

Review of cardiovascular health among Indigenous Australians

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Preface

This review of the cardiovascular health of Indigenous people has been prepared by the Australian Indigenous HealthInfoNet as a part of our efforts to contribute to 'closing the gap' in health between Indigenous people and other Australians by making relevant, high quality knowledge and information easily accessible to policy makers, health service providers, program managers, clinicians, researchers and the general community¹. The review is an example of the HealthInfoNet's translational research [1], defined as 'comprehensive applied research that strives to translate the available knowledge and render it operational' [2, p1794].

The main purpose of the review, which follows the model of narrative reviews/syntheses [3], is to provide a comprehensive, authoritative, up-to-date review of the cardiovascular health of Indigenous people that (1) is a valuable up-to-date overview for people working in the area; and (2) assists in the development/refinement of policies, strategies and programs.

Research for the review involves the collection, collation, and analysis of a wide range of relevant information, including both published and unpublished material. Sources include government reports, particularly those produced by the Australian Bureau of Statistics (ABS), the Australian Institute of Health and Welfare

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1 The term Indigenous is used in this overview to refer generally to the two Indigenous populations of Australia – Australian Aboriginal people and Torres Strait Islanders.

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(AIHW) and the Steering Committee for the Review of Government Service Provision (SCRGSP). As well as the regular ABS and AIHW publications, this review draws on the reports in the *Aboriginal and Torres Strait Islander health performance framework* series. These reports, prepared by the AIHW for the Australian Department of Health and Ageing in 2006, 2008 and 2011, are accompanied by substantial detailed analyses. The review also draws on information from the main administrative data collections (such as the death registration system and the hospital inpatient collections) and national surveys².

After providing the context of Indigenous cardiovascular, the body of review outlines the extent of cardiovascular disease among Indigenous people (including attention to the major conditions), provides an overview of the various contributing factors, considers management, prevention and rehabilitation, summarises a number of relevant policies and strategies, and provides some brief concluding comments. Rather than commence with an executive summary, the review is preceded by a section devoted to 'Key facts', which presents the summarised information in a more concise form.

Further information about the cardiovascular health of Indigenous people is accessible from the relevant section of HealthInfoNet's website (www.healthinfonet.ecu.edu.au), which provides access to: the complete Indigenous-specific literature; details of policies and strategies, programs and projects, and organisations involved in the area; and databases of health promotion and health practice resources. The section also contains a plain language version of this review.

We welcome your comments and feedback about the review.

Neil Thomson, Director, on behalf of the HealthInfoNet team

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2 Information from these sources has been published mainly in government reports, particularly those produced by the ABS and the AIHW.

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Key facts

Indigenous population

- At 30 June 2011, the estimated Australian Indigenous population was 669,736.
- NSW had the highest number of Indigenous people (208,364, 31% of the total Indigenous population); the NT had the highest proportion of Indigenous people in its population (30% of the NT population are Indigenous).
- In 2011, the majority of Indigenous people lived in cities and towns; around one quarter of Indigenous people lived in remote or very remote areas.
- The Indigenous population is much younger than the non-Indigenous population.

All cardiovascular disease

- According to the 2004-2005 NATSIHS, long-term heart and related conditions were 1.2 times more common for Indigenous males and 1.4 times more common for Indigenous females than for their non-Indigenous counterparts; cardiovascular disease (CVD) was more common for Indigenous people than for non-Indigenous people across all age groups with an earlier age of onset among Indigenous people.
- In 2008-09, rates of hospitalisation for CVD for Indigenous people living in NSW, Vic, Qld, WA, SA and the NT were almost twice those of their non-Indigenous counterparts; hospitalisation rates were higher for Indigenous people than for non-Indigenous people across all age groups, with the disparity largest in the young and middle adult years.
- CVD is the leading cause of death for Indigenous people; for Indigenous people living in NSW, Vic, Qld, WA, SA and the NT in 2004-2008, death rates for CVD were almost twice those of their non-Indigenous counterparts; CVD death rates were higher for Indigenous than for non-Indigenous people across all age groups, with greatest disparity among people aged 35 to 54 years.

Coronary heart disease

- According to the 2004-2005 NATSIHS, coronary heart disease (CHD) was 1.7 times more common for Indigenous males and 2.7 times more common for Indigenous females than for their non-Indigenous counterparts.
- Hospitalisation rates for CHD were 2.1 times higher for Indigenous people living in NSW, Vic, Qld, WA, SA and the NT in 2006-2008 than for their non-Indigenous counterparts; rates for

acute myocardial infarction (AMI – heart attack) were 2.5 times higher.

- The death rate from CHD for Indigenous people living in NSW, Vic, Qld, WA, SA and the NT in 2004-2008 was 1.8 times that for their non-Indigenous counterparts; the rate was 1.7 times higher for AMI; the greatest disparity on death rates for CHD is among people aged 35-54 years.

Cerebrovascular disease

- According to the 2004-2005 NATSIHS, cerebrovascular disease (CBVD), including stroke, was 1.5 times more common for Indigenous males and 1.9 times more common for Indigenous females than for their non-Indigenous counterparts.
- Hospitalisation rates for CBVD were 1.8 times higher for Indigenous people living in NSW, Vic, Qld, WA, SA and the NT in 2006-2008 than for their non-Indigenous counterparts; rates for stroke were 1.9 times higher.
- The death rates from CBVD for Indigenous people aged 74 or younger living in NSW, Vic, Qld, WA, SA and the NT in 2004-2008 were 1.6 times those for their non-Indigenous counterparts.

Hypertension

- According to the 2004-2005 NATSIHS, hypertension (high blood pressure) was 1.5 times more common for Indigenous males and 1.7 times more common for Indigenous females than for their non-Indigenous counterparts; hypertension was more common for Indigenous people than for non-Indigenous people across all age groups with an earlier age of onset among Indigenous people.
- Hospitalisation rates for hypertension among Indigenous people Australia-wide were 2.5 times the rates of hospitalisations among non-Indigenous people in 2006-2008.
- Deaths from hypertension are not common, but hypertension is a major risk factor for fatal CVDs, such as CHD and CBVD.

Rheumatic heart disease

- Rheumatic heart disease (RHD), including acute rheumatic fever (ARF), is almost exclusively experienced by Indigenous people in Australia; Indigenous children and young adults are most affected by ARF and RHD.
- There were 213 notifications of new and recurrent cases of ARF in the Top End of the NT and central Australia in 2006-2009; more than a quarter of notifications were recurrences; rates for ARF were highest for Indigenous females aged 5-14 years.
- Almost 93% of the 1,479 people registered with RHD in the Top

End of the NT and central Australia in 2009 were Indigenous; more than two-thirds of the Indigenous people registered with RHD were females, but the disparity between Indigenous and non-Indigenous people was greater for males than for females.

- The hospitalisation rate for RHD (including ARF) for Indigenous people living in NSW, Qld, WA, SA and the NT in 2006-2008 was 6.9 times higher for Indigenous people than for their non-Indigenous counterparts.
- Death rates from RHD were almost six times higher for Indigenous people living in NSW, Qld, WA, SA and the NT in 2004-2008 than for their non-Indigenous counterparts.

Congenital heart disease

- For cases of congenital heart disease reported in Australia in 2002-2003, transposition of the great vessels, Tetralogy of Fallot, and coarctation of the aorta were more common among Indigenous people than among non-Indigenous people, and hypoplastic left heart syndrome was less common.

Factors contributing to cardiovascular disease

Based on the findings of national surveys:

- In 2008, 47% of Indigenous people aged 15 years and over were current smokers.
- In 2008, only one-third of Indigenous people aged 15 years and older participated in some form of physical activity in the previous 12 months; for people with CVD in Australia in 2004-2005, Indigenous people were 1.6 times more likely than non-Indigenous people to be physically inactive.
- For people with CVD in Australia in 2004-2005, Indigenous people were 1.3 times more likely than non-Indigenous people to have poor levels of consumption of fruit and vegetables.
- In 2008, almost two-thirds of Indigenous people aged 15 years and older consumed alcohol in the previous 12 months; for people with CVD in Australia in 2004-2005, Indigenous people were 1.6 times more likely than non-Indigenous people to have consumed alcohol at a high risk level.
- In 2004-2005, three-fifths of Indigenous people were overweight, and almost one-third were obese; for people with CVD in Australia in 2004-2005, levels of overweight and obesity were higher for Indigenous people than for non-Indigenous people.
- A range of social and emotional wellbeing issues, including psychosocial stressors (such as death of a family member or close friend, serious injury or disability) and depression, are more common among Indigenous people than among non-Indigenous people.

Comorbidity

- The levels of other health problems and multiple behavioural

and biomedical risk factors are higher among Indigenous people than among non-Indigenous people; the comorbidity score of Indigenous people in the NT who had their first AMI in the period 1992 to 2004 was 59% higher than that of their non-Indigenous counterparts, due predominantly to the much higher prevalence of diabetes, diabetes complications, and renal disease.

Management

- Indigenous people do not receive the same level of primary prevention and management, emergency and acute care, rehabilitation, ongoing management, and secondary prevention care for CVD as do non-Indigenous people.
- Of people hospitalised with a principal diagnosis of CVD in 2006-2008, just over one-half of Indigenous people had a procedure undertaken, compared with almost three-quarters of their non-Indigenous counterparts; for acute coronary syndrome, the rates of coronary angiography and revascularisation for Indigenous people were only one-half of the rates for their non-Indigenous counterparts.
- Indigenous patients with CBVD were less likely than non-Indigenous patients to be treated in a stroke unit, assessed within 48 hours by a speech pathologist, occupational therapist or physiotherapist, receive aspirin within 48 hours for an ischaemic stroke, and be discharged on antithrombotic medication for an ischaemic stroke; Indigenous patients were more likely than non-Indigenous patients to have had their mood assessed during admission.
- Many Indigenous people with a past history of ARF or RHD do not receive the recommended levels of penicillin prophylaxis – only 18% of eligible people in far north Queensland and the Kimberley region of WA received 80% or more of their recommended doses in the preceding 12 months; the low levels of prophylaxis are reflected in the proportion of ARF notifications classified as recurrences – 27% of cases for the Top End of the NT and 30% for central Australia in 2002-2006.
- People with established RHD require secondary prevention (see penicillin prophylaxis above), monitoring of anticoagulant therapy (for people with AF and/or mechanical prosthetic valves); access to oral healthcare; access to echocardiography; access to appropriate specialist(s); and access to cardiothoracic and interventional cardiology services; in far north Queensland and the Kimberley region of WA, only 20% of RHD patients had been prescribed an anticoagulant, 55% had been reviewed by a specialist in line with local management guidelines, 61% had had a timely echocardiogram, and 22% had undergone valve surgery; the short-term results of valve repair and related procedures for NT patients with RHD were similar, but long-term outcomes were worse for Indigenous patients than for their non-Indigenous counterparts.

Introduction

Cardiovascular disease (CVD) is a major health problem for all Australians, but the levels and impacts are much greater for Indigenous people than they are for other Australians. CVD is the leading cause of premature death, and death overall, for Indigenous people, as it is for all Australians [1-5].

Box 1: Cardiovascular health

Cardiovascular health involves the heart and circulatory system. The term CVD refers to all diseases and conditions of this system including coronary (ischaemic) heart disease (CHD), heart failure, rheumatic heart disease (RHD), cerebrovascular disease (including stroke) (CBVD), peripheral vascular disease, as well as key risk factors such as hypertension (high blood pressure), and high blood cholesterol [6]. CVD is usually caused by damage to the blood supply of the heart, brain, and/or legs, with the exception of RHD, which involves damage to the heart valves as a consequence of (usually) repeated episodes of acute rheumatic fever (ARF). CVD is a term used to encompass all of the major diseases of the heart and circulatory system. Risk factors for CVD include biomedical and behavioural risk factors [7, 8]. Apart from RHD (including ARF), which is specifically associated with poor living conditions, many of the CVDs share common modifiable risk factors. These include: tobacco smoking; physical inactivity; poor nutrition; conditions of being overweight and obese; high blood pressure; high blood cholesterol and diabetes, among others. Many of these risk factors are largely preventable and, if addressed, could reduce the extent and burden of CVD among Indigenous people. Other risk factors include socioeconomic and psychosocial factors. Risk factors and the associated burden are covered in more detail later in this review.

Indigenous people are more likely to die from CVD than are non-Indigenous people, with the death rate ratios being particularly high for young and middle-aged adults [5, 9]. The leading cardiovascular conditions contributing to the higher mortality for Indigenous people are coronary heart disease (CHD), cerebrovascular disease (CBVD) and hypertension. These conditions account for 76% of all cardiovascular related deaths [10]. Rheumatic heart disease (RHD), now a rare cause of death for non-Indigenous Australians, still causes a considerable number of deaths in the Indigenous population, primarily due to the persistence of acute rheumatic fever (ARF), especially in children.

Information on the trends of CVD in Australia indicate that Indigenous people have not experienced to the same substantial declines in death rates that have occurred among the non-

Indigenous population [5, 10]. The continuing decline in overall death rates suggests that significant gains should be possible for the Indigenous population.

The factors contributing to CVD among Indigenous people are complex, but the disease and its impact could be significantly reduced through the modification of behavioural and biochemical risk factors, many of which are influenced by contributing factors including the social disadvantage experienced disproportionately by Indigenous people [6]. Modifiable risk factors for CVD include smoking, alcohol, physical inactivity, nutrition, overweight and obesity, diabetes, high blood pressure and high blood cholesterol. Almost 70% of the burden of CVD among Indigenous people is directly associated with these risk factors [9]. The highest contributor is tobacco smoking followed by overweight and obesity, high blood cholesterol, physical inactivity, and high blood pressure. A similar proportion of the burden of CVD among other Australians is attributable to the same risk factors, but the largest contributors are high blood pressure and high blood cholesterol, followed by physical inactivity, overweight and obesity, tobacco and low fruit and vegetable consumption [11].

This review focuses on the burden of CVD for Indigenous people. It addresses overall prevalence, hospitalisation and mortality, and the factors contributing to this burden. The review provides information on a number of specific conditions including: CHD; CBVD; hypertension; RHD (including ARF); and congenital heart disease. The review also considers: factors contributing to CVD; management; prevention and rehabilitation, and policies and strategies.

The context of Indigenous cardiovascular health

Indigenous population

Based on information collected as a part of the 2011 Census of Population and Housing, the Australian Bureau of Statistics (ABS) has estimated the Aboriginal and Torres Strait Islander population at 669,736 at 30 June 2011 [12]. The estimated population for NSW is the highest (208,364 Indigenous people), followed by Qld (188,892), WA (88,277), and the NT (68,901) (Table 1). The NT has the highest proportion of Indigenous people among its population (29.8%) and Vic the lowest (0.9%).

Detailed information about the geographic distribution of the Indigenous population at 30 June 2011 is not yet available, but, based on figures from the 2006 Census of Population and Housing,

the majority of Indigenous people live in cities and towns [13]. The Indigenous population is much more widely dispersed across Australia than is the non-Indigenous population. Slightly more than one-half of the Indigenous population lives in areas classified as 'major cities' or 'inner regional' areas, compared with almost nine-tenths of the non-Indigenous population. (As well as these two classifications of 'remoteness' in terms of access to goods and services and opportunities for social interaction, the Australian Standard Geographical Classification (ASGC) has four other categories: 'outer regional', 'remote', 'very remote', and 'migratory' [14].) Almost one-quarter of Indigenous people live in areas classified as 'remote' or 'very remote' in relation to having 'very little access to goods, services and opportunities for social interaction'[15]. Less than 2% of non-Indigenous people live in 'remote' or 'very remote' areas.

According to the 2011 Census, around 90% of Indigenous people were Aboriginal, 6% were Torres Strait Islanders, and 4% people identified as being of both Aboriginal and Torres Strait Islander descent [16]. Around 63% of Torres Strait Islander people, including those who identified as being of both Aboriginal and Torres Strait Islander descent, lived in Qld; NSW was the only other state with large number of Torres Strait Islander people.

The Indigenous population is much younger overall than the non-Indigenous population [12]. According to estimates from the 2011 Australian Census, at June 2011 about 36% Indigenous people were aged less than 15 years, compared with 18% of non-Indigenous people (Figure 1). About 3% of Indigenous people were aged 65 years or over, compared with 14% of non-Indigenous people.

Table 1. Estimated Indigenous population, by jurisdiction, Australia, 30 June 2011

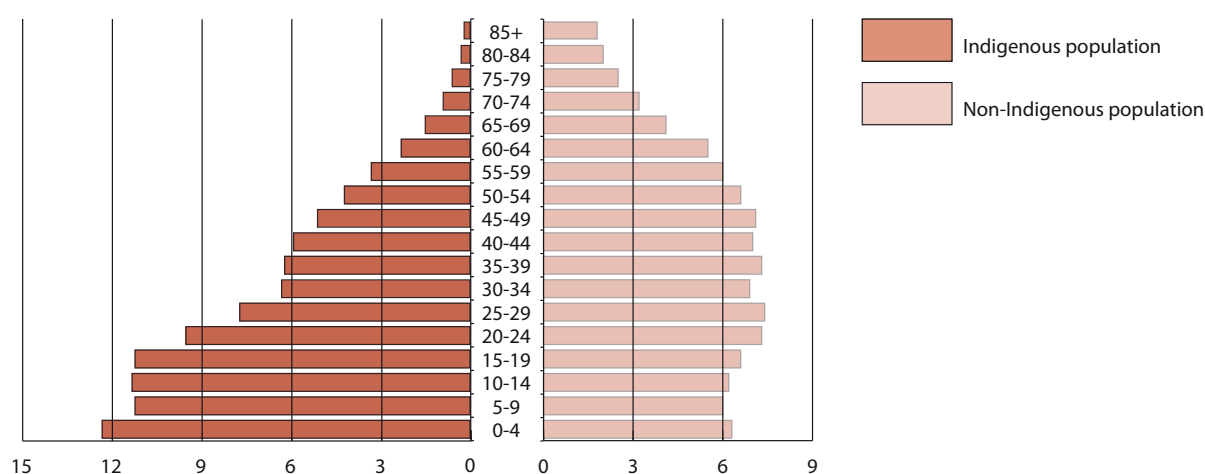
Jurisdiction	Indigenous population (number)	Proportion of Australian Indigenous population (%)	Proportion of jurisdiction population (%)
NSW	208,364	31.1	2.9
Vic	47,327	7.1	0.9
Qld	188,892	28.2	4.2
WA	88,277	13.2	3.8
SA	37,392	5.6	2.3
Tas	24,155	3.6	4.7
ACT	6,167	0.9	1.7
NT	68,901	10.3	29.8
Australia	669,736	100.0	3.0

Source: ABS, 2012 [12]

Notes:

- 1 The preliminary estimates are subject to revision; population projections are expected to be finalised by 2014
- 2 Australian population includes Jervis Bay Territory, the Cocos (Keeling) Islands, and Christmas Island
- 3 Proportions of jurisdiction populations have used total population figures estimated from demographic information for June 2011

Figure 1. Population pyramid of Indigenous and non-Indigenous populations, 30 June 2011



Source: ABS, 2012 [12]

Historical, social and cultural context

The arrival of European settlers commencing in the late 18th Century and their progressive spread across Australia had significant impacts on the lifestyles of Indigenous people [19, 20]. The activity involved with finding renewable food and resources, maintaining familial and cultural practices and sustaining the spiritual connection to country changed over time for Indigenous people [19, 21, 22]. As key modifiable risk factors for cardiovascular disease and other chronic conditions, the changes in the physical activity and nutrition of Indigenous people played an important role in the development of CVD and diabetes, particularly in the second half of the 20th Century [22]³. Psychosocial issues and factors impacting on social and emotional wellbeing are also likely to be significant risk factors for CVD among Indigenous people, and contribute to the higher prevalence [23].

The health disadvantages experienced by Indigenous people can be considered historical in origin [24], but perpetuation of the disadvantages owes much to contemporary structural and social factors, embodied in what are termed the 'social determinants' of health [25-27]. In broad terms, economic opportunity, physical infrastructure and social conditions influence the health of individuals, communities, and societies as a whole. These factors are specifically manifest in measures such as education, employment, income, housing, access to services, social networks, connection with land, racism, and incarceration. On all these measures, Indigenous people suffer substantial disadvantage.

It is also important in coming to an understanding of Indigenous health to understand how Indigenous people themselves conceptualise health. There was no separate term in Indigenous languages for health as it is understood in western society [28]. The traditional Indigenous perspective of health is holistic. It encompasses everything important in a person's life, including land, environment, physical body, community relationships and law, and is not seen as an isolated 'clinical' matter [19, 29]. This conceptualisation of health has much in common with the social determinants model.

Extent of cardiovascular disease

The most recent source of comprehensive information about the burden of CVD among Indigenous people is the *National Aboriginal and Torres Strait Islander Health Survey: Australia, 2004-05* (NATSIHS) [2]. Of all Indigenous people surveyed in the NATSIHS, 12% reported a long-term heart or related condition; the proportion

was slightly higher for those living in remote areas (14%) than in non-remote areas (11%).

Box 2: Information about the cardiovascular health of Indigenous people

Comparing the cardiovascular health status of Indigenous and non-Indigenous people should be viewed with a degree of caution as data are derived from an array of different data sources. The same caution can be applied when comparing the most recent measures of Indigenous cardiovascular health with those from previous data sources. This is for a number of reasons, including issues relating to the identification of Indigenous people in the various health-related collections.

Not all Indigenous people are correctly identified as such, with some identified as non-Indigenous. Estimating the proportions of Indigenous people identified correctly is complex, so it is difficult to estimate, for example, the actual number of separations or deaths of Indigenous people, and the corresponding rates [4, 8, 30-33]. Improved data collection methods have contributed to the more complete identification of Indigenous people in some collections over time [31, 32]. This may lead to increased accuracy and can produce an amplification of national data which may be misleading [1]. Differential Indigenous identification across jurisdictions can also impact on the accuracy of comparisons, particularly in quasi national data.

Surveys, such as the national ones conducted by the Australian Bureau of Statistics, rely mainly on self-reported information about the cardiovascular health of Indigenous peoples. This can lead to some uncertainty for a number of reasons. First, self-reported information may not provide a true representation of the actual extent of CVD among Indigenous people as a consequence of cultural concepts and limited health literacy [34]. In addition, survey questions can be worded differently over time, which may lead to different interpretations of the question and can impact on final data outcomes.

As noted under the section above on population, the Indigenous population is younger than the non-Indigenous populations. As a result, measures that don't take account of this difference (known as 'crude' measures) do not enable accurate comparisons between Indigenous people and non-Indigenous people. A procedure known as standardisation adjusts health measures (such as death rates) to minimise the effects of the differences in the age structures of the Indigenous and non-Indigenous populations [31, 32]. Measures in this review that have been standardised are indicated as having been age adjusted.

3 Chronic health conditions, such as diabetes and CVDs, were not features of Indigenous health until well into the 20th century. CVD, in particular, only really emerged as a major health problem for Indigenous people from around the 1970s. It is not possible, however, to explore here the complex reasons for the quite recent emergence of CVD as the leading cause of Indigenous deaths.

Prevalence

A detailed analysis of information collected by the 2004-2005 NATSIHS reveals that long-term heart and related conditions were 1.2 times more common for Indigenous males and 1.4 times more common for Indigenous females than for their non-Indigenous counterparts (Table 2) [7]. Cardiovascular conditions were more common overall for Indigenous males and females than for non-Indigenous males and females, with hypertension being the most common cardiovascular condition among Indigenous people.

Table 2. Prevalence and ratios of self-reported cardiovascular conditions among Indigenous people, by sex and condition, Australia, 2004-2005

Condition	Males		Females	
	Prevalence (%)	Ratio	Prevalence (%)	Ratio
Coronary heart disease	1.2	1.7	1.2	2.7
Cerebrovascular disease	0.3	1.5	0.3	1.9
Heart failure	0.6	1.9	1.3	1.6
Hypertension	6.4	1.5	7.7	1.7
Rheumatic heart disease	0.4	n/a	1.1	n/a
Other conditions	0.5	n/a	2.4	n/a
All CVD	9.5	1.2	14	1.4

Source: Australian Institute of Health and Welfare, Penm E, 2008 [7]

Notes:

- 1 Prevalence is expressed as a percentage
- 2 Ratios are standardised prevalence ratios, the ratio of observed Indigenous numbers expected from the age-sex-cause specific prevalence for the non-Indigenous population
- 3 In view of the relatively small numbers involved, the estimates for CBVD, heart failure and RHD should be interpreted with caution

The most common cardiovascular conditions reported by Indigenous people were hypertension (7.1%), CHD (1.2%), heart failure (1.0%). Cardiovascular conditions were noted more commonly for Indigenous people than for non-Indigenous people across all age groups with an earlier age of onset of CVD among Indigenous people (Table 3) [2]. The prevalence of cardiovascular conditions among Indigenous people aged 35-44 years was almost twice that among their non-Indigenous counterparts (21% compared with 12%).

Importantly, self-reported levels of CVD were higher among Indigenous males and females than among their non-Indigenous counterparts across all adult age groups. The greatest disparities were in the 45-54 years age group for Indigenous females (29% compared with 20% for non-Indigenous females), 55-64 years age groups for Indigenous males (61% compared with 39% for non-Indigenous males), and, for both sexes, 55-64 years age group (50% compared with 37%) [7].

RHD (0.7%) and CBVD (0.3%) [7]. After age adjustment, the greatest disparity in prevalence was for CHD: the level among Indigenous people was 2.1 times that of non-Indigenous people. This was followed by the disparities for CBVD and heart failure (each 1.7 times higher), and hypertension (1.6 times higher) [7].

Hospitalisation

The relatively high levels of CVD among the Indigenous population are partly reflected in hospitalisation rates, which were 1.9 times higher for Indigenous people living in NSW, Vic, Qld, WA, SA and the NT⁴ in 2008-09, than for their non-Indigenous counterparts (40 separations per 1,000 compared with 21 per 1,000) [35]⁵.

The more detailed data available for the two-year period July 2006 to June 2008 were similar overall, with the number of episodes of hospitalisation for CVD for Indigenous males 1.4 times the number expected from the age-cause-specific rates for non-Indigenous males (Table 4) [10]. The number for Indigenous females was 1.8

Table 3. Self-reported prevalence of cardiovascular conditions, by Indigenous status and selected age groups, Australia, 2004-2005

Condition	Age groups					
	35-44 years		45-54 years		55 years and over	
	Indigenous	Non-Indigenous	Indigenous	Non-Indigenous	Indigenous	Non-Indigenous
	Prevalence (%)		Prevalence (%)		Prevalence (%)	
Hypertension	12	4	22	14	42	33
Other cardiovascular diseases	12	8	16	11	28	26
All CVD	21	12	31	22	54	48

Source: Australian Bureau of Statistics, 2008 [2]

Note:

- 1 Sum of components may be more than total as persons may have reported more than one type of condition

4 Public hospitals only for the NT.

5 Detailed information about hospitalisation rates is not provided in the 2009-10 and 2010-11 hospital statistics report.

times the number expected from the age-cause-specific rates for non-Indigenous females. Overall, cardiovascular conditions made up 3% of all hospitalisations of Indigenous people during this time period, and 1.8% of all hospitalisations for CVD in Australia [10]; of Indigenous hospitalisations, 52% were of males and 48% of females. Of all hospitalisations of Indigenous people for cardiovascular conditions, 43% were for CHD, at a rate of between two and three times that of non-Indigenous people; approximately 17% of these hospitalisations were for acute myocardial infarction (AMI). The disparity in hospitalisation rates was particularly high for RHD, the rate for Indigenous males was five times that for non-Indigenous males, and the rate for Indigenous females was eight times that for non-Indigenous females. Rates of hospitalisations for hypertension were also higher among the Indigenous population with the rate more than double that of other Australians.

For the two-year period July 2006 to June 2008, hospitalisation rates for CVD increased with age for both the Indigenous and non-Indigenous populations, with rates higher for Indigenous people than for non-Indigenous people across all age groups (Figure 2) [10]. The hospitalisation rates for Indigenous females were higher than those for their non-Indigenous counterparts across all age groups; the largest disparity occurred in the 35-44, 45-54, and 55-64 years age groups, with rates for Indigenous females approximately three times those of non-Indigenous females. Hospitalisation rates were higher for Indigenous males than for non-Indigenous males in all age groups, apart from the 65 and older years age group; the greatest disparity occurred in the 25-34, 35-44 and 45-54 years age groups, with rates between two and three times higher for Indigenous males than for non-Indigenous males.

Table 4. Numbers, rates and ratios of hospitalisation of Indigenous people for cardiovascular conditions, by sex and disease category, NSW, Vic, Qld, WA, SA and the NT, 2006-2008

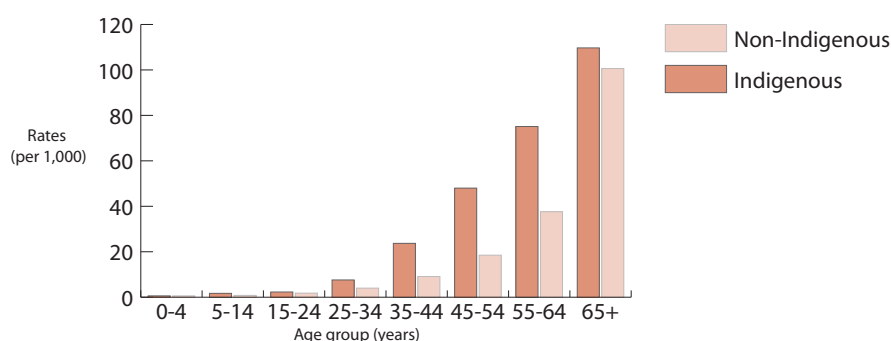
Condition	Males			Females		
	Number	Rate	Ratio	Number	Rate	Ratio
Coronary (ischaemic) heart disease	4,069	17	1.7	3,143	12	2.8
Acute myocardial infarction	1,742	7	2.2	1,129	5	3.1
Pulmonary & other forms of heart disease	2,516	12	1.5	2,469	10	1.9
Cerebrovascular disease	646	4	1.6	683	3	1.9
Stroke	557	3	1.7	603	3	2.1
Acute rheumatic fever & rheumatic heart disease	274	1	5.3	428	1	8.2
Hypertension	200	1	2.6	269	1	2.5
Other circulatory conditions	925	3	0.6	908	3	0.6
All CVD	8,630	37	1.4	7,900	31	1.8

Source: Australian Institute of Health and Welfare, 2011 [10]

Notes:

- Categories are based on the ICD-10-AM. Figures shown in *italics* (acute myocardial infarction and stroke) are sub-categories of the categories immediately above
- Rates are per 1,000
- Rates are directly age-standardised rates using the 2001 Australian standard population
- Ratios are the numbers of hospitalisations of Indigenous males and females divided by the number expected from the age-sex-cause specific rates for non-Indigenous people. All ratios are significant at the $p < 0.05$ level

Figure 2 Hospitalisation rates for CVD, by Indigenous status and age group, NSW, Vic, Qld, WA, SA and the NT, 2006-08



Source: Australian Institute of Health and Welfare, 2011 [10]

Hospitalisation rates for Indigenous people for CVD were virtually the same in 2007-08 as they were in 2001-02 (38 per 1,000 people and 37 per 1,000 people respectively) [10]. On the other hand, the rate for other Australians was slightly lower in 2007-08 (20 per 1,000) than in 2001-02 (22 per 1,000). As a consequence the Indigenous:non-Indigenous rate ratio increased from 1.7 to 1.9.

It has been recognised for some time, however, that Indigenous people admitted to hospital for CVD do not receive the same level of relevant procedures, such as coronary angiography and revascularisation procedures (percutaneous coronary intervention (PCI) and coronary artery by-pass grafts (CABG)) as do non-Indigenous people [36, 37]. The most recent comprehensive data – for the two-year period July 2006-June 2008 – reveal that the rates of coronary angiography and revascularisation for Indigenous people admitted to hospital with a principal diagnosis of CHD were only one-half of the rates for their non-Indigenous counterparts [10]. (For more details of procedures for CHD, see the relevant section in ‘Management of cardiovascular disease’)

Indigenous people admitted to hospital for CHD have a higher level of comorbidities than do non-Indigenous people (see ‘Comorbidity’ below), but Indigenous people with CHD were less likely than their non-Indigenous counterparts to have a coronary procedure across all levels of comorbidity [10].

Mortality

In 2010, CVD was the leading cause of death for Indigenous people, accounting for 668 deaths among Indigenous people (26% of all deaths among Indigenous people) [5]. CHD and CBVD were the two most common causes of death from CVD.

CHD was responsible for 349 deaths among Indigenous people in 2010, 13% of all deaths and 52% of cardiovascular deaths among Indigenous people (it was also the leading cause of death for non-Indigenous people) [5, 10]. The rate of deaths from CHD was almost

twice as high for Indigenous people than for non-Indigenous people (179 deaths per 100,000 compared with 89 per 100,000). Deaths from this condition were more common for Indigenous males than for Indigenous females, with a sex ratio of 2.1 [5]. The highest number of deaths of Indigenous people from CHD was among the 55-64 years age group (278 deaths); the rates of deaths were highest among the 75 years and older age groups (1,381), and the largest rate ratio was among the 25-34 years age group (12.6). For Indigenous males, the greatest number of deaths from CHD was among the 45-54 years age group (203), with rates highest among the 75 years and older age group (1,588); the largest rate ratio was for the 25-34 years age group (10.4). For Indigenous females, the greatest number of deaths was recorded for the 75 years and older age group (149), along with the highest rates (1,247); the largest rate ratio was for the 25-34 years age group (24.8).

CBVD was responsible for 119 deaths among Indigenous people in 2010 (5% of all Indigenous deaths, and 18% of the deaths among Indigenous people from CVD) [5]. Deaths from CBVD were more common among Indigenous people than non-Indigenous people (rate ratio: 1.8). Unlike the case for CHD, deaths from CBVD were more common for Indigenous females than for Indigenous males, with a sex ratio of 1.4.

The more detailed data available for the four-year period 2004 to 2008 show that the rates of deaths among Indigenous people from CVD were almost double the rates among non-Indigenous people (Table 5) [10].

Table 5. Numbers and rates of deaths of Indigenous people for cardiovascular conditions, by sex and disease category, and Indigenous:non-Indigenous rate ratios, NSW, Vic, Qld, WA, SA and the NT, 2004-2008

Condition	Males			Females		
	Number	Rate	Ratio	Number	Rate	Ratio
Coronary (ischaemic) heart disease	961	240	1.8	598	152	1.8
Acute myocardial infarction	438	112	1.7	273	21	1.6
Pulmonary & other forms of heart disease	260	93	1.8	277	79	1.4
Cerebrovascular disease	206	68	1.8	222	60	1.5
Stroke	263	63	1.9	232	56	1.8
Acute rheumatic fever & rheumatic heart disease	30	4	4.1	69	9	6.8
Hypertension	37	13	2.3	70	20	2.5
Other circulatory conditions	55	15	1.0	56	17	1.7
All CVD	1606	427	1.8	1302	332	1.7

Source: Australian Institute of Health and Welfare, 2011 [10]

Notes:

- 1 Categories are based on the ICD-10-AM. Figures shown in *italics* (acute myocardial infarction and stroke) are sub-categories of the categories immediately above
- 2 Rates are per 100,000
- 3 Rates are directly age-standardised rates using the 2001 Australian standard population
- 4 Ratios are the numbers of deaths of Indigenous males and females divided by the number expected from the age-sex-cause specific rates for non-Indigenous people

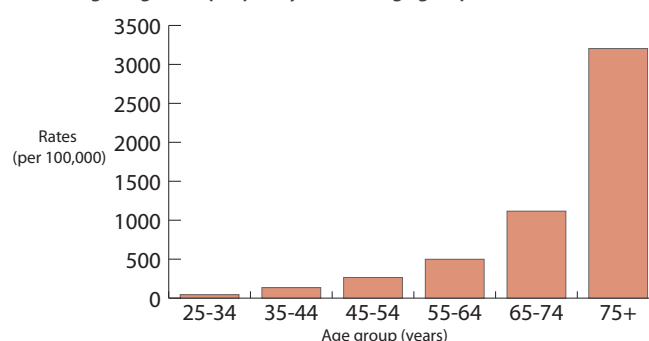
Over the period 2001-2008, death rates from CVD among Indigenous people declined by 13%⁶, and rates for non-Indigenous people by 19% [10]. Over this time period, there were no significant changes to the rate ratios between the two population groups.

Age-specific death rates

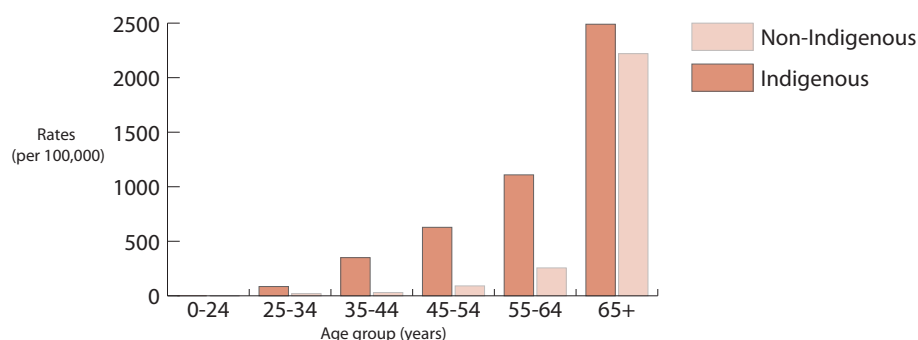
During the period 2004-2008, CVD accounted for the most deaths among Indigenous people for all age groups [10]. As is the case for non-Indigenous people, CVD death rates increase with age, particularly from the middle adult years (Figure 3).

⁶ Data are limited to the jurisdictions of WA, SA and the NT which have adequate records of identification.

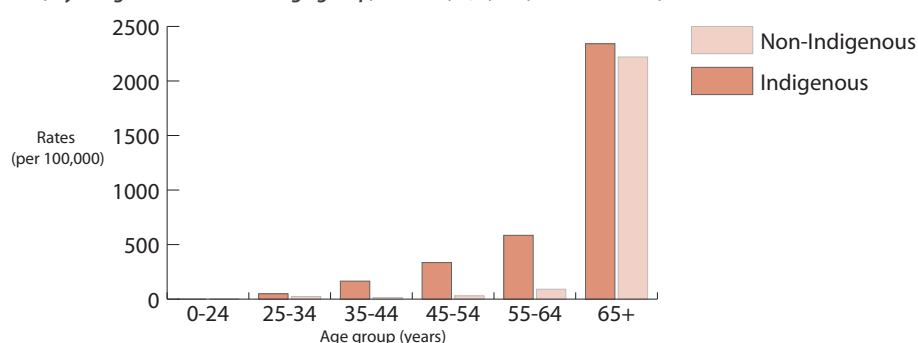
Figure 3 Age-specific death rates from CVD among Indigenous people, by selected age groups, NSW, Qld, WA, SA and the NT, 2004-2008



Source: Australian Institute of Health and Welfare, 2011 [10]

Figure 4 Death rates for CVD, by Indigenous status and age group, males, Qld, WA, SA and the NT, 2002-2005

Source: Australian Institute of Health and Welfare, Penm E, 2008 [7]

Figure 5 Death rates for CVD, by Indigenous status and age group, females, Qld, WA, SA and the NT, 2002-2005

Source: Australian Institute of Health and Welfare, Penm E, 2008 [7]

Note: Rates are per 100,000 population

Main causes of avoidable deaths

Avoidable and preventable deaths are those deaths from health conditions that could have been avoided if appropriate health care had been provided in a timely manner [10]. During 2004-2008, there were 6,443 deaths of Indigenous people that could have been avoided, 5.5% of the total avoidable deaths experienced by all Australians. Importantly, 72% of all deaths among Indigenous people could be classified as avoidable. For Indigenous people, there were 1,238 deaths due to CHD that could have been avoided, accounting for 19% of the total avoidable deaths

among Indigenous people, a level 4.0 times higher than among the non-Indigenous population (Table 6) [10]. CBVD accounted for 331 avoidable deaths among Indigenous people, 5.1% of all avoidable deaths among Indigenous people, a level 3.6 times that of non-Indigenous people. RHD⁷ was responsible for 96 avoidable deaths among Indigenous people, 1.5% of all avoidable deaths among Indigenous people, a level 16.7 times higher than among non-Indigenous people.

Table 6. Numbers and rates of avoidable deaths from selected CVDs, by Indigenous status, and Indigenous:non-Indigenous rate ratios, Qld, WA, SA and the NT, 2004-2008

Cause of death	Indigenous		non-Indigenous	Rate ratio
	Number	Rate	Rate	
Coronary heart disease	1,238	110	28	4
Cerebrovascular disease	331	32	9	4
Rheumatic heart disease (including other valvular)	96	6	0	17

Source: Australian Institute of Health and Welfare, 2011 [10]

Notes:

- 1 Categories are based on the ICD-10-AM
- 2 Rates are per 100,000
- 3 Rates are directly age-standardised rates using the 2001 Australian standard population
- 4 Rates have been rounded for presentation
- 5 Rate ratio is the Indigenous rate divided by the non-Indigenous rate

Coronary heart disease

CHD is the most common CVD among Indigenous people, with a level around twice that of non-Indigenous people [7]. The prevalence of CHD increases with age for both Indigenous and non-Indigenous people, but the disparity in levels is greatest in the younger age groups. Of all Indigenous people with CHD, approximately two-thirds had experienced angina, and one-third had had a previous AMI [38]. CHD is the highest specific cause of death among Indigenous people and contributes most to premature and avoidable deaths.

7 Includes other valvular heart disease.

Box 3: Coronary heart disease (CHD)

CHD refers to conditions of the blood vessels that supply blood to the heart [39, 40]. The main conditions include acute myocardial infarction (AMI) and angina. AMI occurs when the blood flow to the heart is stopped, usually when a coronary artery becomes completely blocked. When a blockage occurs, the heart muscle may become damaged or start to die off, thus reducing its ability to function. The longer the blockage is present, the more damaging it is to the heart muscle. Without early medical treatment, this damage can be permanent, and can result in death. Angina refers to a severe yet partial blockage which temporarily reduces blood flow to the heart. This condition causes temporary chest pain.

recent period for which detailed information is available, CHD was responsible for 1,559 deaths among Indigenous people (54% of all cardiovascular deaths among Indigenous people) (Table 9) [10]. AMI was responsible for 711 of these deaths (24% of all cardiovascular deaths among Indigenous people).

In the 2004-2005 NATSIHS, CHD was reported as a long-term condition by 2,800 Indigenous males and 3,000 Indigenous females [7]. After age-adjustment, the prevalences for Indigenous males and females were 1.7 times and 2.7 times higher respectively than those for their non-Indigenous counterparts (Table 7). The disparity between Indigenous people and non-Indigenous people was greatest for the 25-44 years age group with a prevalence ratio of 3.4.

Table 7. *Prevalence of CHD among Indigenous people, by sex and selected age groups, and Indigenous:non-Indigenous rate ratios, Australia, 2004-2005*

Sex	Age groups		
	25-44 years	45-64 years	65 years+
Males			
Per cent (%)	1.1	4.3	15.3
Ratio	2.9	1.6	1.4
Females			
Per cent (%)	0.6	6.4	7.2
Ratio	5.5	5.1	1.0
Persons			
Per cent (%)	0.9	5.4	10.8
Ratio	3.4	2.8	1.2

Source: Australian Institute of Health and Welfare, Penm E, 2008 [7]

Note:

- 1 Based on self-reported data from the NATSIHS, 2004-2005
- 2 Ratio is the Indigenous prevalence divided by the non-Indigenous prevalence

There were over 7,000 admissions to hospital for CHD of Indigenous people living in NSW, Vic, Qld, WA, SA and the NT in the two-year period June 2006 to June 2008 (Table 4, Table 8) [10]. Of these admissions, almost 2,900 were for AMI. Hospitalisation rates for Indigenous people for CHD were 2.1 times higher than those non-Indigenous people; for AMI, rates were 2.5 times higher.

In 2010, there were 349 deaths attributable to CHD among Indigenous people (13% of all deaths) [5]. Standardised death rates among Indigenous people were more than twice those among non-Indigenous people. For the period 2004-2008, the most

Table 8. Hospitalisations of Indigenous people for CHD, by sex, NSW, Vic, Qld, WA, SA and the NT, June 2006-June 2008

Condition	Males				Females				Persons			
	Number	%	Rate	Ratio	Number	%	Rate	Ratio	Number	%	Rate	Ratio
Acute myocardial infarction	1,742	20	7	2.2	1,129	14	5	3.1	2,871	17	6	2.5
All coronary heart disease	4,069	47	17	1.7	3,143	40	12	2.8	7,212	44	15	2.1

Source: Australian Institute of Health and Welfare, 2011 [10]

Notes:

- 1 Rates are per 1,000
- 2 Rates are directly age-standardised using the 2001 Australian standard population
- 3 Rate ratio is the Indigenous rate divided by the non-Indigenous rate. All ratios are significant at the p<0.05 level
- 4 Percent (%) is the percentage of all cardiovascular separations among Indigenous people

Table 9. Deaths of Indigenous people for CHD, by sex, NSW, Vic, Qld, WA, SA and the NT, 2004-2008

Condition	Males				Females				Persons			
	Number	%	Rate	Ratio	Number	%	Rate	Ratio	Number	%	Rate	Ratio
Acute myocardial infarction	438	27	112	1.7	273	21	74	1.6	711	24	91	1.7
All coronary heart disease	961	60	240	1.8	598	46	152	1.8	1,559	54	192	1.8

Source: Australian Institute of Health and Welfare, 2011 [10]

Notes:

- 1 Rates are per 100,000
- 2 Rates are directly age-standardised using the 2001 Australian standard population
- 3 Rate ratio is the Indigenous rate divided by the non-Indigenous rate
- 4 Percent (%) is the percentage of all cardiovascular deaths among Indigenous people

Table 10. Rates of death from selected CVDs, by Indigenous status, and Indigenous:non-Indigenous rate ratios, people aged 35-54 years, Qld, WA, SA and the NT, 2001-2005

Condition	Males			Females		
	Indigenous	Non-Indigenous	Rate ratio	Indigenous	Non-Indigenous	Rate ratio
Coronary heart disease	228	32	7.0	87	6	14.2
Other selected forms of heart disease	46	6	8.1	22	2	10.8
Cerebrovascular disease	28	6	5.1	24	5	5.2

Source: Australian Bureau of Statistics, Australian Institute of Health and Welfare, 2008 [3]

Notes:

- 1 Categories are based on the ICD-10-AM. ICD codes are in parentheses
- 2 Rates are per 100,000 population
- 3 Ratios are the Indigenous rates divided by the non-Indigenous rates

Full details of deaths from CHD are not available for all age groups, but the rates were much higher for Indigenous people aged 35-54 years living in Qld, WA, SA and the NT in 2001-2005 than for their non-Indigenous counterparts (Table 10) [3]. The largest number of excess deaths occurred in this age group; approximately 40% of these deaths would have been avoided if Indigenous people had the same age-specific death rates as non-Indigenous people [41].

An analysis of deaths, admissions and procedures for CHD for Indigenous and non-Indigenous people living in Qld in 2003-2008 revealed the highest differences in death and admission rates were in the 30-39 years age group, with Indigenous rates generally much higher than non-Indigenous rates for deaths and admissions (Table 11) [42]. The death and admission rate ratios declined with age until the 80 years and older age group, where Indigenous death rates became slightly lower than non-Indigenous rates. Procedure rates remained lower for Indigenous people than for other people living in Qld across all age groups, despite the relatively higher

admission rates. Procedure rates were similar for Indigenous and non-Indigenous people aged 30-39 years, but declined steadily with age. For people aged 80 years or older, the Indigenous:non-Indigenous rate ratio was 0.3.

Table 11. CHD events, Indigenous:non-Indigenous age specific rate ratios, Qld, 2003-2008

Age group	Age specific rate ratios		
	Mortality	Admission	Procedure
30-39	8.7	7.5	0.9
40-49	7.5	4.6	0.7
50-59	4.9	3.1	0.5
60-69	3.6	2.3	0.5
70-79	2.0	1.8	0.5
80+	0.9	1.2	0.3

Source: Webster, 2010 [42]

Note:

- 1 Mortality data are for 2003-2007 and admissions and procedures data for 2004-2008

Cerebrovascular disease

Indigenous people experience CBVD at a level almost twice that of the non-Indigenous population [7]. CBVD occurs at younger ages among Indigenous people than it does among non-Indigenous people: the majority of CBVD in the Indigenous population occurs in the 25-64 years age groups (80%); whereas CBVD in the non-Indigenous population is more common in those aged 65 years or older (66%) [7].

Box 4: Cerebrovascular heart disease (CBVD)

CBVD refers to conditions of the blood vessels that supply blood to the brain [43, 44]. The main conditions include stroke and transient ischaemic attack (TIA). Stroke, the most common condition, has two main forms: ischaemic stroke and haemorrhagic stroke. Ischaemic stroke occurs when the blood flow to the brain is stopped, usually due to a blood clot or the build up of cholesterol. Haemorrhagic stroke occurs when a blood vessel ruptures and bleeds within the brain [43, 44].

When a blockage or rupture occurs, oxygen to the brain is interrupted, and parts of the brain may become damaged or start to die off, thus reducing function. The longer the blockage is present, the more damaging it is to the brain. This damage cannot be undone, and can result in the loss of sensory and motor functions, brain damage or death. Ischaemic stroke is up to five times more common than haemorrhagic stroke, but the disability and death rates associated with haemorrhagic stroke are much higher.

TIA is a less severe form of interrupted blood flow that results in the temporary reduction of oxygen flow to the brain [7]. This condition causes temporary symptoms such as impairment to brain functioning, and is usually not life threatening.

In the 2004-2005 NATSIHS, CBVD was reported as a long-term condition by 0.3% of both Indigenous males and females (Table 2) [7]. After age adjustment, CBVD was 1.7 times more common among Indigenous people than among other Australians (1.5 times for males and 1.9 times for females) (Table 12) [7].

Table 12. Prevalence of CBVD among Indigenous people, by sex, Australia, 2004-2005

Sex	Prevalence (%)	SPR
Males	0.3	1.5
Females	0.3	1.9
Persons	0.3	1.7

Source: Australian Institute of Health and Welfare, Penm E, 2008 [7]

Notes:

- 1 Based on self reported data from the NATSIHS, 2004-2005
- 2 Standardised prevalence ratio (SPR) is the ratio of observed cases to expected cases if the Indigenous population experienced the same age-sex specific prevalences as the non-Indigenous population

There were over 1,300 admissions of Indigenous people to hospital for CBVD in the two-year period June 2006 to June 2008 (Table 4, Table 13) [10]. Of these admissions, 1,160 were for stroke. Hospitalisation rates of Indigenous people for CBVD were 1.8 times higher than those of other Australians, and 1.9 times higher for stroke.

Standardised death rates of Indigenous people from CBVD are almost twice those of non-Indigenous people [7]. In 2010, CBVD accounted for 119 deaths of Indigenous people (4.5% of all deaths of Indigenous people), approximately 2.9% of male and 6.6% of female deaths [45]. For the period 2004-2008, the most recent period of which detailed information is available, CBVD was the second leading cause of cardiovascular deaths for Indigenous people, being responsible for 537 deaths (18% of all deaths from CVD among Indigenous people) (Table 5) [10]. Strokes accounted for 428 of these deaths (15% of all deaths from CVD among Indigenous people).

Table 13. Hospitalisations of Indigenous people for CBVD, by sex, NSW, Vic, Qld, WA, SA and the NT, July 2006–June 2008

Condition	Males				Females				Persons			
	Number	%	Rate	Ratio	Number	%	Rate	Ratio	Number	%	Rate	Ratio
Stroke	557	6.5	3.0	1.7	603	7.6	2.8	2.1	1,160	7.0	2.9	1.9
All cerebrovascular disease	646	7.5	3.5	1.6	603	7.6	2.8	2.1	1,329	8.0	3.2	1.8

Source: Australian Institute of Health and Welfare, 2011 [10]

Notes:

- 1 Rates are per 1,000
- 2 Rates are directly age-standardised using the 2001 Australian standard population
- 3 Rate ratio is the Indigenous rate divided by the non-Indigenous rate. All ratios are significant at the $p < 0.05$ level
- 4 Percent (%) is the percentage of all cardiovascular separations among Indigenous people

An analysis of causes of death for people aged 74 years or less living in NSW, Vic, Qld, WA, SA and the NT in 2004-2008 found that the rate for Indigenous people for CBVD was 1.6 times the rate for non-Indigenous people [10].

Full age details of deaths from CBVD are not available, but the rates were much higher for Indigenous people aged 35-54 years living in Qld, WA, SA and the NT in 2001-2005 than for their non-Indigenous counterparts (Table 10) [3]. Death rates for both Indigenous males and females increased with age, but the patterns of increase were different. Indigenous male death rates increased progressively whereas Indigenous female death rates increased less rapidly with age until the 65 years and older age group, where there was a marked increase in the rate [7]. Between 25 and 64 years of age, both Indigenous males and females experienced higher death rates than did their non-Indigenous counterparts, as much as three to eight times for males, and four to seven times for females.

Hypertension

Hypertension is the most common cardiovascular condition among Indigenous people, being reported by 6.4% of males and 7.7% of females in the 2004-2005 NATSIHS (Table 2) [7]. After age adjustment, the prevalence for Indigenous males was 1.5 times that of non-Indigenous males, and for Indigenous females 1.7 times that of non-Indigenous females.

Box 5: Hypertension

Hypertension refers to the elevation of blood pressure over a prolonged period of time [46]. The pressure is the force of the blood on the walls of the blood vessels and is measured by systolic and diastolic blood pressure. Systolic blood pressure is a measurement when the heart muscle contracts to pump blood, the highest pressure in the arteries; diastolic blood pressure is a measurement when the heart muscle relaxes, the lowest pressure in the arteries. High blood pressure causes the heart to work harder, and can cause damage to the heart, making it weak and enlarged.

The 2004-2005 NATSIHS found that the prevalence of hypertension increased with age for Indigenous people (as it does for non-Indigenous people), but the prevalence was higher for Indigenous people than for non-Indigenous people across all age groups (Figure 6) [7].

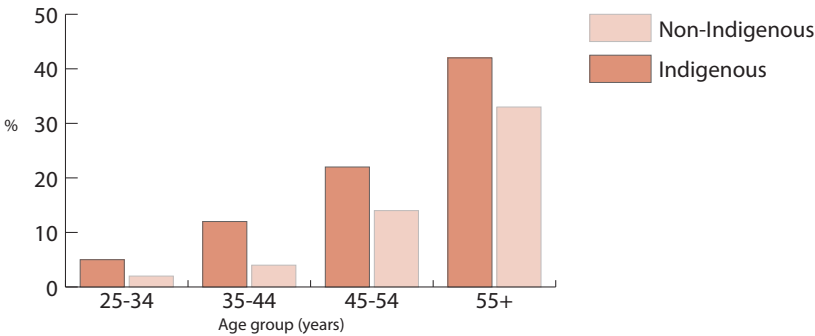
The highest disparities between the Indigenous and non-Indigenous populations in hypertension were in the younger age groups (Figure 6) [2, 7]. Indigenous males aged 25-44 years had a level 2.2 times that of non-Indigenous males, and Indigenous females in the 25-44 years age group had a level 2.8 times that of non-Indigenous females (Table 14) [7]. Hypertension was more commonly reported by Indigenous people living in remote areas (10%) than those living in non-remote areas (6%) [2].

Table 14. Prevalence of hypertension among Indigenous people, by sex and selected age groups, and Indigenous:non-Indigenous rate ratios, Australia, 2004-2005

Sex	Age groups		
	25-44 years	45-64 years	65+ years
Males			
Prevalence (%)	8.4	25.0	44.2
Ratio	2.2	1.3	1.2
Females			
Prevalence (%)	7.4	30.4	49.3
Ratio	2.8	1.6	1.2
Persons			
Prevalence (%)	7.8	27.8	47.1
Ratio	2.5	1.5	1.2

Source: Australian Institute of Health and Welfare, Penm E, 2008 [7]
Notes:
1 Based on self reported data from the NATSIHS, 2004-2005
2 Rate ratio is the Indigenous rate divided by the non-Indigenous rate. All ratios are significant at the p<0.05 level

Figure 6 Reported proportions of hypertension, by Indigenous status and age group, Australia, 2004-2005



Source: Australian Institute of Health and Welfare, Penm E, 2008 [7]
Note: Based on self reported data from the NATSIHS, 2004-2005

In NSW, Vic, Qld, WA, SA and the NT⁸, there were 469 admissions of Indigenous people to hospital for hypertension in the two-year period July 2006-June 2008 (Table 4, Table 15) [10]. Admission rates for Indigenous people for hypertension were 2.6 times higher than those for non-Indigenous Australians. Rates for Indigenous males and females were 2.6 and 2.5 times higher respectively than those for non-Indigenous counterparts.

Hospitalisation rates for hypertension among Indigenous people Australia-wide in 2006-2008 were 2.5 times the rates of hospitalisations among non-Indigenous people (Table 16) [10].

Table 15. Hospitalisations of Indigenous people for hypertension, by sex, Australia and selected jurisdictions, July 2006-June 2008

Sex	Indigenous status			
	NSW, Vic, Qld, WA, SA & NT		Australia	
	Indigenous	Non-Indigenous	Indigenous	Non-Indigenous
Males				
Number	200	5,254	204	5,463
Rate	0.7	0.3	0.7	0.3
Rate ratio	2.6		2.6	
Females				
Number	269	8,710	274	9,016
Rate	1.0	0.4	0.9	0.4
Rate ratio	2.5		2.5	
Persons				
Number	469	13,965	478	14,480
Rate	0.8	0.3	0.8	0.3
Rate ratio	2.6		2.5	2.5

Source: Australian Institute of Health and Welfare, 2011 [10]

Notes:

- 1 Rates are per 1,000
- 2 Rates are directly age-standardised using the 2001 Australian standard population
- 3 Rate ratio is the Indigenous rate divided by the rate for other Australians
- 4 Other figures include non-Indigenous people and those where Indigenous status was not recorded
- 5 NSW, Vic, Qld, WA, SA and NT are considered to have adequate levels of identification
- 6 Australia includes all eight states and territories and where resident status is not applicable such as overseas, no fixed address

Deaths from hypertension are not common, but hypertension is a major risk factor for fatal CVDs, such as CHD and CBVD [46]. There are a relatively low number of direct deaths from hypertension; recent national Indigenous data reveal that hypertension was responsible for 1.2% of all deaths of Indigenous people living in NSW, Qld, SA, WA and the NT in 2010 [5]. The proportion was the same among non-Indigenous people (1.2% of all deaths among non-Indigenous people) [5].

For the period 2004-2008, hypertension among Indigenous people was responsible for 107 deaths (3.7% of all deaths from CVD among Indigenous people) [10]. As noted above, deaths from hypertension were more common for Indigenous females (70 deaths; 5.4% of all deaths from CVD) than for Indigenous males (37 deaths; 2.3%) (Table 5, Table 17) [10]. The death rate among Indigenous people for hypertension was almost two and a half times the rate among non-Indigenous people. Indigenous females were 2.5 times more likely to die from hypertension than were non-Indigenous females, and Indigenous males were 2.3 times more likely to die from this condition than were their non-Indigenous counterparts.

Table 16. Deaths of Indigenous people from hypertension, by sex, NSW, Vic, Qld, WA, SA and the NT, 2004-2008

Sex	
Male	
Number	37
Per cent (%)	2.3
Rate	13
Rate ratio	2.3
Female	
Number	70
Per cent (%)	5.4
Rate	20
Rate ratio	2.5
Persons	
Number	107
Per cent (%)	3.7
Rate	17
Rate ratio	2.5

Source: Australian Institute of Health and Welfare, 2011 [10]

Notes:

- 1 Rates are per 100,000
- 2 Rates are directly age-standardised using the 2001 Australian standard population
- 3 Rate ratio is the Indigenous rate divided by the non-Indigenous rate
- 4 Percent (%) is the percentage of all deaths from CVD among Indigenous people

Rheumatic heart disease

RHD and acute rheumatic fever remain almost exclusively experienced by Indigenous people in Australia. Indigenous children and young adults are the most affected by the disease [47]. A recent editorial in the Australian and New Zealand *Internal Medicine Journal* noted that the countries 'shared the ignominy of being affluent industrialised countries with rates of acute rheumatic fever (ARF) that are among the highest in the world and similar to those found in less developed countries' [48, p.963]

⁸ These jurisdictions are considered to have adequate levels of identification of Indigenous people.

Box 6: Rheumatic heart disease (RHD)

RHD refers to the long-term damage of the heart valves and heart muscle caused by acute rheumatic fever (ARF), an inflammatory disease that can cause damage to the heart valves, muscle and lining, as well as connective tissues in the brain and other parts of the body (such as joints) [47]. An untreated or poorly treated bacterial throat infection, specifically group A streptococcus, is thought to be the most common cause of ARF, but there is growing evidence that streptococcal skin sores may be another cause of this disease.

ARF and RHD are linked to poor living conditions, including lack of clean water, inadequate sewerage facilities, overcrowding, low levels of hygiene, and limited access to health care [7, 32]. As such, the morbidity and mortality associated with ARF and RHD can be largely prevented.

Australia is now fortunate to have a national RHD control unit, RHD Australia. The national coordination unit, established in 2009, supports the control of RHD in Australia. RHD control programs have been established in the NT, Qld, and WA; each area has its own set of priorities and characteristics in terms of burden of disease, location and the provision of services. The national control unit supports the state-based programs by providing technical assistance and promoting best practice [49].

Most of the information about RHD has been derived in the past from the registers of RHD and ARF in the Top End of the NT and central Australia (comprising parts of NT, and including neighbouring parts of WA and SA). Control programs (of which registers are a central component) were established in 1997 in the Top End and in 2000 in central Australia to collect data on new and existing cases, they have since amalgamated to form a territory-wide program [7, 8, 31]. There are some limitations with the data however: the register for central Australia covers parts of WA and SA, but these figures in some cases have not been included due to difficulties determining denominator populations needed for calculating rates [10].

Regional programs have more recently been established in Far North Qld (2006) and WA (2009), and registry information is available for Far North Qld for the period 2004-2009, and for the Kimberley region of WA for the period 1988-1992 [8, 33, 50, 51].

The control programs maintain records of people with known past ARF and RHD, and collect information about new and recurrent cases. This information is essential for an effective secondary prevention program involving antibiotic prophylaxis. The information presented in this section draws on that compiled by the AIHW from data extracted from these registers and control programs.

Acute rheumatic fever

There were 213 notifications of new and recurrent cases of ARF in the Top End of the NT and central Australia in 2006-2009 (Table 17) [10]. There were more cases recorded in the Top End, 151 cases, than

in central Australia, 62 cases [52]. Almost all cases were Indigenous people, 99% in the Top End and 98% in central Australia. Recurrent cases made up 27% of cases for the Top End and 30% for central Australia in 2002-2006, the most recent period with data available [7].

In 2006-2009, almost two-thirds (65%) of the Indigenous notifications of ARF in the Top End of the NT and central Australia were for people aged 5-14 years (2.3 cases per 1,000 population). The rates for ARF were highest for Indigenous females in the 5-14 years age group (2.7 cases per 1,000) (Table 1) [10]. Indigenous females accounted for 130 (61%) of the notifications for ARF and Indigenous males for 83 notifications (39%).

Table 17. New and recurrent cases of ARF among Indigenous people, by sex and selected age groups, NT, 2006-2009

Sex	Age groups			All ages
	5-14	15-24	25-34	
Males				
Number	55	18	6	83
Rate	1.8	0.7	0.3	0.7
Females				
Number	78	26	12	130
Rate	2.7	1.0	0.6	1.0
Persons				
Number	133	44	18	213
Rate	2.3	0.9	0.4	0.8

Source: Australian Institute of Health and Welfare, 2011 [10]

Notes:

- 1 Rates are per 1,000
- 2 Age-specific rates calculated using the average number of registrations for 2005-2008 divided by the 2006 estimated resident Indigenous Australian population for the Top End, NT and central Australia
- 3 Total includes missing figures for other groups not recorded here

In Far North Qld in 2004-2009, there were 203 notifications of new and recurrent cases of ARF among 194 Indigenous people [51]. Almost three-fifths of these cases (57%, 111 cases) involved females. Around two-thirds of notifications (67%, 131 notifications) were for children aged 5-14 years. The overall rate of new and recurrent cases among Indigenous people was 59 per 100,000 population. The rate for Indigenous children aged 5-14 years was 155 per 100,000 children.

Similar levels were documented for the Kimberley region of WA in 1988-1992; of the 96 notifications of new and recurrent cases of ARF among 81 people, 80 were Indigenous people [50]. Slightly more than one-half of the notifications among Indigenous people involved females (52%, 42 notifications) and 50 of the total notifications (52%) were children aged 5-14 years. The rate for new and recurrent cases among Indigenous people was 241 per 100,000 population. The rate for Indigenous children aged 5-14 years was 375 per 100,000 population.

Rheumatic heart disease

Reflecting the high number of cases of ARF, Indigenous people experience far higher levels of RHD than do non-Indigenous people. In the Top End of the NT and central Australia in 2009, there were 1,479 cases of RHD recorded, 1,374 of whom were Indigenous. Nearly three times as many cases were recorded in the Top End (1,153) than in central Australia (328) [10]. Almost all cases involved Indigenous people: 92% in the Top End of the NT and 94% in central Australia.

In 2009, registered cases of RHD were highest for Indigenous females, with 3.6% of Indigenous females in the Top End of the NT on the register (Table 18) [10]. The greatest disparity was for Indigenous males in the Top End of the NT with a ratio of 38.1. In the NT overall, the age-standardised prevalences were 3.2% for Indigenous females and 1.7% for Indigenous males (Table 19) [10]. The disparity between Indigenous and non-Indigenous people was substantial: the age-standardised prevalence ratios were around 31 for males and 21 for females.

Table 18. Prevalence (%) of RHD among Indigenous people, by sex and selected areas, Top End and central Australia, NT, 2009

Area	Area, prevalence		Ratio
	Indigenous	Non-Indigenous	
Top End, NT			
Males	1.9	0.1	38.1
Females	3.6	0.2	23.1
Persons	2.8	0.1	28.7
Central Australia			
Males	1.2	0.1	14.2
Females	2.3	0.1	19.9
Persons	1.8	0.1	18.2
Northern Territory			
Males	1.7	0.1	30.9
Females	3.2	0.2	21.4
Persons	2.5	0.1	25.4

Source: Australian Institute of Health and Welfare, 2011 [10]

Notes:

- 1 Prevalences are directly age-standardised using the 2001 Australian standard population
- 2 Prevalences have been rounded for presentation
- 3 Ratio is the Indigenous prevalence divided by the non-Indigenous prevalence. All ratios are significant at the $p < 0.05$ level

Table 19. Registered cases of RHD among Indigenous people, by sex and selected age groups, Top End NT and central Australia, 2009

Sex	Age groups							All ages	Age-adjusted
	0-14	15-24	25-34	35-44	45-54	55-64	65+		
Males									
Number	56	133	104	87	59	24	13	476	..
Prevalence (%)	0.5	2.1	2.1	2.1	2.3	2.0	1.9	1.5	1.7
Ratio	72.9	110.0	140.1	96.3	31.1	29.3	6.9	33.6	30.9
Females									
Number	81	185	205	199	131	66	31	898	..
Prevalence (%)	0.7	2.9	3.8	4.6	4.5	4.3	2.7	2.8	3.2
Ratio	..	69.1	91.6	79.9	32.8	15.6	4.4	27.2	21.4
Persons									
Number	137	318	309	286	190	90	44	1,374	..
Prevalence (%)	0.6	2.5	3.0	3.4	3.5	3.3	2.8	2.2	2.5
Ratio	177.7	83.5	108.4	87.5	33.4	21.1	5.7	30.0	25.4

Source: Australian Institute of Health and Welfare, 2011 [10]

Notes:

- 1 Prevalences are expressed as rates per 1,000
- 2 Percentages are by age group
- 3 Age-specific prevalences calculated using the 2006 estimated resident Indigenous Australian population for the Northern Territory
- 4 Ratio is the Indigenous prevalence divided by the non-Indigenous prevalence. All ratios are significant at the $p < 0.05$ level
- 5 The prevalences and ratios for 'all ages' have been age adjusted

In 2002-2006, the prevalences of RHD among Indigenous people were 30 times higher in central Australia and 35 times higher in the Top End of the NT than those of their non-Indigenous counterparts [7].

Hospitalisations

RHD (including ARF) was responsible for 702 admissions to hospital of Indigenous people living in NSW, Vic, Qld, WA, SA and the NT in the two-year period July 2006-June 2008 (Table 4, Table 20) [10]. The hospitalisation rate for Indigenous people for RHD (including ARF) was 6.9 times higher than that for non-Indigenous Australians.

Table 20. Hospitalisations of Indigenous people for RHD (including ARF), by sex, NSW, Qld, WA, SA and the NT, 2006-2008

Male	
Number	274
Per cent (%)	3.2
Rate	0.5
Rate ratio	5.3
Female	
Number	428
Per cent (%)	5.4
Rate	0.9
Rate ratio	8.2
Persons	
Number	702
Per cent (%)	4.2
Rate	0.7
Rate ratio	6.9

Source: Australian Institute of Health and Welfare, 2011 [10]

Notes:

- 1 Rates are per 1,000
- 2 Rates are directly age-standardised using the 2001 Australian standard population
- 3 Rate ratio is the Indigenous rate divided by the non-Indigenous rate. All ratios are significant at the p<0.05 level
- 4 Percent (%) is the percentage of all hospitalisations from CVD among Indigenous people

Deaths

In the Top End of the NT in 2009, there were 7 deaths among Indigenous people from RHD (approximately 1.6% of deaths of Indigenous males and 1.5% of deaths of Indigenous females) [45].

RHD was responsible for 99 deaths among Indigenous people living in NSW, Qld, WA, SA and the NT in 2004-2008 (Table 21) [10]. More than two-thirds (69) of these deaths were of females. Deaths from RHD were more common among Indigenous people than among non-Indigenous people with a rate almost six times higher. Indigenous females were 6.8 times more likely to die from RHD than were non-Indigenous females, and Indigenous males 4.1 times more likely to die from this disease than their non-Indigenous counterparts. Detailed data for age-groups are not available for this period, but previous data suggest that nearly one-half of deaths from RHD among Indigenous people occurred in the 35-54 years

age group (45% for Indigenous females and 43% for Indigenous males) [7].

Table 21. Deaths of Indigenous people from RHD, by sex, NSW, Qld, WA, SA and the NT, 2004-2008

Sex	Rheumatic heart disease
Male	
Number	30
Rate	3.7
Rate ratio	4.1
Female	
Number	69
Rate	9.3
Rate ratio	6.8
Persons	
Number	99
Rate	6.8
Rate ratio	5.8

Source: Australian Institute of Health and Welfare, 2011 [10]

Notes:

- 1 Rates are per 100,000
- 2 Rates are directly age-standardised using the 2001 Australian standard population
- 3 Rate ratio is the Indigenous rate divided by the non-Indigenous rate

Congenital heart disease

Recent information about congenital heart disease among Indigenous people is restricted to the major types of congenital heart disease included in the general reports of congenital anomalies in Australia.

For cases reported in Australia in 2002-2003, transposition of the great vessels, Tetralogy of Fallot, and coarctation of the aorta were more common among Indigenous people than among non-Indigenous people, and hypoplastic left heart syndrome was less common (Table 22) [53]. Differences in prevalence between Indigenous and non-Indigenous people were not statistically significant.

Box 7: Congenital heart disease

Congenital heart disease, which refers to conditions or malfunctions of the heart at birth, usually results in ongoing morbidity [53]. Some cases of congenital heart disease are fatal. The most common forms of congenital heart disease are: transposition of the great vessels; Tetralogy of Fallot; hypoplastic left heart syndrome; and coarctation of the aorta.

Information about the overall extent of congenital heart disease among Indigenous babies is limited, and dated. One of the most comprehensive reports was based on notifications received by the Western Australian Birth Defects Registry regarding babies born in WA in the 10-year period 1980-1989 [54]. Congenital heart disease was found to be 30% more common among Indigenous

babies than among non-Indigenous babies, affecting almost 1% of Indigenous babies. Congenital heart defects occurring with other defects were significantly more frequent in Indigenous babies than in non-Indigenous babies, but the excess of isolated heart defects was of borderline significance. Ventricular septal defect was responsible for more than two-fifths (43%) of cases of isolated congenital heart disease among Indigenous babies.

An analysis of the patient records of babies born in Alice Springs Hospital during the period 1993-2000 found a slightly higher rate of congenital heart disease among Indigenous babies (19 per 1,000 live births) than among non-Indigenous babies (16 per 1,000 live births) (Table 23) [55]⁹. (The difference was not statistically significant.)

- 9 Cases, which were confirmed by electrocardiography, excluded patent ductus arteriosus in babies born before 37 weeks gestation, asymptomatic patent ductus arteriosus in the first 3 months of life, and a number of other minor defects with no clinical significance

Table 22. Numbers and prevalence for selected types of congenital heart disease, by Indigenous status, and Indigenous:non-Indigenous prevalence ratios, Australia, 2002-2003

Type of congenital heart disease	Indigenous		non-Indigenous		Ratio
	Number	Prevalence	Number	Prevalence	
Transposition of the great vessels	11	7.4	194	4.1	1.8
Tetralogy of Fallot	9	6.1	145	3.1	2.0
Hypoplastic left heart syndrome	2	1.3	79	1.7	0.8
Coarctation of aorta	7	4.7	2	3.6	1.3

Source: Abeywardana, Sullivan, 2008 [53]

Notes:

- 1 The source document was restricted to these four types of congenital heart disease
- 2 Figures do not include cases for the NT
- 3 Prevalence is number of cases per 10,000 women who gave birth
- 4 Ratio is the Indigenous prevalence divided by the non-Indigenous prevalence
- 5 None of the differences in prevalence between Indigenous and non-Indigenous cases is statistically significant

Table 23. Numbers and incidence of congenital heart disease, by Indigenous status and disease type, and Indigenous:non-Indigenous incidence ratio, central Australia, 1993-2000

Type of congenital heart disease	Indigenous		non-Indigenous		Ratio
	Number	Incidence	Number	Incidence	
Ventricular septal defect	30	10.0	32	10.1	1.0
Atrial septal defect	5	1.7	7	2.2	0.8
Patent ductus arteriosus	5	1.7	3	0.9	1.8
Double outlet right ventricle	4	1.3	1	0.3	4.2
Other defects	13	4.3	8	2.5	1.7
All defects	57	19.0	51	16.1	1.2

Source: Bolisetty, et al., 2004 [55]

Notes:

- 1 Based on cases confirmed by echocardiography in the Alice Springs Hospital among babies born between 1 January 1993 and 30 June 2000
- 2 Incidence is number of cases per 1,000 live births
- 3 Ratio is the Indigenous incidence divided by the non-Indigenous incidence
- 4 None of the differences in incidence between Indigenous and non-Indigenous cases is statistically significant

Factors contributing to cardiovascular disease

Risk factors contributing to CVD among Indigenous people are complex. They reflect a combination of broad historical, social, cultural, and economic factors, as well as the more commonly described proximal risk factors. The importance of historical, psychosocial and socioeconomic aspects is recognised, but it has been beyond the scope of this review to address these factors in any great detail. As a result, the main risk factors addressed in this review are behavioural and biomedical risk factors. It is also beyond the scope of this review to fully address comorbidity with diseases such as diabetes and chronic kidney disease, which are recognised as important contributing risk factors¹⁰.

Behavioural and biomedical risk factors

Conventional risk factors for CVD can be divided into two main categories: behavioural and biomedical [7]. Behavioural risk factors are based on an individual's behaviour (such as tobacco smoking) but can be influenced by underlying socioeconomic, psychosocial and cultural factors. Biomedical risk factors (such as high blood cholesterol), many of which are also influenced by underlying socioeconomic, psychosocial and cultural factors, can be addressed by modifications to behaviour, lifestyle, or the use of medical interventions. Behavioural risk factors include tobacco smoking, physical inactivity, poor nutrition and risky alcohol consumption [6, 7, 56]. Biomedical risk factors include high blood pressure (hypertension)¹¹, high blood cholesterol, being overweight or obese, diabetes and chronic kidney disease¹².

According to the 2004-2005 NATSIHS, at least one risk factor was present for almost all Indigenous people with CVD living in non-remote areas [2]. Indigenous males were more likely to have had multiple risk factors than were Indigenous females, and Indigenous people overall were more likely than non-Indigenous people to have had multiple risk factors. For all risk factors for CVD, the prevalence for Indigenous people was greater than that for non-Indigenous people, particularly diabetes, at a level four times higher; and smoking, at a level two times higher [7].

Smoking

Smoking is the most important single risk factor for CVD. Tobacco smoke damages both the heart and blood vessels [7]. The nicotine in

tobacco smoke contributes to the development of atherosclerosis, the accrual of fat (such as cholesterol) on the walls of blood vessels. This narrows blood vessels, reducing oxygen delivery, increasing blood pressure and placing increased stress on the heart muscle.

In 2008, 47% of Indigenous people aged 15 years and over reported in the NATSISS being current smokers [1, 57]. This compares with a level of 20% among non-Indigenous people. For both population groups, most current smokers reported smoking daily. Similar proportions of Indigenous males and Indigenous females reported smoking and the proportions were high across all age groups, ranging from 42% to 59% [58]. Overall, the proportion of Indigenous people living in remote areas who reported smoking (53%) was slightly higher than the proportion of those living in major cities (42%) [59]. Time analysis reveal that these levels have decreased from 51% in 2002 to 47% in 2008 [60].

The 2010 National drug strategy household survey recorded a lower proportion of current smokers, 34% of Indigenous people aged 14 years or older [61]. There were a total of 460 Indigenous respondents, 1.7% of the total sample. Due to the relatively small sample size (based on population estimates) and the survey methodology, the proportion of Indigenous smokers is likely to have been underestimated, and therefore caution should be used when interpreting these data.

According to 2004-2005 NATSIHS, Indigenous people with CVD were more than twice as likely as their non-Indigenous counterparts to be daily smokers [2]. Across all age groups, Indigenous people with CVD had a higher prevalence of daily smoking than did non-Indigenous people with CVD; this was particularly high for people aged 65 years of older, for whom the prevalence was nearly four times higher.

Physical inactivity

Physical inactivity is an important risk factor for the development of CVD, particularly CHD, heart failure and stroke [7]. Physical activity causes the body to increase strength, develop lean muscle mass, burn calories and reduce body fat and blood pressure.

The benefits of regular physical activity are not only linked to a reduction in developing CVD, but also in reducing some of the associated risk factors (such as overweight and obesity, hypertension, type 2 diabetes, and high levels of high-density lipoprotein and total blood cholesterol) [7].

In 2008, almost one-third (30%) of Indigenous people aged 15 years and older participated in some form of physical activity in the previous 12 months [Derived from 62]¹³. Indigenous females and

10 Further information can be obtained through various Australian Institute of Health and Welfare publications [7, 41].

11 Hypertension is a condition of the cardiovascular system, as well as a risk factor for other CVD.

12 Diabetes and chronic kidney disease are both risk factors for CVD and individual diseases.

13 The most recent data enabling comparison between Indigenous and non-Indigenous people are for 2004-2005, when one-half of Indigenous people and one-third of non-Indigenous people were sedentary; around one-fifth of Indigenous people and one-third of non-Indigenous people

older Indigenous people were more likely to be physically inactive than were Indigenous males.

Of Indigenous people living in non-remote areas who reported having CVD in 2004-2005 in Australia, 58% were physically inactive [2]. After adjusting for age, Indigenous males and Indigenous females had similar levels of inactivity. Physical inactivity levels increased with age, and almost three-quarters of Indigenous people aged 65 years or older with CVD were sedentary.

For people with CVD in 2004-2005 in Australia, Indigenous people were 1.6 times more likely than non-Indigenous people to be physically inactive [7]. Across all age groups, Indigenous people with CVD had higher levels of physical inactivity than did non-Indigenous people with CVD; this was particularly high for the 45-64 years age groups with levels almost twice as high.

Nutrition

Poor nutrition, including the inadequate consumption of fruit and vegetables, can increase the risk of developing chronic diseases, particularly diabetes and CVD (including CHD, stroke, hypertension and atherosclerosis) [7]. A diet high in saturated fat and salt, has been linked to high blood pressure, high blood cholesterol levels, type 2 diabetes, and being overweight or obese. Excess fat and salts in the circulatory system can place increased pressure on the heart muscle and blood vessels through the accrual of fatty substances. These substances can reduce the efficiency of blood and oxygen flow placing stress on the system; blockages can eventually occur and the results can be fatal.

Dietary guidelines make recommendations on the intake of certain food groups [63, 64]. Regular consumption of fruit and vegetables can lower blood cholesterol and blood pressure, and help to reduce the risk of developing atherosclerosis, CHD and stroke.

In 2004-2005, approximately 15% of Indigenous people did not eat fruit on a daily basis, 6% did not eat enough vegetables daily, and 3% did not eat enough fruit or vegetables daily [2]. Poor nutrition was higher among Indigenous males, who were, after adjusting for age, were 1.4 times more likely than Indigenous females to not eat any fruit or vegetables daily. The poor consumption of fruit was twice as common among Indigenous people than among non-Indigenous people, and the inadequate consumption of vegetables was more than six times more common [7]. For people with CVD, Indigenous people were 1.3 times more likely to have poor consumption levels than were non-Indigenous people [7].

Alcohol consumption

Alcohol consumption can increase blood pressure and blood triglyceride levels, and can also be directly cardiotoxic [7, 65],

increasing the risk of heart failure, stroke and abnormal heart rhythm. Alcohol consumption can also contribute towards obesity, and increase the risk of developing type 2 diabetes.

Alcohol guidelines make recommendations on the intake of alcohol for different population groups including adult males and females, and pregnant women [66]. The guidelines now refer to a progressive increase in the risk of harm with the amount of alcohol consumed rather than specifying the risks for different levels of alcohol consumption¹⁴.

In 2008, almost two-thirds (65%) of Indigenous people aged 15 years and older reported consuming alcohol in the 12 months prior to the NATSISS [57]. Almost one-half (46%) consumed alcohol at low risk levels, 11% at medium risk levels, and 6% at high risk levels. Alcohol consumption for Indigenous males was higher than for Indigenous females [58]. The highest levels of high risk alcohol consumption were among Indigenous males aged 45-54 years (13%) and Indigenous females aged 25-34 years (5%). Overall, Indigenous people had a rate of high risk alcohol consumption 1.5 times that of non-Indigenous people [7].

For people with CVD in 2004-2005 in Australia, Indigenous people were 1.6 times more likely than non-Indigenous people to have consumed alcohol at a high risk level [7]. Indigenous males with CVD had a higher prevalence of high risk alcohol consumption than did non-Indigenous males with CVD, with rates almost twice as high (1.9). The prevalence of high risk alcohol consumption of Indigenous females was 1.2 times that of non-Indigenous females.

The levels of abstention from alcohol among Indigenous people were higher than among their non-Indigenous counterparts, 2.2 times for Indigenous males and 1.7 times for Indigenous females.

Overweight and obesity

The risk of developing CVD (particularly CHD and stroke) and type 2 diabetes is higher among people who are overweight or obese [67]. Other risk factors for CVD are also exacerbated by excess body fat; these include high blood pressure, high blood cholesterol, and high levels of blood lipids.

The commonly accepted classification measure used for bodyweight is the *Body mass index* (BMI), which relates a person's weight to their height. BMI categories include: underweight, healthy weight; overweight; obese; and morbidly obese¹⁵ [7]. This measure may not be suitable for all population groups. There is increasing evidence to suggest that waist measurement or waist-to-hip ratio are more accurate in predicting the risk of CVD, but

14 It is beyond the scope of this review to provide further details on these guidelines.

15 It is beyond the scope of this review to explain BMI in any further detail. More information can be obtained through the Australian Government Measure up campaign.

had moderate or high levels of physical activity.

measures of BMI are routinely reported in many national and other surveys [7, 68].

In 2004-2005, 60% of Indigenous people were reported to be overweight, and 31% were obese (13% of whom were morbidly obese) [2]. Indigenous males were 1.1 times more likely to be overweight than were Indigenous females, but Indigenous females were more likely to be obese (1.2 times) than were Indigenous males. Obesity levels were highest among Indigenous people in the 45-64 years age group (39%) and the 65 years or older age group (33%) [7].

Indigenous people were more likely to be overweight (rate ratio: 1.2), obese (1.9), and morbidly obese (3+) than were their non-Indigenous counterparts [7]. Across all age groups, Indigenous people had a higher prevalence of obesity. The greatest disparities were seen in the 18-24 years age group (prevalence 2.4 times higher), and in the 65 years or older age group (prevalence 2.1 times higher).

For people with CVD, Indigenous people had a higher prevalence in all of the excess weight categories than did non-Indigenous people [7]. Indigenous people with CVD were 1.2 times more likely to be overweight than were non-Indigenous people, 1.6 times more likely to be obese, and 2.4 more likely to be morbidly obese.

Social and emotional wellbeing

Research has highlighted the important relationships between CVD and social and emotional wellbeing [7, 69]. Factors such as social isolation, stress, depression, and lack of social support in particular have now been acknowledged as factors independently associated with the cause and prognosis of CHD [7, 69, 70]. Social and emotional wellbeing are now recognised to be of similar importance to the conventional risk factors (smoking, high blood cholesterol, high blood pressure and obesity).

Acknowledgment of the equal importance of psychosocial and conventional risk factors has clear implications for the assessment and management of CHD among Indigenous people, and for public health policy and research.

Other risk factors related to social and emotional wellbeing have also been recognised as important contributors to the development of CVD among Indigenous people:

- cultural and historical factors, such as loss of land, and disruptions to culture, language and identity [7, 71];
- environmental and socioeconomic factors, such as poor housing, low education and income [7, 69];
- psychosocial stressors, such as death of a family member or close friend, serious injury or disability [7, 69]; and
- limited access to appropriate health care, both preventive and clinical [72, 73].

Understanding the actual contributions of the 'upstream' factors is important when addressing modifiable risk factors. Many of the upstream factors contribute to behavioural risk factors. Low socio-economic status, for example, contributes to behavioural risk factors such as smoking, physical inactivity and poor nutrition (which can result in overweight or obesity) [7]. The extent to which the various upstream factors contribute to biomedical risk factors (such as high blood cholesterol and high blood pressure) is unclear however.

Comorbidity

Many Indigenous people with CVD also have other health problems and multiple behavioural and biomedical risk factors [41, 74, 75]. The coexistence of other health problems and multiple risk factors magnifies the risk of CVD [7, 75, 76], so a thorough analysis and an understanding of the roles of all these factors would be important in the development and implementation of policies and strategies addressing CVD among Indigenous people¹⁶.

A detailed analysis of NT residents who suffered their first acute myocardial infarction (AMI) in the period 1992 to 2004 found that the comorbidity score of Indigenous patients was 59% higher than that of non-Indigenous patients, due predominantly to the much higher prevalence of diabetes, diabetes complications, and renal disease [77]¹⁷. After adjustment for sex, age, year and comorbidity, short-term fatal outcomes were similar for Indigenous and non-Indigenous patients. After adjustment for sex, age and year, long-term fatal outcomes were higher for Indigenous than for non-Indigenous patients, and adjustment for comorbidity only partly reduced this difference.

A two-year follow-up study of Indigenous and non-Indigenous people in WA who had survived for 28 days after their first-ever AMI found substantial differences in risks – assessed as hazard ratios (HR) – of CVD death, recurrent AMI and combined outcomes [78]¹⁸. After adjustment for demographic information, the risk of CVD death or recurrent AMI within two years for survivors of the incident AMI was 3-4 times higher for Indigenous people than for non-Indigenous people. After adjusting for comorbidity, the HRs were 2.3 for males and 2.4 for females. The authors conclude: 'the high prevalence and substantial contribution of comorbidity to the disparity of post-MI outcomes ... reinforce the importance of early and comprehensive management of chronic conditions' in the Indigenous population [78, p988].

16 Such analysis is beyond the scope of this review, which predominantly focuses on modifiable behavioural and biomedical risk factors.

17 The comorbidity score was based on the Charlson Comorbidity Index.

18 Hazard ratios are used in survival analysis, where two groups are followed over time.

Management of cardiovascular disease

Indigenous people do not receive the same level of care for CVD as non-Indigenous people [10, 79-81]. This disparity is seen in services relating to primary prevention and management, emergency and acute care, rehabilitation, ongoing management, and secondary prevention [81]. In terms of hospital care, just over one-half of Indigenous people (57%) hospitalised with a principal diagnosis of CVD in the period July 2006 to June 2008 had a procedure undertaken; almost three-quarters (74%) of their non-Indigenous counterparts had a procedure [10].

Coronary heart disease

For acute coronary syndrome, the rates of coronary angiography and revascularisation (PCI and CABG) for Indigenous people living in NSW, Vic, Qld, WA, SA and NT and hospitalised with a principal diagnosis of CHD in the two-year period July 2006-June 2008 were only one-half of the rates for their non-Indigenous counterparts [10]. The age-adjusted Indigenous:non-Indigenous rate ratios of PCI and CABG for people admitted with a principal diagnosis of CHD were 0.4 and 0.8 respectively. The largest differences in rates for both coronary angiography and revascularisation occurred in the 55-64 and 65-74 years age groups.

The comparative risk factors, management and outcomes for Indigenous and non-Indigenous patients have been described in a retrospective study of people presenting to the Darwin and Alice Springs hospitals with acute coronary syndrome in 2001 and 2002 [38]. The Indigenous patients were more than nine years younger on average than their non-Indigenous counterparts (50.1 years compared with 59.3 years). A significantly higher proportion of Indigenous patients was female (43% compared with 30%); a history of hypertension, smoking, diabetes, and chronic kidney disease was significantly more common among Indigenous patients than among their non-Indigenous counterparts. Importantly, the onset of ACS occurred in a rural or remote setting (greater than 100 kilometres from the participating hospitals) for almost one-half of Indigenous patients (the proportion for non-Indigenous patients was 8%); presentation to Darwin or Alice Springs hospital was more than 12 hours after onset of symptoms for 29% of Indigenous patients and for 17% of non-Indigenous patients.

Similar proportions of hospitalised Indigenous and non-Indigenous patients received revascularisation procedures (PCI – 11% and 15%; CABG – 6% and 7%), but diagnostic angiography was significantly less common for Indigenous patients than for their non-Indigenous counterparts (36% compared with 48%) [38]. Indigenous patients were also less likely than non-Indigenous patients to receive in-hospital cardiac rehabilitation (9% and 16%), but more likely to receive pre-hospital aspirin (45% and 25%) and

oxygen (76% and 51%). At discharge, Indigenous patients were more likely than non-Indigenous patients to be prescribed an angiotensin-converting enzyme inhibitor (ACE) or angiotensin-receptor blocking agent (ARB) (66% and 56%), but less likely to be prescribed a lipid-lowering agent (45% and 58%). Otherwise, levels of evidence-based care were similar.

Of the 228 patients who had been discharged alive from the Alice Springs hospital, 143 (63%) attended their primary health care provider on a routine basis in the two years after discharge, but all were under-prescribed evidence-based therapies; there were no significant differences between Indigenous and non-Indigenous patients [38]. With the exception of the HDL-C target¹⁹, which was reached significantly more commonly by non-Indigenous patients than by Indigenous patients, the achievement of clinical targets was similar for Indigenous and non-Indigenous patients.

The proportions of Indigenous and non-Indigenous patients who died in hospital was not significantly different (8.4% and 6.5%), but Indigenous people were significantly more likely than non-Indigenous people to die within two years of hospital discharge from any cause (30% compared with 18%) or from a cardiovascular event (17% compared with 10%) [38].

Two recent studies have reported that the rates of in-hospital procedures for were similar for Indigenous and non-Indigenous people presenting to hospital with chest pain [82] or admitted with CHD [83], but it is likely that small rural and remote of hospitals have been under-represented in these studies [81].

Stroke

Indigenous people received lower quality of hospital care and experienced worse outcomes following stroke than did non-Indigenous people [84, 85]. Quality of care has been recognised as an important risk factor for the reduction of disability and death following a stroke. Indigenous people were estimated to be three times more likely than non-Indigenous people to become dependent on others at discharge or die.

A recent audit of hospitals across Australia revealed that Indigenous stroke patients were significantly younger than non-Indigenous patients (mean age: 59 years compared with 74 years) [80]. Indigenous and non-Indigenous patients had similar levels of independence prior to stroke, and of hypercholesterolaemia and hypertension, important risk factors for stroke. Other risk factors were more common among Indigenous people than among non-Indigenous people: diabetes (49% compared with 27%); current or past smoking (74% compared with 46%); and high alcohol consumption (34% compared with 8%). Many aspects of the clinical management of Indigenous and non-Indigenous patients

19 HDL-C is amount of cholesterol contained in high density lipoprotein particles.

were similar, but Indigenous patients were significantly less likely than non-Indigenous patients to be: treated in a stroke unit (29% compared with 41%); assessed within 48 hours by a speech pathologist, occupational therapist or physiotherapist (45%, 26% and 47% compared with 60%, 36% and 62% respectively); received aspirin within 48 hours for an ischaemic stroke (47% compared with 61%); and discharged on antithrombotic medication for an ischaemic stroke (82% compared with 93%). On the other hand, Indigenous patients were significantly more likely than non-Indigenous patients to have had their mood assessed during admission (49% compared with 25%).

Acute rheumatic fever and rheumatic heart disease

The management of ARF and RHD involves both prevention of recurrent cases of ARF and the appropriate, timely medical and surgical management of those with RHD [47, 86].

The proportion of ARF notifications classified as recurrences is an important indicator of the effectiveness of ARF control programs [87]. The proportion of recurrences has probably declined in recent years, but still comprised 27% of cases for the Top End of the NT and 30% for central Australia in 2002-2006 [7]. These levels confirm ongoing shortcomings with secondary prophylaxis programs, which are most effectively implemented very early in the natural history of RHD; with effective prophylaxis, many people with mild RHD may have no detectable disease 5 to 10 years later [47, 88]. The main shortcoming with current secondary prophylaxis programs is that many people with a past history of ARF or RHD do not receive the recommended levels of penicillin prophylaxis, optimally with intra-muscular benzathine penicillin G [47]: an audit of control programs in far north Queensland and the Kimberley region of WA found that only 18% of eligible people had received 80% or more of their doses in the preceding 12 months [89].

The various possible manifestations of RHD – damage to the heart valves and associated structures, cardiomyopathy, atrial fibrillation, systemic embolism, TIAs and strokes, and infective endocarditis [90] – require ongoing monitoring and appropriate medical and surgical management. For people with established RHD, best practice requires: secondary prevention; monitoring of anticoagulant therapy (for people with AF and/or mechanical prosthetic valves); access to oral healthcare; access to echocardiography; access to appropriate specialist(s); and access to cardiothoracic and interventional cardiology services [47].

There is no comprehensive information about how these requirements are being addressed, but an audit of control programs in far north Queensland and the Kimberley region of WA reported that only 20% of RHD patients had been prescribed an anticoagulant, 55% had been reviewed by a specialist in line with local management guidelines, 61% had had a timely echocardiogram, and 22% had undergone valve surgery [89].

The progression of valve damage is much more rapid among Indigenous patients with RHD than among their non-Indigenous counterparts: the mean age for 45 Indigenous patients from the NT who had undergone mitral valve repair procedures at the Flinders Medical Centre was 23 years [91]. Around 45% of the Indigenous patients and 4% of non-Indigenous patients were less than 25 years. Despite their youth, many of the Indigenous patients had major valve destruction as well as substantial comorbidity. Short-term results were similar for Indigenous and non-Indigenous patients, but long-term outcomes were worse for Indigenous patients than for their non-Indigenous counterparts.

Summary

The burden of disease in the Indigenous population, particularly from CVD, is likely to grow over the coming years; this, combined with the age structure of the Indigenous population (where younger ages are affected by CVD), is likely to lead to large cohorts of the Indigenous population needing cardiac care [81]. Therefore recommendations have been developed by the National Heart Foundation (NHF) and the Australian Healthcare and Hospitals Association (AHHA) to improve care for Indigenous people. These recommendations aim to improve the care received by Indigenous people in a number of health care settings including: co-ordinated care across the continuum of service; in-hospital care; pre-hospital diagnosis and evacuation for remote areas; post-hospital care; consistent data; and awareness of disparity in hospital care [81].

Prevention and rehabilitation

Much of the morbidity and mortality caused by CVD is preventable, both in terms of initial onset of the disease (primary prevention) and in terms of managing and controlling established disease (secondary prevention and rehabilitation) [6, 7, 52]. CVD has attracted substantial attention due to the largely preventable aspects of the disease, and the associated high level of health burden and costs in Australia. This attention has contributed to advances in cardiovascular health in mainstream Australia, but these advances have not been translated fully to the Indigenous population [45, 92, 93]. This is evidenced through the continuing high prevalence, hospitalisation and death rates of Indigenous people from CVD.

Barriers for Indigenous people

Indigenous people are culturally diverse, with cultural differences providing unique access issues for health care services [71, 94]. Health service planning should consider the needs of individual communities, and rates of disease, rather than adopting a 'one size fits all' approach. Therefore, while primary prevention strategies might vary little across communities, the level of resourcing for screening and treatment programs should depend on the disease burden [75].

Other barriers experienced by Indigenous people include: poor coordination across the health system; socio-economic disadvantage; poor access to acute care services and to primary and specialist health care; sub-optimal provision of in-hospital services; the availability of transport to health services; delays in presentation; and language and cultural differences [71, 95-101].

Primary prevention

Coronary heart disease

There is a large and ever-increasing evidence base for the primary prevention of CHD [102, 103]. At a population level, everyone is encouraged to reduce their cardiovascular risk by eating a healthy and varied diet, being physically active on a regular basis, maintain a healthy weight, and to cease smoking. As well as these behavioural aspects, high blood pressure and blood lipids are also important risk factors for CHD.

For those who have one or more risk factors for CVD, primary prevention strategies must be tailored to the individual. It has been observed that the majority of Indigenous people who present with a cardiovascular event have at least one comorbidity or risk factor [41, 74, 104], and should therefore receive individually tailored prevention programs. Development of these programs are now usually guided by an algorithm that assesses an individual's overall or absolute risk of CHD; the CHD section of the revised *National guide to a preventive health assessment for Aboriginal and Torres Strait Islander people* was informed by the Framingham Risk Equation [105]. In recognition that there are some doubts about the strict applicability of the algorithms to Aboriginal and Torres Strait Islander people [106], their use should be

- guided by clinical judgement as well the risk assessment
- recognise that Aboriginal and Torres Strait Islander people are at much higher risk than non-Indigenous people of vascular events, particularly at younger ages, and are also less likely than non-Indigenous people to receive preventive and/or acute care for vascular disease
- consider the interactions of diabetes and renal impairments and vascular risks [103].

A thorough discussion of the primary prevention of CHD is beyond the scope of this review, but it is important to note that the risk factors for CHD are often linked, meaning that they can act synergistically when they occur in the same person (see 'Comorbidity' above) [6]. In addition, the reduction of these risk factors will also help prevent several other major diseases (such as type 2 diabetes) that share these risk factors. Thus, risk factors should not be viewed in isolation when looking at possible prevention strategies. Even after allowing for the effects of behavioural and biomedical risk factors (such as smoking, physical inactivity and obesity), socioeconomic variables remain independently associated with the risk of death from CVD [47, 86, 107].

Stroke

As well as the various aspects outlined above for CHD, the primary prevention of stroke needs to direct attention to risky alcohol consumption, the presence of atrial fibrillation (AF), and a history of TIAs (mini-strokes [108, 109]. Reducing the risk of stroke in people with AF can benefit from oral anticoagulants and aspirin, and anti-platelet therapy can be beneficial for people with a history of TIA [109].

Rheumatic heart disease

RHD (including ARF) is a preventable cause of morbidity and mortality among Indigenous people, and organised primary health care is essential for its control [47]. Genuine prevention of ARF and RHD requires improvements in socioeconomic conditions and housing, which would lower the carriage and transmission of group A streptococci, the causative agent for ARF, and reduce the need for early detection and treatment with antibiotics to prevent ARF [110]. There is also a great need for health care providers to concentrate on meeting the needs of Indigenous people with RHD through better prevention, diagnosis, service delivery and access to care [111, 112].

Primary prevention requires broad political commitment to addressing the social, economic and environmental inequities experienced by Indigenous people [111, 113]. Improvements in the interrelated areas of housing, education and employment are required to address chronic disease, rather than concentrating solely on health service delivery [114]. Limitations in the delivery of holistic care seem to be due to the lack of structure between services of the commonwealth, state, and territory governments in this area [115]. Many areas affecting health, including education, employment, social services, and transport, are not greatly influenced by the health sector, therefore national health policies for Indigenous people may require much greater integration.

A key area in the primary prevention of RHD (including ARF) is the prevention, diagnosis and treatment of group A streptococcus upper respiratory tract infection pharyngitis/tonsillitis [47]. These measures can help control infection and prevent an initial case of ARF. Treatment is with oral antibiotics such as penicillin.

There is considerable potential for reduction in the incidence of RHD among Indigenous people, but there must be committed application of the knowledge currently available [47, 86, 113]. As well as action addressing the various behavioural risk factors, attention also needs to be directed to the adverse social, economic, and environmental conditions of many Indigenous people.

Secondary prevention and rehabilitation

Secondary prevention for Indigenous people refers to interventions for those who have experienced a cardiovascular event (for example, a heart attack or stroke or episode of ARF) and

are therefore at risk of another event [6]. Secondary prevention includes treatment with medication, as well as rehabilitation to help patients return to an active life. Rehabilitation begins during a patient's hospital stay, but the majority occurs after discharge. Continuing medical treatment after a cardiovascular event can help to control symptoms and reduce ongoing risk factor levels. The reduction of risk factors has even greater potential to prevent further cardiovascular events in those with established CVD than in those without.

Improvements in secondary prevention services for CVD, including outpatient rehabilitation, is critical for reducing the likelihood of further cardiovascular events [97]. It is important for Indigenous communities and health services to be involved in the continual development of secondary prevention and rehabilitation programs for Indigenous people, particularly in rural and remote areas.

Cardiac rehabilitation

Cardiac rehabilitation is an important part of secondary prevention of CHD, aiming to give people the confidence, motivation and skills to make a lifelong commitment to a healthy lifestyle and greater wellbeing [73].

The level of Indigenous participation in cardiac rehabilitation programs is much lower than it should be [6, 97, 98]. Appropriate services are not available or accessible for all Indigenous people with CVD, especially those living in rural and remote Australia. Not all patients eligible for cardiac rehabilitation are referred, even when a program is available and accessible. Despite increases in the awareness of such issues, referral may not be standard practice and some patients who are referred do not attend. Rural and remote services need to be coordinated and the shortage of allied health staff acknowledged. A standardised data-collection tool is needed, so more information on attendance at cardiac rehabilitation programs can be gathered [38]. Programs for Indigenous people also need to be made more accessible and culturally appropriate, so participation rates improve [94, 116].

Stroke rehabilitation

Stroke can result in the sudden and catastrophic decline in ability, lifestyle, and independence, especially for younger patients [6]. Social and emotional wellbeing may also be affected by stroke, and conditions such as depression may develop [117]. Family members and carers of people who have suffered a stroke may also be vulnerable to these conditions [117, 118]. Various factors are associated with successful stroke rehabilitation, but there is no standardised approach for identifying who will benefit from rehabilitation. The majority of strokes in the general population affect older people, but rates among Indigenous people are similar to those for non-Indigenous Australians who are around 20 years older. Stroke rehabilitation programs rarely meet the specific needs of younger patients, and this is likely to be particularly so for

Indigenous people [7, 95, 117].

The provision of culturally appropriate stroke rehabilitation services for Indigenous people is complex, particularly for patients living in remote areas [95]. Some of the challenges include: difficulties in communication; misunderstandings by patients of the meaning of rehabilitation; a desire by patients for same-sex carers; poor access to care and services; and difficulties with obtaining equipment and modifying the home in remote environments [95, 119, 120].

The stroke rehabilitation services available to Indigenous people vary greatly by location, with services clustered in some areas and few or no services in others, particularly rural and remote areas [71]. Assessment procedures, management approaches, and outcome measures vary between services, limiting effective communication between centres and impeding attempts to work towards best practice.

Despite the higher levels of mortality and morbidity from stroke in the Indigenous population, the availability of programs for primary and secondary prevention and rehabilitation for Indigenous people, especially those living in rural and remote areas, appear to be fragmented [95]. Expenditure for stroke in Australia made up 9% of the total funding spent on CVD in 2004-05, of which only 8% went to out-of-hospital services [121]. Prevention services appeared relatively underfunded compared with treatment services.

Rheumatic heart disease

The secondary prevention RHD, which aims to prevent recurrences of group A streptococcus infection and recurrent cases of ARF, uses regular long-term prophylaxis with penicillin [47]. To be effective, a high level of prophylaxis must be achieved. Four-weekly courses of antibiotics are the treatment of choice, except in patients considered to be at high risk, for which 3-weekly administration may be recommended. The benefits of a longer course of medication are offset by the difficulties of achieving good adherence to the regimen. The appropriate duration of secondary prophylaxis is determined by age, time since the last episode of ARF, and potential harm from recurrent disease. For Indigenous people with established rheumatic valvular disease, access to cardiac surgery may be important.

Future directions

Comprehensive primary health care programs and increased training and support for health care providers will provide a basis for addressing the inequities in health care for Indigenous people [99]. More accessible and culturally appropriate primary health care should enable Indigenous people with CVD to be identified earlier in the course of their illness and have comorbidities treated in a more timely fashion [37, 100]. This would be better achieved by involvement of Indigenous patients in decision making, and

greater development of key services including: Aboriginal Health Workers; liaison officers, and interpreters [94, 97, 116].

In terms of specific initiatives for CVD, the National Indigenous Health Equality Summit, held in Canberra in March 2008, outlined specific targets and processes for primary prevention, secondary prevention and the management of chronic heart disease [122].

Primary prevention

The reduction of cigarette smoking and improved access to healthy foods were identified as crucial to reducing the risk of vascular events among Indigenous people [122]. Multi-layered smoking cessation approaches were seen as necessary in the achievement of parity in the smoking rates of Indigenous and non-Indigenous people by 2020, and significant reform beyond the health sector was recognised as important in moving towards food security.

To reduce the absolute risk of a vascular event by 2.5% in 10 years, it was proposed that more than 80% of eligible Indigenous adults should have at least one risk assessment in each two-year period [122]. Indigenous people with an elevated vascular risk should receive appropriate medical and non-medical management.

Secondary prevention

For Indigenous people with existing cardiovascular disease, there is a need to increase availability of specialists, including outreach services through Aboriginal community-controlled health organisations, and other urban, rural and remote settings [122]. In view of the relationships between CHD, diabetes and chronic kidney disease, all Indigenous people with existing disease should also have regular reviews of appropriate biomedical and other measures, and regular screening for potential complications. The resources required for effective secondary intervention will differ among communities according to the disease burden, and the specific community, and can best be determined through consultation with the communities and individuals targeted [75].

The secondary prevention of acute rheumatic fever and rheumatic heart requires more than 80% of those needing prophylaxis to receive greater than 80% of scheduled injections each year [122]. Adherence to prophylaxis for RHD can be improved when patients feel a sense of personalised care and 'belonging' to the healthcare service or clinic [47]. It would therefore be beneficial to extend this type of care to Indigenous people experiencing any form of CVD, and further broaden out to include all chronic disease.

Management of chronic heart disease

To reduce adverse outcomes in chronic disease, the National Indigenous Health Equality Summit set targets for both reducing the time to care and in-hospital management for Indigenous people [122]. It was recognised that more than 80% of people experiencing acute coronary syndrome (ACS) should receive

appropriate and timely care, and that more than 80% of high-risk ACS patients should have access to appropriate management and care. With reduction in the time to care, improved in-hospital treatment, appropriate discharge care, long-term of CVD, and improved continuity of care across sectors, the excess case fatality of Indigenous CHD patients at 12 months should be reduced from 30% to 10%.

Policies and strategies

Selected information on some of the key developments in the area of Indigenous Australian cardiovascular health are included below; the information does not include all developments in the area.

National chronic disease strategy

CVD forms part of the Australian Government's National chronic disease strategy endorsed at the Australian Health Ministers' Conference in 2005 [123]. The strategy has three main components: an overarching framework for improving chronic disease prevention and management in Australia; *National service improvement frameworks* for five chronic diseases, including heart, stroke and vascular disease [118]; and the *Blueprint*, a framework for nationwide surveillance for chronic diseases and associated determinants [124].

The *National service improvement framework for heart, stroke and vascular disease* is not specific for Indigenous people, but states that all health services provided to Indigenous people should be provided in accordance with the Australian Health Ministers' Advisory Council's *Cultural respect framework for Aboriginal and Torres Strait Islander health, 2004-2009* [118, 125]. The framework identifies the barriers to health care access for Indigenous people including: distance and access to transport; affordability; availability of health professionals; cultural appropriateness; and acceptability of services.

The rheumatic fever strategy

This strategy aims to address RHD (including ARF) among Indigenous people, particularly children. It provides a coordinated program including prevention and treatment; funding for state-based register and control programs in the NT, WA and Qld; and a national coordination unit, RHD Australia. The strategy builds on the RHD program, which was established in the Top End of the NT in 1997 and extended to include central Australia in 2000 (where it became fully operational in 2002) [126, 127].

The key outcomes of this strategy include improvements to clinical responses, and support for monitoring and treatment of this disease, through the establishment of a national data collection system. These outcomes will be achieved by: conducting surveillance, including identification and registration of new and recurrent cases; providing education and training for health care providers;

improving clinical care and follow-up; providing education and health promotion to clients, families and the community; and supporting the uptake of and adherence to secondary prophylaxis [47, 86, 126, 128].

The 2006 guidelines for the diagnosis and management of RHD (including ARF) in Australia are based on a review by the NHF and the Cardiac Society of Australia and New Zealand (CSANZ), and informed by the National Health and Medical Research Council (NHMRC) [47]. The second edition of these guidelines was released in 2012 [49].

Cardiac rehabilitation geographic information system

Resources to assist health professionals working with Indigenous people who have experienced a cardiac event have been developed by the NHMRC [94, 116]. These resources were developed in conjunction with the National Aboriginal Community Controlled Health Organisation (NACCHO) and the Australian Indigenous Doctors' Association (AIDA).

Their development also involved wide consultation with health professionals and consumers to determine why Indigenous people did not attend cardiac rehabilitation programs, and how services could be made more accessible. The information contributed to a practical guide for health professionals *Strengthening cardiac rehabilitation and secondary prevention for Aboriginal and Torres Strait Islander peoples: a guide for health professionals* [94, 116].

In addition, the *Cardiac geographic information system project* was commissioned. This involved the development of an interactive report and maps that integrate the location of cardiac rehabilitation services with patients who have had a cardiac event. Designed as a resource for primary health care providers and cardiac rehabilitation services, the tool can be used to locate services and understand the distribution of cardiac illness in local areas [128].

Outreach programs

The barriers faced by many remote Indigenous people accessing specialist care are substantial. Outreach delivery of specialist services has overcome some of the barriers relating to distance, communication and cultural appropriateness [129].

The *Medical specialist outreach assistance program* is funded by the Australian Department of Health and Ageing to improve access to medical specialist services for people living in rural and remote Australia [130, 131]. The outreach specialist services provided by the NT and state governments allow for financial assistance to cover some of the costs for specialists associated with delivering outreach services, including travel, accommodation, and consulting room hire costs. They also provide financial assistance

for professional support to local general practitioners, specialists and other health professionals (such as allied health professionals).

The delivery and support of outreach medical specialist services has achieved considerable success since 2004 [130, 131]. The program provides more than 1,375 specialist services annually to rural and remote communities. Additional funding of \$9 million over three years, commenced in 2008-09, to support the expansion of the program to improve rural and remote community access to a range of medical specialist services. The aim was to provide opportunities for new and expanded services, and to reduce waiting lists for people in rural and remote communities to obtain treatment.

Indigenous chronic disease fund

Indigenous health, Outcome 8 of the 2011-12 Australian Government budget, included the objective of improving the prevention and management of chronic disease through the *Aboriginal and Torres Strait Islander chronic disease fund* [132]. This fund was developed after a review of administration arrangements in the portfolio, and will be established by consolidating exiting programs and initiatives of the Indigenous chronic disease package [133].

Part of this objective includes three key areas: preventing chronic disease; improving the detection and ongoing management of chronic disease; and, building the capacity of the workforce [132]. Prevention areas include the establishment of increased regionally focused teams to deliver preventive health care that focuses on reducing risk factors for chronic disease. Areas of detection and management will see improvements to the range of services: greater services to those at risk of developing chronic disease; the reduction of prescription payments to those at risk; greater geographic coverage of management services; and further training for health workers in chronic disease self-management support for patients. The workforce area includes: funding for orientation and training in the Indigenous health workforce; support and encouragement to join or remain in the workforce; an advertising campaign and an engagement program to attract students and health professionals to the field; and funding for additional staff of nine health professionals; 11 practice managers; and 22 Indigenous outreach workers, nationally.

Concluding comments

Indigenous people experience much poorer cardiovascular health than do other Australians. CVD makes the largest substantial contribution to the disparities in health between Indigenous people and non-Indigenous people. Reflecting the higher levels of CVD among Indigenous people, mortality from the disease is three and four times higher for Indigenous people than for other Australians.

CHD is the leading cause of death for Indigenous people, with the differences in death rates between the Indigenous and non-Indigenous populations being particularly high in the middle adult years (35-54 years). The pattern for CBVD, another major contributor to Indigenous mortality, is similar. Deaths from RHD are not uncommon among Indigenous people, but are rare among the non-Indigenous population.

The factors contributing to the high levels of CVD among Indigenous people, and associated hospitalisation and mortality, are complex. The high levels of behavioural and biomedical risk factors seen among Indigenous people are clearly associated with the high levels of CVD, but these factors cannot be seen in isolation; they must be viewed within a social determinants context. As with other areas of Indigenous health, historical, socio-cultural and economic aspects are the upstream factors within which the behavioural and biomedical risk factors and the actual impacts of CVD should be viewed.

Reductions in the various factors that contribute to the development of CVD among Indigenous people are very important, but improvements in some of these areas, particularly in behavioural risk factors and upstream factors, are likely to take some time to be reflected in better cardiovascular health among Indigenous people.

On the other hand, current deficiencies in the management of established disease suggest there is considerable scope for better services that should lead to improvements in the short to medium term. There is clearly great scope for improvement in the management of CHD and CBVD, both in-hospital and in secondary and tertiary prevention. The scope for improvement in the management of RHD would appear to be even greater. Improvements in this area would require secondary prevention through penicillin prophylaxis for people with a history of ARF and RHD, as well as much better medical and surgical management of those with established RHD.

Reducing the impact of CVD among Indigenous people is a crucial aspect in 'closing the gap' in health between Indigenous and other Australians, one of the commitments made in 2008 by all Australian governments through the Council of Australian Governments (COAG) [134]. As a part of its overall commitments to reducing

Indigenous disadvantage, COAG set a number of targets, the first two of which related specifically to Indigenous health:

- close the life expectancy gap within a generation
- halve the gap in mortality rates for Indigenous children under five within a decade
- ensure access to early childhood education for all Indigenous four year olds in remote communities within five years
- halve the gap in reading, writing and numeracy achievements for children within a decade
- halve the gap for Indigenous students in year 12 attainment rates by 2020 [135].

In addressing the targets specifically related to health, COAG committed \$1.57 billion over four years to 'closing the gap in Indigenous health outcomes' [136], with a significant proportion devoted to addressing chronic diseases including CVD. The COAG and other commitments to reductions in chronic disease among Indigenous people, along with a number of other initiatives (including the ARF and RHD, cardiac rehabilitation and outreach programs noted above), raise the probability of real reductions in CVD among Indigenous people.

As encouraging as these developments are, achievement of substantial improvements in the cardiovascular health of will also depend the effective implementation of comprehensive strategies and policies that address the complexity of the factors underlying the disadvantages experienced by Indigenous people.

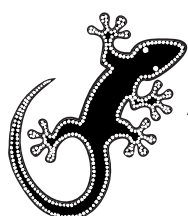
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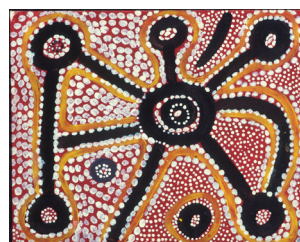
The Australian Indigenous HealthInfoNet is an innovative Internet resource that contributes to 'closing the gap' in health between Indigenous and other Australians by informing practice and policy in Indigenous health.

Two concepts underpin the HealthInfoNet's work. The first is evidence-informed decision-making, whereby practitioners and policy-makers have access to the best available research and other information. This concept is linked with that of translational research (TR), which involves making research and other information available in a form that has immediate, practical utility. Implementation of these two concepts involves synthesis, exchange and ethical application of knowledge through ongoing interaction with key stakeholders.

The HealthInfoNet's work in TR at a population-health level, in which it is at the forefront internationally, addresses the knowledge needs of a wide range of potential users, including policy-makers, health service providers, program managers, clinicians, Indigenous health workers, and other health professionals. The HealthInfoNet also provides easy-to-read and summarised material for students and the general community.

The HealthInfoNet encourages and supports information-sharing among practitioners, policy-makers and others working to improve Indigenous health – its free on line yarning places enable people across the country to share information, knowledge and experience. The HealthInfoNet is funded mainly by the Australian Department of Health and Ageing. Its award-winning web resource (www.healthinfonet.ecu.edu.au) is free and available to everyone.

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FEATURED ARTWORK

Ceremonial grounds

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