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

collected measured data, thus highlighting some of the important issues to be considered when interpreting survey estimates.

Some limitations of the analysis are also described.

Prevalence of risk factors

More than nine in ten people were estimated to have at least one risk factor, with men being less likely than women to have none. While such a large number of people at increased risk of ill health has serious public health implications, some risk factors can be modified through lifestyle changes, and these changes may have a positive impact on other risk factors. For example, the modification of risk factors such as smoking, overweight, physical inactivity and poor nutrition may slow the development of atherosclerosis (Berenson et al. 1998). Given the high prevalence of modifiable risk factors, there is the potential for most Australian adults to make changes to improve their health.

Regardless of age, the most common number of risk factors was two. While these data can show the distribution of the number of risk factors people have by age group, the data cannot show what happens to people throughout the course of their lives. So it cannot be determined here whether people who have two risk factors when they are in their early twenties will maintain that level, or develop more or fewer risk factors as they age. Analysis of a single cross-sectional survey also means that age trends in the risk factor profile of people cannot be inferred; for example, these data cannot show whether people who are in their twenties in 2001 have more or fewer risk factors on average than people of the same age 10 years ago.

In the older age groups, it is possible that the observed risk factor profile is confounded by what may be termed the 'healthy survivor effect'. That is, the people who survive into older age may have a different risk factor profile from those who do not.

The prevalence of high blood pressure and high blood cholesterol increased with age, with those in the youngest age group least likely to report these conditions (ABS 2003a). Young people were also the group least likely to be physically inactive or obese (compared with people in older age groups). However, inadequate fruit and vegetable consumption and smoking were more common among young people. Nutrition in particular improved with age; 57% of people aged 18–24 years reported low usual fruit consumption and 79% reported low usual vegetable consumption, compared to 34–35% and 62–63% respectively among people aged 65 years and over. The high proportion of young people reporting inadequate fruit and vegetable consumption is likely to be the main reason why people aged 18–24 years had the lowest rate of not reporting any risk factors.

An association was observed between the number of risk factors and socioeconomic status: people of lower socioeconomic status tended to have more risk factors than people of higher socioeconomic status. While a causal relationship cannot be inferred from these results, the greater prevalence of multiple risk factors among people of low socioeconomic status together with the link between social factors and cardiovascular disease means that this group may be at substantially increased risk of poor health outcomes.

The focus of this bulletin has been on the relationship between risk factors and cardiovascular disease. However, it is important to note that the risk factors analysed here are also predictive of other diseases. For example, smoking, physical inactivity and poor nutrition are all risk factors for various forms of cancer.

Prevalence of cardiovascular disease

A heart attack is often fatal; 4 in 10 Australians die within a year of the event. Similarly, about a third of people die within a year of having a stroke (AIHW 2004). These statistics mean that many people who have had a heart attack or stroke are not represented in the NHS. Nor will all people who survive a heart attack or a stroke be represented, as people in nursing and convalescent homes, hospitals and other institutions were beyond the scope of the survey.

Angina was the most prevalent of the four conditions investigated among people aged 75 years and over. This may reflect that while people with angina are more prone to sudden cardiac death or heart attack than the general population, angina itself is generally not life-threatening—in contrast to the mortality risks noted for heart attack and stroke (AIHW 2004).

The prevalence of self-reported atherosclerosis was quite low. The process leading to atherosclerosis is slow, complex and not easily detected, so it is difficult to find statistics on the prevalence of this condition and it is likely that many people who have atherosclerosis are not aware that they have the condition. It is also possible that some respondents did not understand the question about this condition. Therefore it is likely that the prevalence of atherosclerosis is underestimated.

Age- and sex-adjusted analysis showed that people with five or more risk factors were much more likely to report having ever had heart attack, stroke, angina or atherosclerosis than those with no risk factors (ranging from six times as likely for angina to twice as likely for atherosclerosis).

Inference about causality cannot be made from this analysis; however, these data are consistent with other work analysing the health of people with multiple risk factors, which showed that they tend to have unfavourable health outcomes, particularly when it comes to cardiovascular disease (Berenson et al. 1998; Lowe et al. 1998; Trevisan et al. 1998).

The results of this analysis suggest that as the number of risk factors increases, so does the presence of heart and circulatory conditions. However, the true extent of the relationship between the number of risk factors and the presence of cardiovascular disease is likely to have been obscured in this analysis (that is, under- or overestimated). On the one hand, as noted above, people who have had fatal or debilitating cardiovascular events are not represented in the survey. On the other hand, some of the design features of the survey were not accounted for in the analysis, and so confidence intervals may be underestimated (that is, the level of uncertainty may be greater than suggested by the confidence intervals given). See Appendix 2 for more detail.

Socioeconomic status was measured using an area-level measure. This is therefore likely to understate the differences in health status due to socioeconomic determinants. The results observed in this bulletin are weaker than what would have been observed had individual measures been used.

Continuous risk

Due to the self-reported nature of the NHS, most risk factors were collected as categorical data (that is, allocated to pre-defined categories rather than recorded as continuous data). However, as noted earlier, there is a continuous relationship between

risk factor levels and risk of disease—for example, as blood pressure or blood cholesterol progressively increase, so too does the likelihood of a person developing cardiovascular disease (Kannel 2000; Law & Wald 2002; NHFA 2003; NHFA & CSANZ 2001; WHO-ISH 1999). The relationship between continuous risk and cardiovascular disease could not be investigated using the NHS.

Combination of risk factors

The multiple risk factor analysis presented here looked at the number of risk factors reported, rather than specific combinations. However, particular risk factors may have a tendency to cluster.

Numerous studies refer to the three major coronary risk factors as high serum cholesterol levels, high blood pressure and tobacco smoking (Daviglus et al. 1998; Lowe et al. 1998; Stamler et al. 1999). These risk factors are considered major because of their significant risk, high prevalence and potential to be prevented or controlled (National Heart Lung and Blood Institute cited in Daviglus et al. 1998). Less than one in 200 (0.4%) adults were estimated to have all three major coronary risk factors, based on the NHS. Due to the limitations discussed below in the reporting of high blood cholesterol in particular, this is likely to be an underestimate.

Another risk factor cluster of interest is the metabolic syndrome, which includes insulin resistance, impaired glucose tolerance, high blood pressure, abnormal blood cholesterol levels and overweight. The prevalence of metabolic syndrome could not be assessed using the NHS.

Another way of analysing risk factors in combination is to assess absolute risk. Absolute risk refers to the likelihood of a person having a cardiovascular event (such as stroke or coronary heart disease) over a given period of time. People at high absolute risk include those with multiple risk factors (NHFA 2003). Assessment tools have been developed for identifying absolute risk for individuals in a clinical setting. Absolute risk could not be assessed using the NHS.

Secondary prevention

Secondary prevention is the attempt to prevent recurrence of disease. In this context, this means reducing the risk of an additional cardiovascular event in someone who has already had a heart attack or stroke, or has angina or atherosclerosis. Secondary prevention interventions include modification of risk factors and medical treatments.

People who have previously had a heart attack, stroke, angina or atherosclerosis are at an increased risk of subsequent cardiovascular events. If the risk for these people is increased even further by having multiple risk factors, they should therefore be particular targets for secondary prevention.

Limitations of the data

While the NHS provides an excellent source of recent nationally representative data on a range of health conditions and demographic data, it has some limitations. The main limitations of the data and analysis for this bulletin are:

- the data are self-reported
- the survey is cross-sectional, so cause and effect cannot be assessed.

Self-reported data

The quality of self-reported data relies on respondents knowing and providing accurate information. For example, high blood cholesterol is conventionally defined as total cholesterol of 5.5 mmol/L or more. However, respondents to the NHS were asked whether they have ever been told by a doctor or nurse that they have high blood cholesterol; some people would never have had cause to have their cholesterol measured, and for those that have, 'high' blood cholesterol may often be based upon differing criteria. Particular issues for some risk factors and conditions are discussed below and in Appendix 1.

Obesity was classified using body mass index (BMI), which was derived from self-reported height and weight. Previous studies have shown that people tend to over-report their height and under-report their weight, which leads to underestimated BMI (ABS 1998a; AIHW: Waters 1993; Flood et al. 2000). This means that the number of people estimated to be obese is likely to be an underestimate. Analysis of measured height and weight data from the 1999–2000 Australian, Diabetes Obesity and Lifestyle (AusDiab) Study estimated that 21% of Australians aged 25 years and over were obese, compared to 18% from the 2001 NHS (unpublished analysis).

Only 9% of 2001 NHS respondents aged 25 years and over reported ever having been told by a doctor or nurse that they have high blood cholesterol, which is likely to be an underestimate of the true prevalence. Estimates from the 1999–2000 AusDiab study suggest that most people with high blood cholesterol are unaware they have the condition—23% of people reported having previously been told that they had high cholesterol, while 51% were found to have total cholesterol of 5.5 mmol/L or more based on blood samples (unpublished analysis).

Analysis of the 2001 NHS found that about 16% of people aged 25 years and over reported having been told by a doctor or nurse that they have high blood pressure compared with about 29% of people being estimated as having high blood pressure based on measurements taken in the 1999–2000 AusDiab study (unpublished analysis).

As with high blood cholesterol and high blood pressure, many people who have diabetes may be unaware they have the condition—analysis of AusDiab found that only half of the 7.4% of people aged 25 years and over found to have diabetes were aware they had the condition (Dunstan et al. 2002).

With all of the above comparisons it should be noted that participation in AusDiab was voluntary and so it is possible that AusDiab respondents had different health characteristics from the general population.

As noted previously, around 40% of people who have a heart attack and a third of people who have a stroke die within a year of the event. Furthermore, people with heart/circulatory conditions who are in hospital, a nursing home or similar are not included in the NHS. This means that there is an under-representation in the survey of people who are affected by these conditions.

As with cholesterol, many people who have atherosclerosis may be unaware that they have the condition, and this also leads to under-reporting.

Cross-sectional survey data

The NHS is a cross-sectional survey, so while it is possible to identify statistical associations between variables, causal relationships cannot be inferred on the basis of these data alone. The presence or number of risk factors a person has may change over time, and indeed may be influenced by the presence of cardiovascular disease, and this change cannot be measured in a cross-sectional survey.

Limitations of the analysis

The logistic regression analysis used for this bulletin was done for the purpose of producing age- and sex-adjusted odds ratios for the prevalence of cardiovascular disease by risk factor status. The models by no means account for all of the factors or potential confounders that influence the risk of cardiovascular disease. For example, risk factors for stroke include atrial fibrillation and transient ischaemic attack, but these were not available for inclusion in the analysis.

The risk factors analysed for this report reflect respondents' current status, whereas the cardiovascular conditions reflect respondents' history (that is, whether they have ever had a cardiovascular condition). While it was possible to extract heart/circulatory conditions considered current from the NHS, this led to additional limitations in the analysis because of the paucity of data. The main aim of this report was to document associations between the number of risk factors reported and the presence of heart/circulatory conditions. Therefore, respondents' history of cardiovascular disease was deemed appropriate.

Conclusion

With coronary heart disease and stroke remaining the leading causes of death in Australia, the identification of groups most at risk of cardiovascular disease will aid in its prevention and control.

The results presented in this bulletin provide a snapshot of the risk factor profile of Australians and confirm the association between the number of risk factors that people report and the likelihood of having previously experienced a cardiovascular event. As the data are sourced from a cross-sectional survey, cause and effect cannot be assessed.

The monitoring of individual risk factors remains important. Poor diet and physical inactivity were the most prevalent of those investigated. These are behaviours with the potential to be modified, and are risk factors not only for cardiovascular disease but various cancers and other conditions. There is, therefore, great scope for the improvement of the health of Australians.

The limitations of self-reported survey data mean that some relationships may be stronger or weaker than found in the analysis. This highlights the importance of a nationally representative health measurement survey, which could collect measured—and therefore more accurate—data on health risk factors.

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Glossary

Angina	Temporary chest pain or discomfort when the heart's own blood supply is inadequate to meet extra needs, as in exercise.
Atherosclerosis	A process that gradually clogs arteries, through fatty and fibre-like deposits that build up on the inner walls of the arteries. It is the main underlying condition in heart attack, angina, stroke and peripheral vascular disease.
Behavioural risk factor	These are behaviours detrimental to health. The behavioural risk factors included here are insufficient physical activity, tobacco smoking, risky alcohol consumption, and low fruit and vegetable consumption. These risk factors can be modified through lifestyle changes.
Biomedical risk factor	A risk factor expressed as a measurement of the body or any of its parts or functions. Obesity, high blood pressure, high blood cholesterol and diabetes were considered for this report. These risk factors may be influenced through lifestyle or medication.
Blood cholesterol	Fatty substance produced by the liver and carried by the blood to supply the rest of the body. Its natural function is to supply material for cell walls and for steroid hormones, but if levels in the blood become too high this can lead to atherosclerosis and heart disease.
Cardiovascular disease	Any disease of the heart or blood vessels.
Cardiovascular event	Any occurrence of events related to cardiovascular disease, such as a heart attack or stroke.

Cholesterol	See *blood cholesterol*.
Confounding	If there is a relationship between the effects of two or more explanatory factors, the measure of the effects of these factors may be distorted (obscured or exaggerated).
Hardening of the arteries	See *atherosclerosis*.
Heart attack	A heart attack is a life-threatening emergency that occurs when a vessel supplying blood to the heart muscle is suddenly blocked completely by a blood clot. The medical term commonly used for a heart attack is myocardial infarction.
Lipids	Fats found in the blood, such as cholesterol and triglycerides.
Metabolic syndrome	A symptom cluster associated with a high risk of coronary heart disease and stroke. Features include insulin resistance or impaired glucose tolerance, high blood pressure, abnormal blood cholesterol levels and overweight.
Risk factor	Any factor that increases the risk of a health disorder or other unwanted condition or event.
Stroke	When an artery supplying blood to the brain suddenly becomes blocked or bleeds. Often causes paralysis of parts of the body normally controlled by that area in the brain, or speech problems and other symptoms. Also known as cerebrovascular disease.
Triglycerides	Triglycerides are a form of fat that is made by the body and can fluctuate according to dietary fat intake. Under some conditions excess levels may contribute to atherosclerosis.

Appendix 1: About the data

Data sources

2001 National Health Survey: conducted by the ABS and designed to obtain national information on the health status of Australians, their use of health services and facilities, and health-related aspects of their lifestyle. The survey is a nationally representative cross-sectional survey of the household population of Australia. Information was collected from approximately 26,900 respondents over the period February to November 2001.

1999–2000 Australian Diabetes, Obesity and Lifestyle (AusDiab) Study: conducted by the International Diabetes Institute and designed to provide estimates of the prevalence of undiagnosed diabetes, self-reported chronic conditions such as heart disease and high blood pressure, and national measurements of blood pressure, blood lipids, blood glucose and overweight, as well as self-reported information on health behaviours and general health and wellbeing. The researchers collected information in all states and the Northern Territory and sampled over 20,000 people aged 25 years and over, of whom more than 11,000 underwent a physical examination.

Definitions and notes about the data

Detailed information about the data available on the 2001 NHS can be found in ABS 2003b.

Biomedical risk factors

Obesity

Obesity was measured using BMI (30 or more) calculated from self-reported height and weight. BMI is calculated by dividing weight in kilograms by the square of height in metres (kg/m^2). BMI derived from self-reported height and weight is likely to be an underestimate.

While obesity was investigated for this report, people who are overweight but not obese (BMI of 25 or more but less than 30) have a higher risk of illness than people of healthy weight. This group are of interest as 42% of men and 25% of women aged 18 years and over are overweight but not obese—this group added to those who are obese gives a total of 58% of men and 42% of women being overweight.

High blood pressure and high blood cholesterol

Respondents were asked about a range of heart and circulatory conditions, including high blood pressure and high blood cholesterol. These risk factors were included in the analysis for people who reported currently having the condition.

Diabetes

People who reported currently having Type 1, Type 2, other diabetes or diabetes of unknown type were categorised as having diabetes. People reporting high sugar levels were not included in this group.

Behavioural risk factors

Physical inactivity

Participation in physical activity focused on leisure-time physical activity undertaken for recreation, sport or health/fitness purposes. People categorised as sedentary (no exercise) or participating in very low amounts of physical activity were classified as being physically inactive. This roughly equates to people doing less than 15 minutes of walking for exercise, or less than 10 minutes of moderate exercise, per week.

While physical inactivity was analysed for this report, people who are insufficiently active (that is, they are not sedentary, but do less than 150 minutes of moderate intensity activity weekly) are also at an increased risk of illness.

Smoking

People were classified as smokers if they reported being current daily smokers of tobacco. Some under-reporting of this risk factor is expected.

Risky alcohol consumption

Alcohol consumption was classified into risk groups based on a calculated 7-day average. The groups 'risky' and 'high risk' were combined to form a 'risky alcohol consumption' group. Some under-reporting of this risk factor is expected. Further, respondents who did not drink alcohol in the previous week, but did so in the previous year, did not have their risk assessed. Risk levels are based on the National Health and Medical Research Council risk levels for harm in the long term, and assume the level of alcohol consumption in the week recorded was typical. See ABS 2003b for more information. Risky alcohol consumption was defined as average daily consumption of more than 50 ml of alcohol (four standard drinks) for men and more than 25 ml of alcohol (two standard drinks) for women.

Nutrition

The Australian Guide to Healthy Eating recommends that adults consume four to eight servings of vegetables and two to four servings of fruit daily (DHFS 1998).

In the NHS, a serve of vegetables was defined as half a cup of cooked vegetables or one cup of salad vegetables, being equivalent to about 75 g. Respondents were asked about usual intake. People reporting three serves or less per day were classified as having low vegetable intake.

In the NHS, a serve of fruit was defined as one medium piece, two small pieces or one cup of diced fruit, being equivalent to about 150 g of fresh or 50 g of dried fruit. Respondents were asked about usual intake. People reporting one serve or less per day were classified as having low fruit intake.

Dietary risk factors for cardiovascular disease include saturated fat and high salt intake. This information could not be derived from the NHS.

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.

Demographic characteristics

Socioeconomic status

Socioeconomic status was measured using five equal groups (quintiles) of relative socioeconomic disadvantage. Quintiles were formed using the area-based Socio-Economic Indexes for Areas (SEIFAs), in this case using the Index of Relative Socio-Economic Disadvantage. The index includes attributes such as income, educational attainment, unemployment and job skill levels. These reflect the socioeconomic characteristics of the area in which an individual lives, rather than being a direct measure of each individual's socioeconomic status. The first quintile corresponds to the most disadvantaged group and the fifth quintile to the least disadvantaged group. An area in the most disadvantaged group would have a smaller proportion of households with high incomes, tertiary education, employees in skilled occupations, and other similar characteristics. (See ABS 1998b or 2003b for more information.)

Appendix 2: Logistic regression analysis

Logistic regression provides a simple way of producing analysis that accounts for potential confounders. For conditions such as cardiovascular disease there is an association between the likelihood of developing the condition and factors such as age and sex. Age and sex may also be associated with the number of risk factors a person has. Therefore, in order to assess whether there is an association between the likelihood of reporting cardiovascular disease and number of risk factors, the analysis needed to include adjustment for age and sex.

Modelling

Models of the following form were fitted for the conditions heart attack, stroke, angina and atherosclerosis:

$$\text{logit}(p) = \beta_0 + \beta_1 * \text{AGE} + \beta_2 * \text{SEX} + \beta_3 * \text{I(1–2 RF)} + \beta_4 * \text{I(3–4 RF)} + \beta_5 * \text{I(5+RF)}$$

where $\text{logit}(p) = \ln(p/(1-p))$

p = probability of having reported the disease of interest

AGE = age in years

SEX = 1 for males, 0 for females

I(1–2 RF) = 1 for 1 or 2 risk factors, 0 otherwise

I(3–4 RF) = 1 for 3 or 4 risk factors, 0 otherwise

I(5+ RF) = 1 for five or more risk factors, 0 otherwise

Odds ratios and standard errors were produced by SAS data analysis software as a part of the standard output.

Odds ratios

When the prevalence of a condition is low (say less than 10%) odds ratios are similar to relative risks. The relative risk is defined as the ratio of the probability of an event in people with the risk factor, for example, to the probability of the same event in people without the risk factor. The odds ratio is the ratio of the odds of event one to the odds of event two.

For the conditions analysed, prevalence was less than 5% in each case. For this bulletin, then, odds ratios have been interpreted as relative risks.

Limitations

The logistic regression analysis used for this bulletin was done for the purpose of producing age- and sex-adjusted odds ratios for the degree of risk of cardiovascular disease by number of risk factors. The models by no means account for all of the factors or potential confounders that influence the risk of developing cardiovascular disease. Indeed, goodness-of-fit tests indicate that a significant proportion of the variation in the response variables remains unexplained.

The 2001 NHS is based on a complex survey design. While weighted logistic regression was used, the clustering of the sample was not accounted for in the estimation of standard errors. This means that standard errors for estimates of odds ratios are likely to be underestimated. The design effect, which could be used to account for the clustering by adjusting the standard errors, is difficult to quantify accurately. It was therefore decided to ignore the design effect. As the main purpose of the modelling was to provide indicative information on relationships, rather than to produce predictive models, ignoring the design effect was considered appropriate.

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