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cardiovascular disease—derived from self-reported data collected in the 2001 National Health Survey (NHS)—in order to identify population groups most at risk.

Box 1: What are risk factors?

Risk factors are a range of health-related behaviours and conditions that can increase the risk of a health disorder or other unwanted condition or event, and they include both modifiable and non-modifiable factors.

Risk factors include behavioural and biomedical factors, as well as socioeconomic, environmental and other societal factors.

Behavioural risk factors include tobacco smoking, insufficient physical activity, poor nutrition and risky alcohol consumption.

Biomedical risk factors are risk factors expressed as a body measurement such as overweight, high blood pressure, high blood cholesterol and diabetes (which is a disease in itself as well as a risk factor).

Background

Cardiovascular disease refers to all diseases of the heart and blood vessels. It includes coronary heart disease, stroke, other vascular disease and heart failure. The two major clinical forms of coronary heart disease are heart attack and angina. The health and economic burden of cardiovascular disease exceeds that of any other disease. Despite major improvements in the cardiovascular health of Australians and falling death rates over the past 30 years, coronary heart disease and stroke remain the leading causes of death in Australia (AIHW 2004).

Atherosclerosis—often called hardening of the arteries—is the main underlying cause of cardiovascular disease. It results in the clogging of blood-supply vessels (the arteries) with deposits of cholesterol and other substances accumulated in the vessels' inner lining. It is most serious when it affects the blood supply to the heart—causing angina or heart attack—or to the brain, which can lead to a stroke (AIHW 2004).

Many characteristics are related to an increased risk of stroke and coronary heart disease, such as behavioural and biomedical risk factors, age, sex and a family history of premature heart disease. The major preventable risk factors for cardiovascular diseases are tobacco smoking, insufficient physical activity, poor nutrition, risky alcohol consumption, raised blood pressure, abnormal cholesterol levels, excess body weight and Type 2 diabetes. Some of these risk factors may be interrelated, and there is clear evidence that reducing or eliminating them, where possible, can prevent a significant proportion of strokes and coronary heart disease events.

The INTERHEART study—a case-control study of acute myocardial infarction (AMI) (heart attack) undertaken in 52 countries—found that 90% of the cases of AMI could be attributed to nine risk factors (smoking, abnormal lipids, hypertension, diabetes, abdominal obesity, psychosocial factors, alcohol consumption, lack of regular physical activity, and insufficient fruit and vegetable consumption). This finding held for men and women of all ages in all regions (Yusuf et al. 2004).

In addition to the behavioural and biomedical factors that increase a person's risk of developing cardiovascular disease, there is a growing body of evidence that the determinants of health go beyond these to the underlying social, economic, psychological and cultural factors (AIHW 2004).

Multiple factors increase risk

While the risk factors described in the previous section are individually important, having more than one risk factor tends to magnify the risk of disease (Kannel 2000; Poulter 1999). For example, a person with mildly raised blood pressure (hypertension) and no other risk factors will be at a lower risk of a cardiovascular event than someone with mild hypertension and one or two other risk factors (WHO-ISH 1999).

The presence of multiple risk factors can accelerate the development of atherosclerosis. Berenson et al. (1998) undertook autopsy studies of participants in the Bogalusa Heart Study who had died (mostly due to external causes such as accidents) aged between 2 and 39 years. They found that the more risk factors people had the worse their arteries were affected by atherosclerosis. They therefore concluded that it is important to focus on multiple cardiovascular risk factors early in life.

As may be expected, the increased risk of illness associated with having multiple risk factors has been shown to translate to reduced life expectancy and greater health care costs. Results from the Chicago Heart Association Study showed that the more risk factors a person had when they were 40–64 years old, the greater were their health care costs later in life (Daviglus et al. 1998).

There is a steady increase in risk of all-cause deaths and cardiovascular disease deaths as the number of risk factors present increases (Trevisan et al. 1998). Lowe et al. (1998) found that combinations of major cardiovascular disease risk factors increased the risk of coronary heart disease, cardiovascular disease and all-cause mortality. According to studies from the United States, people who have low cholesterol and low blood pressure, do not smoke and do not have diabetes or heart abnormalities live 6 to 9 years longer on average than people who have the corresponding risk factors (Stamler et al. 1999).

It is not just the number of risk factors a person has that is important. While risk factors are often categorised by whether or not they exceed a certain cut-off value, the risk of illness tends to increase across the continuum of levels. Generally, the lower the level of a risk factor the better. For example, starting from quite low levels, as blood cholesterol increases so does the risk of death from coronary heart disease (NHFA & CSANZ 2001). So while someone with total cholesterol of 5.5 mmol/L may be categorised as having high cholesterol, a person with a cholesterol level of say 5.0 mmol/L has a higher risk of illness than a person with a cholesterol level of 4.5 mmol/L. However, for population monitoring purposes, it is conventional to categorise risk factors using cut-offs (such as 5.5 mmol/L for total blood cholesterol).

Methods

The analysis presented in this report is based on data collected in the Australian Bureau of Statistics (ABS) 2001 NHS. The 2001 NHS is a nationally representative cross-sectional survey of the household population of Australia. It is important to note that data collected in the survey are self-reported, and so rely on respondents' knowledge of their health status for their degree of accuracy. Also, as the NHS is a cross-sectional survey, it is possible to identify statistical associations between variables, but not causal

relationships. Results presented in this bulletin are survey estimates based on the self-reported data, including derived items for some risk factors.

Estimates of the prevalence of risk factors and the distribution of the number of risk factors that people are estimated to have, by key demographic variables and the self-reported presence of heart or circulatory conditions, are presented for adults aged 18 years and over.

The nine risk factors included in the analysis are tobacco smoking, physical inactivity, low fruit and vegetable consumption, risky alcohol consumption, high blood pressure, high blood cholesterol, obesity and diabetes. The risk factor data were categorised so as to indicate whether or not the risk factor was present to an extent likely to have a significant impact on risk. See Box 2 and Appendix 1 for definitions of these variables.

The NHS included information on self-reported heart and circulatory conditions, which are used here as an indicator of the existence of cardiovascular disease. For this report, heart attack, angina and stroke were examined because of their significant contribution

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Box 2: Risk factors and heart and circulatory conditions defined

Risk factors

Smoking: *current daily smoking of tobacco.*

Physical inactivity: *very low levels of leisure-time exercise (less than 15 minutes weekly).*

Low fruit consumption: *usual daily intake of one serve or less.*

Low vegetable consumption: *usual daily intake of three serves or less.*

Risky alcohol consumption: *average daily consumption of more than four standard drinks for men and more than two standard drinks for women.*

High blood pressure and high blood cholesterol: *people who have previously been told by a doctor or nurse that they have the condition, for whom the condition is current.*

Obesity: *body mass index of 30 kg/m² or more.*

Diabetes: *self-reported current Type 1, Type 2 or other diabetes.*

Note: *obesity, physical inactivity and risky alcohol consumption are derived data items. The remaining risk factors are as reported by respondents.*

Heart and circulatory conditions

Respondents were asked, after being shown a prompt card with examples, whether they had ever been told by a doctor or nurse that they have a heart or circulatory condition (including those controlled with medication). Those people who answered yes were asked what the names of these conditions were, with the choices including heart attack, stroke (including after-effects of stroke), angina, hardening of the arteries/atherosclerosis/arteriosclerosis and others. Respondents may have reported more than one of these conditions.

Source: ABS 2003b.

to deaths in Australia. Atherosclerosis was also included because of its key role in the development of cardiovascular disease. See Box 2 and Appendix 1 for more details.

The likelihood of having had a heart or circulatory condition (as reported by respondents) by risk factor status was estimated using logistic regression (controlling for age and sex). The number of risk factors was grouped for this analysis as none, one or two, three or four, five or more. More detail on the modelling is given in Appendix 2.

Limitations of the data analysed and methods used are provided in the discussion and appendixes.

Results

Prevalence of risk factors

Individual risk factors

An estimated 92% of Australian adults had at least one of the nine risk factors investigated (corresponding to around 13 million people) (Table 1). Overall, men were more likely than women to have at least one of these nine risk factors (94% versus 91%).

The most common risk factor among Australian adults was poor diet; nearly 70% of people reported low usual vegetable consumption, and 48% reported low usual fruit consumption (Table 1). Men were more likely than women to report usually consuming less than four serves of vegetables or two serves of fruit daily. Nearly a third of Australians were estimated to be physically inactive, with women being slightly more likely than men to be inactive. These three risk factors alone indicate that many Australians are at an increased risk of poor health. A large proportion of men and women reported being current daily smokers—men being more likely to smoke than women (25% versus 20%). Men were also more likely than women to report consuming alcohol at risky levels (13% of men compared with 9% of women).

Table 1: Risk factor prevalence among Australians aged 18 years and over, 2001

Risk factor	Number[a]			Per cent		
	Men	Women	Persons	Men	Women	Persons
Low vegetable consumption	5,086,000	4,806,500	9,892,500	73.2	66.4	69.8
Low fruit consumption	3,726,200	3,016,300	6,742,400	53.7	41.7	47.5
Physical inactivity	2,126,700	2,336,600	4,463,300	30.6	32.3	31.5
Smoking	1,762,900	1,410,500	3,173,400	25.4	19.5	22.4
Obesity	1,086,700	1,226,500	2,313,200	15.6	16.9	16.3
High blood pressure	886,700	1,062,900	1,949,600	12.8	14.7	13.7
Risky alcohol consumption	924,200	614,000	1,538,300	13.3	8.5	10.8
High blood cholesterol	607,700	572,300	1,180,000	8.8	7.9	8.3
Diabetes	268,700	282,400	551,100	3.9	3.9	3.9
One or more risk factors	*6,523,300*	*6,546,700*	*13,070,000*	*93.9*	*90.5*	*92.2*

(a) Rounded to the nearest 100.

Note: Estimates based on self-reported data.

Source: AIHW analysis of the 2001 NHS.

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Obesity and high blood pressure were estimated to occur in 16% and 14% of Australian adults respectively (Table 1). As discussed in the Limitations section, these are both likely to considerably underestimate the true prevalence of these risk factors. Similarly, the number of people affected by high blood cholesterol levels and diabetes, here estimated to be around 8% and 4% of the adult population respectively, are likely to be underestimates of the true prevalence of these conditions (see Discussion).

Multiple risk factors

It was estimated that more than half of all adults had two or three of the nine risk factors analysed (53%), with nearly one person in six (16%) having four or more risk factors (Table 2). Men and women were similarly likely to have five or more risk factors (5%), while women were slightly more likely than men not to report any risk factors (10% compared with 6%).

Table 2: Multiple risk factor[a] prevalence among Australians aged 18 years and over, 2001

Number of risk factors	Number[b]			Per cent		
	Men	Women	Persons	Men	Women	Persons
None	420,300	691,100	1,111,400	6.1	9.5	7.8
One	1,420,600	1,900,900	3,321,500	20.5	26.3	23.4
Two	2,071,300	2,121,600	4,193,000	29.8	29.3	29.6
Three	1,776,400	1,476,700	3,253,100	25.6	20.4	22.9
Four	892,500	722,600	1,615,100	12.9	10.0	11.4
Five or more	362,500	324,800	687,300	5.2	4.5	4.8

(a) Obesity, high blood pressure, high blood cholesterol, diabetes, physical inactivity, smoking, risky alcohol consumption, low vegetable consumption and low fruit consumption.

(b) Rounded to the nearest 100.

Note: Estimates based on self-reported data.

Source: AIHW analysis of the 2001 NHS.

Multiple risk factors by age

Regardless of age, people were most likely to have two risk factors; this ranged from an estimated 35% of 18–24 year olds to 26% of 55–64 year olds (Table 3). People in the youngest and oldest age groups were estimated to have the lowest prevalence of no risk factors (6%). The estimated prevalence of five or more risk factors increased with age to 74 years, and then decreased slightly for people aged 75 years and over.

Interestingly, while the proportion of men in each age group with no risk factors showed little variation, women aged 25–64 years were more likely to have no risk factors than women outside this age range (10–12% compared to 6–8%).

Multiple risk factors by socioeconomic status

Socioeconomic status was measured using an area-based socioeconomic index (SEIFA, developed by the ABS). The index is presented here in five equal groups (quintiles), with the first quintile corresponding to the most disadvantaged group, and the fifth to the least disadvantaged group (for more information see Appendix 1).

Table 3: Number of risk factors reported by age group and sex, Australia, 2001

	Age group (years)						
Number of risk factors	18–24	25–34	35–44	45–54	55–64	65–74	75+
	Per cent						
Men							
None	5.7	6.1	6.0	6.1	6.2	6.0	6.5
One	22.1	21.0	19.0	21.5	16.7	19.5	26.6
Two	34.5	32.9	30.8	27.0	25.5	30.1	23.5
Three	26.2	23.6	26.7	24.0	28.7	26.1	24.5
Four	9.7	12.4	12.2	14.1	15.8	12.8	13.7
Five or more	1.8	3.9	5.4	7.3	7.2	5.5	5.2
Women							
None	6.6	9.9	10.1	11.1	11.6	8.3	6.3
One	31.1	27.5	27.4	26.8	24.9	20.7	20.3
Two	34.5	32.4	29.4	27.1	25.7	25.9	28.2
Three	17.6	19.2	21.2	19.3	21.2	22.3	24.6
Four	8.3	9.1	9.1	10.6	10.3	11.7	13.1
Five or more	2.0	1.9	2.8	5.0	6.3	11.2	7.5

Notes

1. Risk factors include obesity, high blood pressure, high blood cholesterol, diabetes, physical inactivity, smoking, risky alcohol consumption, low vegetable consumption and low fruit consumption.

2. Estimates based on self-reported data.

*Source:* AIHW analysis of the 2001 NHS.

The prevalence of physical inactivity, obesity, inadequate fruit and vegetable intake, smoking and high blood pressure have all been shown individually to be more common among people in the most disadvantaged group than among those in the least disadvantaged group (ABS 2003a; AIHW: O'Brien & Webbie 2003). Similarly, people in the most disadvantaged group were more likely to have three or more risk factors than those in the least disadvantaged group (Figure 1). The use of an aggregated measure of socioeconomic status may lead to underestimation of the disadvantage at an individual level (see Discussion).

Prevalence of heart and circulatory conditions

The 2001 NHS collected information on whether respondents reported having ever been told by a doctor or nurse that they have a heart or circulatory condition (see Box 2 and Appendix 1). Table 4 shows the estimated number and proportion of people reporting selected conditions. A greater proportion of men than women reported having ever been told that they had suffered a heart attack, stroke, angina or atherosclerosis. This was particularly so for heart attack and atherosclerosis, where the proportion of men reporting ever having been told they had these conditions was about double that for women. Overall, 8% of men and 5% of women reported ever having being told they had at least one of these conditions—corresponding to nearly one million people in total.

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Figure 1: Number of risk factors by socioeconomic status for Australians aged 18 years and over, 2001
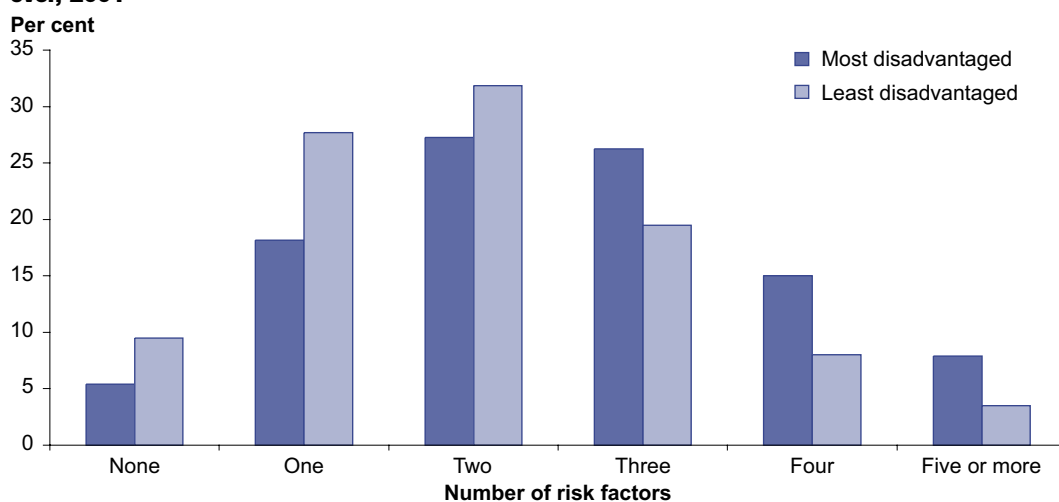
Per cent

Notes

1. Risk factors include obesity, high blood pressure, high blood cholesterol, diabetes, physical inactivity, smoking, risky alcohol consumption, low vegetable consumption and low fruit consumption.

2. Estimates based on self-reported data.

3. Socioeconomic status based on quintiles of relative socioeconomic disadvantage.

Source: AIHW analysis of the 2001 NHS.

Table 4: Heart and circulatory condition prevalence among Australians aged 18 years and over, 2001

Heart/circulatory condition[b]	Number[a]			Per cent		
	Men	**Women**	**Persons**	**Men**	**Women**	**Persons**
Heart attack	264,200	116,100	380,300	3.8	1.6	2.7
Stroke	121,700	93,500	215,200	1.8	1.3	1.5
Angina	227,400	177,100	404,500	3.3	2.4	2.9
Atherosclerosis	161,100	75,300	236,400	2.3	1.0	1.7
Total[c]	**552,300**	**360,000**	**912,300**	**8.0**	**5.0**	**6.4**

(a) Rounded to the nearest 100.

(b) Respondents could report more than one of these conditions.

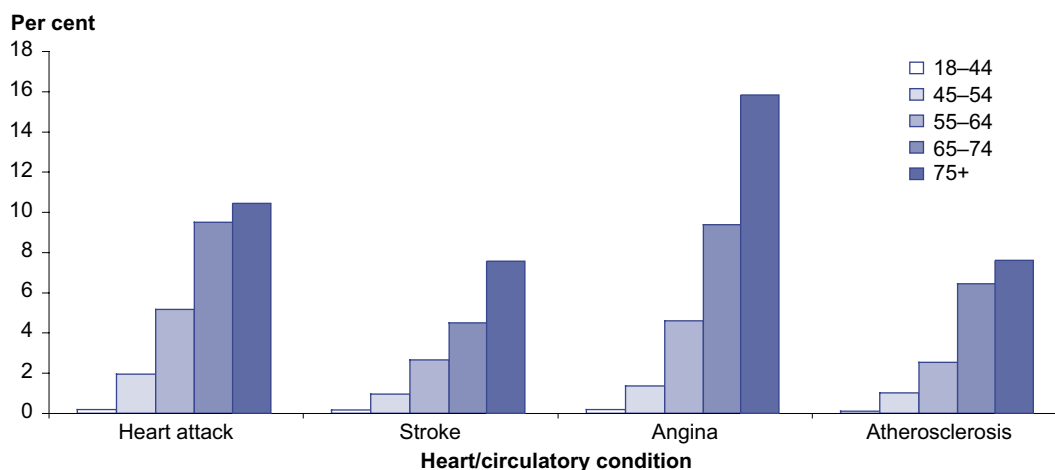(c) Any one or more of heart attack, stroke, angina or atherosclerosis.

Note: Estimates based on self-reported data.

Source: AIHW analysis of the 2001 NHS.

Heart and circulatory conditions by age

The estimated prevalence of self-reported heart and circulatory conditions, as expected, increased dramatically with age: very few people under the age of 45 reported these conditions, while people aged 75 years and over were most likely to report these conditions (Figure 2). In particular, more than one in seven (16%) people aged 75 years and over reported ever having had angina.

Figure 2: Prevalence of selected heart/circulatory conditions by age group, Australia, 2001

Note: Estimates based on self-reported data.

Source: AIHW analysis of the 2001 NHS.

Heart and circulatory conditions by socioeconomic status

The estimated prevalence of heart attack, stroke, angina and atherosclerosis were higher among people in the most disadvantaged socioeconomic group than those in the least disadvantaged group (Table 5).

Heart and circulatory conditions by number of risk factors

The prevalence of selected self-reported heart and circulatory conditions by the number of risk factors reported is shown in Figure 3. While the overall percentage of people reporting each of these conditions was low, they are estimated to affect nearly one million people, and the prevalence showed a clear increase as the number of risk factors increased. A dramatic increase in the prevalence of heart attack, stroke, angina and atherosclerosis was seen for people with five or more risk factors.

Table 5: Heart and circulatory condition prevalence among Australians aged 18 years and over by socioeconomic status and sex, 2001

Heart/circulatory condition[a]	Men		Women	
	Most disadvantaged group[b]	Least disadvantaged group[b]	Most disadvantaged group[b]	Least disadvantaged group[b]
	Per cent			
Heart attack	4.7	3.2	2.5	1.1
Stroke	3.2	1.3	1.6	0.9
Angina	4.9	2.1	3.4	1.7
Atherosclerosis	2.5	1.9	1.8	0.8

(a) Respondents could report more than one of these conditions.

(b) Based on quintiles of relative socioeconomic disadvantage.

Note: Estimates based on self-reported data.

Source: AIHW analysis of the 2001 NHS.

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Results accounting for age

While the results shown in Figure 3 suggest that there is an association between the number of risk factors and the prevalence of heart/circulatory conditions, these are likely to be confounded by age, sex and socioeconomic status. Age and sex showed a strong association with the prevalence of heart/circulatory conditions; a weaker association was seen for the number of risk factors. Socioeconomic status showed a moderate association with each of these. To account for this potential confounding, age, sex and socioeconomic status were included in logistic regression models of the number of risk factors against the presence of heart and circulatory conditions. The method used for the logistic regression analysis, including interpretation of parameter estimates, is included in Appendix 2.

Although socioeconomic status is a well-recognised component of disease risk, it was generally not statistically significant in the models. One reason for this is that an area-level measure of socioeconomic status was used rather than an individual measure, which tends dampen its impact. Secondly, socioeconomic status is a determinant of risk rather than a risk factor in itself. Socioeconomic status is thus partly expressed through its influence on the presence of risk factors.

Odds ratios resulting from logistic regression models for selected heart/circulatory conditions are shown in Table 6. Due to the low prevalence of the conditions modelled, odds ratios were interpreted as relative risks (see Appendix 2). The results shown here are cross-sectional associations, and should not be interpreted as cause and effect.

Taking age and number of risk factors into account, men were more likely than women to report ever having had a heart attack, stroke, angina or atherosclerosis. The difference

Figure 3: Prevalence of selected heart/circulatory conditions by number of risk factors reported among Australians aged 18 years and over, 2001
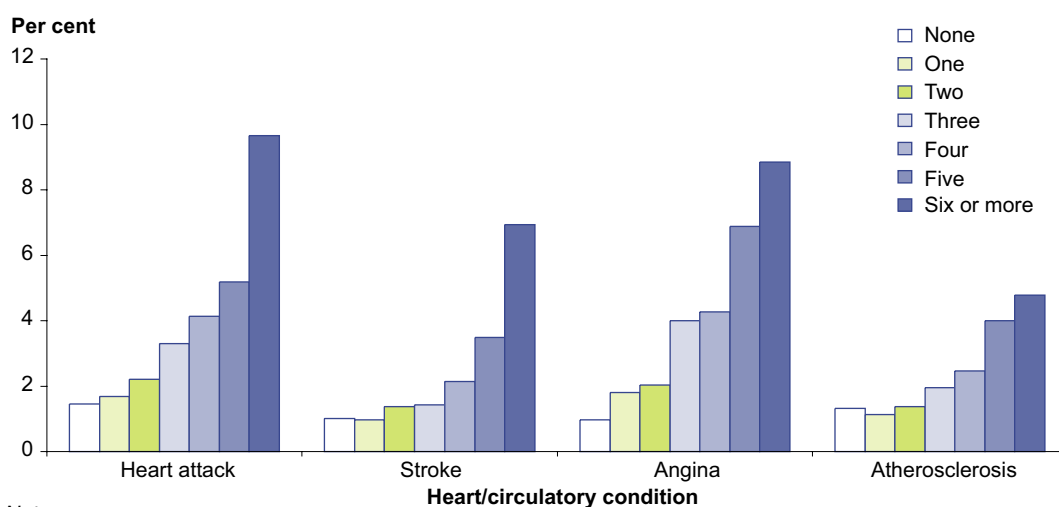
Notes

1. Risk factors include obesity, high blood pressure, high blood cholesterol, diabetes, physical inactivity, smoking, risky alcohol consumption, low vegetable consumption and low fruit consumption.

2. Estimates based on self-reported data.

Source: AIHW analysis of the 2001 NHS.

between men and women was greatest for heart attack and atherosclerosis, with men being about three times more likely to have reported these conditions than women.

Taking age and sex into account, people with three or four risk factors were four times more likely to have reported angina and twice as likely to have had heart attack than people with no risk factors. Similarly, people with five or more risk factors were more likely to report ever having had heart attack, stroke angina or atherosclerosis than people with less than five risk factors. People with five or more risk factors were six times as likely as people with no risk factors to report having angina; for heart attack and stroke, the likelihood was three times as much, and double for atherosclerosis.

Table 6: Odds ratios for selected heart/circulatory conditions

	Heart attack		Stroke		Angina		Atherosclerosis	
Category	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Sex (controlling for age and number of risk factors)								
Women	1.0	. .	1.0	. .	1.0	. .	1.0	. .
Men	3.0	(2.5–3.8)	1.6	(1.3–2.1)	1.6	(1.3–2.0)	2.8	(2.1–3.6)
Number of risk factors (controlling for age and sex)								
None	1.0	. .	1.0	. .	1.0	. .	1.0	. .
One or two	1.3	(0.8–2.2)	1.2	(0.7–2.1)	2.0	(1.1–3.5)	0.9	(0.5–1.5)
Three or four	2.1	(1.3–3.4)	1.4	(0.8–2.5)	3.9	(2.2–6.9)	1.3	(0.8–2.2)
Five or more	3.2	(1.8–5.6)	3.0	(1.6–5.8)	5.9	(3.2–11.0)	2.3	(1.2–4.2)

. .   not applicable

OR   odds ratio

CI   confidence interval

Notes

1. Respondents could report more than one of these conditions.

2. Risk factors include obesity, high blood pressure, high blood cholesterol, diabetes, physical inactivity, smoking, risky alcohol consumption, low vegetable consumption and low fruit consumption.

3. Estimates based on self-reported data.

4. Odds ratios interpreted as relative risks.

5. An odds ratio of 1.0 with no confidence interval indicates the reference category.

6. Confidence intervals were not adjusted for the design effect.

Source: AIHW analysis of the 2001 NHS.

Discussion

In the discussion following, key issues relating to the prevalence of risk factors, heart and circulatory conditions, and the observed relationship between these are described.

Important concepts for analysing the relationship between risk factors and cardiovascular disease are discussed. These include continuous risk, combinations or clustering of risk factors and secondary prevention.

The NHS, while an excellent source of data on health conditions, has some limitations. These are primarily because of the data being self-reported. Comparisons are made between estimates from the NHS and those from a major Australian study which