day Survivors

A total of 615 men and women survived 28 days after the index event. Amongst 28-day survivors, the proportion diagnosed with a definite myocardial infarction was 76% (464).

Chapter 3 reports mortality rates of the cohort, focusing primarily on six-year mortality of 28-day survivors, and the methods employed in the follow-up study.

Figure 2.1 Prospective case ascertainment at John Radcliffe and Horton General Hospitals ('Hot Pursuit')



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Chapter 3

Mortality

3.1 Introduction

In the previous chapter, the methods of identifying the patient cohort were described. This chapter examines six-year mortality in this patient cohort.

International differences in mortality within one month of a myocardial infarction have been studied extensively by the World Health Organization (WHO) Monitoring Trends and Determinants of Cardiovascular Disease (MONICA) project.[1] In the United Kingdom a number of population-based studies (including the Glasgow MONICA centre) have shown that between 45% and 52% of patients die within one month of a myocardial infarction.[2 3 4] There are, however, only four cohorts, that have been studied for long-term prognosis, and most studies have been hospital-based studies that excluded both patients admitted to hospital outside the catchment area and those receiving domiciliary treatment.[5 6 7] Of the population-based follow-up studies that recruited patients from the 1990s, none related to an English population.[8 9 10 11 12]

Amongst studies of long-term mortality in infarct survivors, follow-up periods ranged from six months to ten years. All cause mortality was the primary outcome in studies from both the UK[8 7 6 5] and from other countries.[13 14] Only a Swedish study reported deaths from CHD separately from other causes, but followed patients for only one year.[15] Several studies found no differences in mortality rates between men and women,[7 5 16 17 13 18] whereas others disagreed.[14 15 19]

3.2 Aims

In this chapter, the six-year all-cause and CHD mortality rates are reported for patients diagnosed with fatal and non-fatal myocardial infarction. The aims were to

document the long-term prognosis for this unselected cohort of myocardial infarction survivors, to examine any differences in mortality between men and women, and to compare their mortality risk with that of the general population.

3.3 Methods

3.3.1 Patients and Past Medical History

This follow-up of the Oxford Myocardial Infarction Incidence Study (OXMIS) included 1118 Oxfordshire residents aged 30 to 79 years with a diagnosis of definite or possible myocardial infarction or death with insufficient data to classify. Two men aged less than 30 years were excluded because the small number in this age group would not permit meaningful analyses.

For patients admitted to hospital, case notes were reviewed to extract baseline diagnostic, clinical and risk factor information. Infarct severity was measured using the Killip score (a score of one indicates no myocardial dysfunction and four indicates severe dysfunction).[20] A Killip score could not be allocated to 20 patients diagnosed at home and another 13 of those admitted to hospital. Past medical history of myocardial infarction, angina, diabetes or hypertension was documented based on the clinical case notes. Past history of hyperlipidaemia was only available for 906 (81%) patients and serum total cholesterol at admission was only measured for 391 (35%). These risk factors are, therefore, not reported. Smoking history and current smoking status was obtained directly from the patient or their relatives. When this was not possible, information was obtained from clinical notes. Current smokers were defined as those patients who reported smoking at least one cigarette a day in the three months prior to the event. Ex-smokers were defined as those previously smoking at least one cigarette a day, but not during the three months before the event and non-smokers as those who reported never smoking cigarettes.

For those patients who died out of hospital or whose notes were incomplete, past medical history was obtained from their general practitioner, and additional information from their relatives, if they consented to an interview. In the entire cohort, 77 (7%) cases had missing data for diabetes, 82 (7%) for previous myocardial infarction and 101 (9.0%) for hypertension. These missing data were primarily accounted for by patients who died in the first 24 hours. Among 28 day survivors, 3 (0.5%) cases had missing data for diabetes, 10 (2%) for previous myocardial infarction, 13 (2%) for angina history, 23 (4%) for hypertension and 26 (4%) for smoking history. The Oxford Research Ethics Committee gave ethical approval for the follow-up study.

3.3.2 Identification of Deaths

Survival status at 28 days was determined for all patients by reviewing death certificates and coroners' reports and through notifications received from the Office of National Statistics. All 28-day survivors were flagged with the Office of National Statistics National Health Service Central Register to trace deaths and emigration. In the event of death, a copy of the death certificate was provided, which was coded to the underlying cause of death using the ninth revision of the WHO International Classification of Diseases (ICD) with codes ICD 9 410-414 corresponding to CHD deaths.[21] The OXMIS database was updated by a database manager between 1995 and 2002 with details of each death, which included the date, ICD code for the underlying and other cause(s) of death for each deceased patient. Oxfordshire age- and sex-specific mid-year population estimates and annual all-cause and CHD deaths were obtained for each year from 1995 through to 2000 from the Oxfordshire Health Authority.

3.3.3 Statistical Analysis

Data were analysed using the statistical packages SPSS 10.0 for Windows (SPSS Inc. 2001, Chicago Illinois) and STATA 7.0 (Stata Corporation, 2001. College Station, Texas). Proportions were compared using the chi-squared test or Fisher's

exact test, and means using Student's t test. Results were considered to be statistically significant when $p<0.05$ in this chapter and throughout the thesis. Standardised mortality ratios (SMRs) were calculated using the 10-year age- and sex-specific annual mortality rates from 1995 to 2000 for the reference population of England and Wales, which were applied to mid-year populations for the OXMIS survivors and the general population of Oxfordshire to calculate the expected number of deaths. The SMR is the ratio of the number of observed deaths to the number expected. 95% confidence intervals for the SMR were calculated based on exact Poisson confidence limits.[22] Survival was calculated using the Kaplan-Meier method and comparison of survival between men and women assessed using the logrank test. Small numbers of women restricted further comparison by age groups and the age cut-off of 70 years was selected to create age groups with adequate numbers of women for meaningful analyses using the Kaplan-Meier method. A Cox regression analysis was attempted to explore the association between six-year survival and baseline risk factors, including age, that were not balanced between the sexes. However, there was evidence of non-proportional hazards over the six-year period, not only for 28-day survivors, but also for three-month and six month survivors. It was, therefore, not possible to use this approach. Using the Kaplan-Meier method, the risk of death from CHD was examined, by treating patients who died from causes other than CHD as censored. Survival defined in this way is referred to as CHD survival.

3.4 Results

3.4.1 Cohort Description

The cohort for this study comprised 754 men and 364 women (after exclusion of two men aged less than 30 years). Table 3.1 shows the baseline risk factors for the entire cohort and for 28-day survivors. Women were five years older than men and in 28-day survivors, 50% of women were 70 years or older compared to 30% of men. Additionally women were more likely to have a history of diabetes and hypertension, although a previous myocardial infarction was more common in men

than women. Among the 28-day survivors, women had higher Killip scores at baseline and men were more likely to have ever smoked. All 613 28-day survivors remained resident in the UK during the six-year follow-up period.

Table 3.1 Baseline Risk Factors of Entire Cohort and 28-day Survivors
% (n), unless stated otherwise

	Men	Women	Difference (Men – women) (95% CI)
Entire Cohort (N)	754	364	
Age			
Mean years (SD)	65.0 (10.4)	69.8 (8.3)	-4.8 (-6.1 to -3.6)
% ≥ 70 years	38.9 (293)	58.2 (212)	-19.4 (-25.5 to -13.2)
Past history of:			
Previous MI	30.3 (213)	16.5 (55)	13.8 (8.5 to 19.0)
Diabetes	14.1 (99)	19.4 (66)	-5.3 (-10.2 to -0.4)
Hypertension	31.9 (219)	43.8 (145)	-11.9 (-18.3 to -5.5)
28-day Survivors (N)	428	185	
Age			
Mean years (SD)	62.9 (10.6)	67.9 (9.1)	-5.1 (-6.8 to -3.3)
% ≥ 70 years	30.4 (130)	49.7 (92)	-19.4 (-27.8 to -10.9)
Killip Score:			
1	83.3 (339)	72.8 (126)	10.5 (2.9 to 18.0)
2	8.1 (33)	12.7 (22)	
3/4	8.6 (35)	14.5 (25)	
Past history of:			
Previous MI	25.2 (107)	12.9 (23)	12.3 (5.8 to 18.7)
Angina	30.2 (127)	27.4 (49)	2.8 (-5.1 to 10.7)
Diabetes	9.8 (42)	15.3 (28)	-5.5 (-11.4 to 0.5)
Hypertension	24.3 (101)	43.1 (75)	-18.8 (-27.3 to -10.4)
Smoking History:			
Non-smoker	20.0 (82)	40.7 (72)	-20.7 (-28.9 to -12.5)
Current	27.1 (111)	23.7 (42)	
Ex-smoker	52.9 (217)	35.6 (63)	

Note: Percentages are based on number with available data.
CI: Confidence interval, MI: myocardial infarction, SD: standard deviation

3.4.2 Case Fatality over Six Years

Table 3.2 shows the six-year all-cause case fatality for men and women. Over a third of both men and women had died within the first 24 hours. In the first 28 days, 97% of deaths were due to CHD. Of the 613 28-day survivors, a further 25% (155) had died from all causes by six years, which included 22% (96) of men (95% CI

19% to 26%), and 32% (59) of women (95% CI 25% to 39%) (difference 10%, 95% CI 2 to 17; p=0.018). Among these deaths, CHD was the underlying cause in 55% of men (53/96) and 44% (26/59) of women. Of the remaining six-year deaths, non-CHD causes for men included cancer (21%), other cardiovascular disease (10%), respiratory disease (8%) and other causes (5%) and for women, other cardiovascular disease (25%), cancer (12%), respiratory disease (12%) and other causes (7%).

Of the 28-day survivors, 70 had diabetes, 540 had no past history of diabetes (three had missing data on diabetes history). By six years, 27% (19) of diabetics and 11% (60) of non-diabetics had died from CHD (difference 16%, 95% CI 5 to 27). The remaining results were restricted to the 28-day survivors, consisting of 428 men and 185 women.

Table 3.2 All cause and CHD deaths over six years after myocardial infarction in women and men: Summary

	Men		Women		
	N	%	N	%	% Difference (95% CI)
Total in cohort	754	100.0	364	100.0	
Deaths in 24 hours	263	34.9	135	37.1	-2.2 (-8.2 to 3.8)
Deaths after 24 hours to 28 days	63	8.4	44	12.1	
Total deaths in first 28 days	326	43.2	179	49.2	-5.9 (-12.2 to 0.3)
Alive after 28 days	428	56.8	185	50.8	
Alive after 28 days	428	100.0	185	100.0	
Deaths after 28 days to 1 year	24	5.6	24	13.0	-7.4 (-12.0 to -2.7)
Deaths after 1 year to 6 years	72	16.8	35	18.9	-2.1 (-8.6 to 4.5)
Deaths up to 6 years: total	96	22.4	59	31.9	-9.5 (-17.0 to -2.0)
CHD	53	12.4	26	14.1	-1.7 (-7.5 to 4.1)
Alive after 6 years	332	77.6	126	68.1	

CI: Confidence interval

3.4.3 Six-Year Overall Survival

Overall survival curves are illustrated in Figure 3.1a for 428 men and 185 women who survived 28 days after the index event and annual survival probabilities based on these curves are shown in Table 3.3. Overall survival was higher in men than women over the six year period (p=0.007). The curves diverged in the first year with significantly fewer men than women having died by 12 months (6% (24/428) v 13% (24/185) respectively; difference -7%, 95% CI -13 to -3; p=0.003). This was explained by fewer non-CHD deaths among men than among women (1% (6/428) v 5% (10/185); difference -4%, 95% CI -7 to -1; p=0.009). The survival curves remained approximately parallel over the subsequent five years.

Survival curves were constructed separately for patients aged less than 70 years and those aged 70 or more (Figs 3.1b, 3.1c) to examine whether the improved survival for men could be explained by their younger age. In the younger age group, survival was still better in men than women (p=0.035). However, in this age group men were significantly younger than women (mean [SD] ages 57.7 [8.3] years and 60.8 [7.3] years respectively; difference 3.1 years, 95% CI 1.2 to 5.0). In the group aged 70 or more, there was no difference in survival between men and women (p=0.88), with the survival curves lying close throughout the period. In this older group, the mean ages of men and women were similar (74.6 [2.9] years v 75.1 [2.8] respectively; difference 0.5 years, 95% CI -0.2, 1.3).

Baseline coronary risk factors amongst men and women within each of these two age groups were examined to determine whether differences in each age group contributed to gender differences in survival between the groups. In both age groups, diabetes and hypertension were more common in women, and men were more likely to have a previous myocardial infarction or to have ever smoked, which was similar to the distribution of risk factors amongst the entire 28-day survivor cohort. Consequently, age was the only factor that differed significantly between men and women within the 30 to 69 year age group.

Figure 3.1a Six-year overall survival for 28-day survivors: All ages

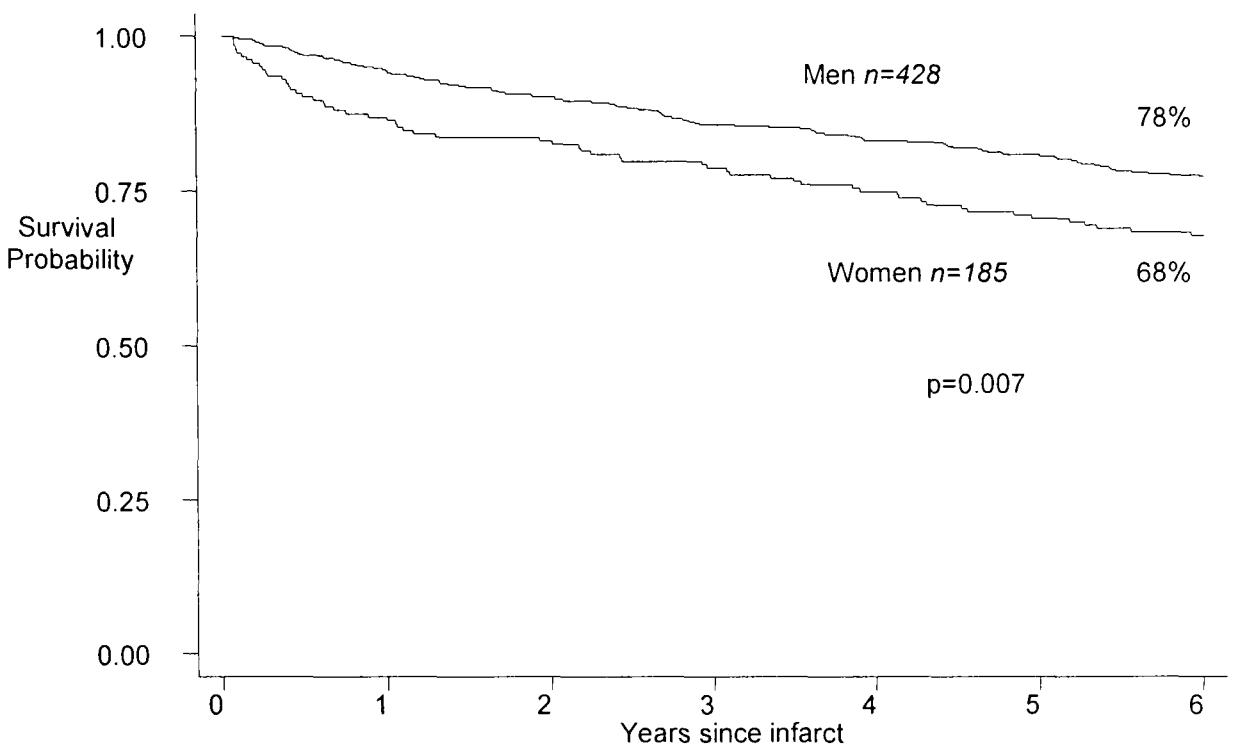


Figure 3.1b Six-year overall survival for 28-day survivors: 30-69 years

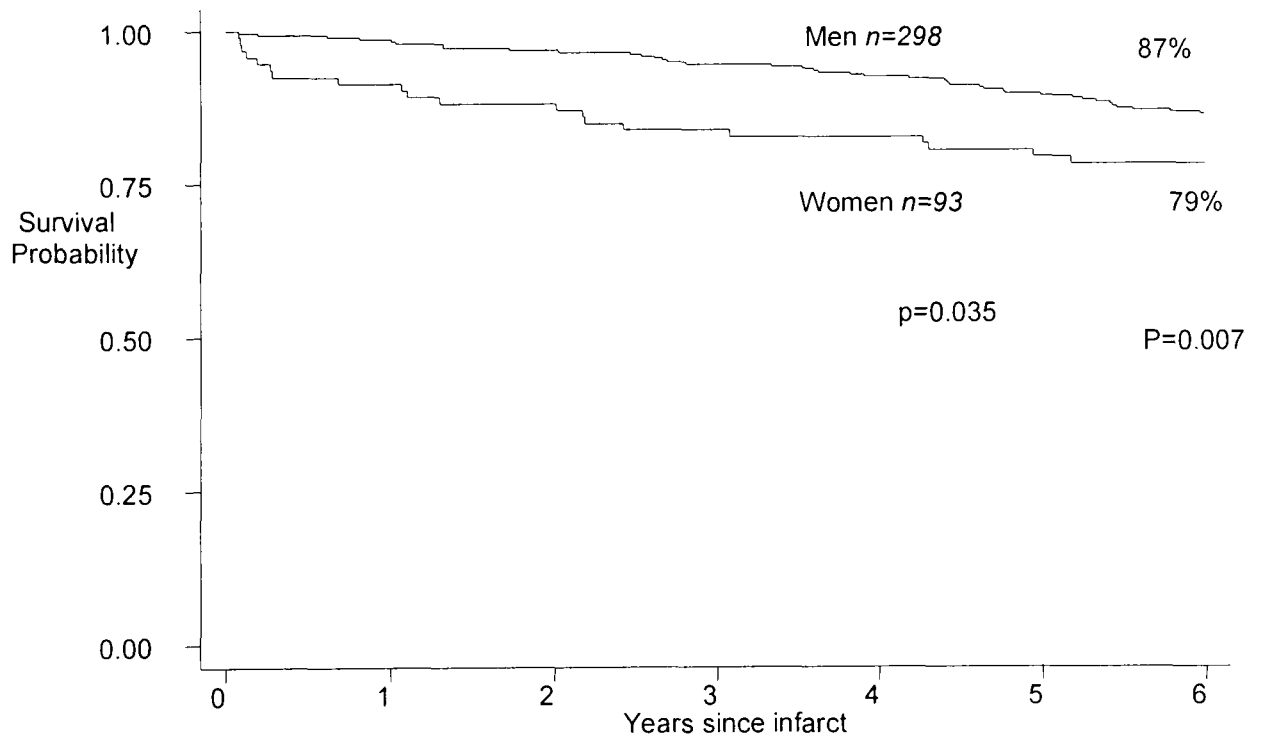
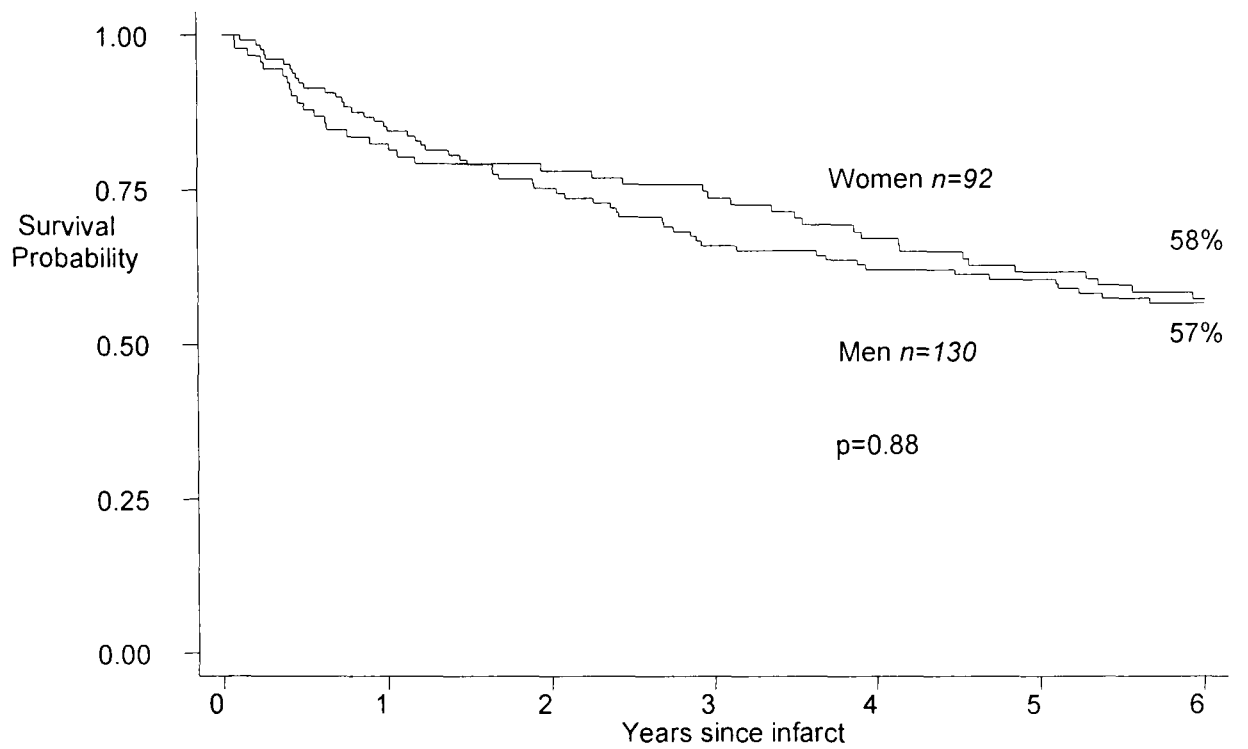


Figure 3.1c Six-year overall survival curves for 28-day survivors: 70-79 years



3.4.4 Six-Year CHD Survival

Kaplan-Meier survival analyses were also performed to examine the risk of CHD death over six years (referred to as CHD survival because patients who died from causes other than CHD were censored). In total, 13% (59) of 28-day survivors (95% CI 10% to 16%) had died of CHD at six years. CHD survival curves are illustrated in Figure 3.2a for men and women separately and annual survival probabilities based on these curves are shown in Table 3.3. There was no significant difference between men and women for CHD survival (p=0.34) with 13% of men and 15% of women having died of CHD at six years. For those aged less than 70 years, CHD survival in men was somewhat better than in women (p=0.064) while the opposite was noted in the group aged 70 or more (p=0.14) (Figs 3.2b, 3.2c and Table 3.3).

Figure 3.2a Six-year CHD survival for 28-day survivors: All ages

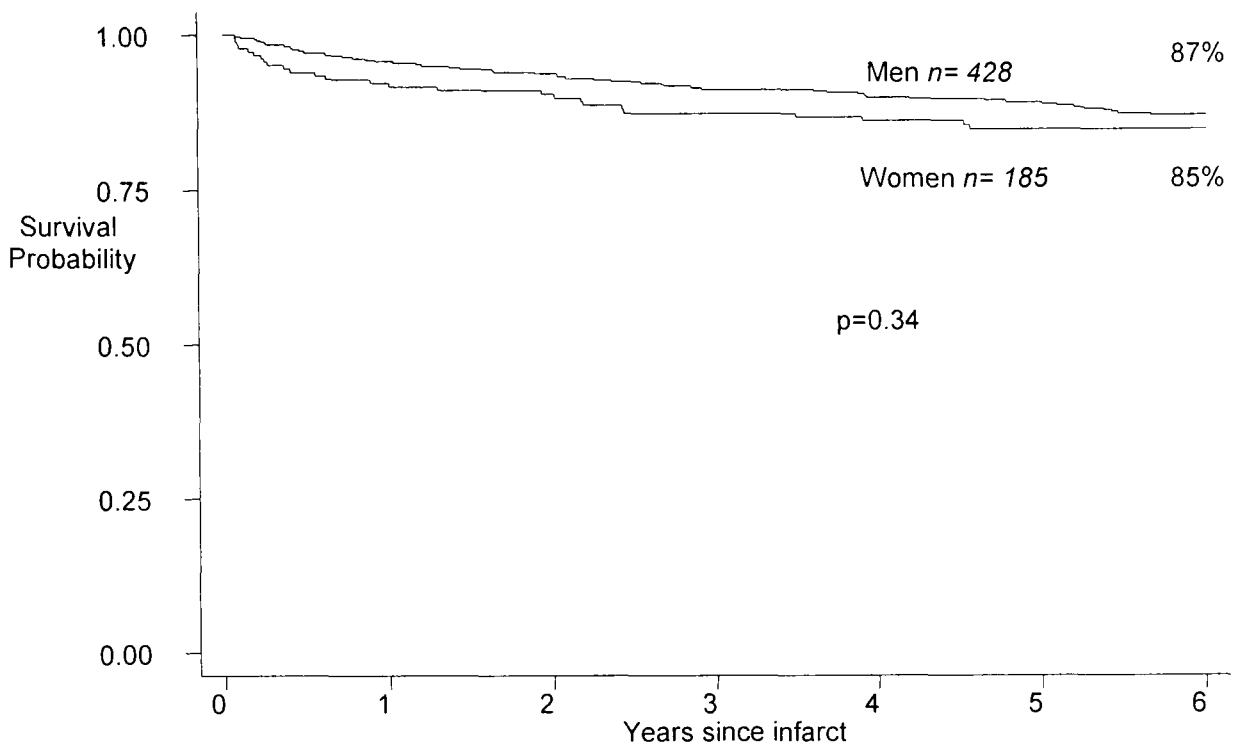


Figure 3.2b Six-year CHD survival for 28-day survivors: 30-69 years

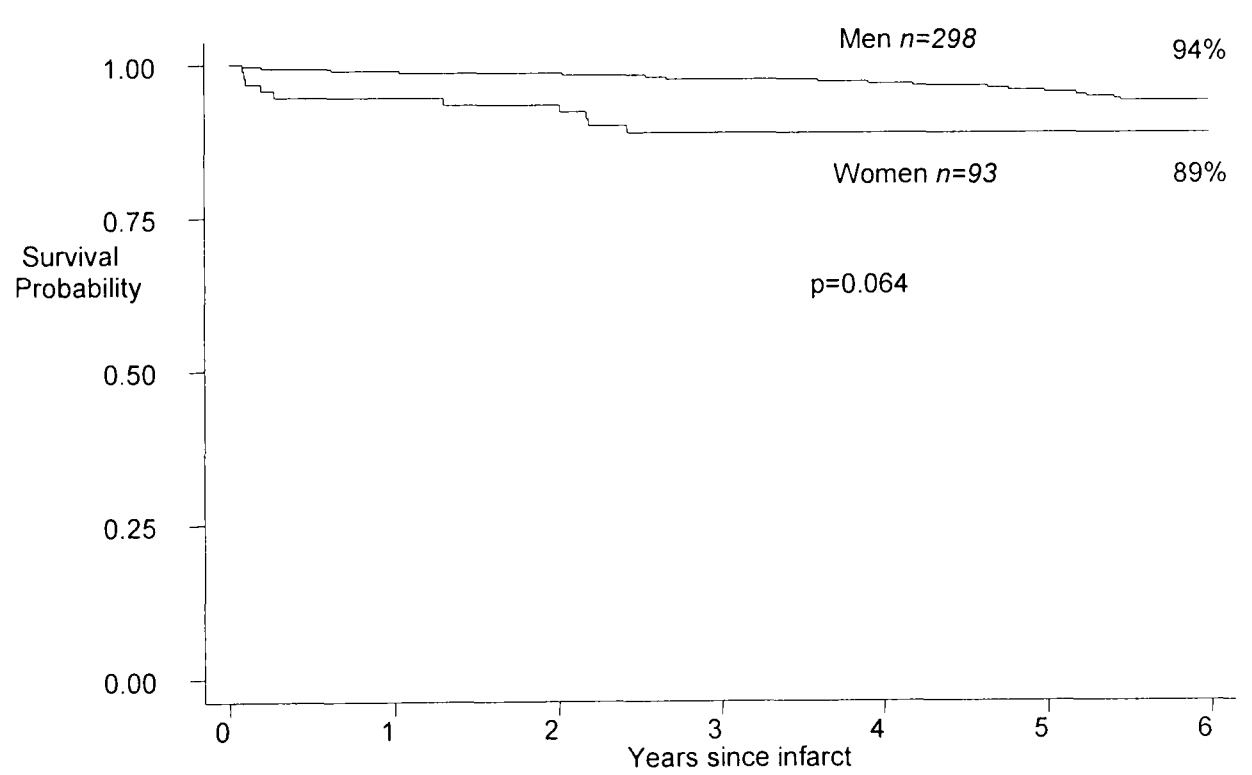
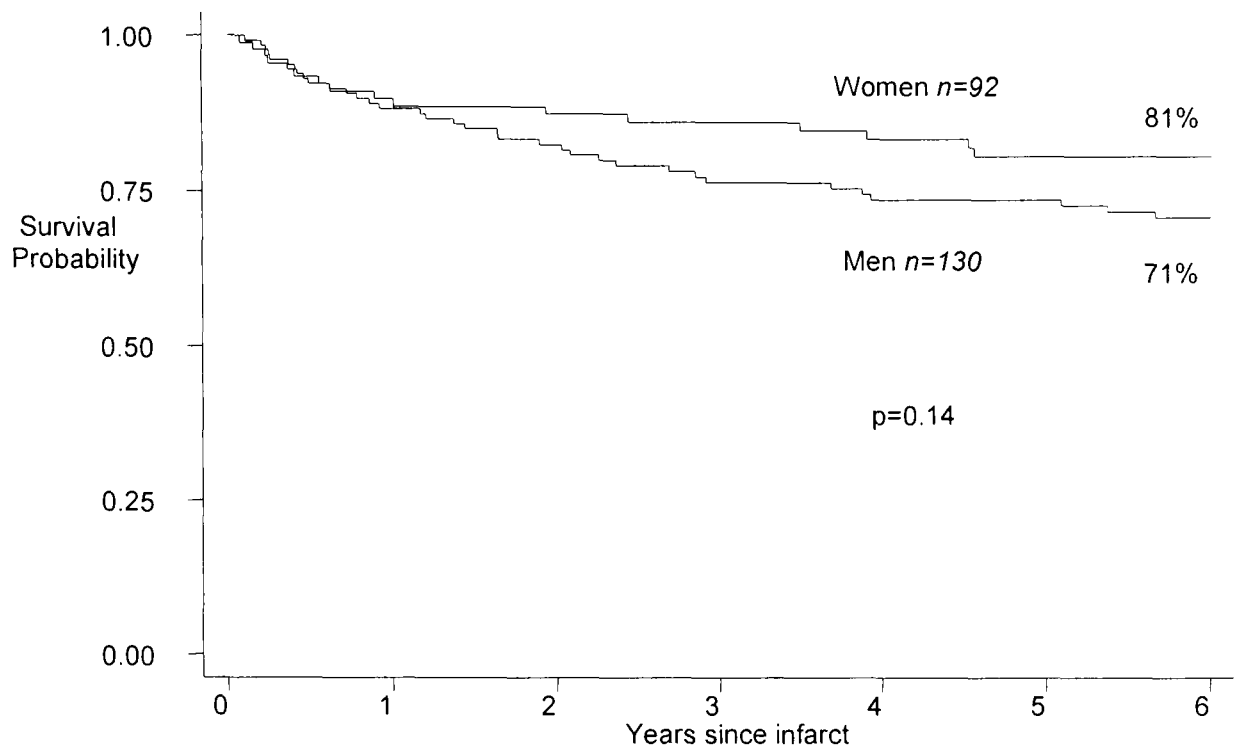


Figure 2c Six-year CHD survival for 28-day survivors: 70-79 years



3.4.5 Association between Baseline Risk Factors and Survival from Coronary Disease

As mentioned in the methods, section 3.3.3, to adjust for the imbalance of baseline risk factors between men and women, a Cox regression analysis was used to explore the association between sex and long term survival in 28-day survivors. The analysis revealed that the relationship between gender, age and survival (both overall and CHD) was complex and not constant over the six year study period. It was, therefore, inappropriate to use this approach when an underlying assumption of proportional hazards (in this case, the constant relative risk of survival between men and women over time) was not fulfilled by the data. Consequently it was not possible to clarify the relationship between sex and long term post- myocardial infarction survival by further adjustment for baseline differences in coronary risk factors other than age given the limitations of the data set.

Table 3.3 Annual Probability of Survival for OXMIS men and women surviving 28 days.

		% Survival					
		At 1 year (95% CI)	At 2 years (95% CI)	At 3 years (95% CI)	At 4 years (95% CI)	At 5 years (95% CI)	At 6 years (95% CI)
Overall	N						
Men	428	94.4 (91.8-96.2)	90.4 (87.2-92.9)	86.0 (82.3-88.9)	83.4 (79.5-86.6)	80.8 (76.8-84.3)	77.6 (73.3-81.2)
Women	185	87.0 (81.3-91.1)	83.2 (77.0-87.9)	78.9 (72.3-84.1)	75.1 (68.3-80.7)	70.8 (63.7-76.8)	68.1 (60.9-74.3)
CHD							
Men	428	95.8 (93.4-97.3)	93.9 (91.1-95.8)	91.4 (88.3-93.7)	90.2 (86.9-92.7)	89.1 (85.7-91.8)	87.3 (83.7-90.2)
Women	185	92.3 (87.3-95.4)	90.6 (85.2-94.0)	87.6 (81.8-91.7)	86.4 (80.3-90.7)	85.1 (78.9-89.6)	85.1 (78.9-89.6)
CHD by age groups							
30-69 years							
Men	298	99.0 (96.9-99.7)	98.7 (96.5-99.5)	97.6 (95.1-98.9)	96.9 (94.2-98.4)	95.5 (92.4-97.4)	94.1 (90.6-96.3)
Women	93	94.6 (87.5-97.7)	93.5 (86.0-97.0)	88.9 (80.3-93.9)	88.9 (80.3-93.9)	88.9 (80.3-93.9)	88.9 (80.3-93.9)
70-79 years							
Men	130	88.4 (81.5-92.8)	82.6 (74.8-88.2)	76.6 (68.1-83.1)	73.9 (65.1-80.8)	73.9 (65.1-80.8)	71.0 (61.9-78.3)
Women	92	89.9 (81.5-94.6)	87.5 (78.6-92.9)	86.3 (77.1-92.0)	83.6 (73.9-90.0)	80.8 (70.5-87.9)	80.8 (70.5-87.9)

CI: Confidence intervals, CHD: coronary heart disease

Table 3.4 **Standardised Mortality Ratios for 28 day survivors of OXMIS and for Oxfordshire residents compared with the population of England and Wales.***

	Male				Female			
	All-cause SMR (95% CI)		CHD SMR (95% CI)		All-cause SMR (95% CI)		CHD SMR (95% CI)	
Time period	OXMIS	Oxfordshire	OXMIS	Oxfordshire	OXMIS	Oxfordshire	OXMIS	Oxfordshire
1st 11 months	2.49 (1.60-3.71)	0.85 (0.80-0.89)	6.22 (3.68-9.82)	0.69 (0.63-0.78)	7.21 (4.62-10.73)	0.92 (0.86-0.97)	18.49 (10.11-31.03)	0.75 (0.65-0.87)
2nd year	1.84 (1.07-2.94)	0.81 (0.77-0.85)	2.55 (1.02-5.25)	0.72 (0.65-0.79)	2.21 (0.89-4.55)	0.86 (0.81-0.91)	4.28 (0.88-12.51)	0.74 (0.64-0.86)
3rd year	2.27 (1.37-3.55)	0.77 (0.73-0.81)	4.19 (2.01-7.70)	0.71 (0.65-0.80)	2.68 (1.16-5.28)	0.83 (0.78-0.88)	7.95 (2.58-18.55)	0.71 (0.60-0.82)
4th year	1.40 (0.70-2.51)	0.78 (0.74-0.82)	2.27 (0.74-5.31)	0.50 (0.44-0.56)	2.49 (1.00-5.13)	0.88 (0.83-0.94)	3.42 (0.41-12.35)	0.43 (0.35-0.53)
5th year	1.60 (0.83-2.80)	0.76 (0.72-0.80)	2.47 (0.80-5.76)	0.74 (0.67-0.83)	3.02 (1.30-5.94)	0.82 (0.77-0.86)	3.87 (0.47-13.97)	0.70 (0.60-0.82)
6th year	2.07 (1.13-3.48)	0.79 (0.75-0.83)	3.93 (1.58-8.10)	0.76 (0.68-0.84)	2.13 (0.69-4.96)	0.85 (0.80-0.90)	0 (0-8.37)	0.81 (0.70-0.95)
Total	1.94 (1.10-3.11)	0.78 (0.75-0.83)	3.73 (1.74-7.22)	0.67 (0.61-0.75)	3.36 (1.64-6.28)	0.85 (0.80-0.91)	7.17 (1.78-16.76)	0.68 (0.58-0.80)

*Age adjusted using mortality rates from national data for England & Wales for each related time period; CHD: coronary heart disease

3.4.6 Age-Standardised All-Cause and CHD Mortality Ratios of 28 Day Survivors over Six Years

Table 3.4 shows standardised mortality ratios (SMRs) for 28-day survivors and for the Oxfordshire population, separately for men and women, in comparison with the population of England and Wales. SMRs for the Oxfordshire population (both all-cause and from CHD) were lower than the general population of England and Wales, whereas those for 28-day Oxfordshire myocardial infarction survivors were higher. Over six years in 28-day survivors, men had a two-fold increase in risk for all-cause mortality and four-fold increase in risk for CHD mortality compared to men of the same age in the general population of England and Wales. For women, there was a three-fold and seven-fold excess mortality respectively for all causes and CHD compared to women of the same age in the general population of England and Wales.

3.5 Discussion

3.5.1 Key Findings

The six-year coronary and all-cause mortality were 13% and 25% in this geographically defined unselected incident cohort of 28-day myocardial infarction survivors diagnosed in the mid-1990's in Oxfordshire. No significant differences were observed in coronary mortality between men and women over the six years. The prognosis is likely to be representative of populations at similarly low or lower risk of CHD in much of southern England.[23] The earlier incidence study found that the age-adjusted coronary event rates for men and women in Oxfordshire aged 25-64 years were similar those for MONICA centres in Brianza in northern Italy and in Toulouse in southern France and only one third of those for in Belfast and Glasgow.[4]

3.5.2 Study Strengths

Incident coronary events were defined rigorously using the WHO MONICA diagnostic criteria, but unlike the WHO MONICA project, patients up to the age of 80 years were included to ensure that the cohort was representative of patients diagnosed in routine clinical practice. The inclusion of patients with a 'possible' myocardial infarction further increased the generalisability. Ascertainment of mortality was likely to be complete since the National Health Service Central Register flagged all 28-day survivors and no patients were lost to follow up. The study reports coronary mortality over a longer time period than previous prospective UK studies and the follow-up period corresponded with the introduction and widespread adoption of more intensive secondary preventive therapy.[24]

3.5.3 Study Limitations

There are a number of limitations to the study. The cohort consisted of a relatively small number of patients, especially in the older age group, which limited the examination of gender differences after adjusting for age. An additional limitation was the reliance on death certificate diagnoses to classify CHD death as this has been shown to over-diagnose cardiac death in patients aged more than 65 years.[25] Consequently, the 13% six-year mortality may be an over-estimate. Since the cohort was identified, prescription of secondary preventive therapy with statins, beta-blockers and ACE-inhibitors has become routine,[24] which would be expected to further improve the long-term prognosis. Further, the change in diagnostic criteria, with the adoption of troponin T as a sensitive specific marker of myocardial damage, complicates the direct application of these findings to current clinical practice. The new criteria may identify at least 50% more patients. The survival rates of these additional patients appear to be poorer, in part, because they are older.[26]

3.5.4 Coronary Mortality

The Nottingham Heart Attack Register Study is the only other recent English study of long-term coronary mortality in infarct survivors, and it reported a 20% (95% CI 17% to 23%) four year CHD mortality in 695 hospital survivors identified in the two district general hospitals in Nottingham.[6] Most of these patients, however, would have been discharged after about a week and deaths occurring in the three weeks after discharge would partly account for the higher mortality observed in that cohort. This was confirmed by re-analysing the Oxfordshire data for one-week survivors, and a 15% four-year coronary mortality was found. The residual difference in CHD mortality of 5% (95% CI 1% to 9%, p=0.01) between the two cohorts may be explained by the Nottingham patients being on average three years older and the background population having a higher age-adjusted CHD mortality rate than in Oxfordshire.[23]

3.5.5 All-Cause Mortality

By contrast, several recent UK studies have reported long term all-cause mortality in myocardial infarction survivors.[7 8 27] However, direct comparison with the OXMIS coronary mortality finding is difficult because, as non-coronary mortality was not reported for these studies, coronary mortality cannot be calculated. Nevertheless, one prospective study of 2153 patients admitted with myocardial infarction to one of 20 hospitals within the old NHS Region of Yorkshire between September and December 1995 reported that two-year unadjusted all-cause mortality for hospital survivors was 17% for men and 27% for women.[7] However, like the Nottingham study patients, most of those in Yorkshire would have been discharged after one week and the observed higher mortality in Yorkshire patients was partly explained by deaths occurring in the subsequent three weeks. Reanalysis of two-year all-cause mortality for one-week survivors in the OXMIS study found 14% of men and 22% of women had died of all causes by two years compared to 9% of male and 18% of female 28-day infarct survivors.

Two other UK studies reported long-term mortality for myocardial infarction patients with results reported separately for 30-day survivors. The Scottish Record Linkage Study followed up 84,440 myocardial infarction patients who were admitted to hospital and identified retrospectively between 1986 and 1995 from a Scottish-wide hospital database.[8] Five-year all-cause mortality in these Scottish patients was 27% for men and 31% for women, although patients with a recurrent infarct were excluded. To allow comparison, reanalysis of OXMIS 28-day survivors with a first myocardial infarction found 16% of men and 25% of women had died by five years. A second study of 608 patients admitted to a coronary care unit in an East London district general hospital were prospectively identified between 1988 and 1991.[5] Amongst 30-day survivors, three-year all-cause mortality was 14% for men and 11% for women compared to 14% of men and 22% of women who had survived 28 days in OXMIS. However, the East London Study only included patients admitted to a coronary care unit and in the Oxfordshire cohort, 58% (302/517) of those admitted to hospital were treated in a coronary care unit[27] and in Yorkshire, the proportion was 68%.[7] Consequently, at least one third of patients diagnosed with myocardial infarction may have been excluded from the East London Study, which may limit the generalisability of their findings.

Other factors may also account for the differences in findings between the OXMIS study and the other UK studies. The background population of the other three cohorts had higher age-adjusted coronary mortality rates than Oxfordshire, which may explain some of the remaining excess mortality.[23] However, further comparisons are confounded by differences in the age structure of each of these three cohorts. Both male and female infarct survivors from Yorkshire[7] and the Scottish Record Linkage Study[8] were on average older than in the OXMIS study, whilst patients in the East London Study[5] were younger with 26% being aged over 70 years compared to 36% in the OXMIS cohort.

3.5.6 Gender Differences

The only other study of gender differences in coronary mortality beyond one month in infarct survivors is the National Acute Myocardial Infarction Register Study in Sweden.[15] All patients with myocardial infarction discharged from hospital in Sweden during 1987 to 1995 were linked with the National Cause of Death Register and included 128,640 men and 73,361 women who survived 28 days. Coronary mortality was examined for those younger than 50 years and by five year age groups, thereafter, up to 89 years. No gender differences in coronary mortality were found for 28-day survivors in any age group, but these results were limited to one year. Likewise in the OXMIS study, no significant differences in six-year coronary mortality were found for men and women within two age groups (30 to 69 years and 70 to 79 years). However, for those younger than 70 years, CHD mortality was somewhat worse for women than men over the six years with 11% of women and 6% of men having died of CHD by six years (p=0.06). In contrast amongst the 70 to 79 year age group, the opposite was observed and by six years, 29% of men and 19% of women had died of CHD (p=0.14). In this latter group, survival curves were closely parallel until one year, after which they diverged suggesting the possibility that differences between men and women occurred subsequent to one year. However, small numbers of women in each age group and the small number of deaths in the younger age group limits the interpretation of these findings. Since the only other UK report of long-term coronary mortality was from the Nottingham Heart Attack Register Study, which did not report four-year coronary mortality separately for men and women,[6] it remains unclear whether gender differences in coronary mortality beyond one year are present or not.

In contrast, there are several recent international studies[14 15 18 28 29 19] and UK studies[17 7 5] investigating gender differences in all-cause long-term mortality following a myocardial infarction. Overall contradictory findings were reported: several studies found no gender differences;[17 7 5 28 18] some found lower mortality in women than men[29], whereas others reported higher mortality in younger

women[15 14] and lower mortality in older women compared to men[14 19] However, the Swedish study was the only one to report non-coronary mortality separately, and the significant gender differences in one-year all-cause mortality found in those aged less than 50 years was explained by significantly higher non-coronary mortality in women compared to men in this age group. In the OXMIS study, six-year all-cause mortality was significantly higher for women compared to men (p=0.007), which was also explained by more non-coronary deaths among women than men in the first year (p=0.009). However, it was not possible to examine non-coronary deaths by age groups, because of the small numbers of such deaths within each group.

Factors other than age have also been suggested as an explanation in the controversy about gender differences in long-term all-cause mortality following a myocardial infarction.[7] These include baseline differences between men and women in past medical history, infarct severity, and hospital and discharge treatment. However, adjustment for such factors did not affect reported mortality differences for men and women.[5 7 14 29 19] In the OXMIS study, the imbalance of baseline factors amongst men and women could not be examined for association with six-year mortality in 28-day survivors, because of data limitations described earlier. Overall, it remains unclear whether gender differences in non-coronary mortality explain the conflicting findings of all-cause mortality in post-infarct patients.

3.5.7 Prognosis

The prognosis following a myocardial infarction has improved for both short and long term survival over the last two to three decades. Several international studies have reported improved in-hospital and one month post-infarct survival,[9 30 31] including the Scottish Record Linkage Study,[8] and similar findings were documented in Oxfordshire with 28-day case fatality between 1966-67 and 1994-95 reduced by 28% for men and 32% for women.[4] Temporal trends in long term

coronary mortality following myocardial infarction over the last two to three decades were also reported for the Framingham cohort.[32] The ten-year coronary mortality among 30-day myocardial infarction survivors, compared to mortality in 1950-69, declined by 30% in the 1970s and a further 20% on the 1980s; and similar findings for all-cause mortality were also reported. Likewise, other international studies[9 33 12 30] and the Scottish Record Linkage Study[8] have reported a decline in long-term all-cause mortality between the 1980s and 1990s for infarct survivors, most of which is probably due to a reduction in coronary mortality.

3.5.8 Health Service Implications

The improved prognosis has major implications for patient care and for health care resources in both secondary and primary care. As more patients survive infarcts, the incidence of recurrent coronary events will increase resulting in a correspondingly larger number of acute hospital admissions, which will be further exacerbated by the reported substantial increase in hospitalisation rates for angina and chest pain in elderly people without previous admissions for coronary disease.[34] In addition, the recent introduction of new diagnostic criteria using troponins has resulted in additional patients diagnosed with myocardial infarction[26 35 36] and further increases in the use of health care resources. A study of 966 such patients identified in one Scottish hospital between 1997 and 2000 found 24% were readmitted to hospital for CHD, 13% had a coronary angiogram and 8% had coronary revascularisation procedure within the first year of diagnosis.[26]

Responsibility for subsequent secondary preventive therapy and systematic monitoring for CHD progression after hospital discharge was assigned to primary care by the National Service Framework for CHD in England.[37] Prior to the publication of the National Service Framework, however, several studies had shown that preventive treatment had not been reliably implemented in clinical practice.[38 39] As a consequence, there will be further substantial resource

implications if primary care is to achieve its goal of improving the delivery and quality of long-term care for infarct survivors.

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Chapter 4

Socioeconomic Status

4.1 Introduction

In the previous chapter, six-year mortality was investigated in the study cohort. In this chapter, socioeconomic status at the time of the index myocardial infarction is examined in relation to coronary event rates and subsequent mortality.

Incidence rates of coronary disease in the general population are higher with lower socio-economic status, using either individually assigned or area-based measures.[1 2 3 4 5] Case-fatality within one month after myocardial infarction is higher in lower individual social classes,[3 1 2 6] but studies using postcode-based area deprivation groups have reported conflicting findings; some showing that case fatality increases with lower socioeconomic status,[7 8 9] whereas one found no relationship.[4] Subsequent overall mortality in 28-day infarct survivors has been reported by most studies as higher in those from areas of greater deprivation.[10 7] However, little is known about subsequent mortality and individual socioeconomic status, because mortality beyond 28 days has not been reported separately.[3 1] These findings suggest that different conclusions may be reached about socioeconomic status and coronary disease outcomes, depending on the type of measure used.

Earlier UK studies using both types of measure have reported all-cause mortality in cohorts of healthy people[11 12 13] or CHD prevalence in the general population.[14] In addition, one UK study used both types of socioeconomic indicators in the investigation of cardiovascular mortality in a healthy cohort from a highly deprived area of Western Scotland, and an independent contribution of each measure was found, after adjustment for baseline coronary risk factors.[15] The investigators recommended that both residential area and individual characteristics need consideration in strategies to reduce cardiovascular mortality in the general

population, but the Scottish results and recommendations may not be applicable to people once they have been diagnosed with coronary heart disease (CHD). The OXMIS cohort provided an opportunity to examine the relationship between the two measures of socioeconomic status and to investigate coronary outcomes using both types of socioeconomic measures in a geographically defined cohort of patients diagnosed with CHD. However, given the small number of deaths by six years for 28-day OXMIS survivors, it was necessary to extend the analyses to the entire patient cohort to achieve the aims of this chapter.

4.2 Aims

In this chapter, two studies are reported which examine the relationship between socioeconomic status, rates of coronary events and subsequent mortality. Two different indicators are used: individually ascertained social class and postcode-based Townsend material deprivation index. The first study describes the Oxfordshire population by socioeconomic and age groups, and reports incidence rates of myocardial infarction. The second study is of the Oxford Myocardial Infarction Incidence Study (OXMIS) cohort and investigates rates of 28-day case fatality and of six-year all-cause and coronary heart disease (CHD) mortality in 28-day survivors. Additionally, the relationship between the two socioeconomic measures is investigated.

4.3 Methods

Study 1: Based on Oxfordshire Population

4.3.1 Measures of Socioeconomic Status

4.3.1.1 Social Class

The first measure of socioeconomic status was occupation-based social class, using the Registrar General's classification, and based on employment details from a 10% sample of the population from the 1991 Census.[16] For those people not

currently working at the time of the Census, who were unemployed, retired or permanently sick, classification was based on their last occupation during the previous ten years. If people were unemployed, retired or permanently sick for more than ten years, they were categorised as unclassifiable. People in the Armed Forces and those employed people who did not state or provide enough information about their occupation were also categorised as unclassifiable.

In this chapter, social class is reported for both head of household and for individuals. Published Census documents of social class are by head of household and social class by individuals was commissioned for Oxfordshire men and women especially for this study from the Office of National Statistics. However using social class data was problematic for two reasons. Firstly, there was a tabulation error in the 1991 Census data by the Office of National Statistics due to the exclusion of those who were considered eligible to work but had not worked in the last 10 years or had been unemployed for more than 10 years. Secondly, a 10% sample has an undetermined amount of imprecision in estimating actual numbers in the entire population of interest. As a result, there are discrepancies in the denominator population of Oxfordshire. Based on the full Census, 120,500 men and 119,156 women aged 30 to 64 years were reported as resident in Oxfordshire (Table 4.3) compared to 109,182 men and 92,254 women estimated from the 10% sample (Table 4.4).

4.3.1.2 Area-Based Deprivation

The second measure of socioeconomic status used was the Townsend material deprivation based on deprivation levels of Oxfordshire enumeration districts. It is a postcode-based composite score using four variables from the Census: unemployment, overcrowding, non-car ownership and non-home ownership.[17] Townsend values can vary from +12 (indicating high levels of deprivation) to -12 (indicating high levels of affluence). An enumeration district covered about 400 households.

Pre-calculated Townsend indices for each enumeration district were obtained from the 1991 Census Small Area Statistics database.[18] Townsend indices cannot be calculated for enumeration districts that lack overcrowded households due to the method of calculation (natural log transformation prior to standardisation for overcrowding). Oxfordshire had 115 (8%) such enumeration districts and these were excluded from analyses. The remaining 1238 enumeration districts were sorted in ascending order of Townsend indices. Four cutpoints were established to create five equally sized groups of enumeration districts for the Oxfordshire population, referred to as quintiles or area deprivation groups. Quintile 1 (Q1) was the least deprived and quintile 5 (Q5) the most deprived.

4.3.2 Oxfordshire Population and Comparison with England and Wales

At the time of the study, Oxfordshire was divided into five administrative districts – Oxford, Cherwell, Vale of the White Horse, West Oxfordshire and South Oxfordshire. The county was relatively affluent in terms of material wealth. Most men (83%) between 16 and 64 years of age and the majority of women (68%) 16 to 59 years of age were employed in the week prior to the last Decennial Population Census in April 1991.[19] Townsend indices for enumeration districts in the five Oxfordshire administration districts and in England and Wales are summarised in Table 4.1. Within England and Wales, the Townsend deprivation Index ranges from 11.80 for the most deprived to -7.55 for the most affluent enumeration districts. Within Oxfordshire, Oxford administrative district was the most deprived with a mean Townsend Index of 1.40. The mean Townsend Index for the remaining four districts ranged between -1.45 and -2.18.

Table 4.1 Townsend Index summaries for Oxfordshire districts and England and Wales

	Enumeration districts (N)	Townsend Index			
		Mean (SD)	Most affluent	Most deprived	Range
Oxfordshire					
Oxford	235	1.40 (2.6)	-4.06	8.79	12.86
Cherwell	260	-1.45 (2.6)	-6.40	6.15	12.55
West Oxfordshire	235	-2.06 (1.7)	-5.66	2.80	8.46
Vale of White Horse	250	-2.08 (2.0)	-6.83	4.17	11.54
South Oxfordshire	258	-2.18 (1.8)	-6.07	3.79	9.86
England & Wales	108,343	0 (3.4)	-7.55	11.80	19.35

Table 4.2 shows social class by head of household for Oxfordshire[19] and England.[20] In comparison with England, Oxfordshire had a more favoured social class distribution (Chi-squared test, 5 d.f, $p<0.0001$), with more households in social class I and II (44.3% vs. 37.8%) and fewer in social class IIINM and IIIM (33.7% vs. 40.1%).

Table 4.2 Social class by head of household for Oxfordshire and England

Social class based on occupation		Oxfordshire % (n)	England % (n)
I	Professional, etc.	10.1 (14,641)	6.8 (790,740)
II	Managerial & technical	34.2 (49,652)	31.0 (3,621,177)
III-NM	Skilled (non-manual)	11.2 (16,307)	13.7 (1,593,814)
III-M	Skilled (manual)	22.5 (32,593)	26.4 (3,084,385)
IV	Partly skilled	12.5 (18,065)	13.4 (1,570,629)
V	Unskilled	4.3 (6,208)	4.5 (572,985)

Table 4.3 shows the county's population of men and women by five year age groups from the 1991 Census.[19] A total of 146,838 men and 152,468 women aged 30 to 79 years were Oxfordshire residents in 1991.

Table 4.3 **Oxfordshire men and women aged 30 to 79 years by five year age groups**

Age group (years)	Men % (N)	Women % (N)
30-34	14.5 (21,340)	13.7 (20,810)
35-39	13.1 (19,219)	12.4 (18,929)
40-44	14.3 (20,981)	13.7 (20,828)
45-49	11.9 (17,441)	11.5 (17,581)
50-54	10.3 (15,099)	9.7 (14,823)
55-59	9.4 (13,776)	8.7 (13,301)
60-64	8.6 (12,644)	8.4 (12,884)
65-69	7.6 (11,143)	8.4 (12,763)
70-74	5.9 (8,598)	7.1 (10,751)
75-79	4.5 (6,597)	6.4 (9,798)
Total	100.0 (146,838)	100.0 (152,468)

Study 2: Based on OXMIS Cohort

4.3.3 Measures of Socioeconomic Status

4.3.3.1 Social Class

Social class was determined for each patient in the OXMIS cohort based on their current or previous job title and their managerial or supervisory responsibility, using the Registrar General's classification.[16] The majority of the occupational data (91%) were obtained from patient interview for non-fatal cases and from patients' relatives or death certificates for fatal cases. An additional 57 (5%) occupations were classified using information obtained from the patient's registered general practitioner. Within the entire cohort, 718 (95%) men were assigned a social class and 333 (92%) women. Allocation of social class for women was based on their own occupation (not head of household), when possible, and 281 (84%) were in this category. The remaining 52 women were allocated a social class based on their partner's occupation. Social class was assigned to each OXMIS patient by a local epidemiologist (Dr. J. Newton).

4.3.3.2 Area-Based Deprivation

Townsend scores were determined for each OXMIS patient based on their residential area postcode at the time of the event. Postcodes were obtained from case notes for those patients admitted to hospital or from general practice records for those who received domiciliary care or who died out of hospital. Postcodes were linked with an enumeration district, a Townsend Index and thus an Oxfordshire deprivation quintile. Two women who lived in enumeration districts without overcrowded households and therefore were not assigned a Townsend index were excluded from analyses. Generally, quintiles were the area deprivation unit of analysis. However to make full use of the available data, the Townsend Index itself was employed in logistic regression analyses.

4.3.4 OXMIS Cohort

As described in the previous chapter, the total study sample consisted of 1118 Oxfordshire residents aged 30 to 79 years diagnosed with a coronary event, using the WHO MONICA Project criteria.[21] A coronary event was registered in the study if its onset was outside 28 days of any preceding event in the same patient and within the one year study period (see Chapter 2). Methods used to collect baseline diagnostic and risk factor data were outlined in Chapter 3.

4.3.5 Identification of Deaths

Survival status at 28 days was determined for all patients by reviewing death certificates, coroners' reports and by notification from the Office of National Statistics. As detailed in chapter 3, all 28-day survivors were flagged with the Office of National Statistics and the database was updated with details of each death by a database manager between 1995 and 2002.

4.3.6 Statistical Analyses

Data for men and women were analysed separately. Data were analysed using the statistical packages SPSS 10.0 for Windows[22] and STATA 7.0.[23] All social class analyses were restricted to classes I to V. For coronary event rate calculations, analyses were further restricted to those aged 30 to 64 years to exclude inaccuracy of incomplete social class data in older age groups within the Oxfordshire population.

Proportions were compared using the chi-squared test. Gradients across socioeconomic groups for coronary events, for cohort baseline risk factors and for 28-day case fatality were assessed using the chi-squared test for trend. Means were compared using Student's t test.

Unadjusted coronary event rates were calculated as the number of OXMIS cohort events divided by the number of people in the Oxfordshire population at the 1991 Census, separate calculations being performed for each socioeconomic group (social class or deprivation quintile). An indirectly standardised event ratio was calculated for each socioeconomic group. Expected numbers of events were based on the five-year age and sex-specific annual coronary event rates for Oxfordshire during the study year as the reference rates, and applying these to 1991 Census populations for each Oxfordshire socioeconomic group. The standardised event ratio was calculated as observed divided by expected number of events. The crude rate of the appropriate standard population (male or female) was applied to each ratio, to give an age-standardised rate for each socioeconomic group. 95% confidence intervals for the standardised ratios were based on the exact Poisson confidence limits.[24]

Within the OXMIS cohort, the relationship between mean Townsend Index and social class was explored using Spearman's rank correlation coefficient. However, small numbers in each social class required the combination of class I with II, class IIINM with IIIM, and class IV with V for more meaningful analysis, and the

relationship was further examined using a one-way analysis of variance. Predictors of 28-day case fatality were explored using multiple logistic regression. The most affluent socioeconomic group (social class I and Q1) was used as the reference category. However, because of small numbers, social classes I and II were combined for women.

Survival analyses for men and women surviving 28 days also used combined socioeconomic groups due to small numbers in each sub-group. Social classes I, II and IIINM were reclassified as non-manual and IIIM, IV and V were reclassified as manual. For area material deprivation, the 'affluent' group consisted of Q1, Q2 and Q3 and the 'deprived' group consisted of Q4 and Q5. Survival was calculated using the Kaplan-Meier method and comparison of survival between groups assessed using the logrank test. The risk of death from CHD was examined, by treating patients who died from causes other than CHD as censored. Survival defined in this way is referred to as CHD survival. Further examination of potential confounders of long term survival was not possible given the limited data set. As mentioned in chapter 3, a Cox regression analysis revealed that the relation between gender, age and survival was complex and not constant over the six year study period and it was, therefore, inappropriate to use this approach.

4.4 Results

Study 1: The Oxfordshire Population and Annual Coronary Event Rates

The first study in this chapter describes the relationship between socioeconomic status and population-based coronary event rates in Oxfordshire.

4.4.1 Oxfordshire Population Description

4.4.1.1 Social Class

The Oxfordshire population by age group and individual social class for men and women aged 30 to 64 years is shown in Table 4.4. There were slightly more women than men in the 30-54 year age group (81.1% vs 78.9%; $p<0.0001$). There were striking differences in the distribution of social classes in the two sexes (Chi-squared test, 8 d.f., $p<0.0001$). More men were in social class I and fewer were in social class V compared to women (social class I: 11.7% vs. 2.9% and social class V: 4.1% vs. 8.1%). In social class III, far more men were in manual occupations compared to women (26.5% vs 5.8%) and in contrast, many fewer men than women were in non-manual occupations.

Table 4.4 Age group and social class for Oxfordshire men and women aged 30 to 64 years

	Men % (n) N=109,182	Women % (n) N=92,254
Age (years)		
30-54	78.9 (86,156)	81.1 (74,800)
55-64	21.1 (23,026)	18.9 (17,454)
Social class		
I	11.7 (12,774)	2.9 (2,705)
II	32.5 (35,496)	31.8 (29,357)
III-Non Manual	7.5 (8,145)	35.7 (32,902)
III-Manual	26.5 (28,962)	5.8 (5,349)
IV	13.2 (14,354)	14.0 (12,926)
V	4.1 (4,447)	8.1 (7,486)
Armed Forces	3.3 (3,627)	0.3 (243)
Unclassified	0.7 (729)	0.6 (567)
Unknown	0.6 (648)	0.8 (719)

The proportions of Oxfordshire men and women aged 30 to 64 years in five year age groups within social classes are illustrated in Figure 4.1a (men) and Figure 4.1b (women). The lower social classes had a greater proportion of men and women aged 55 to 64 years (an age of increased risk for coronary events) compared to those aged 30 to 54 years (X^2 test for trend, $p<0.0001$ for both men and women). Furthermore, the proportion of people aged 55 to 64 years in social class V compared to class I was 35% vs 19% for men and 33% vs 9% for women.

Figure 4.1a Proportion of Oxfordshire men aged 30 to 64 years in each age group within social classes

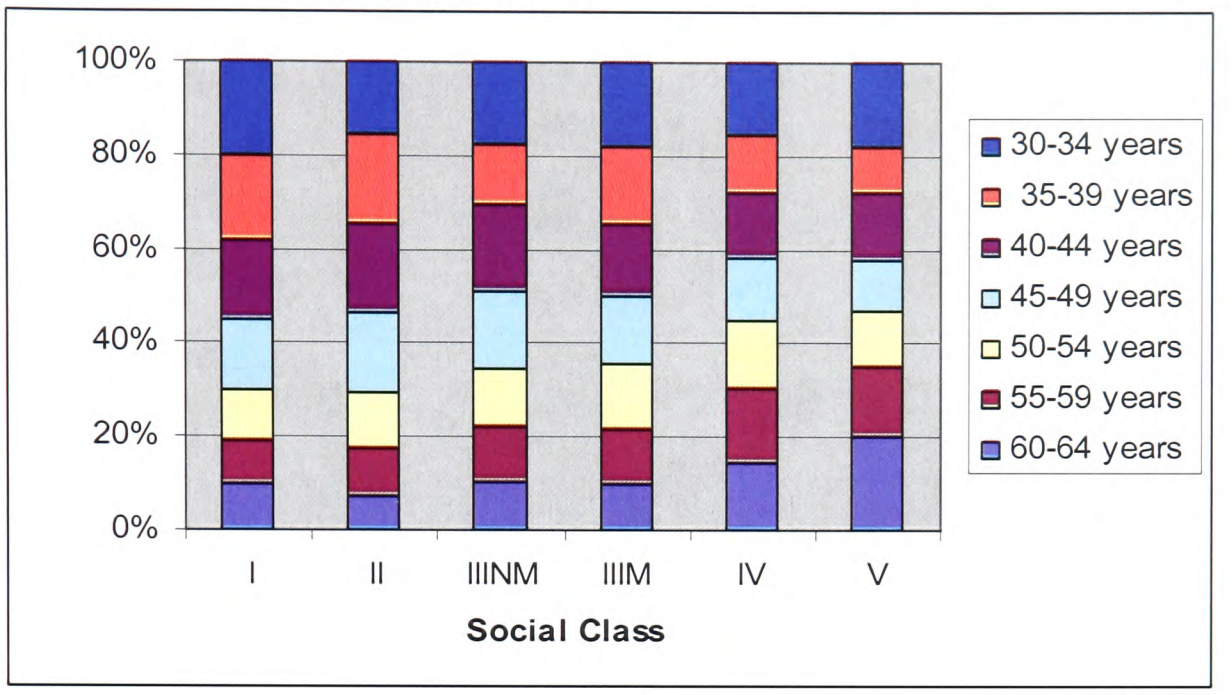
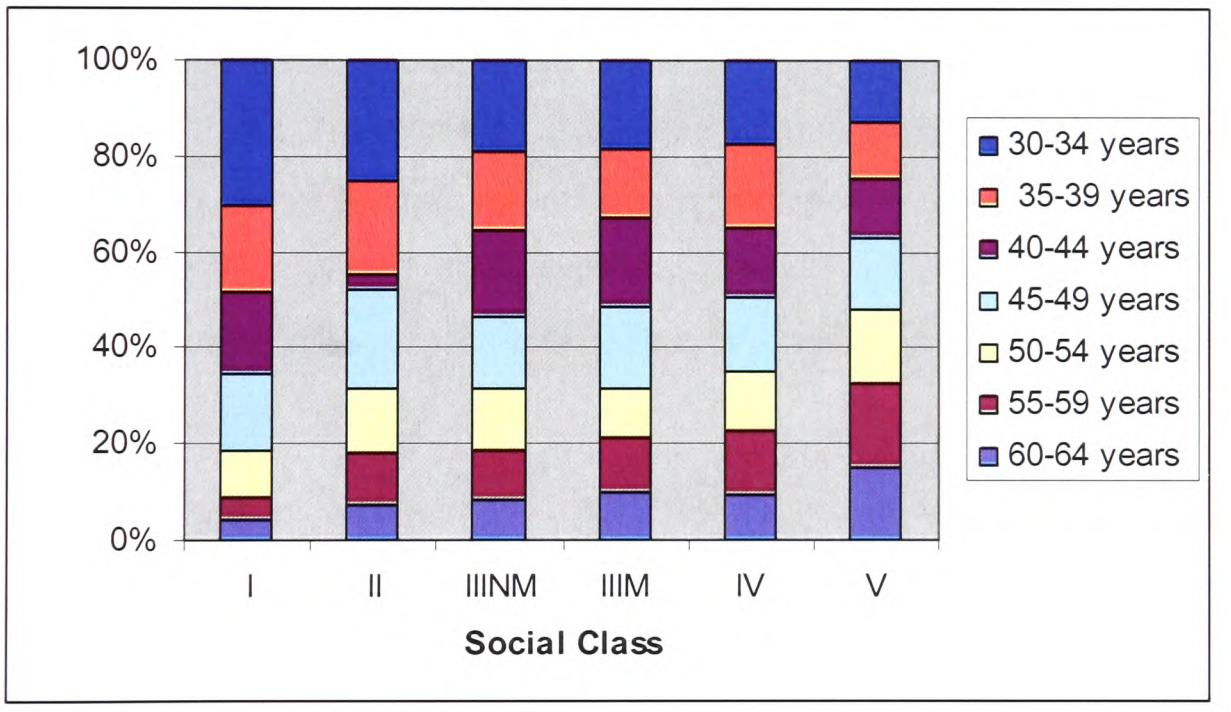


Figure 4.1b Proportion of Oxfordshire women aged 30 to 64 years in each age group within social classes



4.4.1.2 Deprivation Quintile

The Oxfordshire population by age group and deprivation quintile for men and women aged 30 to 79 years is shown in Table 4.5. The distribution by area deprivation quintile was similar for men and women.

Table 4.5 Age group and deprivation quintiles for Oxfordshire men and women aged 30 to 79 years*

		Men % (n) N=145,772	Women % (n) N=151,859
Age (years)			
	30-54	64.0 (93,271)	61.0 (92,356)
	55-64	18.0 (26,284)	17.2 (26,182)
	65-79	18.0 (26,217)	21.9 (33,321)
Deprivation Quintile			
(Least deprived)	Q1	19.9 (29,014)	19.5 (29,626)
	Q2	20.9 (30,411)	20.6 (31,295)
	Q3	19.5 (28,432)	19.5 (29,607)
	Q4	20.1 (29,316)	20.7 (31,411)
(Most deprived)	Q5	19.6 (28,599)	19.7 (29,920)

* Note: numbers are smaller than those in Table 4.3, because enumeration districts with no overcrowding are omitted in this table.

The proportions of men and women aged 30 to 79 years by five year age groups within deprivation quintiles are illustrated in Figure 4.2a (men) and Figure 4.2b (women). The more deprived quintiles had a greater proportion of men and women aged 65 to 79 years compared to those aged 30 to 64 years (X^2 test for trend, $p<0.0001$ for both men and women). Additionally, the proportion of men aged 65 to 79 years was 20% in Q5 compared to 15% in Q1 and for women, 25% in Q5 compared to 17% in Q1.

Figure 4.2a Proportion of Oxfordshire men aged 30 to 79 years in each age group within deprivation quintiles

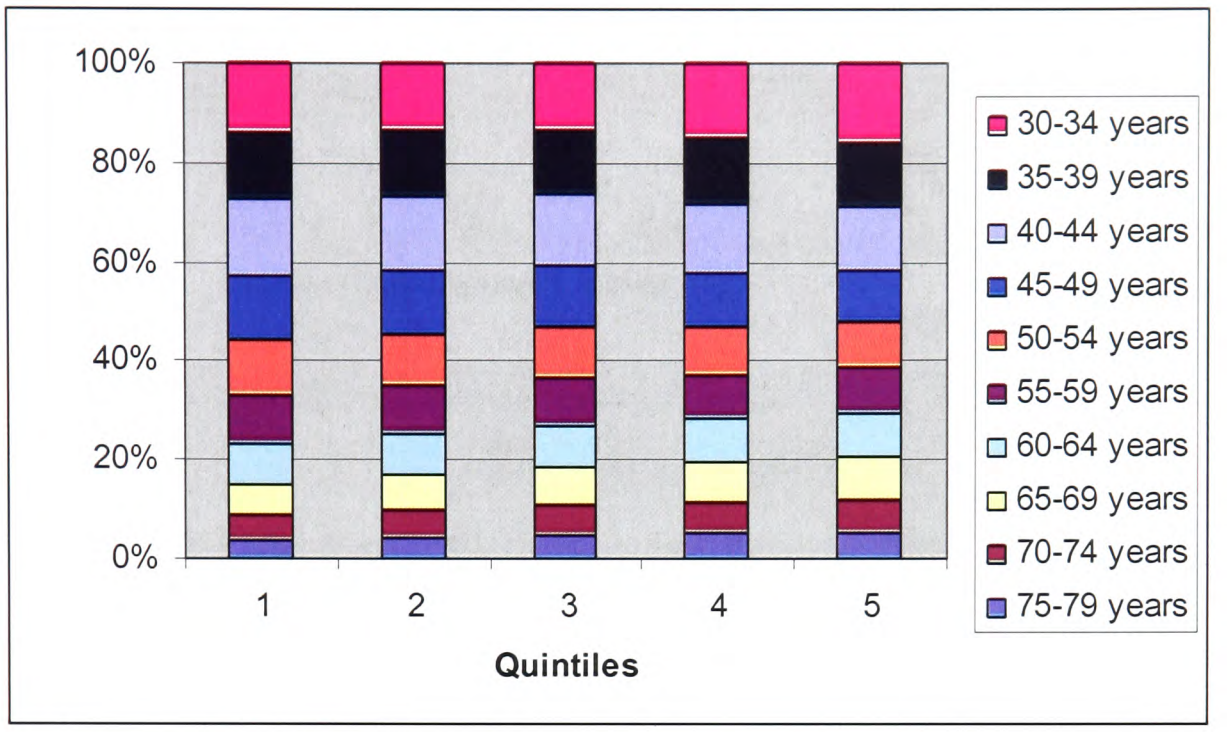
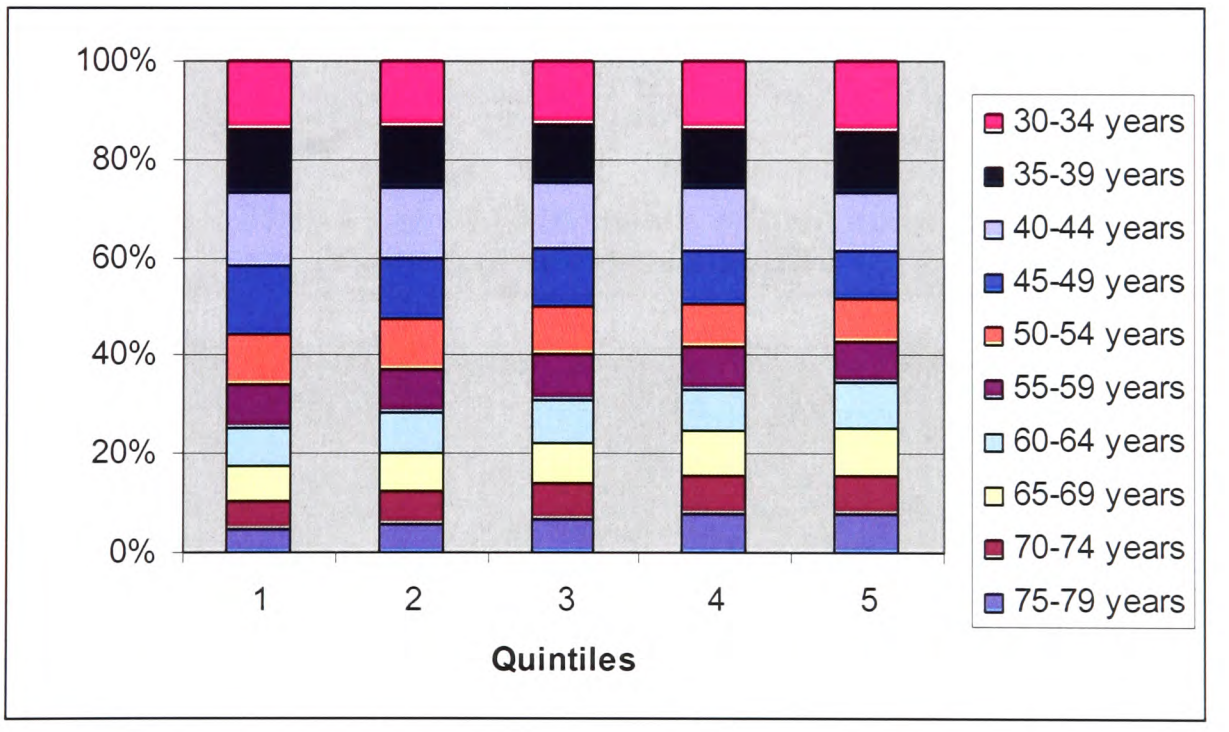


Figure 4.2b Proportion of Oxfordshire women aged 30 to 70 years in each age group within deprivation quintiles



For direct comparison with the social class data, the breakdown by age within deprivation quintiles for the subgroup aged 30 to 64 years is given in Figure 4.3a (men) and Figure 4.3b (women). In this sub-group, there was also a trend in age across quintiles with more men and women aged 55 to 64 years compared those

aged 30 to 54 years in the more deprived quintiles (X^2 test for trend, $p<0.0001$ for both men and women). However, the trend was slight; the proportion of men aged 55 to 64 years in Q5 was 23% compared to 21% in Q1 and for women, 23 % in Q5 compared to 20% in Q1.

Figure 4.3a Proportion of Oxfordshire men aged 30 to 64 years in each age group within deprivation quintiles

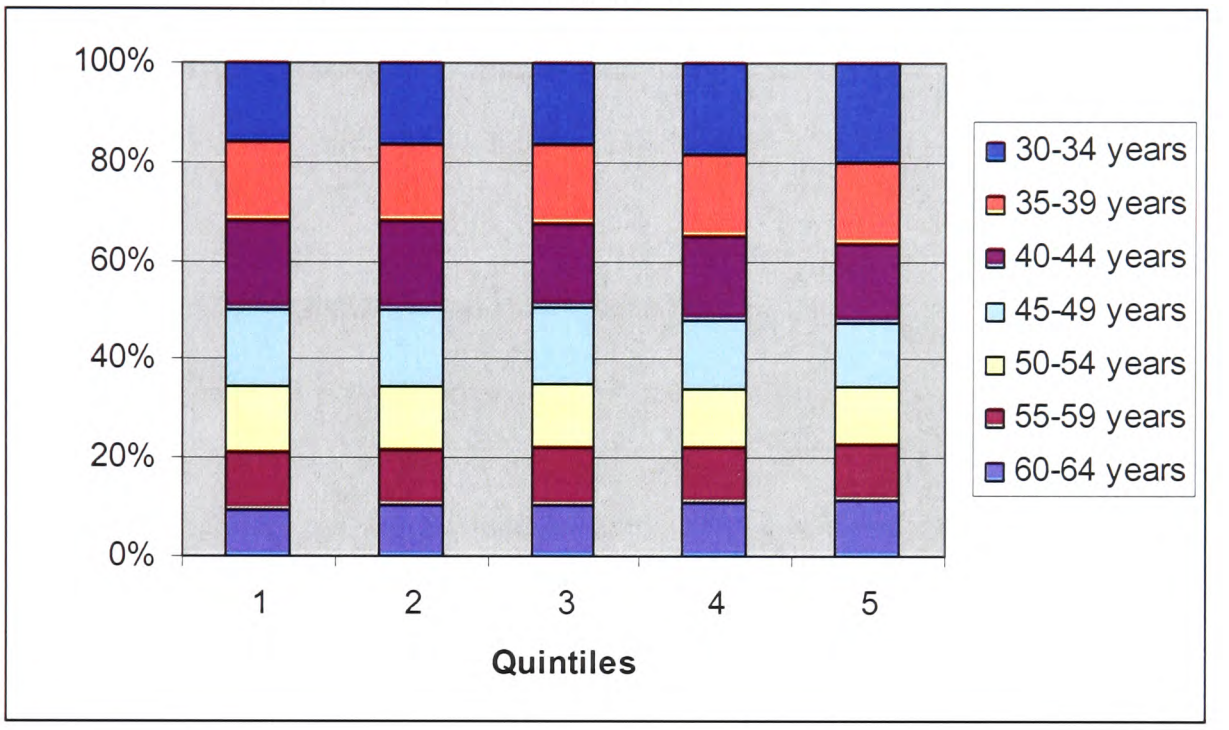
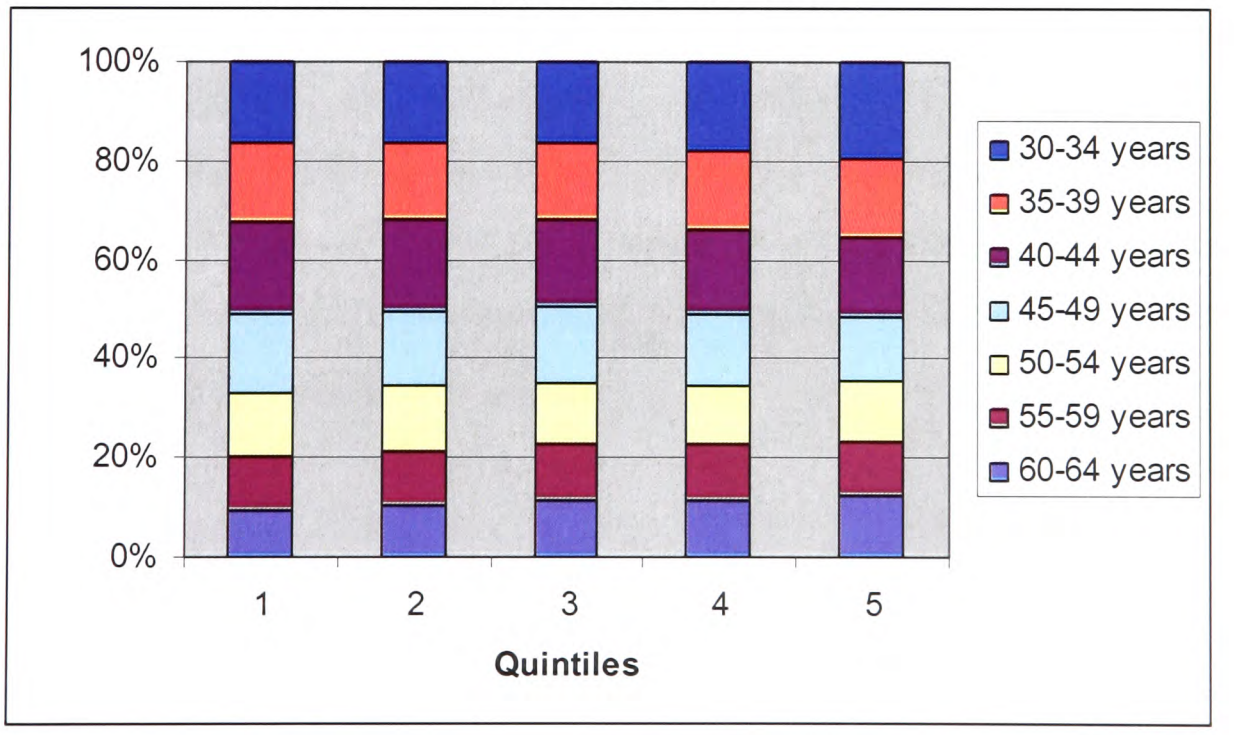


Figure 4.3b Proportion of Oxfordshire women aged 30 to 64 years in each age group within deprivation quintiles



4.3.1.3.. Summary of Oxfordshire Population Description

In the Oxfordshire population, there were strong gender differences within social classes with more men than women in the professional classes and also in skilled manual occupations. No such differences were evident within deprivation quintiles. There was an excess of older men and women in lower socioeconomic groups, which was evident using both indicators, even though social class was limited to those younger than 65 years. When the same age restriction was applied to deprivation quintiles, the age structure difference was less striking than in social class.

4.4.2 Annual Coronary Event Rates

In total, 1149 coronary events were recorded in the 1118 OXMIS patients – 1089 suffered a single event, 27 experienced two events and two people had three separate events (all separated by more than 28 days) during one year.

4.4.2.1 Social Class

Table 4.6 shows annual coronary event rates per 1000 population in Oxfordshire by social class for men and women aged 30 to 64 years. Higher unadjusted coronary event rates were associated with lower social class for men and women (X^2 test for trend, $p<0.0001$ for both). Because of the excess of older people in the lower social classes, the rates were standardised for age. This reduced the socioeconomic gradient and produced an uneven pattern across the classes with the highest risk of a coronary event in class IIIM for both men and women. However, these estimates were imprecise due to the small number of events and should be interpreted with caution.

Table 4.6 Coronary event rates per 1000 population in Oxfordshire by social class for men and women aged 30 to 64 years.

Social class	Population (N)	Events (n)	Rate (n/N x 1000)	Age-standardised Rate (95% CI)	Relative risk
Men					
I	12,774	30	2.35	2.58 (1.74 to 3.69)	1
II	35,496	81	2.28	2.57 (2.04 to 3.19)	1.00
III-NM	8,145	30	3.68	3.63 (2.45 to 5.18)	1.41
III-M	28,962	117	4.04	4.03 (3.34 to 4.83)	1.56
IV	14,354	52	3.62	2.92 (2.18 to 3.83)	1.13
V	4,447	18	4.05	3.04 (1.80 to 4.81)	1.18
Total	104,177	328	3.15		
p-value*			<0.001		
Women					
I	2,705	1	0.37	0.62 (0.02 to 3.44)	1
II	29,357	15	0.51	0.61 (0.34 to 1.01)	0.98
III-NM	32,902	20	0.61	0.61 (0.37 to 0.94)	0.98
III-M	5,349	11	2.06	1.92 (0.96 to 3.43)	3.08
IV	12,926	26	2.01	1.80 (1.17 to 2.63)	2.89
V	7,486	9	1.20	0.78 (0.36 to 1.48)	1.25
Total	90,724	82	0.90		
p-value*			<0.001		

* X^2 test for trend

4.4.2.2 Deprivation Quintile

Initially, coronary event rates were examined within deprivation quintiles for those aged 30 to 64 years for comparison with the age-truncated social class results. Table 4.7 shows annual coronary event rates per 1000 population by deprivation quintile for men and women aged 30 to 64 years. For women, greater deprivation was associated with higher unadjusted coronary event rates (X^2 test for trend, p=0.007). Event rates changed only marginally after age adjustment, because there was little association between age and deprivation quintile. For women in Q5, the risk of a coronary event was almost three times that for those in Q1, whereas there was no clear gradient for men.

Table 4.7 Coronary event rates per 1000 population by deprivation quintile for men and women aged 30 to 64 years

Deprivation Quintile	Population (N)	Events (n)	Rate (n/N x 1000)	Age-standardised Rate (95% CI)	Relative risk
Men					
(Least deprived) 1	24,659	62	2.51	2.53 (1.94 to 3.25)	1
2	25,299	68	2.69	2.68 (2.08 to 3.40)	1.06
3	23,194	81	3.49	3.65 (2.73 to 4.27)	1.44
4	23,648	62	2.62	2.50 (2.25 to 3.68)	0.99
5	22,755	67	2.94	2.95 (2.29 to 3.75)	1.17
Total	119,555	340	2.84		
p-value*			0.45		
Women					
(Least deprived) 1	24,466	8	0.33	0.35 (0.15 to 0.68)	1
2	25,022	15	0.60	0.61 (0.34 to 1.00)	1.74
3	22,969	18	0.78	0.76 (0.45 to 1.21)	2.17
4	23,712	22	0.93	0.91 (0.57 to 1.38)	2.60
5	22,369	22	0.98	0.96 (0.60 to 1.45)	2.74
Total	118,538	85	0.72		
p-value*			0.007		

* X^2 test for trend

Further analyses were performed including those aged 65 to 79 years to assess coronary event rates within deprivation quintiles using all available data. Table 4.8 shows annual coronary event rates per 1000 population by deprivation quintile for men and women aged 30-79 years. For both men and women aged 30 to 79 years, higher coronary event rates were associated with greater deprivation (X^2 test for trend, p=0.003 and <0.0001 respectively). The excess of people aged 65 to 79 years in more deprived quintiles resulted in a reduced socioeconomic gradient in the age standardised rates. However, this gradient persisted for both sexes. People living in the more deprived areas of Oxfordshire were at a higher risk of a coronary event than those in less deprived areas.

Table 4.8 Coronary event rates per 1000 population by deprivation quintile for men and women aged 30 to 79 years

Deprivation Quintile	Population (N)	Events (n)	Rate (n/N x 1000)	Age-standardised Rate (95% CI)	Relative risk
Men					
(Least deprived) 1	29,014	124	4.27	4.66 (3.88 to 5.56)	1
2	30,411	156	5.13	5.30 (4.50 to 6.20)	1.14
3	28,432	167	5.87	5.74 (4.91 to 6.68)	1.23
4	29,316	144	4.91	4.75 (4.01 to 5.60)	1.02
5	28,599	183	6.40	6.02 (5.18 to 6.96)	1.29
Total	145,772	774	5.31		
p-value*			0.003		
Women					
(Least deprived) 1	29,626	42	1.42	1.71 (1.23 to 2.31)	1
2	31,295	68	2.17	2.32 (1.80 to 2.95)	1.36
3	29,607	61	2.06	2.02 (1.54 to 2.59)	1.18
4	31,411	90	2.87	2.62 (2.10 to 3.22)	1.53
5	29,920	112	3.74	3.36 (2.76 to 4.04)	1.97
Total	151,859	373	2.46		
p-value*			<0.0001		

* X^2 test for trend

4.4.2.3 Summary of Oxfordshire Coronary Event Rates

For social class, a small but uneven gradient in coronary event rates was found for both men and women aged 30 to 64 years with higher rates in lower social classes. In deprivation quintiles, there were substantially higher event rates in areas of greater deprivation compared to more affluent areas for men and women aged 30 to 79 years and women aged 30 to 64 years. There was no socioeconomic gradient for men aged 30 to 64 years.

Study 2: The OXMIS Cohort

The second study in this chapter investigates the association of socioeconomic status with 28-day case fatality in the entire cohort of patients diagnosed with myocardial infarction, and with six-year survival in 28-day infarct survivors.

4.4.3 Cohort Description

Table 4.9 shows baseline age, social class and deprivation quintile for the 754 men and 364 women in the OXMIS cohort. Men were on average five years younger than women; (mean age difference [95% CI], 4.8 years [3.6 to 6.1]). A higher proportion of men than women were in social classes I and IIIM and in contrast, there were fewer men in social class IIINM compared to women. Women tended to live in more deprived areas than men (X^2 4 d.f., p=0.01), and there were considerably more women in the two most deprived quintiles (53.8% vs. 42.8%).

Table 4.9 **Baseline age, social class and deprivation quintile of men and women in OXMIS cohort**

% (n), unless stated otherwise

	Men N=754	Women N=364
Age (years)		
Mean (SD)	65.0 (10.4)	69.8 (8.3)
30-54	17.4 (131)	6.6 (24)
55-64	27.2 (205)	16.5 (60)
65-79	55.4 (418)	76.9 (280)
Social class		
I	9.7 (73)	3.6 (13)
II	21.8 (164)	19.8 (72)
III-NM	9.6 (72)	20.6 (75)
III-M	31.6 (238)	17.9 (65)
IV	16.6 (125)	20.9 (76)
V	6.1 (46)	8.8 (32)
Armed Forces	1.6 (12)	0.3 (1)
Unclassifiable	0.7 (5)	3.9 (14)
Unknown	3.1 (19)	4.4 (16)
Deprivation Quintile		
(Least deprived) Q1	15.8 (119)	11.3 (41)
Q2	20.0 (151)	18.0 (65)
Q3	21.4 (161)	16.9 (61)
Q4	18.8 (142)	24.0 (87)
Q5	24.0 (181)	29.8 (108)

Note: 2 women who lived in enumeration districts with no overcrowding were excluded

4.4.3.1 Relationship between Individual Occupation and Residential Area Deprivation Level

Both socioeconomic indicators were available for 1049 patients (93.8%) in social I to V: 718 men (95.2%) and 331 (90.9%) women. This allowed for the exploration of the relationship between social class and area deprivation within the cohort.

The distributions of deprivation quintiles within social classes are illustrated in Figure 4.4a (men) and Figure 4.4b (women). With the exception of the absence of Q1 in social class V for men, all deprivation quintiles were represented in each social class. Lower social class was associated with greater area deprivation; a higher proportion of those in the lower social classes were in Q4 and 5 compared to Q1 to 3 (X^2 test for trend, $p<0.0001$ for men and women).

Figure 4.4a **Proportion of OXMIS men in each deprivation quintile within social classes**

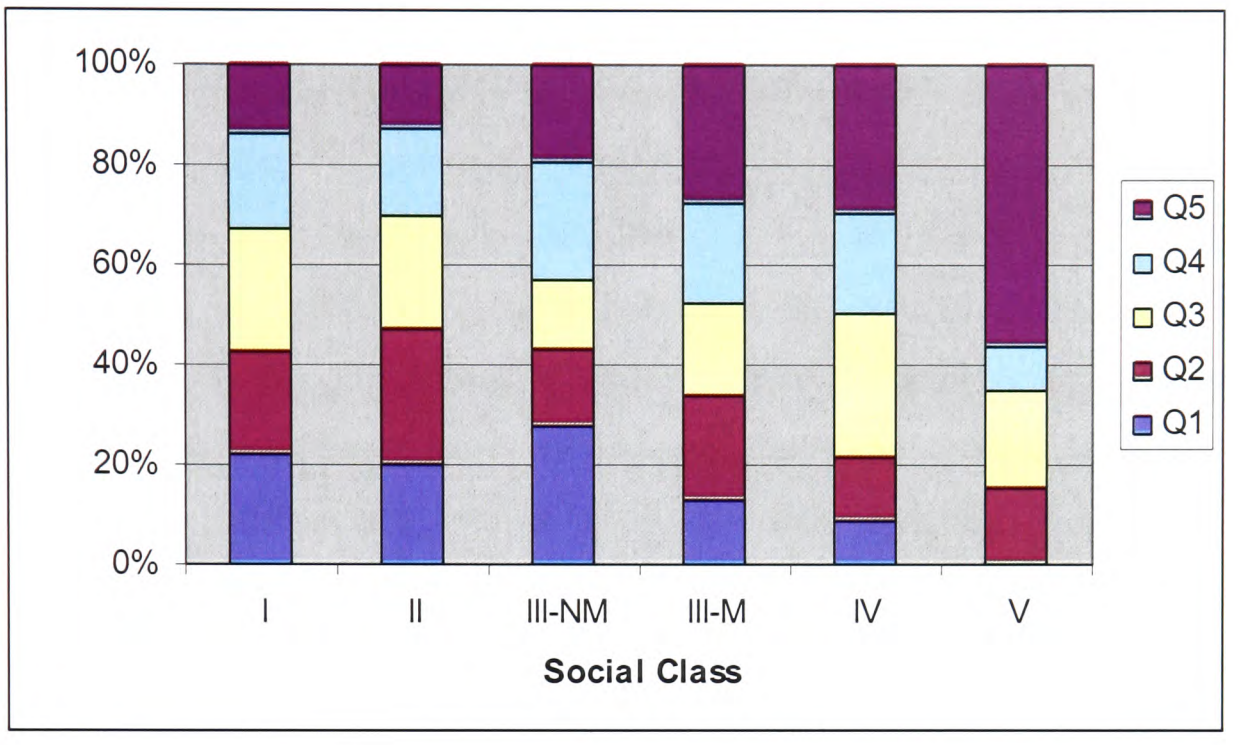
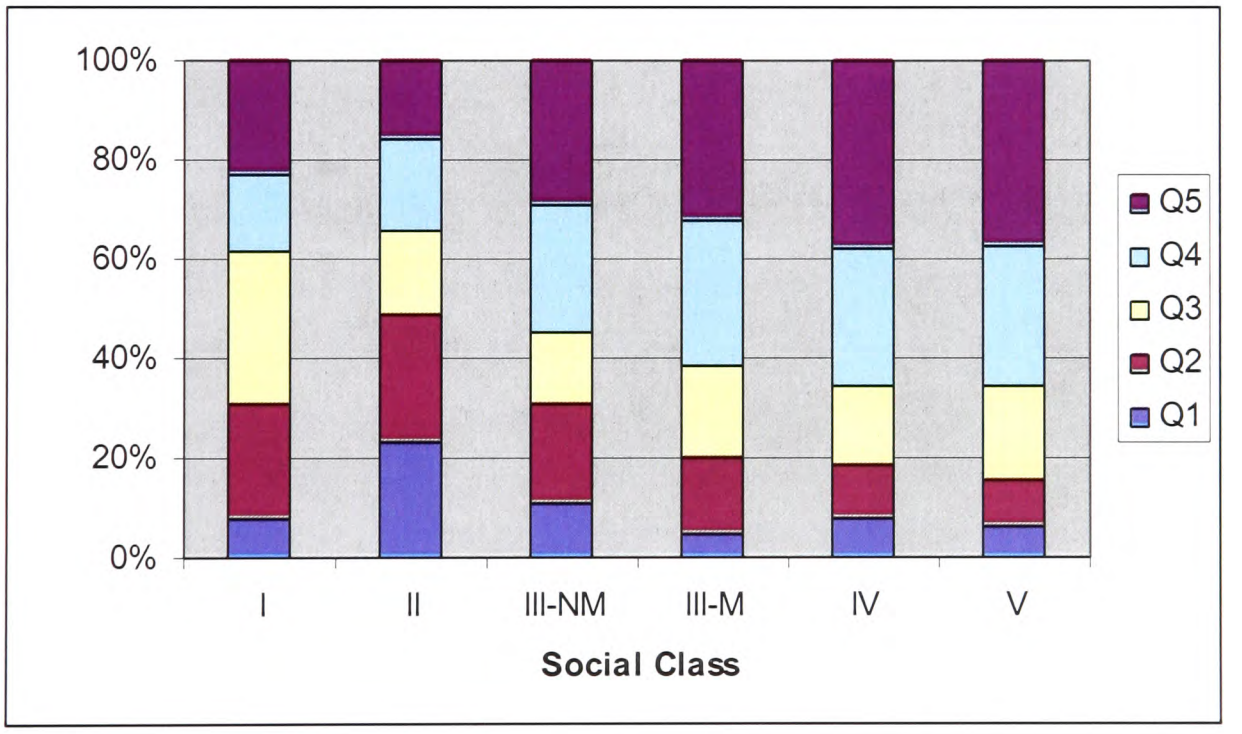


Figure 4.4b **Proportion of OXMIS women in each deprivation quintile within social classes**



A Townsend Index was also assigned to each patient. For the entire cohort, Townsend Indices ranged from -5.76 to 6.91 (mean [SD]; -0.86 [2.58] and median [IQR] -1.44 [-2.85 to 0.86]). Men lived in more affluent areas than women. For men, mean [SD] Townsend Index was -1.01 [2.58] and median [IQR] was -1.60 [-

2.94 to 0.56]) and for women, the mean [SD] was -0.55 [2.57] and median [IQR] was -0.86 [-2.57 to 1.11] (p=0.006). Townsend Indices within social classes for men and women are summarised in the top of Table 4.10. Mean and median Townsend Indices for men showed a clear gradient that decreased from social class V to I showing that men in higher social classes lived in less deprived areas. This pattern was similar for women, but the gradient was smaller and uneven. There was a significant association between social class and Townsend Index (Spearman's rho coefficient: 0.253 for men and 0.245 for women, p<0.0001 for both). Social classes were combined, because there were small numbers of women in each class and of men in some classes. Townsend Indices within combined social classes are shown in the bottom of Table 4.10 and for both men and women, there was a significant trend, with those in lower social classes having scores indicating greater area deprivation (Analysis of variance; $F_{2,715}$=21.94, p<0.0001 for men and $F_{2,328}$=9.66, p<0.0001 for women).

Table 4.10 Townsend deprivation Index summaries by social class and combined social classes for men and women

	Men			Women		
		Townsend Index			Townsend Index	
	n	Mean	Median (IQR)	n	Mean	Median (IQR)
Social class						
I	73	-1.72	-2.18 (-3.34 to -0.44)	13	-0.70	-1.43 (-2.69 to 0.72)
II	164	-1.79	-2.34 (-3.15 to -0.82)	70	-1.66	-2.41 (-3.24 to -0.66)
III-NM	72	-1.41	-1.91 (-3.69 to 0.32)	75	-0.71	-0.88 (-2.66 to 1.03)
III-M	238	-0.71	-0.71 (-2.87 to 1.06)	65	-0.20	-0.24 (-2.04 to 2.11)
IV	125	-0.47	-1.28 (-2.35 to 1.10)	76	0.10	0.21 (-2.04 o 2.11)
V	46	0.78	0.90 (-2.04 to 2.79)	32	-0.11	-0.38 (-1.86 to 1.24)
Combined class						
I & II	237	-1.77	-2.28 (-3.19 to -0.76)	83	-1.51	-2.28 (-3.11 to -0.25)
III-NM & M	310	-0.87	-1.47 (-3.01 to 0.86)	140	-0.47	-0.65 (-2.46 to 1.05)
IV & V	171	-0.13	-0.54 (-2.18 to 1.85)	108	0.04	0.20 (-1.97 to 1.64)
Total	718			331		

Note: 2 women who lived in enumeration districts with no overcrowding were excluded

4.4.3.2 Coronary Risk Factors

Coronary risk factors were examined by socioeconomic groups to investigate a potential relationship. In the entire cohort, 77 (7%) cases had missing data for diabetes, 82 (7%) for previous MI, 101 (9%) for hypertension and 352 (32%) for smoking status. The proportion of patients with missing data for each factor was examined amongst socioeconomic groups and no significant trends were found.

4.4.3.3 By Social Class

Table 4.11 shows baseline risk factors by social class for men and women. There was no association between age and social class for men or women. The proportion of known diabetics and of current smokers increased with lower social class in men (X^2 test for trend, p=0.037 and 0.036 respectively), but the trend did not reach conventional statistical significance for women.

Table 4.11 Baseline risk factors by social class for men and women in the OXMIS cohort
% (n), unless otherwise stated

	Social class						
Risk factor	I	II	III-NM	III-M	IV	V	
MEN	N=73	N=164	N=72	N=238	N=125	N=46	p*
Age (years)							
Mean (SD)	66.5 (11.0)	64.8 (10.3)	65.7 (9.3)	63.7 (10.9)	66.1 (9.9)	65.1 (10.7)	
30-54 years	19.2 (14)	18.9 (31)	12.5 (9)	18.9 (45)	14.4 (18)	15.2 (7)	
55-64 year	21.9 (16)	28.0 (46)	29. 2 (21)	30.3 (72)	27.2 (34)	23.9 (11)	
65-79 years	58.9 (43)	53.0 (87)	58.3 (43)	50.8 (121)	58.5 (73)	60.9 (28)	0.82
Past history of:							
Previous MI	32.4 (22)	29.8 (45)	31.0 (22)	26.2 (58)	35.7 (41)	34.9 (15)	0.68
Diabetes	12.7 (9)	14.0 (21)	4.5 (3)	10.4 (23)	26.1 (30)	18.2 (8)	0.037
Hypertension	32.9 (23)	34.9 (52)	31.9 (22)	30.1 (65)	31.0 (35)	38.5 (15)	0.16
Smoking history:							
Non-smoker	33.3 (19)	24.6 (29)	18.8 (9)	18.6 (31)	17.1 (14)	19.4 (6)	
Current	19.3 (11)	17.0 (20)	31.2 (15)	31.7 (53)	36.6 (30)	29.0 (9)	0.036
Ex-smoker	47.4 (27)	58.5 (69)	50.0 (24)	49.7 (83)	46.3 (38)	51.6 (16)	
WOMEN	N=13	N=72	N=75	N=65	N=76	N=32	
Age (years)							
Mean (SD)	70.2 (7.7)	69.6 (8.1)	68.6 (9.2)	71.5 (7.0)	70.0 (9.3)	69.0 (7.6)	
30-54 years	7.7 (1)	6.9 (5)	10.7 (8)	3.1 (2)	9.2 (7)	3.1 (1)	
55-64 year	0	13.9 (10)	16.0 (12)	13.8 (9)	23.7 (18)	25.0 (8)	
65-79 years	92.3 (12)	79.2 (57)	73.3 (55)	83.1 (54)	67.1 (51)	71.9 (23)	0.09
Past history of:							
Previous MI	16.7 (2)	16.7 (11)	15.9 (11)	12.3 (7)	21.9 (16)	12.9 (4)	0.84
Diabetes	15.4 (2)	13.0 (9)	14.3 (10)	30.0 (18)	24.3 (17)	19.4 (6)	0.07
Hypertension	53.8 (7)	45.3 (29)	46.3 (31)	48.3 (29)	37.3 (26)	34.4 (11)	0.14
Smoking history:							
Non-smoker	44.4 (4)	51.2 (24)	28.9 (15)	50.0 (17)	40.4 (23)	42.9 (9)	
Current	22.2 (2)	12.8 (6)	25.0 (13)	20.6 (7)	26.3 (15)	38.1 (8)	0.052
Ex-smoker	33.3 (3)	36.2 (17)	46.2 (24)	29.4 (10)	33.3 (19)	19.0 (4)	

Note: percentages are based on number with available data; * X^2 test for trend

4.4.3.4 Coronary Risk Factors by Deprivation Quintiles

Table 4.12 shows baseline coronary risk factors by deprivation quintiles for men and women. The proportion of men aged 65 to 79 years increased from the least to the most deprived quintile (X^2 test for trend, $p<0.001$), but for women there was no association between age and deprivation group. Additionally, no trends were observed between deprivation and past medical history for men or women. There was a strong association between deprivation quintile and smoking, with the proportion of current smokers increasing from the least to most deprived quintiles for men and women (X^2 test for trend, $p=0.006$ and 0.009 respectively).

Table 4.12 Baseline risk factors by deprivation quintiles for men and women in the OXMIS cohort
% (n), unless otherwise stated

	Deprivation Quintile					
Risk factor	1	2	3	4	5	p*
Men	N=119	N=151	N=161	N=142	N=181	
Age (years)						
Mean (SD)	63.8 (10.3)	65.4 (10.4)	65.0 (9.8)	65.3 (10.7)	65.3 (10.9)	
30-54 years	20.2 (24)	15.2 (23)	14.3 (23)	19.7 (28)	18.2 (33)	
55-64 years	31.1 (37)	29.1 (44)	34.8 (56)	23.9 (34)	18.8 (34)	
65-79 years	48.7 (40)	55.6 (84)	50.9 (82)	56.3 (80)	63.0 (114)	<0.001
Past history of:						
Previous MI	29.7 (33)	30.8 (44)	32.7 (49)	28.0 (37)	29.9 (50)	0.83
Diabetes	10.9 (12)	12.7 (18)	17.8 (27)	17.8 (23)	11.3 (19)	0.73
Hypertension	32.1 (35)	29.4 (40)	36.5 (54)	28.6 (36)	32.2 (54)	0.99
Smoking history:						
Non-smoker	28.9 (24)	26.3 (30)	22.3 (25)	18.0 (18)	12.3 (14)	
Current	22.9 (19)	23.7 (27)	23.7 (24)	29.0 (29)	38.6 (44)	0.006
Ex-smoker	48.2 (40)	50.0 (57)	50.0 (65)	53.0 (53)	49.1 (56)	
Women	N=41	N=65	N=61	N=87	N=108	
Age (years)						
Mean (SD)	69.9 (8.2)	69.8 (7.9)	69.0 (9.3)	69.4 (9.1)	70.7 (7.2)	
30-54 years	7.3 (3)	6.2 (4)	11.5 (7)	6.9 (6)	3.7 (4)	
55-64 years	12.2 (5)	16.9 (11)	18.0 (11)	18.4 (16)	14.8 (16)	
65-79 years	80.5 (33)	76.9 (50)	70.5 (43)	74.7 (65)	81.5 (88)	0.66
Past history of:						
Previous MI	13.2 (5)	12.3 (7)	12.5 (7)	13.8 (11)	24.0 (24)	0.051
Diabetes	17.9 (7)	11.9 (7)	20.7 (12)	18.3 (15)	24.0 (24)	0.16
Hypertension	40.0 (14)	56.9 (34)	39.3 (22)	46.3 (38)	37.4 (37)	0.15
Smoking history:						
Non-smoker	42.3 (11)	54.6 (24)	50.0 (22)	27.8 (15)	41.7 (30)	
Current	7.7 (2)	13.6 (6)	22.7 (10)	29.6 (16)	27.8 (20)	0.009
Ex-smoker	50.0 (13)	31.8 (14)	27.3 (12)	42.6 (23)	30.6 (22)	

Note: percentages are based on number with available data; * X^2 test for trend

4.4.3.5 Summary of OXMIS Cohort Description

Among men and women in Oxfordshire diagnosed with CHD, there was a strong relationship between an individual's occupational group and the deprivation level of their area of residence; those in lower social classes were more common in areas of greater deprivation. Except for a greater proportion of men aged 65 to 79 years in more deprived quintiles, there was no association between age and socioeconomic group. The proportion of current smokers increased with lower socioeconomic group for both men and women, but showed a stronger association with deprivation quintile than with social class. Past history of diabetes in men was

associated with lower social class, but was not associated with deprivation quintile. No other associations were found between past medical history and socioeconomic groups.

4.4.4 28-Day Case Fatality

4.4.4.1 Social Class

Table 4.13 shows 28-day case fatality rates by social class for men and women in the OXMIS cohort. In total, 44% (315) of 718 men and 49% (164) of 333 women aged 30 to 79 years died within 28 days of a coronary event. Higher case fatality rates were associated with lower social class in men (X^2 test for trend, p=0.005), but no statistically significant social gradient for women was found (X^2 test for trend, p=0.70). 28-day case fatality rates by age for a standard population were not available, so social class gradient standardised for age could not be examined.

Table 4.13 28-day case fatality rates by social class and sex aged 30 to 79 years
(%=number of deaths in 28 days/N)

	Men		Women	
Social class	N	% (n)	N	% (n)
I	73	30.1 (22)	13	53.8 (7)
II	164	43.9 (72)	72	51.4 (37)
III-NM	72	44.4 (32)	75	42.7 (32)
III-M	238	39.9 (95)	65	60.0 (39)
IV	125	55.2 (69)	76	44.7 (34)
V	46	54.3 (25)	32	46.9 (15)
All	718	43.9 (315)	333	49.2 (164)
p-value*		0.005		0.70

* X^2 test for trend

4.4.4.2 Deprivation Quintiles

Table 4.14 shows 28-day case fatality rates by deprivation quintiles for men and women aged 30 to 79 years. In total, 44% (326) of men and 49% (179) of women aged 30 to 79 years had died of a coronary event within 28 days. Higher case fatality rates were associated with greater deprivation in men (X^2 test for trend, p=0.015), but not for women (p=0.46). There was an excess of older men in more

deprived groups, but it was not possible to standardise the case fatality rates for age, because rates for case fatality by age from a standard population were not available.

Table 4.14 28-day case fatality rates by deprivation quintiles and sex aged 30 to 79 years.
(%=number of deaths in 28 days/N)

	Men		Women	
Quintile	N	% (n)	N	% (n)
(least deprived) 1	119	37.8 (45)	41	58.5 (24)
2	151	39.1 (59)	65	43.1 (28)
3	161	42.9 (69)	61	52.5 (32)
4	142	43.0 (61)	87	51.7 (45)
5	181	50.8 (92)	108	45.4 (49)
All	754	43.6 (325)	362	49.2 (179)
p-value*		0.015		0.46

* X^2 test for trend

4.4.4.3 Association with Deprivation Quintile after Adjustment for Age and Social Class

Logistic regression was used to explore the age-adjusted relationship between 28-day case fatality, area deprivation and social class. Table 4.15 shows logistic regression odds ratios for 28 day case fatality by deprivation quintile adjusted for age and social class for men and women. In both men and women, the association between area deprivation quintile and 28-day case fatality did not reach statistical significance. Adjustment for age and social class did not affect the results for women. However, in men, adjustment tended to weaken the relationship between deprivation quintile and 28-day case fatality, while social class was shown to be significantly associated with 28-day case fatality. Since Townsend Index was available as a continuous variable and as such gives more information, it was used in the logistic regression analyses and the relationship between social class and 28-day case fatality was explored further.

Table 4.15 Odds ratios for 28-day case fatality by deprivation quintiles adjusted for age and social class for men and women

	Odds Ratio (95% CI)		
Deprivation Quintile	Unadjusted	Age-adjusted	Adjusted for age & social class
Men (N=718)			
(Least deprived) 1	1.0	1.0	1.0
2	1.03 (0.62 to 1.71)	0.95 (0.56 to 1.61)	0.92 (0.54 to 1.57)
3	1.30 (0.79 to 2.14)	1.24 (0.74 to 2.07)	1.15 (0.68 to 1.94)
4	1.26 (0.75 to 2.10)	1.19 (0.70 to 2.01)	1.13 (0.66 to 1.93)
5	1.80 (1.11 to 2.93)	1.71 (1.04 to 2.83)	1.52 (0.90 to 2.57)
Overall*	0.08	0.11	0.31
Class overall**			0.024
Women (N=331)			
(Least deprived) 1	1.0	1.0	1.0
2	0.60 (0.26 to 1.39)	0.61 (0.25 to 1.44)	0.59 (0.25 to 1.40)
3	0.69 (0.30 to 1.60)	0.74 (0.31 to 1.76)	0.70 (0.29 to 1.70)
4	0.77 (0.35 to 1.69)	0.78 (0.35 to 1.76)	0.76 (0.33 to 1.74)
5	0.61 (0.28 to 1.31)	0.57 (0.26 to 1.27)	0.56 (0.25 to 1.27)
Overall*	0.71	0.64	0.64
Class overall**			0.65

* p value for overall area deprivation; ** p value for overall social class within the model

4.4.4.4 Association with Social Class after Adjustment for Age and Townsend Index

Odds ratios for 28-day case fatality by social class adjusted for age and individual Townsend Index for men and women are shown in Table 4.16. There were gender differences in the association with 28-day case fatality. For women, there was no statistically significant relationship with social class at any point, whereas for men the relationship was highly statistically significant (p=0.009). With age-adjustment, this relationship remained unchanged (p=0.008). After adjustment for Townsend Index, social class was still associated with 28-day case fatality (p=0.021), although the effect was attenuated. Nevertheless, men in each social class were at two to three-fold increased risk of 28-day case fatality compared to those in class I, although odds ratios for classes IIINM and IIIM were lower than for class II, creating an uneven social class gradient. There was a suggestion of an independent effect of Townsend Index, after adjustment for age and social class (p=0.057).

Table 4.16 Odds ratios for 28-day case fatality by social class adjusted for age and Townsend Index for men and women

Social class	Odds Ratio (95% CI)		
	Unadjusted	Age-adjusted	Adjusted for age & Townsend Index
Men (N=718)			
I	1.0	1.0	1.0
II	1.81 (1.01 to 3.26)	2.09 (1.14 to 3.84)	2.10 (1.14 to 3.86)
III-NM	1.85 (0.94 to 3.67)	2.05 (1.01 to 4.14)	2.00 (0.99 to 4.06)
III-M	1.54 (0.88 to 2.70)	1.86 (1.04 to 3.33)	1.75 (0.97 to 3.14)
IV	2.86 (1.55 to 5.26)	3.18 (1.69 to 5.98)	2.95 (1.56 to 5.58)
V	2.76 (1.28 to 5.93)	3.21 (1.45 to 7.11)	2.77 (1.24 to 6.21)
Overall*	0.009	0.008	0.021
Townsend Index			1.06 (1.00 to 1.13) p=0.057
Women (N=331)			
I & II	1.0	1.0	1.0
III-NM	0.69 (0.37 to 1.30)	0.73 (0.38 to 1.39)	0.75 (0.30 to 1.45)
III-M	1.40 (0.72 to 2.69)	1.30 (0.66 to 2.54)	1.37 (0.69 to 2.71)
IV	0.75 (0.40 to 1.41)	0.78 (0.41 to 1.48)	0.83 (0.43 to 1.61)
V	0.82 (0.35 to 1.86)	0.87 (0.38 to 2.00)	0.92 (0.39 to 2.14)
Overall*	0.27	0.50	0.51
Townsend Index			0.96 (0.88 to 1.05) p=0.38

* p value for overall social class within the model

4.4.4.5 Association with Past Medical History

The socioeconomic effect on 28-day case fatality might be partly explained by differences in past medical history. Potential confounders were previously assessed within the cohort (Table 4.11 and Table 4.12), and of these, only diabetes was clearly associated with social class, being more common in men from lower social classes. In addition, current smokers were more common in lower socioeconomic groups, although these data were substantially incomplete (32% missing). Previous MI and history of hypertension were regarded as surrogate measures for infarct severity (known to influence coronary mortality) and, therefore, were also considered. Complete past medical history (those with missing data for each condition were excluded) was available for 629 men and 311 women (88% of men and 93% of women in classes I to V). Although there was no socioeconomic trend for missing smoking status data, its inclusion reduced the number of men with a complete history to 66% (476) and of women to 60% (200)

of the original cohort and it was, therefore, not included in the logistic regression analysis.

Table 4.17 shows odds ratios for 28-day case fatality by social class for men and women adjusted for age, Townsend Index and past medical history. There was still no statistically significant association between social class and 28-day case fatality for women. However after adjustment for age and past medical history, social class and Townsend Index for men remained independently associated with 28-day case fatality. In addition, a history of hypertension or diabetes also appeared to be independently associated with 28-day case fatality (although the evidence for diabetes did not reach conventional statistical significance [p=0.057]). Cautious interpretation of these findings is necessary, since smoking status was excluded from the analysis. Amongst the available data, current smokers were more common in lower social classes and smoking is associated with mortality, and therefore may be confounding these results.

Table 4.17 Odds ratios for 28-day case fatality by social class adjusted for age, Townsend Index and past medical history for men and women

	Odds Ratio (95% CI)		Odds Ratio (95% CI)
Men (N=629)		**Women (N=311)**	
Social class			
I	1.0	**Social class**	
II	2.05 (1.04 to 4.04)	I & II	1.0
III-NM	2.11 (0.97 to 4.60)	III-NM	0.63 (0.31 to 1.29)
III-M	1.61 (0.83 to 3.11)	III-M	1.21 (0.57 to 2.57)
IV	2.81 (1.38 to 5.71)	IV	0.69 (0.34 to 1.43)
V	3.05 (1.24 to 7.54)	V	0.92 (0.37 to 2.26)
Overall*	0.043	Overall*	0.43
Townsend Index	1.08 (1.01 to 1.16)	Townsend Index	0.95 (0.85 to 1.05)
p-value	0.033	p-value	0.29
Past history of:		**Past history of:**	
Previous MI	1.20 (0.82 to 1.75)	Previous MI	1.18 (0.59 to 2.36)
Diabetes	1.64 (0.98 to 2.74)	Diabetes	1.86 (0.94 to 2.36)
Hypertension	2.04 (1.41 to 2.93)	Hypertension	0.82 (0.50 to 1.36)

* p value for overall social class within the model

4.4.4.6 Summary of 28-Day Case Fatality

The relationship between socioeconomic status and 28-day case fatality after a myocardial infarction differed for each indicator and between the sexes. Amongst men, individual social class was significantly associated with 28-day case fatality, and although the effect was reduced after adjustment for age, Townsend Index and past medical history, social class remained statistically significant. Additionally, hypertension was found to be independently associated with 28-day case fatality in men. There was a suggestion that individual Townsend Index and diabetes were also independently associated with 28-day case fatality in men. However, smoking may have been a confounder of these results. In contrast, 28-day case fatality had no association with area deprivation quintile for men. For women, there was no association between 28-day case fatality and social class or area deprivation measures.

4.4.5 Six-Year Overall Survival in 28-Day Survivors by Social Class and Area Deprivation Group

In total, 428 men and 185 women had survived 28 days after the index event, of whom social class data were available for 94.2% (403) of men and 91.4% (169) of women. Social classes were reclassified to non-manual (social classes I, II, IINM) and manual (social classes IIIM, IV and V) groups. The non-manual group consisted of 183 men and 84 women and manual included 220 men and 85 women. Deprivation quintiles were also reclassified to the 'affluent' (Q1 to Q3) and 'deprived' (Q4 and Q5) area deprivation groups. The 'affluent' group included 258 men and 83 women and the 'deprived' group included 170 men and 101 women.

4.4.5.1 Social Class

At six years, 78% (315) of men and 67% (114) of women in social classes I to V were still alive. Overall survival curves for men and women who survived 28 days by non-manual and manual classes are illustrated in Figure 4.5 a (men) and Figure 4.5b (women). Based on these curves, survival probabilities for one and six years

are shown in Table 4.18. Overall survival was similar between non-manual and manual social classes for men and women (p=0.50 for men and p=0.81 for women).

Table 4.18 One- and six-year overall Kaplan-Meier survival probabilities for men and women surviving 28 days by non-manual and manual social class

Social class	N	% survival at 1 year (95% CI)	% survival at 6 years (95% CI)
Men			
Non-manual	183	94.5 (90.1 to 97.0)	79.8 (73.2 to 84.9)
Manual	220	94.6 (90.6 to 96.9)	76.8 (70.7 to 81.9)
Women			
Non-manual	84	84.5 (74.9 to 90.7)	66.7 (55.5 to 75.6)
Manual	85	87.1 (77.9 to 92.6)	68.2 (57.2 to 77.0)

Figure 4.5a **Six-year overall survival for men surviving 28 days by non-manual and manual classes**

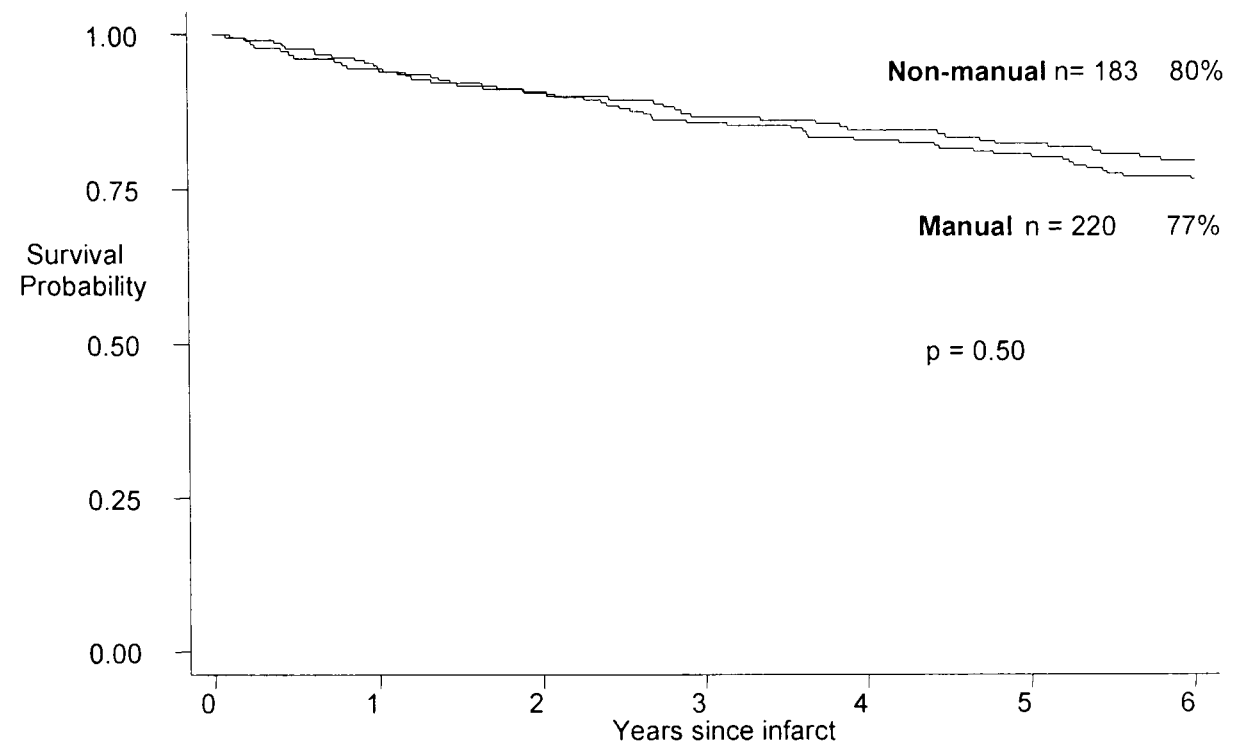
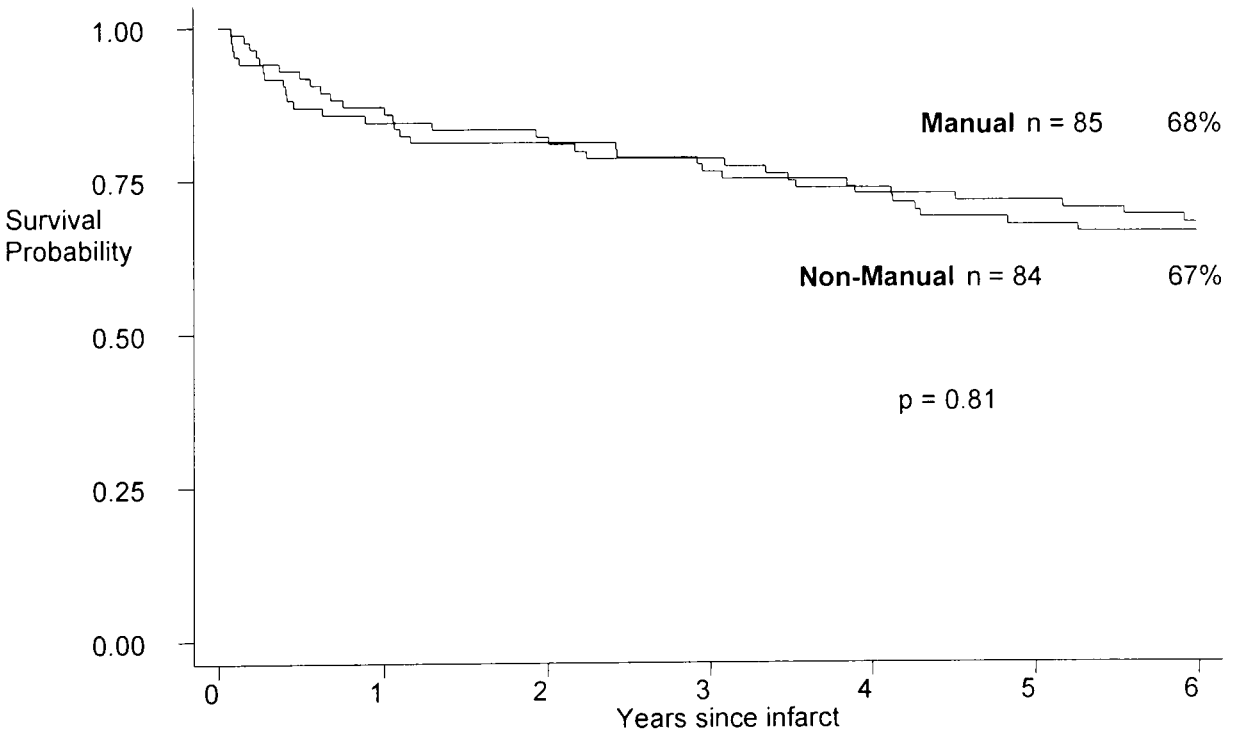


Figure 4.5b **Six-year overall survival for women surviving 28 days by non-manual and manual classes**



4.4.5.2 Area Deprivation

At six years, 77% (331) of men and 68% (126) of women were still alive. Overall survival curves by deprivation group for 28-day survivors are illustrated in Figure 4.6a (men) and Figure 4.6b (women). Table 4.19 shows survival probabilities for one and six years based on these curves. Overall survival was higher for men from affluent areas than men from deprived ones (p=0.035). For women, there was no difference in overall survival between area deprivation groups (p=0.91).

Table 4.19 One- and six-year overall Kaplan-Meier survival probabilities for men and women surviving 28 days by area deprivation group

Deprivation group	N	% survival at 1 year (95% CI)	% survival at 6 years (95% CI)
Men			
Non-manual	258	95.7 (92.4 to 97.6)	81.0 (75.7 to 85.3)
Manual	170	92.4 (87.2 to 95.5)	72.4 (65.0 to 78.4)
Women			
Non-manual	83	89.2 (80.2 to 94.2)	68.7 (57.5 to 77.5)
Manual	101	86.1 (77.7 to 91.2)	68.3 (58.3 to 76.4)

Figure 4.6a **Six-year overall survival for men surviving 28 days by area deprivation group**

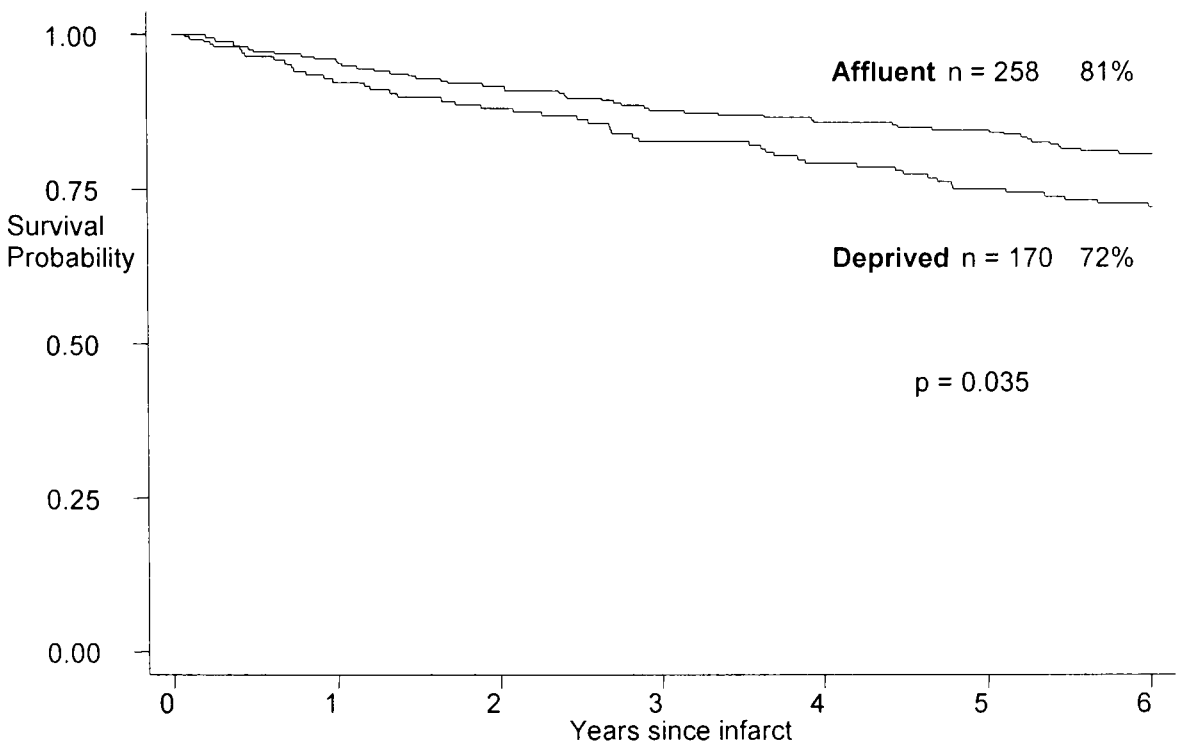
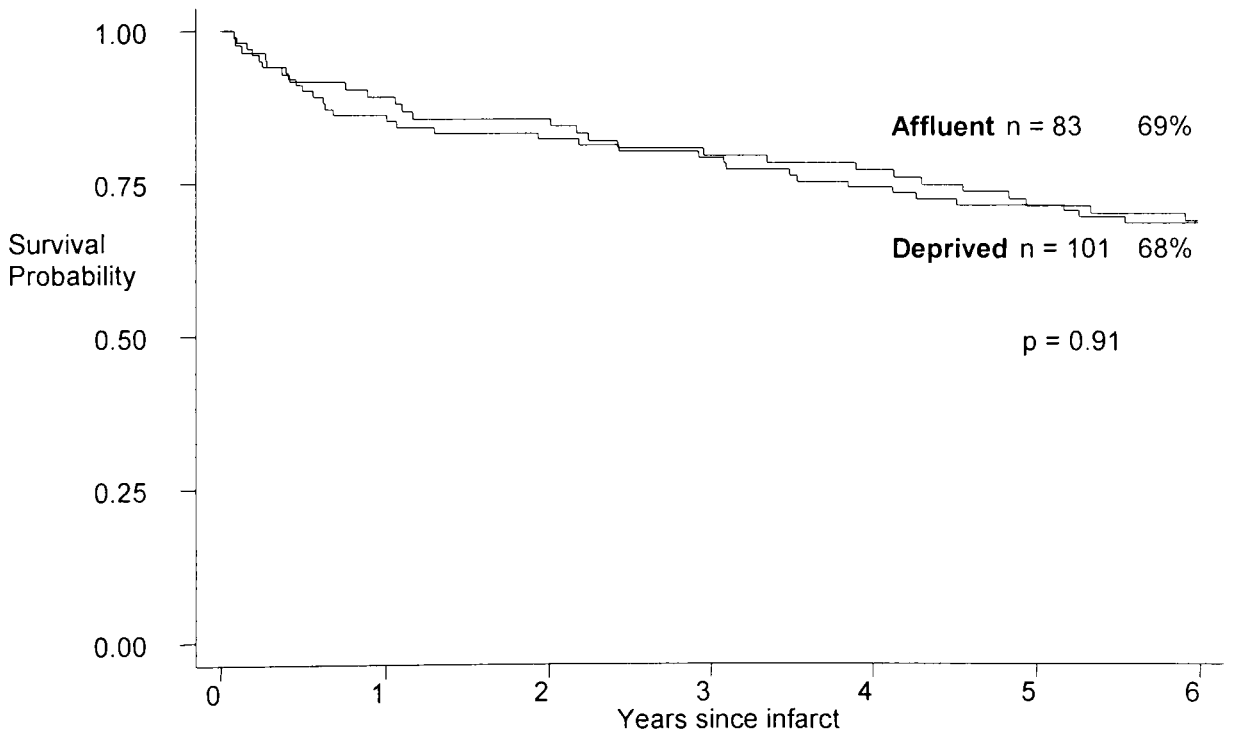


Figure 4.6b **Six-year overall curves for women surviving 28 days by area deprivation group**



4.4.6 Six-Year CHD Survival in 28-Day Survivors by Social Class and Area Deprivation

CHD survival (counting deaths from other causes as censored observations) was also examined in 28-day survivors by social class (Figures 4.7a and 4.7b, and Table 4.20) and by deprivation groups (Figures 4.8a and 4.8b, and Table 4.21). For both men and women, there were no significant differences in CHD survival by social class (p=0.63 and 0.73 respectively) or amongst deprivation groups (p=0.16 and 0.34, respectively), although men and women living in more deprived areas had approximately five percent higher coronary mortality rates at six years compared to those living in less deprived areas.

Table 4.20 One- and six-year CHD Kaplan-Meier survival probabilities for men and women surviving 28 days by non-manual and manual social class

Social class	N	% survival at 1 year (95% CI)	% survival at 6 years (95% CI)
Men			
Non-manual	183	95.6 (91.4 to 97.8)	86.6 (80.6 to 90.8)
Manual	220	95.9 (92.3 to 97.8)	88.1 (82.9 to 91.8)
Women			
Non-manual	84	92.6 (84.3 to 96.6)	86.0 (76.2 to 92.0)
Manual	85	90.6 (82.0 to 95.2)	84.0 (74.0 to 90.4)

Table 4.21 One- and six-year CHD Kaplan-Meier survival probabilities for men and women surviving 28 days by area deprivation group

Deprivation group	N	% survival at 1 year (95% CI)	% survival at 6 years (95% CI)
Men			
Non-manual	258	96.1 (92.9 to 97.9)	89.2 (84.6 to 92.5)
Manual	170	95.3 (90.8 to 97.6)	84.5 (77.9 to 89.3)
Women			
Non-manual	83	95.0 (87.3 to 98.1)	88.1 (78.4 to 93.7)
Manual	101	91.0 (83.4 to 95.2)	83.5 (74.4 to 89.6)

Figure 4.7a **Six-year CHD survival for men surviving 28 days by non-manual and manual classes**

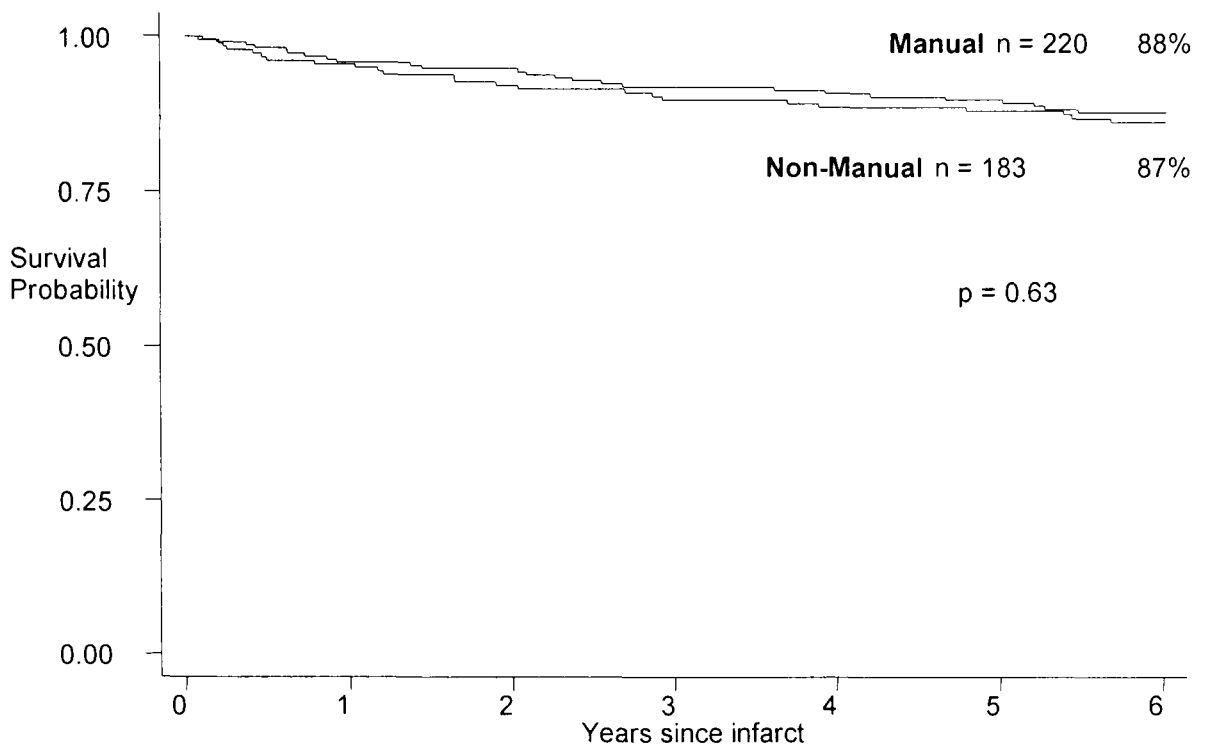


Figure 4.7b **Six-year CHD survival for women surviving 28 days by non-manual and manual class**

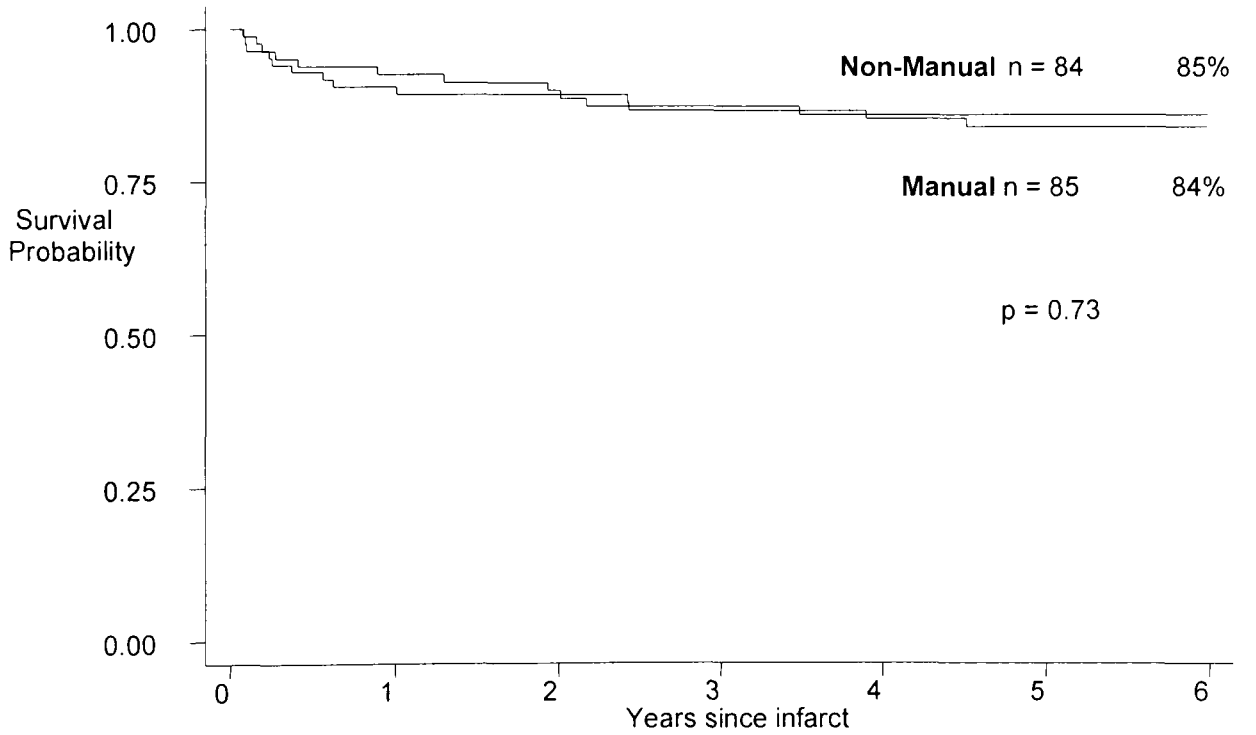


Figure 4.8a **Six-year CHD survival for men surviving 28 days by area deprivation group**

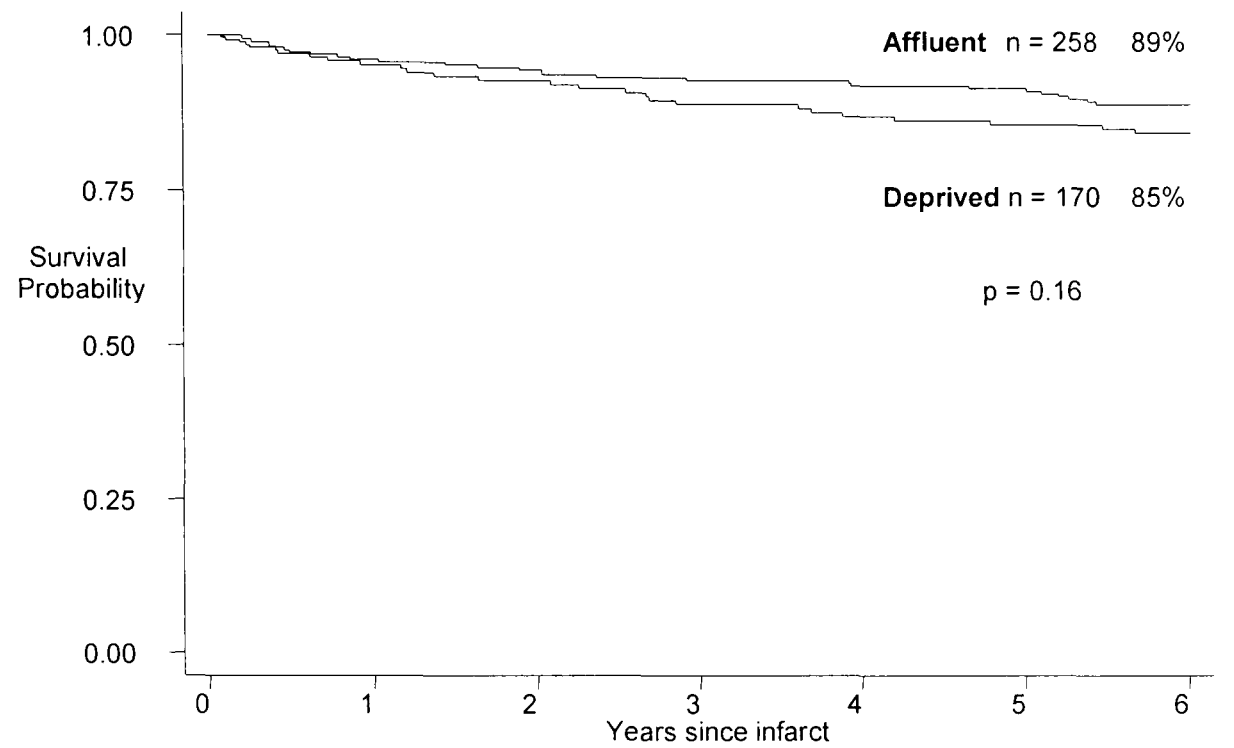
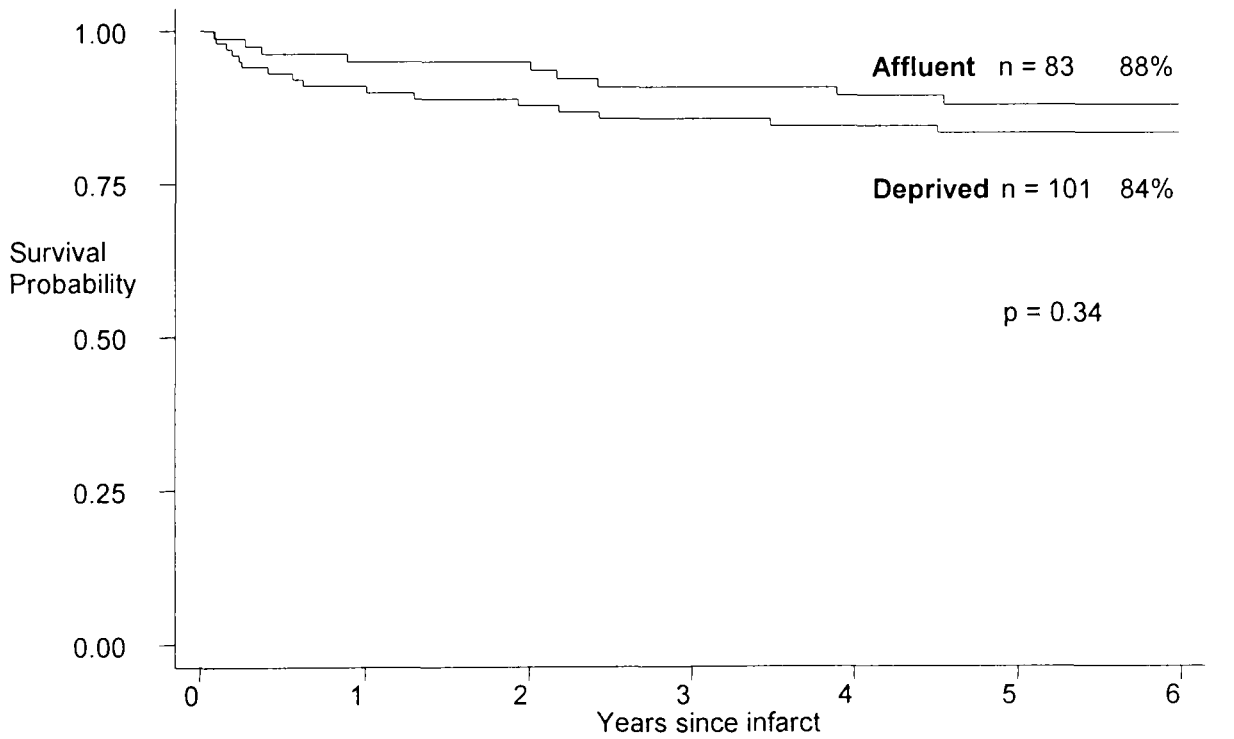


Figure 4.8b **Six-year CHD survival for women surviving 28 days by area deprivation group**



4.4.6.1 Summary of Six-Year Survival in 28-Day Survivors

Six-year overall survival was better for men who survived for 28 days from affluent residential areas in Oxfordshire compared to those from deprived ones. However

no differences in six-year overall survival were found by social class. For women, there were no differences in overall six-year survival either by social class or area deprivation group. No significant socioeconomic differences were found for six-year coronary mortality in men or women; however numbers were small and confidence intervals wide.

4.5 Discussion

In this chapter, the relationship between socioeconomic status and rates of coronary events and of subsequent mortality were examined. Two different measures of socioeconomic status were used (individually ascertained social class and postcode-based Townsend Index of material deprivation).

4.5.1 Key Findings

An inverse relationship between socioeconomic status and coronary event rates was found, using either type of socioeconomic measure. For 28-day case fatality, an inverse gradient was observed for individually ascertained social class, but no socioeconomic gradient was found for postcode-based area deprivation groups. Within the cohort, there was a strong relationship between social class and individual Townsend Index with more patients in lower social classes living in areas of greater deprivation. Amongst 28-day survivors, men living in more deprived areas had higher six-year all-cause mortality than those living in affluent areas, although there was no association for women. By social class, there was no difference in six-year all-cause mortality for men and women. Furthermore, for six-year coronary mortality in 28-day survivors, no socioeconomic gradient was observed using either socioeconomic measure.

4.5.2 Study Strengths

In contrast to other studies of myocardial infarction patients, socioeconomic status was defined using two indicators (individually ascertained social class and

postcode-based area deprivation measured by Townsend Index). This allowed comparison of the relationship between each type of indicator and study outcomes, and the opportunity to determine whether conclusions about socioeconomic status and coronary disease were different based on the type of indicator. Additionally, the two measures contributed different information. Social class was based on an individual's current or most recent occupation[16] and may also be considered an alternative measure of education, whereas Townsend Index was based on four components of household material circumstances and is unlikely to be regarded as a proxy for education.[17]

Data were complete for most of the patient cohort at baseline, with social class assigned to 94.0%, Townsend Index to 99.8% and both measures were available for 93.8%. Additionally, complete past medical history data were available for 88% of the total cohort, which ensured that potential confounding effects of these factors could be taken into account. Amongst 28-day survivors, 99.8% were allocated a Townsend Index and 93.3% were assigned to a social class.

4.5.3 Study Limitations

There are some limitations to the interpretation of the results. The patient cohort consisted of relatively small numbers, which restricted the examination of socioeconomic group differences, particularly six-year coronary mortality amongst 28-day survivors. Classifying women by their own occupation was another limitation, because it may not have reflected actual socioeconomic circumstances as satisfactorily as using the conventional head of household. Furthermore, Townsend Index was an aggregate deprivation measure of approximately 400 households within artificially defined geographical areas of enumeration districts, which were established for Census data collection, not for this study. Other studies have used area deprivation measures that relate to much smaller geographical areas[4 7] or to socioeconomic circumstances specific to the study's geographical area.[25]

4.5.4 Coronary Event Rates

Overall, higher age-adjusted coronary event rates were associated with lower socioeconomic status, using either individual social class or area deprivation groups. These results confirmed findings from previous studies of coronary event rates using individually assigned socioeconomic indicators from France,[2] Sweden[1] and Finland,[3] or using area deprivation groups from North Glasgow[4] and Malmo, Sweden.[5] However, in OXMIS men aged less than 65 years, there was no socioeconomic gradient for coronary event rates and area deprivation groups, yet in North Glasgow, men younger than 65 years who lived in areas of greater deprivation had higher coronary event rates compared to those in less deprived areas.[4] This disparity may be explained by different background population deprivation levels within the geographical areas of each study, since Oxfordshire is a relatively affluent county compared to England and Wales, whereas North Glasgow is an area of high deprivation compared to the rest of Scotland.[4] Consequently, lower socioeconomic circumstances in North Glasgow may have contributed to more men of working age being at higher risk of a coronary event compared to men of the same age living in Oxfordshire.

Higher prevalence of established coronary risk factors in lower socioeconomic groups is a possible explanation for socioeconomic gradients in coronary event rates within the general population. Coronary risk factors are more prevalent in lower socioeconomic groups in the UK,[26], in the United States of America[27] and in Sweden.[28] Furthermore, a Swedish study found that higher levels of smoking, obesity and hypertension in the background population were associated with higher incidence of myocardial infarction independently of area-based socioeconomic status.[5] Coronary risk factors explained 40% to 60% of the area variation in myocardial infarction incidence, whereas area socioeconomic levels explained up to a further 2% to 16%. A much earlier UK study of the relationship between individually assigned social class differences, coronary event rates and

coronary risk factors in a population-based cohort was the British Regional Heart Study.[29] Social class differences in coronary risk factors explained the higher coronary event rates for men in manual classes compared to those in non-manual social classes. However, coronary risk factors were not available for the Oxfordshire population, by either individual social class or postcode, and it remains unclear whether risk factors contributed to the socioeconomic gradients in coronary event rates observed in this county during the 1990s.

4.5.5 28-Day Case Fatality

4.5.5.1 Using Two Socioeconomic Measures

Men diagnosed with myocardial infarction in lower social classes had approximately twice the risk of 28-day case fatality compared to those in social class I after accounting for Townsend Index, age and past medical history in the OXMIS study. Furthermore, Townsend Index may have been associated with age-adjusted 28-day case fatality independently of individual social class, infarct severity and coronary risk factors (p=0.033). However, current smokers were more common in lower socioeconomic groups (more smokers in lower social classes or living in areas of greater deprivation) and adjustment for this imbalance was not possible, because only two thirds of patients had available smoking status data. Therefore, it remains unclear whether current smokers confounded these results and provided the explanation for the inverse social gradient observed in 28-day case fatality.

The original intention of using two socioeconomic status indicators that measured different factors was to determine whether area deprivation had an effect independently of individual social class. Previously, findings of a modest but small effect of neighbourhood on various diseases and health outcomes, after adjusting for individual characteristics, have resulted in recommendations to address the characteristics of the area in which people live as well as the characteristics of the people who live there.[30] Such studies in the UK have examined associations with

CHD prevalence in the general Scottish population [14] or with cardiovascular mortality in a cohort of healthy people from a relatively deprived region of Western Scotland,[15] so these findings may not be generalisable to patients with CHD. The neighbourhoods in which people live may have an effect on health through such mechanisms as: the availability and accessibility of health services; infrastructure deprivation such as lack of parks or stores selling healthy foods at affordable prices; the prevalence of prevailing attitudes towards health and health related behaviours; and stress and a lack of social support.[31] [30] However in this chapter, the residential areas used were Census enumeration districts, which do not necessarily equate to a neighbourhood or community with characteristics shared by residents (such as those listed above). Thus interpretation of the area deprivation findings is limited. This is further complicated by the strong relationship between Townsend Index and social class within the OXMIS cohort.

There are other issues for each socioeconomic indicator that interfere with the interpretation of the 28-day case fatality results. The Townsend Index was not originally designed for individuals, but as a indicator of socio-economic circumstances within small geographical areas (like all measures of area deprivation).[17] This allowed investigation into potential environmental risk factors for observed geographical differences in disease occurrence and mortality in general populations with more certainty than previous larger scale geographical studies.[32] As such, the Townsend Index as an indicator of small-area socio-economic status, when assigned to an individual (as in this study), could only measure the risk of material deprivation, (based on deprivation levels of other households within the same enumeration district), not the individual's actual household material circumstances.

Until recently, the most commonly used measure of an individual's socioeconomic status in the UK was the occupation-based Registrar General's classification of social class.[16] However, there has been no general consensus on what exactly was being measured and it is unclear whether social class measures social

standing in the community,[33] or occupational skill.[34] More recently, it was suggested that it was a predictor of income,[35] even though large variations in income levels can be found in the same social class. Social class II, for example, contains both the corner shopkeeper and the senior manager in a multi-national company and there are likely to be large income differences. Thus, social class only provides a rather imprecise measure of income. This uncertain, non-specific basis for the Registrar General's classes was one of the main reasons behind its recent replacement with the National Statistics Socio-Economic Classification[36] and the use of the new system in the 2001 Census.

4.5.5.2 By Individual Socioeconomic Status

Individual social class (classified by six categories) was examined prior to accounting for area deprivation levels, and an inverse socioeconomic gradient for 28-day case fatality for OXMIS men was found. Similarly, several European studies of 28-day case fatality in WHO MONICA cohorts have reported similar findings for men.[2 6 3 1]

In contrast, no association between social class and 28-day case fatality for OXMIS women was observed. This may be explained by the limitations of the Registrar General's classification system to measure women's actual socioeconomic circumstances, since studies from Sweden and Finland reported findings for women, and found that socioeconomic gradients were less distinct but similar to those for men.[1 3] Furthermore, 28-day case fatality was not reported for women by the French and Italian studies due to small numbers that resulted from low coronary event rates in the originating populations. Coronary event rates in France and Italy were similar to those previously reported for Oxfordshire[37] whereas, Sweden and Finland had higher coronary event rates.[38] It, therefore, remains unclear whether there is a relationship between individual socioeconomic status and 28-day case fatality for women diagnosed with myocardial infarction who originated from populations with low coronary event rates.

4.5.5.3 By Area Deprivation

There was no relationship between 28-day case fatality and area deprivation groups (classified into five categories) for OXMIS men and women, whether or not social class was taken into account. This finding was consistent with the North Glasgow MONICA study,[4] but contrasted with the Scottish Record Linkage Study which found an inverse socioeconomic gradient in 30-day fatality after a myocardial infarction using area deprivation groups.[9] The Scottish Record Linkage Study linked two national databases (the Scottish Morbidity Record of all hospital admissions and the General Registrar's Office for Scotland for all deaths) and retrospectively identified 200,924 patients across Scotland with a first fatal or non-fatal myocardial infarction between 1986 and 1995. Patients aged less than 65 years from areas of greatest deprivation had twice the risk of 30-day case fatality than those from the least deprived areas, and those aged 65 to 75 years living in more deprived areas were at 30 to 50% higher risk than those from more affluent areas. The exclusion of patients with previous myocardial infarction in the Scottish Record Linkage Study complicates direct comparison with both the OXMIS and North Glasgow studies, since such patients were included in these cohorts. Furthermore, this may have resulted in some systematic bias in socioeconomic status, although the extent of this is not possible to determine. Additionally, the North Glasgow patients were from a highly deprived area and therefore the findings are only generalisable to myocardial patients from similar areas of deprivation. It is, therefore, difficult to determine the reasons for the different findings amongst these cohorts.

4.5.6 All-Cause Mortality beyond 28 Days

4.5.6.1 By Area Deprivation

Six-year all-cause mortality in 28-day survivors was higher in OXMIS men from deprived areas compared to those from affluent ones, although adjustment for age was not possible due to small numbers in each group. Several previous studies have investigated socioeconomic status and all-cause mortality following a

myocardial infarction, and overall, lower residential area socioeconomic status is associated with higher age-adjusted all-cause mortality beyond one month.[7 10] In contrast, the East London Study found no relationship between area deprivation and age-adjusted one year survival for 1417 30-day infarct survivors identified between 1988 and 1997.[39] However this study included patients from a highly deprived area of London and the narrower range of deprivation within the background population may have contributed to lack of a socioeconomic gradient for all-cause mortality. This also limits the generalisability of the East London findings to one month infarct survivors from similar areas of deprivation. Furthermore, only patients admitted to a coronary care unit were included, and at least one third of patients diagnosed with a myocardial infarction may not be admitted to a coronary care unit.[40] This further limits the generalisability of their findings.

4.5.6.2 By Individual Socioeconomic Status

In contrast to area-based socioeconomic status, there was no difference between individually assigned social class and six-year all-cause mortality for men and women in the OXMIS study. However, two studies of individual socioeconomic status and long term all-cause mortality for MONICA cohorts reported that patients in lower socioeconomic groups had higher death rates than those in higher socioeconomic groups in Finland[3] and in Sweden.[1] However, inclusion of deaths within 28 days together with no separate report of age-adjusted mortality for 28-day survivors complicate interpretation of the findings of both studies. Thus it remains unclear whether or not individual socioeconomic status was associated with mortality beyond 28 days for infarct survivors in these countries.

4.5.7 Coronary Mortality beyond 28 Days

There was no difference in six-year coronary mortality for 28-day infarct survivors by socioeconomic group using either social class or area deprivation, and this is the first time coronary mortality beyond 28 days has been reported. Furthermore,

direct comparison of these findings with other studies of all-cause mortality is not possible, because non-coronary mortality was not reported separately by any other studies and coronary mortality cannot be calculated.

4.5.8 Health Service Implications

The health service implications of social inequalities in coronary disease relate to primary prevention, and are therefore mainly relevant for those health professionals in public health and general practice responsible for implementing coronary prevention strategies in the general population. Initiatives such as smoking cessation clinics, supported by the National Service Framework for Coronary Heart Disease,[41] could be located in deprived areas. This would provide easier access for those who are at highest risk of developing CHD. General practice was assigned the responsibility for coronary risk screening and treatment of those patients consider at high risk for but not yet diagnosed with CHD by the National Service Framework for CHD, and risk stratification could include socioeconomic status.

In contrast, once individuals have been diagnosed with a myocardial infarction and survived for the first 28 days, risk stratification using socioeconomic status is no longer useful in the provision of ongoing care. The diagnosis of myocardial infarction places patients in a group with disease specific health care needs, regardless of socioeconomic status at the time of the index event. The emphasis for hospital and primary care doctors and nurses should, therefore, be on providing appropriate treatment, including the initiation and maintenance of coronary preventive care to reduce the risk of subsequent fatal events as well as non-fatal coronary events.

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Chapter 5

Non-Fatal Coronary Heart Disease Progression

And Preventive Treatment

5.1 Introduction

The previous chapter investigated the relationship between socioeconomic status and the rates of coronary events and subsequent mortality in patients diagnosed with myocardial infarction. This chapter focuses on non-fatal coronary events and reports the progression of coronary heart disease (CHD) over the subsequent six years in myocardial infarction survivors. Details of preventive coronary treatment after the index event are also reported.

Non-fatal progression of coronary heart (CHD) disease after a myocardial infarction has been investigated in relatively few studies. Of these, most have failed to distinguish between non-fatal and fatal events.[1 2 3] Some have reported rates of reinfarction only,[1] or of angina only,[4] whereas others that included both reinfarction and angina reported each separately but not combined as a single composite measure of non-fatal CHD progression for each patient.[5 2] Furthermore, most studies have been restricted to reporting coronary events requiring hospital admission.[5 3 2] Non-fatal coronary disease progression has not been investigated using all possible first noted manifestations of CHD as a single outcome per patient or separately from fatal events.

Of the two follow-up studies that reported the occurrence of congestive heart failure in infarct survivors,[6 5] neither examined incidence rates after hospital discharge. One included patients with congestive heart failure noted at the time of the index event[6] whereas the other did not report rates separately for those with no past history of congestive heart failure.[5]

The prescribing of aspirin, beta-blockers, ACE-inhibitors and statins for infarct survivors is already recognised as sub-optimal in clinical practice.[7 8 9 10 11 12 13 14] Additionally, most studies have reported sub-optimal ACE-inhibitor prescribing at hospital discharge for congestive heart failure after a myocardial infarction,[15 16 17] and those that examined such treatment after hospital discharge were limited to two-year infarct survivors.[11 12 14] The occurrence of congestive heart failure (incidence and prevalence) following hospital discharge and the extent of treatment with ACE-inhibitors in 28-day infarct survivors have not been reported. Prescribing of statins for patients with established CHD has improved since the mid-1990s,[18 19 20] but initiation of prescriptions of coronary preventive medications for infarct survivors discharged from hospital without such a prescription has not been reported beyond one year.[14]

5.2 Aims

This chapter investigates non-fatal CHD and initiation of preventive treatment after a myocardial infarction over the subsequent six years in two patient groups. Non-fatal coronary events and congestive heart failure were examined in 28-day survivors. The extent of preventive treatment for CHD and hypercholesterolaemia was examined as well as the treatment of congestive heart failure with ACE-inhibitors in hospital survivors.

The aims were firstly to describe in 28-day survivors:
(i) CHD history prior to the index myocardial infarction
(ii) the extent of complications and
(iii) procedures performed at the time of the index myocardial infarction.

Then, over the subsequent six years the following were investigated in 28-day survivors:
(i) first subsequent occurrence of a non-fatal coronary event or a diagnosis of congestive heart failure

(ii) incidence of angina and of congestive heart failure in those with and without a previous history of these conditions
(iii) annual probabilities of overall and coronary event-free survival and
(iv) non-fatal coronary events and congestive heart failure diagnosed in six-year survivors.

For hospital survivors, the following were examined over the six years after discharge:
(i) first preventive medication prescriptions
(ii) congestive heart failure treatment with ACE-inhibitors and
(iii) serum cholesterol management including treatment with statins.

5.3 Methods

5.3.1 Patients

The cohort for this study comprised the 613 patients (428 men and 185 women) who survived 28 days after the index myocardial infarction. Of these, seven patients (five women and two men) died before being discharged. The remaining 606 (99%) patients were classified as hospital survivors.

5.3.2 Locating Medical Casenotes

5.3.2.1 Hospital Records

Of the 613 28-day survivors, most were admitted for the index myocardial infarction to one of the two acute hospitals in Oxfordshire: 460 patients to the John Radcliffe Hospital in Oxford and 68 patients to the Horton General Hospital in Banbury. An additional 40 Oxfordshire residents were admitted to one of the two acute hospitals in Reading, because of proximity to their residence. Another 25 patients lived within the catchment area of other hospitals in neighbouring counties or were admitted to the local hospital where they were visiting at the time of the

index myocardial infarction. Twenty patients were managed at home by their general practitioner.

Hospital identity numbers from the baseline database were used to locate casenotes through the hospital medical records database. Patients originally admitted to hospitals other than those in Oxfordshire or those managed at home may have been referred to the John Radcliffe Hospital for subsequent investigation or follow-up. For these patients, casenote searches were conducted in the John Radcliffe Hospital database, using the patient's name and date of birth.

5.3.2.2 General Practice

All 28-day survivors were flagged with the Office of National Statistics to trace deaths and emigration and a list of patients' survival status and current registered health authority in February 2003 was obtained. Of the 606 hospital survivors, 433 were alive at this time. A study information pack was forwarded directly to each of these patients by the health authority, which consisted of an invitation letter, an information sheet and consent form (see Appendices C, D and E respectively). In total, 63% (274) of the 433 patients gave permission to review their general practice casenotes. The Applied and Qualitative Research Ethics Committee in Oxford gave approval for this study.

General practice casenotes of deceased patients are stored by the Thames Valley Primary Care Agency. Of the 173 deceased patients, only 26 sets of paper records were available. The remaining casenotes had been destroyed in a fire at the storage facility. Of these patients who died in Oxfordshire, computerised records were reviewed in the surgery, when available. In total, general practice data were extracted for 68% (117) deceased patients.

5.3.3 Events at the Time of or After the Index Myocardial Infarction

Cardiac complications and procedures were noted at the time of the index myocardial infarction. A non-fatal coronary event was defined as the first record of a recurrent myocardial infarction, unstable angina, exertional angina or coronary revascularisation, which the patient survived. Non-fatal coronary events and congestive heart failure were recorded over the subsequent six years. Events were based on a clinical diagnosis or procedure documented in hospital (including admission and outpatient episodes) and general practice casenotes. The source, date and details of symptoms, investigations and results confirming each event were recorded.

5.3.3.1 Congestive Heart Failure

Congestive heart failure was noted either as a complication at the time of the index myocardial infarction or as a subsequent diagnosis. Diagnosis was objectively confirmed by:

(i) an echocardiogram report and defined by left ventricular ejection fraction less than 50% or by a diagnosis of mild, moderate or severe heart failure or

(ii) a chest x-ray report of pulmonary oedema.

If no objective confirmation was documented, congestive heart failure was noted when a patient had symptoms (breathlessness or peripheral oedema) and a clinical diagnosis of heart failure.

5.3.3.2 Arrhythmias

Arrhythmias were noted as a complication at the time of the index myocardial infarction only and included heart block, atrial fibrillation and cardiac arrest.

5.3.3.3 Angina

Angina was classified into two categories: unstable or exertional. Unstable angina was noted as a complication of the index myocardial infarction, when chest pain recurred after resolution of the acute episode prior to discharge or as a subsequent

event, when a patient was rehospitalised with chest pain. Diagnosis was objectively confirmed by:

(i) a resting electrocardiogram (ECG) showing ST depression or a non-Q wave myocardial infarction, or

(ii) an exercise ECG showing ST depression, or

(iii) raised cardiac enzyme levels that were not definitive for a diagnosis of myocardial infarction (Troponin I > 1 or < 10; creatinine kinase < 390, AST < 84 or LDH < 500 (twice upper normal limits), or

(iv) a coronary angiogram showing coronary artery stenosis if ongoing chest pain (either at the time of the index myocardial infarction or during a subsequent emergency admission for cardiac chest pain) was the indication for the procedure.

If no objective confirmation was documented, unstable angina was noted when a patient had typical symptoms (chest pain or breathlessness) and a discharge diagnosis of unstable angina.

Angina was classified as exertional, when there was a clinical diagnosis of stable or exertional angina or of myocardial ischaemia with or without hospitalisation. Diagnosis was objectively confirmed by:

(i) an exercise ECG showing ST depression less than 1mm, or

(ii) a nuclear scan showing reversible ischaemia, or

(iii) a coronary angiogram showing coronary artery stenosis if it was performed during an elective admission for stable angina and no other earlier investigations were documented.

If no objective confirmation was found in the casenotes, exertional angina was noted for patients reporting chest pain on exertion and a clinical diagnosis of angina was recorded. It was excluded if ischaemic ECG changes were associated with arrhythmias detected by Holter monitor.

5.3.3.4 Revascularisation Procedures

Revascularisation procedures were recorded during admission for the index myocardial infarction or over the subsequent six years and included percutaneous

coronary intervention (balloon angioplasty with or without a stent) and coronary artery bypass graft surgery.

5.3.3.5 Recurrent Myocardial Infarction

Recurrent myocardial infarction was noted when a resting ECG showed ST elevation or 'Q wave' infarct or elevated cardiac enzymes were at least twice normal limit (CK > 390, AST > 84 or LDH > 500) or Troponin I was > 10. If event details were missing, a clinical diagnosis of myocardial infarction in a hospital discharge summary or general practice casenotes was accepted.

5.3.4 Preventive Treatment

For patients diagnosed with myocardial infarction, cardiac rehabilitation programmes and lifestyle advice about smoking cessation, diet and exercise are considered integral components of preventive treatment. However, provision of such care was sparse in Oxfordshire in the 1990s and documentation of such care was likely to be poorly recorded in casenotes. Therefore no attempt was made to assemble such information.

Preventive medications included aspirin, beta-blockers, angiotensin converting enzyme inhibitors (ACE-inhibitors) and statins. Prescriptions at hospital discharge (or at time of the index infarct for those patients managed at home) were extracted from the baseline database of Oxford Myocardial Infarction Incidence Study (OXMIS). Serum cholesterol levels measured at hospital admission were also obtained from this database. At subsequent hospital contact for CHD, all preventive medication prescriptions, serum cholesterol measurements and dates were extracted from casenotes. General practice records were reviewed for current medication prescriptions, and serum cholesterol levels, dates of measurement, and dates of statin and ACE-inhibitor prescriptions were recorded over the six year follow-up period.

5.3.5 Design and Pilot of Data Collection Instruments

A set of data collection instruments was developed specifically for the study and the aim was to identify subsequent diagnoses of myocardial infarction, angina and congestive heart failure, the investigations used to confirm these diagnoses, prescriptions of preventive medications, and serum cholesterol levels. The data collection instrument set consisted of CHD Hospital Admission, CHD Outpatient Appointment and General Practice Note Review forms (see Appendices F, G and H respectively). Diagnostic and medication sections of the baseline OXMIS data collection tool were revised using both the Swedish Acute Myocardial Infarction Registry Study instrument[21] and the recommendations outlined in the National Service Framework for CHD.[22] Criteria for each diagnosis used in 1994 were included, and updated diagnostic criteria for myocardial infarction, congestive heart failure and angina were critiqued by a consultant cardiologist (Dr A. Banning) to ensure that the data collection form conformed to clinical practice.

The CHD diagnostic sections were piloted using hospital records of 10 post-infarct patients attending a cardiac surgery pre-admission clinic and revisions were made primarily to the format of investigation results. Further revisions were made after the first 10 study patients' hospital casenotes were reviewed. The same format was used for coronary events and congestive heart failure sections in the data collection forms for the extraction of additional details of the index event (see Appendix I), subsequent hospital episodes and general practice note review.

5.3.6 Quality Assurance

Procedural guidelines (see Appendix J) were developed to assist standardised data collection. Training was provided for the research nurses to ensure that they were fully conversant with the study procedures. One nurse with 10 years experience of extracting data from hospital casenotes for research studies assisted the principal investigator with hospital records, by collecting data for patients admitted to the two Reading hospitals and the Horton General Hospital. Two

research nurses with previous experience in primary care data extraction were also trained and were responsible for collecting data from the general practice records. Data collection was coordinated by the author who was also available by mobile telephone for any queries. In addition, the study nurses met with the principal investigator fortnightly to discuss any issues that may have arisen during the course of their work.

5.3.7 Availability of Data

5.3.7.1 At Time of Index Event

Past medical history, complications documented at the time of the index myocardial infarction and discharge medications were extracted from hospital notes or general practice referral letters for those patients managed at home. Casenotes of the index event were missing for 3.6% (22) of the 613 28-day survivors, and data were retrieved for these patients from the baseline OXMIS paper records. Of the 417 patients with complications noted at the time of the index myocardial infarction, 2.9% (12) had complications ascertained from OXMIS paper records. Diagnostic investigation results were not available from this source. Medication data were obtained for all 606 hospital survivors.

5.3.7.2 After Index Event

Follow-up data were extracted from hospital and general practice casenotes for the 606 hospital survivors. Casenote availability and completeness from each source is shown in Table 5.1. Hospital notes were located for 96.7% (586) of patients and 95.9% (562) provided complete data. General practice records were accessible for 64.5% (391) and of these 93.1% (364) had complete morbidity data. Follow-up data from either hospital or general practices notes were missing for only 1.7% (10) of hospital survivors.

Table 5.1 Number of patients with follow-up medical casenote data by source availability and completeness

	Men	Women	Total
28-day Survivors	428	185	613
Died of index event	2	5	7
Hospital Survivors	426	180	606
Hospital casenotes			
Complete	394	168	562
Partially complete	18	6	24
Missing	14	6	20
General practice casenotes			
Complete	266	98	364
Partially complete	23	4	27
Missing	137	78	215
Hospital & General Practice (GP) Casenotes			
Both sources complete	255	95	350
Hospital complete & GP partial or missing	139	73	212
GP complete & hospital partial or missing	11	3	14
One source partial & the other missing	14	6	20
Both sources missing	7	3	10

Coronary disease progression analyses were restricted to 421 men and 182 women who survived 28 days after the index myocardial infarction and analyses for preventive treatment were limited to 419 male and 177 female hospital survivors (10 patients with no follow-up data from either source were excluded from each dataset). For the 18 patients who had moved from the area before the six-year follow-up period was complete, first coronary events, congestive heart failure diagnosis and preventive treatment after the index myocardial infarction were recorded from available hospital notes (after which no further CHD progression was presumed). The median length of available follow-up data from hospital notes was 22 months (IQR, 8 months to 43 months).

5.3.8 Statistical Analysis

Data were analysed separately for men and women and the statistical packages SPSS 10.0 for Windows[23] and STATA 7.0[24] were used. Proportions were

compared using the chi-squared test or Fisher's exact test, and means using Student's t test. Overall event-free survival (defined as all-cause death or non-fatal coronary event) was calculated using the Kaplan-Meier method and comparison of survival between men and women assessed using the logrank test. Overall event-free survival was also examined separately by whether or not the patient had a CHD history (myocardial infarction, angina, or coronary revascularisation prior to or unstable angina noted at the time of the index myocardial infarction). Using the Kaplan-Meier method, the risk of fatal or non-fatal coronary events was examined, by treating patients who died from causes other than CHD as censored. Survival defined in this way is referred to as coronary event-free survival. As stated in chapter 3, a Cox regression analysis revealed a complex relationship between sex, age and survival, which was not constant over the six-year study period. It was, therefore, inappropriate to use this method to further examine the data.

5.4 Results

5.4.1 CHD before and at the time of the Index Myocardial Infarction

These analyses are for all 613 28-day survivors. Table 5.2 shows the medical history before the index myocardial infarction, the complications recorded at the time of the index event and the procedures performed during admission for the index event. A history of coronary heart disease was more common in men than women, with a history of myocardial infarction or revascularisation prior to the index event being more common in men than women. At the time of the index event, however, two thirds of men and of women had at least one complication, and no statistically significant differences between men and women were observed. There was a non-statistically significant gender difference found for angiograms performed during the admission for the index event with more men than women having had such a procedure.

Table 5.2 **Medical history before, complications noted at the time of and procedures performed during admission for the index MI: 28-day survivors** % (n), unless otherwise stated

	Men N=428	Women N=185	Difference (Men – Women) % (95% CI)
Age			
Mean years (SD)	62.9 (10.6)	67.9 (8.8)	-5.0 (-6.8 to -3.2)
Past History* before index MI of:			
Congestive Heart Failure	4.7 (20)	5.4 (10)	-0.7 (-4.6 to 3.1)
MI with Angina	14.0 (60)	9.7 (18)	4.3 (-1.1 to 9.7)
MI without Angina	10.0 (43)	4.3 (8)	5.7 (1.6 to 9.8)
Angina only	12.9 (55)	15.1 (28)	-2.3 (-8.3 to 3.8)
Revascularisation	11.2 (48)	3.2 (6)	8.7 (4.8 to 12.5)
Any coronary heart disease**	37.4 (160)	29.2 (54)	8.2 (0.2 to 16.2)
Complications* noted at time of index MI:			
Congestive Heart Failure	36.9 (158)	43.2 (80)	-6.3 (-14.8 to 2.2)
Unstable Angina	39.0 (167)	34.6 (64)	4.4 (-3.8 to 12.7)
Arrhythmias	25.4 (107)	30.2 (55)	-4.8 (-12.7 to 3.1)
Any complication	68.2 (292)	67.6 (125)	-0.4 (-8.5 to 7.6)
Procedures during admission for index MI:			
Angiogram	26.9 (115)	20.5 (38)	6.3 (-0.9 to 13.5)
CABG	3.1 (13)	2.8 (5)	-0.3 (-2.5 to 3.2)
PTCA	3.6 (15)	4.4 (8)	-0.8 (-4.3 to 2.6)

Notes: MI; myocardial infarction; CI confidence interval;
* conditions are not exclusive; ** either MI or angina or revascularisation

5.4.1.1 Confirmation of Diagnosis at the time of the Index Myocardial Infarction

The diagnosis of congestive heart failure and unstable angina as a complication at the time of the index myocardial infarction was objectively confirmed in the majority of 28-day survivors. For congestive heart failure, confirmation was by echocardiogram for 80% (126) of the 158 men and 74% (59) of the 80 women diagnosed, by chest x-ray only for 18% (28) of men and 24% (19) of women, and by symptoms only for the remaining four men and two women. The diagnosis of unstable angina was confirmed by coronary angiography in 69% (115/167) of men and 59% (38/64) of women, by exercise ECG for 14% (24) of men and 16% (9) of women, resting ECG only for 16% (26) of men and 27% (17) of women and

symptoms only for the remaining two men. None of the differences in investigations between men and women reached statistical significance.

5.4.2 Non-Fatal Coronary Events and Congestive Heart Failure

The following results are for 421 men and 182 women (notes for 10 patients were missing; see section 1.3.7.2). Table 5.3 shows non-fatal coronary events and congestive heart failure noted after the index myocardial infarction by year first recorded and sex amongst 28-day survivors. The time of highest risk for any non-fatal coronary event for both men and women was in the first year and there were no differences between men and women at one year or at six years. For recurrent non-fatal myocardial infarction and coronary revascularisation, no significant gender differences were observed at six years. By six years, fewer men than women were diagnosed with unstable angina; 17% of men and 25% of women (difference [95% CI] -8%, [-15% to -1%], p=0.033). In contrast, more men than women were diagnosed with exertional angina; 34% of men and 21% of women (difference 13%, [5% to 20%], p=0.003). As with non-fatal coronary events, the highest risk of congestive heart failure was in the first year and there were no differences between men and women at one year or six years. At six years following the index myocardial infarction, 38% of both men and women had been noted to have congestive heart failure.

Table 5.3 Deaths, non-fatal coronary events and congestive heart failure after index MI by year first recorded and sex: 28-day survivors*

	1st year % (n)	2nd year % (n)	3rd year % (n)	4th year % (n)	5th year % (n)	6th year % (n)	Total % (n)
Men	N=421	N=397	N=380	N=361	N=350	N=339	N=421
Deaths	5.7 (24)	4.3 (17)	5.0 (19)	3.1 (11)	3.1 (11)	4.1 (14)	22.8 (96)
Non-fatal**							
Congestive heart failure	23.0 (97)	5.0 (20)	4.0 (15)	4.2 (15)	1.7 (6)	2.4 (8)	38.2 (161)
Recurrent MI	1.7 (7)	0 (0)	0.5 (2)	1.7 (6)	0.6 (2)	0.3 (1)	4.3 (18)
Unstable angina	9.7 (41)	3.0 (12)	2.1 (8)	1.1 (4)	1.1 (4)	1.2 (4)	17.3 (73)
Exertional angina	27.8 (117)	1.3 (5)	1.6 (6)	1.1 (4)	2.3 (8)	0.3 (1)	33.5 (141)
Revascularisation***	5.7 (24)	0.8 (2)	0.8 (1)	0.6 (2)	0.6 (2)	0.3 (1)	7.4 (32)
Any non-fatal coronary event#	38.5 (162)	4.0 (16)	3.7 (14)	2.5 (9)	3.7 (13)	1.2 (4)	51.8 (218)
Women	N=182	N=160	N=153	N=145	N=138	N=130	N=182
Deaths	12.1 (22)	4.4 (7)	5.2 (8)	4.8 (7)	5.8 (8)	3.9 (5)	31.3 (57)
Non-fatal**							
Congestive heart failure	26.4 (48)	3.8 (6)	2.0 (3)	2.8 (4)	3.0 (4)	3.1 (4)	37.9 (69)
Recurrent MI	3.9 (7)	0.6 (1)	0 (0)	0.7 (1)	0.7 (1)	0.8 (1)	6.0 (11)
Unstable angina	15.9 (29)	4.4 (7)	3.3 (5)	0.7 (1)	1.5 (2)	1.5 (2)	25.3 (46)
Exertional angina	14.8 (27)	3.8 (6)	0 (0)	2.1 (3)	0 (0)	1.5 (2)	20.9 (38)
Revascularisation***	3.3 (6)	0.1 (2)	0 (0)	0 (0)	0.7 (1)	0 (0)	5.0 (9)
Any non-fatal coronary event#	33.0 (60)	8.1 (13)	3.3 (5)	2.8 (4)	1.5 (2)	3.1 (4)	48.4 (88)

Notes: MI: myocardial infarction. * Excludes those with missing non-fatal event follow-up data: ** Non-fatal events are not exclusive; *** Excludes those who had a revascularisation procedure during admission for index MI; # Includes either recurrent MI, revascularisation, or unstable angina or exertional angina.

5.4.2.1 Confirmation of Diagnosis

Diagnoses of non-fatal coronary events and of congestive heart failure were objectively confirmed in the majority of 28-day survivors over the six years following the index myocardial infarction. Myocardial infarction was confirmed by a resting ECG showing ST elevation for 11 of the 18 men and 10 of the 11 women, and for those with no such confirmation, raised cardiac enzymes were the basis for diagnosis. Table 5.4 shows the confirmation methods for the first non-fatal unstable angina diagnosis after the index myocardial infarction by sex. There were no differences between men and women in the confirmatory diagnostic procedure for unstable angina, although symptoms alone were the basis of diagnosis for 36% of men and 41% of women. Confirmation methods for the first non-fatal exertional angina diagnosis by sex and source are shown in Table 5.5. No difference in the source of diagnosis for men and women was observed, although more men than women had exertional angina confirmed by exercise ECG at an outpatient appointment. For congestive heart failure diagnoses, the source and confirmation details are shown in Table 5.6. More men than women were diagnosed at an outpatient appointment (56% of men and 41% of women; difference 15%, [1% to 29%], p=0.047). There were no differences in the investigations to confirm congestive heart failure between men and women, and at least 70% of diagnoses were objectively confirmed by echocardiogram.

Table 5.4 Confirmation methods for first non-fatal unstable angina diagnosis after index myocardial infarction over six years by sex: 28-day survivors

	Men % (n) N=421	Women % (n) N=182	% Difference (95% CI)
Unstable angina diagnosis	17.3 (73)	25.3 (46)	-7.9 (-15.2 to -0.7)
Confirmation method			
Resting ECG	24.7 (18)	26.1 (12)	-1.4 (-17.5 to 1.5)
Exercise ECG	6.9 (5)	4.4 (2)	2.5 (-5.8 to 10.8)
Cardiac enzymes	2.7 (2)	6.5 (3)	-3.8 (-11.8 to 4.3)
Angiogram	30.1 (22)	21.7 (10)	8.4 (-7.5 to 24.3)
Symptoms only	35.6 (26)	41.3 (19)	-5.7 (-23.7 to 12.3)

Note: Includes most invasive investigation only

Table 5.5 Confirmation methods for first non-fatal exertional angina diagnosis after index myocardial infarction over six years by sex and source: 28-day survivors

	Men % (n) N=421	Women % (n) N=182	% Difference (95% CI)
Exertional angina diagnosis	33.5 (141)	20.9 (38)	12.6 (5.2 to 20.0)
Diagnosis from admission	28.4 (40)	23.7 (9)	4.7 (-10.7 to 20.1)
Confirmation method			
Exercise ECG	2.6 (1)	0 (0)	2.5 (-2.3 to 7.3)
Angiogram	80.0 (32)	55.6 (5)	24.4 (-10.3 to 59.2)
Symptoms only	17.5 (7)	44.4 (4)	-26.9 (-61.5 to 7.6)
Diagnosis from outpatient appointment	64.5 (91)	71.1 (27)	-6.5 (-23.0 to 9.9)
Confirmation method			
Exercise ECG	67.0 (61)	40.7 (11)	26.3 (5.4 to 47.2)
Nuclear scan	3.3 (3)	3.7 (1)	-0.4 (-8.4 to 7.6)
Symptoms only	29.7 (27)	55.6 (15)	-25.9 (-46.8 to -4.9)
Diagnosis from general practice	7.1 (10)	5.3 (2)	1.8 (-6.4 to 10.1)
Confirmation method			
Exercise ECG	10.0 (1)	0 (0)	10.0 (-8.6 to 28.6)
Symptoms only	90.0 (9)	100.0 (2)	-10.0 (-28.6 to 8.6)

Note: * Includes most invasive investigation only

Table 5.6 Confirmation methods for first congestive heart failure diagnosis after index myocardial infarction by sex and source over six years: 28-day survivors

	Men % (n) N=421	Women % (n) N=182	% Difference (95% CI)
Congestive heart failure diagnosis	38.2 (161)	37.9 (69)	0.3 (-8.1 to 8.8)
Diagnosis from admission	41.0 (66)	53.6 (37)	-12.6 (-26.6 to 1.4)
Confirmation method			
Echocardiogram	62.1 (41)	59.5 (22)	2.7 (-17.0 to 22.3)
Chest x-ray	28.8 (19)	29.7 (11)	-0.9 (-19.3 to 17.4)
Symptoms only	9.1 (6)	10.8 (4)	-1.7 (-13.9 to 10.5)
Diagnosis from outpatient appointment	55.9 (90)	40.6 (28)	15.3 (1.4 to 29.2)
Confirmation method			
Echocardiogram	85.6 (77)	89.3 (25)	-3.7 (-17.3 to 9.8)
Chest x-ray	12.2 (11)	0	12.2 (5.5 to 19.0)
Symptoms only	2.2 (2)	10.7 (3)	-8.5 (-20.3 to 3.4)
Diagnosis from general practice	3.1 (5)	5.8 (4)	-2.7 (-8.8 to 3.4)
Confirmation method			
Echocardiogram	20.0 (1)	25.0 (1)	-5.0 (-60.0 to 50.0)
Chest x-ray	40.0 (2)	0	40.0 (-2.9 to 82.9)
Symptoms only	40.0 (2)	75.0 (3)	-35.0 (-95.4 to 25.4)

Note: Includes most invasive investigation only.

5.4.3 Angina by History

Patients with no history of angina (noted prior to or at the time of the index myocardial infarction) were analysed separately from those with such a history. Table 5.7 shows non-fatal angina after the index myocardial infarction by year first recorded and sex in 28-day survivors. At one year, men with no history of angina were somewhat more likely to have angina diagnosed than those with a history; 42% of men with no history compared to 34% of men with a history (difference 8% [-1% to 17%], p=0.10). For women, there was no difference in angina after the index myocardial infarction by history at one year. However, by six years, there was a tendency for more women with a history of angina to have it noted compared to those with no history; 54% of women with a history compared to 39% with no history (difference 15% [1% to 29%], p=0.059). Furthermore, more men

than women were diagnosed with incident angina by six years (difference, 14% [2% to 26%], p=0.037), although no gender differences were observed amongst those with a history of angina.

5.4.4 Congestive Heart Failure by History

Non-fatal congestive heart failure after the index myocardial infarction by year first recorded and sex in 28-day survivors is shown in Table 5.8. At one year and six years, men with a history of congestive heart failure were more likely to have a new episode noted than those with no history. At one year, 30% of men with a history compared to 19% of those with no history had congestive heart failure documented (difference 11%, [2% to 19%], p=0.015), and at six years, the proportions were 49% compared to 31% (difference 18% [8% to 27%], p=0.0002). In women, there was a similar difference between patients with and without a prior history of congestive heart failure, but confidence intervals were wide. At one year, the proportions were 33% and 22% (difference 11% [-2% to 24%], p=0.14) and at six years, 44% and 33% (difference 10% [-4% to 25%], p=0.20). Incidence rates of congestive heart failure were similar for men and women at one year and six years, with one third of men and of women diagnosed with incident congestive heart failure over the six years.

Table 5.7 Deaths and non-fatal angina after index myocardial infarction by year first recorded, sex and angina history: 28-day survivors

	1st year % (n)	2nd year % (n)	3rd year % (n)	4th year % (n)	5th year % (n)	6th year % (n)	Total % (n)
Men							
Past history*	N=220	N=204	N=196	N=186	N=177	N=169	N=220
Deaths	7.3 (16)	3.9 (8)	5.1 (10)	4.8 (9)	4.5 (8)	4.1 (7)	26.3 (58)
Non-fatal angina	33.6 (74)	4.4 (9)	4.1 (8)	2.2 (4)	5.1 (9)	2.4 (4)	49.1 (108)
No history of angina	N=201	N=193	N=184	N=175	N=173	N=170	N=201
Deaths	4.0 (8)	4.7 (9)	4.9 (9)	1.1 (2)	1.7 (3)	4.1 (7)	18.9 (38)
Non-fatal angina	41.8 (84)	4.2 (8)	3.3 (6)	2.3 (4)	1.7 (3)	0.6 (1)	52.7 (106)
Women							
Past history*	N=87	N=75	N=73	N=67	N=64	N=60	N=87
Deaths	13.8 (12)	2.7 (2)	8.2 (6)	4.5 (3)	6.3 (4)	1.7 (1)	32.2 (28)
Non-fatal angina	33.3 (29)	13.3 (10)	1.4 (1)	6.0 (4)	3.1 (2)	1.7 (1)	54.0 (47)
No history of angina	N=95	N=85	N=80	N=78	N=74	N=70	N=95
Deaths	10.5 (10)	5.9 (5)	2.5 (2)	5.1 (4)	5.4 (4)	5.7 (4)	30.5 (29)
Non-fatal angina	28.4 (27)	3.5 (3)	5.0 (4)	0 (0)	0 (0)	4.3 (3)	39.0 (37)

Note: * Noted prior to or at the time of the index myocardial infarction.

Table 5.8 Deaths and non-fatal CHF after index MI by year first recorded, sex and CHF history: 28-day survivors

	1st year % (n)	2nd year % (n)	3rd year % (n)	4th year % (n)	5th year % (n)	6th year % (n)	Total % (n)
Men							
Past history*	N=166	N=152	N=142	N=130	N=125	N=118	N=166
Deaths	8.4 (14)	6.6 (10)	8.5 (12)	3.9 (5)	5.6 (7)	3.4 (4)	31.3 (52)
Non-fatal CHF	29.5 (49)	5.3 (8)	7.0 (10)	6.2 (8)	2.4 (3)	3.4 (4)	49.4 (82)
No history of CHF	N=255	N=245	N=238	N=231	N=225	N=221	N=255
Deaths	3.9 (10)	2.9 (7)	2.9 (7)	2.6 (6)	1.8 (4)	4.5 (10)	17.3 (44)
Non-fatal CHF	18.8 (48)	4.9 (12)	2.1 (5)	3.0 (7)	1.3 (3)	1.8 (4)	31.0 (79)
Women							
Past history*	N=80	N=68	N=63	N=60	N=57	N=53	N=80
Deaths	15.0 (12)	7.4 (5)	4.8 (3)	5.0 (3)	7.0 (4)	3.8 (2)	37.5 (30)
Non-fatal CHF	32.5 (26)	1.5 (1)	3.2 (2)	1.7 (1)	1.8 (1)	7.6 (4)	43.8 (35)
No history of CHF	N=102	N=92	N=90	N=85	N=81	N=77	N=102
Deaths	9.8 (10)	2.2 (2)	5.6 (5)	4.7 (4)	4.9 (4)	3.9 (3)	27.5 (28)
Non-fatal CHF	21.6 (22)	5.4 (5)	1.1 (1)	3.5 (3)	3.7 (3)	0 (0)	33.3 (34)

Notes: CHF: congestive heart failure. * Noted prior to or at the time of the index myocardial infarction.

5.4.5 Six-Year Overall Event Free Survival

At six years, 34% of men and 31% of women had survived free of any subsequent non-fatal coronary events (excludes congestive heart failure). Overall event-free survival curves for men and women who survived 28 days are illustrated in Figure 5.1a. Based on these survival curves, annual survival probabilities are shown in Table 5.8. Overall event-free survival was similar for men and women (p=0.85). However, given the difference between men and women in previous CHD history, survival curves were constructed separately for those with a CHD history and those with no history, to examine the effect of prior coronary disease on survival. Overall event-free survival curves for men and women are illustrated in Figure 5.1b for those with a CHD history and Figure 5.1c for those no CHD history. Annual survival probabilities based on these curves for both groups are shown in Table 5.9. There was no difference in survival between men and women with a CHD history (p=0.36) or for those with no CHD history (p=0.58).

Figure 5.1a Six-year overall event-free survival by sex: 28-day survivors

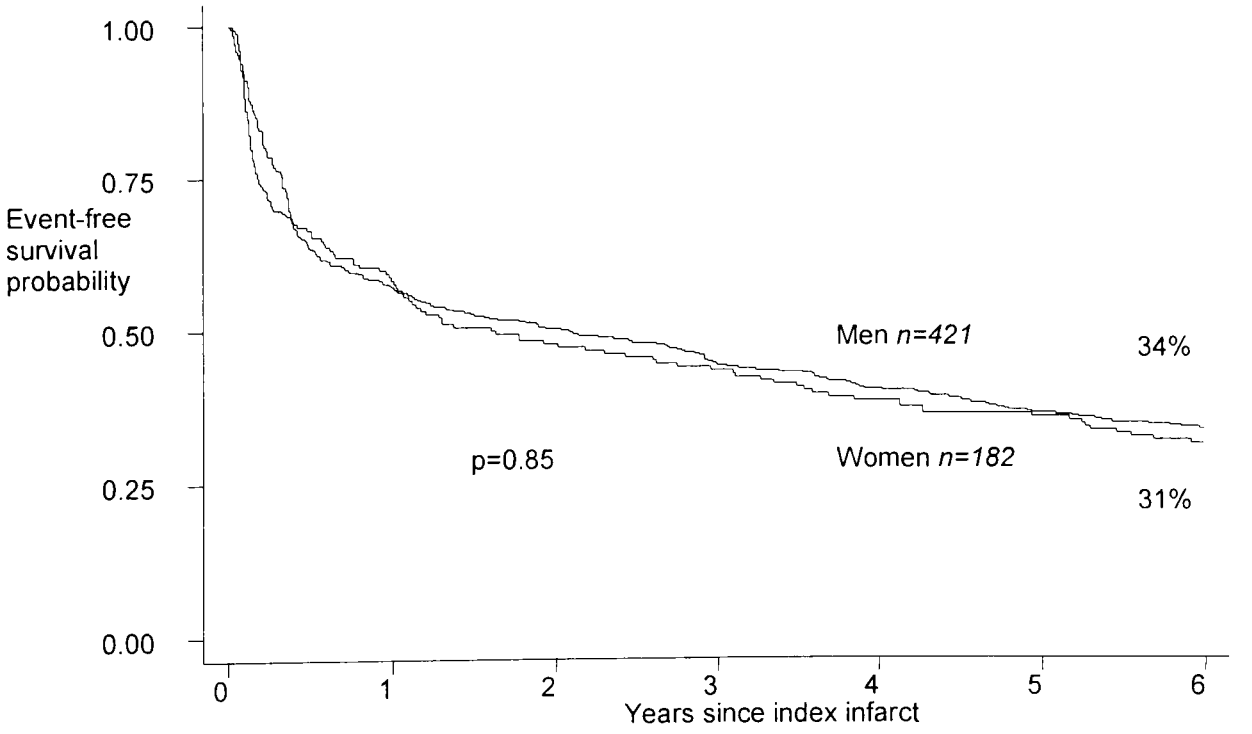

Figure 5.1b Six-year overall event-free survival for those with CHD history by sex: 28-day survivors

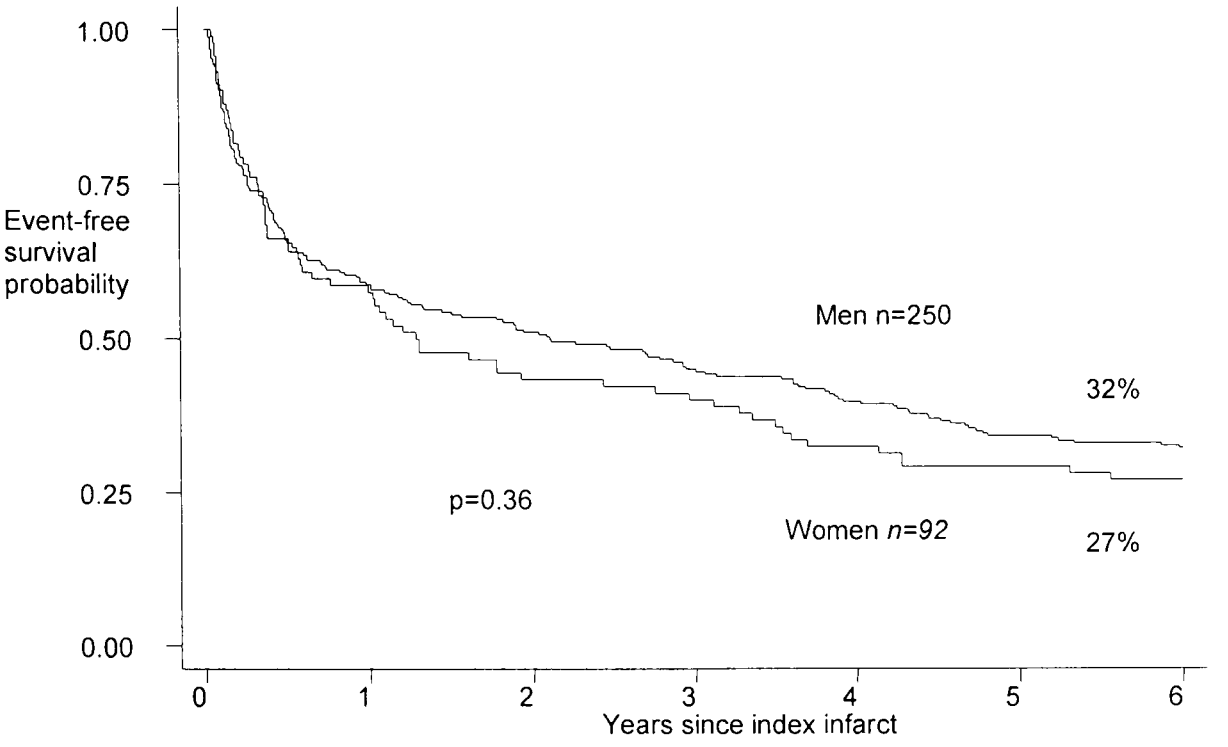

Figure 5.1c Six-year overall event-free survival for those with no previous CHD history by sex: 28-day survivors

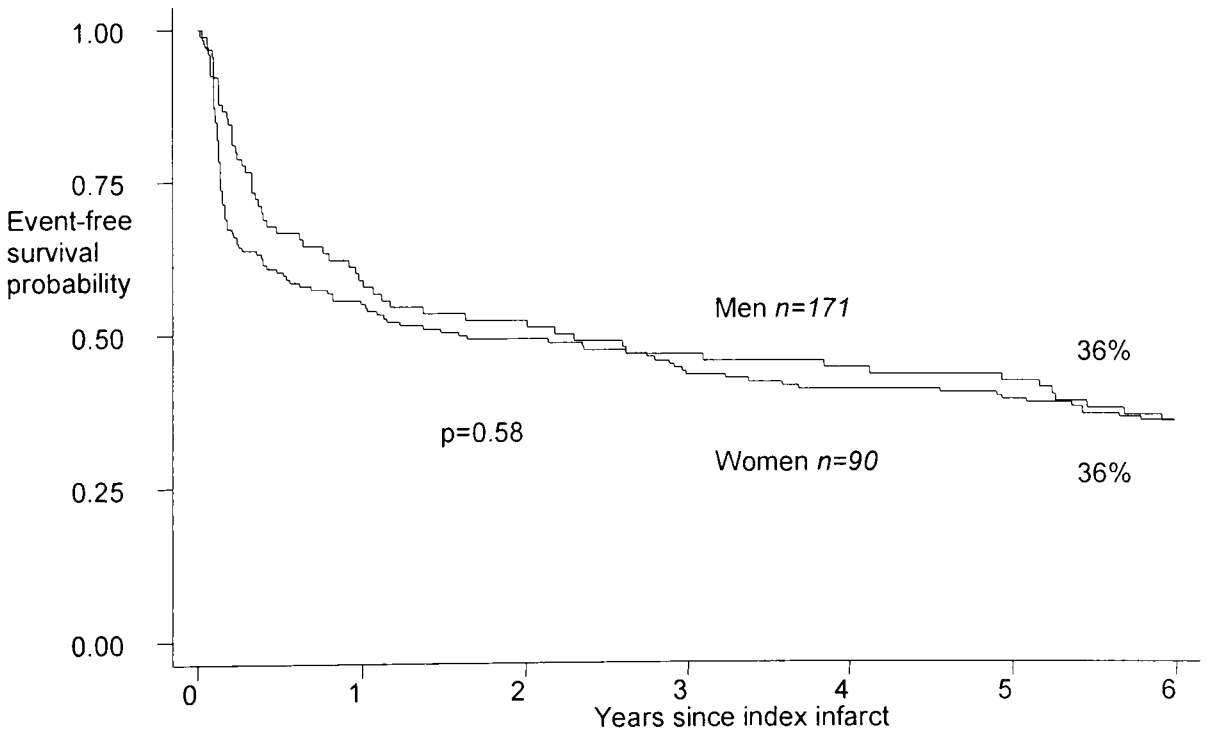

Table 5.9 Annual probability of overall event-free survival by sex and by CHD history: 28-day survivors

		% Survival (95% CI)					
		At1 year	At 2 years	At 3 years	At 4 years	At 5 years	At 6 years
All	n						
Men	421	57.2 (52.4-61.8)	50.4 (45.5-55.0)	44.2 (39.4-48.9)	40.4 (35.7-45.0)	36.3 (31.8-40.9)	33.7 (29.3 38.3)
Women	182	58.2 (50.7-65.0)	47.8 (40.4-54.8)	43.4 (36.1-50.5)	38.5 (31.4-45.5)	35.7 (28.8-42.7)	31.3 (24.7-38.1)
By CHD history							
Men							
With history*	250	58.8 (52.4-64.6)	51.2 (44.8-57.2)	44.8 (38.6-50.8)	40.0 (33.9-46.0)	34.4 (28.6-40.3)	32.4 (26.7-38.2)
With no history	171	55.0 (47.2-62.1)	49.1 (41.4-56.4)	43.3 (35.8-50.5)	40.9 (33.5-48.2)	39.2 (31.9-46.4)	35.7 (28.6-42.8)
Women							
With history*	92	57.6 (46.9-66.9)	43.5 (33.2-53.3)	40.2 (30.2-50.0)	32.6 (23.3-42.2)	29.4 (20.4-38.8)	27.2 (18.6-36.5)
With no history	90	58.9 (48.0-68.2)	52.2 (41.5-61.9)	46.7 (36.1-56.5)	44.4 (34.0-54.3)	42.2 (31.9-52.1)	35.6 (25.8-45.5)

Notes: CHD coronary heart disease; CI confidence interval.
* Includes those with a past CHD history noted before or at the time of the index myocardial infarction.

5.4.6 Six-Year Coronary Event Free Survival

Kaplan-Meier survival analyses were also performed to examine the risk of fatal and non-fatal coronary events over six years (referred to as coronary event-free survival because patients who died of non-CHD causes were censored). Overall, 41% of 28-day survivors were still alive and free of coronary events by six years (excludes congestive heart failure). Coronary event-free survival curves for men and women are illustrated in Figure 5.2a and annual survival probabilities based on these curves are shown in Table 5.10. There was no significant difference between men and women in coronary event-free survival (p=0.36); 60% of men and 57% of women had experienced a fatal or non-fatal coronary event at six years. For those with a CHD history (Figure 5.2b), no difference between men and women was noted in coronary event-free survival (p=0.53). However, in those with no previous history of CHD (Figure 5.2c), women had somewhat higher coronary event-free survival than men (p=0.07).

Figure 5.2a Six-year coronary event-free survival by sex: 28-day survivors

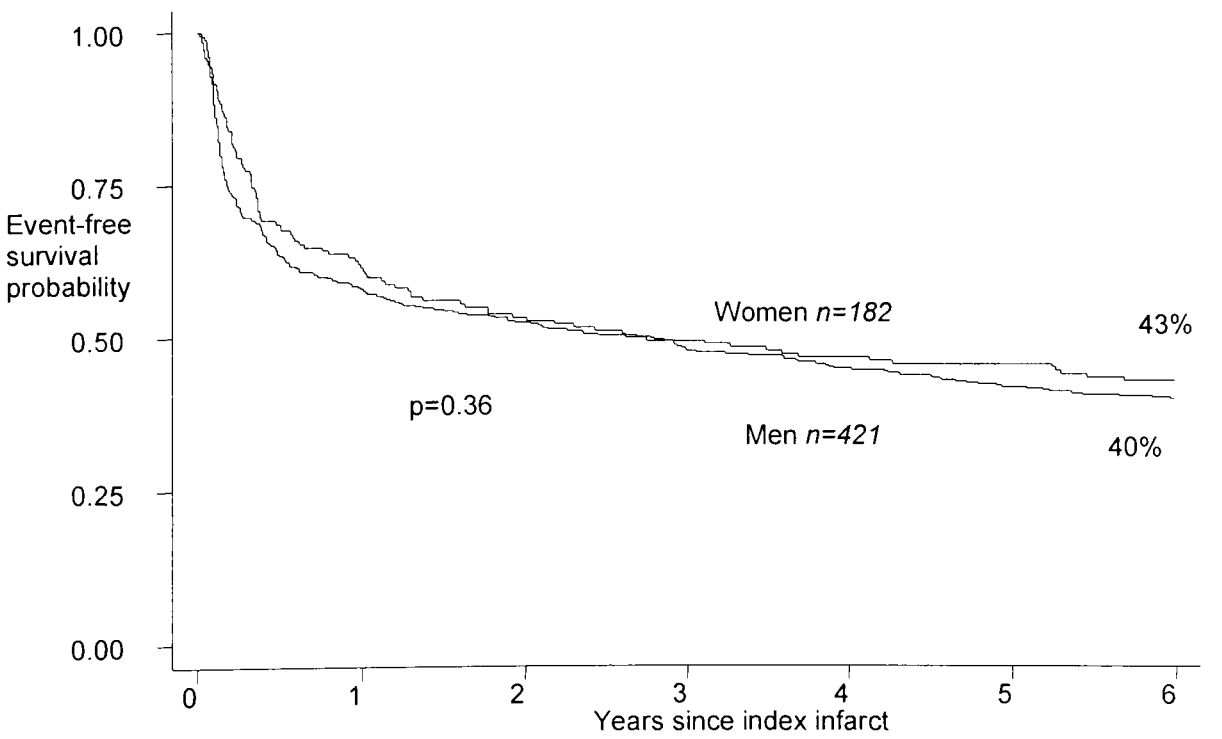

Figure 5.2b Six-year coronary event free survival for those with a history of CHD by sex: 28-day survivors

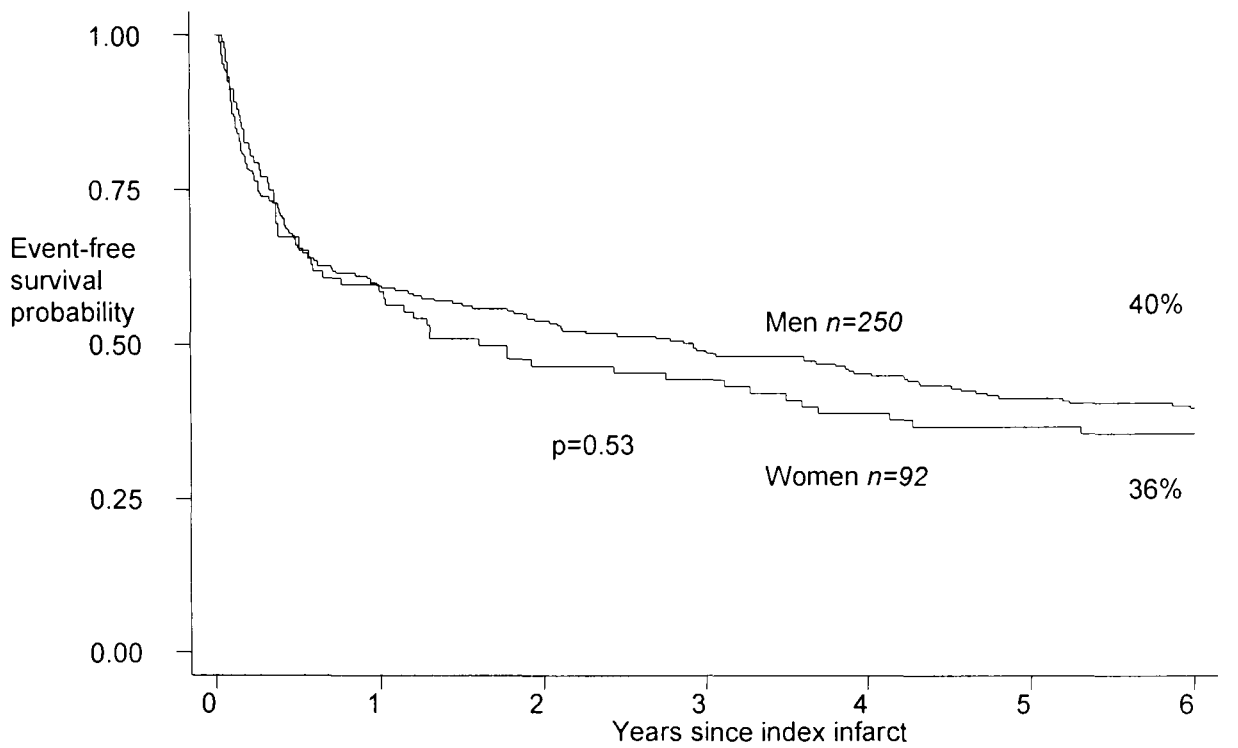

Figure 5.2c Six-year coronary event free survival for those with no history of CHD by sex: 28-day survivors

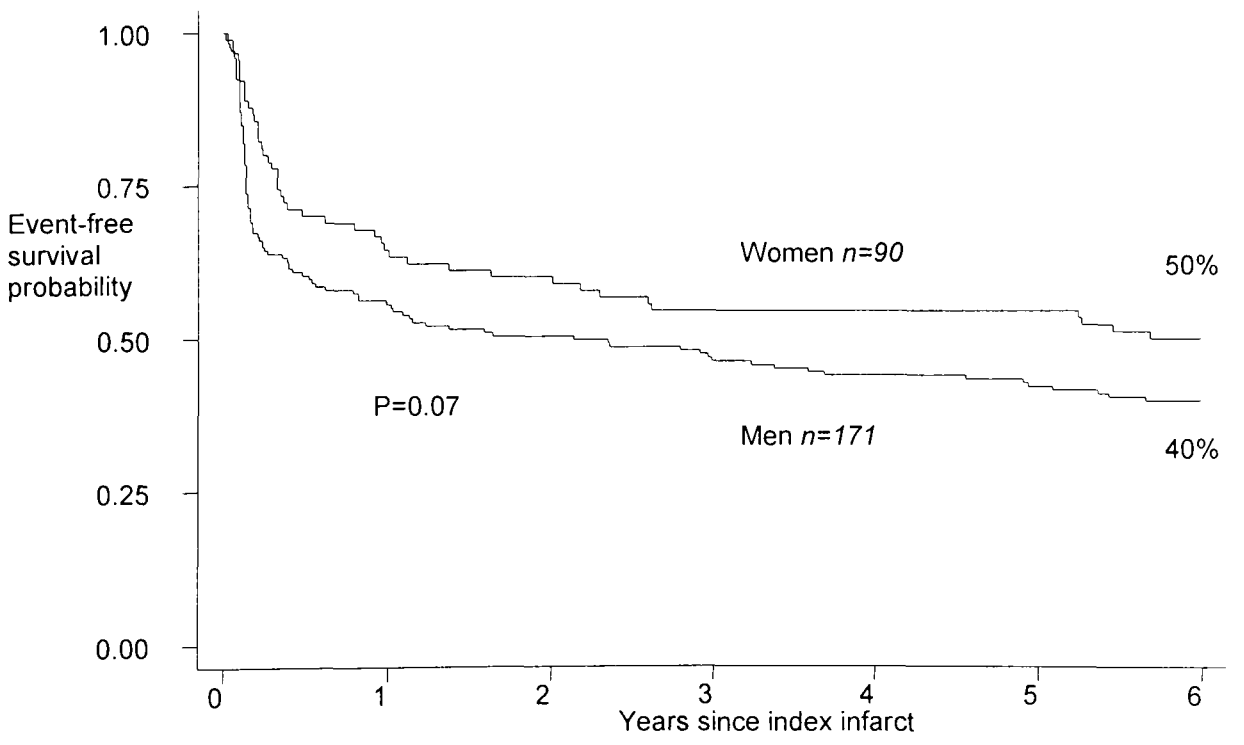

Table 5.10 Annual probability of coronary event-free survival by sex and by CHD history: 28-day survivors

		% Survival (95% CI)					
		At1 year	At 2 years	At 3 years	At 4 years	At 5 years	At 6 years
All	n						
Men	421	58.0 (53.1-62.5)	52.5 (47.6-57.1)	47.7 (42.9-52.4)	44.9 (40.1-49.6)	41.8 (37.1-46.5)	39.9 (35.2-44.6)
Women	182	61.5 (54.1-68.2)	53.3 (45.8-60.2)	49.5 (42.0-56.5)	46.7 (39.3-53.7)	45.6 (38.3-52.7)	42.9 (35.6-49.0)
By CHD history							
Men							
With history*	250	59.6 (53.2-65.4)	54.0 (47.6-59.9)	48.8 (42.5-54.8)	45.6 (39.3-51.6)	41.6 (35.3-47.6)	40.0 (33.9-46.0)
With no history	171	55.6 (47.8-62.6)	50.3 (42.6-57.5)	46.2 (38.6-53.5)	43.9 (36.6-51.1)	42.1 (34.7-49.4)	39.8 (34.2-47.0)
Women							
With history*	92	58.7 (48.0-68.0)	46.7 (36.6-56.5)	44.6 (34.3-54.4)	39.1 (29.2-48.9)	37.0 (27.2-46.7)	35.9 (26.2-45.6)
With no history	90	64.4 (53.6-73.4)	60.0 (49.1-69.3)	54.4 (43.6-64.1)	54.4 (43.6-64.1)	54.4 (43.6-64.1)	50.0 (39.3-59.5)

Notes: CHD coronary heart disease; CI confidence interval.
* Includes those with a past CHD history noted before or at the time of the index myocardial infarction.

5.4.7 Non-Fatal Coronary-Related Morbidity in Six-Year Survivors

A summary of non-fatal coronary events in six-year survivors by diagnosis is shown in Table 5.11. Amongst six-year survivors, only 44% (95% CI, 40% to 49%) of men and women had not experienced a subsequent coronary event. However, an additional 11% had a diagnosis of congestive heart failure only. Inclusion of these latter patients reduced the proportion of six-year survivors with no cardiac-related morbidity to 33% (95% CI, 29% to 38%).

Table 5.11 Deaths at six years and non-fatal coronary events by diagnosis and congestive heart failure in six-year survivors: 28-day survivors
% (n)

	Men	Women	Total
28-day survivors	N= 421	N=182	N=603
Deaths by 6 years	22.8 (96)	31.1 (57)	25.4 (153)
6-year survivors	N=325	N=125	N=450
Coronary events			
Reinfarction	1.9 (6)	1.6 (2)	1.8 (8)
Revascularisation	1.0 (3)	0	1.0 (3)
Angina only	30.5 (99)	29.6 (37)	30.2 (136)
Angina & CHF	23.1 (75)	23.2 (29)	23.1 (104)
No coronary event	43.7 (142)	45.6 (57)	44.2 (199)
CHF only	11.7 (38)	8.8 (11)	11.1 (50)
No CHF or coronary event	31.7 (103)	36.8 (46)	33.1 (149)

5.4.8 Preventive Medications

The following analyses are restricted to the 419 male and 177 female hospital survivors with acceptable follow-up data. Table 5.12 shows preventive medication given after the index myocardial infarction for hospital survivors, with the time the medication was first prescribed. Over the six years following the myocardial infarction, aspirin was prescribed for 94% of men and 89% of women, a beta-blocker for 64% of men and 57% of women and an ACE-inhibitor for 59% of men and 60% of women. However, only 44% of men and 38% of women were ever

prescribed a statin. Overall, there was a non-significant lower prescribing rate of preventive medications for women compared to men.

Of those patients ever prescribed aspirin, a beta-blocker or an ACE-inhibitor, most prescriptions were issued at the time of discharge from hospital after the index myocardial infarction. Amongst those patients not prescribed any of these medications at this time, the highest prescription rate was in the following year. However, statins were prescribed for only 10% of men and 9% of women at the time of the index myocardial infarction and for a further 11% of men and 14% of women by the end of the first year. In the subsequent five years, the average annual rate of first statin prescriptions was 5% for men and 4% for women.

Table 5.12 Preventive medication after index MI by sex at hospital discharge or in year first prescribed: Hospital survivors

Time of first prescription	At discharge	After discharge* % (n) In 1st year	In 2nd year	In 3rd year	In 4th year	In 5th year	In 6th year	Ever
Men	N=419	N=419	N=397	N=380	N=361	N=350	N=339	N=419
Deaths		5.3 (22)	4.3 (17)	5.0 (19)	3.1 (11)	3.1 (11)	4.1 (14)	22.4 (94)
Medication:								
Aspirin	85.2 (357)	7.4 (31)	1.3 (5)	0 (0)	0.3 (1)	0 (0)	0 (0)	94.0 (394)
Beta-blocker	50.6 (212)	8.8 (37)	1.3 (5)	0.5 (2)	1.2 (5)	1.1 (4)	1.5 (5)	64.4 (270)
ACE-inhibitor	40.1 (168)	8.4 (35)	2.0 (8)	2.1 (8)	2.2 (8)	2.6 (9)	3.0 (10)	58.7 (246)
Statin	10.3 (43)	11.0 (46)	5.0 (20)	6.6 (25)	5.0 (18)	5.1 (18)	4.1 (14)	43.9 (184)
Women	N=177	N=177	N=160	N=153	N=145	N=138	N=130	N=177
Deaths		9.6 (17)	4.4 (7)	5.2 (8)	4.8 (7)	5.8 (8)	3.9 (5)	29.4 (52)
Medication:								
Aspirin	84.2 (149)	4.0 (7)	0.6 (1)	0 (0)	0 (0)	0 (0)	0 (0)	88.7 (157)
Beta-blocker	45.2 (80)	5.7 (10)	1.3 (2)	2.0 (3)	0.7 (1)	2.2 (3)	1.5 (2)	57.1 (101)
ACE-inhibitor	46.3 (82)	7.9 (14)	0 (0)	0.7 (1)	1.4 (2)	1.5 (2)	3.9 (5)	59.9 (106)
Statin	9.0 (16)	13.6 (24)	3.1 (5)	2.6 (4)	5.5 (8)	1.5 (2)	6.9 (9)	38.4 (68)

Note: * Excludes those with prescriptions at hospital discharge

5.4.9 Congestive Heart Failure Treatment

Congestive heart failure treatment with an ACE-inhibitor prescription at the time of and after the index myocardial infarction for hospital survivors is shown in Table 5.13. Over the six years, 58% of men and 63% of women were noted to have congestive heart failure at any time and of these, 72% of men and 67% of women were treated with an ACE-inhibitor. There was no difference between men and women in the occurrence of congestive heart failure diagnosis or its treatment with an ACE-inhibitor. However, more patients diagnosed with congestive heart failure at the time of the index myocardial infarction were treated with an ACE-inhibitor compared to those newly diagnosed over the subsequent six years. For men, the proportions were 68% versus 48% (difference 20% [7% to 33%], p=0.005), and for women 72% versus 32% (difference 39% [21% to 58%], p=0.002). Of those first treated with an ACE-inhibitor after the index myocardial infarction, prescriptions were first noted at hospital contact for 65% of men and 58% of women.

Table 5.13 Congestive heart failure diagnosis and treatment at the time of and after index MI: Hospital survivors

	Before or at time of index MI % (n)	Not at time of index MI, but over next 6 years % (n)	Ever % (n)
Men	N=419	N=254	N=419
CHF diagnosis	39.4 (165)	31.1 (79)	58.2 (244)
ACE-inhibitor *	67.9 (112)	48.1 (38)	71.7 (175)**
Women	N=177	N=99	N=177
CHF diagnosis	44.1 (78)	34.3 (34)	63.3 (112)
ACE-inhibitor *	71.8 (56)	32.4 (11)	67.0 (75)**

Notes: MI myocardial infarction; CHF congestive heart failure
* Of those with heart failure diagnosis
** Row total is inflated because it includes those with CHF at the time of the index MI, not discharged on an ACE-inhibitor, but subsequently prescribed an ACE-inhibitor (25 men & 8 women)

5.4.10 Serum Cholesterol Management

Table 5.14 shows the management of serum cholesterol for hospital infarct survivors. Over six years, 88% (369/419) of men and 81% (143/177) of women had a cholesterol measurement recorded. Of these patients, 84% of men and 90% of women had raised cholesterol (greater than 5.0 mmol/L) and of these, a statin was prescribed for 57% of men and 49% of women. Within the first year (including those performed during the hospital admission), 83% (346) of men and 72% (128) of women had a cholesterol level measured. Overall, more men than women had a cholesterol level measured during the six years; 88% of men and 81% of women (difference 7% [1% to 14%], p=0.028). Furthermore, at the time of the index event, more women than men had a serum cholesterol greater than 5.0 mmol/L; 88% of women compared to 74% of men (difference 14% [6% to 22%], p=0.004).

Statin prescribing rates for men and women were similar over the six years. Prescription of statins for elevated cholesterol increased markedly in the six years of the study. Of men with hypercholesteraemia recorded in the six years after the index event, 55% received a statin compared to 17% at the time of the index event (difference 38% [24% to 51%], p<0.0001), and in women, the proportions were 56% versus 12% (difference 44% [26% to 62%], p<0.0001). Of those prescribed a statin after the time of the index myocardial infarction, prescriptions were first noted at hospital contact for 50% of men and 52% of women.

Table 5.14 Cholesterol management at the time of and after index MI: Hospital survivors

	At time of index MI % (n)	Not at time of index MI, but over next six years % (n)	Ever % (n)
Men	N=419	N=129	N=419
Cholesterol measured	69.2 (290)	61.2 (79)	88.1 (369)
Cholesterol > 5.0 mmol/L (as % of those measured)	74.1 (215)	78.5 (62)	84.3 (311)*
Statin prescription (as % of those with raised cholesterol)	17.2 (37)	54.8 (34)	57.2 (178)**
Women	N=177	N=74	N=177
Cholesterol measured	58.2 (103)	54.1 (40)	80.8 (143)
Cholesterol > 5.0 mmol/L (as % of those measured)	88.3 (91)	85.0 (34)	90.2 (129)*
Statin prescription (as % of those with raised cholesterol)	12.1 (11)	55.9 (19)	48.8 (63)**

Notes: MI myocardial infarction
* Row total inflated because it includes those with baseline cholesterol <= 5.0 (34 men & 4 women), but with a cholesterol > 5.0 mmol/L in subsequent six years
** Row total inflated because it includes those with baseline cholesterol > 5.0 & no baseline statin prescription, & those with baseline cholesterol <= 5.0 (107 men & 33 women), but with a cholesterol > 5.0 mmol/L in subsequent six years

5.5 Discussion

This chapter examined the non-fatal progression of coronary heart disease (CHD) and initiation of preventive treatment after a myocardial infarction. In 613 28-day survivors, subsequent non-fatal progression of coronary heart disease and diagnosis of congestive heart failure was investigated over the subsequent six years. Additionally, cardiac-related morbidity (excluding and including congestive heart failure) was reported for those still alive at six years. In 606 hospital survivors, the extent of preventive treatment for CHD, including the prescribing of statins for elevated cholesterol and ACE-inhibitors for congestive heart failure was examined.

5.5.1 Key Findings

The six-year non-fatal coronary event rate was 52% for men and 48% for women, and for both sexes the time of highest risk was within the first year. The six-year coronary disease progression rate (which included fatal coronary events) was 59%, with no gender differences observed. By six years, one third of both men and women had a new diagnosis of congestive heart failure, however more men (53%) than women (39%) were newly diagnosed with angina. Amongst six-year survivors, 44% of men and women had remained free of coronary disease progression (excluding congestive heart failure). Only a third remained totally free of any non-fatal cardiac related morbidity (including congestive heart failure).

Over the six years, aspirin was prescribed for 93% of patients, beta-blockers for 62%, ACE-inhibitors for 59% and a statin for 42%, and most of these prescriptions were initiated at either hospital discharge or within the first year. However, those diagnosed with congestive heart failure at the time of the index myocardial infarction were more likely to be prescribed an ACE-inhibitor compared to those newly diagnosed in the subsequent six years. In contrast, statin prescribing for those with raised cholesterol (greater than 5.0 mmol/L) in the six years after the index myocardial infarction was higher than for those with elevated cholesterol noted at the time of the index event.

5.5.2 Study Strengths

Unlike other follow-up studies of infarct survivors, angina, myocardial infarction and revascularisation were all included to ensure a comprehensive measure of first non-fatal coronary heart disease progression for each myocardial infarction survivor. Furthermore, outpatient and general practice notes were also reviewed. Ascertainment of coronary events and congestive heart failure diagnoses was likely to be complete, since 93% of hospital casenotes were complete and only 3% of patients were lost to hospital follow-up. In addition, review of both hospital and general practice notes increased the number of patients for whom follow-up data

were available, and hospital or general practice records were reviewed for 98% of patients. Trained research nurses collected follow-up data using standardised forms, which included recent changes to diagnostic criteria to ensure that all possible coronary events and diagnoses of congestive heart failure were recorded over the six year study period. Objective confirmation for 63% of angina and 81% of congestive heart failure diagnoses further increased the validity of these data. Details of first recorded preventive cardiac medications were extracted from both hospital and general practice notes to determine prescription initiation dates and to confirm hospital recommendations were prescribed in general practice or in a subsequent outpatient appointment.

5.5.3 Study Limitations

The cohort consisted of a relatively small number of patients, which limited the examination of coronary events and congestive heart failure stratified by age. Reliance upon clinical records for diagnoses, confirmation details and medication prescriptions may limit the completeness and accuracy of these data, because systematic documentation could not be guaranteed. In addition, the review of only 60% of complete general practice records may also have contributed to an underestimation of subsequent coronary diagnoses and of preventive medications initiated by general practitioners. Furthermore, it was not possible to determine if prescribed medications were continued for the entire study period. Finally, extrapolation from the results requires caution because there may be regional differences in prescribing.

5.5.4 Coronary Events

This chapter reported that 52% of men and 48% of women who survived 28 days after a myocardial infarction were noted to have had CHD progression as a non-fatal coronary event (either recurrent myocardial infarction, angina or revascularisation) over the subsequent six years. The first year was the time of highest risk, and the risk in the following years remained fairly constant at an

average of three percent for men and four percent for women. No other follow-up study of myocardial infarction survivors has used an inclusive single outcome of non-fatal coronary events for each patient, which complicates direct comparison. By reporting myocardial infarction or angina separately as an outcome, documentation of non-fatal coronary disease progression has been incomplete. In addition, the studies that limited the source of subsequent non-fatal coronary events to hospital admission data would have missed diagnoses made in outpatient appointments and in general practice.[5] [3] Thus previous reports of coronary disease progression in one-month myocardial infarction survivors from the 1990s are likely to have been greatly underestimated. This will be discussed in more detail later.

Other methodological differences between OXMIS and the relatively few previous studies of subsequent coronary events for infarct survivors make direct comparison difficult. The patient sample for the Framingham & FINMONICA studies was restricted to those with a first myocardial infarction only and had identified patients prior to the 1990s when prognosis would have been poorer because acute care may not have routinely included thrombolysis.[4] [1] The inclusion of fatal and non-fatal in subsequent coronary event outcomes further complicates direct comparison with OXMIS. The FINMONICA study outcome was a combined endpoint of fatal and non-fatal infarctions. However it is unclear whether the Nottingham Heart Attack Register study included fatal cases or not in their report of reinfarction and angina rates.[5]

5.5.4.1 Myocardial Infarction

The Nottingham Heart Attack Register is the only UK study of infarct survivors identified in the 1990s that reported recurrent myocardial infarction,[5] and an 11% four-year reinfarction rate in hospital survivors was found. This compares with a 4% non-fatal reinfarction rate in 28-day survivors in OXMIS and a rate of 14% when both fatal and non-fatal events were included. It is not possible to be certain that the latter OXMIS reinfarction rate is similar to that in Nottingham, since the

Nottingham study did not specifically state whether non-fatal as well as fatal events were included.

Outside the UK, the only other relatively recent study of reinfarction rates in myocardial infarction survivors is the FINMONICA Study in Finland.[1] Between 1983 and 1990, 3653 men and 1247 women aged 35 to 64 years were diagnosed with a first definite or probable myocardial infarction using the WHO MONICA criteria, and 34% of male and 27% of female 28-day survivors had a recurrent fatal or non-fatal myocardial infarction by six years. Reanalysis of six-year re-infarction rates for OXMIS patients with a first myocardial infarction only (i.e. excluding those with previous myocardial infarction) found 14% of men and 15% of women had a coronary death or non-fatal reinfarction by six years. (This compares with 16% of male and 18% of female OXMIS patients with either a first or recurrent infarction as the index event). The residual difference of 20% in men and 12% in women may be due to the high coronary event rates in Finland,[25] which are at least two-fold higher than those reported for Oxfordshire[26].

5.5.4.2 Angina

Angina occurring after hospital discharge in infarct survivors was also reported for hospital survivors of the Nottingham Heart Attack Register study.[5] At four years, 16% of Nottingham patients had been rehospitalised for unstable angina compared to 17% of OXMIS patients by four years. However, it was unclear from the Nottingham study whether admissions for angina were exclusively for non-fatal events, so it is not possible to determine whether these findings were truly similar for the two cohorts.

In contrast to the Nottingham study, only non-fatal angina after a myocardial infarction was reported in the US Framingham study. Of 433 first infarct survivors identified between 1950 and 1986, 25% had newly diagnosed angina within two years.[4] (However, 48% (143/296) of all OXMIS patients had been diagnosed with incident angina by two years.) To allow comparison, reanalysis of data for those

patients with a first infarct from the OXMIS study found 40% of 28-day survivors newly diagnosed with angina by two years. Further comparison between the two studies is difficult for two reasons. Firstly, the index myocardial infarction in the Framingham Study was clinically unrecognised in 34% of men and 47% of women. Secondly, angina was less common in this group, so it is likely that the Framingham result was an underestimate of incident angina in infarct survivors found in routine clinical practice.

5.5.5 Congestive Heart Failure

The six-year incident rate of congestive heart failure was 32%. No other follow-up study of infarct survivors has reported incidence rates of congestive heart failure after hospital discharge, so direct comparison is difficult. Furthermore, there are methodological differences between OXMIS and the only other two follow-up studies of congestive heart failure in hospital infarct survivors which further complicate comparison. The only UK study was the Nottingham Heart Attack Register study, which by not stratifying outcomes by history included patients with an exacerbation of their existing congestive heart failure.[5] A US study classified subsequent diagnoses of congestive heart failure as incident cases by only excluding patients diagnosed before the index myocardial infarction.[6] Therefore, their study included those patients with congestive heart failure noted at the time of the index event and is not a report of incident congestive heart failure after hospital discharge.

Congestive heart failure was documented in 38% of all 28-day infarct survivors by six years, and like non-fatal coronary events, the time of highest risk was the first year. The Nottingham Heart Attack Register found 10% of 695 hospital infarct survivors identified in 1992 had been readmitted for congestive heart failure or left ventricular failure by four years.[5] Reanalysis of the OXMIS data showed that congestive heart failure was first recorded during a hospital admission for 15% of patients by four years. The Nottingham study did not include patients with

congestive heart failure diagnosed at an outpatient appointment or in general practice. Their occurrence rates for congestive heart failure would therefore be expected to be lower than those from the original OXMIS analysis, as 55% of congestive heart failure diagnoses in OXMIS were first recorded from these sources.

By contrast, outpatient appointment data were included in the outcome of the US study. Between 1979 and 1994, 1658 first infarct hospital survivors were identified, and 43% were diagnosed with congestive heart failure by seven years.[6] In a similar group of OXMIS patients (i.e. including only those with a first myocardial infarction and no previous history of congestive heart failure), the six-year rate was lower at 34% (difference 10% [5% to 15%]).

5.5.6 Overall Event-Free Survival

Within six years, 67% of men and women died or had a non-fatal coronary event. Thus, one third of 28-day infarct survivors were still alive at six years free of subsequent coronary disease (excluding congestive heart failure). The East London Study is the only other recent English study of long term overall event-free survival in myocardial infarction survivors, and a 68% three-year event-free survival rate for 30-day survivors was reported.[3] In contrast, three-year overall event-free survival probability was 44% in OXMIS. Different sources of angina diagnoses used in the two studies may partly explain this disparity in the findings. Angina diagnosed in outpatients or general practice were included in the OXMIS study, but not in the East London Study. These sources provided 47% of all first OXMIS angina diagnoses in the first three years, thus reducing the number of patients who remained event free. Further analysis of the OXMIS data (excluding three-year survivors with angina noted in outpatient or general practice notes) found a 62% three-year overall event free survival, similar to the East London rate. However, the East London Study rates of event-free survival would be expected to

be better than those in OXMIS because the East London cohort were younger with 26% being aged over 70 years compared to 36% in OXMIS.

5.5.7 Coronary Event-Free Survival

By six years, 41% of OXMIS patients had survived free of any further coronary disease (non coronary deaths excluded). Thus 59% of 28-day infarct survivors experienced a fatal or non-fatal coronary event by six years. No difference between men and women was observed, although amongst those with a CHD history, men had a (non-significant) higher rate of coronary disease progression than women. Comparison of these findings with the East London Study is not possible, because non-CHD deaths were not excluded from the East London analyses and rates of coronary events were not reported.

Overall, coronary event-free rates and congestive heart failure rates over six years are lower in the OXMIS cohort than in other comparable studies. Apart from the two US studies, coronary events or congestive heart failure diagnoses were only identified from hospital admission data. In OXMIS, a high proportion of cases of angina and congestive heart failure were first diagnosed at outpatient clinics and general practice surgeries. The OXMIS data, therefore, gives a more complete picture of coronary morbidity in infarct survivors than previous studies.

5.5.8 Preventive Medications

Over the six years following the index myocardial infarction, the proportion of 28-day survivors ever prescribed preventive medications was 93% for aspirin, 62% for beta-blockers, 59% for ACE-inhibitors and 42% for statins. Excluding statins, the majority of these prescriptions were initiated in the first year. Other studies have reported preventive medications after hospital discharge, but comparison with the OXMIS results is difficult for two reasons. Firstly, patients in two study cohorts were identified at least four years after OXMIS[12 10] and preventive medication prescribing has improved during this time period.[13 18] Secondly, three studies

investigated preventive medication prescribing for infarct survivors at one year[8] and two years after the index myocardial infarction.[12] [11] Exclusion of patients who had died since the index event would have reduced the number of patients being assessed and inflated the estimate of those receiving prescriptions. In OXMIS, patients prescribed a preventive medication were included regardless of survival status at six years.

In OXMIS, most new prescriptions in the first year after the index event were issued at hospital discharge. Overall, hospital prescription rates at discharge for all four preventive medications were similar in OXMIS to other UK studies of myocardial infarction patients identified in the mid-1990s. [9] [7] However, the exception was the ASPIRE study of preventive medication prescribing in 24 randomly selected UK hospitals, which found that 26% of infarct patients were discharged on ACE-inhibitors compared to 42% of OXMIS patients. This difference may have resulted from the local dissemination of evidence-based guidelines for the secondary prevention of myocardial infarction within Oxfordshire hospitals.[27]

Little is known about the continuation of medications once prescribed, although an earlier study of OXMIS one-year survivors found that prescriptions of aspirin, ACE-inhibitors and lipid lowering drugs initiated at hospital discharge were continued at one year in more than 85% and for beta-blockers, the proportion was 79%.[14] However, it was not possible to determine from these data what proportion of myocardial infarction survivors received continuous prescriptions of preventive medications after one year, or the extent of the medication compliance.

5.5.9 Treatment of Congestive Heart Failure with ACE-Inhibitors

Several studies have examined the prescribing of ACE-inhibitors for congestive heart failure complicating a myocardial infarction. Prescribing rates at hospital discharge were between 40% and 51% in studies from London[15] and the US[16] [17] compared to 69% in OXMIS. The disparities between these findings may be partly

due to different eligibility criteria for an ACE-inhibitor prescription in each study, which also complicates comparison. One of the US studies selected only myocardial infarction patients with an ejection fraction less than 40%,[17] while the other also included those with unspecified evidence of heart failure.[16] The London study did not report heart failure diagnostic criteria.[15] In these studies, the proportion of all infarct patients defined as eligible for an ACE-inhibitor was 16%,[17] 39%[16] and 72%.[15] In OXMIS, patients with a clinical diagnosis with or without objective evidence were included, and 40% (243/603) of hospital survivors were eligible for an ACE-inhibitor.

More ACE-inhibitor prescriptions for heart failure were issued to OXMIS patients at hospital discharge than to patients with congestive heart failure diagnosed subsequently (68% versus 48% for men and 72% versus 32% for women). A number of factors may have contributed to this difference. Lack of echocardiographic evidence of heart failure in primary care may explain why some patients were not prescribed an ACE-inhibitor, since having such an assessment has been found to be associated with ACE-inhibitor prescribing.[17] [28] Also, reluctance by general practitioners to prescribe ACE-inhibitors has been previously reported,[29] and only one third of ACE-inhibitor prescriptions for OXMIS patients newly diagnosed with heart failure were initiated by general practitioners. Contraindications may also partly explain why some patients were not prescribed this medication, although data on contraindications were not available in OXMIS.

5.5.10 Cholesterol Management

Overall, 88% of men and 81% of women had at least one cholesterol measurement recorded in the six year study period. The only other study of cholesterol measurement in myocardial infarction survivors was from south Derbyshire, and 74% of one-year infarct survivors identified in 1995 had a cholesterol level recorded by one year;[20] it is not clear whether this figure included measurements at the time of admission. In OXMIS, 80% of patients had a

cholesterol measurement documented either at the time of the index event or during the first year.

Amongst OXMIS patients with a known cholesterol level, 84% of men and 90% of women had at least one recording higher than 5.0 mmol/L over the six years. These rates are similar to those found around the time of the index event. In the ASPIRE study conducted in 1995, 489 infarct survivors had a cholesterol measurement taken at a six month interview, and 77% of men and 87% of women had a serum cholesterol greater than 5.0 mmol/L.[7] Similarly, 74% of OXMIS men and 88% of OXMIS women had cholesterol above 5.0 mmol/ L. The Derbyshire study reported the last cholesterol measurement within the one year follow-up period, and a similar rate of hypercholesterolaemia was reported for men (73%), but that for women was lower (77%).[20]

A statin was prescribed in response to an elevated serum cholesterol at the time of the index event for 17% of men and 12% of women at hospital discharge in OXMIS. The only other UK study of statin prescribing in myocardial infarction survivors is the ASPIRE study, and 6% of men and 10% of women were on a statin at six months. Similar to the higher rates of ACE-inhibitor prescribing in OXMIS compared to those of the ASPIRE study, this difference between the two studies may have been partly due to the local Oxfordshire guidelines and an increased awareness of secondary prevention.

Initiation of statin prescriptions in OXMIS patients with elevated cholesterol continued over the six years. Additionally, 38% more men and 44% more women had statin prescriptions initiated over the six years after the index myocardial infarction compared to hospital discharge, and by six years 57% of men and 49% of women had received at least one prescription. This may be partly explained by the expansion of the evidence-base for statin prescriptions for patients diagnosed with CHD over the six year follow-up period.[30] [31] [32] This evidence was gradually implemented in UK general practice as illustrated by the rise in statin prescriptions

for patients with CHD from 4% to 56% for men and 3% to 41% for women in 1994 and 2001, respectively.[19] Similarly, comparison between EUROASPIRE I and EUROASPIRE II showed an overall increase of 28% in statin prescribing for patients diagnosed with CHD between 1995-96 and 1999/2000.[18] In OXMIS, subsequent non-fatal coronary events and contact with either hospital clinicians or general practitioners may also explain the increase in statin prescriptions observed over the six years. Nevertheless, a substantial number of patients with elevated cholesterol were never prescribed a statin.

5.5.11 Health Service Implications

The burden of non-fatal progression of CHD and its preventive treatment after a myocardial infarction has substantial implications for the health service. The development of angina or congestive heart failure symptoms requires at the minimum either a general practice or outpatient appointment for confirmation of the diagnosis and treatment. Hospital admission is necessary for the management of unstable angina or reinfarction. Additionally, general practice has been assigned responsibility for systematic and regular monitoring of patients diagnosed with CHD by the National Service Framework for CHD to enable early recognition and treatment of such disease progression.[22] For patients like the OXMIS survivors who were diagnosed before the publication of the National Service Framework, the initial challenge for general practice was to identify such patients, and then assess the quality of preventive care, which has been previously documented as sub-optimal.[33] [34] [35] In addition, there are implications for those responsible for primary prevention of CHD, since there were substantially high six-year rates of fatal and non-fatal coronary events despite the majority of OXMIS patients having received a prescription for coronary preventive medication. As stated in chapter 4, the National Service Framework has also assigned this task to general practice. However, it is as yet unclear whether the aims of the National Service Framework to improve the quality of follow-up care for prevalent cases of CHD and those at high risk of CHD has been achieved.

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Chapter 6

Psychological Health

6.1 Introduction

The last three chapters reported six-year mortality and coronary-related morbidity after a myocardial infarction. This chapter reports psychological health and its relationship with non-fatal coronary events over the subsequent six to seven years in 28-day myocardial infarction survivors.

Most previous studies have examined the relationship between depression at the time of the index myocardial infarction and subsequent death. There were conflicting findings with some studies showing that baseline depression was associated with higher subsequent mortality up to five years after the index event,[1] [2] [3] [4] whereas other studies showed no relationship.[5] [6] [7] In one of the above studies that also reported anxiety,[7] [4] no relationship between anxiety and mortality was found. Nevertheless in a study only considering anxiety (but not depression), highly anxious infarct survivors at baseline had higher five-year mortality rates compared to those with low levels of anxiety.[8] These findings suggest that psychological state (either baseline depression or anxiety) may predict subsequent mortality in patients diagnosed with a myocardial infarction, and that depression may be the more powerful predictor. However a composite measure of anxiety and depression (defined as emotional distress) was investigated in an earlier study of OXMIS patients, and no association between emotional distress and mortality at 18 months was found.[9]

Amongst the studies reporting depression and mortality after myocardial infarction, only one also reported the occurrence of subsequent non-fatal coronary events separately from deaths.[10] No relationship was found between baseline depression and non-fatal coronary event rates at five years. However, this study did not examine anxiety levels, and it therefore remains unclear whether infarct survivors

with baseline anxiety or emotional distress (anxiety and depression) experience higher rates of non-fatal coronary events than non-distressed patients.

The role of baseline psychological factors in predicting other outcomes such as emotional, psychosocial and physical well-being after a myocardial infarction has also been investigated. High levels of baseline emotional distress, anxiety and depression have been found to be associated with impaired emotional and physical well-being after hospital discharge in infarct survivors,[9 11 12 13 14] but outcomes have not been reported beyond one year. It is, therefore, unclear whether baseline psychological problems persist after one year and whether there is an association between baseline emotional problems and continued psychological and physical difficulties beyond one year for infarct survivors. Nevertheless, the earlier study of baseline psychological health of OXMIS patients[9] provided an opportunity to examine the relationship between baseline psychological problems and coronary disease (latter reported in chapter 5) and the extent of psychological health in the longer term for patients with and without baseline emotional distress. In addition the relationship between psychological health and physical problems due to coronary heart disease progression in long-term infarct survivors was explored. The median follow-up time of the OXMIS cohort for the psychological measures reported in this chapter was 6.8 years (IQR 6.6 to 7.0); this will be subsequently referred to as seven years.

6.2 Aims

In this chapter, data from three different groups of OXMIS patients enabled the examination of psychological health and its relationship with coronary disease over seven years following an index myocardial infarction. Baseline and one-year psychological data were collected by OXMIS research nurses on behalf of a local psychiatrist (Professor R.A. Mayou) and seven-year data were collected by the author.

The aims were to:

(i) report psychological health and quality of life at baseline in men and women who survived 28 days after a myocardial infarction

(ii) examine the relationship between baseline psychological health and coronary disease, both at baseline and over the subsequent seven years

(iii) report psychological health and quality of life at seven years in men and women

(iv) determine the relationship between seven-year psychological health and coronary disease both at seven years and during the previous seven years

(v) investigate the course of psychological health from the time of the index myocardial infarction over the subsequent seven years in a sub-group of patients who responded to questionnaires at baseline, one year and seven years

6.3 Methods

6.3.1 Patients

Patients for this chapter originated from the OXMIS cohort of 613 28-day myocardial infarction survivors (428 men and 185 women). The number of patients who responded to questionnaires or died over the seven year follow-up period is illustrated for baseline questionnaire responders in Figure 6.1a and for baseline non-responders in Figure 6.1b.

The three patient groups providing data for this chapter were comprised as follows:

(i) The first patient group consisted of 341 28-day survivors with available baseline psychological and quality of life data (top box of Figure 6.1a).

(ii) The second patient group (indicated by ** in Figures 6.1a and 6.1 b) consisted of 266 survivors with seven-year questionnaire data and included 26 with baseline but no one-year data, 142 with baseline and one-year data and 98 patients without baseline data.

(iii) The third patient group (indicated by *** at bottom of Figure 6.1a) was the sub-group of 142 who were still alive at seven years and had completed a questionnaire at baseline, one year and seven years.

Figure 6.1a Questionnaire response and survival status at one year and seven years: Baseline responders

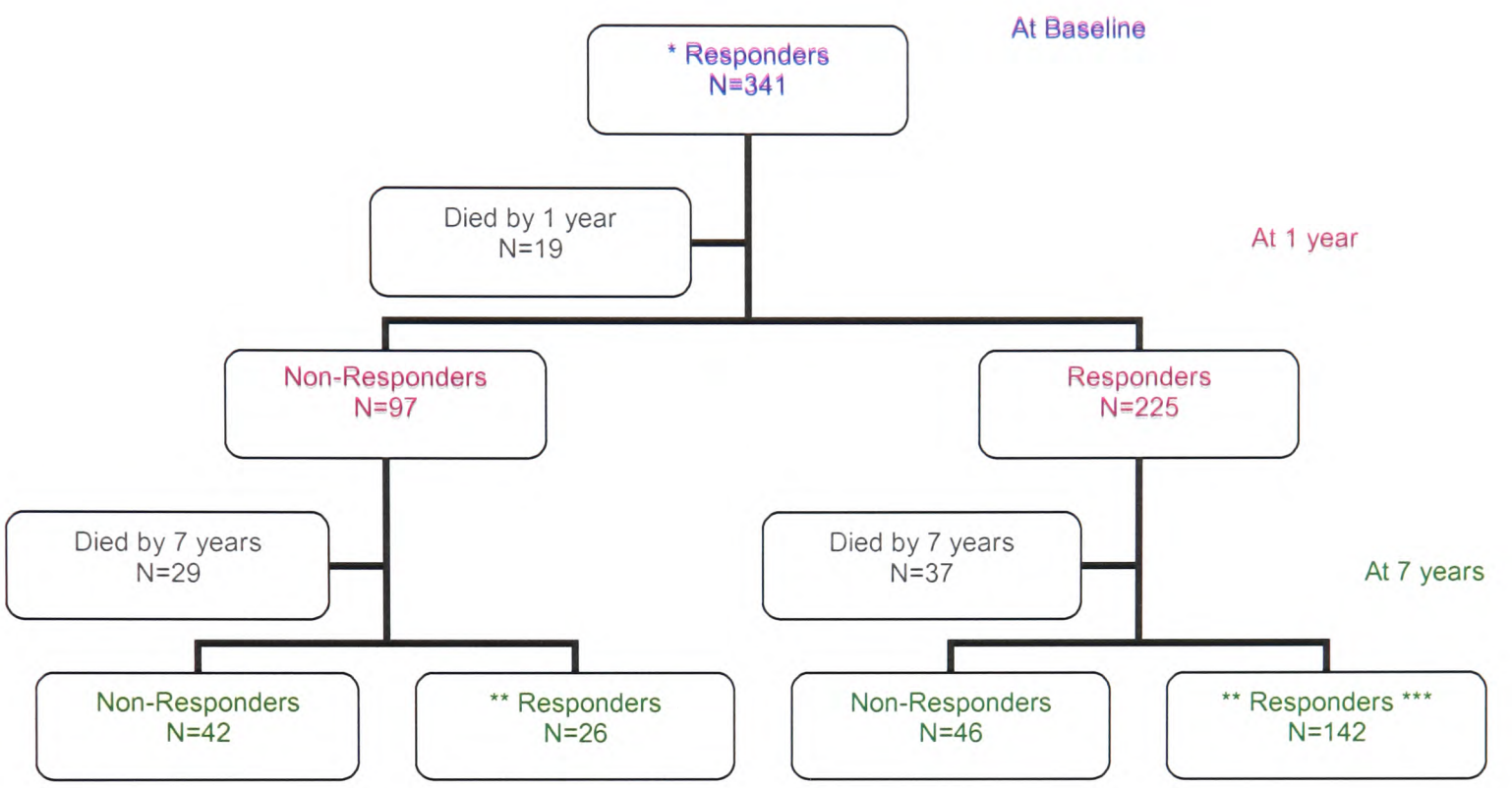
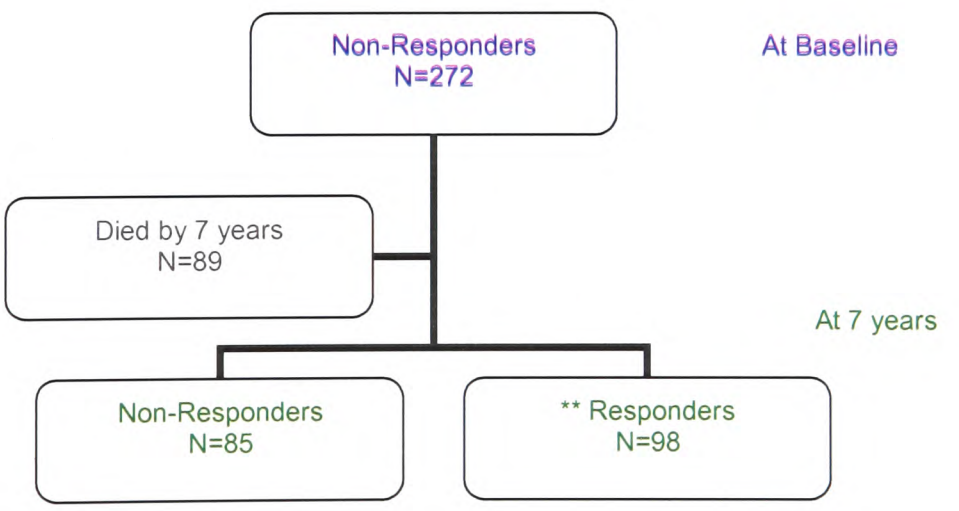


Figure 6.1b Questionnaire response and survival status at seven years: Baseline non-responders



Notes:
* Baseline responders (1st group: N=341)
** Seven-year responders (2nd group: N=26 + 142 + 98);
*** baseline, 1 year & 7 year responders (3rd group N=142)

6.3.2 Psychological Health Measurement at the time of and after the Index Event

Psychological health was measured at the time of the index event and at one year and seven years after the index event, using the Hospital Anxiety and Depression Scale (HADS). The HADS is a reliable and valid instrument for assessing probable cases of anxiety, depression or emotional distress in medical patients.[15] [16] [17] It consists of 14 items with subscales for anxiety and depression. All items are scored on a 4-point scale from 0 to 3 and summed within each subscale and then totalled. For the subscales, scores range from 0 (no anxiety or depression) to 21 (very anxious or depressed), and in total from 0 (no emotional distress) to 42 (very emotionally distressed). Scores for anxiety, depression and overall emotional distress were categorised using cut-off points recommended by the authors of the scale.[17] The categories for anxiety and depression are normal (less than 8), borderline (between 8 and 10) and clinically significant (greater than 10). Emotional distress was defined as a depression score higher than 10 or a summed depression and anxiety score higher than 19. Using this definition, patients with a score above the threshold of 19 will be referred to as distressed and those at or below as non-distressed.

6.3.3 Quality of Life Measurement at the Time of and After the Index Event

Quality of life was also measured at the time of and at seven years after the index myocardial infarction, using the 36 item Short Form (SF-36). These data were collected as described above for the HADS. The SF-36 is a generic health status measure, originally developed in the USA from long-form questionnaires used in the RAND Health Insurance Experiment and Medical Outcomes Study.[18] [19] The anglicised version used here has been well validated and shown to have high levels of reliability and validity.[20] The instrument contains 36 items, together comprising eight multi-item dimensions of health status relating to the previous four weeks [number of items relating to each dimension] (physical functioning [10], role limitations due to physical problems [4], role limitations due to emotional problems

[3], social functioning [2], mental health [5], energy and vitality [4], bodily pain [2], and general health perception [5]). There is also a single item relating to change in health over the previous year. For each dimension, items are scored, summed, and transformed onto a scale from 0 (worst health) to 100 (best health).[19]

At seven years, an additional instrument was used to measure quality of life - the EuroQol.[21] The EuroQol questionnaire relates to the day of its completion and consists of five dimensions (mobility, self-care, usual activities, pain/discomfort and anxiety/depression) with three levels of 'severity' each, broadly speaking corresponding to 'no problems' (level 1), 'some problems' (level 2) and 'extreme problems' (level 3).[21] The levels from all five dimensions are used to calculate a utility index, which is a quality of life score or value for the corresponding health state as determined by the UK general population.[22] Values range from 100 (best) to -59 (worst), and negative values relate to health states valued as worse than death. The cohort median score of 79.6 was used as a cut-off point to create two quality of life groups; patients in the low quality of life group had scores below the median and patients in the high quality of life had scores at or above the median.

6.3.4 Baseline and One-Year Data Collection

At the time of the index myocardial infarction, the 529 patients admitted to the John Radcliffe or the Horton General Hospital were invited to participate in the study of psychological factors by OXMIS research nurses. Within the first three days after hospital admission, patients were asked to complete a questionnaire that included the HADS and SF-36. Completed baseline questionnaires were obtained from 65% (341) of patients. The 84 patients (64 men and 20 women) treated outside the John Radcliffe and Horton General Hospitals were not approached. At one year, a postal questionnaire with the same instruments was sent to the patients who participated in the baseline assessment. A second questionnaire was sent to non-responders after two weeks. A completed questionnaire was returned by 70% (225) of one-year survivors.

6.3.5 Seven-Year Data Collection

All 28-day survivors were flagged with the Office of National Statistics to trace deaths and emigration and a list of patients' survival status and current registered health authority in February 2003 was obtained. At seven years, all OXMIS survivors were asked to complete the questionnaire regardless of their initial participation status. An invitation letter, study information sheet and a questionnaire (see Appendices C, D and K respectively) for the 439 patients alive at this time were forwarded directly to each patient by the health authority. A second study packet was forwarded to non-responders after three weeks. Completed questionnaires were returned by 61% (266) of patients and by 76% (142/188) of those with baseline and one year questionnaire data. The Applied and Qualitative Research Ethics Committee in Oxford gave approval for this study and consent was assumed by questionnaire completion.

The seven-year questionnaire consisted of the same instruments used at baseline and one year (HADS and SF-36). In addition, the EuroQoL and Rose chest pain questionnaire were included. The HADS and SF-36 were included for comparison with earlier responses and the latter two provided additional information for long-term infarct survivors. The Rose chest pain questionnaire is a self-administered instrument that identifies individuals with exertional angina within the previous two weeks.[23] It consists of seven questions that relate to the characteristics of ischaemic cardiac pain assessed during a medical history and include the occurrence of chest pain when walking uphill or quickly, in specific chest sites, usually causing the individual to slow down or stop, and promptly relieved by rest. An individual is classified as having angina symptoms when all of the characteristics are reported and the chest pain site is the sternum, left anterior chest or left arm.

6.3.6 Completeness of Data

6.3.6.1 Psychological Data

Amongst the 341 28-day survivors who returned the baseline questionnaire (first patient group), HADS data were complete for 99% (338). For the 266 seven-year questionnaire responders (second patient group), HADS data were available for 97% (258) and baseline emotional distress category was only available for 63% (167). For the 142 patients who returned all three questionnaires (third patient group), HADS data were complete at baseline, available at one year for 99% (141) and at seven years for 98% (139).

6.3.6.2 Quality of Life

For the first patient group, baseline SF-36 data varied for completeness amongst the eight dimensions. Physical functioning, which is based on more separate questions than any of the other dimensions, was available for only 63% (214) of patients. The proportion of patients with complete data for the other dimensions ranged from 88% (301) for mental health to 98% (333) for social functioning. For the second group of patients, 88% (234) had available data for physical functioning. The proportion of patients with available data for the remaining dimensions ranged from 88% (316) for role limitations due to physical problems to 99% (264) for change in health status over last year. In this group, EuroQol data were available for 99% (263 to 264) of responders for each dimension and 99% (262) for the utility index score. Data for the Rose chest pain questionnaire were available for 98% (260) and smoking status for 99.6% (265). Quality of life data are not reported for the third patient group.

6.3.7 Past Medical History, Complications, Non-Fatal Coronary Events and Congestive Heart Failure

As described in chapter 5, past medical history and complications noted at the time of the index myocardial infarction were extracted from hospital notes. The details

of non-fatal coronary events and congestive heart failure occurring after the index event were extracted from both hospital and general practice casenotes.

6.3.8 Identification of Deaths

As stated in chapter 3, all 28-day survivors were flagged with the Office of National Statistics and the database was updated quarterly with details of each death by a database manager between 1995 and 2002.

6.3.9 Statistical Analysis

Data were analysed using the statistical package SPSS 10.0 for Windows (SPSS Inc. 2001, Chicago Illinois). Proportions were compared using the chi-squared or Fisher's Exact test, and means using Student's t test. Factors associated with seven-year emotional distress were explored using multiple logistic regression. Individual differences in mean scores between baseline, one year and seven years were assessed using repeated measures of analysis (ANOVA). Where there were statistically significant differences between the three time points, pair wise comparisons were performed with no adjustment made for multiple comparisons.

6.4 Results

6.4.1 Follow-up of 28-Day Survivors

The following results are for the first group of patients: 28-day survivors with baseline psychological and quality of life data (see Figure 6.1a).

6.4.1.1 Comparison between Responders and Non-Responders

Baseline characteristics of responders and non-responders to the baseline questionnaire are shown in Table 6.1. Amongst men, questionnaires were received from fewer in manual than non-manual social classes. More men with congestive heart failure and with unstable angina at the time of the index MI had completed the questionnaire than those with no such complications. No statistically significant differences between women were observed, although numbers were small.

Table 6.1 Baseline characteristics for all 28-day myocardial infarction survivors, for baseline questionnaire responders and non-responders by sex
% (n), unless otherwise stated

	All 28-day survivors	Responders	Non-responders#	p*
% Women	30.2 (185/613)	27.6 (93/341)	33.8 (92/272)	0.10
Men	N=428	N=248	N=180	
Age, mean years (SD)	62.9 (10.6)	62.1 (10.2)	63.9 (11.0)	0.08
Current smoker	27.3 (111)	26.7 (66)	28.3 (45)	0.81
Manual social class	54.6 (220)	50.0 (121)	61.5 (99)	0.030
Past history:				
Previous MI	24.1 (103)	23.8 (59)	24.4 (44)	0.97
Diabetes	9.6 (41)	10.5 (26)	8.3 (15)	0.56
Infarct severity:				
Killip score > 1	16.7 (68)	15.2 (37)	18.9 (31)	0.40
Complications at time of index MI				
CHF	36.9 (158)	41.1 (102)	31.1 (56)	0.044
Arrhythmias	25.5 (109)	23.4 (58)	28.3 (51)	0.30
Unstable angina	39.0 (167)	45.2 (112)	30.6 (55)	0.003
Women	N=185	N=93	N=92	
Age, mean years (SD)	67.9 (9.1)	67.2 (9.5)	68.7 (8.5)	0.26
Current smoker	23.7 (42)	22.6 (21)	25.0 (21)	0.63
Manual social class	50.3 (85)	50.5 (46)	48.7 (38)	0.80
Past history:				
Previous MI	14.1 (26)	16.1 (15)	12.0 (11)	0.55
Diabetes	14.6 (27)	14.0 (13)	15.2 (14)	0.98
Infarct severity:				
Killip score > 1	27.2 (47)	26.7 (24)	27.7 (23)	0.88
Complications at time of index MI:				
CHF	43.2 (80)	38.7 (36)	47.8 (44)	0.27
Arrhythmias	30.3 (56)	23.7 (22)	37.0 (34)	0.07
Unstable angina	34.6 (64)	39.8 (37)	29.3 (27)	0.18

Notes: Percentages based on number with available data; MI myocardial infarction; CHF congestive heart failure;
includes 64 men and 20 women who were treated outside Oxfordshire hospitals & did not receive baseline questionnaire; * p-value for difference between responders & non-responders

6.4.2.1 Baseline Psychological Health and Quality of Life for Men and Women

Amongst those with baseline questionnaire data, baseline age and psychological health are shown for men and women in Table 6.2. In total, 15% (95% CI, 11% to

19%) of 28-day survivors were classified as emotionally distressed. There were no differences between men and women in baseline depression or anxiety (depression p=0.30, anxiety, p=0.12). Additionally, similar proportions of men and women were in the emotionally distressed group.

Women were five years older than men. To provide a complete account, quality of life was also examined by sex. For most quality of life dimensions, men had higher scores than women (i.e. better quality of life) with the exception of bodily pain and health perception.

Table 6.2 Age, psychological health and quality of life at baseline by sex: Baseline questionnaire responders
% (n), unless otherwise stated

	Men N=248	Women N=93	Difference (95% CI) (Men – women)
Age			
Mean years (SD)	62.1 (10.2)	67.2 (9.5)	-5.1 (-7.5 to -2.7)
Psychological health:			
Depression score			
> 8 (borderline or higher)	15.9 (39)	21.5 (20)	-5.6 (-14.7 to 3.5)
Anxiety score			
> 8 (borderline or higher)	35.2 (87)	45.2 (42)	-9.9 (-21.5 to 1.7)
Emotional distress*	14.3 (35)	16.1 (15)	-1.8 (-10.5 to 6.8)
Total HADS			
Mean score (SD)	11.0 (6.9)	12.4 (6.9)	-1.4 (-3.1 to 21.7)
Quality of life			
Mean score** (SD)			
Physical functioning	73.6 (27.5)	59.6 (30.0)	14.0 (5.2 to 22.8)
Role physical	63.1 (41.5)	45.8 (43.3)	17.3 (6.8 to 27.9)
Role emotional	68.5 (41.1)	55.4 (43.4)	13.1 (2.5 to 23.7)
Social functioning	79.9 (25.1)	72.4 (30.7)	7.5 (1.0 to 14.0)
Mental health	76.5 (17.2)	71.6 (20.9)	5.0 (0.2 to 9.8)
Energy & vitality	60.0 (21.5)	46.8 (24.7)	13.1 (7.5 to 18.8)
Bodily pain	75.6 (27.3)	69.4 (29.4)	6.2 (-0.5 to 13.0)
Health perception	64.2 (16.1)	66.3 (17.0)	-2.1 (-6.3 to 2.1)

Notes: Percentages based in number with available data;
* depression score > 10 or summed anxiety and depression score >19
** higher score = better quality of life

6.4.1.3 Baseline CHD Factors by Baseline Emotional Distress Group

Patients with emotional distress at baseline were compared with those with no such distress. Men and women were combined in these analyses, because numbers were small. Age and coronary heart disease (CHD) factors noted at the time of the index myocardial infarction for patients with and without baseline emotional distress are shown in Table 6.3. Distressed patients at the time of the index event were six years younger than those with no distress. There was no evidence that a past CHD history or a coronary procedure performed during the index admission was different for distressed and non-distressed patients at baseline, although numbers were small and differences did not reach statistically significance. However, severity of the index myocardial infarction was worse for emotionally distressed patients than non-distressed with 29% of distressed patients having myocardial damage (Killip score greater than one) compared to 16% of non-distressed patients (p= 0.042). Furthermore, 20% more distressed patients had cardiac complications of the index myocardial infarction; 58% of distressed patients had congestive heart failure versus 38% of non-distressed (p=0.012) and 60% of distressed had unstable angina versus 41% of non-distressed (p=0.017).

Table 6.3 Sex, age and and cardiac-related factors by baseline emotional distress: Baseline questionnaire responders
% (n), unless otherwise stated

	Distressed* at baseline N=50	Non-distressed at baseline N=288	Difference (95% CI) (Distressed – Non-D)
Women	30.0 (15)	27.1 (78)	2.9 (-10.8 to 16.6)
Age, Mean years (SD)	58.7 (12.2)	64.4 (9.6)	-5.7 (-8.7 to -2.7)
CHD history before index MI of:**			
MI with angina	18.0 (9)	13.2 (38)	4.8 (-6.5 to 16.1)
MI without angina	4.0 (2)	8.7 (25)	-4.7 (-11.0 to 1.7)
Angina only	20.0 (10)	12.8 (37)	7.2 (-4.6 to 1.9)
Revascularisation	18.0 (9)	10.8 (31)	7.2 (-4.0 to 18.5)
Any coronary heart disease#	44.0 (22)	35.1 (101)	8.9 (-5.9 to 23.8)
Infarct severity:			
Killip score > 1	29.2 (14)	16.7 (47)	12.5 (-1.1 to 28.4)
Complications at the time of the index MI:			
CHF	58.0 (29)	37.8 (109)	20.2 (5.4 to 34.9)
Arrhythmias	14.0 (7)	25.3 (73)	-11.3 (-22.2 to -0.5)
Unstable angina	60.0 (30)	40.6 (117)	19.4 (4.7 to 34.1)
Procedures during admission for index MI:			
Coronary angiogram	40.0 (20)	29.9 (86)	10.1 (-4.4 to 24.7)
Revascularisation	14.0 (7)	9.4 (27)	4.6 (-5.6 to 14.8)

Note: Percentages are based on number with available data; MI myocardial infarction; CHF congestive heart failure; * depression score > 10 or summed anxiety and depression score >19; ** conditions are not exclusive; # either MI, angina or revascularisation

6.4.1.4 Deaths, Non-Fatal Coronary Events and Congestive Heart Failure in the Subsequent Seven Years by Baseline Emotional Distress Group

Table 6.4 shows fatal and non-fatal events within one year and seven years by baseline emotional distress. There were no statistically significant differences between those with and without baseline emotional distress in deaths, in the occurrence of non-fatal coronary events or in diagnoses of congestive heart failure within one year and within the subsequent seven years. However, numbers in the distressed group were very small, so that even large differences between groups did not reach statistical significance. There were somewhat more events (both fatal

and non-fatal) occurring in distressed patients compared to non-distressed, at least in the first year.

Table 6.4 Deaths, non-fatal coronary events and congestive heart failure in 7 years following the index myocardial infarction by baseline emotional distress: Baseline questionnaire responders
% (n), unless otherwise stated

	Distressed at baseline	Non-distressed at baseline	Difference (95% CI) (Distressed – Non-D)
Within 1st year	N=50	N=288	
Deaths	12.0 (6)	4.5 (13)	7.5 (-1.8 to 16.8)
Non-fatal events*			
Recurrent MI	6.0 (3)	0.7 (2)	5.3 (-1.4 to 12.0)
Angina	40.0 (20)	32.6 (94)	7.4 (-7.3 to 22.0)
Revascularisation	10.0 (5)	2.8 (8)	7.2 (-1.3 to 15.8)
Any coronary event**	50.0 (25)	36.5 (105)	13.5 (-1.4 to 28.5)
Non-fatal CHF	28.0 (14)	22.9 (66)	5.1 (-8.3 to 18.4)
After 1st year & within 7 years	N=44	N=275	
Deaths	18.2 (8)	16.7 (46)	1.5 (-10.8 to 13.7)
Non-fatal events*			
Recurrent MI	9.1 (4)	1.5 (4)	7.6 (-1.0 to 16.2)
Angina	22.7 (10)	15.3 (42)	7.5 (-5.6 to 20.5)
Revascularisation	6.8 (3)	1.8 (5)	5.0 (-2.6 to 12.6)
Any coronary event**	27.3 (12)	26.9 (74)	0.4 (-13.8 to 14.5)
Non-fatal CHF	18.3 (8)	14.9 (41)	3.3 (-8.9 to 15.4)

* Conditions are not exclusive; ** Includes either recurrent MI, angina or revascularisation as 1st note of non-fatal CHD progression

6.4.1.5 Summary of 28-Day Survivors

There were differences in social class and complications noted at the time of the index myocardial infarction between baseline questionnaire responders and non-responders. Amongst men, fewer responders than non-responders were from manual social classes. More responders experienced congestive heart failure and unstable angina at the time of the index event. No differences were found for women, although numbers were small.

Overall, baseline psychological health was similar for men and women and 15% (95% CI, 11% to 19%) of the entire cohort had emotional distress at the time of the index myocardial infarction. However, men reported better quality of life than women.

Patients with baseline emotional distress were younger than those non-distressed. More severe infarcts were observed in distressed patients than non-distressed at baseline. There were 13% more distressed patients than non-distressed with a Killip score greater than one, In addition, 20% more distressed patients had congestive heart failure and/or unstable angina noted at the time of the index event compared to non-distressed. No other statistically significant differences in baseline CHD factors were found. Nevertheless, there was a consistent pattern with more distressed than non-distressed patients having a past CHD history or a coronary procedure performed during the index admission. Similarly over the next year, there were somewhat more deaths, non-fatal coronary events and congestive heart failure diagnoses in those patients with baseline emotional distress than in the non-distressed.

6.4.2 Seven-Year Survivors

The following set of results relates to the second patient group: 266 seven-year survivors who completed the seven-year questionnaire (see Figure 6.1a and b).

6.4.2.1 Comparison of Responders with Non-Responders

To determine whether responders were different to non-responders, characteristics were compared and are shown in Table 6.5. There were fewer women among responders than non-responders (p=0.028). Fewer questionnaire responders were from manual social classes than non-responders. For men, 46% of responders were in manual social classes and 67% of non-responders (p=0.0004). For women, the proportions were 41% of responders and 60% of non-responders (p=0.034).

Table 6.5 Social class, age, non-fatal coronary events and congestive heart failure by sex for all, for questionnaire responders and non-responders: Seven-year survivors
% (n), unless otherwise stated

	All 7-year survivors	Responders	Non-responders	p*
% women	26.9 (118/439)	22.9 (61/266)	32.9 (57/173)	0.028
Men	N=321	N=205	N=116	
At baseline				
Age, mean years (SD)	60.7 (10.3)	61.5 (9.8)	59.4 (11.0)	0.08
Manual social class	53.4 (163)	45.6 (89)	67.3 (74)	<0.001
Over 7 years:				
Recurrent MI	4.0 (13)	5.4 (11)	1.7 (2)	0.20
Angina	54.8 (176)	57.1 (117)	50.9 (59)	0.34
Revascularisation	8.4 (27)	8.8 (18)	7.8 (9)	0.91
Any coronary event#	55.8 (179)	58.5 (120)	50.9 (59)	0.23
CHF	36.4 (117)	36.6 (75)	36.2 (42)	0.95
Women	N=118	N=61	N=57	
At baseline				
Age, mean years (SD)	66.2 (9.3)	65.8 (10.4)	66.5 (8.1)	0.69
Manual social class	50.0 (53)	41.1 (23)	60.0 (30)	0.034
Over 7 years:				
Recurrent MI	3.4 (4)	3.3 (2)	3.5 (2)	0.97
Angina	53.4 (63)	59.0 (36)	47.4 (27)	0.28
Revascularisation	6.8 (8)	4.9 (3)	8.8 (5)	0.64
Any coronary event#	54.2 (64)	60.7 (37)	47.4 (27)	0.21
CHF	32.2 (38)	39.3 (24)	24.6 (14)	0.13

Notes: % based on number with available data; MI myocardial infarction; CHF congestive heart failure;
Either recurrent MI, angina or revascularisation as 1st note of non-fatal CHD progression
* p-value for difference between responders and non-responders

6.4.2.2 Psychological Health and Quality of Life for Men and Women

Amongst those with seven-year questionnaire data, only 13% (95% CI, 9% to 17%) were emotionally distressed at seven years after the index event. In contrast, 36% [30% to 41%] of seven-year survivors had an overall EuroQol score of 100 (best quality of life possible), and mean EuroQol score was 76 [95% CI, 73 to 79] similar to that for the South East Region general population of the same age (79.6 [78 to 82], difference p=0.07).[24]

Psychological health and quality of life at seven years were examined by sex and are shown in Table 6.6. In this group, women were four years older than men. Women fared worse than men for psychological health, with more women having depression (p=0.033) and emotional distress (p=0.028). Additionally, women had higher mean total HADS scores than men (p=0.009). However, there was no difference between the number of men and women with high anxiety levels (p=0.14).

For completeness, differences in quality of life scores were also compared between men and women. Women also had poorer quality of life compared to men. On all SF-36 dimensions, women reported somewhat lower scores than men (statistically significant for social functioning, mental health, energy and bodily pain) and women had strikingly lower scores for physical functioning than men (p<0.0001). Mean quality of life scores (EuroQol) were also lower for women than men (p=0.006), and more women had low quality of life scores (< cohort median of 79.6) than men with 61% of women and 39% of men with a low score (p=0.004). Angina symptoms were also experienced by more women than men with 37% (22) of women and 21% (43) of men reporting angina (difference 16% [2% to 30%], p=0.021).

Men and women were combined for the following analyses by emotional distress group because of small numbers.

Table 6.6 Age, psychological health and quality of life at seven years after the index myocardial infarction by sex: 7-year questionnaire responders
% (n), unless otherwise stated

	Men N=205	Women N=61	Difference (95% CI) (Men- Women)
Age at baseline			
Mean years (SD)	61.5 (9.8)	65.8 (10.4)	-4.3 (-7.1 to -1.5)
Psychological health:			
Depression score			
>8 (borderline or higher)	11.6 (23)	23.7 (14)	-12.2 (-22.4 to -2.0)
Anxiety score			
> 8 (borderline or higher)	23.1 (45)	33.9 (20)	-10.8 (-23.5 to 1.9)
Emotional distress*	10.1 (20)	22.0 (13)	-12.0 (-23.4 to -0.6)
Total HADS, mean (SD)	8.4 (6.4)	11.5 (8.3)	-3.1 (-5.4 to -0.8)
Quality of life:			
Mean score**, (SD)			
SF-36 dimensions			
Physical functioning	66.0 (29.4)	43.9 (30.0)	22.0 (12.9 to 31.2)
Role physical	60.4 (44.8)	51.4 (43.1)	9.0 (-4.7 to 22.7)
Role emotional	77.6 (37.3)	73.9 (37.3)	3.7 (-7.9 to 15.3)
Social functioning	71.8 (24.5)	63.9 (28.2)	7.8 (0.3 to 15.3)
Mental health	62.0 (13.5)	56.9 (16.0)	5.1 (0.9 to 9.3)
Energy & vitality	45.2 (17.5)	36.5 (16.3)	8.7 (3.4 to 13.9)
Pain	74.6 (25.9)	66.1 (30.4)	8.6 (0.6 to 16.5)
Health perception	59.0 (24.3)	52.2 (23.1)	6.8 (-0.4 to 14.0)
Change in health	48.0 (17.1)	44.2 (19.2)	3.9 (-1.2 to 9.0)
EuroQol			
Low quality of life#	38.9 (79)	61.0 (36)	-22.1 (-36.2 to -8.0)
Utility score of 100 (highest)	40.4 (82)	18.6 (11)	21.8 (9.7 to 33.8)
Utility score, mean (SD)	78.6 (25.6)	67.9 (27.7)	10.7 (3.1 to 18.3)

Notes: Percentages based in number with available data;
* depression score > 10 or summed anxiety and depression score >19;
** higher score = better quality of life; # score < cohort median of 79.6;

6.4.2.3 Factors at Baseline, at Seven Years and Over the Previous Seven Years by Emotional Distress Group at Seven Years

Seven-year infarct survivors were classified with emotional distress or not, and baseline and seven-year characteristics and coronary events and congestive heart

failure over seven years for each group are shown in Table 6.7. At seven years, there was an excess of women in the emotionally distressed group with 39% in the distressed group and 20% in the non-distressed group (p=0.028). More emotionally distressed patients had current angina symptoms than non-distressed patients; 44% of distressed patients versus 22% of non-distressed patients (p=0.016). Additionally, more distressed patients had a low EuroQol score compared to non-distressed patients; 97% of distressed and 36% of non-distressed patients (p<0.001).

During the previous seven years, somewhat more patients with emotional distress at seven years had experienced at least one coronary event than non-distressed patients, but the difference was not statistically significant. Over a third of patients with and without seven year emotional distress had a diagnosis of congestive heart failure noted over the previous seven years.

Table 6.7 Characteristics at baseline and seven years, coronary events and congestive heart failure noted over seven years by seven-year emotional distress: Seven-year questionnaire responders
% (n), unless otherwise stated

	Distressed* at 7 years N=33	Non-distressed at 7 years N=225	Difference (95% CI) (Distressed – Non-D)
At baseline			
Age, Mean years (SD)	63.4 (11.0)	62.3 (10.0)	1.1 (-2.7 to 4.8)
Women	39.4 (13)	20.4 (46)	18.9 (1.5 to 36.4)
At 7 years			
Current smoker	9.1 (3)	10.7 (24)	-1.6 (-12.2 to 9.0)
Angina symptoms	43.8 (14)	22.3 (49)	21.5 (3.4 to 39.5)
Low quality of life#	97.0 (32)	36.0 (80)	60.9 (52.3 to 69.5)
Over previous 7 years:			
Any coronary event**	72.7 (24)	56.4 (127)	16.3 (-1.7 to 34.3)
Non-fatal CHF	42.4 (14)	36.4 (62)	6.0 (-12.0 to 24.0)

Notes: Percentages based on number with available data;
* depression score > 10 or summed anxiety and depression score >19;
** Either recurrent MI, angina or revascularisation as 1st note of CHD progression
# EuroQol score < cohort median of 79.6

6.4.2.4 Association between Seven-Year Emotional Distress and Quality of Life, Angina Symptoms and Sex

Logistic regression was used to explore the relationship between seven-year emotional distress, age and factors that were significantly different between the two emotional distress groups in the previous univariate analysis (sex and angina symptoms). Quality of life was not included in the analysis, because 97% of emotionally distressed patients had a low EuroQol score, so the two measures were virtually identical.

Table 6.8 shows odds ratios for seven year emotional distress related to female sex and angina symptoms with and without adjustment. For women, there was a 2.5 times risk of emotional distress compared to men (p=0.018). For those with angina symptoms, there was a 2.7 times risk of emotional distress compared to those with no angina (p=0.011). After adjustment for age and the other factor, the odds ratios were slightly reduced, but remained statistically significant for both factors (p=0.033 for female sex and p=0.030 for angina).

Table 6.8 Odds ratios for seven-year emotional distress in infarct survivors

	Odds Ratios for Emotional Distress* at 7 years (95% CI)	
	Unadjusted	Adjusted**
Factors		
Female sex	2.53 (1.17 to 5.46) p=0.018	2.41 (1.07 to 5.40) p=0.033
Angina symptoms	2.71 (1.26 to 5.85) p=0.011	2.40 (1.09 to 5.29) p=0.030

* depression score > 10 or summed anxiety and depression score >19
** adjusted for age and for the other factor shown (angina symptoms or sex)

6.4.2.5 Summary of Seven-Year Survivors

There were social class differences between questionnaire responders and non-responders at seven years with fewer responders from manual social classes. In addition, there were fewer women in the responder group compared to non-responders.

In the entire cohort, only 13% (95% CI, 9% to 17%) had emotional distress and overall quality of life score at seven years after the index myocardial infarction was similar to that for the general population of the South East Region. Nevertheless, women had poorer psychological health and quality of life than men. Women also reported more current angina symptoms than men. Women were overrepresented in the emotionally distressed group compared with the non-distressed.

There were similar occurrence rates of a non-fatal coronary event or of congestive heart failure for distressed and non-distressed patients at seven years. However, distressed patients reported more current angina symptoms and much lower (overall) quality of life than non-distressed patients. In a logistic regression analysis taking account of sex and angina simultaneously, the relative odds of current emotional distress was 2.4 for women compared to men and 2.4 for those with angina symptoms compared to those with no angina.

6.4.3 Responders to all Three Questionnaires: at Baseline, One Year and Seven Years

The third set of patients was a sub-group with baseline, one- and seven-year data, which allowed examination of the course of psychological health after a myocardial infarction (see Figure 6.1a).

6.4.3.1 Comparison of Responders with Non-Responders

Characteristics of all eligible seven year survivors and differences between responders to all three questionnaires and non-responders are presented in Table 6.9. In this sub-group, there were fewer women among responders than non-responders (p=0.044). Fewer questionnaire responders were from manual social classes than non-responders. For men, 40% of responders and 64% of non-responders were in manual social classes (p=0.037) and for women, the proportions were 31% versus 51% (p=0.19).

Table 6.9 Baseline characteristics and non-fatal coronary events by sex for questionnaire responders and non-responders: Seven-year survivors with baseline and one year data
% (n), unless stated otherwise

	All eligible 7 year survivors#	Responders	Non-responders	p*
% Women	22.8 (43/189)	19.0 (27/142)	34.8 (16/46)	0.044
Men	N=145	N=115	N=30	
At baseline				
Age, mean years (SD	61.1 (9.5)	60.9 (9.4)	61.8 (10.2)	0.65
Manual social class	45.0 (63)	40.2 (45)	64.3 (18)	0.037
Emotional distress	13.0 (19)	12.1 (14)	16.7 (5)	0.54
Over 7 years:				
Any coronary event	65.5 (95)	64.3 (74)	70.0 (21)	0.72
CHF	35.9 (52)	33.9 (39)	43.3 (13)	0.46
Women	N=43	N=27	N=16	
At baseline				
Age, mean years (SD)	64.1 (9.9)	63.1 (10.3)	65.8 (9.1)	0.39
Manual social class	40.5 (17)	30.8 (8)	56.3 (9)	0.19
Emotional distress	18.6 (8)	14.8 (4)	25.0 (4)	0.69
Over 7 years:				
Any coronary event	62.8 (27)	66.7 (18)	56.2 (9)	0.72
CHF	30.2 (13)	33.3 (8)	25.0 (4)	0.74

7-year survivors with baseline and 1 year questionnaire data;
* p-value for difference between responders and non-responders

6.4.3.2 Course of Psychological Health over Seven Years by Baseline Emotional Distress Group

Table 6.10 shows age and psychological health at one year and at seven years after the index event in those with and without baseline emotional distress. Overall, 18/142 (13%, 95% CI 7% to 18%) had emotional distress at baseline. Emotionally distressed patients were 10 years younger than those not distressed. Psychological health at one year and at seven years was poorer for patients with baseline distress than non-distressed patients. Whether psychological problems were indicated by depression, anxiety or the combined measure of emotional distress, there was a consistent pattern, with those distressed at baseline continuing to have more psychological problems than those not distressed at baseline (At one year and at seven years: For depression: $p=0.003$ and $p<0.001$;

For anxiety: p=<0.001 and p=0.001) In addition, at both one year and seven years, those with baseline emotional distress were more likely to be distressed than those not distressed at baseline (for one year and seven years p<0.0001).

Table 6.10 Baseline characteristics, psychological health at one year and seven years after the index myocardial infarction by baseline emotional distress group: Responders to all 3 questionnaires
% (n), unless stated otherwise

	Distressed* at baseline N=18	Non-distressed at baseline N=124	Difference (95% CI) (Distressed – Non-D)
At baseline			
% women	22.2 (4)	18.5 (23)	
Age, mean years (SD)	52.8 (10.0)	62.7 (8.8)	-9.9 (-14.4 to -5.4)
At 1 year			
Depression score			
> 8 (borderline or higher)	44.4 (8)	13.0 (16)	31.4 (7.7 to 55.1)
Anxiety score			
> 8 (borderline or higher)	77.8 (14)	30.1 (37)	47.7 (26.9 to 68.5)
Emotional distress*	38.9 (7)	5.7 (7)	33.2 (10.3 to 56.1)
At 7 years			
Depression score			
> 8 (borderline or higher)	44.4 (8)	8.9 (11)	35.6 (12.1 to 59.1)
Anxiety score			
> 8 (borderline or higher)	65.7 (11)	23.5 (28)	41.2 (17.2 to 65.1)
Emotional distress*	44.4 (8)	6.6 (8)	37.8 (14.5 to 61.2)

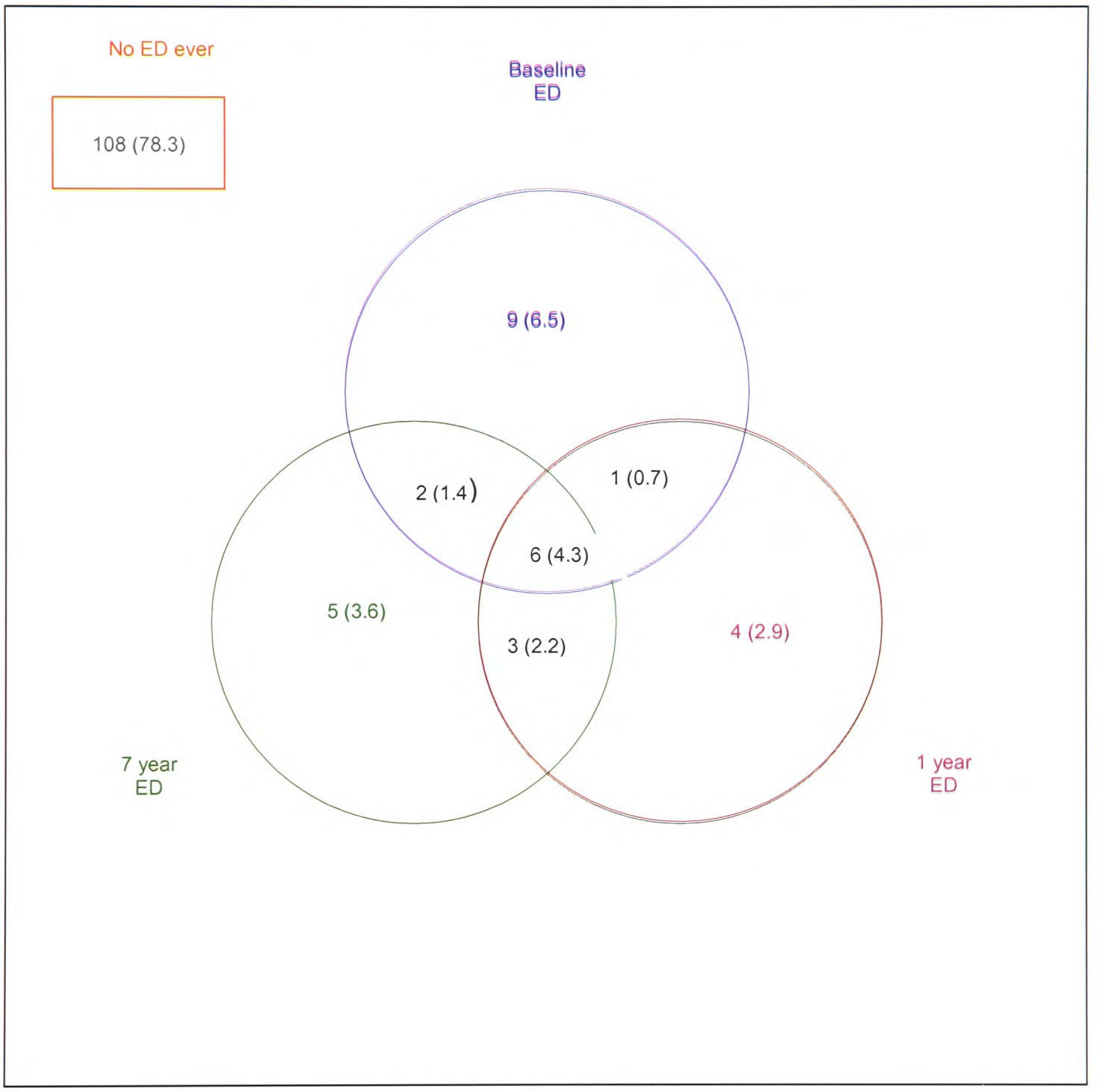
Note: Percentages and scores based on number with available data;
* depression score > 10 or summed anxiety and depression score >19

6.4.3.3 Course of Psychological Health at Baseline, One Year and Seven Years

To determine changes to individual patients' psychological health between baseline, one year and seven years, two further analyses were performed. Firstly, emotional distress status for each patient was examined at baseline, one year and seven years. Figure 6.2 illustrates the overlaps between emotional distress at baseline, one year and seven years. Of the 18 patients distressed at baseline, nine

were not distressed subsequently, while six continued to have emotional distress at both one year and seven years.

Figure 6.2 **Number of patients (%) with and without emotional distress (ED) amongst the 138 patients with HADS total scores at baseline, one year and seven years and overlap between the three time points**



Secondly, mean scores for depression, anxiety and total HADS at the three time points were examined and are shown in Table 6.11. Depression scores were similar between baseline, one year and seven years (repeated measures ANOVA, p=0.07). However, anxiety and total HADS scores differed between the three time

points (anxiety p=0.003; total HADS p=0.040) with a reduction in scores (i.e. lessening anxiety) over the period. Further tests were performed to examine the extent of the differences.

For anxiety, baseline and one year mean scores were similar (difference 0.4 [95% CI -0.3 to 1.1], p=0.25) However, both baseline and one-year mean scores were higher than the seven year score (fall from baseline to seven years 1.3 [0.5 to 1.9], p=0.001; one year to seven years 0.8 [0.2 to 1.5], p=0.012) For total HADS score, there was a small but non-significant decrease from baseline to one year (0.9, [-0.2 to 1.9]) and from one year to seven years (0.7, [-0.3 to 1.6]). However, between baseline and seven years, there was a reduction of 1.6 points (0.4 to 2.8) indicating an overall improvement in psychological health (p=0.011).

Table 6.11 Changes in mean depression and anxiety scores over time

Scores, Mean (SD)	At baseline	At 1 year	At 7 years	p*
Depression N=138	4.4 (3.2)	3.8 (3.4)	4.0 (3.6)	0.067
Anxiety N=134	6.4 (4.3)	6.0 (4.4)	5.2 (4.1)	0.003
Total HADS N=135	10.8 (6.7)	9.9 (7.2)	9.2 (7.0)	0.040

p-value for overall differences in individuals' scores at the three different time points

6.4.3.4 Summary of Responders to all Three Questionnaires

In this sub-group of 28-day survivors with data at baseline, one year and at seven years, one difference between responders and non-responders to the questionnaires was social class, with fewer responders from manual social classes than non-responders. Additionally, there were fewer women in the responder group compared to non-responders. The prevalence of baseline emotional distress was 13% (7% to 18%). Patients with baseline emotional distress reported poorer psychological health at both one year and seven years compared to non-distressed patients.

Over the seven years, depression levels remained static. In contrast, the severity of anxiety changed very little between baseline and one year but had reduced by seven years. Overall psychological health (measured by total HADS score) improved from baseline to seven years.

6.5 Discussion

In this chapter, the extent of psychological problems at the time of the index myocardial infarction and at seven years was reported. The relationship between psychological well-being and cardiac disease was investigated at both baseline and over the subsequent seven years in 28-day survivors. Amongst seven-year survivors, the association between existing psychological health and cardiac disease was examined both at seven years and over the previous seven years. Differences in psychological health and quality of life between men and women were explored at baseline and seven years. The course of psychological health from baseline to seven years was also reported.

6.5.1 Key Findings

The majority of men and women had good psychological health with only 13% to 15% classified as emotionally distressed at the time of the index myocardial infarction and at seven years. Amongst seven-year infarct survivors, the overall quality of life score was comparable to the general population of southeast England.

Distressed patients at baseline were more likely to have a complicated index myocardial infarction than non-distressed. Over the subsequent seven years in 28-day survivors, there appeared to be a pattern of more fatal and non-fatal events in baseline distressed patients than non-distressed particularly in the first year. This would be expected, since more distressed patients had myocardial damage and cardiac complications at baseline compared to non-distressed. However, there were small numbers in the emotionally distressed group, and none of these

differences were statistically significant. In seven-year survivors, those with current angina symptoms had a two-fold increased risk for seven-year emotional distress than those with no angina.

At the time of the index event, there were no differences in psychological well-being between men and women, whereas amongst seven-year survivors women reported more psychological problems. Women also reported more emotional distress and more current angina at seven years. Women had a two-fold increase in risk for emotional distress at seven years compared to men. In contrast to psychological health, at both baseline and seven years, women consistently reported poorer quality of life than men.

Patients with baseline emotional distress continued to have poorer psychological health over the following seven years compared to those with no baseline psychological problems. The severity of depression was constant over the seven year study period, whereas the severity of anxiety and overall psychological health had improved by seven years.

6.5.2 Study Strengths

Unlike most other studies of psychological health in myocardial infarction survivors that used the Beck Depression Inventory (BDI), probable cases of psychological problems (depression, anxiety or emotional distress) were identified in OXMIS patients using the HADS instrument. This was specifically designed to screen physically ill medical patients, not psychiatric patients, for clinically relevant psychological problems and two recent systematic reviews have provided updated information about its validity as an assessment tool.[15 16] The availability of baseline psychological data made it possible to examine psychological and non-fatal cardiac outcomes for a longer follow-up period and in the same cohort of patients than previous studies. Psychological data were at least 97% complete at baseline, one year and seven years. Additionally, data availability at baseline and one year

also allowed examination of patients' recovery over time, and 76% of eligible survivors completed the seven-year questionnaire which increased the generalisability of these results. Within each of the three patient groups, responders were similar to non-responders in age which eliminated any age-related bias. Amongst 28-day survivors, infarct severity (Killip score) and past history of coronary disease was similar between baseline responders and non-responders. Furthermore in seven-year survivors, the occurrence of non-fatal coronary events or congestive heart failure since the index event was similar between responders and non-responders. Thus the severity of coronary disease is unlikely to have contributed any response bias.

6.5.3 Study Limitations

The cohort consisted of a relatively small number of patients, which was further reduced by missing data within the different datasets. This limited the investigation of baseline emotional distress as an independent predictor of long term outcomes. The generalisability of the findings relating to baseline emotional distress may be limited, since baseline questionnaire data were only available for 59% of all 28-day infarct survivors. Unlike at baseline, women were under-represented at seven years, because fewer women were in the responder group compared to non-responder group. When sexes were combined for seven-year emotional distress analyses, women's experiences would have been underweighted. At both baseline and seven years, fewer questionnaires were received from patients in manual social classes. There was no evidence of social class differences in psychological health at either time point with a similar proportion of patients with emotional distress in both manual and non-manual social classes. However, this imbalance may have biased some of the physical findings, since infarct survivors from manual social classes have reported poorer physical but not mental health recovery than those in non-manual classes by one year.[25]

6.5.4 Psychological Health

This chapter reports psychological outcomes over the subsequent seven years in infarct survivors with and without baseline emotional distress. The majority of OXMIS patients had good psychological health at the time of the index myocardial infarction and at seven years: only 15% (95% CI 11% to 19%) had emotional distress at baseline and 13% (95% CI 9% to 17%) at seven years. This contrasted with other studies of baseline psychological health in myocardial infarction patients, which investigated depression and anxiety separately and found an overall higher prevalence of psychological problems at baseline than OXMIS.

Of the studies reporting baseline depression in myocardial infarction patients, two from Canada[5 10] and one from England[7] used the BDI. They reported 31% to 35% of patients had at least mild depression at baseline. The other study used the Zung Depression Scale and found 42% of 1042 Japanese patients had depression three months after the index infarction. In the OXMIS cohort, the prevalence was lower with 7% with clinically significant depression and 18% with at least borderline depression, using the cut-off scores recommended by the authors of HADS.

Two studies investigated the prevalence of baseline anxiety using the Speilberger anxiety inventory and found 17% of 288 Birmingham myocardial infarction patients[7] and 24% of 896 Montreal patients were anxious at baseline.[26] However a more stringent threshold was used in Birmingham, so the cohorts may have had similar anxiety prevalence rates. In OXMIS the prevalence of clinically significant anxiety was 19%, which increased to 38% when those with borderline anxiety were included.

The use of different instruments may partly explain the different prevalence rates for depression and anxiety amongst myocardial infarction patient cohorts. In 2001 (five to six years after the baseline data collection) a study compared several self-report questionnaires for depression within a cohort of 206 myocardial infarction patients, using the structured clinical interview for DSM-IV criteria as a gold

standard.[27] The HADS and the BDI were found to be comparable measures for depression, but only when a total HADS score was used. Patients with mild or major depression were identified using either a BDI score of at least 10 or a HADS total score of 13 or higher.

To allow comparison of depression prevalence rates between OXMIS and the previous studies using BDI scores of 10 or more, total HADS scores were reanalysed and 135 (40%, 95% CI 35% to 45%) of OXMIS patients had a total HADS score of 13 or higher at baseline. This was similar to the 35% (191/550) reported by the Quebec study[5] (difference 5% [95% CI -1% to 12%], p=0.14). However, more OXMIS patients had depression using this threshold compared to the 31% (89/288) in the Birmingham cohort[7] (difference 9% [2% to 17%], p=0.023) and the 32% (290/896) in the Montreal cohort[10] (difference 8% [2% to 14%], p=0.015). This confirmed that the use of different measures could explain all of the differences in prevalence rates of psychological problems found between OXMIS patients and those in other studies. The threshold used to identify emotional distress in OXMIS patients appears unusually stringent. It also illustrates the arbitrariness of using thresholds to categorise patients' psychological status.

Other studies have found little change in the prevalence or severity of depression from baseline to one year.[5 10 11] This is consistent with the OXMIS findings where similar depression and anxiety scores were found at baseline and at one year. In contrast, anxiety scores in the OXMIS cohort had decreased by seven years. No other follow-up studies have investigated psychological health beyond one year for myocardial infarction survivors with baseline psychological information; consequently direct comparison with other studies is not possible.

Differences in psychological well-being between OXMIS men and women were observed at seven years but not at baseline, although fewer women responded at seven years. Amongst seven-year survivors, women fared worse than men for long term psychological health; more women had emotional distress than men and

more women had clinically significant anxiety compared to men. An earlier Swedish study examined gender differences in psychological outcomes for 595 myocardial infarction patients identified between 1986 to 1987 and anxiety was more common in women than men at one year.[28] Another study of 266 one-year survivors (of myocardial infarction or of a revascularisation procedure) also reported that women were at higher risk of anxiety as well as depression compared to men.[29] No other more recent studies of infarct survivors have reported long-term psychological outcomes separately for men and women.

Like psychological health, previous studies have found gender differences in quality of life after a myocardial infarction. Women had poorer quality of life compared to men at six months[14] and at one year.[12] Similarly, quality of life was worse for OXMIS women compared to OXMIS men at both baseline and at seven years.

6.5.5 Cardiac Disease: Relationship with Psychological Health

At baseline, more cardiac complications were noted in emotionally distressed OXMIS patients than non-distressed. Approximately 20% more distressed patients than non-distressed had unstable angina and congestive heart failure as a complication of their index myocardial infarction. The Quebec study was the only other recent report of the relationship between baseline psychological health (measured with BDI) and physical complications of the index myocardial infarction (N=550). However, the Quebec study only found five percent (non-statistically significant) more depressed patients (BDI higher than nine) compared to non-depressed had an episode of unstable angina or congestive heart failure at baseline.[5] Comparison with the OXMIS results is difficult for two reasons. Firstly, the diagnostic criteria of the infarct complications were not described in the Quebec study. Secondly, different instruments were used to classify psychological health. Nevertheless, reanalysis of the OXMIS data (after reclassification for comparison with the studies using the BDI - see section 6.5.4) still found that more

unstable angina was observed in OXMIS patients with depression (53%) compared to those with no depression (37%) (difference 15%, [4% to 26%], p=0.008). Additionally, there was slightly more congestive heart failure recorded for depressed infarct survivors (47%) than non-depressed (37%) (difference 11%, [0% to 22%], p=0.06).

Most other studies of the relationship between baseline psychological health and recurrent cardiac events only followed up patients to one year and reported conflicting results.[30 6 5] In Japan, more infarct patients with depression at baseline had experienced cardiac events by one year with 31% of depressed patients and 24% of non-depressed patients having a cardiac death or hospital readmission (p=0.011).[6] Similarly in Quebec, depressed patients had 13% more readmissions for cardiac reasons than non-depressed (95% CI, 5% to 22%).[5] These results are consistent with the pattern observed in the OXMIS cohort of slightly more patients with baseline emotional distress having a non-fatal coronary event (50% versus 37%) by one year than those not distressed at baseline. In contrast, the Birmingham study reported similar one-year cardiac event rates of 30% for both depressed and non-depressed patients.[30] Further comparisons are not possible, because admissions for arrhythmias were included in the outcome of these other studies, whereas the OXMIS study excluded hospital and general practice contact for arrhythmias. Comparison is further complicated by the inclusion of deaths in the outcome of two studies,[30 6] and the other not stating whether deaths were included in the outcome or not.[5]

A Montreal-based study is the only other to report non-fatal coronary events separately from deaths. In this study, patients were classified with or without depression at baseline using a score of 10 or more on the Beck Depression Inventory and follow-up was for five years.[10] To allow comparison, OXMIS patients were reclassified as depressed at baseline if they had a HADS depression score of 13 or more to correspond to the Beck Depression Inventory threshold.[27] Reanalysis of the OXMIS data showed that five year rates of non-fatal coronary

events were similar for depressed and non-depressed patients; 68% of depressed patients and 61% of non-depressed (difference 7% [-4% to 17%]). This was consistent with the Montreal findings that baseline depression was not associated with non-fatal coronary events over five-years, although actual event rates were not reported.[10] However, the Montreal study only included diagnoses from hospital admissions and may have underestimated the rate of non-fatal coronary events. This was confirmed by further reanalysis of the OXMIS data excluding events noted in outpatient appointments and general practice records. There was a reduction in the rates, but in both patient groups. There were similar five-year non-fatal coronary event rates between depressed and non-depressed patients: 47% of depressed patients and 39% of non-depressed (difference 8% [-3% to 19%]).

Likewise at seven years, there were similar rates of coronary events and congestive heart failure during the previous seven years after the index event for OXMIS patients with or without seven-year emotional distress. Most of these events occurred within the first year, and the earlier report of the OXMIS patients found that baseline emotional distress was associated with chest pain at one year.[9]

Seven-year OXMIS survivors with angina symptoms at seven years were at two-fold increased risk of emotional distress at seven years compared to those with no angina. Cross-sectional studies of two other UK cohorts also investigated the relationship between current angina symptoms and psychological outcomes several years after a myocardial infarction. In contrast to OXMIS, no association with emotional problems was found in 149 two-year survivors from Sutherland[31] or in 424 four-year survivors from the Nottingham Heart Attack Study.[32] This disparity with the OXMIS findings may be due to reliance upon quality of life instruments to measure psychological health in these other two cohorts, since the Sutherland study used the SF-12 and the Nottingham study used the SF-36. These generic instruments may not have been sensitive enough to detect psychological problems and may partly explain why these other studies reported different findings compared to OXMIS.

At seven years, there were gender differences for current angina with more OXMIS women reporting symptoms than men. The only other study of differences in health problems between men and women after a myocardial infarction was the Swedish study conducted in the 1980s.[28] Cardiac symptoms including angina were more frequent in women than men at one year, but after controlling for age and co-morbidities the only gender difference detected was dyspnoea on exertion.

6.5.6 Health Service Implications

Although the group of OXMIS infarct survivors with emotional distress at the time of the index event who continued to have ongoing emotional distress over the subsequent seven years was small, there are still implications for the delivery of comprehensive discharge and follow-up care. Hospitalisation for a myocardial infarction could serve as a potential screening opportunity to identify patients with current emotional problems (particularly patients with complicated infarcts), so treatment could be offered to improve their psychological recovery.[33] Furthermore, these findings support the need for early recognition of psychological problems and individually planned behavioural treatment by the cardiac rehabilitation team, which can result in a more successful and complete recovery after a myocardial infarction for more patients.[34 35]

The identification of myocardial infarction patients with emotional distress is a clinical priority for health professionals routinely responsible for providing comprehensive patient care, since qualified psychiatrists or psychologists are rarely involved in acute or follow-up care for myocardial infarction patients. In clinical practice, the HADS (as in the OXMIS study) remains a valid and easily administered screening tool for emotional problems in physically ill patients, such as infarct survivors.

Identification and treatment of psychological problems should also be incorporated in the clinical management of post-infarct patients after hospital discharge.

Systematic long term follow-up care is now the responsibility of the primary care team and should include psychological assessment (and treatment, if necessary) for both women and men. Additionally, patients with current angina symptoms may be at higher risk of emotional difficulties and benefit from counseling or treatment.

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Chapter 7

Health Service Resource Use and Costs

7.1 Introduction

The previous chapters have reported six-year mortality, coronary morbidity and psychological health after a myocardial infarction. To provide a comprehensive account of the progression and long-term financial consequences of coronary heart disease (CHD) after a myocardial infarction, this chapter examines health service use and economic costs associated with CHD progression and its treatment incurred over the subsequent six years in 28-day infarct survivors.

In economics, a cost or burden of illness study estimates the resources consumed in disease prevention, detection, and treatment. This type of study can provide data, based on which, better informed decisions can be made in setting priorities in health care research and resource allocation.

Most previous studies of health resource use and costs associated with a myocardial infarction have only reported details for the index admission. They included studies from the USA,[1] France,[2] and Ireland[3] and one of comparisons between European countries.[4] The relatively few reports of resource use and costs after hospital discharge from the index myocardial infarction were confined to non-representative patient groups,[5 6] or exclusively to hospital episodes[5 7] or were limited to one-year follow-up.[6] The one UK study of resource use beyond one year after hospital discharge for infarct survivors did not include annual rates of health service use, general practice consultation rates or economic costs.[8]

7.2 Objectives and Aims

In this chapter, there are two objectives: first to determine, in a cohort of 28-day survivors of myocardial infarction, annual health service resource use over the six

years following the index event and second, to estimate health service costs for coronary heart disease (CHD) over the same period.

Over the six years from the index event, the aims are to determine the number and costs per patient per year of:

i) hospital admissions for CHD
ii) hospital outpatient appointments for CHD
iii) consultations with general practitioners and practice nurses
vii) tablets of preventive cardiac medications prescribed.

7.3 Methods

Cost of illness studies are commonly conducted using either the 'top down' or 'bottom up' approach. The former approach estimates economic cost by using aggregate data on mortality, morbidity, hospital admissions, general practice consultations, disease related costs, and other health related indicators. An advantage of the top down approach is it makes use of national data, which are readily available. The bottom up approach uses information on disease and treatment probabilities from follow-up studies to derive annual incidence estimates and associated costs. The main advantage of the latter approach is that it makes full use of available epidemiological data, but the construction of a bottom up model is more complex. In this chapter, a bottom up approach was employed to attribute the total expenditure to CHD from health service utilisation and medication data collected after hospital discharge from the index event as part of the six-year follow-up study of 28-day myocardial infarction survivors.

7.3.1 Summary of Economic Analysis

(i) Six-year health service resource use data were collected from hospital and general practice casenotes starting from the time of the index myocardial infarction.

(ii) The entire six-year follow-up period was partitioned into yearly intervals and patients who were alive at the beginning of each follow-up year were included in that year.[9]

(iii) Patients with incomplete follow-up data, because they had moved from the area before the finish of the six-year study period, were excluded for the year after the move.[9]

(iv) Health service resource use data were reported for patients with available data for each category of resource use.

(v) Imputed mean values of resource use were allocated conditionally to patients with missing data in order to calculate associated annual economic costs.

(vi) Hospital in-patient episodes were costed using length of stay and clinical specialty.

(vii) Weighted averages of cost were employed for both outpatient appointments and preventive medication to simplify analyses.

7.3.2 Summary of Statistical Analysis

(i) Data were analysed using the statistical package SPSS 10.0 for Windows (SPSS Inc. 2001, Chicago Illinois).

(ii) Means were compared using Student's t test and variance was reported as either a standard deviation or 95% confidence interval.

7.3.3 Patients

The patient cohort for this chapter consisted of 606 hospital survivors (426 men and 180 women) and was described in Chapter 5.

7.3.4 Definitions of Health Service Resource Use

7.3.4.1 Hospital Resource Use

Hospital resource use for the index myocardial infarction was recorded. From this point onwards, any hospital re-admissions and outpatient appointments were

classified as CHD or non-CHD, based on clinical reasons for hospital contact, regardless of clinical speciality. In-patient CHD admissions included those for any non-fatal or fatal coronary event. As in chapter 5, a coronary event was defined as a recurrent myocardial infarction, unstable angina, exertional angina or coronary revascularisation. Definitions for each coronary diagnosis were described in section 5.3.3. Day case admissions for CHD were for a diagnostic coronary angiogram procedure only. CHD outpatient appointments included: (i) those that were immediately after discharge from hospital having been admitted for CHD reasons; (ii) those for follow-up of ongoing CHD problems; or (iii) those during which a new CHD diagnosis was made. All other hospital contacts (admissions or outpatient appointments) were classified as non-CHD and were excluded from analyses.

7.3.4.2 General Practice Resource Use

Consultations with general practitioners (GPs) and practice nurses (PNs) were noted separately. If it was unclear from the casenotes which health professional had seen the patient, the consultation was categorised as with a GP. In contrast to hospital data, general practice consultations for all reasons were recorded and included in the data analyses. (The difficulty of distinguishing those specifically for CHD had already been established from the author's previous experience of general practice research.[10])

7.3.4.3 Preventive Medication

As in chapter 5, preventive medications comprised aspirin, beta-blockers, ACE-inhibitors and statins.

7.3.5 Data Collection

The procedures for locating hospital and general practice casenotes were detailed in section 5.3.2. Additionally, re-admission and outpatient appointment data were retrieved from computerised hospital records for those patients with no available

paper records (two men and three women). Design and pilot of the data collection instrument were reported in section 5.3.5 and quality assurance was described in section 5.3.6.

7.3.5.1 Hospital Resource Use

Admission and discharge dates were recorded for the index myocardial infarction. For each subsequent admission and outpatient appointment for CHD, the date(s), clinical speciality and clinical reason of each episode were recorded (see Appendices F and G respectively).

7.3.5.2 General Practice Use

Consultations were counted from each patient's index event date in 1994 or 1995 to the six-year follow-up date in 2000 and were recorded by calendar year (see Appendix H).

7.3.5.3 Preventive Medication

Details of data collection were reported in section 5.3.4 and dates were recorded each time a medication prescription was noted in hospital or general practice records.

7.3.6 Data Availability

7.3.6.1 Hospital Resource Use

For the index myocardial infarction, 586 patients (413 men and 173 women) were admitted to hospital. Of these, admission and discharge dates for the index event were extracted from medical casenotes in Oxford, Banbury and Reading hospitals for all 561 patients. For the remaining 25 patients admitted to other hospitals, the number of days in hospital was extracted from the baseline OXMIS electronic database. There were 20 patients treated by their general practitioner and never admitted to hospital.

Table 7.1 shows follow-up casenote availability and completeness for the 606 hospital survivors. Hospital records were located for 97.5% (591) of patients and 95.9% (567) provided complete data. Notes were missing for 2.5% (15) of survivors and these patients (12 men and 3 women) were excluded from analyses of hospital resource use data. For the 19 patients who moved from the area before the six-year follow-up period was complete, data were collected from available hospital notes up to the move date. Patients were excluded from analyses for the year following the move date. The median length of follow-up from hospital notes for these 19 patients was 3.8 years (IQR, 1.9 years to 4.6 years).

Table 7.1 Number of patients with follow-up hospital resource use data by completeness

	Men	Women	Total
Hospital survivors	426	180	606
Hospital casenotes			
Complete*	396	171	567
Partially complete	18	6	24
Missing	12	3	15

Note: *Includes those with computerised data only for re-admissions and outpatient appointments. (2 men and 3 women)

7.3.6.2 General Practice Resource Use

General practice consultation data were obtained from each patient's registered practice. Table 7.2 shows data availability and completeness by sex. General practice records were available for 64% of patients. Casenotes were unavailable or missing for 36% (221) of survivors (see section 5.3.4.2 for explanation) and these patients (141 men and 80 women) were excluded from analyses of general practice resource use data. (Annual CHD hospital use was compared for patients with and without available general practice records and no significant differences were observed between the groups.) Management of patients who had moved from the area during the study follow-up period was as described above for the hospital resource use.

Table 7.2 Number of patients with follow-up general practice resource use data by completeness

	Men	Women	Total
Hospital survivors	426	180	606
GP Casenotes			
Complete	269	98	367
Partially complete	16	2	18
Missing	141	80	221

7.3.6.3 Preventive Medication

Preventive medication data were available from three potential sources, which included hospital casenotes, general practice casenotes and a postal questionnaire. The availability of follow-up prescriptions for coronary preventive medications by source of data for men and women is shown in Table 7.3. Follow-up data were available from at least one source for 99% (602) of hospital survivors. For the four patients with no available follow-up data from these sources, medications prescribed at hospital discharge for the index myocardial infarction were used. All 606 hospital survivors were, therefore, included in the medication analyses.

Table 7.3 Available follow-up medication data by source of data, availability and completeness: hospital survivors

	Men	Women	Total
Hospital survivors	426	180	606
From hospital casenotes			
Complete	394	168	562
Partially complete	18	6	24
Missing	14	6	20
From general practice casenotes			
Complete	283	102	385
Partially complete	3	0	3
Missing	140	78	221
From postal questionnaire at 7 years			
Died before questionnaire sent	115	58	173
Responder	205	61	266
Non-responder	106	61	167
From hospital & general practice casenotes & questionnaire			
At least 1 source of casenotes complete	408	172	580
Incomplete casenotes & questionnaire complete	7	3	10
Incomplete casenotes & no questionnaire	5	3	8
Questionnaire only	4	0	4
OXMIS discharge notes only	2	2	4

7.3.7 Data Preparation

7.3.7.1 General

The three health resource use datasets (hospital, general practice and medications) consisted of different sub-groups of the patient cohort due to missing data. Cost analyses for the entire cohort of 606 hospital survivors required that values be assigned to those patients with missing data from hospital and/or general practice records. Generally, mean values from the available data for each resource use event were applied to patients with missing data, using the appropriate sex and year of follow-up for which the data were missing. Further details are described later in the relevant sections.

7.3.7.2 Hospital Resource Use

Each CHD hospital event was categorised into the appropriate follow-up year, using the episode date. For example, all CHD hospital events were included in the first follow-up year if they occurred within 365 days of the OXMIS event date. The second year included those that occurred between 366 and 730 days after the OXMIS event and so on.

7.3.7.3 Hospital Costs

Cardiology, general medicine and cardiac surgery were the three clinical specialities primarily responsible for CHD hospital care. CHD admissions that were classified as such because of clinical reason (but not officially admitted under one of these three clinical specialities) were re-classified as follows: cardiology, if a coronary angiogram or angioplasty was performed; cardiothoracic surgery, if coronary artery bypass surgery was carried out; and general medicine, if there were no such procedures.

The 15 patients with no available hospital records (Table 7.1) were assigned the mean number of CHD admissions from the available resource use data by sex, follow-up year and clinical speciality. For outpatient appointments, mean values were assigned using sex and follow-up year.

For CHD admissions, the average costs per day in hospital for each clinical speciality, based on data from British hospitals, was £446 for cardiology, £189 for general medicine and £654 for cardiac surgery.[11] The mean number of days in hospital per patient for each speciality was calculated for each follow-up year. The relevant cost per day was applied to produce an accurate cost estimate for CHD hospital admissions.

For CHD outpatient appointments, the differences in cost per attendance between specialities were less than for admissions, so a weighted average was used to simplify analyses. The average cost for an outpatient appointment with cardiology

was £81, general medicine was £98 and cardiac surgery was £108.[11] A weighted average unit cost for CHD outpatient appointments was calculated based on the overall proportion of appointments for each speciality during the six year study period (cardiology: 43%, medicine 53% and cardiac surgery 4%). These figures were multiplied by the relevant cost and summed to give £91 as the weighted mean cost of a CHD outpatient appointment.

7.3.7.4 General Practice Resource Use

The patient denominator for each general practice follow-up year differed from that for hospital data (see section 7.3.5.2). In general, it was defined as the number of patients alive on January 1 at the beginning of each calendar year in the study period. For example, the second follow-up year was 1996; the third was 1997, etc). The exception was the first year, because patients had been identified between November 14 1994 and November 13 1995 and the first general practice follow-up year was from November 14 1994 to December 31 1995. Consequently, all identified patients contributed data for between 13.5 and 1.5 months. To adjust for the varying number of months in this 'first' year and create a standard twelve-month year for each patient, the total number of consultations was divided by the number of months that each patient was included (index event date to December 31 1995) and multiplied by 12.

The second to fifth years (1996 to 1999 respectively) consisted of twelve months for each patient alive on January 1 of each year, so no adjustments were necessary. For the sixth year, only data from 2000 were used for simplicity. For those patients identified in 1994 (34 men and 6 women) who were alive on January 1 2000, the number of months contributing data ranged from 10.5 to 12. For example, a patient identified in December 1 1994 would have a cut-off date at the end of their six-year follow-up of November 30 2000, therefore contributing data for only 11 months. As before, the total number of consultations was divided by the number of months that each patient was included and multiplied by 12. For

patients identified in 1995 and alive on January 1 2000, it was a twelve-month year and no adjustments were necessary.

7.3.7.5 General Practice Costs

The 221 patients with no available general practice consultation data (Table 7.2) were allocated the mean number of GP and practice nurse consultations from the available general practice resource use data by sex, history of diabetes and follow-up year. Diabetic history was included because systematic care for known diabetic patients had been established as routine in general practice and these patients would therefore have more consultations than non-diabetics.

Costs of consultations with general practitioners and practice nurses for the 606 hospital survivors were calculated. The costs of consultations in general practice were based on the national average of a nine minute GP consultation costing £18 and a 20 minute practice nurse consultation costing £10.[12] Both of these figures included qualification costs (equivalent annual costs of pre- and post-registration education, after the total investment cost has been annuitised over the expected working life of the health professional). Direct care staff costs were excluded from those for GP consultations, because practice nurse consultations were presented separately.

7.3.7.6 Preventive Medication

7.3.7.6.1 Stop Dates

Prescription start dates were previously ascertained and reported in chapter 5. For this chapter, stop dates for prescriptions were also needed to describe medication use. They were determined in several ways by cross-referencing between hospital casenotes, general practice records and current prescriptions reported by patients on seven-year questionnaires (see section 6.3.5 for data collection details).

i) when a patient had been prescribed the medication of interest at hospital admission but not at discharge, the admission date was assigned as the stop date.

ii) when the last recorded prescription date was within the six-year follow-up period, stop dates were assigned as follows:

a) the mid-point from the last noted prescription date and the first date when there was no prescription for the medication of interest.
b) six year follow-up or death date, if there was no record of the medication being stopped.

For ACE-inhibitors and statins, detailed drug histories were available for patients with general practice records. These were cross-referenced with hospital records. If there were discrepancies, hospital records were used, since the gradual introduction of computerised records in general practices during the follow-up period may have resulted in omissions.

7.3.7.6.2 Calculation of Annual Number of Preventive Medication Tablets

The number of tablets for each medication group was estimated by first calculating the number of days within each year that a patient was prescribed the medication. Since aspirin and statins were prescribed to be taken once a day, the number of days was equal to the number of tablets within each year.

The daily frequency of beta-blocker and ACE-inhibitor prescriptions varied from daily to three times a day. The mean daily medication frequency was calculated from the current general practice prescription data for each drug group by dividing the number of tablets prescribed per day by the number of patients with prescriptions for each daily frequency and is shown in Table 7.4. For beta-blockers, the mean daily frequency was 1.1 (190/169) and for ACE-inhibitors it was 1.4 (289/211). The mean number of days within each follow-up year was then multiplied by the relevant adjustment factor to produce a weighted mean for the number of beta-blocker and ACE-inhibitor tablets per patient per year.

Table 7.4 Mean daily dose of Beta-blocker and ACE-inhibitor medications

Number of tablets per day	Number of prescriptions	Number of tablets per day (number of tablets per day x number of prescriptions)
Beta-blockers		
1	154	154
2	9	18
3	6	18
Total	**169**	**190**
ACE-inhibitors		
1	155	155
2	34	68
3	22	66
Total	**211**	**289**

7.3.7.7 Preventive Medication Costs

Medication costs were based on the 2001 prescription costs.[13] The most common drug and dose recorded in the current prescriptions of the general practice database were determined for each medication group. For aspirin, the cost was £0.01 per tablet for both 75mg and 150mg. For beta-blockers, atenolol was the most commonly prescribed accounting for 78% of beta-blocker prescriptions. Consequently, beta-blocker costs were calculated based on atenolol prices; the most frequent doses were 50mg at £0.03 (58%), 100mg at £0.03 (20%) and 25mg at £0.02 (19%) and the weighted average cost was £0.03.

For ACE-inhibitors, four medications accounted for 97% of prescriptions: lisinopril (43%), enalapril (27%), captopril (15%) and ramipril (12%). A weighted cost was chosen to simplify analyses. To calculate the weighted cost, the proportion of prescriptions for each available dose was determined for each medication, and then multiplied by the relevant tablet price to calculate the weighted cost of prescriptions for each medication. The sum of these provided the weighted cost of each medication by dose and was multiplied by the proportion of ACE-inhibitor prescriptions accounted for by the specific medication. The details are shown in Table 7.5.

Table 7.5 Weighted cost calculations for ACE-inhibitors

Drug and dose	% of prescriptions for each dose	Cost per tablet (£)	Contribution to weighted cost by dose (£)
Lisinopril (Zestril)			
2.5mg	12	0.26	0.03
5.0mg	27	0.28	0.08
10.0mg	38	0.35	0.13
20.0mg	24	0.39	0.09
Total weighted cost			**0.33**
Enalapril			
2.5mg	7	0.09	0.01
5.0mg	25	0.14	0.04
10.0mg	40	0.18	0.07
20.0mg	26	0.23	0.06
Total weighted cost			**0.17**
Captopril			
12.5	25	0.04	0.01
25.0	47	0.05	0.02
50.0	25	0.07	0.02
Total weighted cost			**0.05**
Ramipril (Tritace)			
2.5	33	0.27	0.09
5.0	41	0.34	0.14
10.0	26	0.46	0.12
Total weighted cost			**0.35**

ACE-Inhibitors	% of prescriptions for each drug	Weighted cost of each drug (£)	% x Cost (£)
Lisinopril (Zestril)	43	0.33	0.14
Enalapril	27	0.17	0.05
Captopril	15	0.05	0.01
Ramipril (Tritace)	12	0.35	0.04
Total weighted cost			**0.24**

Simvastatin was the most common statin accounting for 65% of statin prescriptions. The doses were 10mg (50%), 20mg (39%) and 40mg (11%). The cost of 10mg tablets was £0.64 per tablet and the cost of the latter two doses was £1.06. An average cost of £0.85 was calculated (50% x £0.64 + 50% x £1.06).

An additional cost to the NHS for dispensing, professional fees, and allowances of £1.49 was included for each prescription,[14] assuming quarterly prescription renewals. For each patient, the number of days on each medication within each follow-up year was the basis for estimating the number of dispensing fees (90 days or less = 1 fee, 91-180 = 2, 181-270 = 3, > 270 = 4).

7.4 Results

7.4.1 Hospital Resource Use

7.4.1.1 Admissions

Amongst the 586 patients admitted to hospital for the index myocardial infarction, the mean number of days spent in hospital was 8.7 (SD 8.0) for men and 9.2 (7.8) for women.

Subsequent hospital resource use analyses were for the 591 patients (414 men and 177 women) with available hospital follow-up data. Table 7.6 shows the number of CHD admissions and days in hospital per patient by year of admission and sex. The time period of most hospital admissions and days in hospital for CHD was the first year after the index myocardial infarction.

For both men and women, the mean number of first year in-patient admissions per patient was 0.3 (0.6) and day-case admissions was 0.1 (0.3). Overall, the number of CHD admissions per patient (in-patient and day case) decreased in the second and third years and was static during the fourth to sixth years. There were no differences between men and women in the annual mean number of admissions (in-patient or day case) or the number of days spent in hospital per patient in any of the six follow-up years.

7.4.1.2 Outpatient Appointments

Hospital outpatient appointments for CHD are shown in Table 7.7. Like hospital admissions, most CHD outpatient appointments occurred during the first year after the index event. For both sexes, the mean number of appointments per patient in the first year was 1.5 (SD 1.3). During the second to sixth years, the annual mean ranged between 0.2 and 0.3 per patient for men and 0.1 and 0.3 for women.

Table 7.6 Number of admissions and days in hospital for CHD per patient within each year by sex
Mean (SD), unless otherwise stated

	1st year#	2nd year	3rd year	4th year	5th year	6th year
Men	N=414	N=392	N=374	N=355	N=341	N=323
All-cause deaths, % (n)	5.3 (21)	4.3 (17)	4.8 (18)	3.1 (11)	3.2 (11)	4.3 (14)
Moved away, % (n)	0.2 (1)	0.3 (1)	0.3 (1)	0.9 (3)	2.1 (7)	0.3 (1)
In-patient admissions (N)	118	57	37	39	30	24
Number per patient*	0.3 (0.6)	0.2 (0.5)	0.1 (0.4)	0.1 (0.4)	0.1 (0.4)	0.1 (0.3)
Total days in hospital (N)	944	435	255	328	196	231
Days in hospital per patient*	2.0 (5.3)	1.0 (3.9)	0.6 (2.6)	0.8 (4.7)	0.5 (2.3)	0.6 (3.7)
Days per admission	8.0 (5.8)	7.6 (6.5)	6.9 (4.3)	8.4 (10.0)	6.5 (4.9)	9.6 (8.8)
Day case admissions (N)	47	6	6	3	6	3
Number per patient**	0.11 (0.33)	0.02 (0.12)	0.02 (0.13)	0.01 (0.01)	0.01 (0.13)	0.01 (0.01)
Women	N=177	N=159	N=149	N=140	N=133	N=124
All-cause deaths, % (n)	10.7 (18)	4.4 (7)	5.4 (8)	5.0 (7)	6.0 (8)	4.0 (5)
Moved away, % (n)	0	1.9 (3)	0.7 (1)	0	0.8 (1)	0
In-patient admissions (N)	59	19	12	10	13	20
Number per patient*	0.3 (0.6)	0.1 (0.5)	0.1 (0.3)	0.1 (0.3)	0.1 (0.4)	0.2 (0.5)
Total days in hospital (N)	554	223	47	102	80	199
Days in hospital per patient*	3.1 (6.9)	1.4 (5.9)	0.3 (1.4)	0.7 (3.4)	0.6 (2.4)	1.6 (7.3)
Days per admission	9.4 (7.1)	11.7 (10.4)	3.9 (2.3)	10.2 (8.4)	6.2 (3.7)	10.5 (12.7)
Day case admissions (N)	12	2	0	0	0	0
Number per patient**	0.07 (0.27)	0.01 (0.11)				

excludes admission for index myocardial infarction; * includes all patients available for hospitalisation in each time period
** also equals number of days in hospital per patient, because each admission was only for one day by definition

Table 7.7 Number of outpatient appointments for CHD within each year by sex

	1st year	2nd year	3rd year	4th year	5th year	6th year
Men	N=414	N=392	N=374	N=355	N=341	N=323
All-cause deaths, % (n)	5.3 (21)	4.3 (17)	4.8 (18)	3.1 (11)	3.2 (11)	4.3 (14)
Moved away, % (n)	0.2 (1)	0.3 (1)	0.3 (1)	0.9 (3)	2.1 (7)	0.3 (1)
CHD Appointments (N)	673	119	76	57	60	64
Mean number per patient, (SD)	1.6 (1.3)	0.3 (0.8)	0.2 (0.6)	0.2 (0.6)	0.2 (0.6)	0.2 (0.6)
Women	N=177	N=159	N=149	N=140	N=133	N=124
All-cause deaths, % (n)	10.7 (18)	4.4 (7)	5.4 (8)	5.0 (7)	6.0 (8)	4.0 (5)
Moved away, % (n)	0	1.9 (3)	0.7 (1)	0	0.8 (1)	0
CHD Appointments (N)	262	53	21	21	18	29
Mean number per patient, (SD)	1.5 (1.3)	0.3 (0.8)	0.1 (0.5)	0.2 (0.5)	0.1 (0.6)	0.2 (0.8)

* includes all patients available for outpatient appointments in each time period

7.4.2 General Practice Consultations

General practice resource use analyses were restricted to the 385 patients (285 men and 100 women) with available general practice data. Table 7.8 shows all consultations in general practice by year and sex. Like hospital resource use, the time period of most general practitioner (GP) consultations (for CHD and non-CHD reasons) was within the first year with an average of 13.1 (SD 10.2) consultations for men and 15.3 (10.4) for women. For the second to sixth years, the annual mean number of GP consultations was 6.9 (6.9) for men and 9.1 (8.9) for women. For practice nurse (PN) consultations, the overall annual average was 1.7 (3.4) for men and 1.8 (5.2) for women during the six years.

Table 7.8 Consultations for all reasons (CHD and non-CHD) in general practice within each year by sex
Mean (SD), unless stated otherwise

	1st year*	2nd year	3rd year	4th year	5th year	6th year*
Men	N=285	N=282	N=270	N=261	N=251	N=243
GP Consultations (N)	3744	2065	1854	1739	1676	1632
Consultations per patient	13.1 (10.2)	7.3 (7.2)	6.9 (6.4)	6.7 (7.2)	6.7 (6.8)	6.7 (6.9)
PN Consultations (N)	505	425	341	343	419	583
Consultations per patient	1.8 (4.5)	1.5 (3.7)	1.3 (2.4)	1.3 (2.4)	1.7 (3.0)	2.4 (4.1)
Total Consultations (N)	4249	2490	2195	2082	2095	2215
Consultations per patient	14.9 (11.3)	8.8 (8.5)	8.1 (7.1)	8.0 (7.9)	8.4 (7.7)	9.1 (8.8)
Women	N=100	N=93	N=89	N=84	N=80	N=77
GP Consultations (N)	1534	933	791	736	676	715
Consultations per patient	15.3 (10.4)	10.0 (8.9)	8.9 (9.3)	8.8 (8.2)	8.5 (9.1)	9.3 (9.2)
PN Consultations (N)	191	185	200	92	152	108
Consultations per patient	1.9 (6.1)	2.0 (7.9)	2.3 (8.6)	1.1 (2.5)	1.9 (4.1)	1.4 (2.1)
Total Consultations (N)	1725	1118	991	828	828	823
Consultations per patient	17.3 (13.7)	12.0 (12.9)	11.1 (13.2)	9.9 (8.3)	10.4 (9.9)	10.7 (9.7)

GP, general practitioner; PN, practice nurse; * standardised

7.4.3 Preventive Medication

The following analyses are for all 606 hospital survivors (426 men and 180 women). Table 7.9 shows preventive medication prescribed for each year after the index myocardial infarction. Over the six year follow-up, the annual mean number of aspirin tablets prescribed was the equivalent of between 295 to 320 per patient for men and 290 to 321 for women. For beta-blockers, the equivalent was between 215 and 244 tablets on average prescribed per patient per year for men and 203 to 218 for women. For ACE-inhibitors, the annual mean was 230 to 239 tablets for men and 233 to 251 for women. However, the annual mean for statin tablets increased over the six year follow-up period. For men, the mean was 55 tablets in the first year, which increased to 165 in the sixth year (difference, 110 (89 to 131], $p<0.0001$). For women, it was 56 in the first year and 149 in the sixth year (difference, 93 [60 to 126], $p<0.0001$).

Table 7.9 Mean number (SD) of preventive cardiac medication tablets per patient within each year by sex

	1st year	2nd year	3rd year	4th year	5th year	6th year
Men	N=426	N=404	N=387	N=368	N=357	N=346
Aspirin	320 (108)	318 (118)	318 (117)	311 (124)	303 (134)	295 (140)
Beta-blocker	208 (192)	211 (197)	205 (197)	190 (197)	186 (198)	186 (198)
ACE-Inhibitor	215 (242)	213 (247)	211 (248)	219 (249)	220 (250)	220 (248)
Statin	55 (120)	83 (149)	104 (161)	128 (171)	148 (175)	165 (180)
Women	N=180	N=161	N=154	N=146	N=139	N=131
Aspirin:	305 (126)	321 (114)	315 (120)	295 (139)	288 (147)	290 (144)
Beta-blocker	177 (193)	189 (198)	186 (198)	181 (197)	176 (196)	183 (198)
ACE-Inhibitor	228 (238)	231 (252)	219 (251)	214 (250)	224 (252)	220 (248)
Statin	56 (118)	87 (153)	95 (158)	115 (166)	127 (174)	149 (175)

7.4.4 Health Service Costs

7.4.4.1 General

Unit costs were applied to resource use data and are shown in Table 7.10. All costs are expressed in UK £s in 2000/2001 prices, the last follow-up year of the six-year follow-up. As this study was descriptive not evaluative, discounting to account for lower costs in the earlier years was not performed.

Table 7.10 Unit cost for health resource events

Item	Unit Cost (2001/2002)	Source
Hospital		
Admissions	per day	Financial Returns for Financial year ending March 2001.[11]
Cardiology	£446.10	
General Medicine	£189.14	
Cardiac Surgery	£653.76	
Outpatient appointments	£91.26*	
General Practice		
Consultations with GP:	£18	Unit costs of health and social care 2002.[12]
Consultations with PN	£10	
Preventive Medication	per tablet	
Aspirin	£0.01	BNF 2001.[13]
Beta-blockers	£0.03	
ACE-inhibitors	£0.24*	
Statins	£0.85*	
Dispensing fee (per item)	£1.49	Main estimates for 2001-2002, Government's expenditure plan 2001.[14]

Notes: GP General Practitioner; PN Practice Nurse; *weighted

7.4.4.2 Hospital Costs

For the index event, the average hospital cost per patient was £2400 for both men and women. Costs for subsequent hospital episodes are shown in Table 7.11. In-patient admissions accounted for the greatest proportion of the costs. The time period of most hospital costs per patient was the first year; £1282 for men and £1415 for women. In the second to sixth years, the annual costs per patient ranged between £231 and £456 for men and between £79 and £502 for women. In the third year, men incurred slightly more hospital costs than women (£174, [£1 to

£347], p=0.049). For the remaining follow-up years, there were no significant gender differences.

Table 7.11 Hospital costs for CHD per patient within each year by sex
Mean cost (SD) £

	1st year*	2nd year	3rd year	4th year	5th year	6th year
Men	N=426	N=403	N=385	N=365	N=351	N=333
CHD Admissions	1133 (3252)	429 (1856)	234 (1041)	287 (1703)	215 (1034)	217 (1270)
CHD Outpatient appointments	148 (119)	28 (69)	19 (59)	15 (52)	16 (52)	18 (54)
Total	**1282 (3268)**	**456 (1878)**	**254 (1065)**	**301 (1709)**	**231 (1049)**	**235 (1294)**
Women	N=180	N=161	N=151	N=142	N=135	N=126
CHD Admissions	1280 (3292)	472 (2430)	67 (290)	256 (1390)	191 (920)	453 (1794)
CHD Outpatient appointments	135 (114)	30 (72)	13 (46)	14 (46)	12 (51)	21 (71)
Total	**1415 (3320)**	**502 (2445)**	**79 (315)**	**269 (1407)**	**203 (935)**	**475 (1828)**

* excludes admission for index myocardial infarction

7.4.4.3 General Practice Costs

General practice consultation costs are shown in Table 7.12. Consultations with a GP contributed more to the total costs than those with practice nurses. Like hospital costs, the first year was the time period of the highest cost; £256 for men and £293 for women. In the second to sixth years, the annual total costs per patient ranged from £136 to £156 for men and £164 to £201 for women. Overall, women incurred higher general practice costs than men within each follow-up year; in the first year, £37 [£10 to £65], p=0.008; second year £50 [£27 to £73], p<0.001; third year £48 [£26 to £71], p<0.001, fifth year £33 [£10 to £56], p=0.005 and sixth year £40 [£15 to £65], p=0.002. The fourth year was the one exception where the costs for men and women were similar (£9, [£14 to £31], p=0.44).

Table 7.12 Mean costs per patient for general practice consultations within each year by sex
Mean cost (SD) £

	1st year	2nd year	3rd year	4th year	5th year	6th year
Men	N=426	N=403	N=385	N=365	N=351	N=333
GP Consultations	238 (150)	135 (109)	124 (98)	121 (110)	122 (104)	124 (105)
PN Consultations	18 (37)	17 (31)	13 (20)	14 (20)	17 (26)	25 (34)
Total	**256 (156)**	**152 (117)**	**136 (102)**	**134 (114)**	**138 (110)**	**148 (118)**
Women	N=180	N=161	N=151	N=142	N=135	N=126
GP Consultations	273 (139)	182 (125)	163 (136)	154 (107)	153 (127)	174 (131)
PN Consultations	20 (45)	20 (60)	22 (66)	11 (19)	19 (32)	14 (16)
Total	**293 (160)**	**201 (147)**	**185 (154)**	**164 (107)**	**171 (131)**	**188 (134)**

GP, general practitioner; PN, practice nurse;

7.4.4.4 Preventive Medication Costs

The cost of preventive medications over the six years is shown in Table 7.13. The total annual preventive medication costs per patient increased over the six years; in the first year, it was £120 for men and £122 for women and in the sixth year, the cost was £213 for men and £205 for women. There were no statistically significant differences between men and women within any of the follow-up years. Statin prescriptions were the main contributor to the cost rises between the first and sixth years (differences: men £94, [£76 to £112], $p<0.0001$ and women £83, [£54 to £112], $p<0.0001$). The annual cost per patient for the other medications remained relatively constant over the six years and ranged between £8-9 for aspirin, £8-10 for beta- blockers and £54-58 for ACE-inhibitors.

Table 7.13 Cost of preventive cardiac medication per patient within each year by sex
Mean (SD) £

	1st year	2nd year	3rd year	4th year	5th year	6th year
Men	N=426	N=403	N=385	N=365	N=351	N=333
Aspirin	9 (3)	8 (3)	8 (3)	8 (3)	8 (4)	8 (4)
Beta-blocker	10 (9)	10 (9)	9 (9)	9 (9)	8 (9)	9 (9)
ACE-Inhibitor	54 (61)	54 (62)	54 (62)	56 (63)	56 (63)	56 (62)
Statin	47 (103)	71 (129)	89 (139)	110 (148)	127 (151)	141 (155)
Total	**120 (119)**	**143 (144)**	**160 (155)**	**182 (163)**	**199 (166)**	**213 (174)**
Women	N=180	N=161	N=151	N=142	N=135	N=126
Aspirin	8 (3)	9 (3)	8 (3)	8 (4)	8 (4)	8 (4)
Beta-blocker	8 (9)	9 (9)	9 (9)	8 (9)	8 (9)	9 (9)
ACE-Inhibitor	57 (60)	58 (64)	56 (63)	55 (63)	58 (64)	58 (63)
Statin	48 (103)	75 (132)	81 (136)	100 (143)	110 (150)	131 (151)
Total	**122 (123)**	**150 (152)**	**154 (156)**	**171 (166)**	**184 (175)**	**205 (174)**

Note: Includes dispensing fee

7.4.4.5 Total Health Service Costs

Table 7.14 shows the total annual health service costs incurred by 28-day infarct survivors over the subsequent six years following the index event. The greatest health service cost was incurred within the first year with a mean of £1566 for men and £1830 for women, 77% of which was due to hospital costs. In the second year, total costs were reduced to £751 for man and £854 for women. In the third to sixth years, the total annual cost per patient reduced further and ranged between £550 and £614 for men and between £418 and £867 for women. There were no statistically significant gender differences.

Total health service costs for each year are also illustrated in Figure 7.1a and 7.1b. After the initial expense of the first year, annual costs per patient fell, but continued at a fairly constant level for each of the subsequent five years.

Table 7.14 Total health service costs within each year by sex and source
Mean (SD) £, unless otherwise stated

	1st year*	2nd year	3rd year	4th year	5th year	6th year
Men	N=426	N=403	N=385	N=365	N=351	N=333
Deaths, % (n)	5.2 (22)	4.2 (17)	4.9 (19)	3.0 (11)	3.1 (11)	4.2 (14)
Moved away, % (n)	0.2 (1)	0.3 (1)	0.3 (1)	0.8 (3)	1.4 (7)	0.3 (1)
Hospital	1282 (3268)	456 (1878)	254 (1065)	301 (1709)	231 (1049)	235 (1294)
General Practice	256 (156)	152 (117)	136 (102)	134 (114)	138 (110)	148 (118)
Medications	120 (119)	143 (144)	160 (155)	182 (163)	199 (166)	213 (174)
Total	**1657 (3303)**	**751 (1903)**	**550 (1116)**	**614 (1666)**	**569 (1083)**	**597 (1336)**
Women	N=180	N=161	N=151	N=142	N=135	N=126
Deaths, % (n)	10.6 (19)	4.4 (7)	5.3 (8)	4.9 (7)	5.9 (8)	4.0 (5)
Moved away, % (n)	0	1.9 (3)	0.7 (1)	0	0.7 (1)	0
Hospital	1415 (3320)	502 (2445)	79 (315)	269 (1407)	203 (935)	475 (1828)
General Practice	293 (160)	201 (147)	185 (154)	164 (107)	171 (131)	188 (134)
Medications	122 (123)	150 (152)	154 (156)	171 (166)	184 (175)	205 (174)
Total	**1830 (3350)**	**854 (2474)**	**418 (405)**	**605 (1423)**	**559 (994)**	**867 (1832)**

* excludes admission for index myocardial infarction

Figure 7.1a Annual mean total health service costs per patient: Men

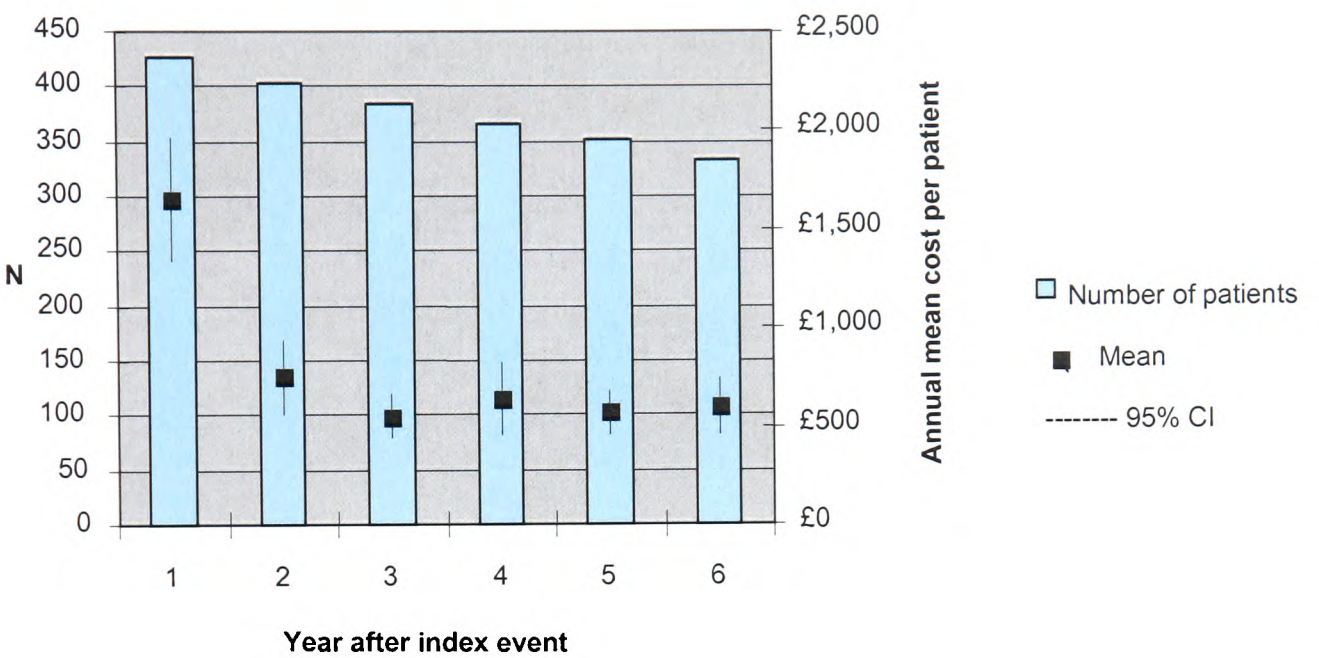
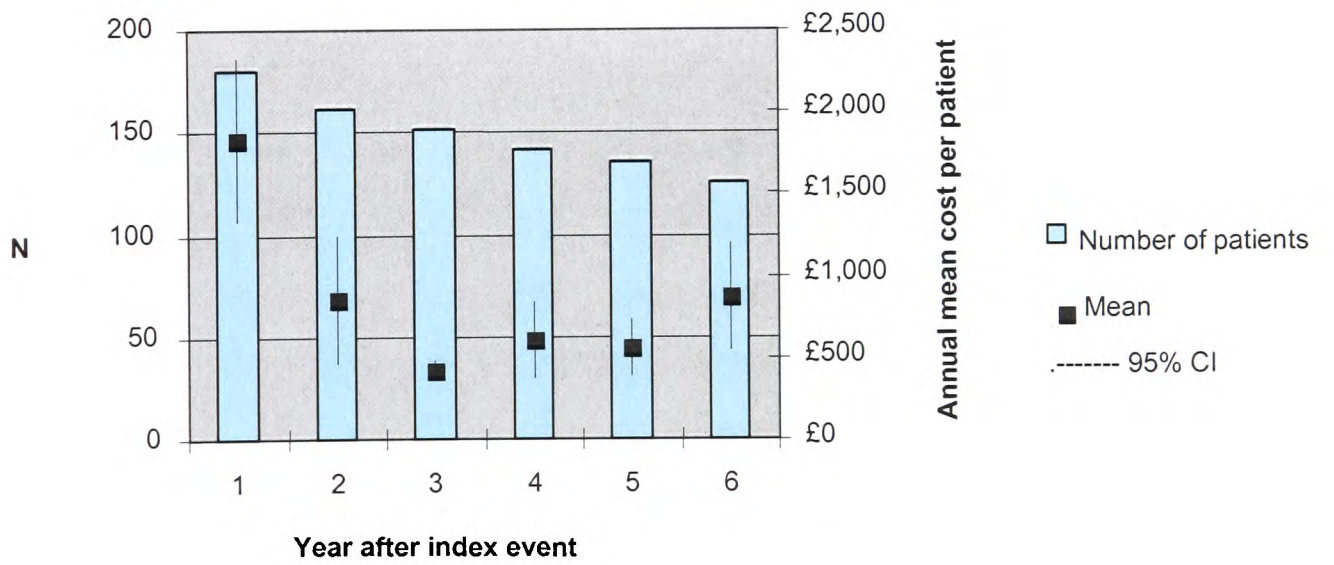


Figure 7.1b Annual mean total health service costs per patient: Women



7.4.4.6 Six-Year Health Service Costs

To calculate the mean total health service cost over the six years, the annual average costs were adjusted to account for deaths occurring during the previous year. The survival probability for each follow-up year was calculated using the

Kaplan-Meier method (see Chapter 3) and applied to the mean annual cost for each health service event and then summed over all six years. The health service costs observed for the entire six-year study period (excluding the index admission) are shown in Table 7.15. After hospital discharge for the index myocardial infarction, the six-year total health service cost for CHD was £4,168 for men and £4,181 for women.

Table 7.15 Adjusted Six-Year Health Service Costs per patient by source and sex

	Cost per patient, £	
Source	Men	Women
Hospital	2,471	2,444
General Practice	837	965
Medication	861	770
Total	**4,168**	**4,181**

7.5 Discussion

7.5.1 Key Findings

This chapter investigated the health service resource use and associated economic costs incurred over the subsequent six years from the index myocardial infarction in 606 hospital survivors. Inpatient costs of the index event were £2400 per patient. Ongoing CHD health service resource use was greatest within the first year after the index event when the associated mean costs per patient totalled £1600 for men and £1800 for women. From the third year onwards, expenses had reduced to a constant annual overhead of about £600 per patient. The six-year total cost was £4200 per patient (excluding the index event). For hospital and medication costs specifically for CHD, no gender differences were observed. However, women attended more general practice consultations than men for any clinical reason (not exclusively CHD).

7.5.2 Study Strengths

Unlike other follow-up studies of infarct survivors, health service use and cost data were collected simultaneously for CHD hospital episodes, general practice consultations and coronary preventive medication prescriptions. This ensured that the pattern and extent of costs due to CHD accurately reflected those incurred by the cohort during the six years following hospital discharge. Furthermore, clinical reason as well as speciality for each hospital episode was incorporated in the data collection. This enabled the inclusion of admissions and outpatient appointments initially for another problem during which a CHD diagnosis or investigation was recorded and included as resource use resulting from CHD progression. In addition, hospital data for those patients with missing or incomplete paper casenotes were obtained from computer records. These files contained data on discharge diagnosis and clinical speciality so that classification as a CHD or non-CHD event was possible, thereby increasing the completeness of hospital follow-up data from 93% to 96%. Thus, hospital data accurately reflect the impact on the health service of CHD progression over the six years of follow-up.

7.5.3 Study Limitations

The unavoidable inclusion of general practice consultations for clinical problems other than CHD was the main limitation to this study. It prevented the extraction and reporting of total health service use and costs exclusively due to CHD progression and monitoring. Furthermore, general practice resource use data were missing for 36% (221) of patients. This necessitated the imputing of mean values, which may have introduced some uncertainty to the total mean number of consultations in general practice within the cohort. Other limitations have been listed in chapter 5, section 5.5.3.

7.5.4 CHD Hospital Resource Use and Costs

This chapter reports the only longitudinal study of both hospital resource use and costs incurred solely due to CHD progression in 28-day survivors of myocardial

infarction identified in the mid-1990s. In this study, most CHD hospital events occurred in the first year after the index event with an average of 0.4 admissions and 1.5 appointments per patient. In the subsequent five years, the average per year was 0.1 for admissions and was 0.2 for appointments. The associated mean costs per patient were £1300 to £1400 in the first year and £300 within each subsequent year. Prior to this report, CHD health resource use and costs incurred by infarct survivors after hospital discharge was unknown and those responsible for budgeting CHD costs for patients discharged from hospital after a myocardial infarction had no concrete data on which to base their projections.

7.5.4.1 Admissions in the UK

The only other UK study to report hospital resource use, but not costs, after hospital discharge for myocardial infarction survivors was the Nottingham Heart Attack Register.[8] Direct comparisons with OXMIS was possible, since admissions in Nottingham were reported by diagnosis or clinical reason. Those with the same clinical reason or diagnosis as OXMIS were identified and after four years, an average of 0.7 (491/695) CHD hospital admissions per patient was found. Reanalysis of the OXMIS data showed an equivalent value for the four-year average per patient in OXMIS hospital survivors (0.7 [427/606] CHD admissions).

7.5.4.2 Outpatient Appointments in the UK

The number of hospital outpatient follow-up appointments in Nottingham was also reported and a mean of 4.1 (2829/695) per patient was found over the four-year study period. This was twice that in OXMIS where a mean of 2.1 (1282/606) was found. This difference may have been due to different inclusion criteria between the studies, since non-CHD appointments were excluded in OXMIS. It is not clear from the Nottingham report whether non-CHD appointments were included, since clinical reason or speciality were not specified for appointments and total hospital admissions for any reason in Nottingham was twice that of CHD only.

For costing and future budget consideration, routine hospital follow-up care usually includes an outpatient appointment four to six weeks after hospital discharge. Further analysis of OXMIS data by excluding one such appointment within the first year for each patient showed that the mean number of subsequent CHD hospital outpatient appointments was 0.8 (SD 1.2) for men and 0.8 (1.1) for women. This illustrates that patients continued to require monitoring for CHD reasons beyond standard hospital care, even within the first year.

7.5.4.3 Non-UK Admissions and Hospital Costs

Outside the UK, there were two other studies of health service use after a myocardial infarction from North America.[5] [6] However, methodological issues made direct comparison between OXMIS and these studies difficult. Firstly, both reports used an incomplete definition of subsequent CHD admissions. One of these, the GUSTO trial sub-group study, did not include admissions for recurrent infarctions or for unstable angina without diagnostic or revascularisation procedure.[6] The other, the Duke Medical Centre study, did not examine admissions for unstable angina or for diagnostic coronary angiograms.[5] Furthermore, the sample for the latter study was restricted to those patients who had a diagnostic angiogram and angiographic evidence of >75% stenosis in a minimum of one coronary artery at the time of their index event. In addition, patients identified as long ago as 1986 were included, when acute care may not have included thrombolysis.

Of the two above studies, only the Duke Medical Centre reported health service costs.[5] For 5,557 30-day infarct survivors during the post-acute phase (31 days to 10 years) the total cost was $23,470 based on 1997 US prices. Annual costs were not reported separately, and therefore comparison with OXMIS findings was not possible.

7.5.5 General Practice Resource Use and Costs

Resource use and costs in general practice followed the same pattern as that found in hospitals. The time of most consultations in general practice (with either a GP or PN) was in the first year with a mean of 15 for men and 17 for women. During the second to sixth follow-up years, the overall average number of consultations was 9 for men and 11 for women. In general, men and women had two practice nurse consultations per patient per year. The difference between men and women occurred in the number of consultations with GPs. This finding was consistent with overall gender differences observed in the UK national general practice data from the General Household Survey, which reported fewer GP consultations for men compared to women.[15] As previously mentioned, it was not possible to separate consultations specifically for monitoring or treatment of CHD.

7.5.6 Preventive Medication Use and Costs

In OXMIS, the total cost of coronary preventive medication increased from £120 per patient in the first year to £210 in the sixth year. The use and cost of aspirin, beta-blockers and ACE-inhibitors per patient remained constant over the six years. However, statin prescribing rose steadily each year and explained the increase in total medication costs. The rise in statin prescribing is likely to be due to the emerging evidence of the preventive benefits of statins in patients with established CHD during the mid to late 1990s. In a contemporary cohort of infarct survivors with similar level of coronary preventive medication prescribing, associated annual costs would be less than reported here, since statins are no longer under patent (as they were during the entire study period). No other studies have reported such data separately, so comparison was not possible.

7.5.7 Total Costs and Health Service Implications

The initial expense of the acute hospital care for the index myocardial infarction was £2400 per patient. Costs post-event totalled about £1800 per patient in the first year. After a reduction in the second year, infarct survivors continued to cost

the health service an average of £600 per year per patient. After six years, the mean total adjusted post-event cost was £4200 per patient.

The high resource use and associated costs in the first year may have been due to physiological factors, like an unstable coronary plaque causing chest pain and hospital admission, or the psychological factors, like anxious patients seeking reassurance from clinicians about their heart condition. The ongoing use and cost is most likely due to the progressive nature of CHD, despite various preventive treatments.

The main implication for the health service is the ongoing annual expense of CHD in myocardial infarction survivors. The National Service Framework (NSF) for CHD was published in March 2000 with recommendations for both hospital and general practice clinicians to improve the quality of follow-up for patients diagnosed with CHD.[16] Since the majority of costs reported in this chapter occurred before this time, the impact of NSF recommendations on the number of hospital referrals, GP consultations or prescriptions for coronary preventive medication for patients diagnosed with a myocardial infarction since 2000 is unclear. This chapter may provide useful comparative data for investigations of the health service use and costs of implementing the NSF.

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Chapter 8

Summary and Implications

8.1 Introduction

Reductions in myocardial infarction incidence and improvements in short-term survival have been well-documented. However, longer term outcomes and costs to the health service have been poorly explored. There have been few UK studies investigating the long-term outcomes and associated risk factors in patients diagnosed with myocardial infarction since 1990 and within these studies, there are a number of limitations (see Chapter 1).

It was in the context of the limitations in the number and quality of previous research studies that this thesis was proposed. It has documented the extent of long-term coronary heart disease (CHD) progression after a myocardial infarction and the consequences for patients' psychological health as well as for health service resources. In order to examine long-term progression of CHD, it was necessary to examine both early and late mortality, particularly in relation to possible sex or social class differences.

8.2 Summary of Main Results

In the first 28 days after the index myocardial infarction, 45% (505) of the entire cohort had died; 97% of deaths were attributed to CHD. Case-fatality was higher for women compared to men (49% vs 43%), which may be partly explained by gender differences in age and other baseline coronary risk factors. Women were on average five years older than men (70 years vs 65 years). Additionally, a history of diabetes and hypertension was more common in women than men, although fewer women had a previous myocardial infarction. In 28-day survivors, more women had had severe infarcts than men, so it is possible that this was the case in the entire cohort too, especially as differences in other baseline risk factors

between men and women in the entire cohort were similar among 28-day survivors.

Lower socioeconomic status was associated with higher coronary event rates in the Oxfordshire population, and within the cohort, lower social class was also associated with higher 28-day case-fatality rates, but only in men. A similar inverse relationship was expected for women, but none was observed, possibly due to the limitations of the classification of women's socioeconomic status. Neither was any socioeconomic gradient evident for postcode-based area deprivation groups.

Of the 613 28-day infarct survivors, 13% died from coronary-related disease during the six-year follow-up period, 5% in the first year. (Deaths from all causes were 25% and 8% respectively). No differences were observed between men and women. There were also no differences in mortality between socioeconomic groups, using either socioeconomic status indicator.

Non-fatal CHD progression was also examined in these 613 patients. About half suffered a further non-fatal coronary event (reinfarction, angina or revascularisation procedure) and over a third of patients were subsequently diagnosed with congestive heart failure. The time of highest risk was the first year after the index event, when 36% of patients were diagnosed with angina and 24% with congestive heart failure. In this first year, 5% of patients also underwent a revascularisation procedure. The risk of further CHD events fell after the first year, but remained more or less stable for the remaining five years of follow-up. At the end of this period, an additional 13% of patients had been diagnosed with angina and 14% with congestive heart failure, and 3% had undergone revascularisation. Of the 450 patients who had survived for six years, a third remained free of any cardiac-related morbidity. Unfortunately the numbers in the study did not allow a detailed investigation of the predictors of CHD-free survival, but no overall differences between men and women were observed.

Although no difference in long-term CHD morbidity was observed between men and women, there was a gender difference in psychological health at seven years, with more women being emotionally distressed. (Interestingly, no sex differences in emotional distress were noted at baseline.) At both baseline and seven years, emotional distress was more common in patients with current coronary symptoms: particularly cardiac complications (e.g. unstable angina, congestive heart failure) at baseline and angina symptoms at seven years. More women had current angina symptoms at seven years than men, but their excess risk of emotional distress persisted after adjustment for these symptoms.

Most infarct patients were treated with the recommended preventive medications (aspirin, beta-blockers and ACE-inhibitors), usually initiated at the time of the index event or in the first year. Statins were the exception, with merely 22% of patients receiving a prescription within the first year. Statin prescribing rose steadily each year and explained the associated increase in total medication costs. In a contemporary cohort of infarct survivors with similar prescribing rates of coronary preventive medication, associated annual health service costs per patient would be less than reported here, since cheaper generic statins are now available. However, this cost-saving may be off-set by other preventive treatments, which are now more routinely available than in the 1990s. These include cardiac rehabilitation programmes offered by hospital-based staff and regular long-term monitoring offered by general practice-based staff. The provision of these interventions would lead to increases in both hospital and general practice costs per patient in the first year after the index myocardial infarction.

The high prevalence of long-term cardiac-related morbidity also resulted in continuing costs and contact with health care providers, both in and out of hospital. Ongoing CHD health service resource use and associated costs were greatest within the first year after the index event reflecting the high risk of further CHD events during this time period. From the third year onwards, expenses had reduced to a constant annual overhead of about £600 per patient. Inpatient costs

of the index myocardial infarction were £2400 per patient, and the additional six-year total health service cost per patient was £4200.

8.3 Summary of Thesis Strengths and Limitations

8.3.1 Strengths of Baseline Data Collection

Rigorous methods were employed to identify the OXMIS patient cohort and to collect baseline diagnostic and survival data. Although these were the responsibility of other researchers, these methods contribute to the strengths of this thesis and therefore should be acknowledged. Baseline coronary events had been defined precisely using the internationally standardised WHO MONICA diagnostic criteria.[1] The inclusion of patients diagnosed with a 'possible' myocardial infarction ensured that the cohort was representative of patients diagnosed in routine clinical practice. Unlike the WHO MONICA project, patients up to the age of 80 years were included to further increase the generalisability. Survival status at 28 days was determined for all patients by review of death certificates and coroner's reports and through notification received from National Health Service Central Register at the Office of National Statistics.

Additional data collection at baseline also enabled classification of patients' socioeconomic status and psychological health. In contrast to other studies of infarct survivors, socioeconomic status had been defined using two indicators (individually ascertained social class and postcode-based area deprivation measured by Townsend Index). Within the cohort, socioeconomic status (using either or both measures) was available for at least 94%. Assessment of baseline psychological health made it possible to examine the relationship between baseline psychological problems and subsequent non-fatal cardiac and psychological outcomes in the same patient cohort and for a longer follow-up period than previous studies. Additionally, unlike other studies, probable cases of psychological problems (depression, anxiety or emotional distress) were identified using the Hospital Anxiety and Depression Scale. This instrument was specifically

designed to screen physically ill medical patients for clinically relevant psychological problems rather than diagnosing psychiatric patients. (Diagnostic details of cardiac complications at the time of the index event were collected retrospectively by the author to supplement the baseline data. These were available for 98% of 28-day survivors.)

8.3.2 Strengths of Follow-up Studies

This thesis built on the strengths of the earlier OXMIS baseline studies. Firstly, each patient's survival status over the six-year follow-up period was determined by extending the death notification arrangements with the National Health Service Central Register beyond 28 days. Ascertainment of all-cause and coronary mortality was complete, since all 28-day survivors were flagged and no patients were lost to follow up. Furthermore, coronary mortality rates were reported annually and for a longer time period than other UK studies.

Secondly, non-fatal coronary events were recorded to supplement the mortality data and complete the account of CHD progression. Non-fatal coronary events included angina, myocardial infarction and revascularisation to ensure a comprehensive outcome measure of first non-fatal CHD progression for each patient. In addition, episodes of congestive heart failure were also noted, since it is a recognised marker of CHD progression. Unlike other follow-up studies of infarct survivors, hospital outpatient and general practice records were reviewed as well as hospital in-patient notes to increase follow-up data completeness. Ascertainment of coronary events and congestive heart failure diagnoses was almost complete, since 93% of hospital casenotes were complete and only 3% of patients were lost to hospital follow-up. In addition, review of both hospital and general practice records increased the number of patients for whom follow-up data were available to 98%.

These non-fatal event follow-up data were collected using standardised forms, which included recent changes to diagnostic criteria to ensure that all possible coronary events and diagnoses of congestive heart failure were recorded over the six-year study period. Objective confirmation using investigative tests were the basis for 63% of angina and 81% of congestive heart failure diagnoses, which further increased the validity of these data. Details of recorded preventive cardiac medications were also extracted from both hospital and general practice notes to determine prescription initiation dates. This permitted cross-checking to confirm hospital recommendations were prescribed in general practice or in a subsequent outpatient appointment.

Thirdly, long-term psychological health was assessed using the same instrument as the baseline study, which allowed a longitudinal investigation of psychological health. For responders to the seven-year psychological questionnaire, data were 97% complete. Both the extent of coronary disease progression after the index myocardial infarction and ages of questionnaire responders were similar to non-responders, which eliminated response or age-related bias from these findings.

Finally, follow-up data for hospital resource use were 96% complete and therefore were likely to accurately reflect the impact on the health service of CHD progression over the six-year follow-up. Health service use and cost data were collected for CHD hospital episodes, general practice consultations and coronary preventive medication prescriptions. This ensured that the pattern and extent of costs due to CHD accurately reflected those incurred by the cohort during the six years after hospital discharge. Furthermore, 'clinical reason' as well as 'speciality' for each hospital episode was incorporated in the data collection. This enabled the inclusion of admissions and outpatient appointments initially for another problem during which a CHD diagnosis or investigation was recorded as resource use resulting from CHD progression.

8.3.3 Limitations of the Thesis

The main limitation of this thesis was the size of the cohort. The consequences of this issue have been discussed in earlier chapters. Other limitations were specific to particular topics and may have generated a degree of bias. A limitation specific to mortality outcomes was the reliance on death certificate diagnoses to classify CHD death, which may have resulted in an overestimate of six-year coronary mortality. Classifying women by their own occupation for social class was a shortcoming for the socioeconomic analyses, because it may not have reflected actual socioeconomic circumstances as satisfactorily as using the conventional head of household classification.

As with any study relying on routine clinical data, the completeness and accuracy of subsequent coronary diagnoses, their confirmation details and medication prescriptions may be limited, since systematic documentation cannot be guaranteed. Although data were available from at least one source for 98% of the cohort, only 60% of general practice records were complete. Thus subsequent coronary diagnoses and preventive medications initiated by general practitioners may have been underestimated.

Some bias might also be present in the psychological data, since questionnaire data were only available at baseline and seven years for 60% of all infarct survivors. At both time points, fewer questionnaires were received from patients in manual social classes. This imbalance may have biased some of the physical findings, since infarct survivors from manual social classes have reported poorer physical recovery than those in non-manual classes at one year.

The main limitation of the health economic analyses was the necessary inclusion of general practice consultations for clinical problems other than CHD. This prevented the extraction of CHD-specific consultation data and the reporting of total health service use and costs exclusively due to CHD progression and monitoring.

8.4 Thesis Results in a Broader Context

Despite these limitations, considered in its entirety, this thesis is unique within the context of previous UK research, since a comprehensive examination of long-term outcomes for the same patient cohort has not been previously reported. Several of its components constitute original research and, as such, have no comparators in the UK literature. These components include the studies of 28-day infarct survivors with the following outcomes: annual rates of coronary mortality, of non-fatal coronary events, of new congestive heart failure diagnoses, of newly prescribed coronary preventive medications and of CHD health service resource use and costs after hospital discharge.

Two of the socioeconomic investigations confirmed earlier UK studies. The inverse relationship between socioeconomic status and coronary event rates found in the relatively affluent Oxfordshire population corroborated a previous WHO MONICA report from the highly deprived population of north Glasgow. Similarly, the general socioeconomic gradient in 28-day coronary case fatality observed in Oxfordshire residents confirmed findings in a population-based study conducted across Scotland[2] and a hospital-based study in East London.[3]

Other aspects of the thesis have added to the existing literature, but due to methodological limitations, have not moved the ongoing debate forward. These include questions about whether or not low socioeconomic status or poor psychological health (noted at the time of a myocardial infarction) are predictors of subsequent CHD progression, both fatal and non-fatal. Additionally, questions about gender differences in long-term coronary disease progression and CHD-related psychological problems remain unanswered.

The cohort originated from a population with a low CHD risk, so the findings have relevance to patients from many areas in southern England with similarly low CHD risk diagnosed in the mid to late 1990s. However, general application of the thesis findings to clinical practice has been complicated by changes in patient care since

the mid-1990s, when the cohort was identified. Prescribing of secondary preventive medications, which include statins, beta-blockers and ACE-inhibitors, has become part of routine clinical care,[4] which would be expected to reduce long-term fatal and non-fatal progression of CHD. Furthermore, revised diagnostic criteria for myocardial infarction were proposed in 2000, with the addition of troponin T (a sensitive specific marker of myocardial damage).[5] This proposal lowers the diagnostic threshold and potentially could result in patients with a lesser extent of myocardial damage being diagnosed with a myocardial infarction. In fact, the number of patients diagnosed with myocardial infarction could be increased by as much as 40%.[6 7 8 9 10 11]

However, there have been a number of problems with the application of the new criteria in clinical practice.[12 13 10] For example, there have been wide variations in the troponin threshold for the diagnosis (depending on the assay used). To address these problems, the definition is currently being reviewed by an international panel. Furthermore, the British Cardiac Society has recently published recommendations that aim to inform the international review panel, to meet current treatment and prognostic needs of patients and to guide clinical practitioners.[14]

Using the revised criteria, the patients followed up in this thesis would still be diagnosed with a myocardial infarction. The cohort would be categorised to the severe end of the new 'acute coronary syndrome' continuum and the thesis findings could be applied to this sub-group of contemporary infarct patients. Consequently, the thesis results are likely to provide a conservative total estimate of the burden of coronary disease, since the longer-term morbidity and mortality may be lower in patients with less severe infarcts. However, if these 'milder' cases of myocardial infarction are included, CHD follow-up treatments (general practice and hospital visits) may be less per patient, so the average cost of CHD per patient might fall, with unpredictable effects on total costs.

Recent trends in acute and long-term treatment could also contribute to the likelihood that the costs of CHD reported in this thesis are conservative. Since the end of the OXMIS follow-up period in 2001, acute treatment of CHD has continued to develop with more costly medications (like clopidogrel and other antiplatelet drugs) and revascularisation procedures (like drug-eluting stents) being more widely used. In addition, the recommended level of post-hospital preventive care for post-infarct patients should have increased since the publication of the National Service Framework for CHD in 2000, with cardiac rehabilitation programmes being offered by hospital-based staff and regular long-term monitoring being offered by general practice-based staff. The delivery of this care would lead to increases in both hospital and general practice costs per patient in the first year after the index coronary event.

In summary, this thesis has ascertained the six-year prognosis for 28-day myocardial infarction survivors diagnosed in the mid-1990s in Oxfordshire. Despite the low coronary mortality rate, the extent of non-fatal coronary disease progression (including congestive heart failure) in the same patient cohort was substantial. This illustrates that the associated costs of living with CHD, rather than dying from it, are high. Similarly, a significant reduction in UK annual CHD mortality rates over the last 20 years was found to be offset by an increase in the annual incidence of angina and resulted in no overall change in CHD incidence.[15] However, it remains unclear to what extent the findings of this thesis are representative of rates of coronary mortality and morbidity in other areas of the country.

8.5 Future research

The work described in this thesis has answered some important questions about the six-year progression of coronary heart disease and associated costs to the health service. Additionally, it has provided a potential template for future studies

of CHD progression in myocardial infarction survivors. It has also highlighted some issues that need consideration in future research

Once the troponin issue in the diagnostic criteria has been resolved in the UK, the Myocardial Infarction National Audit Project (MINAP) offers a wonderful opportunity for national studies of CHD progression. The MINAP database was initially developed to assist hospital clinicians with the audit requirements of the National Service Framework for CHD by providing a centralised system for monitoring levels of care.[16] [17] [18] It has become a national register with hospital admission details for all 'suspected' myocardial infarctions for all 231 English and Welsh hospitals. It has been linked to the Office of National Statistics NHS Central Register to record details of deaths.[19] [20] This will allow routine monitoring of mortality and case-fatality rates for acute myocardial infarction and coronary syndromes in England and Wales.

However, recent guidance from the General Medical Council and other professional bodies on data protection[21] make epidemiological studies of non-fatal coronary events in post-infarct patients virtually impossible. The need for informed consent to access medical records and anonymised databases denies future researchers the opportunity to build on and expand the work of this thesis. Research affected includes any study that relies on individual patient identification to enable long-term follow-up studies of disease progression.[22] [23] [24] [25]

This situation is in a state of transition in the UK.[21] If it can be resolved, especially for MINAP as a coronary disease register, the matching of an individual's MINAP record with hospital and general practice records for subsequent CHD diagnoses would permit a comprehensive study of CHD progression. It could also provide data from randomly selected hospitals for a research programme of follow-up studies using a similar set of comprehensive outcomes as this thesis. Once established, future comprehensive studies of trends in coronary disease

progression examining both mortality and morbidity would be possible for England and Wales.

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Baseline OXMIS paper

Coronary event and case fatality rates in an English population: results of the Oxford myocardial infarction incidence study

Heart 1998;80:40–44

Coronary event and case fatality rates in an English population: results of the Oxford myocardial infarction incidence study

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Abstract

***Objectives*—To determine coronary event and case fatality rates in an English population aged less than 80 years in Oxfordshire, and to compare these rates with those reported by the UK monitoring trends and determinants of cardiovascular disease (MONICA) centres in Scotland and Northern Ireland and those ascertained in Oxfordshire in 1966–67.**

***Design*—A population wide surveillance study conducted in 1994–95 using prospective and retrospective case ascertainment.**

***Setting*—A resident population in Oxfordshire of 568 800.**

***Subjects*—Patients with suspected myocardial infarction or coronary death.**

***Outcome measures*—A diagnosis of definite or possible myocardial infarction or coronary death using WHO MONICA diagnostic criteria based on symptoms, electrocardiograms, cardiac enzymes, necropsy findings, and past medical history.**

***Results*—The annual rate for a first or recurrent coronary event per 100 000 population aged less than 65 years in 1994–95 was 273 for men and 66 for women after age adjustment to a standard world population. Rates in the age group 65–79 years were 1350 for men and 677 for women. Between 1966–67 and 1994–95, the age standardised event rate in the age group 30–69 years decreased significantly by 33% (95% confidence interval (CI) 44 to 21) in men, and there was a non-significant reduction of 8% (95% CI −33 to 17) in women. The age standardised 28 day case fatality rates also decreased significantly by 28% (95% CI 41 to 15) in men and by 32% (95% CI 55 to 9) in women.**

***Conclusions*—The coronary event rate in Oxfordshire was much lower than rates reported by MONICA centres in Glasgow and Belfast, and similar to rates reported by MONICA centres in France and northern Italy. The substantially lower event rate accounts for lower coronary heart disease mortality in Oxfordshire than in Scotland and Northern Ireland. The reduced coronary mortality in this region is attributable to declines in coronary event and case fatality rates.**

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Keywords: myocardial infarction; coronary heart disease; incidence; case fatality

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Mortality from coronary heart disease (CHD) has been decreasing over the past two decades in the UK and most Western industrialised countries. In England and Wales between 1972 and 1989 age adjusted mortality fell by 33% in men and 23% in women aged 30–69 years[1] but there are wide geographical variations.[2,3] The relative contribution of coronary event and case fatality rates to temporal and geographical variation in mortality from CHD remains poorly understood, and there is concern that inpatient case fatality in England may not have declined since the early 1980s despite major advances in treatment.[4]

The aim of the Oxford myocardial infarction incidence study (OXMIS), a 12 month prospective, surveillance study, was to identify all patients with acute myocardial infarction among a population of 568 800 in Oxfordshire, England, in 1994–95 using World Health Organisation monitoring trends and determinants of cardiovascular disease (MONICA) project diagnostic criteria.[5] It provides the only data for an English population that are comparable with the MONICA data for Glasgow and Belfast. We report coronary event and case fatality rates and compare these with previously published data from a study conducted in the same county in 1966–67.[6,7]

Methods

Patients less than 80 years of age with first or recurrent myocardial infarction who were resident in Oxfordshire were registered in the study, irrespective of whether the event occurred in the study area. Patients were excluded if onset of the event was outside the study period, or occurred within 28 days of a preceding event. The resident population of Oxfordshire was based on the mid-1994 population estimates for the health authority. The study was approved by the central Oxford research ethics committee.

CASE ASCERTAINMENT

Multiple overlapping sources of case ascertainment were used to register patients with suspected infarction. Most non-fatal events were identified prospectively within hours to days of onset of the attack using the method previously referred to as "hot pursuit".[8] This involved searching the computerised hospital admission system daily and inquiring from staff in coronary care units and other medical wards, to identify patients with potential infarction admitted during the previous 24

Table 1 Annual event rates per 100 000 population for fatal and non-fatal first and recurrent coronary events in men and women

Age group (years)	Population	Non-fatal definite MI		Non-fatal possible MI		Fatal events	
		Number	Rate	Number	Rate	Number	Rate
Men							
< 35	155283	5	3.2	0	0	0	0
35–49	62321	38	61.0	11	17.7	20	32.1
50–64	43378	136	313.5	44	101.4	90	207.5
65–79	27230	163	598.6	44	161.6	225	826.3
Women							
< 35	143283	0	0	0	0	0	0
35–49	60339	6	9.9	3	5.0	2	3.3
50–64	43599	38	87.2	14	32.1	23	52.8
65–79	33218	90	270.9	40	120.4	159	478.7

Fatal events include definite myocardial infarction (MI), possible MI, and unclassifiable death.

hours. The results of serum cardiac enzyme estimations were examined daily, and results of electrocardiography (ECG) carried out in hospital were obtained monthly. General practitioners were also asked to notify, by telephone, patients with suspected myocardial infarction or coronary death.

Retrospective scrutiny of routine sources of information, "cold pursuit", was used to identify patients with fatal infarctions and some with non-fatal events. The contract minimum datasets compiled by Oxfordshire Health Authority were searched to detect patients discharged with a diagnosis of myocardial infarction. This method was important for identifying patients treated outside Oxfordshire. Death certificates for Oxfordshire residents were examined and those with *International Classification of Diseases*, ninth revision, codes 410 to 414 were registered. Necropsy reports were scrutinised to identify deaths caused by CHD. Cause specific mortality statistics compiled by the Office for Population Censuses and Surveys were also examined.

Where possible, patients were interviewed to obtain details of the acute event and any previous coronary events; where death occurred, the closest relative was interviewed. Information obtained by interview was supplemented by review of case notes together with ambulance, police, and coroners reports. The previous study conducted in 1966–67[7] used similar methods and both studies used the same procedures for case ascertainment.

Table 2 Annual event rate per 100 000 population for first and recurrent events in men and women aged 35 to 79 years using different coronary event definitions after age standardisation to a world standard population

Age group (years)	Coronary event definitions					
	1		2		3	
	Rate	95% CI	Rate	95% CI	Rate	95% CI
Men						
35–64	273	241, 304	271	239, 302	325	290, 359
65–79	1350	1210, 1490	1290	1160, 1420	1500	1350, 1640
Women						
35–64	66	50, 82	61	46, 76	82	65, 100
65–79	677	589, 765	661	574, 748	784	689, 879

Event definition 1 includes non-fatal and fatal definite myocardial infarction (MI), fatal possible MI, and unclassifiable coronary death.
Event definition 2 includes non-fatal and fatal definite MI, and fatal possible MI.
Event definition 3 includes non-fatal and fatal definite MI, non-fatal and fatal possible MI, and unclassifiable coronary death

DIAGNOSTIC CRITERIA

The diagnosis of myocardial infarction was validated using WHO MONICA criteria, which are primarily based on symptoms, ECG findings, cardiac enzymes, and necropsy reports.[9] ECGs were coded by trained coders at the Glasgow MONICA centre using a combination of MONICA protocol criteria and the *Minnesota code manual of electrocardiographic findings*.[10] Each event was assigned to one of five diagnostic categories: definite myocardial infarction, possible myocardial infarction, ischaemic cardiac arrest, fatal infarction with insufficient data (also termed unclassifiable death), and no acute myocardial infarction.

EVENT DEFINITIONS

Three coronary event definitions employed in the MONICA project were used[11]: *event definition 1* includes all coronary events that satisfy the criteria for non-fatal definite myocardial infarction or coronary death (fatal definite infarction, fatal possible infarction, or unclassifiable death); *event definition 2* is the same as definition 1, except for exclusion of unclassifiable deaths; and *event definition 3* retains unclassifiable deaths (as in definition 1) and adds non-fatal possible infarction.

Event definition 1 was used for reporting coronary event and case fatality rates, unless specifically indicated otherwise, because it allows the most reliable geographical and temporal comparisons of rates.

The coronary event rate was defined as the rate of first or recurrent coronary events (whether fatal or non-fatal) per 100 000 population per year. The first event rate was defined as the rate in that part of the population not known to have previously suffered a myocardial infarction. An event that occurred more than 28 days after any previous event in the same person was considered to be a new event.

Events were classified as fatal or non-fatal depending on whether the patient survived the first 28 days from onset of symptoms. The overall case fatality rate at 28 days was the proportion of patients who died within 28 days of onset of symptoms, and the out of hospital case fatality rate was the proportion of these patients who died before reaching hospital. Sudden death rates, rather than out of hospital case fatality rates, were used in the Oxford study[6 7] in 1966–67 and were calculated for 1994–95 to allow comparison. Sudden death was defined as a fatal infarction in which death occurred before the patient could be seen by a doctor. The 28 day case fatality rate for hospitalised patients was defined as the proportion of patients who received hospital treatment and died by day 28.

STATISTICAL ANALYSIS

Event rates for men and women were age adjusted by direct standardisation by five year age group using Segi's standard world population.[12] Case fatality rates were age standardised using weights derived from either the age distribution of coronary events in the MONICA project,[10] or the age distribution of patients in the OXMIS. Normal approximation

Table 3 Age specific and age standardised event rates per 100 000 population for first and recurrent coronary events in men and women aged 30 to 69 years in 1994–95 compared with 1966–67*

	Rate		Change in rates	
	1966–67	1994–95	%	95% CI
Men				
Non-fatal definite MI				
30–49 years	70.4	46.8	−33.5	−72.3, 54.1
50–69 years	365.5	358.2	−2.0	−23.9, 19.8
Age standardised	188.4	171.4	−9.0	−27.8, 9.8
All fatal events				
30–49 years	77.7	22.8	−70.7	−105.8, −37.3
50–69 years	494.7	266.8	−46.1	−63.3, −29.3
Age standardised	244.5	120.4	−50.8	−64.9, −36.6
All events				
30–49 years	148.8	69.7	−53.2	−78.6, −27.6
50–69 years	861.3	625.0	−27.4	−40.9, −13.9
Age standardised	433.8	291.8	−32.7	−44.1, −21.3
Women				
Non-fatal definite MI				
30–49 years	8.5	7.2	−15.3	−130.6, 103.5
50–69 years	71.5	114.8	60.6	6.5, 114.4
Age standardised	33.7	50.2	50.0	0.0, 99.7
All fatal events				
30–49 years	5.5	2.4	−56.4	−210.9, 71.6
50–69 years	163.5	105.5	−35.3	−64.8, −5.8
Age standardised	68.7	43.6	−36.5	−64.2, −8.9
All events				
30–49 years	13.9	9.5	−31.7	−126.6, 55.0
50–69 years	235.0	220.5	−6.2	−32.4, 20.1
Age standardised	102.3	93.9	−8.2	−33.1, 16.7

* Rates for both studies are directly standardised to a world standard population

methods were used to calculate 95% confidence intervals (CI) for age standardised rates, changes in age standardised rates, and changes in age specific rates.[13–15]

Results

Between 14 November 1994 and 13 November 1995, a total of 1343 patients with suspected infarction were identified. These comprised 648 definite myocardial infarctions, 462 possible myocardial infarctions, five ischaemic cardiac arrests, 41 unclassifiable deaths, and 187 without evidence of a myocardial infarction.

Table 4 Age specific and age standardised fatality rates at one month for all cases, hospitalised cases, and for sudden death in men and women aged 30 to 69 years in 1994–95 compared to 1966–67*

	Fatality rate % (number of deaths)		Change in fatality rates	
	1966–67	1994–95	Percentage	95% CI
Men				
All cases				
30–49 years	52.7 (29)	32.8 (20)	−37.8	−71.3, −4.4
50–69 years	57.5 (134)	42.7 (146)	−25.7	−40.2, −11.5
Age standardised	56.7	41.0	−27.7	−40.9, −14.5
Hospitalised cases				
30–49 years	37.2 (12)	2.4 (1)	−93.5	−134.4, −53.0
50–69 years	25.2 (22)	18.0 (43)	−28.7	−65.5, 8.3
Age standardised	27.2	15.4	−43.4	−72.8, −14.0
Sudden death				
30–49 years	27.3 (15)	29.5 (18)	8.1	−52.0, 68.5
50–69 years	41.6 (97)	26.3 (90)	−36.8	−53.8, −17.9
Age standardised	39.2	26.8	−31.6	−49.5, −13.8
Women				
All cases				
30–49 years	40.0 (2)	25.0 (2)	−37.5	−93.5, 1.7
50–69 years	69.6 (48)	48.0 (59)	−31.0	−51.1, −10.9
Age standardised	64.6	44.1	−31.7	−55.0, −8.5
Hospitalised cases				
30–49 years	0 (0)	14.3 (1)	–	–
50–69 years	54.5 (18)	22.9 (19)	−58.0	−89.7, −26.4
Age standardised	45.5	21.5	−52.7	−87.0, −18.5
Sudden death				
30–49 years	40.0 (2)	12.5 (1)	−68.8	−190.5, 15.0
50–69 years	37.7 (26)	28.5 (35)	−24.4	−124.9, 61.5
Age standardised	38.1	25.8	−32.3	−68.8, 4.2

* 1966–67 rates are directly standardised to the age distribution of OXMIS cases.
The 30 day case fatality rate in 1966–67 was compared with the 28 day case fatality rate in 1994–95. The duration of the earlier study was nine months and the population studied was 375 000. Sudden deaths were defined as coronary deaths that occurred before the patient was seen by a doctor.

CORONARY EVENT RATES

Table 1 shows the annual age specific rate for first and recurrent coronary events in men and women aged less than 80 years. Table 2 gives the annual event rates for MONICA event definitions 1, 2, and 3 for men and women aged 35–64 and 65–79 years after age standardisation to a standard world population.[12] At younger ages, a higher proportion of events were first events. In the age group 35–64 years, the age standardised first event rate per 100 000, using event definition 1 (non-fatal definite infarction and coronary death), was 189 (95% CI 162 to 215) in men and 58 (44 to 73) in women. In the age group 65–79 years, the first event rate was 788 (95% CI 682 to 894) in men and 493 (95% CI 417 to 570) in women. These may underestimate first event rates as it was not possible to determine whether there was a history of a previous infarction in 19 patients aged 35–64 and in 58 aged 65–79 years.

COMPARISON OF CORONARY EVENT RATES FOR 1994–95 AND 1966–67

Table 3 shows rates of non-fatal definite infarctions, fatal events, and all events in men and women aged 30–69 years for 1994–95 and 1966–67 after age standardisation to a standard world population.[12] Over this period the age standardised event rate in men fell significantly by one third, but in women there was a non-significant decline of 8%. The reduction in event rate in men was much greater in the 30–49 year old group than in those aged 50–69 years. Similarly, there was a larger reduction in event rate in younger women, but the 95% CIs were wide. The rate of non-fatal infarctions in women seems to have increased largely because of an increase of 60% in the age specific rate in the 50–69 year age group. Age standardised mortality declined by about half in men and by over a third in women.

CASE FATALITY RATE

During the study period, 519 coronary deaths occurred within 28 days of event onset. Of these deaths, 361 (69.6%) occurred outside hospital and 296 (82.0%) were medically unattended. The overall crude 28 day case fatality rate, which includes out of hospital deaths, was 52.2% for patients younger than 80 years of age. Case fatality increased sharply with age from 34.5% in men aged 35–49 years to 58.0% in those aged 65–79, and there was a corresponding increase in women from 25.0% to 63.9%. Under the age of 80 years the crude 28 day case fatality for hospitalised patients was 24.9% and the out of hospital case fatality was 36%.

After direct standardisation to the age distribution of MONICA cases, the overall 28 day case fatality for men aged less than 65 years was 38.6% (95% CI 31.7 to 46.3), the out of hospital case fatality was 30.3% (95% CI 23.9 to

36.8), and the 28 day case fatality for hospitalised cases was 12.2% (95% CI 7.4 to 17.0). For women in this age group the corresponding rates were 36.1% (95% CI 21.4 to 50.7), 25.7% (95% CI 13.4 to 38.0), and 14.0% (95% CI 3.3 to 24.6). For hospitalised patients surviving 24 hours, however, the 28 day rates were lower: 9.9% (95% CI 5.4 to 14.3) in men and 4.9% (95% CI −2.1 to 11.9) in women.

COMPARISON OF CASE FATALITY RATES FOR 1994–95 AND 1966–67

Table 4 shows the one month age specific and age standardised case fatality (after standardisation to age distribution in the OXMIS) for 1994–95 and 1966–67 in individuals aged 30–69 years. Overall case fatality declined significantly by 28% in men and 32% in women. The age standardised case fatality among hospitalised patients declined significantly by 43% in men and 53% in women. Age standardised case fatality for sudden death declined by 32% for both sexes. In women, however, the 95% CI for the decline overlapped zero.

Discussion

Our study used internationally standardised methods and provides the only English data for coronary event and case fatality rates that are directly comparable to those of the WHO MONICA project. The OXMIS included patients aged 65 years and more, the age group in which about two thirds of heart attacks occur, but which was excluded from the core MONICA project. The study also provides information about changes in coronary event and case fatality rates over the past three decades.

The age standardised event rates for men and women aged 35–64 years were low: they were only one third of those reported from the MONICA centres in Glasgow and Belfast, and were similar to rates in France and northern Italy.[11] MONICA rates apply to the period 1985–87 whereas the current data were obtained in 1994–95, therefore the actual differences in rates within the UK may be less. Even allowing for some decline in rates in recent years, however, the difference is likely to be considerable. The substantially higher event rates for the age group 65–79 years compared to those less than 65 years underlines the importance of targeting interventions at older patients who are often excluded from preventive strategies.

The relatively low coronary event rate observed in Oxfordshire is likely to be real as under-ascertainment of cases is unlikely given the comprehensive, multiple overlapping, case finding methods used in the study. Non-fatal events classified as possible infarctions are most likely to be differentially included across studies and are a potentially important source of bias.[16] If non-fatal possible infarcts are excluded from the comparison, however, large differences in event rates persist between the OXMIS and the UK MONICA centres.[11] These geographical differences in coronary event rates may be explained partly by variation in conventional cardiovascular risk factors, especially smoking.[17] Other risk factors may also be important—for example, dietary antioxidant intake,[18] which is lowest in socioeconomic classes IV and V.[19] Lower socioeconomic status is not only associated with higher coronary incidence and mortality, but the Glasgow MONICA centre recently reported that it is also associated with decreased hospital admission.[20] Socioeconomic difference may therefore account for some of the variation in rates between a relatively affluent population in Oxfordshire and the MONICA centres in Glasgow and Belfast, which include areas of economic deprivation.[21]

In contrast to coronary event rates, there were no marked differences between Oxfordshire and the UK MONICA centres in age standardised overall case fatality rates for patients aged less than 65.[11] The 28 day case fatality rates for men in Oxfordshire, Glasgow, and Belfast were 39, 49, and 40%, respectively. The corresponding rates for women were 36, 49, and 44%. Other studies have also found that differences between populations in case fatality are much smaller than differences in incidence and mortality.[22] As most deaths occur before reaching hospital, opportunities for reducing case fatality through improved hospital care are limited. Nevertheless, among patients admitted to hospital in Oxfordshire in 1994–95, the 28 day case fatality rates for men (12%) and women (14%) were lower than rates reported for several MONICA populations in the 1980s.[22 23] This may be explained by an improvement in prognosis because of increasing use of thrombolytic treatment, aspirin, β blockers, and angiotensin converting enzyme inhibitors. It is consistent with our finding of higher rates of in-hospital administration of drugs for secondary prevention of myocardial infarction than previously reported in the UK.[24]

We have demonstrated a substantial decline in coronary event and case fatality rates in Oxfordshire between 1966–67 and 1994–95. An important exception, however, was the 60% increase in non-fatal definite myocardial infarction events in women aged 50–69 years. This finding may be a result of chance or be related to the decline in smoking occurring some 10 years later in women who started smoking 20 years later than men.[25] Unlike the Nottingham heart attack register, which showed no apparent change in inpatient mortality between 1982 and 1992[4] despite advances in treatment, we found a reduction in one month case fatality in hospitalised men (43%) and women (53%) between 1966 and 1995.

Care is needed in interpreting our results because different diagnostic criteria for myocardial infarction were used in the OXMIS and 1966–67 study. The original study used modified 1959 WHO criteria,[7] while the OXMIS used WHO MONICA criteria.[9] The major change is that current criteria use Minnesota ECG coding rather than more subjective ECG interpretation, and only 82% of cases categorised as definite infarction by the old criteria would fulfil the new criteria.[26] The adoption of

more stringent MONICA criteria could account for some of the decrease in coronary event rates. Increasing awareness among patients and clinicians of myocardial infarction as a possible diagnosis and more sensitive diagnostic tests, such as creatine kinase,[27] however, may contribute to more complete case ascertainment offsetting some of the reduction in the proportion of patients diagnosed using the new ECG diagnostic criteria. Despite the difficulties of comparison, our findings suggest that coronary event rates have decreased by about one third in men, rather less in women, and that case fatality has fallen by nearly one third in men and women.

In summary, we have documented a decline in coronary event and case fatality rates in Oxfordshire. This suggests that a combination of reduced population risk factors, mainly as a result of decreased cigarette smoking and changes in diet,[28] and improved medical care have contributed to reduced coronary mortality. A striking finding was that the event rate was only a third of that reported by the Glasgow and Belfast MONICA centres and similar to rates in France and northern Italy. Older patients aged 65–79 years were not studied in the MONICA project, and in these patients we found non-fatal and fatal myocardial infarction event rates to be two to fourfold higher than in younger patients. This emphasises the importance of including older patients in preventive strategies.

We thank the research nurses and administrative staff for help with data collection and processing; general practitioners, hospital staff, the coroner, and staff of the Oxfordshire ambulance department, family health services authority, and district health authority for access to data; staff of the Glasgow MONICA centre for Minnesota coding; and Professor Leo Kinlen, Dr Pat Yudkin, Dr Caroline Morrison, and Professor Hugh Tunstall-Pedoe for invaluable advice.

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OXMIS Data Collection Form

CONFIDENTIAL 1 **STUDY ID NO**_____

OXFORD MYOCARDIAL INFARCTION INCIDENCE STUDY

PATIENT IDENTIFICATION

2 Title ____ Surname _____

Forenames _____

3 Home Address _____

_____

PATIENT LABEL

Post Code _____

4 Telephone Home _____ Work _____

5 Date of Birth _____ 6 Sex ___ 1 = male
2 = female

7 Hospital Number _____ 8 NHS Number _____

9 Arrival A & E: Date _____ Time _____

GP IDENTIFICATION

10 Surname _____ Initials _____

11 Practice Address _____

_____ Telephone _____

Post Code _____

12 GP National code _____

Survival code _____

GP LABEL

STUDY ID NO _____

13 ASCERTAINMENT OF CASES

	SOURCE	DATE
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____

14 Follow-up Information

Presenting Problem _____ Location _____

Date	CPK	AST	LDH	Cholesterol

1 = CCU
2 = ITU
3 = Ward

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STUDY ID NO _____

THE INTERVIEW

15 Date of Interview _____ 16 Time of Interview _____

17 Interviewee ___ 18 Name of Interviewer _____

1 = Patient in hospital
2 = Patient at home
3 = Relative interviewed by phone
4 = Relative interviewed at home
5 = Interview refused

THE ACUTE EVENT

19 Please could you tell me when the symptoms of your present illness started?

Date _____ Time _____

20 Place of onset of symptoms _____

1 = Home
2 = Work
3 = Hospital
4 = Other

21 Did you have any pain? Yes _____ No _____ Not known _____

IF NO PAIN GO TO QUESTION 24

22 Where was the pain? (tick one or more) Chest _____ Arm _____ Abdomen _____

Jaw _____ Back _____ Other (specify) _____

23 How long did the pain last?

More than 20 minutes ____

More than 20 minutes (assumed) ____

Less than 20 minutes ____

Don't know ____

STUDY ID NO _____

24 Which other symptoms did you experience at the start of your illness?

.....

.....

25 Symptom code ___

1 = Typical
2 = Atypical
3 = Other
4 = None
5 = Inadequately described
9 = Insufficient data

26 Was a GP called or seen as a result of the onset of your symptoms? _____

1 = Yes (seen outside surgery)
2 = Yes (see at surgery)
3 = Yes (not seen)
4 = No
8 = Not relevant
9 = Do not know

27 How long did it take for the GP to see you? ____ hours ____ minutes

28 Was an ambulance called as a result of the onset of your symptoms? _____

1 = Yes (self)
2 = Yes (relative or f
3 = Yes (GP)
4 = Yes (Other)
5 = No
8 = Not relevant
9 = Don't know

29 How long did it take for the ambulance to reach you? ____ hours _____ minutes

STUDY ID NO _____

SMOKING

30 Have you ever been a cigarette smoker? (at least one a day) _____

1 = yes
2 = no

IF NEVER SMOKED GO TO QUESTION 38

31 How old were you when you began to smoke cigarettes? _____

32 Have you smoked regularly in the last three months. (al least once a day)? _____

1 = yes
2 = no

IF NO, GO TO QUESTION 35

33 On average, how many cigarettes do you smoke a day? _____

34 If roll-ups, how many ounces of tobacco do you smoke a week? _____

EX SMOKERS ONLY

35 When did you stop smoking cigarettes? Year _____

36 At the time you decided to stop smoking how many cigarettes, on average, were you smoking a day? _____

37 If roll-ups, how many ounces of tobacco were you smoking a week? _____

EXERCISE

38 During the day, on an average weekday, do you spend most of your time: _____

1 = Sitting down (eg driving, sitting at desk)
2 = Engaged in moderate activity (eg walking, light housework)
3 = Engaged in vigorous activity

39 On average, how often do you undertake vigorous sport or recreational activities which make you breathless e.g. aerobics, jogging, tennis, etc? _____

1 = Less than once a month
2 = One to three times a month
3 = Once a week or more

40 On average, how often do you undertake less vigorous sport or exercise in addition to your normal daily activities e.g. going for a walk, yoga, gardening, etc? _____

1 = Twice a week
2 = Three times a week

STUDY ID NO _____

PERSONAL INFORMATION

41 What type of housing do you live in? _____

1 = Owned/ mortgaged by you or your family
2 = Rented from council
3 = Rented from a housing association
4 = Rented from a private landlord
5 = Other, please specify

42 Who else lives at home with you? _____

1 = Yes
2 = No
9 = Not known

Parent _____

Husband/wife/partner _____

Ch ildren _____

Other relatives _____

Friends _____

Other _____

Live alone _____

43 What is your marital status? _____

1 = Widowed
2 = Divorced / Separated
3 = Married or living as married
4 = Single and never been married

44 What is your employment? _____

1 = Working full-time (30 hours a week or more)
2 = Working part-time (less than 30 hours a week)
3 = Caring for home or family (not seeking paid work)
4 = Unemployed and looking for work
5 = Unable to work due to illness or disability
6 = Retired
7 = Student

45 What is your present or most recent occupation? .....

.....

STUDY ID NO _____

46 Are/were you: Tick one

47 *Code for social class* ____

1= A manager _____

2 = A foreman or supervisor? _____

3 = Self employed? _____

4 = An employee? _____

IF MALE, OR FEMALE AND NOT CURRENTLY MARRIED OR LIVING AS MARRIED GO TO QUESTION 51

48 What is your partner's present or most recent occupation? .....

.....

49 Is he/was he: Tick one

50 *Code for social class* _____

1= A manager _____

2 = A foreman or supervisor? _____

3 = Self employed? _____

4 = An employee? _____

51 What is your height?. _____ feet _____ inches

52 What is your weight? _____ stones ____ pounds

53 How would you describe your ethnic origin? _____

1 = White
2 = Black Caribbean
3 = Black African
4 = Indian
5 = Pakistani
6 = Bangladeshi
7 = Chinese
8 = Other

PREVIOUS NERVOUS PROBLEMS

54 Could you tell me if you have ever consulted a doctor about a nervous problem? _____

1 = Yes
2 = No
9 = Unknown

IF NO OR NOT KNOWN GO TO QUESTION 58

STUDY ID NO _____

55 Did you consult a general practitioner? _____

1 = Yes
2 = No
9 = Unknown

56 Did you consult a psychiatrist? _____

1 = Yes
2 = No
9 = Unknown

57 Are you currently receiving treatment for a nervous problem? _____

1 = Yes
2 = No
9 = Unknown

If yes, state nature of treatment .....

CASE NOTES

PAST MEDICAL HISTORY

58 Medical problems *prior to onset* of the acute event: ___

1 = Yes
2 = No
9 – Insufficient data

Angina	____	Hypertension	____
Myocardial Infarction	____	Diabetes Mellitus	____
Other Ischaemic Heart Disease	____	Stroke	____
Valvular Heart Disease	____	Peripheral Vascular Disease	____
Cardiomyopathy	____	Hyperlipidaemia	____
Cardiac Arrest	____	Psychiatric Disorder (specify)	_____
Cardiac Failure	____	Aspirin Allergy	____

59 Procedures *prior to the onset* of the acute event

Coronary Angiography	____
PTCA/Angioplasty	____
CABG	____
Cardiac Pacing	____

60 Procedures < *3 days prior to the onset* of the acute event

General Anaesthetic	____
Coronary Angiography	____
PTCA or CABG	____

61 *Iatro Code* ____

STUDY ID NO _____

62 Regular medication taken at the time of onset of acute event. If none, tick here

_____ _____ _____
_____ _____. _____

CARDIAC ARREST

63 Did apparent cardiac arrest occur outside of hospital? _____
1 = Yes
2 = No
8 = Not relevant
9 = Insufficient data

IF CARDIAC ARREST DID NOT OCCUR GO TO QUESTION 65

64 Who performed CPR? ____
1 = bystander
2 = GP
3 = ambulance
4 = other (please specify)
5 = CPR not performed
8 = Not relevant

CLINICAL FINDINGS

65 *First* recorded systolic blood pressure after the start of medical care? _____
000 = no pressure
030 – 270 = as recorded
888 = not recorded
999 = insufficient data

66 *First* recorded pulse rate after the start of medical care? _____
000 = no pulse
030 – 300 = as recorded
888 = not recorded
999 = insufficient data

67 Was left ventricular failure present within the *first 24 hours* of medical care? __
1 = Yes
2 = No
8 = Not relevant
9 = Insufficient data

68 Was pulmonary oedema present within the *first 24 hours* of medical care? ___
1 = Yes
2 = No
8 = Not relevant
9 = Insufficient data

69 Was cardiogenic shock present within the *first 24 hours* of medical care? ___
1 = Yes
2 = No
8 = Not relevant
9 = Insufficient data

STUDY ID NO _____

ECGs

70 Number of ECGs coded _____

71 *ECG code* _____

1 = Definite
2 = Probable
3 = Ischaemic
4 = Other
5 = Uncodable
9 = Insufficient data

BIOCHEMISTRY

72 Date	CPK	AST	LDH
Maximum level of each			

73 *Enzyme code* _____

1 = Abnormal
2 = Equivocal
3 = Non-specific
4 = Normal
5 = Incomplete
9 = Insufficient data

74 Date _____ CHOLESTEROL_____

MEDICATIONS AND PROCEDURES

Medications after the onset of the acute event (also state route of administration)

75 Out of hospital (GP): if none, tick here ___

_____ _____ _____

_____ _____ _____

76 Out of hospital (ambulance): if none, tick here ____

_____ _____ _____

_____ _____ _____

STUDY ID NO _____

77 In hospital: if none, tick here ___

_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

78 Procedures after the onset of the acute event. If none, tick here _____

_____	_____	_____
_____	_____	_____
_____	_____	_____

79 Was thrombolytic therapy administered? _____

1 = yes
2 = no
9 = insufficient data

IF NO, GO TO QUESTION 82

80 When and where was thrombolytic therapy administered? Date _____

Time _____

Place _____

1 = A & E
2 = CCU/ ITU
3 = Other
9 = Not known

81 Which thrombolytic was administered? _____

1 = streptokinase
2 = alteplase
3 = anistreplase
4 = other (specify)

82 Why was thrombolytic therapy not administered? _____

1 = late presentation
2 = diagnosis uncertain
3 = bleeding risk
4 = other (specify)
8 = not relevant
9 = not known

STUDY ID NO _____

83 AMBULANCE

If not relevant, tick here _____

	Date	**Time**
Call received	_____	_____
Arrived at scene	_____	_____
Departure from scene	_____	_____
Arrival at hospital	_____	_____

DISCHARGE

84 How many days did the patient spend in hospital altogether? _____

00 – 27 = length of stay in calendar days
28 = more than 27 days
88 = not relevant
99 = insufficient data

85 How many days did the patient spend in CCU/ITU? _____

00 – 27 = length of stay in calendar days
88 = not relevant
99 = insufficient data

86 Discharge medication: if none, tick here ___

_____ _____ _____

_____ _____ _____

_____ _____ _____

87 Clinical diagnosis at discharge (ICD 9/10)

1. _____ _____ 2a. _____ _____

2b. _____ _____ 2c. _____ _____

88 Did cardiac arrest occur in hospital? _____

1 = yes
2 = no
8 = not relevant
9 = insufficient data

89 If so, was CPR performed? _____

1 = yes, date_____
2 = no
9 = insufficient data

STUDY ID NO _____

90 Did the following occur in hospital?

1 = yes
2 = no
8 = not relevant
9 = insufficient data

Bleeding, no transfusion	_____	Sites and dates _____
Bleeding, with transfusion	_____	Sites and dates _____
Stroke	_____	Date _____
Allergic reaction	_____	Sites and dates _____
Anaphylactic shock	_____	Date _____
Arrhythmias	_____	Types and dates _____
		_____
		_____
Cardioversion	_____	Dates _____

FATAL CASES

91 What was the date and time of death? Date _____

Time _____

92 If the exact time of death is not known what was the approximate survival time in the event? _____

1 = less than one hour
2 = 1 – 23 hours 59 minutes
3 = 24 hours or more
8 = not relevant
9 = insufficient data

93 What was the place of death? _____

1 = out of hospital and not in ambulance
2 = in ambulance or on way to hospital
3 = in hospital A&E department/ GPRU
4 = death occurred around time of arrival at hospital but place is not known
5 = death in CCU / ITU
6 = death in ward
7 = death in other unspecified location in hospital
9 = insufficient data

STUDY ID NO _____

94 What was/were the cause(s) of death as stated on the death certificate (ICD 9/10)?

1 (i) _____ _____

1 (ii) _____ _____

1 (iii) _____ _____

2 _____ _____

95 Was an autopsy performed on the patient? _____

1 = yes, routine
2 = yes, medicolegal
3 = no
9 = insufficient data

96 When was the autopsy performed? Date _____

97 What were the autopsy findings (ICD 9/10)?

1 (i) _____ _____

1 (ii) _____ _____

1 (iii) _____ _____

2 _____ _____

Comments related to cardiovascular system .....

.....

.....

98 *Autopsy Code* _____

1 = Definite
2 = Equivocal
3 = negative
8 = not relevant
9 = Insufficient data

Invitation Letter

Department of Primary Health Care

Lucy Wright
Research Fellow

Institute of Health Sciences
Old Road
Headington
Oxford OX3 7LF

Telephone +44(0)1865 227191

Date

Patients' Address
Address
Address
POSTCODE

Dear Patient

Heart Follow-up Study

You may remember taking part in a study about the frequency of heart disease about seven years ago. Your involvement in this study was very helpful.

I would now like to invite you to participate in a follow-up of this study. Any help you might give us would be very valuable, but you are under no obligation to take part. Please read the enclosed **information sheet** to find out more and feel free to contact me on the above number, if you have any questions.

If you decide NOT to participate in the study, I would be grateful if you would indicate this by ticking the box for **question 1** on the **consent form** and return it in the prepaid envelope by *(date two weeks after letter date).*

If you DO decide to take part in the study, I would be grateful if you would complete and sign the **consent form** and fill in and return the questionnaire in the prepaid envelope by *(date two weeks after letter date).*

Yours sincerely

Lucy Wright

Follow-up Study Information Sheet

Department of Primary Health Care

Institute of Health Sciences
Old Road
Headington
Oxford OX3 7LF

Lucy Wright
Research Fellow

Telephone 01865 227191

Study Number A01.043

Study Title:
' Disability, Risk and Disease Progression After Myocardial Infarction: Seven Year Follow-up'

Invitation.
About seven years ago, you kindly agreed to take part in a research study about the frequency of heart disease. You are now being invited to take part in a follow-up, but you are under no obligation to take part in this study. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with friends, relatives and your GP if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

What is the purpose of the follow-up?
Little is known about the long term health care needs of people after a heart attack, but this information is important to help plan care for others. I would like to find out how you are doing, in particular whether your heart troubles have changed. I would also like to know the effect on your day-to-day activities and health.

Why have I been chosen?
All 610 people who participated in the frequency of heart disease study between November 1994 and November 1995 are being invited to participate.

Do I have to take part?
It is up to you to decide whether or not to take part. If you do decide to take part, you would be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason. If you decide not to take part, you would be asked to indicate this by ticking the box for question 1 on the consent form, so we know your decision and we would not contact you again. This would not affect the standard of care you receive.

What would happen to me if I take part?
With your agreement we would look at your medical notes and you would be asked to write the name of your GP and the surgery on the consent form. You would also be asked to complete the enclosed questionnaire and return it in the prepaid reply envelope.

What are the disadvantages or risks of taking part?
There are no disadvantages or risks involved in taking part in this study.

What are the possible benefits of taking part?
There is no intended benefit to you from taking part in this study. The information we get from this study would help us to improve future care for people with a heart attack.

What if something goes wrong?
If you wish to complain about any aspect of the way you have been approached or treated during the course of this study, the normal National Health Service complaints mechanisms may be available to you.

Will my taking part in this study be kept confidential?
All information that is collected about you during the course of the research will be kept strictly confidential. Any information about you which leaves the hospital or surgery will have your name and address removed so that you cannot be recognised from it. If you are happy for us to contact your general practitioner (GP), we will let them know of your involvement.

What will happen to the results of the study?
The study results will be presented to NHS staff and published in a scientific journal. It will also be part of a PhD thesis. Neither the presentations nor publications will identify individuals who participated in the study. (If you would like copies of the publications please inform Ms. Lucy Wright at the above address)

Who is organising and funding the research?
The study is being funded by the National Health Service.

Who has reviewed this study?
The Applied and Qualitative Research Ethics Committee, based at Oxford Radcliffe Hospital reviewed the study.

Contact for Further Information
Please contact Ms. Lucy Wright, via the address/telephone details provided above for more information.

Please keep this information sheet and return the signed consent form.

Thank you for reading this!

Ms. Lucy Wright

1st February 2002

Department of Primary Health Care

Lucy Wright
Research Fellow

Institute of Health Sciences
Old Road
Headington
Oxford OX3 7LF

Telephone 01865 227191

Study Number: A01.043

CONSENT

Title of Project:
' Disability, Risk and Disease Progression After Myocardial Infarction: Seven Year Follow-up'

Name of Researcher: Ms Lucy Wright

EITHER

I do **not** wish to complete the questionnaire **AND:**

Please tick one box IF appropriate

1. I do **not** give permission for my medical notes to be reviewed. Please do not contact me again. ☐

2. I **give permission** for my medical notes to be reviewed. Please do not contact me again. *(Please complete question 5)* ☐

OR

I **am** willing to complete the questionnaire **AND**:

Please circle as appropriate

3. I confirm that I have read and understand the information sheet dated 1st February 2002 for the above study and have had the opportunity to ask questions. **Yes / No**

4. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected. **Yes / No**

5. I give permission for my medical notes to be reviewed for the purpose of this study. Please see below for details of my current general practitioner. **Yes / No**

Name of Participant (Your name)	Signature (Your signature)	Date (Today's date)
_____	_____	_____

My GP's name: Dr. _____

My GP Surgery Name: _____

CHD Hospital Admission Data Collection Form

CHD Hospital Admission No. ☐☐☐ **OXMIS ID No:** ☐☐☐☐☐

Date of Form Completion: _____

Admission Date: _____

Admitting Diagnosis: ☐☐
1 = Myocardial Infarction 2 = Exertional Angina 3 = Unstable Angina
4 = Heart Failure 5 = Chest Pain 6 = Breathlessness 7 = Collapse
8 = Cardiac Arrest 9 = Arrhythmias 10 = Other: _____

Type of Admission: ☐ 1 = NHS 2 = Private

Hospital: ☐ 1 = John Radcliffe 2 = Horton General 3 = Reading
4 = Other: specify _____

Location: ☐ 1 = Ward 2 = CCU 3 = ITU 4 = Other

Speciality: ☐ 1 = Cardiology 2 = Medicine 3 = Cardiac Surgery 4 = Other: (specify) _____

Medication Pre-Admission: ☐ 1 = Yes 0 = No 9 = Not recorded

Name of Drug (Generic)	Dose in mg	Frequency	OXMIS Code
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			

Current Risk Factor Profile

Risk Factors	1 = Yes 0 = No 8 = N/A 9 = Not recorded	**Measurements on Admission** 88 = Not applicable 99 = Not recorded
Current Tobacco Use	☐	Amount: _____ (cigs/week OR oz tobacco/day)
Raised Cholesterol >5.0mmol/L	☐	TC: __ __. __ HDL: __. __ Triglycerides: __ __. __ Date: _____
Glucose Intolerance	☐	Glucose: ___ ___. ___ Hb1Ac: ___ ___. ___ %
Diabetes	☐	
If yes, how treated?	☐	1 = Insulin 2 = Tablets 3 = Diet

CHD DIAGNOSES THIS ADMISSION

1) **Myocardial Infarction** : ☐ 1 = Yes 0 = No 9 = Not recorded

Confirmed by:		**Results:** 9 = Not recorded
12 Lead ECG	☐ 1 = Yes 0 = No	☐ 1 = ST Elevation 2 = T- Wave Inversion 3 = Q Wave MI 4 = Non-Q Wave MI 5 = Other: _____
Infarct Location	☐☐ 1 = Inferior 2 = Posterior 3 = Anterior 4 = Lateral 5 = Rt Ventricle 6 = Infero-lateral 7 = Antero-Lateral 8 = Septal 9 = Infero-posterior-lateral 10 = Other: _____	
Biochemistry: ☐ 1 = Yes 0 = No 8 = N/A 9 = Not Recorded		
Infarct Marker 1	☐ 1 = CK 2 = CKMB 3= LDH 4 = AST 5 = TnT 6 = TnI	Max value ☐☐☐☐.☐
Infarct Marker 2	☐ 1 = CK 2 = CKMB 3= LDH 4 = AST 5 = TnT 6 = TnI	Max value ☐☐☐☐.☐
Infarct Marker 3	☐ 1 = CK 2 = CKMB 3= LDH 4 = AST 5 = TnT 6 = TnI	Max value ☐☐☐☐.☐
Infarct Marker 4	☐ 1 = CK 2 = CKMB 3= LDH 4 = AST 5 = TnT 6 = TnI	Max value ☐☐☐☐.☐

2a) **Angina / CAD**: ☐ 1 = Yes 0 = No 2 = Progression 9 = Not recorded

2b) If yes, **type**: ☐ 1= Exertional 2 = Chronic/Stable 3 = Unstable 4 = Silent Ischaemic
5 = Coronary Artery Disease 6 = Other: _____ 9 = Not recorded

Confirmed by:	1 = Yes 0 = No 9= Not recorded	**Results:** 8 = N/A 9 = Not recorded
12 Lead ECG	☐	a ☐ b ☐ 1 = LVH 2 = Left Bundle Branch Block 3 = Right Bundle Branch Block 4 = Atrial Fib 5 = Ischaemia (ST↓) 6 = Other: _____
Biochemistry	☐ 2 = TnT 3 = TnI	Max value ☐☐.☐
Holter Monitor	☐	a ☐ b ☐ 1 = LVH 2 = Left Bundle Branch Block 3 = Right Bundle Branch Block 4 = Atrial Fib 5 = Ischaemia (ST↓) 6 = Other: _____
Exercise - ECG	☐	☐ 1 = ST ↓ > 2mm 2 = ST ↓ > 1 mm 3 = ST ↓ 0-1 mm 4 = Other: _____
Nuclear Scan	☐	☐ **Ischaemia**: 1 = Reversible 0 = Non- reversible ☐☐ Ejection Fraction (%) ☐ No of diseased vessels
Coronary Angiography	☐	☐☐ Ejection Fraction (%) ☐ No of diseased arteries OR SYSTOLIC FUNCTION: 5 = Mildly impaired 6 = Moderately impaired 7 = Severely impaired 0 = Normal

3) **Heart Failure/ Left Ventricular Failure:** ☐ 1 = Yes 0 = No 2 = Progression 9 = Not recorded

Confirmed by:	1 = Yes 0 = No 9 = Not recorded	**Results:** 9 = Not recorded
Chest X-Ray	☐	☐ 1 = Pulmonary oedema 2 = No pulmonary oedema 3 = Other: _____
Echo	☐	☐ 1 = LVEF>50% 2 = LVEF 40-50% 3 = LVEF 30-39% 4 = LVEF < 30% OR SYSTOLIC FUNCTION: 5 = Mildly impaired 6 = Moderately impaired 7 = Severely impaired 8 = Other: _____ (specify

4) **Arrhythmias:** ☐ 1 = Yes 0 = No 2 = Progression 9 = Not recorded

Confirmed by:	1 = Yes 0 = No 9 = Not recorded	**Results:** 8 = Not applicable 9 = Not recorded
12 Lead ECG	☐	a ☐ b ☐ c ☐ 1 = Cardiac (VF) Arrest 2 = Left Bundle Branch Block 3 = Right Bundle Branch Block 4 = AV Block Post-MI 5 = Atrial Fib 6 = Other: _____

PROCEDURES This Admission ☐ 1 = Yes 0 = No 3 = Planned 9 = Not recorded

	Date	**Procedure**	**Date**
☐ PCI + Stent / - Stent	☐☐ ☐☐ ☐☐	☐ Cardiac Transplant	☐☐ ☐☐ ☐☐
☐ CABG	☐☐ ☐☐ ☐☐	☐ LV Assist Device	☐☐ ☐☐ ☐☐
☐ Pacemaker	☐☐ ☐☐ ☐☐		

In-Hospital Death:

☐ 1 = yes 0 = No **Date** ☐☐ ☐☐ ☐☐

Causes of Death ICD-9 or10 (circle)

1) _____ ☐ ☐☐☐

2) _____ ☐ ☐☐☐

3) _____ ☐ ☐☐☐

DISCHARGE

Discharge Date: ☐☐ ☐☐ ☐☐

Discharged to: ☐
1 = Home 2 = Local DGH
3 = Cottage Hospital 4 = Nursing Home
5 = Other: _____ (specify)
9 = Not recorded

Discharge Medication: ☐ 1 = Yes 0 = No 9 = Not recorded

Name of Drug (Generic)	Dose in mg	Frequency	OXMIS Code
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Post-Discharge Plans 0 = No 1 = Booked 2 = Planned 8 = N/A 9 = Not recorded			
Outpatient Appointment	☐	Cardiac Rehabilitation Programme	☐

Other New Non-CHD Diagnoses ☐ 0 = None 1 = Yes	*ICD Code 9 or 10*
1.	
2.	
3.	

CHD Outpatient Appointment Data Collection Form

CHD Outpatient Appointment No. ☐☐ **OXMIS ID No.** ☐☐☐☐☐

Date of Form Completion: _____

Date of Appointment : ☐☐ ☐☐ ☐☐

Speciality: ☐ 1 = Cardiology 2 = Medicine 3 = Cardiac Surgery 4 = Cardiac Rehab 5 = Diabetes
6 = Lipid Clinic 7 = Other: (specify) _____

Type: ☐ 1 = NHS 2 = Private

Location: ☐ 1 = John Radcliffe 2 = Horton General 3 = Reading
4 = Other: (specify) _____

New CHD Diagnosis: ☐ 1 = Yes 0 = No 9 = Not Recorded

1a) **Angina / CAD:** ☐ 1 = Yes 0 = No 2 = Progression 9 = Not Recorded

1b) If yes, **type:** ☐ 1 = Exertional 2 = Chronic/Stable 3 = Unstable 4 = Silent Ischaemic
5 = Coronary Artery Disease 6 = Other: _____ (specify) 9 = Not recorded

Confirmed by:	1 = Yes 0 = No 9 = Not recorded	**Results:** 9 = Not recorded
12 Lead ECG	☐	a ☐ 1 = LVH 2 = Left Bundle Branch Block 3 = Right Bundle Branch Block 4 = Atrial Fib b ☐ 5 = Ischaemia (ST↓) 6 = Other: _____
Biochemistry	☐ 2 = TnT 3 = TnI	Max value ☐☐.☐
Investigations		**Results**
Holter Monitor	☐	a ☐ 1 = LVH 2 = Left Bundle Branch Block 3 = Right Bundle Branch Block 4 = Atrial Fib b ☐ 5 = Ischaemia (ST↓) 6 = Other: _____
Exercise - ECG	☐	☐ 1 = ST ↓ > 2mm 2 = ST ↓ > 1 mm 3 = ST ↓ 0-1 mm 4 = Other: _____
Nuclear Scan	☐	☐ **Ischaemia**: 1 = Reversible 0 = Non- reversible ☐☐ Ejection Fraction ☐ No of diseased vessels

2) **Heart Failure/ Left Ventricular Failure:** ☐ 1 = Yes 0 = No 2 = Progression 9 = Not recorded

Confirmed by:	1 = Yes 0 = No 9 = Not recorded	**Results:** 9 = Not recorded
Chest X-Ray	☐	☐ 1 = Pulmonary oedema 2 = No pulmonary oedema 3 = Other: _____
Echo	☐	☐ 1 = LVEF>50% 2 = LVEF 40-50% 3 = LVEF 30-39% 4 = LVEF < 30% OR SYSTOLIC FUNCTION: 5 = Mildly impaired 6 = Moderately impaired 7 = Severely impaired 8 = Other: _____ (specify)

3) **Arrhythmias:** ☐ 1 = Yes 0 = No 2 = Progression 9 = Not recorded

Confirmed by:	1 = Yes 0 = No 9 = Not recorded	**Results:** 8 = Not applicable 9 = Not recorded
12 Lead ECG	☐	a ☐ b ☐ 1 = LVH 2 = Left Bundle Branch Block 3 = Right Bundle Branch Block 4 = Atrial Fib 5 = Other: _____

Planned Coronary Procedures: ☐ 1 = Yes 0 = No		
☐ *Angiography*	☐ *PCI*	☐ *Bypass Surgery*
☐ *Pacemaker*	☐ *Cardiac Transplant*	☐ *LV Assist Device*

Risk Factors	1 = Yes 0 = No 8 = N/A 9 = Not recorded	**Measurements from this appointment** 88 = Not applicable 99 = Not recorded
Current Tobacco Use	☐	Amount: _____ (cigs/day OR oz tobacco/week)
Raised Cholesterol	☐	TC: __ __. __ HDL: __. __ Triglycerides: __ __. __
Raised B/P	☐	B/P: ___ ___ ___ / ___ ___ ___
Glucose Intolerance Diabetes	☐ ☐	Glucose: ___ ___. ___ Hb1Ac: ___ ___. ___ %
If yes, How treated?	☐ 1 = Insulin 2 = Tablets 3 = Diet	

Medication Pre-Appointment: ☐ 1 = Yes 0 = No 9 = Not recorded

Name of Drug (Generic)	Dose in mg	Frequency	OXMIS Code
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Recommended Medication Change: ☐ 1 = Yes, prescription given 2 = Yes, recommended to GP 3 = Possible, pending test result 4 = Discontinue 0 = No

Name of Drug (Generic)	Dose in mg	Frequency of dose/day	OXMIS Code
1.			
2.			
3.			
4.			
5.			

General Practice Note Review

Date of Birth: _____ **OXMIS ID No** | | | | | |

Date of Form Completion: _____

OXMIS Event Date: _____

Date of Death: _____ OR Date of 6 year follow-up: _____

CORONARY RISK FACTORS

1) Diagnosis of Diabetes Since OXMIS Event: ☐ 1 = Yes 0 = No 9 = Not recorded

Diagnosis Made by: ☐ 1= Hospital 2 = General Practitioner 3 = Practice Nurse

Date of Diagnosis: ☐☐ ☐☐ ☐☐

Diagnosis Confirmed By: 1 = Yes 0 = No 9 = Not recorded			
Serum Glucose	☐ 2 = Fasting 3 = Random	***Glucose Tolerance Test***	☐
Current Treatment: ☐ 1 = Insulin 2 = Tablets 3 = Diet 0 = None 9 = Not recorded			

2) Most Recent Record of Smoking Status

☐ Most recent date recorded: ___/___/___

1 = Current smoker 2 = Ex-smoker 0 = Never smoked 9 = Not recorded

If current smoker, 88 = Not relevant	***If ex-smoker,*** 88 = Not relevant
☐☐ How many cigarettes/day?	☐☐ How many cigarettes were smoked /day before quitting?
Year Started Smoking: 19____	Year Quit Smoking: 19 _____
☐ What was most recent treatment offered? 1 = Leaflet 2 = Counselling 3 = NRT 4 = Not offered	
Date of offered treatment: ☐☐ ☐☐ ☐☐	

CURRENT MEDICATION

Preventive Medication	1 = Yes 0 = No	*Code*	If yes, specify drug name, dose in mg & frequency	If **no**, why not? Specify 1 = Side effects 2 = Contraindications 9 = Not recorded
Aspirin	☐	*13A*	Dosage & Frequency: _____	☐ _____
Beta-blocker	☐	*03*	Drug: _____ Dosage & Frequency: _____	☐ _____
ACE-inhibitor	☐	*07*	Drug: _____ Dosage & Frequency: _____	☐ _____
Lipid Lowering	☐	*15*	Drug: _____ Dosage & Frequency: _____	☐ _____

Other Current Medications ☐ *1 = Yes 0 = No*

(or Last Recorded Medications Before Death)

Generic Medication Name	**Dosage**	**Frequency**	**Code** *(office use)*
1)			
2)			
3)			
4)			
5)			
6)			
7)			
8)			
9)			
10)			

GENERAL PRACTICE DRUG HISTORY

OXMIS Event Date: _____

6 Year Follow-up Date: _____ OR **Death Date:** _____

A) ACE-INHIBITORS ((OXMIS Drug Code 07)
Since the OXMIS Event Date, has this patients been prescribed *ACE-Inhibitors*? ☐ 1 = Yes 0 = No

If **yes,**
list all *ACE-inhibitors* prescribed between OXMIS Event Date & 6 Year Follow-up Date (or Death Date).

Drug Name	Dose	Frequency	Start Date	Stop Date (if applicable)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				

B) STATINS ((OXMIS Drug Code 15A)
Since the OXMIS Event Date, has this patients been prescribed *Statins*? ☐ 1= Yes 0 = No

If **yes,**
list all *Statins* prescribed between OXMIS Event Date & 6 Year Follow-up Date (or Death Date).

Drug Name	Dose	Frequency	Date of Initiation	Date of Discontinuation (if applicable)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				

C) NON-ASPIRIN ANTIPLATELETS (OXMIS Drug Code 13B)
Since the OXMIS Event Date, has this patients been prescribed *Non-Aspirin Antiplatelets*? ☐ 1 = Yes 0 = No

If **yes,**
list all *Non-Aspirin Antiplatelets* prescribed between OXMIS Event Date & 6 Year Follow-up Date (or Death Date).

Drug Name	Dose	Frequency	Date of Initiation	Date of Discontinuation (if applicable)
1.				
2.				
3.				
4.				
5.				
6.				

D) ANGIOTENSIN II RECEPTOR ANTAGONISTS (OXMIS Drug Code 22)

Since the OXMIS Event Date, has this patients been prescribed *A2 Receptor Antagonists*? ☐ 1 = Yes 0 = No

If **yes,**

list all of them prescribed between OXMIS Event Date & 6 Year Follow-up Date (or Death Date).

Drug Name	Dose	Frequency	Date of Initiation	Date of Discontinuation (if applicable)
1.				
2.				
3.				
4.				
5.				
6.				

E) VIAGRA (OXMIS Drug Code 26)

Since the OXMIS Event Date, has this patients been prescribed *Viagra*? ☐ 1 = Yes 0 = No

If **yes,**

list all V*iagra* prescriptions between OXMIS Event Date & 6 Year Follow-up Date (or Death).

Drug Name	Dose	Frequency	Date of Initiation	Date of Discontinuation (if applicable)
1.				
2.				
3.				
4.				
5.				
6.				

HEALTH SERVICE USE **Follow-up Date** _____

Practice Consultations: (Total number for each year) 88 = Not relevant

Who	1994	1995	1996	1997	1998	1999	2000	2001
GP								
PN								

(If unable to decide WHO saw the patient, assume GP)

Investigations (Total number for each year) or 88 = Not relevant; 99 = Not recorded

What	1994	1995	1996	1997	1998	1999	2000	2001
FBC								
U&Es								
Creat								
LFTs								
Chol								
Glucose								
HbA1c								

RISK FACTOR MEASUREMENTS

1) Record of Lipid Profile Since OXMIS Event ☐ *1 = Yes 0 = No*

From Hospital Letters			From GP Notes			From Screen		
Date *(dd/mm/yy)*	Readings *mmol/l*		Date *(dd/mm/yy)*	Readings *mmol/l*		Date *(dd/mm/yy)*	Readings *mmol/l*	
	TC	*HDL*		TC	HDL		*TC*	*HDL*
1			9			17		
2			10			18		
3			11			19		
4			12			20		
5			13			21		
6			14			22		
7			15			23		
8			16			24		

2) Record of Blood Pressure Since OXMIS Event ☐ *1 = Yes 0 = No*

From GP Notes		From GP Notes		From Screen	
Date *(dd/mm/yy)*	Reading *mm/Hg*	Date *(dd/mm/yy)*	Reading *mm/Hg*	Date *(dd/mm/yy)*	Reading *mm/Hg*
1		13		25	
2		14		26	
3		15		27	
4		16		28	
5		17		29	
6		18		30	
7		19		31	
8		20		32	
9		21		33	
10		22		34	
11		23		35	
12		24		36	

NEW CHD DIAGNOSES

New CHD Diagnoses In Primary Care: ☐ 1 = Yes 0 = No 9 = Not Recorded

1a) **Angina/CAD** : ☐ 1 = Yes 0 = No 2 = Progression 9 = Not recorded

If yes, **type:** ☐ 1 = Exertional 2 = Chronic/Stable 3 = Unstable 4 = Silent Ischaemic
5 = Coronary Artery Disease 6 = Other: _____ (specify) 9 = Not recorded

Date of Angina Diagnosis: ☐☐ ☐☐ ☐☐

Confirmed by:

Symptoms:	Chest Pain ☐ 1 = Yes 0 = No	Breathlessness ☐ 1 = Yes 0 = No

Investigations:	1 = Yes 0 = No 9 = Not recorded	**Results** 8 = N/A 9 = Not recorded
Biochemistry	☐ 2 = TnT 3 = TnI	Max value ☐☐ . ☐
12 Lead ECG	☐	a ☐ 1 = LVH 2 = Left Bundle Branch Block 3 = Right Bundle Branch Block 4 = Atrial Fib b ☐ 5 = Ischaemia (ST↓) 6 = Other: _____
Holter Monitor (24 Hour ECG)	☐	a ☐ 1 = LVH 2 = Left Bundle Branch Block 3 = Right Bundle Branch Block 4 = Atrial Fib b ☐ 5 = Ischaemia (ST↓) 6 = Other: _____
Exercise - ECG	☐	☐ 1 = ST ↓ > 2mm 2 = ST ↓ > 1 mm 3 = ST ↓ 0-1 mm 4 = Other: _____
Nuclear Scan	☐	☐ **Ischaemia**: 1 = Reversible 0 = Non- reversible ☐☐ Ejection Fraction (%) ☐ No of diseased vessels
Coronary Angiography	☐	☐☐ Ejection Fraction (%) ☐ No of diseased arteries OR SYSTOLIC FUNCTION: 5 = Mildly impaired 6 = Moderately impaired 7 = Severely impaired 0 = Normal

If more than one entry about angina or coronary artery disease, then complete the following page.

1b) **Angina/CAD** : ☐ 1 = Yes 0 = No 2 = Progression 9 = Not recorded

If yes, **type**: ☐ 1 = Exertional 2 = Chronic/Stable 3 = Unstable 4 = Silent Ischaemic
5 = Coronary Artery Disease 6 = Other: _____ (specify) 9 = Not recorded

Date of Angina Diagnosis: ☐☐ ☐☐ ☐☐

Confirmed by:

Symptoms:	Chest Pain ☐ 1 = Yes 0 = No	Breathlessness ☐ 1 = Yes 0 = No

Investigations:	1 = Yes 0 = No 9 = Not recorded	**Results** 8 = N/A 9 = Not recorded
Biochemistry	☐ 2 = TnT 3 = TnI	Max value ☐☐ . ☐
12 Lead ECG	☐	a ☐ b ☐ 1 = LVH 2 = Left Bundle Branch Block 3 = Right Bundle Branch Block 4 = Atrial Fib 5 = Ischaemia (ST↓) 6 = Other: _____
Holter Monitor (24 Hour ECG)	☐	a ☐ b ☐ 1 = LVH 2 = Left Bundle Branch Block 3 = Right Bundle Branch Block 4 = Atrial Fib 5 = Ischaemia (ST↓) 6 = Other: _____
Exercise - ECG	☐	☐ 1 = ST ↓ > 2mm 2 = ST ↓ > 1 mm 3 = ST ↓ 0-1 mm 4 = Other: _____
Nuclear Scan	☐	☐ **Ischaemia:** 1 = Reversible 0 = Non- reversible ☐☐ Ejection Fraction (%) ☐ No of diseased vessels
Coronary Angiography	☐	☐☐ Ejection Fraction (%) ☐ No of diseased arteries OR SYSTOLIC FUNCTION: 5 = Mildly impaired 6 = Moderately impaired 7 = Severely impaired 0 = Normal

2a) **Heart Failure/ Left Ventricular Failure :** ☐ 1 = Yes 0 = No 2 = Progression 9 = Not recorded

Date of Heart Failure Diagnosis/ Progression: _____

Confirmed by:			
Symptoms 1 = Yes 0 = No 9 = Not recorded			
Breathlessness ☐	*Orthopnoea* ☐	*Paroxysmal Nocturnal Dyspnoea* ☐	*Peripheral Oedema* ☐

Investigations		**Results:** 8 = N/A 9 = Not recorded
Chest X-Ray	☐	☐ 1 = Pulmonary oedema 2 = No pulmonary oedema 3= Other: _____
Echo	☐	☐ 1 = LVEF>50% 2 = LVEF 40-50% 3 = LVEF 30-39% 4 = LVEF < 30% OR SYSTOLIC FUNCTION: 5 = Mildly impaired 6 = Moderately impaired 7 = Severely impaired 8 = Other: _____ (specify)

If more than one entry about heart failure or LVF, then complete the following section.

2b) **Heart Failure/ Left Ventricular Failure :** ☐ 1 = Yes 0 = No 2 = Progression 9 = Not recorded

Date of Heart Failure Diagnosis/progression: _____

Confirmed by:			
Symptoms 1 = Yes 0 = No 9 = Not recorded			
Breathlessness ☐	*Orthopnoea* ☐	*Paroxysmal Nocturnal Dyspnoea* ☐	*Peripheral Oedema* ☐

Investigations		**Results:** 8 = N/A 9 = Not recorded
Chest X-Ray	☐	☐ 1 = Pulmonary oedema 2 = No pulmonary oedema 3= Other: _____
Echo	☐	☐ 1 = LVEF>50% 2 = LVEF 40-50% 3 = LVEF 30-39% 4 = LVEF < 30% OR SYSTOLIC FUNCTION: 5 = Mildly impaired 6 = Moderately impaired 7 = Severely impaired 8 = Other: _____ (specify)

3) **Arrhythmias :** ☐ 1 = Yes 0 = No 9 = Not recorded

Date of Diagnosis: ☐☐ ☐☐ ☐☐

Confirmed by:	1 = Yes 0 = No 9 = Not recorded	**Results:** 9 = Not recorded
12 Lead ECG	☐	a ☐ 1 = Cardiac Arrest 2 = Left Bundle Branch Block 3 = Right Bundle Branch Block 4 = AV Block Post-MI 5 = Atrial Fib 6 = Other: _____ b ☐

(If more than one, please complete additional 'arrhythmias' sections below)

Arrhythmias : ☐ 1 = Yes 0 = No 9 = Not recorded

Date of Diagnosis: ☐☐ ☐☐ ☐☐

Confirmed by:	1 = Yes 0 = No 9 = Not recorded	**Results:** 9 = Not recorded
12 Lead ECG	☐	a ☐ 1 = Cardiac Arrest 2 = Left Bundle Branch Block 3 = Right Bundle Branch Block 4 = AV Block Post-MI 5 = Atrial Fib 6 = Other: _____ b ☐

Arrhythmias : ☐ 1 = Yes 0 = No 9 = Not recorded

Date of Diagnosis: ☐☐ ☐☐ ☐☐

Confirmed by:	1 = Yes 0 = No 9 = Not recorded	**Results:** 9 = Not recorded
12 Lead ECG	☐	a ☐ 1 = Cardiac Arrest 2 = Left Bundle Branch Block 3 = Right Bundle Branch Block 4 = AV Block Post-MI 5 = Atrial Fib 6 = Other: _____ b ☐

4) **Myocardial Infarction** : ☐ 1 = Yes 0 = No **Date of MI Diagnosis:** _____

(If more than one, please complete additional 'myocardial infarction' sections)

Confirmed by:		**Results:** 9 = Not recorded
12 Lead ECG	☐ 1 = Yes 0 = No	☐ 1 = STElevation 2 = T-Wave Inversion 3 = Q Wave MI 4 = Non-Q Wave MI 5 = Other: _____
Infarct Location	☐☐ 1 = Inferior 2 = Posterior 3 = Anterior 4 = Lateral 5 = Rt Ventricle 6 = Infero-lateral 7 = Antero-Lateral 8 = Septal 9 = Infero-posterior-lateral 10 = Other: _____	
Biochemistry ☐	1 = Yes 0 = No 9 = Not recorded	
Cardiac Enzymes	1 = CK 2 = CKMB 3= LDH 4 = AST 5 = TnT 6 = TnI	Max value _____ . ___

4b) **Myocardial Infarction** : ☐ 1 = Yes 0 = No **Date of MI Diagnosis:** _____

Confirmed by:		**Results:** 9 = Not recorded
12 Lead ECG	☐ 1 = Yes 0 = No	☐ 1 = STElevation 2 = T-Wave Inversion 3 = Q Wave MI 4 = Non-Q Wave MI 5 = Other: _____
Infarct Location	☐☐ 1 = Inferior 2 = Posterior 3 = Anterior 4 = Lateral 5 = Rt Ventricle 6 = Infero-lateral 7 = Antero-Lateral 8 = Septal 9 = Infero-posterior-lateral 10 = Other: _____	
Biochemistry ☐	1 = Yes 0 = No 9 = Not recorded	
Cardiac Enzymes	☐ 1 = CK 2 = CKMB 3= LDH 4 = AST 5 = TnT 6 = TnI	Max value ☐☐☐☐ . ☐

4c) **Myocardial Infarction** : ☐ 1 = Yes 0 = No **Date of MI Diagnosis:** _____

Confirmed by:		**Results:** 9 = Not recorded
12 Lead ECG	☐ 1 = Yes 0 = No	☐ 1 = STElevation 2 = T-Wave Inversion 3 = Q Wave MI 4 = Non-Q Wave MI 5 = Other: _____
Infarct Location	☐☐ 1 = Inferior 2 = Posterior 3 = Anterior 4 = Lateral 5 = Rt Ventricle 6 = Infero-lateral 7 = Antero-Lateral 8 = Septal 9 = Infero-posterior-lateral 10 = Other: _____	
Biochemistry ☐	1 = Yes 0 = No 9 = Not recorded	
Cardiac Enzymes	☐ 1 = CK 2 = CKMB 3= LDH 4 = AST 5 = TnT 6 = TnI	Max value _____ . ____

Additional OXMIS Event Information Data Collection Form

FRONT SHEET (CONFIDENTIAL)

OXMIS ID Number: ☐☐☐☐☐

Patient Details:

(Use sticky label if available)

GP Details:

(Use sticky label if available)

Title: Mr/Miss/Ms/Mrs/Dr./Prof (circle appropriate title)

Forenames:_____

Surname: _____

Address1: _____

Address2: _____

GP Phone:_____

Town: _____

POSTCODE: _____ _____

Hospital Number: ☐☐☐☐☐☐☐☐

Data Collection Monitoring:

Subsequent Hospital Admissions: *Yes* ☐ *No* ☐ ***End of Admission Note Review:*** ☐

Comments: _____

_____

Subsequent Outpatient Appts: *Yes* ☐ *No* ☐ ***End of Outpatient Review:*** ☐

Comments: _____

_____

Current Vital Status: ☐ 1 = Dead 0 = Alive (if applicable) **Date of Death**: ☐☐ ☐☐ ☐☐

Date of OXMIS Event: (includes symptom onset)

☐☐ ☐☐ ☐☐

DESTROY THIS SHEET AFTER DATA COLLECTION COMPLETED

Additional OXMIS Event Information

OXMIS ID Number ☐☐☐☐☐

Date of OXMIS Event: (includes symptom onset)
☐☐ ☐☐ ☐☐

Hospital of OXMIS Admission: ☐
1 = John Radcliffe 2 = Horton General 3 = Reading
4 = Other: specify_____

Admission Date: _____ **Discharge Date:** _____

Hospital Number: ☐☐☐☐☐☐☐☐

Sex: ☐ 1 =Male 0 = Female **Date of Birth:** ☐☐ ☐☐ ☐☐

Current Vital Status: ☐ 1 = Dead 0 = Alive (if applicable) **Date of Death:** ☐☐ ☐☐ ☐☐

During OXMIS Admission, New Diagnosis or Objective Documentation of:

1) **Heart Failure/ Left Ventricular Failure:** ☐ 1 = Yes 0 = No 2 = Progression 9 = Not recorded

Confirmed by:	1 = Yes 0 = No 9 = Not recorded	**Results:** 9 = Not recorded
Chest X-Ray	☐	☐ 1 = Pulmonary oedema 2 = No pulmonary oedema 3 = Other: _____
Echo	☐	☐ 0 = Normal 1 = LVEF>50% 2 = LVEF 40-50% 3 = LVEF 30-39% 4 = LVEF < 30% OR SYSTOLIC FUNCTION: 5 = Mildly impaired 6 = Moderately impaired 7 = Severely impaired 8 = Other: _____ (specify

2) **Arrhythmias:** ☐ 1 = Yes 0 = No 2 = Progression 9 = Not recorded

Confirmed by:	1 = Yes 0 = No 9 = Not recorded	**Results:** 8 = Not applicable 9 = Not recorded
12 Lead ECG	☐	a ☐ b ☐ c ☐ 1 = Cardiac (VF) Arrest 2 = Left Bundle Branch Block 3 = Right Bundle Branch Block 4 = AV Block Post-MI 5 = Atrial Fib 6 = Other: _____

3a) **Angina / CAD**: ☐ 1 = Yes 0 = No 2 = Progression 9 = Not recorded

3b) If yes, **type**: ☐ 1= Exertional 2 = Chronic/Stable 3 = Unstable 4 = Silent Ischaemic 5 = Coronary Artery Disease 6 = Other: _____ 9 = Not recorded

Confirmed by:	1 = Yes 0 = No 9= Not recorded	**Results:** 8 = N/A 9 = Not recorded
12 Lead ECG	☐	a ☐ b ☐ 1 = LVH 2 = Left Bundle Branch Block 3 = Right Bundle Branch Block 4 = Atrial Fib 5 = Ischaemia (ST↓) 6 = Other: _____
Biochemistry	☐ 2 = TnT 3 = TnI	Max value ☐☐ . ☐
Holter Monitor	☐	a ☐ b ☐ 1 = LVH 2 = Left Bundle Branch Block 3 = Right Bundle Branch Block 4 = Atrial Fib 5 = Ischaemia (ST↓) 6 = Other: _____
Exercise - ECG	☐	☐ 1 = ST ↓ > 2mm 2 = ST ↓ > 1 mm 3 = ST ↓ 0-1 mm 4 = Other: _____
Nuclear Scan	☐	☐ **Ischaemia**: 1 = Reversible 0 = Non- reversible ☐ No of diseased vessels
Coronary Angiography	☐	☐☐ Ejection Fraction (%) OR SYSTOLIC FUNCTION: ☐ No of diseased arteries 5 = Mildly impaired 6 = Moderately impaired 7 = Severely impaired

OXMIS ID Number: ☐☐☐☐☐

Past Medical History 0 = No 1 = Yes 9 = Not recorded

Diagnosis	Date of Diagnosis	Procedure / Diagnosis	Date of Procedure or Diagnosis
☐ *Angina*		☐ *Angiogram*	_____
☐ *MI (most recent)*	_____	☐ *CABG (most recent)*	_____
☐ *MI (2nd most recent)*	_____	☐ *CABG (2nd most recent)*	_____
☐ *MI (3rd most recent)*	_____	☐ *PCI (most recent)*	_____
☐ *Other IHD*	_____	☐ *PCI (2nd most recent)*	_____
☐ *CVA*	_____	☐ *Pacemaker*	_____
☐ *PVD*	_____	☐ *Cardiac Arrest*	_____
☐ *Cardiac Failure*	_____	☐ *Chronic AF*	_____
☐ *Hypertension*	_____	☐ *Renal Disease*	_____
☐ *Hyperlipidaemia*	_____	☐ *Asthma*	_____
☐ *Diabetes*	_____	☐ *COPD*	_____

History of Smoking ☐ 0 = No, never smoked 1 = Yes, still smoking 2 = Yes, ex-smoker

Year Quit: _____

Family History		
Dx or death < 55 yrs for men & < 60 for women	☐ 0 = No 1 = Yes 9= Not recorded	Siblings: ☐ Parents: ☐ 1 = Yes 0 = No 9 = Not recorded

Procedural Guidelines for Data Collection

PROCEDURE FOR ADDITIONAL OXMIS EVENT INFORMATION

Using Master List

1. Find OXMIS ID Number by matching name, date of birth and hospital number from master list.

2. Enter **OXMIS ID No** on pages 1 &2 of Patient Information form.

3. Copy **Date of OXMIS Event, Current Vital status** and **Date of Death** (if applicable) from master list to pages 1 & 2.

Page 1

4. Place Patient & GP sticky labels if available on page 1 OR copy **Patient & GP Details**. Write **GP Phone** number from blue admission sheet.

Page 2

5. Find hospital admission notes related to OXMIS event.
   a) Noting that **Date of OXMIS Event** is symptom onset and the date of actual admission may be the next day or so. UNLESS they were admitted for something else and experienced an MI during that admission. The discharge diagnosis is usually MI, but may be unstable angina, acute coronary syndrome, etc. If in doubt, make a note and contact me so I can check in the original data.
   b) **Hospital of Admission** usually corresponds to the OXMIS ID No:
   J=JR,
   B=Banbury
   E = Other which includes all patients admitted to Reading hospitals.
   Complete as appropriate.
   c) Look for an **Admission Date** close to symptom onset with admitting complaint of chest pain, breathlessness, collapse etc. Determine the **Discharge Date** from discharge summary or letter. Complete details on pages 2-4 of Patient Information form.
   d) Complete **Sex** and **Date of Birth** from hospital sticky label or blue sheet.

Page 2

CORONARY HEART DISEASE DIAGNOSES

Aim: To obtain details about new CHD diagnoses or objective documentation of heart failure/ LVF, arrhythmias or angina/ coronary artery disease during the OXMIS admission.

1. **Heart Failure/ Left Ventricular Failure**
   (May also be written as CHF, LVF, systolic function.)
   Check for past medical history in admission notes. If there is a history AND further information is documented during this admission, then this will be classified as progression.
   a) *Chest X-Ray* (CXR) results will be documented in the medical notes and in the report.
      - Pulmonary oedema on chest X-Ray confirms hear failure. If there is something else documented that may be relevant, write in 'other' and discuss with me.
   b) Plans for an *Echo* (ECHO or echocardiogram) will be documented in the medical notes. Results are usually hand written in the medical notes. Systolic function of the left ventricle is the finding of interest for confirming heart or left ventricular failure.
      - May be written as mildly, moderately or severely impaired systolic function OR as a % of the ejection fraction (LVEF or EF). If there is something else documented that may be relevant, write in 'other' and discuss with me.

2. **Arrhythmias**
   Check for past medical history. If there is a history AND further information is documented during this admission, then this will be classified as progression – but this unlikely.
   a) *12 Lead ECG* results will be documented in the notes with various abbreviations. (see Glossary)
      - If only one arrhythmia documented during this admission, complete results box a.
      - If more than one, complete results b and c box as appropriate.

3. **Angina / Coronary Artery Disease (CAD)**
   Check for past medical history. If there is a history AND further objective documentation during this admission, then this will be classified as progression. For example, if someone with past history of angina has angiography now, then this will be classified as progression.

Type: To complete this section, see Glossary. If in doubt, photocopy the section & contact me.

a) *12 Lead ECG* results will be documented in the notes with various abbreviations. (see Glossary).
   - If only one result is documented during this admission, complete **Results** box a.
   - If more than one, complete results b. If more, write them on the side & discuss with me.

b) *Biochemistry*: Troponins are used to confirm the diagnosis of unstable angina or acute coronary syndrome (ACS) and to rule out an MI. Documented in medical notes as TnT (most usual) or TnI and biochemistry laboratory results slip.

c) *Holter Monitor*: 24 hour ECG monitoring is used to identify silent myocardial ischaemia (common in diabetics) and those patients suspected to be at high risk of death or MI. Unlikely to be used if patient has had Exercise ECG. Also used to detect arrhythmias. Results will be documented in medical notes. I'm not sure if a report ends up in the notes.

d) *Exercise ECG:* (See glossary for alternate terms.) May be requested during in-patient stay if patient experiences new or recurrent angina. The results will be documented in medical notes. There may be a report from the non-invasive cardiology department.

e) *Nuclear Scan:* Covers all myocardial perfusion imaging scans (see glossary for alternate terms). It is a non-invasive method to assess presence or absence of disease but also its extent and severity. Investigates inducible thus reversible myocardial ischaemia. The order and results will be documented in medical notes. There may be a report from the nuclear cardiology department. The findings of interest to us are the type of ischaemia and number of disease vessels. If these are not reported, enter 9 in each results box, make a note and discuss with me. (may need to change the form)

f) *Coronary Angiography*: Usually referred to as Cardiac Catheterisation or Cardiac Cath. Results usually documented in medical notes, sometimes with diagram illustrating diseased vessels. Results of interest are number of diseased vessels and extent of systolic function. Report will be on a pink sheet (JR) usually filed in middle section of notes, which may contain results of interest if you are unable to find them in medical notes (it varies).

PAST MEDICAL HISTORY

- Clinical diagnoses documented in notes under PMH. NOT new diagnoses on this admission.
- Enter 9 if nothing recorded.
- If diagnosis is recorded, enter date of diagnosis (month/year).

Does this patient have a history of:
Angina
MI – if more than one, put most recent first. If more than three document the first three only. Ignore *Other IHD*.
CVA – any type of stroke
PVD – peripheral vascular disease; May have history of fem-pop bypass grafts, aortic aneurysm repair, intermittent claudication.
Cardiac Failure – may be recorded as left ventricular failure (LVF), chronic heart failure or congestive cardiac failure (CCF)
Hypertension – may be recorded as ↑ B/P
Hyperlipidaemia – may be recorded as ↑ serum cholesterol
Diabetes – type 1 or type 2, NIDDM, IDDM

Angiogram – Angiography, cardiac cath
CABG – Bypass surgery
PCI – Percutaneous coronary intervention, includes balloon angioplasty with or without stent
Pacemaker –permanent pacemaker; Check with me about temporary pacemaker..
Cardiac Arrest – History, does not include if they were admitted because if cardiac arrest
Chronic AF -
Renal Disease -
COPD – chronic obstructive airways disease (COAD), emphysema,

History of Smoking: documentation of cigarette smoking and if ex-smoker, note the year they quit. Make a note if they are cigar smokers.

Family History: Record if there is documentation of a family history (1^{st} degree relatives =) of heart disease – diagnosis of angina or MI or coronary artery disease from angiogram or coronary artery bypass graft surgery or angioplasty. If at diagnosis less than 55 years for men or less than 65 years for women, document in boxes if older

PROCEDURE FOR HOSPITAL NOTE REVIEW

Using Master List

6. Find OXMIS ID Number by matching name, date of birth and hospital number from master list.

7. Enter **OXMIS ID No** on pages 1 &2 of Patient Information form. Copy **Date of OXMIS Event, Current Vital status** and **Date of Death** (if applicable) from master list to pages 1 & 2.

8. Find hospital admission notes related to OXMIS event.
   - Noting that **Date of OXMIS Event** is symptom onset and the date of actual admission may be the next day or so. UNLESS they were admitted for something else and experienced an MI during that admission. The discharge diagnosis is usually MI, but may be unstable angina, acute coronary syndrome, etc. If in doubt, make a note and contact me so I can check in the original data.

9. Make rough list of subsequent admissions & outpatient appointments:
   - Note dates.
   - Note reason for hospital contacts; look for presenting complaint in admission notes, discharge diagnosis on summary or GP letter & any new CHD diagnoses or progression of CHD diagnoses (primarily Angina and heart failure).

10. Decide whether each subsequent admission & outpatient appointment is CHD or non-CHD.

Criteria for CHD:

a) **CHD Admission**
   - **i)** New CHD diagnosis
     OR
   - **ii)** CHD diagnosis progression,
     (like CHF confirmed by ECHO or CAD confirmed by angiography.)

b) **CHD Outpatient Appointment or Investigation**
   - **i)** Follow-up appointment post-CHD admission (MI, unstable angina, bypass surgery or angioplasty)
     OR
   - **ii)** when NEW CHD diagnosis is made
     OR
   - **iii)** when established diagnosis is confirmed by investigation,
     (like CHF by ECHO or CAD by angiography.)

Criteria for Non-CHD:

Non-CHD Admission or Outpatient Appointment

i) when it is only for subsequent monitoring or medication adjustment for CHD diagnosis with NO confirmation of progression.
   OR
ii) when it is fro some other health problem, like an ischaemic leg (vascular) or gastritis

11. Complete appropriate forms.

12. When appropriate, record on page 1 if notes from another hospital may exist & chase PRN.
    - E.g. Horton General Hospital or Reading patients referred to JR or vice versa.

PROCEDURE FOR CHD HOSPITAL ADMISSION

Aim: To obtain details about hospital admission for CHD when a new CHD diagnosis is made or there is documentation of CHD progression.

Look for written documentation in medical notes and summary in the letters to GP.

Page 1

OXMIS ID No. Enter this from master list. **CHD Hospital Admission No.** Ignore

Admission Date. Check blue admission sheet for date of admission

Admission Diagnosis: Look on A&E notes and on history sheet for presenting complaint and enter.

Type of Admission: Assume NHS admission unless it is specifically as private.

Hospital: Check top of blue admission sheet for hospital & enter the corresponding number.

Location: Check at top of blue admission sheet & enter the appropriate number indicating whether the patient was admitted to a general ward, coronary care unit or intensive care unit. (Eg WL 7F ward level 7 ward F)

Speciality: Check blue admission sheet for clinical speciality on admission. Note this on the side and check if the patient is transferred to another speciality during this admission. Enter the final speciality in the box.
Eg: May be admitted under general medicine then transferred to cardiology and then be transferred to cardiac surgery. In this case, cardiac surgery would be entered in the box, but write the others down.

Medication Pre-Admission

- Look in the A&E notes and the admission history for record of patient's medication before admission. Indicate yes or no in the box.
- If yes, record the name (preferably generic, but just copy what is written), dose in mg, frequency.
- **OXMIS Code** – will be entered by me once the forms get returned to the office.
- If there are more than 10, record cardiac drugs first (refer to drug list)

Risk Factors

Look in the admission history for record of coronary risk facrors. May be under SH/FH or RFs.

Current Tobacco Use: Only record current status; if still smoking, record the number of cigarettes or ounces of tobacco per week and circle which one.

Raised Cholesterol: Check for a record of cholesterol measurement during admission. If it is measured and cholesterol is greater than 5.0 mmol/L, record 1 for yes and the value. If it is measured and cholesterol is less than 5.0 mmol/L, record 2 for no and the value. If it isn't measured, enter 9 for not recorded. Check for a measurement in the admitting blood results. NOTE: If cholesterol has been measured & it is less than 5.0 mmol/L still record the value.

Glucose Intolerance: Check for record of glucose intolerance in the admitting medical notes. Will probably be written out.

Diabetes: Check for record of diabetes in the admitting medical notes. May be written as IDDM, NIDDM, DM under PMH. If yes, record the way in which it is treated at this time. Has a serum glucose been measured in admitting blood results? If yes, record the result. If no but there is a diabetes diagnosis enter 88, If not and there is NO diabetes diagnosis, enter 99.

Treatment of DM: Has the method of treatment been recorded? Don't forget to check admission medications. If no mention record 9 for not recorded.

Page 2 **CHD Diagnosis This Admission**

Read through medical notes and discharge summary.

- If there was a new CHD diagnosis or objective confirmation of MI, angina/ coronary artery disease, heart failure/ LVF or arrhythmias during this admission, complete ALL of the appropriate sections.
- If no go to Procedures this Admission section on page 3.

1. **Myocardial Infarction:**
   (documented as MI, AMI, acute myocardial infarction with various qualifying descriptions)

   Confirmation of diagnosis:
   Read discharge summary, medical notes and laboratory results looking for ECG and biochemistry lab results.
   12 lead ECG: usually written near the diagnosis of MI and should indicate the basis for diagnosis and the myocardium location.
   Biochemistry: Should be stated in the notes but also check Biochemistry lab results.
   CK = creatinine kinase; CKMB = creatinine kinase myocardial B isoenzyme; LDH; AST or Tn = Troponins either T or I. Any combination of these are used to diagnose an MI. Look for the highest levels of each and record.

2. **Angina / Coronary Artery Disease (CAD)**
   Check for past medical history in admitting notes. If there is a history AND further information is documented during this admission, then this will be classified as progression. For example, if someone with past history of angina has angiography <u>now</u>, then this will be classified as progression. Also if ischaemia post-MI is documented from an investigation then this section needs to be completed even if you have documented details of the MI.

Type: To complete this section, see Glossary.

Confirmation of diagnosis:

g) *12 Lead ECG* results will be documented in the notes with various abbreviations. (see Glossary) It is rare for ECG results to be written on the request form.
   - If only one result is documented during this admission, complete **Results** box a.
   - If more than one, complete results b. If more, then write then down and discuss.

h) *Biochemistry*: Troponins are used to confirm the diagnosis of unstable angina or acute coronary syndrome (ACS) and to rule out an MI. Documented in medical notes as TnT (most usual) or TnI and biochemistry laboratory results.

i) *Holter Monitor*: 24 hour ECG monitoring is used to identify silent myocardial ischaemia (common in diabetics) and those patients suspected to be at high risk of death or MI. Also used to detect arrhythmias. Results will be documented in medical notes.

j) *Exercise ECG*: *(See glossary for alternate terms.)* May be requested during in-patient stay if patient experiences new or recurrent angina. The results will be documented in medical notes. There may be a report from the non-invasive cardiology department.

k) *Nuclear Scan:* Covers all myocardial perfusion imaging scans *(see glossary for alternate terms).* It is a non-invasive method to assess extent and severity of disease. Investigates inducible thus reversible myocardial ischaemia. The results will be documented in medical notes. There may be a report from the nuclear cardiology department. The findings of interest are the type of ischaemia and number of disease vessels. If these are not reported, enter 9 in each results box, make a note and discuss with me. (may need to change the form)

Page 3

3. **Heart Failure/ Left Ventricular Failure**
   (May also be written as CHF, LVF, systolic function.)
   Check for past medical history in admission notes. If there is a history AND further information is documented during this admission, then this will be classified as progression.

   c) *Chest X-Ray* (CXR) results will be documented in the medical notes and the report.
   - Pulmonary oedema on chest X-Ray results confirms heart failure. If there is something else documented that may be relevant, write in 'other' and discuss with me.

   d) Plans for an *Echo* (ECHO or echocardiogram) will be documented in the medical notes. Results are usually hand written in the medical notes. Systolic function of the left ventricle is finding of interest to us for confirming heart or left ventricular failure.
   - May be written as mildly, moderately or severely impaired systolic function OR as a % of the ejection fraction (LVEF or EF). If there is something else documented that may be relevant, write in 'other' and discuss with me.

4. **Arrhythmias**
   Check for past medical history. If there is a history AND further information is documented during this admission, then this will be classified as progression – but this unlikely.
   b) *12 Lead ECG* results will be documented in the notes with various abbreviations. (see Glossary).
   - If only one arrhythmia documented during this admission, complete results box a.
   - If more than one, complete results b and c box as appropriate.

Procedures This Admission
Note if the patient has had any of the following procedures associated with CHD.
- If **yes**, complete as appropriate including date.
- If **no**, go to In-hospital Death section.

PCI: Percutaneous coronary intervention, includes balloon angioplasty with or without stent
Bypass Surgery: Usually referred to as CABG or Coronary Artery Bypass Graft Surgery
Pacemaker: This refers to the insertion of a permanent pacemaker
Cardiac Transplant: Usually planned for end-stage heart failure patients. Not that common.
LV Assist Device: May be referred to as left ventricular assist device, Jarvik Heart and is planned for end-stage heart failure patients. Not that common. Check with me if you're in doubt.

In-Hospital Death

Note if the patient died during this admission. This will be stated in the discharge summary and documented in the medical notes.
- If **yes**, enter the date of death and record the causes of death. If the ICD codes are available note them on the side, but I will need to check be entered in the office.

THIS FORM IS NOW COMPLETE. Check that all of the sections have been completed.
- If **no**, go to **Discharge** section on page 4.

Page 4

Discharge

Discharge Date: Look for this on discharge summary, but verify it with last entry in notes and written summary to GP. This can be elusive.

Discharge Medication:
- Look in discharge summary, GP letter or pharmacy order sheet for the discharge medications.

Indicate yes or no in the box.

- If yes, record the name (preferably generic, but just copy what is written), dose in mg, frequency.
- **OXMIS Code** – will be entered by me once the forms get returned to the office.
- If there are more than 10, record cardiac drugs first (refer to drug list).

Post-discharge Plans:
Look in the medical notes or discharge summary for documentation of plans after discharge.
Outpatient Appointment: If there is date on the discharge summary record it as booked; If it is mentioned but no date record it as planned.
Cardiac rehabilitation: there may be a letter from the Cardiac Rehabilitation team informing the consultant of the invitation (enter planned).

Other New Non-CHD Diagnoses.
Enter any other discharge diagnoses that were not recorded in this form. If none, enter 0 in the box.

THIS FORM IS NOW COMPLETE. Check that all of the sections have been completed.

PROCEDURE FOR CHD OUTPATIENT APPOINTMENTS

Aim: To obtain details about outpatient appointments after a CHD admission or when a new CHD diagnosis is made.
Look for written documentation in medical notes and summary in the letters to GP.

Page 1
OXMIS ID No. Enter this from master list. **CHD Outpatient Appointment No.**

Speciality: Pick the appropriate clinical speciality, by looking at the most recent hospital admission speciality or GP letter with the summary.

Type: Assume NHS appointment unless it is specifically documented as private.

Location: Enter the corresponding number for the hospital at which the appointment took place. It should say on the letter, and if not assume it is the same as the previous admission.

New CHD Diagnosis
Read through the medical notes and the GP letter.

- If there was a new diagnosis made or objective documentation of heart failure/ LVF, arrhythmias or angina/ coronary artery disease confirmed by investigations associated with this appointment, enter yes and complete ALL of the appropriate sections.
- If no, go to the planned coronary procedures section.

4. **Angina / Coronary Artery Disease (CAD)**
   Check for past medical history. If there is a history AND further information is documented during this admission, then this will be classified as progression. For example, if someone with past history of angina has angiography now, then this will be classified as progression.

Type: To complete this section, see Glossary.

Confirmation of diagnosis:

l) *12 Lead ECG* results will be documented in the notes with various abbreviations. (see Glossary).
   - If only one result is documented during this admission, complete **Results** box a.
   - If more than one, complete results b. If more, write them down and discuss.

m) *Biochemistry*: Troponins are used to confirm the diagnosis of unstable angina or acute coronary syndrome (ACS) and to rule out an MI. Documented in medical notes as TnT (most usual) or TnI and biochemistry laboratory results slip.

n) *Holter Monitor*: 24 hour ECG monitoring is used to identify silent myocardial ischaemia (common in diabetics) and those patients at high risk of death or MI. Also used to detect arrhythmias. Results will be documented in medical notes.

o) *Exercise ECG:* (See glossary for alternate terms.) May be performed on an outpatient basis along with a follow-up outpatient appointment after a CHD admission. The results will be documented in medical notes.

p) *Nuclear Scan:* Covers all myocardial perfusion imaging scans (see glossary for alternate terms). It is a non-invasive method to assess the extent and severity of disease. Investigates inducible thus reversible myocardial ischaemia. The results will be documented in medical notes. The findings of interest are the type of ischaemia and number of disease vessels. If these are not reported, enter 9 in each results box, make a note and discuss with me.

Page 2

5. **Heart Failure/ Left Ventricular Failure**
   (May also be written as CHF, LVF, systolic function.)
   Check for past medical history in notes. If there is a history AND further information is documented during this admission, then this will be classified as progression.
   e) *Chest X-Ray* (CXR) results will be documented in the medical notes, the report & GP letter.
      - Pulmonary oedema on chest X-Ray results confirms heart failure diagnosis. If there is something else documented that may be relevant, write in 'other' and discuss with me.
   f) Plans for an *Echo* (ECHO or echocardiogram) will be documented in the notes. Results are usually hand written in the medical notes and in the GP letter. Systolic function of the left ventricle is finding of interest for confirming heart or left ventricular failure.
      - May be written as mildly, moderately or severely impaired systolic function OR as a % of the ejection fraction (LVEF or EF). If there is something else documented that may be relevant, write in 'other' and discuss with me.

6. **Arrhythmias**
   Check for past medical history. If there is a history AND further information is documented during this admission, then this will be classified as progression – but this unlikely.
   c) *12 Lead ECG* results will be documented in the notes with various abbreviations. (see Glossary).
      - If only one arrhythmia documented during this admission, complete results box a.
      - If more than one, complete results b and c box as appropriate.

Planned Coronary Procedures
Note of there are plans for the following procedures associated with CHD:

- If **yes**, complete as appropriate.
- If **no**, go to Risk Factors section.

Angiography: Usually referred to as Cardiac Catheterisation or Cardiac Cath.
PCI: Percutaneous coronary intervention, includes balloon angioplasty with or without stent
Bypass Surgery: Usually referred to as CABG or Coronary Artery Bypass Graft Surgery
Pacemaker: This refers to the insertion of a permanent pacemaker
Cardiac Transplant: Usually planned for end-stage heart failure patients. Not that common.
LV Assist Device: May be referred to as left ventricular assist device, Jarvik Heart and is planned for end-stage heart failure patients. Not that common. Check if you're in doubt.

Risk Factors
Risk factors may be documented in the notes or GP letter.

Current Tobacco Use:	Only record <u>current</u> status; if still smoking, record the number of cigarettes or ounces of tobacco per week and circle which.
Raised Cholesterol:	Check for serum cholesterol level in the medical notes, GP letter or in the lab results. If cholesterol is greater than 5.0 mmol/L, record <u>yes</u> and the value. If cholesterol has been measured & it is less than 5.0 mmol/L enter <u>no</u> but still record the value.
Raised B/P:	Check for blood pressure measurement in the medical notes or GP letter and record the reading. If greater than 140/85, record yes for raised.
Glucose Intolerance:	Check for record of glucose intolerance in the medical notes or GP letter.
Diabetes:	Check for record of diabetes in the medical notes or GP letter. If yes, record the way in which it is treated at this time. Has a serum glucose been measured? If <u>yes</u>, record the result. If <u>no</u>, but there is a diabetes diagnosis enter 88, If not and there is NO diabetes diagnosis, enter 99.

Page 3

Medication Pre-Appointment

Look in medical notes or GP letter for record of current medication.
- If yes, record the name (preferably generic, but just copy what is written), dose in mg, frequency.
- **OXMIS Code** – will be entered by me once the forms get returned to the office.
- If there are more than 10, record cardiac drugs first (refer to drug list)

Recommended Medication Change

As a result of the appointment, the doctor may make recommendations to change medications to the GP.

1 = This option isn't usual and if it's NOT clear that a hospital prescription has been given, then choose number 2. If it is clear, record drug details.

2 = Most common that hospital doctor recommends a change to the GP in the letter. Record drug details.

3 = Sometimes it is documented that a test result will indicate whether a potential change is needed. Record drug details.

4 = Hospital doctor will recommend the discontinuation of a current medication. Record drug details.

5 = Hospital doctor may suggest that current medications should stay the same. Assume this if no comment made in the notes or letter.

PROCEDURE FOR GENERAL PRACTICE NOTE REVIEW

Page 1

Using Master List

13. Find OXMIS ID Number by matching name, date of birth and hospital number from master list.

14. Enter **OXMIS ID No,** (if applicable) from master list to page 1.
Enter today's date
15. Do one of the following to figure out during which dates you are searching the notes.
    - If patient is <u>still alive</u>, calculate 6 Year Follow-up by adding 6 years to **Date of OXMIS Event** and enter this in the 6 Yr F/U Date.
    - If patient is <u>dead</u> enter the **Date of Death** from the master list.

Except where stated otherwise, you are looking for data from the OXMIS event date onwards.

CORONARY RISK FACTORS

1) **Diagnosis of Diabetes Since OXMIS Event.**
   Look for a new diagnosis SINCE the date of the original MI.

2) **Most Recent Record of Smoking Status**
   Look for the most recent date when a record had been made about the patients' smoking status. If necessary, go to before the OXMIS MI.

   If current smoker, look for the number of cigarettes smoked per day, the year they started smoking, the most recent treatment offered and the date if applicable.
   If ex-smoker, look for the number of cigarettes smoked per day before they quit and the year they quit smoking.

Page 2

CURRENT MEDICATION

For <u>Surviving Patients</u>, look at current prescriptions.
For <u>Deceased Patients</u>, look for last prescription record before date of death (may be printout).

Preventive Medication:
Look on prescriptions for Aspirin, Beta-blockers, ACE-inhibitors and Lipid lowering drugs. If you are unsure of category, check drug list using the Code as a guide. Record the drug name, dosage and frequency. If there is no prescription for any of these medications, look for a record of why not.

Other Current Medications:
Is the patient on any other medication. Indicate yes or no in the box.

If yes, record the name (preferably generic, but just copy what is written), Dose in mg, frequency.
OXMIS Code – will be entered by me once the forms get returned to the office. If there are more than 10, record cardiac drugs first (refer to drug list)

Page 3

GENERAL PRACTICE DRUG HISTORY

From page 1, copy the **6 Year Follow-up Date** or **Date of Death** as appropriate.

In this section, you are looking for data from the OXMIS event date onwards to either today's date or date of death.

Record the first prescription of the medication in the category, including the name, dose, frequency and start date.
Check from this date onwards, for any changes in the prescription: like change in the drug (Ramipril to Lisinopril), or dose strength (5 to 10 mg of Ramipril) or if it was stopped and then restarted at a later date.

Page 4

HEALTH SERVICE USE

Practice Consultations:
Record the number of practice consultations for each year. If it's not clear whether the consultation was with a practice nurse or GP, assume GP.
If there are consultations with any other professionals, record this freetext and notify me, so I can adjust the form and the database.

Investigations:
Record the number of times each investigation was conducted for each year. If none for a year, please write 0 in the box.

Page 5

RISK FACTOR MEASUREMENTS

Record of Lipid Profile Since OXMIS Event:
Is there a lipid profile recorded for this patient? Enter the answer in the box above the table.
If yes, record the lipid profiles from hospital letters, from GP paper notes and from the results screen if this facility exists for the practice computer system.

Record of Blood Pressure Since OXMIS Event:
Is there a blood pressure recorded for this patient? Enter the answer in the box above the table.
If yes, record the blood pressure measurements from hospital letters, from GP paper notes and from the results screen if this facility exists for the practice computer system.

NEW CHD DIAGNOSES

Check for disease summary or active problems list for CHD diagnoses and dates. Read through the hospital letters, discharge summaries and in the medical notes. Was a new diagnosis made or was there objective documentation of heart failure/ LVF, arrhythmias or angina/ coronary artery disease confirmed by investigations during a hospital admission or during an outpatient appointment? If no then you are finished reviewing this patient's notes. Check that all sections have been completed.

5. **Angina / Coronary Artery Disease (CAD)**

Need to check for past medical history. If there is a history AND further information is documented since the OXMIS Event, then this will be classified as progression. For example, if someone with past history of angina has angiography, then this will be classified as progression OR ischaemia is documented from an investigation then this section needs to be completed even if you have documented details of any other CHD diagnoses.

Type: To complete this section, see Glossary.

Confirmation of diagnosis:

q) *12 Lead ECG* results will be documented in the discharge letter or summary with various abbreviations. (see Glossary)

- If only one result is documented during this admission, complete **Results** box a.
- If more than one, complete results b.

r) *Biochemistry*: Troponins are used to confirm the diagnosis of unstable angina or acute coronary syndrome and to rule out an MI. May be documented in medical notes as TnT (most usual) or TnI and results in the back of the notes on a usual biochemistry laboratory results slip.

s) *Holter Monitor*: 24 hour ECG monitoring is used to identify silent myocardial ischaemia (common in diabetics) and those patients at high risk of death or MI. It is usually performed on an outpatient basis. Unlikely to be used if patient has had Exercise ECG. Also used to detect arrhythmias. Results will be documented in medical notes. I'm not sure if a report ends up in the notes.

t) *Exercise ECG:* (See glossary for alternate terms.) May be performed during in-patient stay if patient experiences recurrent angina or is referred for cardiac rehabilitation. Otherwise it is usually performed on an outpatient basis. The results will be documented in hospital letter or discharge summary. There may be a report from the non-invasive cardiology department.

u) *Nuclear Scan:* Covers all myocardial perfusion imaging tests (see glossary for alternate terms). It is a non-invasive method to assess presence or absence of disease but also its extent and severity. Investigates inducible thus reversible myocardial ischaemia. May be performed during in-patient stay if patient experiences recurrent angina or ischaemia. It is usually performed on an outpatient basis. The results will be documented in hospital letter or discharge summary. There may be a report from the nuclear cardiology department. The results of interest are the type of ischaemia and number of disease vessels. If these are not reported, enter 9 in each results box, make a note and discuss with me. (may need to change the form)

Page 8

6. **Heart Failure/ Left Ventricular Failure** (May also be written as CHF, LVF, systolic function.)
   Need to check for past medical history. If there is a history AND further information is documented during this admission, then this will be classified as progression.

   g) *Chest X-Ray* (CXR) results will be documented in the hospital letter or discharge summary.

- Pulmonary oedema on chest X-Ray results confirms this diagnosis. If there is something else documented that may be relevant, write in 'other' and discuss with me.
  h) The reults of an *Echo* (ECHO or echocardiogram) will be documented in the hospital letter or discharge summary. Systolic function of the left ventricle is detail of interest for confirming heart or left ventricular failure.
- May be written as mildly, moderately or severely impaired systolic function OR as a % of the ejection fraction (LVEF or EF). If there is something else documented that may be relevant, write in 'other' and discuss with me.

Page 9

7. Arrhythmias
Need to check for past medical history. If there is a history AND further information is documented during this admission, then this will be classified as progression – but this unlikely.

  d) *12 Lead ECG* results will be documented in the hospital letter or discharge summary using various abbreviations. (see Glossary)

- If only one arrhythmia documented during this admission, complete results box a.
- If more than one, complete results b and c box as appropriate.

Page 10

8. **Myocardial Infarction:**
(documented as MI, AMI, acute myocardial infarction with various qualifying descriptions)

Confirmation of diagnosis:
Go through discharge letter or summary, medical notes and laboratory results looking for ECG and biochemistry results.
12 lead ECG: usually written near the diagnosis of MI and should indicate the basis for diagnosis and the myocardium location.
Biochemistry: Should be stated in the notes but also check Biochemistry lab results.
CK = creatinine kinase; CKMB = creatinine kinase myocardial B; LDH; AST or Tn = Troponins either T or I. Any combination of these is used to diagnose an MI. Look for the highest levels of each and record.

Postal Questionnaire

Study No: | | | | | |

Your Date of Birth (day/month/year) ___ / ___ / ___

Today's Date: (day/month/year)___ / ___ / ___

SECTION 1 PHYSICAL SYMPTOMS

The following questions are about physical symptoms you may have had **in the last month** such as chest discomfort or breathlessness. *Please answer by ticking the appropriate box(es).*

A. CHEST PAIN

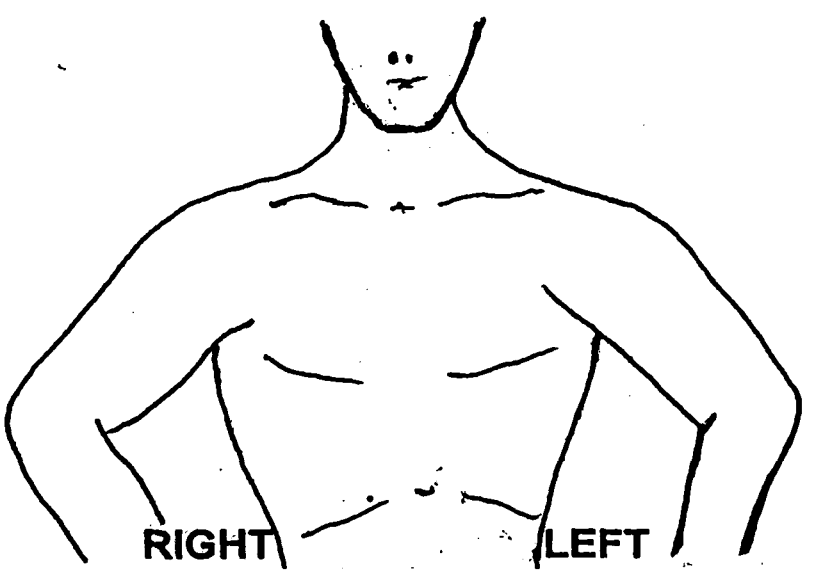
1. **Have you ever had any pain or discomfort in your chest?** *(Please tick **one** box)*

Yes ☐ *(If yes, go to question 2)*

No ☐ *(If no, go to question 9)*

2. **Where do you feel this pain or discomfort?**

Mark the place(s) with an X on the diagram below.



3. **Do you get this pain or discomfort when you walk uphill or hurry?**

Yes ☐

No ☐

4. **Do you get it when you walk at an ordinary pace on the level?**

Yes ☐

No ☐

5. **When you get any pain or discomfort in your chest what do you do?**

Stop ☐

Slow down ☐

Continue at same pace ☐

6. **Does it go away when you stand still?**

*(Please tick **one** box)*

Yes ☐
No ☐

7. **How soon?**

10 minutes or less ☐
More than 10 minutes ☐

8. **Does the chest pain limit you in your daily life?**

Not limiting ☐
Slightly limiting ☐
Moderately limiting ☐
Very limiting ☐

B. BREATHLESSNESS

1. **Are you troubled by shortness of breath when hurrying on level ground or walking up a slight hill?**

(Please tick one box)

Yes ☐ *(Go to question 10)*
No ☐ *(Go to SECTION 2-FEELINGS)*

2. **Do you get short of breath walking with other people of your own age on level ground?**

Yes ☐
No ☐

3. **Do you have to stop for breath when walking at your own pace on level ground?**

Yes ☐
No ☐

4. **Are you short of breath on washing and dressing?**

Yes ☐
No ☐

SECTION 2 FEELINGS

The following questions ask about your feelings. Read each item and place a tick in the box opposite the reply which comes the closest to how you have been feeling **in the past week.** Don't take too long over you replies; your immediate reaction to each item will probably be more accurate than a long , thought-out response.

1. **I feel tense or "wound up":** *(Please tick **one** box)*

Most of the time	☐
A lot of the time	☐
Time to time, occasionally	☐
Not at all	☐

2. **I feel as if I am slowed down:**

Nearly all the time	☐
Very often	☐
Sometimes	☐
Not at all	☐

3. **I still enjoy the things I used to enjoy:**

Definitely as much	☐
Not quite so much	☐
Only a little	☐
Hardly at all	☐

4. **I get a sort of frightened feeling like "butterflies" in the stomach:**

Not at all	☐
Occasionally	☐
Quite often	☐
Very often	☐

5. **I get a sort of frightened feeling as if something awful is about to happen:**

Very definitely and quite badly	☐
Yes, but not too badly	☐
A little, but it doesn't worry me	☐
Not at all	☐

6. **I have lost all interest in my appearance:**

Definitely	☐
I don't take as much care as I should	☐
I may not take quite as much care	☐
I take just as much care as ever	☐

7. **I can laugh and see the funny side of things:**

As much as I always could	☐
Not quite so much now	☐
Definitely not so much now	☐
Not at all	☐

8. I feel restless as if I have to be on the move: *(Please tick **one** box)*

- Very much indeed ☐
- Quite a lot ☐
- Not very much ☐
- Not at all ☐

9. Worrying thoughts go through my mind:

- A great deal of the time ☐
- A lot of the time ☐
- From time to time, but not too often ☐
- Only occasionally ☐

10. I look forward with enjoyment to things:

- As much as I ever did ☐
- Rather less than I used to ☐
- Definitely less than I used to ☐
- Hardly at all ☐

11. I feel cheerful:

- Not at all ☐
- Not often ☐
- Sometimes ☐
- Most of the time ☐

12. I get sudden feelings of panic:

- Very often indeed ☐
- Quite often ☐
- Not very often ☐
- Not at all ☐

13. I can sit at ease, and feel relaxed:

- Definitely ☐
- Usually ☐
- Not often ☐
- Not at all ☐

14. I can enjoy a good book or radio or TV programme:

- Often ☐
- Sometimes ☐
- Not often ☐
- Very seldom ☐

SECTION 3 OVERALL HEALTH NOW

A. HEALTH STATE TODAY

Please indicate which statement describes your own health state **today.**

Please answer all by placing a tick ☑ in **one** of the three options for each question.

1. Mobility

- ☐ I have no problems in walking about
- ☐ I have some problems in walking about
- ☐ I am confined to bed

2. Self-care

- ☐ I have no problems with self care
- ☐ I have some problems with washing or dressing myself
- ☐ I am unable to wash and dress myself

3. Usual activities

- ☐ I have no problem in performing my usual activities(e.g. work, study, housework, leisure activity)
- ☐ I have some problems in performing my usual activities
- ☐ I am unable to perform my usual activities

4. Pain/Discomfort

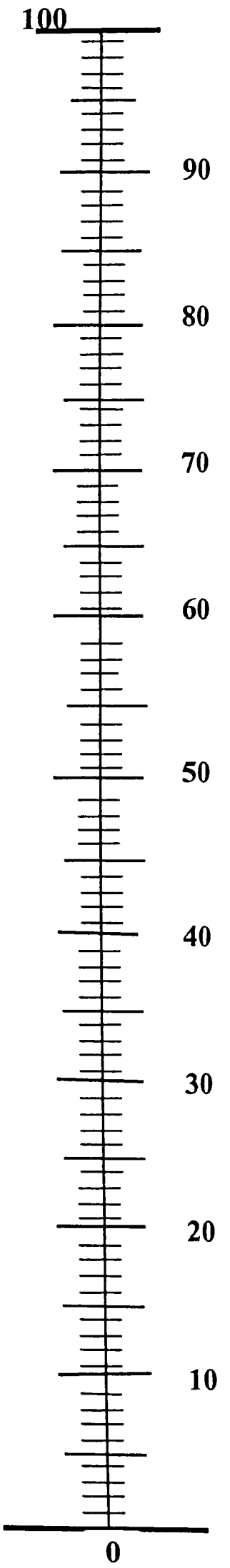
- ☐ I have no pain or discomfort
- ☐ I have moderate pain or discomfort
- ☐ I have extreme pain or discomfort

5. Anxiety/Depression

- ☐ I am not anxious or depressed
- ☐ I am moderately anxious or depressed
- ☐ I am extremely anxious or depressed

To help people say how good or bad a health state is, we have drawn a scale (rather like a thermometer) on which the best state you can imagine is marked by 100 and the worst state is marked by 0.
We would like you to indicate on this scale how good or bad your own health is, in your opinion.
Please do this by drawing a **single line** from the box below to whichever point on the scale indicates how your health state is.

(BEST imaginable health state)



Your own

health today

(WORST imaginable health state)

The following questions ask your views about your health, how you feel and how well you are able to do your usual activities. If you are unsure about how to answer any question, try and think about your *overall* health and give the best answer you can. Do not spend too much time answering as your initial response is likely to be the most accurate.

1. **In general, would you say your health is:** *(Please tick one box)*

Excellent	☐
Very good	☐
Good	☐
Fair	☐
Poor	☐

2. **Compared to one year ago, how would you rate your health in general now?**

Much better than one year ago	☐
Somewhat better than one year ago	☐
About the same	☐
Somewhat worse now than one year ago	☐
Much worse now than one year ago	☐

HEALTH AND DAILY ACTIVITIES

The following questions are about activities you might do during a typical day.

3. **Does your health limit you in these activities? If so, how much?**

*(Please tick **one** box only for **each** line)*

		Yes, limited a lot	**Yes, limited a little**	**No, not limited at all**
a)	**Vigorous activities**, such as running, lifting heavy objects, participating in strenuous sports	☐	☐	☐
b)	**Moderate activities**, such as moving a table, pushing a vacuum, bowling or playing golf	☐	☐	☐
c)	Lifting or carrying groceries	☐	☐	☐
d)	Climbing **several** flights of stairs	☐	☐	☐
e)	Climbing **one** flight of stairs	☐	☐	☐
f)	Bending, kneeling or stooping	☐	☐	☐
g)	Walking more than **a mile**	☐	☐	☐
h)	Walking **half a mile**	☐	☐	☐
i)	Walking **100 yards**	☐	☐	☐
j)	Bathing and dressing yourself	☐	☐	☐

4. During the <u>past 4 weeks</u>, how much time have you had any of the following problems with your work or other regular daily activities <u>as a result of your physical health ?</u>

(Please answer Yes or No to each question)

		Yes	No
a)	Cut down on the **amount of time** you spent on work or other activities	☐	☐
b)	**Accomplished less** than you would like	☐	☐
c)	Were limited in the **kind** of work or other activities	☐	☐
d)	Had **difficulty** performing the work or other activities (eg it took more effort)	☐	☐

5. During the <u>past 4 weeks</u>, how much time have you had any of the following problems with your work or other regular daily activities <u>as a result of any emotional problems</u> (such as feeling depressed or anxious)?

		Yes	No
a)	Cut down on the **amount of time** you spent on work or other activities	☐	☐
b)	**Accomplished less** than you would like	☐	☐
c)	Didn't do work or other activities as **carefully** as usual	☐	☐

6. During the <u>past 4 weeks</u>, to what extent have your physical health or emotional problems interfered with your normal social activities with family, friends, neighbours or groups?

*(Please tick **one** box)*

- Not at all ☐
- Slightly ☐
- Moderately ☐
- Quite a bit ☐
- Extremely ☐

7. How much bodily pain have you had during the <u>past 4 weeks?</u>

- None ☐
- Very mild ☐
- Mild ☐
- Moderate ☐
- Severe ☐
- Very severe ☐

8. During the <u>past 4 weeks</u> how much did pain interfere with your normal work (including work both outside the home and housework)?

- Not at all ☐
- A little bit ☐
- Moderately ☐
- Quite a bit ☐
- Extremely ☐

PTO

C. YOUR FEELINGS

These questions are about how you feel and how things have been with you during the past month. For each question please give one answer that comes closest to the way you have been feeling

*(Please tick **one** box only for **each** line)*

9. How much time during the last month:	All of the time	Most of the time	Some of the time	A little of the time	None of the time
a) Did you feel full of life?					
b) Have you been a very nervous person					
c) Have you felt so down in the dumps that nothing could cheer you up?					
d) Have you felt calm and peaceful?					
e) Did you have a lot of energy?					
f) Have you felt downhearted and low?					
g) Did you feel worn out?					
h) Have you been a happy person?					
i) Did you feel tired?					
j) Has your **health limited your social activities** (like visiting friends or close relatives)					

D. HEALTH IN GENERAL

10. How TRUE or FALSE is each of the following statements for you?

		Definitely true	**Mostly true**	**Not sure**	**Mostly false**	**Definitely false**
a)	I seem to get ill more easily than other people					
b)	I am as healthy as anybody I know					
c)	I expect my health to get worse					
d)	My health is excellent					

PTO

SECTION 4 LIFESTYLE

The following questions are about your daily activities and other aspects of your life. Please answer as best you can and make any other comments you want.

A. SMOKING

*(Please tick **one** box)*

1. At the moment, are you a smoker?

Yes ☐ *(Now go to question 4)*

No ☐ *(Now go to question 2)*

2. IF NO, were you ever a smoker?

Yes ☐ *(Continue to question 3)*

No ☐ *(Now go to Section B)*

3. When did you give up smoking completely?

Month ☐

Year ☐

4. How much on average do you smoke?

Cigarettes ...../day

Cigars ...../day

Tobacco ...../week

5. How many times in the past 12 months have you seriously tried to give up smoking?

Never ☐

Once ☐

Twice ☐

Three times ☐

More than three times ☐

B. HEALTHY EATING

In the last 4 weeks, about how often have you eaten or used the following foods?

Tick one appropriate box for each food

FOOD	Never	Less than once/week	1-3 days a week	4-6 days a week	1-2 times a day	3-4 times a day	More than 4 times a day
Fresh fruit, fresh or frozen vegetables, including salad vegetables							
Fish, not fried (including 'oily' fish)							
Spreads (High in polyunsaturated fat)							
Olive oil/ Olive oil-based spread							

C. WORK AND EMPLOYMENT

1. Has there been a change in your employment status between 1994/95 to now?

*(Please tick **one** box)*

Yes ☐
No ☐

2. If yes, was this change because of your heart troubles?

Yes ☐
No ☐

Any further details:

---

3. What is your current employment status?

Retired ☐
Off sick ☐
Unemployed, looking for work ☐
Working ☐
Housewife, homemaker etc ☐
Other (detailed below) ☐

Detail for other:

---

4. What was your employment status at the time of your heart troubles in 1994 or 1995?

Retired ☐
Off sick ☐
Unemployed, looking for work ☐
Working full time ☐
Working part-time ☐
Housewife, homemaker etc ☐
Other (detailed below) ☐

Detail for other:

D. PHYSICAL ACTIVITY

How often do you take part in sports or activities that are:

*(Please tick **one** box on each line)*	**3 times a week or more**	**1 or 2 times a week**	**About 1 to 3 times a month**	**Never / hardly ever**
1) Mildly energetic? (e.g. walking, woodwork, weeding, hoeing, bicycle repair, playing darts, general housework)	☐	☐	☐	☐
2) Moderately energetic? (e.g. scrubbing, polishing car, chopping, dancing, golf, cycling, decorating, lawn mowing, leisurely swimming)	☐	☐	☐	☐
3) Vigorous? (e.g. running, hard swimming, tennis, squash, digging, cycle racing)	☐	☐	☐	☐

5. MEDICATION

Please list ALL of the medication you take on a regular basis?
(Please include **all** prescription and over-the-counter **aspirin** if applicable)

Name of medication:	Dose:	Number of times per day: