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Western Australia population trends in the incidence of acute myocardial infarction between 1993 and 2012☆

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ABSTRACT

Background: Acute myocardial infarction (AMI) incidence has been declining throughout the developed world. Australia has been an outlier to this trend, with AMI incidence reportedly increasing. This study provides a detailed investigation on the incidence of acute myocardial infarction (AMI) in Western Australia overall, and by age, sex, level of geographic remoteness and socioeconomic status.

Methods: Individual level data was sourced from routinely collected hospital admissions and the Western Australian mortality register, providing coverage of the entire population. Hospital admissions were grouping into continuous inpatient stays to avoid double counting individual AMIs. The mortality register provided coverage of out of hospital AMI deaths.

Results: AMI incidence decreased in Western Australia from 1993 to 2012 by 1.2% per year (95% confidence interval (CI): −1.7 to −0.8). This decrease was concentrated in the 50–80 age group, with rates for those under 50 and over 80 remaining stable. AMI rates increased in both regional (Annual percentage change (APC), 95% (CI): 4.7, 3.7 to 5.7) and remote areas (APC, 95% CI: 4.6, 3.5 to 5.6). There was a large effect of socioeconomic status, with those from the lowest quintile having a 68% higher AMI incidence than those from the highest socioeconomic quintile.

Conclusions: These results are generally in line with other developed nations. Previous findings of increased incidence Australia-wide appear likely the result of double-counting AMIs within hospitals, and excluding out of hospital deaths. Further focus is required on particular subpopulations showing increased incidence of AMI, such as those in regional and remote areas. Focus on primary care prevention of cardiovascular risk factors will likely be the most effective method to ensure reductions in AMI incidence in these populations.

1. Introduction

Declines in acute myocardial infarction (AMI) incidence occurred through the 1980's in Australia and throughout the Western world [1–3]. More recent studies have shown that this trend has generally continued [4–6]. This reduction in AMI has been largely attributed to controlling, treating or modifying cardiac risk factors [7], such as high blood pressure, cholesterol, obesity, tobacco use, lack of physical activity and diabetes in the population. However, Australia has been an outlier to recent trends [7], with incidence of AMI reported to be increasing at almost 2% a year [8].

This study aims to investigate AMI incidence in Australia in more detail, including both hospitalisations for AMI and out of hospital AMI deaths in the Western Australian population from 1993 to 2012. We assessed AMI trends by comparing incidence rates by sex, age, socioeconomic status and remoteness level, to identify potential differences between these subgroups.

2. Methods

Data for this study were sourced from WA Data Linkage Branch (WA DLB) at the Department of Health, Western Australia, which routinely captures all public and private hospitalisations in Western Australia (population 2.6 million) within the Hospital Morbidity Data Collection. This data collection is routinely linked to information held by the Register of Births, Deaths and Marriages for Western Australia. This routine linkage system enables data to be analysed as patient care pathways, rather than individual treatment episodes. The project was approved by the Department of Health WA, and Curtin University ethics committees. A de-identified extraction of all hospital morbidity records from 1993 to 2012 with a primary diagnosis of an AMI in Western Australia, along with all mortality records where AMI was listed as the cause of death from the Register of Births, Deaths and Marriages, was undertaken by the WA DLB staff. For the purposes of the study an AMI was defined as a primary diagnosis using International Classification of Diseases (ICD) codes (ICD9-CM 410; ICD-AM I21, I22).

Hospital admission data included principal diagnosis, age, gender and admission and separation dates. Mortality data included cause of death, age, gender and date of death. Incident AMI cases included hospital discharges/separations with a principal diagnosis of AMI and deaths outside hospital with an AMI cause of death. Hospital separations which formed part of the same continuous package of care were excluded to avoid double counting. In line with the MONICA definition of a new myocardial infarction [4], AMIs of

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an individual which occurred within 30 days of a previous AMI were also excluded. An additional sensitivity analysis was run to determine the effect on incidence of counting all hospital separations, as carried out in previous Australian studies [8].

Incidence of ST wave elevated myocardial infarction (STEMI; full thickness damage to heart muscle) and non-ST wave elevated myocardial infarction (nonSTEMI; partial thickness damage to heart muscle) were also analysed. In line with previous literature [8], ICD9-CM codes 410.0 to 410.6, 410.8 and ICD10-AM codes I21.0 to I21.3 were classified as STEMI and ICD-9-CM codes 410.7 and 410.9, and ICD10-AM codes I21.4 and I21.9 were classified as nonSTEMI. A previous detailed chart review over this time period has found a positive predictive value of 98.6% for any myocardial infarction, 78.5% for STEMI and 91.5% for nonSTEMI, which was consistent over time [8]. For out of hospital deaths, those coded as I21.9 or 410.9 were not classified as either STEMI or nonSTEMI.

Indices of geographical remoteness (Accessibility Remoteness Index of Australia (ARIA+) [9] and social disadvantage (Socio-economic Indices for Areas (SEIFA) [10] an index derived from principal components analysis of over 40 census variables), were supplied for the study. The social disadvantage index was classified into quintiles (least to most disadvantage) and geographical remoteness was classified into major cities, regional areas, and remote areas (8.1% of records had missing ARIA codes and 8.0% had missing SEIFA codes).

Incidence rates were calculated for AMIs, STEMIs and non-STEMIs per 100,000 person years, for each year. These rates were directly standardised by age and sex, using the age and gender structure of Western Australia in 2010. Age was categorised into those under 50, 50–59, 60–69, 70–79 and 80+. Population estimates for each year were sourced from the Australian Bureau of Statistics.

Incidence rates directly standardised by age and sex were also stratified by ARIA and by SEIFA social disadvantage quintiles. In these cases, denominator data outlining the number of individuals of each age and sex category with a particular ARIA and SEIFA score were sourced from the Australian Bureau of Statistics, based on 2001, 2006 and 2011 censuses. The proportion of individuals in each age/sex category was linearly interpolated for all non-census years, based on the scores of the nearest censuses. Reliable denominator data for ARIA and SEIFA could only be sourced from 2000 to 2012. Trends in yearly changes in standardised AMI incidence were assessed using Poisson regression models. Data was analysed using Python 2.7 and Stata 12.

3. Results

There were 97,638 incident acute myocardial infarctions in WA from 1993 to 2012. The median age for an AMI was 74 (IQR 62–83). There was a small increase in the median age of AMI, from 72 in 1993, to 74 in 2012 ($p < 0.001$). Males accounted for 61% of AMIs overall, which was consistent across the study period. Out of hospital deaths accounted for 25% of AMIs in 1993 and 11% of AMIs in 2011.

Incidence rates adjusted for age and sex are shown in Fig. 1. Incidence of AMI declined over the study period from 382 AMIs per 100,000 person years in 1993, to 280 AMIS per 100,000 person years in 2012 (Annual percentage change (APC), 95% CI: −1.2, −1.7 to −0.8). There were large changes in the type of AMI recorded, with a decrease in the incidence of STEMI (APC, 95% CI: −7.2, −7.9 to −6.4) and an increase in the incidence of nonSTEMI (APC, 95% CI: 5.6, 4.9 to 6.3). This pattern of a decreased incidence of STEMI and an increase incidence of nonSTEMI was found for gender and across all age groups and socioeconomic status quintiles, as well as for those living in major cities and regional areas.

In 1993, 7% of AMIs had more than one separation (i.e. either a transfer within or between hospitals), while by 2012, this had increased to 31% of AMIs. Analysis of incidence rates excluding out of hospital deaths and which did not take into account multiple separations per episode of care (i.e. using the same methodology as Wong et al. [8]), showed a significant increase in AMI incidence over the study period (APC, 95% CI: 0.7, 0.3–1.2) with an increase of 2.3% per year over the final 10 years (95% CI: 1.1–3.6).

Males had a higher rate of AMIs compared to females over the 20 year period, with an average rate-ratio of 1.54. The difference between males and females decreased over the study period ($p < 0.001$), with the incidence of AMI for both males and females decreasing (APC, 95% CI: *male*: −1.5, −1.9 to −1.1; *female*: −0.8, −1.3 to −0.3).

Incidence rates by age are shown in Fig. 2. AMI incidence decreased for those in their fifties (APC, 95% CI: −1.0, −1.5 to −0.6), sixties (APC, 95% CI: −2.8, −3.1 to −2.5): and seventies (APC, 95% CI: −2.6, −2.8 to −2.4), while incidence remained stable for those over 80 (APC, 95% CI: −0.1, −0.2 to 0.0), and those under 50 (APC, 95% CI: 0.9, −0.5 to 2.4). When excluding those aged eighty and over, there was an overall decrease in AMI incidence of 2.0% per year (95% CI: −2.5 to −1.4).

AMI incidence rates in rural and remote areas changed from being lower than in cities in 2000 to be higher than rates in cities by 2012 (see Fig. 3). While AMI rates decreased in major cities by 1.4% per year (95% CI: −2.4 to −0.5), AMI rates increased in both regional (APC, 95% CI: 4.7, 3.7 to 5.7) and remote areas (APC, 95% CI: 4.6, 3.5 to 5.6). The increase in non-metropolitan areas was driven by an increased rates of nonSTEMIs (APC, 95% CI: *regional*: 12.2, 10.7 to 13.6; *remote*: 9.7, 8.2 to 11.2) with stable or decreasing incidence of STEMIs (APC, 95% CI: *regional*: −3.4, −5.2 to −1.6; *remote*: 0.9, −1.1 to 2.9). Metropolitan areas showed a large decrease in STEMI incidence (APC, 95% CI: −9.2, −11.0 to −7.4) with an increase in nonSTEMI incidence (APC, 95% CI: 4.3, 0.3 to 5.6). By 2012, the rate of AMI in regional areas compared to metropolitan areas was 1.62, while for remote areas it was 1.11.

There was a clear effect of socioeconomic status on the incidence of AMI across the study period, with those of higher levels of disadvantage found to have higher rates of AMI (see Fig. 4). Over the study period, the average rate of AMIs for those in the most disadvantaged quintile was 323 AMIs per 100,000 person years, while for those in the least disadvantaged quintile it was 183 AMIs per 100,000 person years. There was no linear change in the rate ratio between the lowest and highest socioeconomic quintiles over time, with the median difference 1.68:1 (IQR 1.36:1 to 2.22:1).

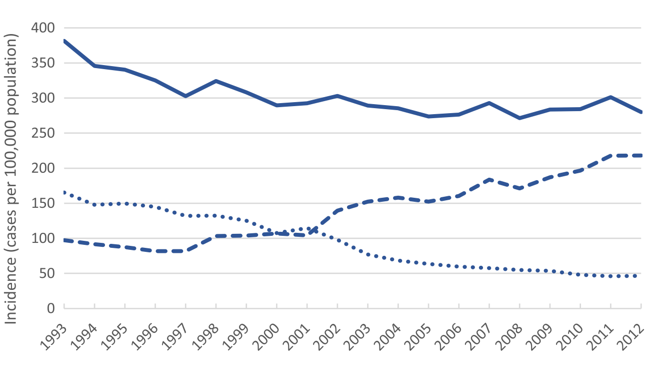

Fig. 1. Age- and sex-standardised rates for all acute myocardial infarction, non-ST elevated myocardial infarction and ST elevated myocardial infarction in Western Australia, from 1993 to 2012.

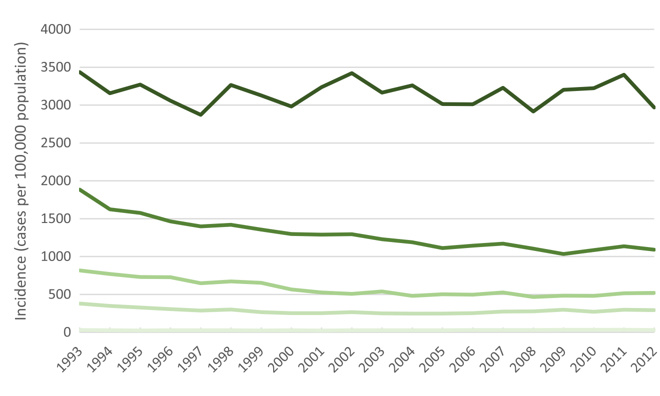

Fig. 2. Sex-standardised rates for all acute myocardial infarction by age group in Western Australia, from 1993 to 2012.