

Heart

Comparative trends in coronary heart disease subgroup hospitalisation rates in England and Australia

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Abstract:	<p>Background: Population-based coronary heart disease (CHD) studies have focused on myocardial infarction (MI) with limited data on trends across the spectrum of CHD. We investigated trends in hospitalisation rates for acute and chronic CHD subgroups in England and Australia from 1996-2013.</p> <p>Methods: CHD hospitalisations for 35-84 year olds were identified from electronic hospital data from 1996-2013 for England and Australia and from the Oxford Region and Western Australia. CHD subgroups identified were acute coronary syndromes (MI, unstable angina), and chronic CHD (stable angina, 'Other CHD'). We calculated age-standardised and age-specific rates, and estimated annual changes (95% CI) from age-adjusted Poisson regression.</p> <p>Results: From 1996-2013, there were 4.9 million CHD hospitalisations in England and 2.6 million in Australia (67% men). From 1996-2003, there</p>

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	<p>was between-country variation in the direction of trends in ACS and chronic CHD hospitalisation rates ($p<0.001$). During 2004-2013, reductions in ACS hospitalisation rates were greater than for chronic CHD hospitalisation rates in both countries, with the largest subgroup declines in unstable angina (England men -7.1%/year, 95% CI -7.2, -7.0; women -7.5%/year, 95% CI -7.7, -7.3; Australia men, -8.5%/year, 95% CI -8.6, -8.4; women, -8.6%/year, 95% CI -8.8, -8.4). Other CHD rates increased in 75-84 year olds in both countries. Chronic CHD comprised half of all CHD admissions, with the majority involving angiography or PCI.</p> <p>Conclusions: Since 2004, rates of all CHD subgroups have fallen, with greater declines in acute than chronic presentations. The slower declines and high proportion of chronic CHD admissions undergoing coronary procedures requires greater focus.</p>

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Comparative trends in coronary heart disease subgroup hospitalisation rates in England and Australia

Short title: Trends in coronary heart disease subgroups

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What is already known about this subject?

- MI event rates have declined in England during recent years, while in Australia, there has been a sustained attenuation of downward trends in MI since the introduction of the Universal Definition of MI in 2000.
- Most population-level studies of coronary heart disease (CHD) have focused on myocardial infarction (MI) but little is known of trends in acute and chronic presentations for CHD.

What does this study add?

- This study shows that the greatest variability in CHD subgroup trends, both within and between countries, is for MI and Other CHD.
- There is greater consistency in CHD subgroup trends since 2004, with reductions in all subgroups in both countries, underpinned by greater reductions in acute coronary syndromes than chronic CHD.
- Chronic CHD presentations make up around half of all CHD hospitalisations, and the majority of these involve a coronary procedure.

How might this impact on clinical practice?

- Greater focus is needed on patients admitted to hospital for stable or chronic CHD including understanding the progression to hospitalisation and outcomes in these patients.

ABSTRACT

Background: Population-based coronary heart disease (CHD) studies have focused on myocardial infarction (MI) with limited data on trends across the spectrum of CHD. We investigated trends in hospitalisation rates for acute and chronic CHD subgroups in England and Australia from 1996-2013.

Methods: CHD hospitalisations for 35-84 year olds were identified from electronic hospital data from 1996-2013 for England and Australia and from the Oxford Region and Western Australia. CHD subgroups identified were acute coronary syndromes (MI, unstable angina), and chronic CHD (stable angina, 'Other CHD'). We calculated age-standardised and age-specific rates, and estimated annual changes (95% CI) from age-adjusted Poisson regression.

Results: From 1996-2013, there were 4.9 million CHD hospitalisations in England and 2.6 million in Australia (67% men). From 1996-2003, there was between-country variation in the direction of trends in ACS and chronic CHD hospitalisation rates ($p<0.001$). During 2004-2013, reductions in ACS hospitalisation rates were greater than for chronic CHD hospitalisation rates in both countries, with the largest subgroup declines in unstable angina (England men -7.1%/year, 95% CI -7.2, -7.0; women -7.5%/year, 95% CI -7.7, -7.3; Australia men, -8.5%/year, 95% CI -8.6, -8.4; women, -8.6%/year, 95% CI -8.8, -8.4). Other CHD rates increased in 75-84 year olds in both countries. Chronic CHD comprised half of all CHD admissions, with the majority involving angiography or PCI.

Conclusions: Since 2004, rates of all CHD subgroups have fallen, with greater declines in acute than chronic presentations. The slower declines and high proportion of chronic CHD admissions undergoing coronary procedures requires greater focus.

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INTRODUCTION

Despite a consistent decline in coronary heart disease (CHD) mortality since the 1970s, CHD is the largest contributor to mortality in most developed countries.¹ CHD remains a major reason for hospitalisation although there is some evidence that the morbidity burden from CHD has declined over time.^{2, 3} Many studies investigating CHD have focused on myocardial infarction (MI),^{4, 5} yet hospitalisations for CHD cover the spectrum of acute and chronic presentations, and whether their contribution to the morbidity burden has changed over time is unclear.

Examining variations in CHD trends between countries provides important insights into prevention and management,⁶ particularly where differences in disease rates or patterns of care exist. CHD mortality rates have been declining in Australia since the late 1960s⁷ but the decline started around ten years later in the United Kingdom,⁸ and years of life lost attributable to CHD have been higher in the UK than Australia since the 1990s.⁹ In contrast, MI event rates declined in England between 2002 and 2010¹⁰, whereas in Australia during the same period, there was no reduction.¹¹ However, studies comparing CHD morbidity between the two countries are limited, and standardised definitions and methods are required to enable direct comparisons.

The primary aim of the study was to compare long-term temporal trends in hospitalisation rates for acute and chronic CHD subgroups and total CHD between England and Australia, stratified by age and sex, and secondarily, to analyse regional linked data from both countries to examine the impact of inter-hospital transfers, early readmissions and coronary procedures on trends.

METHODS

Setting and data sources

In 2013, the population of England was 53.9 million and of Australia 23.3 million, with 17% and 14% respectively aged 65 years and over.^{12, 13} Both countries have a universal health care system. Coronary

care in Australia is provided in public and private hospitals, while the majority of coronary care in England is delivered in National Health Service (NHS) hospitals. National hospitalisation data were available for all NHS hospitalisations in England and all public and private hospitalisations in Australia. We also used regional person-linked data from both countries for comparisons using record linkage – the Oxford Record Linkage Study (ORLS) and Western Australia (WA), both of which covered a population of 2.5 million in 2013 (Supplementary Information).¹² Both regional datasets covered the period 1985 to 2013.

[Ethics approval was obtained from the Central and South Bristol Multi-Centre Research Ethics Committee \(04/Q2006/176\) for the English and ORLS record-linked data by the Unit of Health-Care Epidemiology. Approval for use of the WA data was obtained from the WA Department of Health and UWA Human Research Ethics Committees.](#)

Standardisation of hospital datasets

Although person-linked English hospitalisation data are available from April 1998 onwards, we used national datasets without person-identifiers for the main analyses, as person-linked data are not available nationally in Australia. In both datasets, each record represents a new admission or inter-hospital transfer. In the English dataset, a new record could also represent a change between medical specialists within the same admission (Finished Consultant Episode, FCE), thus we only used records coded as the first FCE in a series of admissions to increase comparability with Australian admissions (Supplementary Information). Australian data were available aggregated by sex, 5-year age group and year.

Both regional datasets were person-linked. Record matching and linkage for ORLS up to 1998 was undertaken using unique personal identifiers. From 1999 onwards, ORLS was a subset of the [Hospital Episodes Statistics \(HES\)](#) dataset with linkage conducted by NHS Digital. Record-linkage for the WA dataset was undertaken by the WA Department of Health using probabilistic matching based on name, sex, date of birth and address, with manual checking of uncertain links.

Identification of CHD subgroups

Datasets included all hospitalisation and mortality records for CHD. Details of the International Classification of Diseases (ICD) versions in use in both countries are in Supplementary Information. We have previously shown differences in coding standards for ST-elevation and non-ST-elevation MI between countries¹⁴ and therefore analysed total MI. People aged 35 to 84 years at the time of CHD hospitalisation were included in the study.

For hospital admissions, CHD was identified from the principal diagnosis field. Three aggregated groupings were identified: total CHD (ICD-9 410-414, ICD-10 I20-I25), acute coronary syndromes (ACS, comprising MI + unstable angina) and chronic CHD (stable angina + Other CHD). Subgroups were MI (ICD-9-CM 410, ICD-10 I21, I22); unstable angina (411.1, I20.0); stable angina (413, I20.1-I20.9); and ‘Other CHD’ (411.0, 411.8, 414, I23, I24, I25). The Other CHD subgroup includes chronic ischaemic heart disease (IHD) (I25), other acute IHD (I24) and complications following MI (I23), however the I25 code comprises >95% of all admissions in both countries for this subgroup. The main period used in this study is 1996 to 2013. We chose not to include subgroup data prior to 1996, as there was no 4th-digit ICD code for unstable angina in ICD-9, and regional data shows inconsistent trends in non-MI subgroup hospitalisations during the 1980s and early 1990s.¹⁵

CHD deaths (ICD-10 I20–I25) were identified from the underlying cause of death. To account for possible differences in the propensity to code CHD as the underlying cause of death, we also identified CHD deaths from multiple-cause-coded mortality data, available from 1995 in England, and from 1997 in Australia.

Event measures

All analyses of national hospitalisation data used unlinked admissions. We also analysed person-linked data from the regional datasets to determine the impact of transfers and early readmissions on trends, based on our published methods.¹⁵ Briefly, series of inter-hospital transfers were considered part of a 'linked admission'. Because more than one CHD sub-group can be recorded as the principal diagnosis within a linked admission, it was labelled according to a diagnosis hierarchy (MI>unstable angina>stable angina>Other CHD),¹⁵ We also created 28-day episodes, where any readmission within 28 days was included in the 28-day episode, and the diagnosis hierarchy was applied. To describe recent hospitalisation history, we identified admissions for ACS and chronic CHD in the 1-year prior to each linked admission.

Coronary angiography, percutaneous coronary intervention (PCI) and coronary artery bypass graft (CABG) procedures were identified for each linked admission in the ORLS and WA data (Supplementary Information). A hierarchy was used to assign procedure type if more than one procedure was recorded during the same linked admission (CABG>PCI>angiography only).

Statistical Analysis

All analyses were undertaken separately for men and women. Average annual number of hospitalisations in each country are presented separately for 1996-2003 and 2004-2013. The average age at admission is presented as mean (SD). For the Australian national data, mean age was estimated by multiplying the midpoint of each 5-year age group by the frequency in that age group, and dividing by total number of admissions. P-values for between-country comparison of mean age are from independent t-tests.

Annual age-standardised and age-specific rates (35-54, 55-64, 65-74, and 75-84 years) were calculated by the direct method using 5-year age groups and the 2013 European Standard Population. Numerators for hospitalisation rates were the annual number of admissions for each CHD subgroup, and for mortality rates, the annual number of CHD deaths. Denominators were annual population numbers from each jurisdiction.

Age-adjusted trends for hospitalisation rates were estimated from Poisson regression models, with 5-year age group and year (continuous) in the models. Because of non-linear trends in some CHD subgroups, and to separate early and contemporary changes, trends were calculated separately for 1996-2003 and 2004-2013. Trends are presented as average annual percentage changes calculated from the exponential of the beta-coefficient for year with 95% confidence intervals. The interaction term for year*country was then included in each model to identify differences in between-country trends, with an interaction term for country*5-year age group to adjust for temporal between-country variation in age distribution. Sensitivity analyses were also undertaken comparing trends in unlinked admissions, linked admissions and 28-day episodes within each of ORLS and WA. All statistical analyses used SAS v9.4.

RESULTS

Cohort characteristics

From 1996 to 2013, there were 4,859,492 CHD hospitalisations in England (67.1% men) and 2,592,021 in Australia (67.9% men). For English men, the average annual number of total CHD hospitalisations was higher during 2004-2013 than 1996-2003, but for English women and Australian men and women, was lower in the later versus earlier period (Table 1). The mean age at time of MI

hospitalisation was on average 1.3 years older in England than Australia, but was younger in England for all non-MI subgroups in both periods ($p < 0.0001$).

Characteristics of ORLS and WA CHD hospitalisations are shown in Supplementary Table 1. The mean age of patients in each subgroup in ORLS and WA was around 1 year younger than their respective national counterparts. In around 10% of MI hospitalisations in both regions, a hospitalisation for either ACS or chronic CHD was recorded in the year preceding the MI. Around a quarter of Other CHD hospitalisations in ORLS and 15% in WA were preceded by a chronic CHD admission.

Trends in total coronary heart disease

In 1996, hospitalisation rates for total CHD were 2 times higher in Australian than English men - 3049 (95% CI 3029, 3069) and 1523/100,000 (95% CI 1516, 1531) respectively, and 2.2 times higher in women - 1435 (95% CI 1422, 1448) and 638/100,000 (95% CI 633, 642) respectively (Figures 1A, 1B).

There was an age-adjusted increase in rates in England from 1996 to 2003, followed by a significant decline from 2004 onwards, whereas CHD rates declined in Australia throughout the study period (Table 2). Mortality rates with CHD as the underlying cause of death declined in men (England 565 to 215/100,000; Australia 523 to 169/100,000) and women (England 255 to 84/100,000; Australia 258 to 69/100,000), with similar downward trends in multiple-cause coded mortality rates (Figure 1C, 1D).

From 1996 onwards, age-adjusted trends in total CHD in ORLS and WA were similar in direction to national trends (Figure 1A, 1B; Supplementary Table 2).

Trends in coronary heart disease subgroups

National comparisons

In England, chronic CHD hospitalisations comprised 53% of cases in men and 49% in women during 1996-2003, increasing to 57% and 52% respectively during 2004-2013 (Figure 2). In Australia, there was a small increase in the proportion of chronic CHD hospitalisations between periods (men 45% to 46%, women 40% to 42%).

From 1996 to 2003, ACS hospitalisation rates in women in England increased (+0.4%/year, 95% CI +0.3, +0.6) but declined marginally in men, while rates of chronic CHD increased for men (+1.7%/year, 1.5% CI +1.6, +1.8) and women (+1.3%/year, +1.2, +1.5) (Figure 3, Table 2). In Australia during the same period, ACS and chronic CHD hospitalisation rates declined significantly in men and women. Trends in ACS in England were underpinned by significant declines in MI and increasing rates of unstable angina; conversely in Australia, MI hospitalisation rates increased significantly while unstable angina rates declined. Chronic CHD trends during 1996 to 2003 were underpinned by marked reductions in stable angina in both countries, but differing trends in Other CHD (between-country comparison $p<0.001$).

During 2004 to 2013, there were greater declines in ACS in England than Australia ($p<0.001$) and for chronic CHD, declines were greater in Australia than England ($p<0.001$). Reductions in ACS rates were greater than for chronic CHD in both countries. The largest declines were in unstable angina in England (men -7.1%/year, 95% CI -7.2, -7.0; women -7.5%/year, 95% CI -7.7, -7.3) and Australia (men, -8.5%/year, 95% CI -8.6, -8.4; women, -8.6%/year, 95% CI -8.8, -8.4).

National age-specific trends

From 1996 to 2003, age-specific trends in England and Australia reflected trends in each CHD subgroup overall (Supplementary Table 3). One exception was Other CHD in Australia, where hospitalisation rates

increased in 75-84 year old men (+4.9%/year, 95% CI +4.4%, +5.4%) and women (+4.8%/year, 95% CI +4.1%, +5.4%). In England, increases in Other CHD rates were greater in those over 65 compared with <65 years. During 2004-2013, Other CHD rates increased in 75-84 year old men and women in both countries. MI rates declined in most age- and sex-groupings, except for 35-54 year old women (England, 0%/year, 95% CI -0.5, +0.4; Australia, +1.9%/year, 95% CI +1.4, +2.4).

Regional comparisons

Trends in the regional data were generally in the same direction as their national counterparts (Supplementary Table 2, Supplementary Figure 1). [An exception was in WA where MI and Other CHD rates increased in men and women during 2004-2013, yet declined marginally at a national level, and Other CHD rates which were unchanged in ORLS during the same period, but declined at a national level.](#)

To determine the impact of using unlinked data for national trends, age-adjusted trends were estimated for unlinked, linked admissions, and 28-day episodes (Supplementary Table 2). Although unlinked rates were higher than either of the linked measures, trends were similar and in the same direction across all measures in ORLS and WA.

Coronary procedures

The proportion of linked admissions involving a coronary procedure increased during the study period for all CHD subgroups, except for stable angina in WA (Figure 4). The proportion of Other CHD linked admissions where a procedure was undertaken increased in ORLS and WA, and by 2013, the majority of these patients had coronary angiography or revascularisation during hospitalisation (ORLS, men 84%, women 83%; WA, men and women 95%).

DISCUSSION

This bi-national study of more than 7 million CHD hospitalisations highlights the complexity of trends in acute and chronic presentations within and between countries. Hospitalisation rates for total CHD have decreased in England and Australia, although the decline is more long-standing in the latter. Inter-country-variation in trends in some CHD subgroups is apparent. In England, hospitalisation rates for MI declined and those for unstable angina increased during 1996-2003, with a contrasting pattern in Australia. Concurrently, trends in Other CHD were increasing in England but decreasing in Australia. From 2004 onwards, rates of acute and chronic CHD consistently fell in both countries but with a greater rate of decline in ACS. This study highlights that around half of all CHD hospitalisations are chronic admissions, and that the majority of these now involve coronary angiography or revascularisation.

Trends in CHD subgroups

There are limited data measuring trends in hospitalisation rates across all CHD subgroups within the same population or between countries, with many studies focusing on trends in MI. Variation between countries in trends in MI hospitalisation rates has been apparent since the introduction of the Universal Definition of MI in 2000, although many have reported attenuation of downward trends.^{4, 16, 17} However, a recent study from Norway reports that declines in MI incidence have accelerated since 2009 compared to prior trends.¹⁸ In the few studies of trends in ACS, generally larger reductions in rates of unstable angina than MI are reported,¹⁶ likely reflecting the impact of increasingly sensitive troponin assays.¹⁹ This pattern was evident in Australia for the whole study period, but only in England from 2004 onwards, which could indicate a later ‘troponin effect’ than reported by other countries. Variation in troponin assays and diagnostic thresholds between countries could also contribute to differences in trends of MI and unstable angina²⁰ The newer high-sensitivity troponin assays were in limited use in Australia during our study

period, but were introduced in England around 2010-2011, which may explain the increase in MI rates in England around that time.

Primary care-based studies have reported declining prevalence of angina presentations in England and Australia.^{21, 22} Hospitalisation rates for chronic CHD in our study declined consistently since 2004 in both countries, driven by reductions in stable angina admissions. Our findings for Other CHD are less consistent, with trends in our study similar to those of a Dutch administrative data study reporting an increase in chronic CHD hospitalisation rates between 1997 and 2008 (using a comparable definition to our Other CHD).¹⁷ However since 2004, this subgroup demonstrated the smallest reduction in rates of all subgroups in our study. Consistent with the Dutch findings was adverse trends in rates of Other CHD in older patients.

Despite the fact that half of all CHD hospitalisations are recorded as stable or chronic, there is limited understanding of hospitalisation data for these admissions. Our regional data show that a high proportion of chronic CHD hospitalisations involve coronary angiography or revascularisation, yet there is debate around the use of angiography in the diagnosis of stable CHD and the efficacy of revascularisation in these patients.^{23, 24} Additionally, rates and trends of chronic CHD could be affected by differing propensities to manage this condition in an outpatient versus inpatient setting The increases in hospitalisation rates for Other CHD in the older age groups may reflect an increasing propensity to investigate and revascularise older patients, a group in whom outcome data are limited. Nearly a quarter of Other CHD patients in our study had a CHD admission in the preceding year, indicating a complex hospital care pathway and consistent with evidence that hospitalised stable CHD patients are increasingly complex with high levels of comorbidities.²⁵ Trends in chronic CHD subgroups from hospitalisation data may therefore reflect changing disease management and patient casemix rather than the true population burden of chronic CHD.

The higher CHD hospitalisation rates in Australia particularly early in the study period are unlikely to reflect a true difference in CHD burden between the two countries. This is because CHD mortality rates are reasonably similar, and premature mortality including from CHD in the UK has been persistently worse than other EU countries and Australia.⁹ This could indicate that there is a lower threshold for hospitalisation for CHD in Australia, particularly early on for the acute subgroups, reflecting differing management practices. Differences in the use of ICD codes could contribute to differences in rates of subgroups between countries, although this would be unlikely to impact overall CHD rates.

Regional variation

Whole-population studies are essential for understanding disease patterns at the national level, yet regional variation in disease burden and trends occurs. Previous studies report wide regional variation in CHD admission, angiography and revascularisation rates within England and Australia.^{26, 27} While trends in our study in national and regional data were generally in the same direction, particularly for the aggregated groupings, we found that any observed differences at a subgroup level were primarily in trends in MI and Other CHD hospitalisations. Differences between national and WA trends in MI could result from differences in implementation of diagnostic criteria however the reasons for this are not clear.

Given that Other CHD hospitalisations appear to reflect procedure-related admissions, regional differences in trends could be associated with availability and utilisation of specialised services and PCI-capable centres rather than changing pattern of disease burden.

Limitations

To account for possible differences in the use of ICD codes between countries, we reviewed all relevant coding standards and matched clinical diagnoses with ICD coding descriptors to inform comparable subgroups. Differences in coding standards for STEMI and NSTEMI between England and Australia up to 2013 informed our analysis of MI as an aggregated grouping.¹⁴ We classified stable angina separately

from unstable angina, in contrast to other studies,¹⁷ as this matches clinical classification more closely, and stable angina hospitalisations are commonly elective admissions, therefore more aligned with Other CHD (unpublished data). The use of unlinked data in national analyses will over-estimate admissions due to inter-hospital transfers, but will only impact trends if rates of inter-hospital transfers change over time. We therefore compared unlinked and linked admissions within our regional data. While our previous WA-based study demonstrated biases in STEMI and NSTEMI trends using unlinked versus linked data due to temporal changes in inter-hospital transfer rates, use of aggregated subgroups such as MI and ACS reduced the variability, resulting in a 0.7%/year increase in the ratio of unlinked to linked admissions.¹⁵ There may be differences in rates of inter-hospital transfers between countries, however the concordance between unlinked and linked regional trends indicates that unlinked data, particularly using aggregated subgroups, is likely reflective of true trends in each country.

Conclusion

In more recent years in England and Australia, the decline in rates of hospitalisation for ACS was greater than for chronic CHD and the increasing proportion of chronic CHD hospital admissions may indicate a shift from acute to chronic morbidity. The greatest between-country variability in specific subgroups was in MI and Other CHD, however use of ACS and chronic CHD allowed better comparability of trends between populations. Reductions in CHD hospitalisations and mortality indicates that prevention and treatment approaches for CHD are broadly effective in England and Australia. However, our study highlights the high proportion of chronic admissions, requiring better understanding of patient pathways and effectiveness of current treatment in this large patient group.

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Contributors: LN and FLW conceived the study; LN, MGr and RG carried out the data analysis; MJG, MSTH, DL and FMS provided input into methodology; MK and MGr provided statistical advice; LN

wrote the manuscript; all authors provided interpretation and critical revisions for the data and reviewed the manuscript.

Confidential: For Review Only

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Table 1. Baseline characteristics of coronary heart disease hospitalisations in England and Australia.*

	England					Australia				
	Myocardial infarction	Unstable angina	Stable angina	Other CHD	Total CHD	Myocardial infarction	Unstable angina	Stable angina	Other CHD	Total CHD
Men										
1996-2003										
Total admissions, n	367 958	248 227	233 889	596 098	1 446 172	186 714	253 397	172 345	182 264	794 720
Average annual admissions, n	45 995	31 028	29 236	74 512	180 772	23 339	31 675	21 543	22 783	99 340
Mean age, years (SD)	65.3 (11.4)	64.4 (11.1)	63.9 (11.2)	62.5 (9.9)	63.9 (10.8)	63.9 (12.0)	65.0 (11.3)	64.6 (10.9)	64.2 (10.5)	64.5 (11.2)
2004-2013										
Total admissions, n	425 569	228 079	207 305	988 739	1 849 692	317 623	208 878	183 805	255 517	965 823
Average annual admissions, n	42 557	22 808	20 731	98 874	184 969	31 762	20 888	18 381	25 552	96 582
Mean age, years (SD)	65.6 (11.8)	64.9 (11.7)	64.9 (11.4)	64.6 (10.3)	65.0 (11.1)	64.4 (12.0)	65.2 (11.4)	66.0 (10.8)	66.3 (10.1)	65.4 (11.2)
Women										
1996-2003										
Total admissions, n	183 859	151 792	161 885	213 644	711 180	85 083	147 494	90 187	67 034	389 798
Average annual admissions, n	22 982	18 974	16 189	26 06	88 898	10 635	18 437	11 273	8 379	48 725
Mean age, years (SD)	71.0 (9.9)	68.2 (10.7)	67.5 (11.1)	66.0 (9.9)	68.2 (10.6)	70.2 (11.0)	68.9 (10.9)	68.1 (11.0)	67.7 (10.1)	68.8 (10.9)
2004-2013										
Total admissions, n	197 293	136 597	147 188	371 370	852 448	140 406	114 280	94 425	92 569	441 680
Average annual admissions, n	19 729	13 660	14 719	37 137	85 244	14 041	11 428	9 443	9 257	44 168
Mean age, years (SD)	70.9 (10.8)	68.2 (11.5)	67.5 (11.4)	67.6 (10.1)	68.7 (10.9)	69.2 (11.7)	67.8 (11.6)	68.1 (11.3)	69.0 (10.0)	68.5 (11.3)

*Hospitalisations are from national unlinked data. $p < 0.0001$ for all between-country comparisons of mean age within each subgroup, from independent t-tests.

CHD, coronary heart disease; SD, standard deviation.

Table 2. Age-adjusted trends in hospitalisation rates for coronary heart disease subgroups in England and Australia.

Average annual % change (95% confidence interval)*				
	1996-2003		2004-2013	
	England	Australia	England	Australia
Men				
Total CHD	+0.8 (+0.7, +0.9)	-2.4 (-2.5, -2.3)‡	-3.0 (-3.1, -3.0)	-3.5 (-3.6, -3.4)‡
Aggregated subgroups†				
Acute coronary syndrome	-0.4 (-0.5, -0.3)	-1.8 (-1.9, -1.7)‡	-4.5 (-4.6, -4.4)	-4.2 (-4.3, -4.2)‡
Chronic CHD	+1.7 (+1.6, +1.8)	-3.2 (-3.4, -3.1)‡	-2.2 (-2.3, -2.2)	-2.6 (-2.7, -2.5)‡
Subgroup				
Myocardial infarction	-1.9 (-2.0, -1.7)	+2.2 (+2.0, +2.4)‡	-3.1 (-3.2, -3.0)	-1.4 (-1.5, -1.2)‡
Unstable angina	+1.9 (+1.7, +2.1)	-4.6 (-4.8, -4.5)‡	-7.1 (-7.2, -7.0)	-8.5 (-8.6, -8.4)‡
Stable angina	-6.1 (-6.2, -5.9)	-5.4 (-5.6, -5.2)‡	-3.3 (-3.4, -3.1)	-6.2 (-6.3, -6.0)‡
Other CHD	+4.9 (+4.8, +5.0)	-1.1 (-1.3, -0.9)‡	-2.0 (-2.1, -1.9)	0.0 (-0.1, +0.2)‡
Women				
Total CHD	+0.9 (+0.8, +1.0)	-2.2 (-2.3, -2.1)‡	-3.5 (-3.6, -3.4)	-4.1 (-4.2, -4.0)‡
Aggregated subgroups†				
Acute coronary syndrome	+0.4 (+0.3, +0.6)	-2.0 (-2.2, -1.8)‡	-5.1 (-5.1, -4.9)	-4.6 (-4.7, -4.5)‡
Chronic CHD	+1.3 (+1.2, +1.5)	-2.5 (-2.7, -2.3)‡	-2.5 (-2.6, -2.4)	-3.4 (-3.6, -3.3)‡
Subgroup				
Myocardial infarction	-2.0 (-2.2, -1.8)	+2.3 (+2.0, +2.6)‡	-3.3 (-3.5, -3.2)	-1.3 (-1.4, -1.1)‡
Unstable angina	+3.5 (+3.2, +3.7)	-4.4 (-4.6, -4.2)‡	-7.5 (-7.7, -7.3)	-8.6 (-8.8, -8.4)‡
Stable angina	-4.3 (-4.5, -4.1)	-4.5 (-4.7, -4.2)	-4.5 (-4.7, -4.3)	-5.9 (-6.1, -5.7)‡
Other CHD	+5.9 (+5.7, +6.1)	+0.3 (0, +0.6)‡	-1.7 (-1.8, -1.6)	-0.8 (-1.1, -0.6)‡

*Estimated from the exponential of the beta-coefficient for calendar year from age-adjusted Poisson regression models.

†Acute coronary syndrome comprises myocardial infarction + unstable angina; Chronic CHD comprises stable angina + Other CHD.

‡p<0.001 from p-value for interaction for country*year (from Poisson regression model for between-country comparison of age-adjusted trends).

FIGURE LEGENDS

Figure 1: Age-standardised total coronary heart disease hospitalisation rates in (A) men and (B) women; and age-standardised coronary heart disease and mortality rates from underlying and multiple-cause coded cause of death in (C) men and (D) women. England and Australia.

Figure 23. Proportion (%) of hospitalisations for each coronary heart disease subgroup in England and Australia.

Figure 23: Age-standardised hospitalisation rates of coronary heart disease subgroups in England and Australia for (A) myocardial infarction; (B) unstable angina; (C) stable angina, and (D) Other coronary heart disease.

Figure 3. Proportion of hospitalisations for each coronary heart disease subgroup in England and Australia.

Figure 4. Proportion of admissions where a coronary procedure was undertaken in each coronary heart disease subgroup for the Oxford Record Linkage Study and Western Australia.

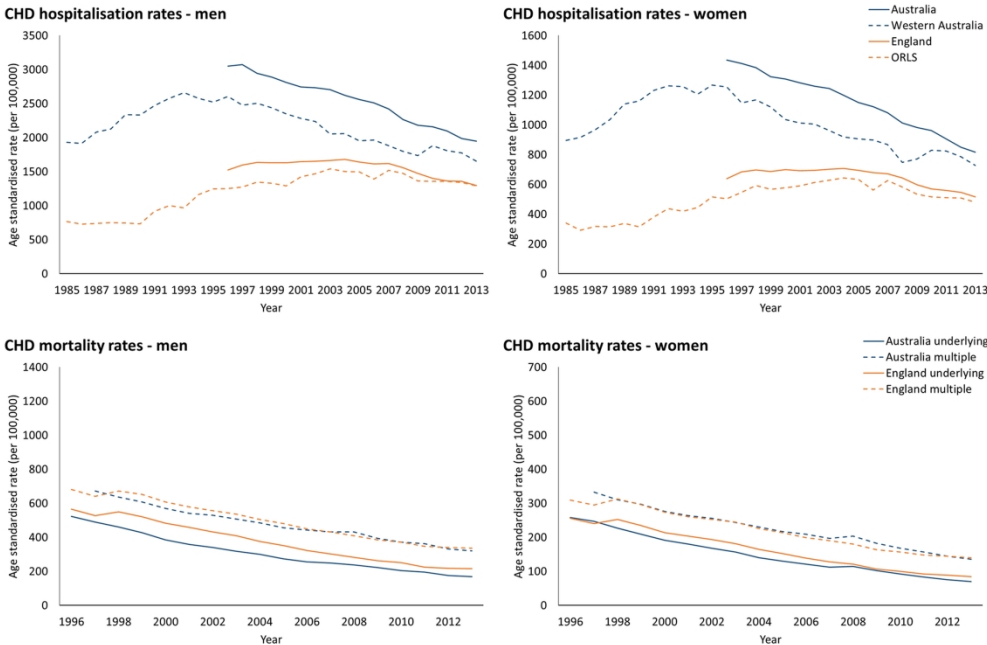


Figure 1

596x397mm (300 x 300 DPI)

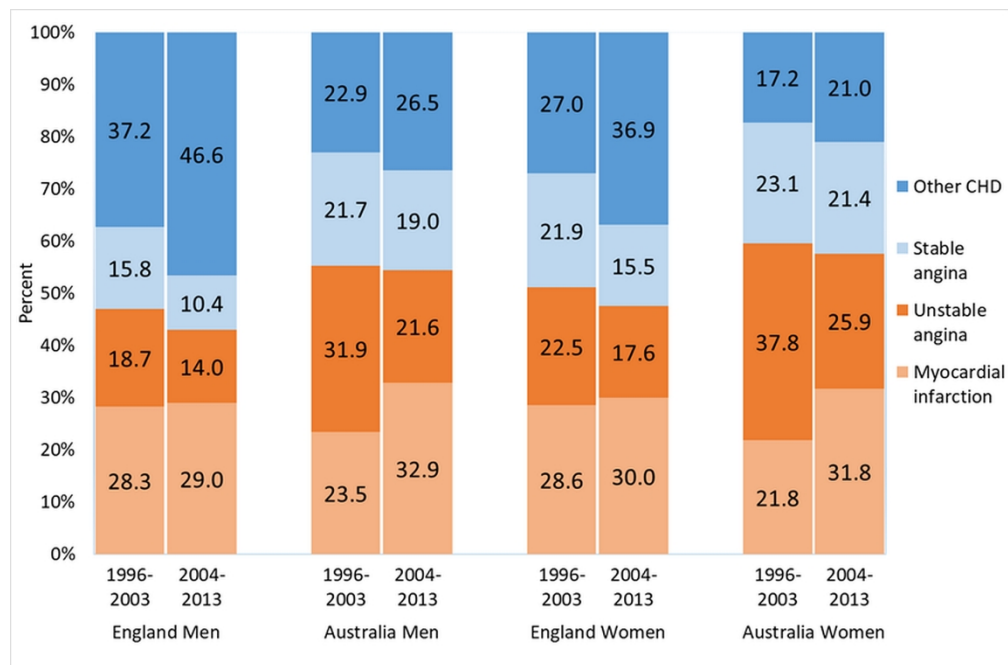


Figure 2

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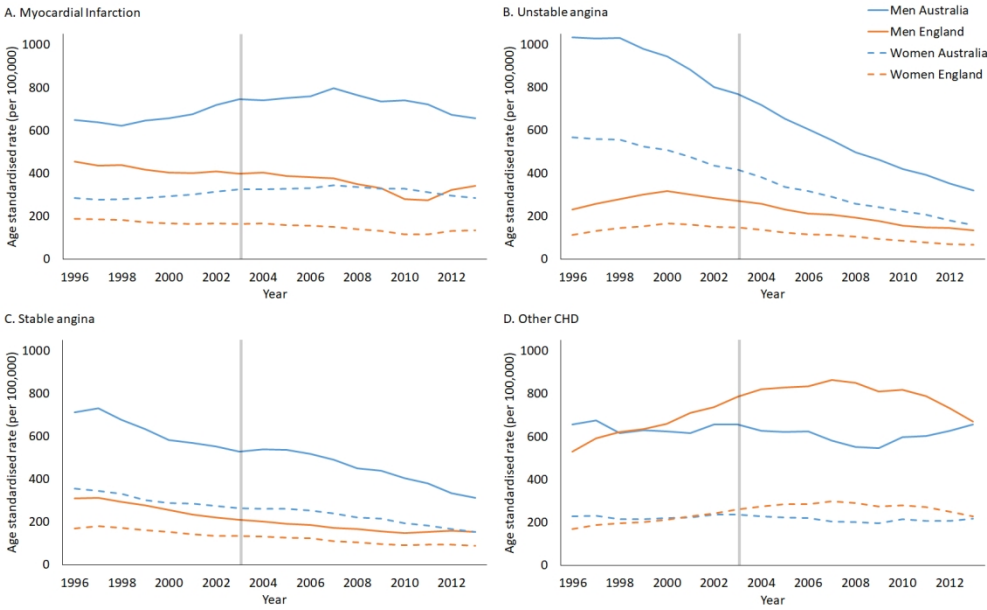


Figure 3

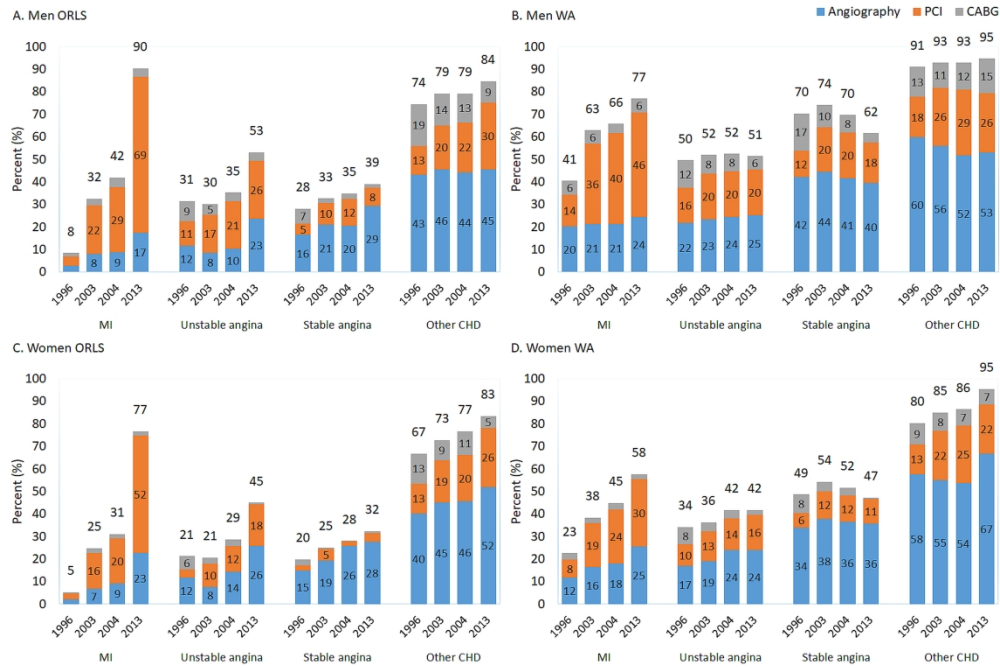


Figure 4

600x399mm (300 x 300 DPI)

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2 **Supplementary Information**

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5 **Methods**

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7 *Data Sources*

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9 National hospitalisation data for England were from the Hospital Episodes Statistics (HES) dataset supplied
10
11 by the English Health and Social Care Information Centre including all NHS hospitalisations in England.
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13 Mortality data for England were from the Office for National Statistics. For Australia, all public and private
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15 hospitalisation and mortality data were from the Australian Institute of Health and Welfare. The Oxford
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17 Record Linkage Study (ORLS) data were provided by the Unit of Health-Care Epidemiology, University of
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19 Oxford, and includes data from hospitals in the former Oxford Regional Health Authority area. The Western
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21 Australian (WA) data were from the Hospital Morbidity Data Collection, a core dataset from the WA Data
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23 Linkage System, and include all hospitalisations within WA.
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29 *International Classification of Diseases versions*

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32 In the English datasets, ICD Revision 9 (ICD-9) was used for hospital diagnoses until 31 March 1995, after
33
34 which ICD-10 (WHO version) was introduced, while for mortality records, the transition to ICD-10 occurred
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36 on 1st January 2001. In Australia, ICD-9 was in use until 31st December 1987; ICD-9-Clinical Modification
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38 (CM) up to 30th June 1998 (30th June 1999 in WA), and ICD-10-Australian Modification (AM) from that
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40 time on.
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43 *Standardisation of datasets*

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45 The English dataset was based on Finished Consultant Episodes (FCEs). A new FCE within this dataset
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47 represents a shift to a different medical specialist within the same admission, an inter-hospital transfer, or a
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49 new hospital admission, and each FCE has a principal diagnosis and secondary diagnoses recorded. As the
50
51 dataset is unlinked, it is not possible to determine which FCEs belong to any particular episode of care, but
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53 the data includes an indicator for first FCE in a series of related admissions. Therefore for the purposes of the
54
55 current study, the FCE coded as the first in an admission sequence was used, as a proxy for admissions. The
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57 Australian hospitalisation dataset is separation-based, that is, one record represents an aggregation of data
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59 where a change between medical specialties within the same hospital occurred. Inter-hospital transfers and
60

statistical type changes are represented by separate records in the dataset. The principal diagnosis is assigned to each admission at discharge, and represents that deemed the main condition requiring treatment and management during the hospitalisation. For the regional data, both datasets included data related to a single admission aggregated on one record. Inter-hospital transfers were identified for an individual patient where the admission date of a record was within one day of the discharge date of the previous record,

The Australian national hospitalisation data are available based on financial year of hospital admission, but are presented as calendar year to match the English, ORLS and WA datasets (for example, financial year 1996/97 in the Australian dataset is labelled as 1996 in the current study). The ICD-9-CM code 412 is not available in the national Australian data at the 3-digit level, due to the small number of admissions recorded with this code in the principal diagnosis. This only impacts 1996 – 1998 in the Australian data.

Coronary procedure codes

In England, procedures undertaken in hospital are coded using the OPCS Classifications of Procedures and Interventions (versions 4.2 to 4.6 during the study period). The following codes were used to identify coronary procedures: coronary angiography (K63), percutaneous coronary angioplasty (K49, K50, K75) and coronary artery bypass grafting (K40, K41, K42, K43, K44, K45, K46). In Australia, in-hospital procedures are coded using ICD-9-CM prior to 01 July 1998 (01 July 1999 in WA), and the ICD-10-AM Australian Classification of Health Interventions from that date on. The codes used to identify coronary angiography were 37.21, 37.22, 37.23, 38215-00, 38218-00, 38218-01, 38218-02; and, percutaneous coronary angioplasty 36.02, 36.05, 36.06, 36.07, 35304-00, 35305-00, 38303-00, 38300-00, 35338-00, 35338-01, 35344-00, 35344-01, 38312-00, 38312-01, 38318-00, 38318-01, 35310-00, 35310-01, 35310-02, 38306-00, 38306-01, 38306-02, 35335-00, 35341-00, 38309-00, 38315-00, 90218-00, 90218-01, 90218-02, 90218-03; and coronary artery bypass grafting 36.10, 36.11, 36.12, 36.13, 36.14, 36.15, 36.16, 36.17, 36.18, 36.19, 38497-00, 38497-01, 38497-02, 38497-03, 38497-04, 38497-05, 38497-06, 38497-07, 38500-00, 38500-01, 38500-02, 38500-03, 38500-04, 38500-05, 38503-00, 38503-01, 38503-02, 38503-03, 38503-04, 38503-05, 90201-00, 90201-01, 90201-02, 90201-03.

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Supplementary Table 1. Baseline characteristics of hospitalisations for coronary heart disease in Oxford Record Linkage Study and Western Australia, using linked admissions.

	Oxford Record Linkage Study					Western Australia				
	Myocardial infarction	Unstable angina	Stable angina	Other CHD	Total CHD	Myocardial infarction	Unstable angina	Stable angina	Other CHD	Total CHD
Men										
1996-2003										
Total admissions, n	15 075	10 566	8638	24 126	58 405	13 342	16 668	19 439	10 061	59 510
Average annual admissions, n	1884	1321	1080	3016	7301	1668	2084	2430	1258	7439
Mean age, years (SD)	64.2 (11.6)	63.8 (11.4)	63.7 (11.2)	62.8 (9.9)	63.5 (10.9)	63.3 (12.1)	64.4 (11.2)	63.6 (10.7)	63.2 (10.3)	63.7 (11.1)
1-year prior admission history, %										
Acute coronary syndromes	4.7	18.8	12.5	17.3	-	8.4	23.6	15.7	20.9	-
Chronic CHD	3.1	16.1	16.4	25.3	-	3.0	11.6	17.3	15.3	-
2004-2013										
Total admissions, n	18 184	7500	7629	51 663	84 976	22 011	15 736	20 315	18 898	76 960
Average annual admissions, n	1818	750	763	5166	8498	2201	1574	2032	1890	7696
Mean age, years (SD)	64.4 (11.9)	63.9 (11.8)	64.8 (11.5)	65.2 (10.2)	64.8 (10.9)	63.5 (12.1)	64.1 (11.4)	64.7 (10.8)	65.3 (10.0)	64.4 (11.2)
1-year prior admission history, %										
Acute coronary syndromes	7.3	13.3	10.8	10.0	-	7.7	18.9	12.0	13.4	-
Chronic CHD	7.3	17.8	22.6	29.0	-	2.8	10.6	15.4	14.7	-

	Oxford Record Linkage Study					Western Australia				
	Myocardial infarction	Unstable angina	Stable angina	Other CHD	Total CHD	Myocardial infarction	Unstable angina	Stable angina	Other CHD	Total CHD
Women										
1996-2003										
Total admissions, n	7039	5961	5356	8133	26 489	5660	9709	9107	3200	27 676
Average annual admissions, n	880	745	670	1017	3311	708	1214	1138	400	3460
Mean age, years (SD)	70.3 (10.3)	67.2 (10.9)	67.3 (11.2)	65.8 (10.0)	67.6 (10.7)	69.9 (11.1)	66.8 (11.8)	66.8 (11.0)	66.6 (10.1)	68.1 (11.0)
1-year prior admission history, %										
Acute coronary syndrome	5.3	16.3	11.3	15.0	-	9.4	22.2	14.7	18.6	-
Chronic CHD	3.1	12.9	14.2	21.2	-	3.0	9.1	12.5	10.8	-
2004-2013										
Total admissions, n	7726	4291	5103	18 433	35 553	9378	8745	10 226	5995	34 344
Average annual admissions, n	773	429	510	1843	3555	938	875	1,023	600	3434
Mean age, years (SD)	70.0 (11.1)	66.6 (11.7)	67.2 (11.4)	67.8 (10.0)	68.1 (10.7)	68.6 (12.0)	68.7 (10.9)	66.7 (11.4)	67.6 (10.2)	67.4 (11.5)
1-year prior admission history, %										
Acute coronary syndrome	8.8	11.6	9.2	8.7	-	8.7	15.7	10.8	12.7	-
Chronic CHD	7.2	15.0	16.6	25.0	-	2.8	8.8	11.4	12.7	-
CHD, coronary heart disease; SD, standard deviation										

Supplementary Table 2. Age-adjusted trends in coronary heart disease subgroups in the Oxford Record Linkage Study and Western Australia, for unlinked admissions, linked admissions, and 28-day episodes, stratified by period.

Average annual % change (95% confidence interval)*						
1996-2003						
	Oxford Record Linkage Study			Western Australia		
	Unlinked	Linked admissions‡	28-day episodes	Unlinked	Linked admissions‡	28-day episodes
Men						
Total CHD	+2.6 (+2.3, +3.0)	+2.4 (+2.0, +2.7)	+2.3 (+1.9, +2.7)	-3.4 (-3.7, -3.1)	-3.4 (-3.8, -3.1)	-3.1 (-3.4, -2.7)
Aggregated subgroups†						
Acute coronary syndrome	-1.3 (-1.9, -0.8)	-1.7 (-2.2, -1.1)	-1.7 (-2.2, -1.1)	-3.1 (-3.6, -2.7)	-3.4 (-3.9, -3.0)	-3.4 (-3.9, -2.9)
Chronic CHD	+5.8 (+5.4, +6.3)	+5.7 (+5.2, +6.2)	+5.7 (+5.2, +6.2)	-3.7 (-4.2, -3.2)	-3.5 (-3.9, -3.0)	-2.7 (-3.3, -2.2)
Subgroups						
Myocardial infarction	-2.2 (-2.8, -1.5)	-3.0 (-3.6, -2.3)	-3.1 (-3.8, -2.4)	-0.9 (-1.6, -0.2)	-1.5 (-2.2, -0.7)	-1.5 (-2.3, -0.8)
Unstable angina	-0.2 (-1.0, +0.6)	+0.3 (-0.6, +1.1)	+0.7 (-0.2, +1.5)	-5.0 (-5.6, -4.4)	-5.0 (-5.6, -4.3)	-4.9 (-5.6, -4.2)
Stable angina	-6.6(-7.5, -5.8)	-6.2 (-7.1, -5.3)	-6.2 (-7.1, -5.3)	-2.9 (-3.5, -2.4)	-2.8 (-3.4, -2.2)	-2.8 (-3.4, -2.1)
Other CHD	+10.5 (+9.9, +11.1)	+10.4 (+9.8, +11.0)	+10.4 (+9.8, +11.1)	-5.2 (-5.9, -4.4)	-4.7 (-5.5, -3.9)	-2.6 (-3.6, -1.7)
Women						
Total CHD	+2.8 (+2.3, +3.3)	+2.6 (+2.0, +3.1)	+2.5 (+2.0, +3.1)	-3.5 (-4.0, -3.0)	-3.7 (-4.2, -3.2)	-3.5 (-4.0, -2.9)
Aggregated subgroups†						
Acute coronary syndrome	-0.7 (-1.4, 0)	-0.7 (-1.5, 0)	-0.7 (-1.5, +0.1)	-3.4 (-4.1, -2.8)	-3.9 (-4.5, -3.2)	-3.9 (-4.6, -3.2)
Chronic CHD	+6.2 (+5.5, +7.0)	+5.9 (+5.1, +6.7)	+5.9 (+5.1, +6.8)	-3.5 (-4.3, -2.8)	-3.4 (-4.2, -2.7)	-2.9 (-3.7, -2.1)
Subgroups						
Myocardial infarction	-3.4 (-4.3, -2.4)	-3.8 (-4.8, -2.8)	-3.8 (-4.8, -2.8)	-0.3 (-1.3, +0.8)	-1.0 (-2.1, +0.1)	-1.0 (-2.2, +0.1)
Unstable angina	+2.5 (+1.4, +3.6)	+3.0 (+1.9, +4.1)	+3.3 (+2.1, +4.5)	-5.3 (-6.0, -4.5)	-5.5 (-6.3, -4.7)	-5.7 (-6.5, -4.8)
Stable angina	-4.2 (-5.3, -3.1)	-3.9 (-5.1, -2.8)	-4.0 (-5.1, -2.8)	-3.1 (-3.9, -2.2)	-3.0 (-3.9, -2.1)	-2.9 (-3.8, -1.9)
Other CHD	+13.2 (+12.2, +14.3)	+13.2 (+12.1, +14.3)	+13.3 (+12.2, +14.5)	-4.8 (-6.2, -3.4)	-4.6 (-6.0, -3.1)	-2.9 (-4.6, -1.2)

2004-2013

Oxford Record Linkage Study

Western Australia

Unlinked

Linked admissions[‡]

28-day episodes

Unlinked

Linked admissions[‡]

28-day episodes

Men

Total CHD	-2.7 (-3, -2.5)	-1.9 (-2.1, -1.6)	-2.0 (-2.2, -1.8)	-1.5 (-1.8, -1.3)	-1.9 (-2.1, -1.6)	-1.6 (-1.9, -1.4)
Aggregated subgroups [†]						
Acute coronary syndrome	-6.1 (-6.5, -5.7)	-5.0 (-5.4, -4.6)	-4.8 (-5.2, -4.4)	-1.7 (-2.0, -1.4)	-2.3 (-2.6, -1.9)	-1.9 (-2.2, -1.5)
Chronic CHD	-1.2 (-1.5, -1.0)	-0.5 (-0.8, -0.2)	-0.7 (-1.0, -0.4)	-1.3 (-1.7, -1.0)	-1.4 (-1.8, -1.1)	-1.4 (-1.7, -0.1)
Subgroups						
Myocardial infarction	-4.7 (-5.1, -4.2)	-3.2 (-3.7, -2.3)	-3.0 (-3.5, -2.5)	+2.2 (+1.8, +2.6)	+1.8 (+1.3, +2.3)	+2.1 (+1.6, +2.6)
Unstable angina	-9.7 (-10.4, -9.0)	-9.2 (-10.0, -8.5)	-9.2 (-10.0, -8.5)	-7.2 (-7.7, -6.7)	-7.7 (-8.2, -7.2)	-7.4 (-8.0, -6.9)
Stable angina	-4.9 (-5.6, -4.2)	-4.6 (-5.4, -3.9)	-4.8 (-5.5, -4.0)	-5.4 (-5.8, -4.9)	-5.5 (-5.9, -5.0)	-5.1 (-5.6, -4.6)
Other CHD	-0.7 (-1.0, -0.5)	+0.2 (-0.1, +0.5)	-0.1 (-0.4, +0.2)	+3.3 (+2.8, +3.8)	+3.1 (+2.6, +3.6)	+3.1 (+2.6, +3.7)

Women

Total CHD	-3.9 (-4.3, -3.6)	-3.3 (-3.6, -2.9)	-3.3 (-3.7, -3.0)	-1.6 (-2.0, -1.3)	-2.0 (-2.4, -1.7)	-1.8 (-2.1, -1.4)
Aggregated subgroups [†]						
Acute coronary syndrome	-6.7 (-7.3, -6.1)	-6.0 (-6.6, -5.4)	-5.8 (-6.4, -5.2)	-2.2 (-2.7, -1.8)	-2.9 (-3.4, -2.5)	-2.6 (-3.1, -2.1)
Chronic CHD	-2.5 (-2.9, -2.1)	-1.9 (-2.3, -1.4)	-2.0 (-2.5, -1.6)	-0.9 (-1.4, -0.3)	-1.0 (-1.5, -0.4)	-0.7 (-1.3, -0.2)
Subgroups						
Myocardial infarction	-5.0 (-5.7, -4.3)	-3.9 (-4.7, -3.2)	-3.7 (-4.5, -3.0)	+1.8 (+1.2, +2.5)	+1.1 (+0.4, +1.8)	+1.4 (+0.6, +2.1)
Unstable angina	-9.8 (-10.7, -8.9) -5.3 (-6.0, -4.5)	-9.6 (-10.6, -8.7) -5.5 (-6.3, -4.7)	-9.6 (-10.6, -8.6) -5.7 (-6.5, -4.8)	-6.7 (-7.3, -6.0)	-7.1 (-7.8, -6.4)	-6.9 (-7.6, -6.2)
Stable angina	-6.7 (-7.6, -5.8) -3.1(- 3.9, -2.2)	-6.6 (-7.5, -5.7) -3.0(- 3.9, -2.1)	-6.7 (-7.6, -5.7) -2.9(- 3.8, -1.9)	-3.3 (-3.9, -2.6)	-3.4 (-4.1, -2.8)	-3.1 (-3.8, -2.4)
Other CHD	-1.4 (-1.9, -1.0) -4.8(- 6.2, -3.4)	-0.5 (-1.0, 0) -4.6(- 6.0, -3.1)	-0.6 (-1.2, -0.1) -2.9(- 4.6, -1.2)	+3.5(+2.6, +4.4)	+3.4 (+2.5, +4.4)	+3.6 (+2.6, +4.6)

*Estimated from the exponential of the beta-coefficient for calendar year from age-adjusted Poisson regression models.

[†]Acute coronary syndrome comprises myocardial infarction + unstable angina; Chronic CHD comprises stable angina + Other CHD.

[‡]Inter-hospital or within-hospital transfers are linked to represent one admission.

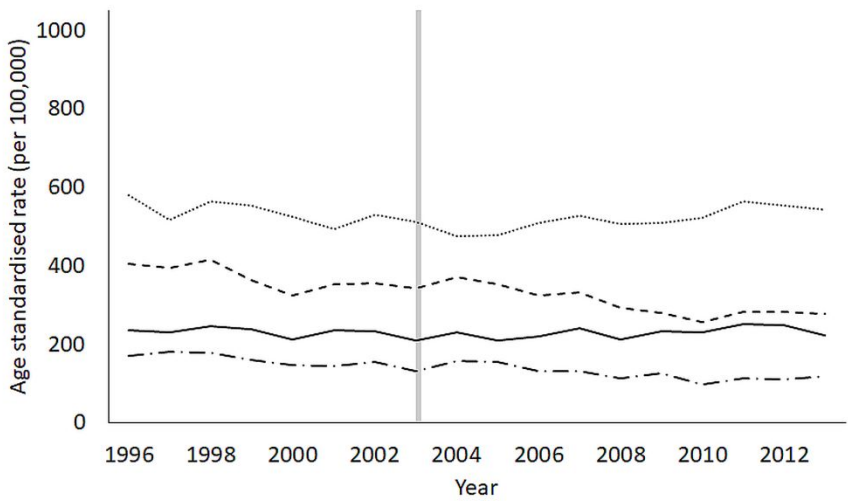
CHD, coronary heart disease.

Supplementary Table 3. Age-specific trends (average annual % change (95% CI)) in coronary heart disease subgroup hospitalisations in England and Australia

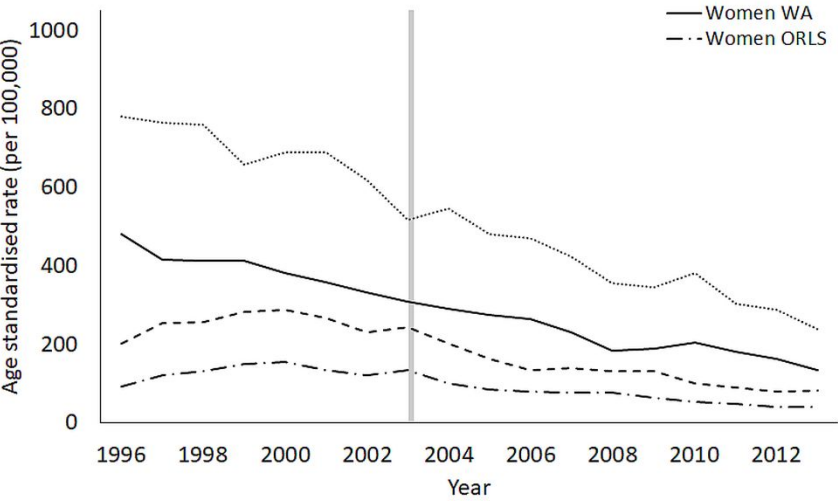
Subgroup		1996-2003		2004-2013		
		England	Australia	England	Australia	
35-54 years	Men	Myocardial infarction	-1.1 (-1.4, -0.8)	+2.2 (+1.8, +2.6)	-1.7 (-1.9, -1.5)	-1.1 (-1.3, -0.8)
		Unstable angina	+2.3 (+1.9, +2.7)	-4.9 (-5.3, -4.5)	-7.4 (-7.7, -7.1)	-7.6 (-7.9, -7.3)
		Stable angina	-6.3 (-6.7, -6.0)	-7.7 (-8.1, -7.3)	-4.1 (-4.4, -3.8)	-6.2 (-6.5, -5.8)
		Other CHD	+1.7 (+1.4, +1.9)	-5.2 (-5.6, -4.7)	-2.8 (-3.0, -2.7)	-2.0 (-2.3, -1.6)
		Acute coronary syndrome	-0.4 (-0.5, -0.3)	-1.6 (-1.9, -1.3)	-3.8 (-3.9, -3.6)	-3.4 (-3.6, -3.2)
		Chronic CHD	-0.6 (-0.8, -0.4)	-6.4 (-6.7, -6.1)	-3.1 (-3.2, -3.0)	-3.9 (-4.2, -3.7)
		Total CHD	-0.3 (-0.4, -0.1)	-3.6 (-3.8, -3.4)	-3.4 (-3.5, -3.2)	-3.6 (-3.7, -3.4)
	Women	Myocardial infarction	+0.4 (-0.3, +1.1)	+4.7 (+3.8, +5.6)	0 (-0.5, +0.4)	+1.9 (+1.4, +2.4)
		Unstable angina	+5.1 (+4.5, +5.7)	-2.1 (-2.7, -1.5)	-7.0 (-7.5, -6.6)	-6.1 (-6.5, -5.6)
		Stable angina	-2.9 (-3.4, -2.4)	-5.3 (-6.0, -4.6)	-4.1 (-4.5, -3.7)	-4.0 (-4.6, -3.5)
		Other CHD	+3.1 (+2.6, +3.6)	-2.5 (-3.4, -1.5)	-1.9 (-2.2, -1.5)	-1.8 (-2.5, -1.1)
		Acute coronary syndrome	+3.1 (+2.6, +3.6)	+0.1 (-0.4, +0.6)	-3.6 (-3.9, -3.3)	-2.0 (-2.3, -1.6)
		Chronic CHD	+0.3 (0, +0.7)	-4.2 (-4.8, -3.6)	-2.7 (-2.9, -2.4)	-3.1 (-3.6, -2.7)
		Total CHD	+1.4 (+1.1, +1.7)	-1.7 (-2.1, -1.4)	-3.0 (-3.2, -2.8)	-2.4 (-2.7, -2.1)
55-64 years	Men	Myocardial infarction	-3.6 (-3.8, -3.3)	+1.5 (+1.1, +1.9)	-2.1 (-2.3, -1.9)	-1.2 (-1.4, -0.9)
		Unstable angina	-1.2 (-1.5, -0.8)	-5.0 (-5.3, -4.7)	-6.4 (-6.7, -6.1)	-9.1 (-9.4, -8.9)
		Stable angina	-7.8 (-8.1, -7.5)	-6.3 (-6.7, -6.0)	-3.1 (-3.4, -2.8)	-7.2 (-7.5, -7.0)
		Other CHD	+2.2 (+2.0, +2.3)	-1.9 (-2.3, -1.5)	-2.8 (-2.9, -2.6)	-1.1 (-1.4, -0.9)
		Acute coronary syndrome	-2.6 (-2.8, -2.3)	-2.3 (-2.6, -2.1)	-3.6 (-3.8, -3.4)	-4.4 (-4.6, -4.3)
		Chronic CHD	-0.4 (-0.6, -0.2)	-4.0 (-4.3, -3.7)	-2.8 (-2.9, -2.7)	-3.7 (-3.8, -3.5)
		Total CHD	-1.2 (-1.3, -1.1)	-3.1 (-3.3, -3.0)	-3.1 (-3.2, -3.0)	-4.1 (-4.2, -3.9)
	Women	Myocardial infarction	-4.8 (-5.2, -4.3)	+1.3 (+0.5, +2.0)	-1.5 (-1.9, -1.2)	-0.8 (-1.3, -0.4)
		Unstable angina	+0.6 (+0.1, +1.0)	-5.3 (-5.8, -4.8)	-7.6 (-8.0, -7.3)	-8.5 (-8.9, -8.1)
		Stable angina	-5.7 (-6.1, -5.2)	-5.7 (-6.3, -5.1)	-5.1 (-5.5, -4.7)	-6.7 (-7.2, -6.3)
		Other CHD	+2.4 (+2.1, +2.8)	-2.1 (-2.8, -1.4)	-3.1 (-3.3, -2.9)	-2.2 (-2.7, -1.7)
		Acute coronary syndrome	-2.0 (-2.4, -1.7)	-3.2 (-3.6, -2.8)	-4.4 (-4.6, -4.1)	-4.7 (-4.9, -4.4)
		Chronic CHD	-0.7 (-1.0, -0.4)	-4.1 (-4.5, -3.6)	-3.6 (-3.8, -3.4)	-4.5 (-4.8, -4.1)
		Total CHD	-1.2 (-1.4, -1.0)	-3.6 (-3.9, -3.3)	-3.9 (-4.0, -3.7)	-4.6 (-4.8, -4.4)

		Heart				
		1996-2003		2004-2013		
Subgroup		England	Australia	England	Australia	
65-74 years	Men	Myocardial infarction	-2.5 (-2.8, -2.3)	+1.9 (+1.5, +2.2)	-4.0 (-4.2, -3.8)	-1.7 (-1.9, -1.4)
		Unstable angina	+2.5 (+2.2, +2.8)	-4.9 (-5.2, -4.6)	-8.1 (-8.3, -7.8)	-8.8 (-9.1, -8.6)
		Stable angina	-5.3 (-5.6, -5.0)	-5.3 (-5.7, -5.0)	-3.9 (-4.2, -3.6)	-6.1 (-6.4, -5.9)
		Other CHD	+7.9 (+7.7, +8.1)	-0.7 (-1.0, -0.4)	-3.0 (-3.1, -2.9)	+0.9 (+0.7, +1.1)
		Acute coronary syndrome	-0.5 (-0.7, -0.3)	-2.3 (-2.6, -2.1)	-5.4 (-5.6, -5.3)	-4.8 (-4.9, -4.6)
		Chronic CHD	+4.8 (+4.5, +5.1)	-3.0 (-3.2, -2.7)	-3.1 (-3.2, -3.0)	-2.0 (-2.1, -1.8)
		Total CHD	+2.2 (+2.1, +2.3)	-2.6 (-2.8, -2.5)	-3.9 (-3.9, -3.8)	-3.4 (-3.5, -3.2)
	Women	Myocardial infarction	-3.4 (-3.8, -3.1)	+1.5 (+1.0, +2.1)	-4.5 (-4.8, -4.2)	-2.1 (-2.4, -1.7)
		Unstable angina	+3.4 (+3.0, +3.8)	-5.1 (-5.5, -4.7)	-8.5 (-8.8, -8.2)	-9.4 (-9.7, -9.0)
		Stable angina	-4.2 (-4.6, -3.9)	-5.0 (-5.5, -4.5)	-5.7 (-6.0, -5.4)	-6.3 (-6.6, -5.9)
		Other CHD	+8.3 (+8.0, +8.6)	-0.4 (-1.0, +0.1)	-3.6 (-3.8, -3.5)	-1.1 (-1.4, -0.7)
		Acute coronary syndrome	-0.4 (-0.6, -0.1)	-2.8 (-3.1, -2.5)	-6.2 (-6.4, -5.9)	-5.5 (-5.7, -5.3)
		Chronic CHD	+3.3 (+3.1, +3.6)	-2.9 (-3.3, -2.6)	-4.1 (-4.3, -4.0)	-3.5 (-3.8, -3.2)
		Total CHD	+1.6 (+1.5, +1.8)	-2.9 (-3.1, -2.6)	-4.8 (-5.0, -4.7)	-4.6 (-4.8, -4.4)
75-84 years	Men	Myocardial infarction	0 (-0.3, +0.3)	+3.5 (+3.0, +3.9)	-4.2 (-4.4, -4.0)	-1.6 (-1.8, -1.3)
		Unstable angina	+4.9 (+4.5, +5.3)	-3.4 (-3.8, -3.1)	-6.4 (-6.7, -6.1)	-8.1 (-8.4, -7.8)
		Stable angina	-4.3 (-4.7, -3.9)	-1.7 (-2.2, -1.2)	-1.8 (-2.1, -1.5)	-5.1 (-5.4, -4.7)
		Other CHD	+11.9 (+11.5, +12.3)	+4.9 (+4.4, +5.4)	+2.0 (+1.9, +2.2)	+1.5 (+1.2, +1.8)
		Acute coronary syndrome	+1.8 (+1.5, +2.0)	-0.6 (-0.9, -0.3)	-4.9 (-5.1, -4.8)	-4.2 (-4.4, -4.0)
		Chronic CHD	+4.8 (+4.5, +5.1)	+1.4 (+1.0, +1.7)	+1.2 (+1.1, +1.4)	-1.4 (-1.6, -1.2)
		Total CHD	+3.1 (+2.9, +3.2)	+0.2 (0.0, +0.4)	-1.4 (-1.5, -1.3)	-3.0 (-3.1, -2.8)
	Women	Myocardial infarction	-0.4 (-0.7, -0.1)	+2.7 (+2.2, +3.2)	-4.0 (-4.2, -3.7)	-2.0 (-2.3, -1.7)
		Unstable angina	+4.8 (+4.4, +5.2)	-4.1 (-4.5, -3.8)	-6.8 (-7.1, -6.5)	-9.2 (-9.5, -8.8)
		Stable angina	-4.2 (-4.5, -3.8)	-2.7 (-3.2, -2.3)	-3.2 (-3.5, -2.9)	-5.8 (-6.2, -5.5)
		Other CHD	+8.0 (+7.6, +8.5)	+4.8 (+4.1, +5.4)	+2.4 (+2.2, +2.6)	+0.6 (+0.2, +1.0)
		Acute coronary syndrome	+1.6 (+1.3, +1.8)	-1.4 (-1.7, -1.1)	-4.9 (-5.1, -4.8)	-4.9 (-5.1, -4.7)
		Chronic CHD	+1.1 (+0.8, +1.4)	+0.1 (-0.3, +0.5)	+0.6 (+0.4, +0.8)	-2.7 (-3.0, -2.5)
		Total CHD	+1.4 (+1.2, +1.6)	-0.9 (-1.1, -0.7)	-2.1 (-2.2, -1.9)	-4.1 (-4.2, -3.9)

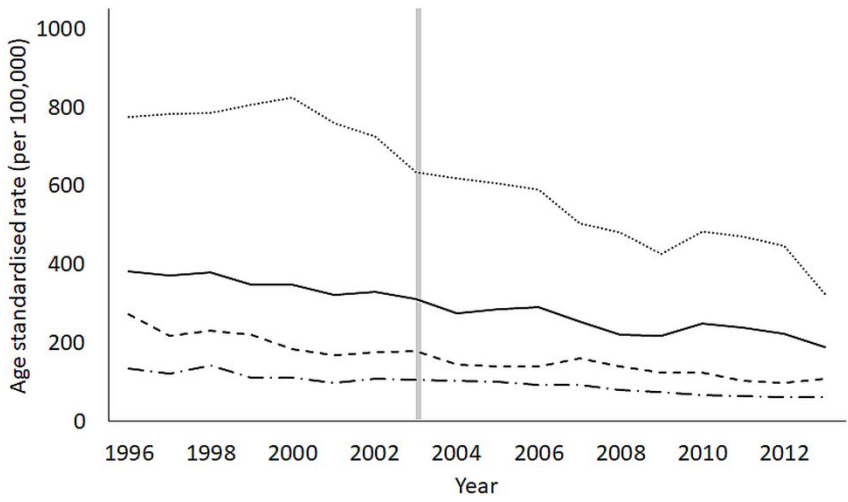
A. Myocardial infarction



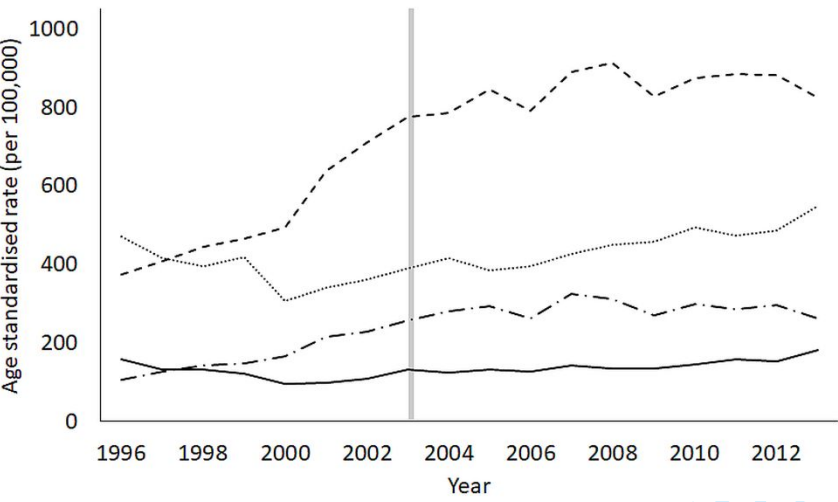
B. Unstable angina



C. Stable angina



D. Other CHD



Supplementary Figure 1. Age-standardised hospitalisation rates for (A) myocardial infarction, (B) unstable angina, (C) stable angina, and (D) other CHD for Oxford Record Linkage Study and Western Australia, stratified by sex. Hospitalisation rates are based on linked admissions.

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6/7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6/7
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	8
		(b) For matched studies, give matching criteria and number of exposed and unexposed	na
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8/9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	9
Study size	10	Explain how the study size was arrived at	8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8/9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	10
		(b) Describe any methods used to examine subgroups and interactions	10
		(c) Explain how missing data were addressed	na
		(d) If applicable, explain how loss to follow-up was addressed	na
		(e) Describe any sensitivity analyses	9/10
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	11
		(b) Give reasons for non-participation at each stage	na
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11; table 1
		(b) Indicate number of participants with missing data for each variable of interest	na
		(c) Summarise follow-up time (eg, average and total amount)	na
Outcome data	15*	Report numbers of outcome events or summary measures over time	

1	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-14; table 2
2			(b) Report category boundaries when continuous variables were categorized	Na
3			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	na
4	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	14
5	Discussion			
6	Key results	18	Summarise key results with reference to study objectives	14
7	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16
8	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-16
9	Generalisability	21	Discuss the generalisability (external validity) of the study results	14-15
10	Other information			
11	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	18

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.