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Objective

To determine the impact of remoteness on Aboriginal and non-Aboriginal myocardial infarction incidence rates in men and women of different ages

Design

Descriptive study

Setting

Western Australia

Participants

Incident cases of myocardial infarction in Western Australia from 2000-2004 identified from person-linked files of hospital and mortality records.

Analysis was undertaken for Aboriginal and non-Aboriginal populations, separately and combined, by broad age group, sex and remoteness.

Main outcome measure

Incidence of myocardial infarction

Results

In the combined analysis, age-standardised incidence was significantly higher for males in very remote areas (rate ratio 1.31: 95% CI 1.19-1.45) and in females in both regional (rate ratio 1.12: 95% CI 1.01-1.20) and very remote (rate ratio 2.05: 95% CI 1.75-2.41) areas. Aboriginal rates were substantially higher than non-Aboriginal rates in all sub-strata. Compared with metropolitan people, regional Aboriginal men and very remote non-Aboriginal men aged 25-54 years had significantly higher incidence rates. For the remaining rural strata, there was either no geographical disadvantage or inconclusive findings.

Conclusions

Non-metropolitan disadvantage in myocardial infarction rates are confirmed in regional areas and women in very remote areas. This disadvantage is partly explained by the high rates in Aboriginal people. Non-metropolitan dwellers are not uniformly disadvantaged, reflecting the interplay of the many factors contributing to the complex relationship between myocardial infarction incidence and sex, age, Aboriginality, and residence. Aboriginal Western Australians in all regions and young non-Aboriginal males living in very remote areas need to be targeted to reduce disparities in myocardial infarction.

Key words

Western Australia
Myocardial infarction
Incidence
Geographical disadvantage
Aboriginal

1: What is already known on this subject?

- The non-metropolitan disadvantage in disease burden and life expectancy partly reflects the poor health status of Aboriginal people who comprise a high proportion of rural populations in Australia.
- Ischaemic heart disease is the highest contributor to the excess deaths outside major Australian cities and contributes substantially to the Aboriginal health gap. Myocardial infarction incidence rates among Aboriginal people are substantially higher than non-Aboriginal rates, with disparities highest at younger ages and among women.
- Evidence from the Northern Territory suggests that myocardial infarction incidence rates were higher in remote than urban areas for non-Aboriginal people but similar for Indigenous people. No metropolitan populations were investigated in that study. No other person-based studies of geographical variation in myocardial infarction incidence have been published in Australia.

2: What does this study add?

- Through separate Aboriginal and non-Aboriginal analyses, this descriptive study demonstrates there is a complex relationship between age, sex, Aboriginality and geographical residence and myocardial infarction incidence, with non-metropolitan dwellers not uniformly disadvantaged.
- Compared with metropolitan people, regional (but not very remote) Aboriginal men and very remote non-Aboriginal men aged 25-54 years had significantly higher incidence rates. For the remaining rural strata, there was either no geographical disadvantage or inconclusive findings.
- Aboriginal Western Australians in all regions and young non-Aboriginal males living in very remote areas need to be targeted to reduce disparities in myocardial infarction.

Introduction

There is substantial variation in the health status of Australians in different regions and population groups.^{1, 2} This is reflected in significantly lower life expectancies at birth (LE) in regional (80.6 years) and remote (78.1) areas than in major cities (81.2) in 2003.² Both fatal and non-fatal burden of disease per population increases with level of remoteness and injuries, diabetes and cardiovascular disease (CVD) all contribute substantially to these differentials.² Additionally, the substantial gap in LE between Indigenous and non-Indigenous Australians has been variously reported to be between 11 and 18 years.³ Because Indigenous people comprise a relatively large proportion of the population in some non-metropolitan areas, the lower LE and higher disease burden in these areas are appreciably influenced by the high mortality experienced by Indigenous people.

Of the 4,600 (annual) excess deaths outside major Australian cities in 2004-2006, the highest contribution (20%) was from coronary/ischaemic heart disease.⁴ Ischaemic heart disease (IHD) is the leading cause of mortality burden in Australia as well as the main non-communicable disease contributor to the Indigenous health gap, particularly in residents of remote areas.¹ Myocardial infarction (MI) is the most severe form of IHD. Because of its severity, high admission proportion and acute fatality rate, its occurrence is usually captured in hospital and mortality administrative data. Consequently, MI is used to monitor IHD in the population.⁵ Three recent person-based Australian studies have shown substantial disparities in the incidence of MI between the Indigenous and non-Indigenous populations of Western Australia

(WA) and Northern Territory (NT).⁶⁻⁸ In those studies, Indigenous to non-Indigenous incident rate ratios were higher in females than males and in younger ages compared with older ages. The NT⁸ study further investigated urban-rural differences in MI incidence, identifying that rates were higher in remote areas than in urban areas for non-Indigenous people but were similar for Indigenous people before and after adjustment for age, sex and event year. The study was unable to investigate metropolitan rates as defined by the Australian Index of Remoteness/Accessibility (Plus) (ARIA+).

This paper builds on our previous state-wide WA analysis of the substantial disparity in MI incidence rates between the Aboriginal and non-Aboriginal populations which showed a complex association between age, sex, and Aboriginality.⁷ We refer to Indigenous people in WA as Aboriginal due to the vast majority identifying as Aboriginal. The current descriptive study focuses on disparities in MI incidence between areas of varying remoteness to: 1) illustrate the extent to which MI incidence disparities in non-metropolitan areas are influenced by Aboriginal rates, and 2) investigate what impact remoteness has on Aboriginal and non-Aboriginal men and women of different ages.

Methods

Analysis was performed on the core datasets of hospital morbidity and deaths of the WA Data Linkage System.⁹ All hospital admissions with a discharge diagnosis of MI (International Classification of Diseases-9-Clinical Modification (ICD-9 CM) 410 or ICD-10 equivalent) were extracted as a person-linked file.

Hospital incident events in 2000-2004 were defined as first-ever admissions if there was a discharge diagnosis of MI in any diagnosis field after applying a 15-year clearance period to exclude previous MI hospitalisations, to minimise inclusion of cases with pre-existing disease. A death record coded as IHD (ICD-9-CM codes 410-414 or ICD-10 I20-I25), in persons not previously hospitalised for MI was considered as an out-of-hospital first-ever MI event. Total incidence was the sum of hospital MI and these IHD-deaths.

To account for under-identification of Aboriginality in administrative data,^{10, 11} any person who had ever been identified as Aboriginal on any hospital admission since 1985 or on their death record was assumed to be Aboriginal. Geocoding at the Statistical Local Area (SLA) level allowed the place of residence to be categorised using ARIA+.¹² The five-category ARIA+ strata were consolidated into three geographical categories: i) metropolitan¹³ (SLAs falling into the Perth metropolitan health services including urban plus some inner regional); ii) regional (remainder of inner regional, outer regional and remote); and iii) very remote to ensure sufficient case numbers in regional analyses.

Age- and sex-specific mid-year estimates of the WA resident population for Aboriginal and non-Aboriginal people for each of the five years 2000-2004 were derived from the Australian Bureau of Statistics.¹⁴

Age-standardised incidence rates were calculated by the direct method using 2001 Australian population estimates¹⁴ as the standard, stratified by

Aboriginality, sex and two broad age-groups, 25-54 and 55-74 years. Confidence intervals (CI) were calculated for age-standardised rates (ASR) and ASR ratios (ASRR).¹⁵

Approval for the study was received from the relevant Aboriginal, University and WA Department of Health human ethics committees.

Results

Case numbers and age-standardised incidence rates by age-group, sex and remoteness of residence are shown by Aboriginality (Table 1). Data showing remoteness differences in MI incidence are summarised in Figures 1 and 2 as ASRRs using metropolitan rates as the reference for each population-, age- and sex-specific stratum.

The majority of Aboriginal incident cases lived in regional (22%) and very remote areas (44%), while non-Aboriginal cases lived predominantly in metropolitan areas (78%), with only 5% in very remote areas. Population rates in metropolitan and regional areas substantially reflected the non-Aboriginal rate (Table 1). The male age-standardised incidence rate of MI (25-74 years) was similar in regional and metropolitan areas, but was significantly higher in very remote areas (ASRR 1.31: 95% CI 1.19-1.45, Figure 1). In females, incidence rates in both regional (ASRR 1.12: 95% CI 1.01-1.20) and very remote (ASRR 2.05: 95% CI 1.75-2.40) were significantly higher than metropolitan rates. When stratified by Aboriginality, MI ASRs in Aboriginal

people were substantially higher in all sub-strata than non-Aboriginal rates, with female disparities being higher than males in both age categories and all locations (Table 1).

Stratification of ASRRs by Aboriginality (Figure 2) shows the variation in the relationship between MI and residential region. In Aboriginal men, regional rates were elevated, but not significantly so for both broad age groups, although reaching significance for the combined 25-74 year age group (ASRR=1.34: 95% CI 1.01-1.78). Rates for very remote Aboriginal males were not elevated relative to metropolitan areas in the separate or combined age groups.

In non-Aboriginal men, there were significant differentials by residential region but were inconsistent by age category. In males 25-54 years regional rates were significantly lower (ASRR= 0.84: 95% CI 0.74-0.95) and very remote rates significantly higher (ASRR=1.21: 95% CI 1.02-1.45) than metropolitan rates. In the 55-74 year age group, regional rates were similar and very remote rates were significantly lower than metropolitan rates.

In Aboriginal women, rates in regional residents were similar to metropolitan rates for both age groups. The elevated rate for very remote residents in the 25-54 year age group was not statistically significant, while the rate in the 55-74 year age group was significantly lower. Non-Aboriginal women living in regional areas had similar incidence rates to those from metropolitan areas in both broad age groups.

Discussion

Geographical disparities in MI incidence were significant in the combined Aboriginal and non-Aboriginal population for males and females living in very remote areas and females in regional areas. However, disparities were attenuated, with stratification by Aboriginality showing that the non-disadvantage in metropolitan areas only persisted for Aboriginal regional males (significant only in all ages combined), while very remote non-Aboriginal men had significantly elevated rates at younger ages only. The remaining rural strata were either not disadvantaged or findings were inconclusive due to low counts in the corresponding strata.

The effect of remoteness on incidence rates varied with age for non-Aboriginal males and Aboriginal females in very remote areas where apparently elevated rates in the younger age group were countered by significantly lower rates in the older age group compared to the corresponding metropolitan rates. This can be partly accounted for by CVD disparities in disadvantaged groups being highest at younger ages, at times showing a cross-over at older ages where the population comprise healthy survivors of their age cohort.¹⁶ People with poor health and significant co-morbidities may migrate from remote areas to access more comprehensive health services such as dialysis which are concentrated in larger urban areas. It is also possible that lifestyles associated with living remotely provide health benefits, as with CVD indicators among Aboriginal people living on outstations¹⁷ and growing up in areas of isolation

from mainstream Australia, where traditional cultures and ways of life are strong, and appear protective against emotional and behavioural difficulties.¹⁸ Another possibility arises from the surprising inverse relationship between perceived racism and coronary artery calcification in African Americans in the United States.¹⁹ It may be that although racism is high in remote areas²⁰ it has a lower adverse effect upon coronary artery disease and health given that a much greater proportion of the population is Aboriginal and there is more psychosocial support. Small case numbers may also be a factor in the result reported here.

These findings indicate that non-metropolitan residents are not uniformly disadvantaged with respect to MI incidence relative to metropolitan residents and support the recent call for attention to both urban and rural Aboriginal health to address the Aboriginal health gap.²¹ The similar incidence rates by residential regions coupled with substantial Aboriginal to non-Aboriginal disparities show the necessity for both urban and rural Aboriginal communities to be resourced for effective primary prevention to reduce MI incidence and secondary prevention to improve outcomes. Improving access to prompt and effective treatment in non-metropolitan areas and Aboriginal people state-wide remains a challenge, with an added imperative of providing culturally safe service for Aboriginal people.^{22, 23}

Incidence, as defined in this study, is critically dependent on both IHD deaths as well as non-fatal hospital admissions for MI. Our results could thus be affected by variations across the State in reporting and coding of either component. The study focuses on geographical comparisons and relies on

accurate recording of address, which may be unreliable for Aboriginal people who move frequently,²⁴ or who supply a current or convenient rather than permanent address on admission. ARIA+ codes were scored at the SLA level, a geographical aggregation that does not allow differentiation of accessibility within relatively large geographical areas resulting in substantial heterogeneity within regional and very remote strata. Additionally, small case numbers in some strata gave rise to large confidence intervals, so that true differences may not reach statistical significance. Inferences on MI case-fatality suggests higher case fatality across all strata in Aboriginal males and non-metropolitan Aboriginal females (data not shown), but findings must be treated with caution given the paucity of events.

Our data were strengthened by the use of the WA Data Linkage System allowing the identification of first-ever cases and follow-up to ascertain 28-day survival status. Data linkage also minimised Aboriginal under-identification due to the use of multiple health system records to identify Aboriginal cases. This is very important when undertaking regional comparisons as under-identification is more common in the metropolitan areas and could result in metropolitan rates in Aboriginal people appearing lower unless some attempt is made to account for such under-estimation.^{10, 11} A synergistic effect of remoteness and social disadvantage on all-cause premature mortality has been shown for Aboriginal people in South Australia.²⁵ Our study was limited by the relatively small number of incident MI events and thus we could not further stratify to investigate the joint effect of remoteness and social disadvantage on MI incidence in Aboriginal and non-Aboriginal people.

Other studies in Australia and using different study designs have investigated urban-rural differences in the incidence of coronary/ischaemic heart disease.^{8,}

²⁶ We conclude that higher Aboriginal rates are responsible for at least some of the elevated rural population IHD rates. Among non-Aboriginal people, younger males living in very remote but not regional areas have a significantly higher IHD risk than those in metropolitan regions, highlighting regional differences in risk factor profiles. Evidence is mounting that Aboriginal IHD incidence rates do not vary consistently by remoteness indicating that the interplay of environmental, psychosocial and clinical risk factors impacting on heart disease is complex. Therefore socio-economic, cultural, environmental and health system barriers to the uptake of health messages in Aboriginal people in all regions and targeting young non-Aboriginal men living in very remote areas is required to reduce the substantial burden of heart disease in WA.

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Table 1: Age-standardised incidence of myocardial infarction, by Aboriginal status, broad age group, remoteness and sex: WA 2000-04

Figure 1:

Age-standardised rate ratios for population-based myocardial infarction incidence in Western Australian residential regions 2000-04 by broad age group and sex: metropolitan rate used as reference

Figure 2:

Age-standardised rate ratios for myocardial infarction incidence in Western Australian residential regions 2000-04, by broad age group and sex, stratified by Aboriginality: metropolitan rate used as reference

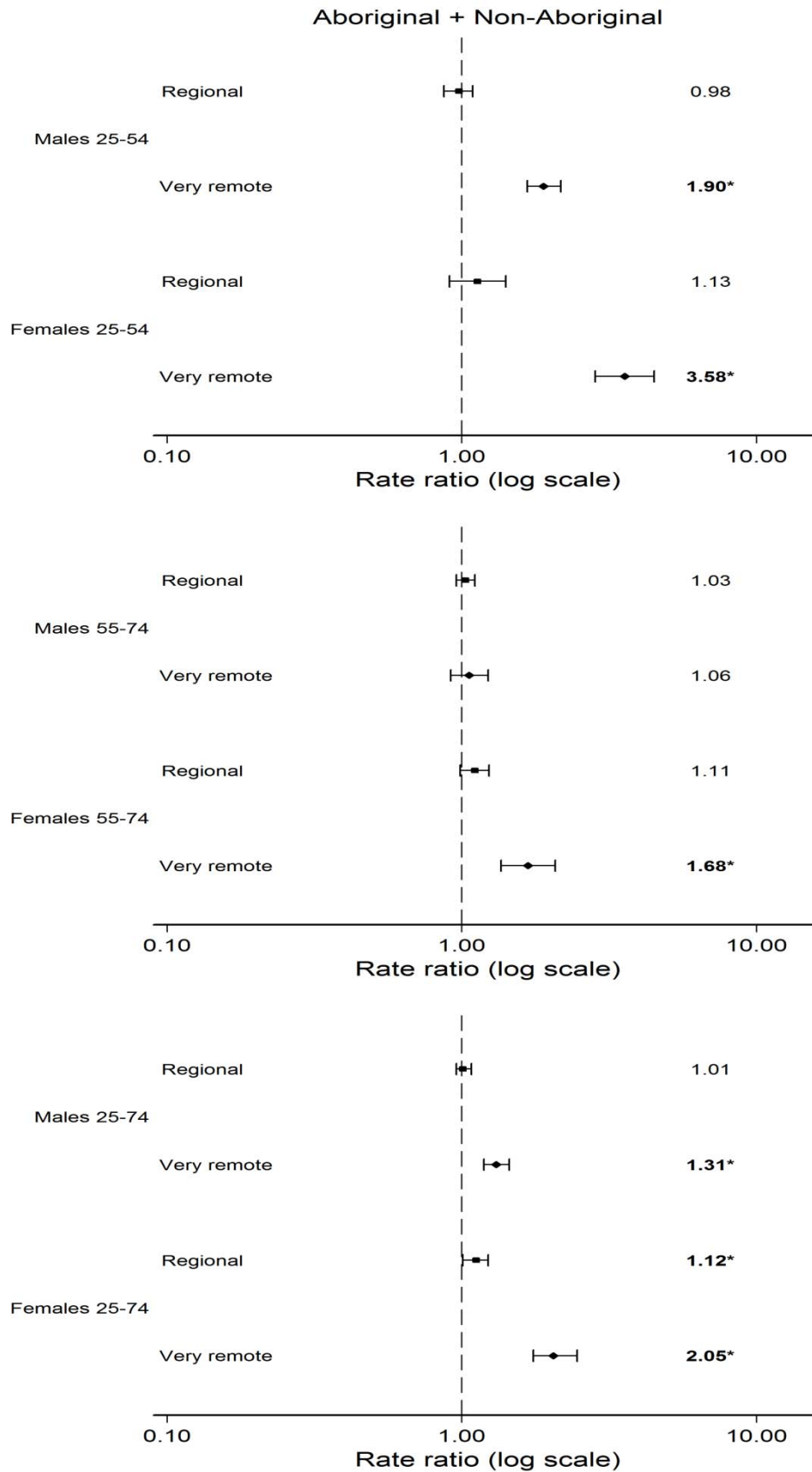
Table 1: Age-standardised incidence of myocardial infarction, by Aboriginal status, broad age group, remoteness and sex: WA 2000-04

MALES									
25-54				55-74			25-74		
Combined Aboriginal and non-Aboriginal population									
	<u>n</u>	<u>Inc ASR</u>	<u>(95% CI)</u>	<u>n</u>	<u>Inc ASR</u>	<u>(95% CI)</u>	<u>n</u>	<u>Inc ASR</u>	<u>(95% CI)</u>
Metro	1714	104	(99 - 109)	3827	672	(650 - 693)	5541	258	(251 - 264)
Regional	397	102	(92 - 112)	975	692	(648 - 735)	1372	261	(247 - 275)
Very Remote	266	198	(174 - 222)	208	715	(614 - 816)	474	338	(305 - 370)
Non-Aboriginal population									
	<u>n</u>	<u>Inc ASR</u>	<u>(95% CI)</u>	<u>n</u>	<u>Inc ASR</u>	<u>(95% CI)</u>	<u>n</u>	<u>Inc ASR</u>	<u>(95% CI)</u>
Metro	1619	99	(94 - 104)	3790	668	(646 - 689)	5409	253	(246 - 260)
Regional	317	83	(74 - 92)	936	672	(629 - 716)	1253	242	(229 - 256)
Very Remote	133	120	(100 - 141)	132	551	(453 - 650)	265	237	(206 - 267)
Aboriginal population									
	<u>n</u>	<u>Inc ASR</u>	<u>(95% CI)</u>	<u>n</u>	<u>Inc ASR</u>	<u>(95% CI)</u>	<u>n</u>	<u>Inc ASR</u>	<u>(95% CI)</u>
Metro	95	588	(467 - 710)	37	1624	(1069 - 2179)	132	868	(694 - 1043)
Regional	80	734	(570 - 898)	39	2315	(1572 - 3058)	119	1161	(928 - 1395)
Very Remote	133	602	(497 - 707)	76	1643	(1266 - 2020)	209	883	(756 - 1011)
FEMALES									
25-54				55-74			25-74		
Combined Aboriginal and non-Aboriginal population									
	<u>n</u>	<u>Inc ASR</u>	<u>(95% CI)</u>	<u>n</u>	<u>Inc ASR</u>	<u>(95% CI)</u>	<u>n</u>	<u>Inc ASR</u>	<u>(95% CI)</u>
Metro	403	24	(22 - 26)	1572	268	(255 - 281)	1975	90	(86 - 94)
Regional	99	27	(22 - 33)	383	298	(268 - 328)	482	100	(91 - 109)
Very Remote	91	86	(68 - 104)	95	451	(358 - 544)	186	185	(156 - 213)
Non-Aboriginal population									
	<u>n</u>	<u>Inc ASR</u>	<u>(95% CI)</u>	<u>n</u>	<u>Inc ASR</u>	<u>(95% CI)</u>	<u>n</u>	<u>Inc ASR</u>	<u>(95% CI)</u>
Metro	355	21	(19 - 24)	1522	261	(248 - 274)	1877	86	(82 - 90)
Regional	73	21	(16 - 25)	349	276	(247 - 305)	422	90	(81 - 98)
Very Remote	20	25	(14 - 36)	45	283	(198 - 369)	65	95	(70 - 119)
Aboriginal population									
	<u>n</u>	<u>Inc ASR</u>	<u>(95% CI)</u>	<u>n</u>	<u>Inc ASR</u>	<u>(95% CI)</u>	<u>n</u>	<u>Inc ASR</u>	<u>(95% CI)</u>
Metro	48	265	(189 - 341)	50	1662	(1184 - 2140)	98	643	(502 - 783)
Regional	26	241	(147 - 334)	34	1649	(1087 - 2210)	60	621	(455 - 788)
Very Remote	71	325	(248 - 403)	50	999	(717 - 1280)	121	507	(413 - 602)

Inc ASR= Age-standardised incidence rate per 100,000

95% CI=95% confidence interval

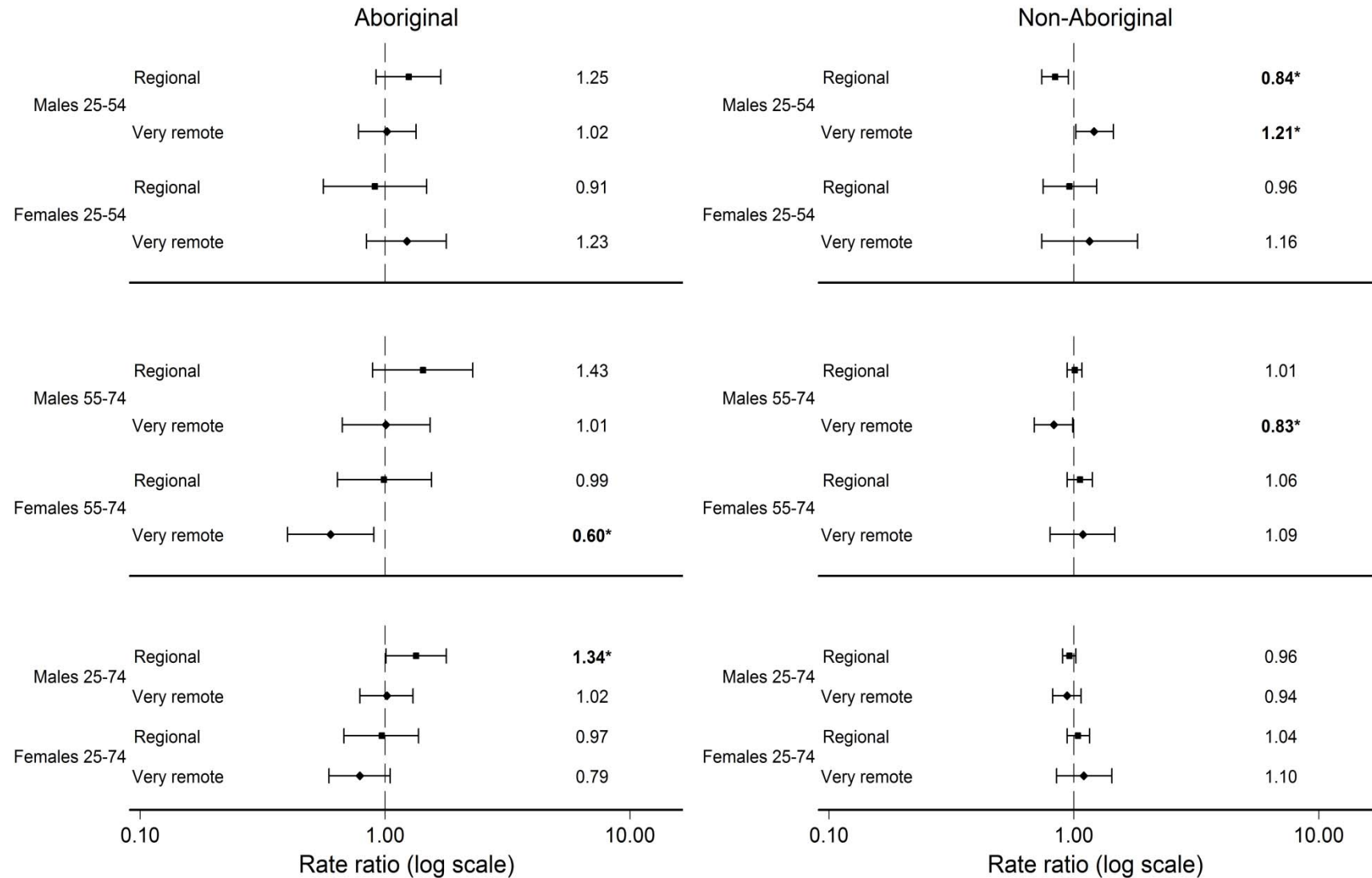
Figure 1: Age-standardised rate ratios for population-based myocardial infarction incidence in Western Australian residential regions 2000-04 by broad age group and sex: metropolitan rate used as reference



Error bars indicate 95% confidence interval

* Statistically different from metropolitan rate= error bars not including 1.00

Figure 2: Age-standardised rate ratios for myocardial infarction incidence in Western Australian residential regions 2000-04 by broad age group and sex, stratified by Aboriginality: metropolitan rate used as reference



Error bars indicate 95% confidence interval

* Statistically different from metropolitan rate= error bars not including 1.00

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