AUSDIAB

AUSTRALIAN DIABETES, OBESITY & LIFESTYLE STUDY

AUSDIAB 2012

THE AUSTRALIAN DIABETES, OBESITY AND LIFESTYLE STUDY

Baker IDI
HEART & DIABETES INSTITUTE

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TABLE OF CONTENTS

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FOREWORD
INTERNATIONAL DIABETES FEDERATION

In the 1990s, Professors Paul Zimmet and Timothy Welborn identified a crucial gap in the understanding of diabetes and related conditions in Australia, and developed the idea for a national survey. The Australian Diabetes, Obesity and Lifestyle (AusDiab) study commenced in 1999, and rapidly established itself on the international stage as one of the premier epidemiological studies of diabetes anywhere in the world.

In addition to reporting on disease prevalence, AusDiab has also made major contributions to the understanding of risk factors, such as physical activity and sedentary behaviour. These risk factors are increasingly recognised as being related to a wide array of chronic conditions, not just diabetes and obesity.

The International Diabetes Federation (IDF), which represents the needs of people with diabetes around the world, is a strong supporter of research into the burden of the disease, and the IDF provides regular country-by-country data in its *Diabetes Atlas*.

It is noteworthy that AusDiab, and its lead investigators, Jonathan Shaw and Paul Zimmet, have contributed significantly to the *Atlas*, providing data, analysis and insights that improve our understanding of the global impact of diabetes. Investigating how diseases influence populations as a whole, and across social and ethnic strata, is essential for the improvement of the health of our world, and the contribution of AusDiab to this has been impressive.

With the current report on the 12-year outcomes of the study, AusDiab makes two further important steps. First, it considerably extends the period of observation of the cohort beyond the five years that had been achieved earlier. This means that the impact of asymptomatic risk factors identified in 1999 can be measured over a time period that is relevant to the gradual development of conditions such as diabetes, heart and kidney disease.

Second, the AusDiab team has taken the opportunity of adding measures of cognitive function and physical disability to the assessments. This recognises the increasing impact of these factors on day-to-day life in an ageing population, and allows the exploration of their links with chronic diseases such as diabetes.

The AusDiab study has already produced over 130 peer-reviewed scientific publications on diabetes, obesity, heart and kidney disease and their risk factors. This third wave of AusDiab will no doubt continue to inform healthcare professionals and providers about the size of the problem that is faced, and the ways in which interventions can be developed and targeted.

Although originally planned to describe the burden of diabetes in Australia, the vision of the AusDiab team over 12 years has produced advancements in knowledge that are relevant on a global scale.

Sir Michael Hirst
President, International Diabetes Federation

EXECUTIVE SUMMARY

Diabetes mellitus has become one of the most common non-communicable diseases in the world. It results in substantial morbidity and mortality, primarily from cardiovascular complications, eye and kidney diseases and limb amputations. It now represents one of the most challenging public health problems of the 21st century.

Australia is a nation that provides a high proportion of its population with the opportunities for good health. Life expectancy is high, but modernization and industrialization have led to a reduction in physical activity and an increase in the consumption of energy-rich foods. Consequently, lifestyle diseases such as type 2 diabetes are increasing rapidly, and leading to an array of adverse outcomes.

The Australian Diabetes, Obesity and Lifestyle study (AusDiab) is the first national Australian longitudinal population-based study to examine the prevalence and incidence of diabetes and its complications, as well as high blood pressure, heart disease and kidney disease.

Identified as being the only national study of its kind to have been undertaken in a developed nation, the AusDiab study began in 1999-2000, when over 11,000 adults across the country took part in the study. These individuals were invited to take part in two follow-up studies, the first in 2004-2005, and the second in 2011-2012.

The 1999–2000 baseline survey collected information about diabetes, cardiovascular disease, obesity and kidney disease, and about risk factors for each of these conditions. The baseline survey enabled the measurement of the number of Australians with these diseases or risk factors at that point in time. It provided an estimate of how many people in Australia had diabetes and other conditions in 1999–2000.

The two follow-up surveys, undertaken five and 12 years after the baseline study, have provided the opportunity to investigate the number of new cases (incidence) arising in the Australian population for each of these conditions. This is possible because people who came to the baseline survey have been followed-up to investigate who did and did not develop these conditions. The most recent follow-up in 2011-2012 added measures of cognitive function and physical disability.

This report presents the main findings from the AusDiab 12-year follow-up based on data collected from people who participated in both the 1999–2000 baseline survey and at least one of the two follow-up surveys.

Annual incidence was estimated from the number of individuals developing each of the diseases and risk factors studied over the 12-year period between surveys.

The findings with respect to the key matters of interest are presented in separate chapters focusing on: disorders of glucose tolerance; weight and obesity status; blood pressure; the metabolic syndrome; kidney disease; and physical activity.

The final chapter presents total mortality data over a 12-year period for the various diseases and risk factors.

DIABETES

- Every year, 0.7% of adults developed diabetes.
- Those who were in the high-risk category of the AUSDRISK score were 16 times more likely to develop diabetes than those in the low-risk group.
- Living in the most socially-disadvantaged areas of Australia doubled the risk of developing diabetes.
- Having diabetes almost doubled the chances of being admitted to hospital and of requiring multiple visits to a GP.
- Among those aged 60 years and over, people with diabetes were more likely to have cognitive impairment and physical disability than those without diabetes.

OBESITY

- Over 12 years, the average gain in waist circumference was 5.3 cm, and was greater in women than in men.
- Younger people gained more weight and waist circumference compared to those who were older.
- Depression was nearly twice as common among those with obesity compared to those who were not obese.
- Among those aged 60 and over, people with obesity were approximately twice as likely to have cognitive impairment and physical disability as were those without obesity.

BLOOD PRESSURE

- Every year, 3% of adults developed high blood pressure.
- The risk of developing high blood pressure was 1.0% per year for people aged 25–34 years and increased to 7.3% per year for people aged 65–74 years.
- The risk of developing high blood pressure was greater for people with pre-diabetes and diabetes, and for those who were overweight or obese.
- Among smokers, the risk of developing hypertension was approximately 50% greater in men compared to women.

METABOLIC SYNDROME

- The incidence of the metabolic syndrome rose with age, peaking among those aged 65 and over.
- Having diabetes and pre-diabetes increased the risks of developing the metabolic syndrome.
- Among those aged 60 and over, people with the metabolic syndrome were more likely to have cognitive impairment and physical disability than were those without the metabolic syndrome.

KIDNEY DISEASE

- Every year, 0.4% of adults developed chronic kidney disease as defined by a reduction in kidney function (impaired glomerular filtration rate).
- Every year, 0.7% of adults developed evidence of early kidney damage as shown by the leakage of albumin into the urine (albuminuria).
- Having high blood pressure and diabetes were key risk factors for developing kidney disease.
- Having signs of kidney disease approximately doubled the chances of being admitted to hospital and of requiring multiple visits to a GP.
- Among those aged 60 and over, people with signs of kidney disease were more likely to have cognitive impairment and physical disability than were those without normal kidney function.

MORTALITY

- Over 12 years, people with previously known diabetes were nearly five times as likely to die compared to people with normal glucose tolerance.
- People with previously known diabetes have a similar risk of mortality to smokers.
- Kidney disease, cardiovascular disease and high blood pressure were associated with an increased mortality risk.

CONCLUSION

The AusDiab study has now been tracking the health of the nation for 12 years. The most recent findings show that diabetes, obesity, high blood pressure and kidney disease all remain major challenges. AusDiab has confirmed that simple risk factors can often be used to identify those most at risk of developing these conditions.

The AUSDRISK tool, which was designed to be used by the public as well as by health care professionals, is a powerful way of identifying people at risk of developing type 2 diabetes. The increasing recognition that social disadvantage plays an important role in the development of chronic disease extends the types of preventive interventions beyond the strictly medical to those in the social and political arenas.

AusDiab has demonstrated that the impact of these chronic conditions can be seen at many levels. This includes the increased mortality risks, the extra costs of delivering health care and the associated, and sometimes devastating, effects of cognitive impairment and physical disability. The broadening array of outcomes associated with diabetes and its related conditions further strengthens the need to improve prevention, screening, diagnosis and treatment.

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1: BACKGROUND

1: BACKGROUND

The Australian Diabetes, Obesity and Lifestyle study (AusDiab) is the first national, Australian, longitudinal population-based study established to examine the prevalence and incidence of diabetes and its complications, as well as heart disease and kidney disease. The study began in 1999, when 11,247 adults (aged 25 years and above) were recruited from the general community. Six locations were randomly selected in each of the six states and in the Northern Territory, and within each of these 42 locations, all adults were invited to take part. Participants underwent physical examinations, blood and urine testing, and provided extensive information on their diet, physical activity levels and other lifestyle parameters. This 'baseline' examination produced estimates of the prevalence of disease that were applicable to the national population.

The key findings included the following:

- the prevalence of diabetes was 7.4%;
- the number of people with diabetes had more than doubled since 1981;
- a further 16.3% had pre-diabetes – either impaired glucose tolerance or impaired fasting glucose;
- 60% were overweight or obese;
- 6.6% had dyslipidaemia;
- 2.5% had proteinuria, 6.4% had haematuria and 1.7% had renal impairment.

In 2004, the participants from the initial baseline study were invited to return for a repeat examination. The main aim of this five-year follow-up was to estimate the incidence of key conditions, and to look for factors that placed individuals at higher risk of developing certain key conditions.

The main findings from the second, follow-up, phase of AusDiab included the following:

- approximately 275 adults develop diabetes every day in Australia;
- the AUSDRISK score was developed to identify people at highest risk of developing type 2 diabetes;
- increasing time spent watching television was associated with increased mortality over 7 years;
- increase in weight and waist circumference was more rapid in younger than older adults;
- people who were obese were six times more likely to develop the metabolic syndrome than were those of normal weight;
- every year, almost 1.0% of adults develop reduced kidney function or leakage of albumin into the urine.

In 2011, the third phase of AusDiab was commenced. Once again, all participants, who took part in the baseline study were invited for repeat testing. On this occasion, the study expanded beyond the assessments included in the two earlier phases.

Measurement of cognitive function, disability and physical function were included, as dementia and physical frailty are becoming increasingly important in the burden of disease.

Sub-groups of participants were also invited to have more detailed measurements of blood pressure and physical activity. This involved having a blood pressure cuff fitted to allow 24-hour ambulatory monitoring of blood pressure, and the wearing of an accelerometer and inclinometer to objectively measure physical activity throughout a seven-day period.

The results of the third phase are presented in this report. Results presented in each chapter are unadjusted, and therefore inform mainly about disease burden. Appendix B provides 95% confidence intervals for all these results, and also age- and sex-adjusted comparisons.

WHAT IS THE DIFFERENCE BETWEEN PREVALENCE AND INCIDENCE?

When investigating the patterns of disease within a population it is useful to describe both the prevalence and the incidence of a condition.

Prevalence

The proportion of people within a population who have a certain disease or condition at a particular point in time. This is usually expressed as a percentage.

Incidence

The number of new cases of a condition or disease that develop over a period of time, among those who are initially free of the condition or disease. This is usually expressed as a rate, e.g. 3 per cent per year.

It is important to note that while the baseline AusDiab study was ideal for estimating disease prevalences, which can be extrapolated to the general community, the follow-up phases are not, because new independent study samples are required to track the community prevalence of diseases over time. Within this report, the percentage of the AusDiab population with various conditions at the three time-points are presented in order to describe how these percentages change as people age. Thus, comparing baseline with the 2011/12 data informs about changes that occur as the AusDiab population aged by 12 years, but does not directly inform us about how the general population of Australia has changed over that time period.

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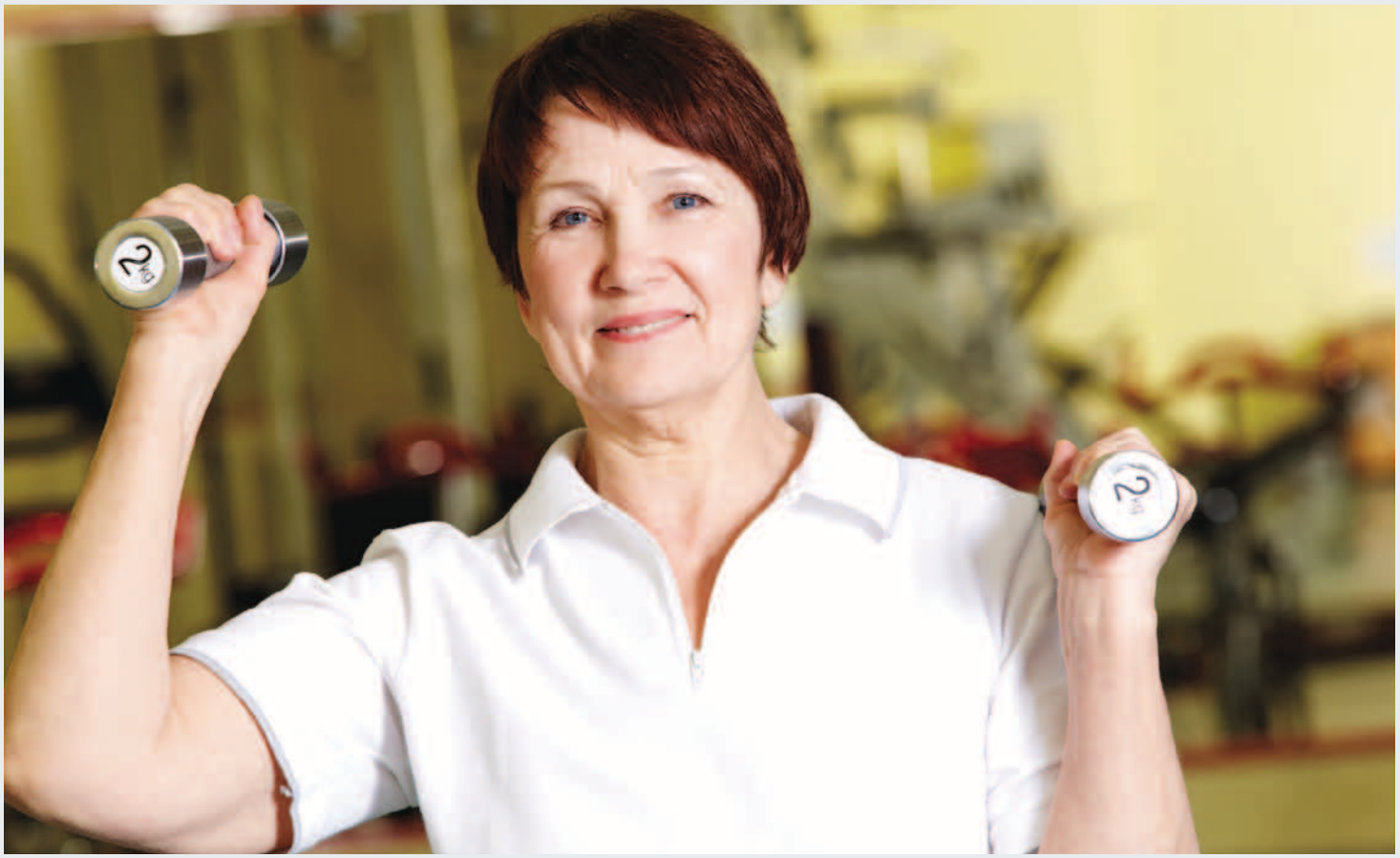
AUSTRALIAN DIABETES, OBESITY & LIFESTYLE STUDY

2: DIABETES AND PRE-DIABETES



2: DIABETES AND PRE-DIABETES

The term diabetes mellitus describes a metabolic disorder with multiple causes characterized by chronically elevated blood glucose levels (hyperglycaemia), with disturbances of carbohydrate, fat and protein metabolism. The effects of diabetes include long-term damage, dysfunction and failure of various organs and tissues. It predisposes those suffering from it to many severe conditions, including cardiovascular disease, visual loss, amputations and renal failure.

Diabetes is a disease with mixed aetiology. There are many risk factors for the development of the disease, including obesity, hypertension and sedentary lifestyle, many of which are also risk factors for cardiovascular disease.

This chapter presents: (i) the incidence (% per year) and trends in the percentage of the population with diabetes, (ii) the impact of various risk factors on the development of diabetes, (iii) the relationship of depression, cognitive impairment, and disability with glucose tolerance, (iv) trends in metabolic targets for diabetes control and the use of treatment and medication in diabetes, and (v) healthcare utilization in diabetes.

DEFINITIONS

DIABETES AND PRE-DIABETES

The diagnostic criteria for diabetes, impaired glucose tolerance (IGT) and impaired fasting glucose (IFG) were based on the values for venous plasma glucose concentration (fasting and two-hour measurements) outlined in the World Health Organization report on the Diagnosis and Classification of Diabetes Mellitus (Table 2.1)[1].

People who reported taking oral hypoglycaemic medication or insulin were classified as having diabetes regardless of their plasma glucose levels. The term 'pre-diabetes' is used to include all those with either IFG or IGT. In this report, results for type 1 and type 2 diabetes have not been reported separately, as the vast majority of cases were classified as type 2.

Table 2.1: Classification values for the oral glucose tolerance test

PLASMA GLUCOSE (MMOL/L)			
	Fasting glucose		2-hour glucose
Diabetes	≥7.0	or	≥11.1
Impaired glucose tolerance (IGT)	<7.0	and	7.8-11.0
Impaired fasting glucose (IFG)	6.1-6.9	and	<7.8
Normal glucose tolerance (NGT)	<6.1	and	<7.8

All participants on oral hypoglycaemic medication or insulin were classified as having diabetes.

INCIDENT DIABETES

New (incident) cases of diabetes were defined as individuals who had either normal glucose tolerance (NGT), IFG or IGT at baseline, but had developed diabetes at follow-up in 2004-05 or 2011-12.

INCIDENT CASES OF IMPAIRED FASTING GLUCOSE AND IMPAIRED GLUCOSE TOLERANCE

New (incident) cases of IFG were defined as: (i) people who had NGT at baseline, but had developed IFG at follow-up in 2004-05, and had neither regressed to NGT nor progressed to IGT or diabetes at follow-up in 2011-12; or (ii) people who had NGT at baseline and at follow-up in 2004-05, but had developed IFG at follow-up in 2011-12.

There were 42 people who had NGT at baseline and developed IFG at follow-up in 2004-05, but regressed to NGT at follow-up in 2011-12, and 34 people who had NGT at baseline, but developed IFG at follow-up in 2004-05 and further progressed to IGT or diabetes at follow-up in 2011-12. These people were not included as incident IFG cases.

New (incident) cases of IGT were defined as: (i) people who had NGT or IFG at baseline, but had developed IGT at follow-up in 2004-05, and had neither regressed to NGT or IFG nor progressed to diabetes at follow-up in 2011-12; or (ii) people who had NGT or IFG and baseline and at follow-up in 2004-05, but had developed IGT at follow-up in 2011-12.

There were 95 people who had NGT or IFG at baseline and developed IGT at follow-up in 2004-05, but reverted to NGT or IFG at follow-up in 2011-12, and 35 people who had NGT or IFG at baseline, but developed IGT at follow-up in 2004-05 and further progressed to diabetes at follow-up in 2011-12. These people were not included as incident IGT cases.

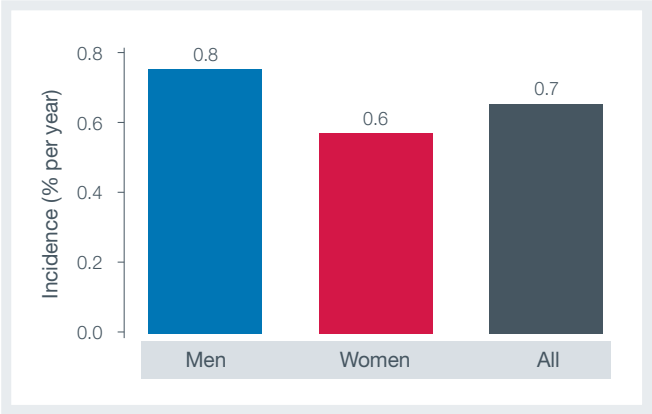
RESULTS

INCIDENCE OF DIABETES AND PRE-DIABETES

The overall incidence (% per year) of diabetes is shown in Figure 2.1, and indicates that there were slightly more new cases of diabetes in men than in women.

A similar pattern of diabetes incidence is observed when diabetes is defined using HbA1c ≥6.5%, although the overall numbers are slightly lower. Using HbA1c, the annual incidence of diabetes is 0.6% and 0.4% in men and women, respectively.

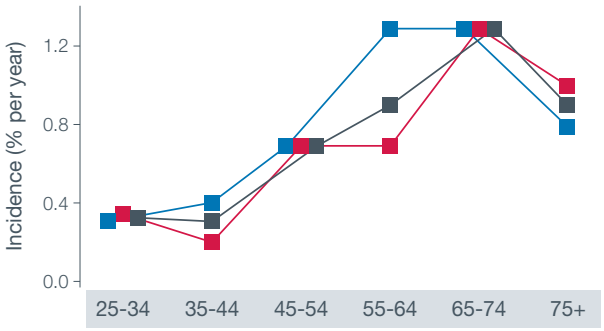
FIGURE 2.1: Annual incidence of diabetes according to sex: the AusDiab study



The heights of bars on all graphs are accurate to two decimal places, but data labels are rounded to one decimal place.

The annual incidence of diabetes increased with age, peaking between the ages of 65 and 74 years, and then decreased after the age of 75 years. For men, the incidence of diabetes increased with age until it plateaued after the age of 55 years, before decreasing after the age of 75 years. For women, the incidence of diabetes increased with age, peaking between the ages of 65 and 74 years, and then decreased after the age of 75 years (Figure 2.2).

FIGURE 2.2: Annual incidence of diabetes according to baseline age: the AusDiab study

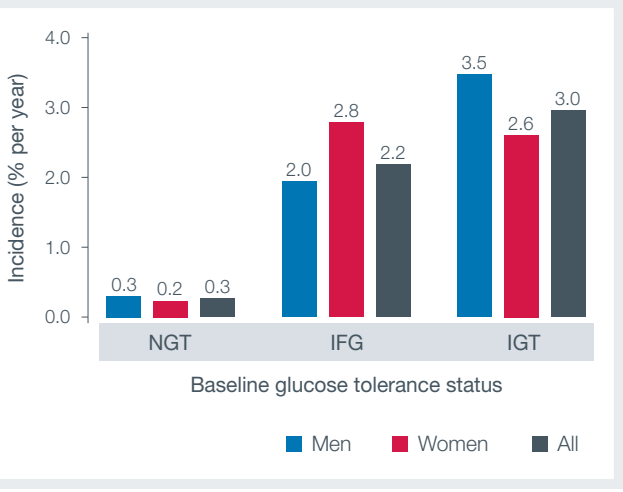


Men
Women
All

	Men	Women	All
25-34	0.3	0.3	0.3
35-44	0.4	0.2	0.3
45-54	0.7	0.7	0.7
55-64	1.3	0.6	0.9
65-74	1.3	1.3	1.3
75+	0.8	1.0	0.9

The annual incidence of diabetes among those with NGT, IFG and IGT at baseline is shown in Figure 2.3. In both men and women, the incidence of diabetes in those with IFG and IGT at baseline was 7-14 times higher than in those with NGT.

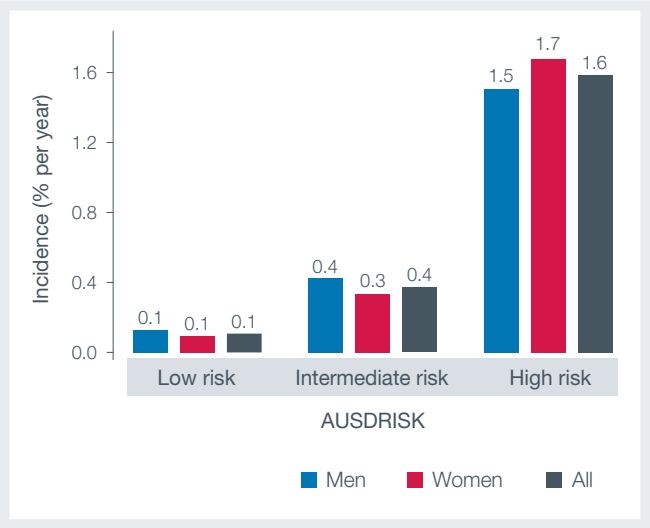
FIGURE 2.3: Annual incidence of diabetes according to baseline glucose tolerance status: the AusDiab study



NGT – normal glucose tolerance; IFG – impaired fasting glucose; IGT – impaired glucose tolerance.

The Australian Diabetes Risk Assessment Tool (AUSDRISK) was developed as a tool to assess 5-year risk of developing diabetes. Compared to those who were scored in the 'low risk' category, the annual incidence of diabetes in those in the 'intermediate risk' category and those in the 'high risk' category were approximately 4 times and 16 times higher, respectively (Figure 2.4).

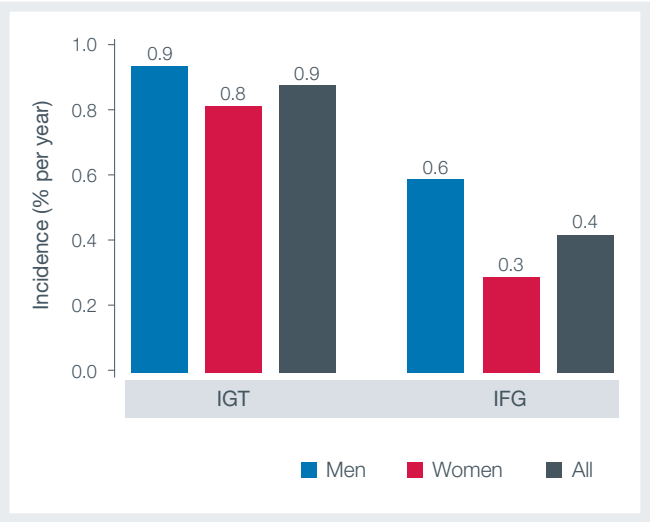
FIGURE 2.4: Annual incidence of diabetes by AUSDRISK score: the AusDiab study



Low risk: AUSDRISK score ≤5; intermediate risk: AUSDRISK score 6–11; High risk: AUSDRISK score ≥12.

The annual incidence of both IFG and IGT were greater in men than in women. The annual incidence of IFG in men was twice as high as the annual incidence in women (Figure 2.5).

FIGURE 2.5: Annual incidence of impaired fasting glucose and impaired glucose tolerance: the AusDiab study



IFG – impaired fasting glucose; IGT – impaired glucose tolerance.

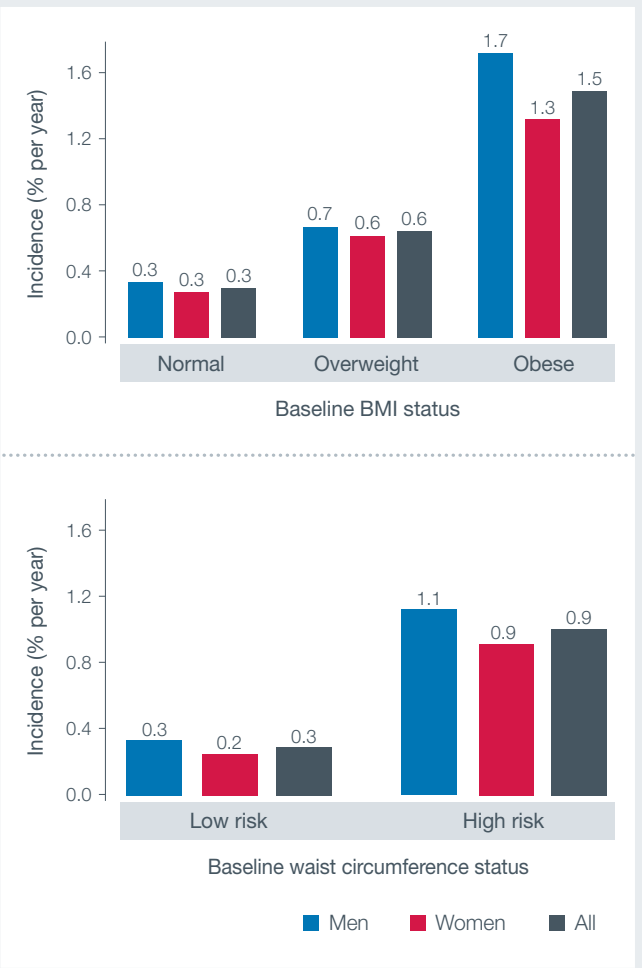
RISK FACTORS FOR DIABETES

Obesity

Compared to those with a body mass index (BMI) in the normal range at baseline, the annual incidence of diabetes was approximately 2 and 5 times higher among those classified as overweight and obese, respectively. Men who were overweight or obese at baseline had a higher annual incidence of diabetes than did overweight or obese women. Both men and women who were classified as obese at baseline had at least double the annual incidence of diabetes compared to those who were overweight at baseline (Figures 2.6).

The incidence of diabetes in those with a high risk waist circumference at baseline was 3 times higher compared to those with a low risk waist circumference at baseline. The incidence of diabetes for both those with low risk and high risk waist circumference at baseline was higher in men than in women (Figure 2.6).

FIGURE 2.6: Annual incidence of diabetes according to baseline BMI and baseline waist circumference status: the AusDiab study

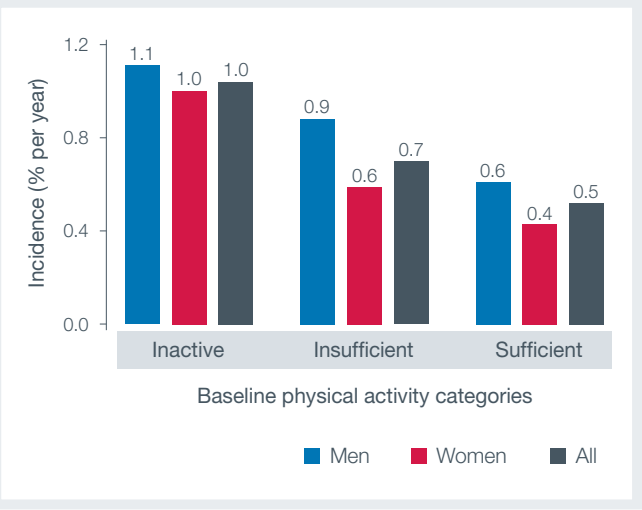


BMI: (i) normal: <25 kg/m2; (ii) overweight: 25-29.9 kg/m2; and (iii) obese: ≥30 kg/m2. Waist: (i) low risk: <94 cm for Europid men, <90 cm for Aboriginal/Torres Strait Islander, Asian and South European men, <80 cm for women; (ii) high risk: ≥94 cm for Europid men, ≥90 cm for Aboriginal/Torres Strait Islander, Asian and South European men, ≥80 cm for women.

Physical activity

The annual incidence of diabetes increased in those who reported being inactive or reported doing insufficient physical activity at baseline compared to those who reported sufficient levels of physical activity. At all levels of physical activity reported at baseline, the annual incidence was greater in men than in women (Figure 2.7).

FIGURE 2.7: Annual incidence of diabetes according to baseline physical activity: the AusDiab study

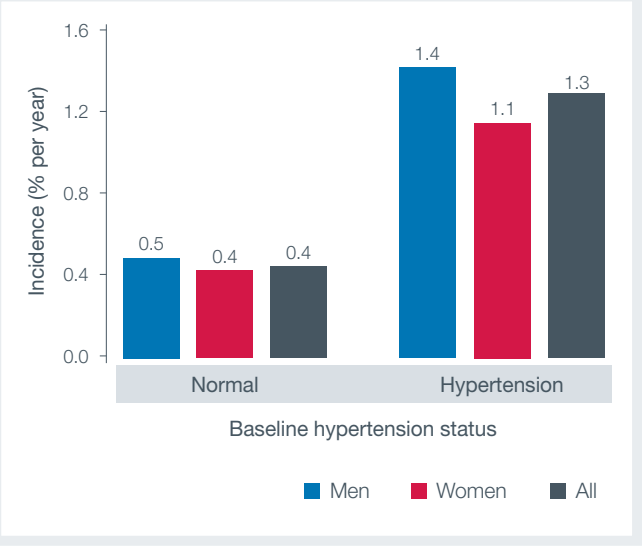


'Physical activity time' for the previous week was calculated as the sum of the time spent performing moderate activity (e.g. walking) plus double the time spent in vigorous activity (to reflect its greater intensity). Inactive: no physical activity in the previous week; insufficient: 1-149 minutes of physical activity in the previous week; sufficient: ≥150 minutes of physical activity in the previous week.

Hypertension

The annual incidence of diabetes was approximately three times greater in those with high blood pressure at baseline compared to those with normal blood pressure at baseline (Figure 2.8).

FIGURE 2.8: Annual incidence of diabetes according to baseline hypertension status: the AusDiab study



Index of remoteness

The annual incidence of diabetes did not greatly differ by Accessibility/Remoteness Index of Australia (ARIA). In all areas, men had a higher annual incidence of diabetes compared to women (Figure 2.9).

FIGURE 2.9: Annual incidence of diabetes according to geographic remoteness of residence*: the AusDiab study

ARIA: Accessibility/Remoteness Index of Australia.
**measured based on postcode of residence*

Index of relative socioeconomic disadvantage

The annual incidence of diabetes decreased by relative index of socio-economic disadvantage. People who lived in areas that were more socio-economically disadvantaged (1st quintile) had a higher annual incidence of diabetes compared to those who lived in less socio-economically disadvantaged areas (5th quintile) (Figure 2.10).

FIGURE 2.10: Annual incidence of diabetes according to baseline socio-economic disadvantage*: the AusDiab study

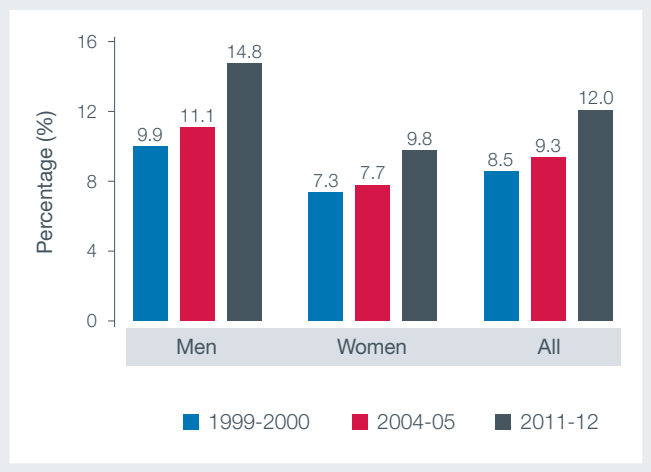
	Men	Women	All
1st	1.1	0.9	1.0
2nd	0.9	0.6	0.7
3rd	0.6	0.7	0.7
4th	0.7	0.5	0.6
5th	0.7	0.4	0.5

**measured based on postcode of residence.*

PERCENTAGE OF THE POPULATION WITH DIABETES

The percentage of the population with diabetes at the three time points is shown in Figure 2.11. As the population aged over the 12 years, this percentage rose from 8.5% to 12.0%. At each time point, the percentage with diabetes was higher in men than women.

FIGURE 2.11: Trends in the percentage of the population with diabetes in 1999-2000, 2004-05 and 2011-12 according to sex: the AusDiab study

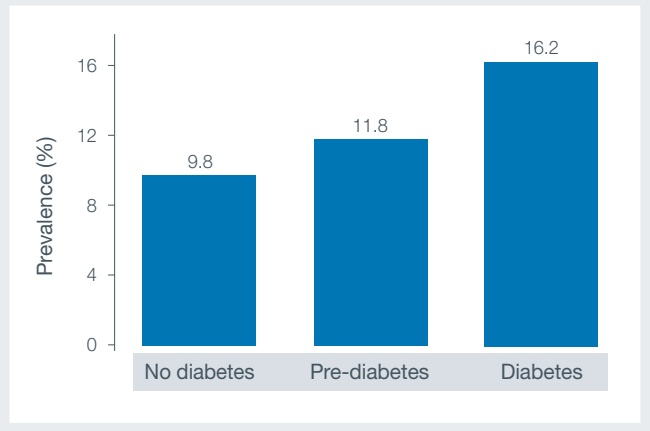


Data have not been standardised for age.

DEPRESSION AND DIABETES

The prevalence of depression according to glucose tolerance status is presented in Figure 2.12. The prevalence of depression was 65% higher in those with diabetes compared to those without diabetes.

FIGURE 2.12: Prevalence of depression in 2011-12 according to glucose tolerance status in 2011-12: the AusDiab Study



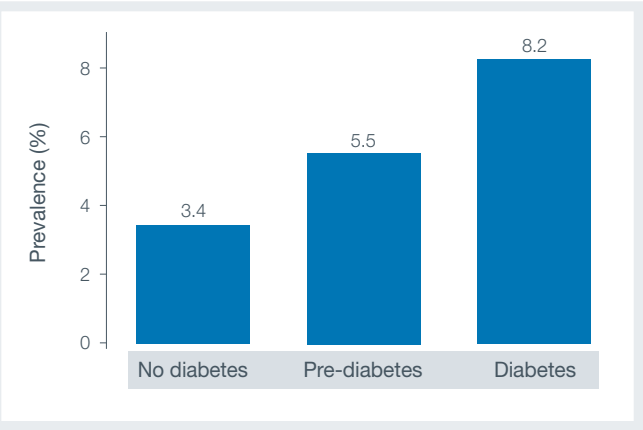
Data have not been standardised for age.

Pre-diabetes includes people with impaired glucose tolerance (IGT) or impaired fasting glucose (IFG).

COGNITIVE IMPAIRMENT AND DIABETES

The prevalence of cognitive impairment among people aged 60 and over according to glucose tolerance status is presented in Figure 2.13. Compared to people with no diabetes, the prevalence of cognitive impairment in those with diabetes was more than double.

FIGURE 2.13: Prevalence of cognitive impairment in 2011-12 according to glucose tolerance status in 2011-12 among people aged 60 and over: the AusDiab Study



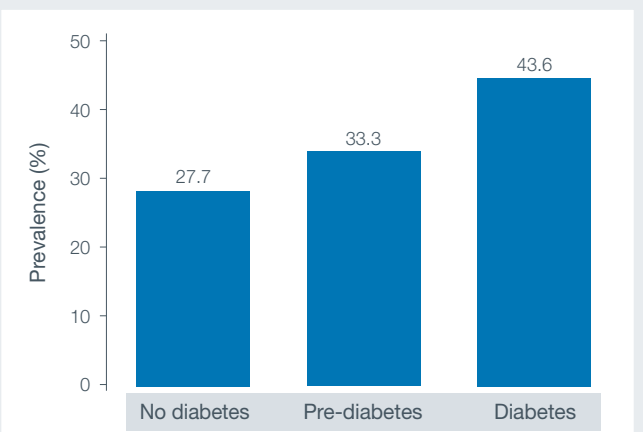
Data have not been standardised for age.

Pre-diabetes includes people with impaired glucose tolerance (IGT) or impaired fasting glucose (IFG).

DISABILITY AND DIABETES

The prevalence of disability in people aged 60 years increased according to glucose tolerance status. The prevalence was highest in those with diabetes and lowest in those without diabetes (Figure 2.14).

FIGURE 2.14: Prevalence of disability in 2011-12 according to glucose tolerance status in 2011-12 among people aged 60 years and over: the AusDiab Study



Data have not been standardised for age.

Pre-diabetes includes people with impaired glucose tolerance (IGT) or impaired fasting glucose (IFG).

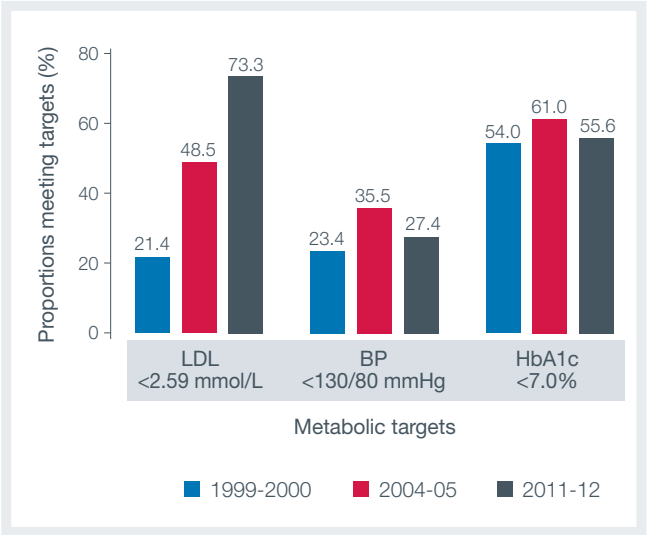
METABOLIC TARGETS FOR DIABETES CONTROL

The percentage of people with diagnosed diabetes who were meeting the recommended low-density lipoprotein (LDL) cholesterol target of less than 2.59 mmol/L was 3.4 times higher at follow-up in 2011-12, compared to baseline (Figure 2.15).

The percentage of people with diagnosed diabetes who were meeting the recommended blood pressure of less than 130/80 mmHg increased between baseline and follow-up in 2004-05, but decreased between follow-up in 2004-05 and in 2011-12 (Figure 2.15).

A similar pattern was observed for HbA1c where the percentage of people with diagnosed diabetes who were meeting the recommend HbA1c target of less than 7.0% increased between baseline and follow-up in 2004-05, but decreased between follow-up in 2004-05 and in 2011-12 (Figure 2.15).

FIGURE 2.15: Percentage of people with diabetes who meet metabolic targets for diabetes control in 1999-2000, 2004-05 and 2011-12: the AusDiab study

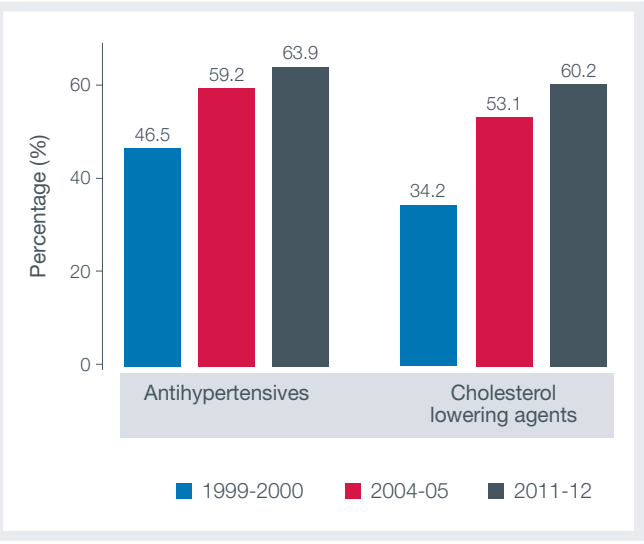


Data have not been standardised for age.

TREATMENT AND MEDICATION USE

Among those with diabetes, the percentage of people using antihypertensive medication and cholesterol lowering agents has increased since baseline. Compared to baseline, the percentage of people with diabetes using antihypertensive medication at follow-up in 2011-12 had increased by approximately 37%, while the percentage of people with diabetes using cholesterol-lowering agents at follow-up in 2011-12 increased by 76% (Figure 2.16).

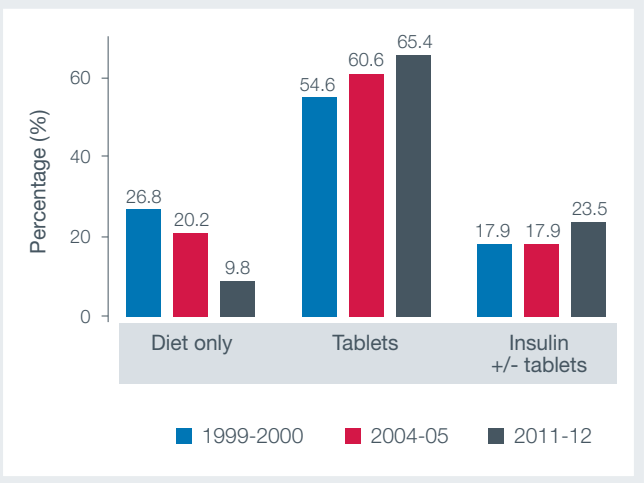
FIGURE 2.16: The use of antihypertensive medication and cholesterol-lowering agents in people with diabetes in 1999-2000, 2004-05 and 2011-12: the AusDiab study



Data have not been standardised for age.

The percentage of people with diabetes who manage their diabetes by diet only had decreased by almost 65% between baseline and 2011-12. However, the percentage of people with diabetes who use tablets and insulin had increased between baseline and 2011-12 (Figure 2.17).

FIGURE 2.17: Use of treatments for diabetes in 1999-2000, 2004-05 and 2011-12: the AusDiab study

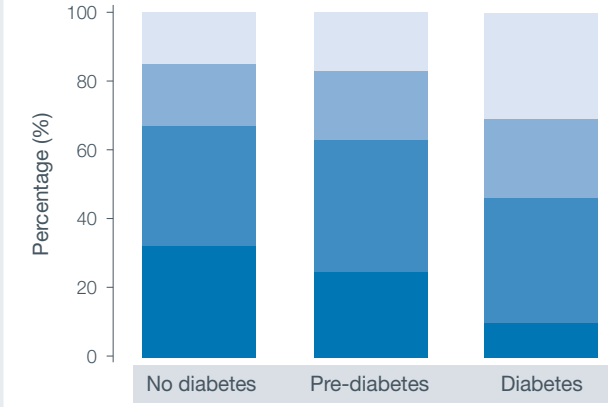


Data have not been standardised for age.

USE OF HEALTHCARE SERVICES

The number of visits to a general practitioner (GP) in the previous 3 months was higher in those with diabetes compared to those with pre-diabetes or those without diabetes. Among those with diabetes, less than 10% of people had not seen a GP in the previous 3 months, compared to more than 24% of people with no diabetes or with pre-diabetes. Over 30% of people with diabetes had seen a GP 3 times or more in the previous 3 months, compared to only 16% and 17% of people with no diabetes and pre-diabetes, respectively (Figure 2.18).

FIGURE 2.18: Number of visits to a general practitioner in the previous 3 months according to glucose tolerance status in 2011-12: the AusDiab study



≥3 visits
2 visits
1 visit
None

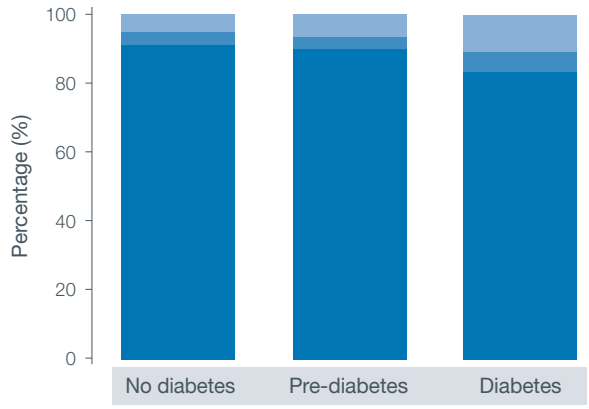
	≥3 visits	2 visits	1 visit	None
No diabetes	15.7	17.8	35.0	31.5
Pre-diabetes	17.4	20.2	37.8	24.6
Diabetes	31.2	23.4	35.6	9.9

Data have not been standardised for age.

Pre-diabetes includes people with impaired glucose tolerance (IGT) or impaired fasting glucose (IFG).

The number of nights spent in a public or private hospital in the previous 12 months was higher in those with diabetes compared to those without diabetes or those with pre-diabetes. Among those with diabetes, approximately 12% had spent 2 nights or more in a hospital in the previous 12 months, compared to 6 - 7% of people without diabetes or with pre-diabetes (Figure 2.19).

FIGURE 2.19: Number of nights spent in a hospital in the previous 12 months according to glucose tolerance status in 2011-12: the AusDiab study



≥2 nights
1 night
None

	≥2 nights	1 night	None
No diabetes	6.0	3.8	90.2
Pre-diabetes	7.0	3.1	89.9
Diabetes	12.0	5.1	83.0

Data have not been standardised for age.

Pre-diabetes includes people with impaired glucose tolerance (IGT) or impaired fasting glucose (IFG).

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AUSDIAB
AUSTRALIAN DIABETES, OBESITY & LIFESTYLE STUDY

3: OBESITY

3: OBESITY

Obesity is strongly linked to type 2 diabetes, and is a major risk factor not only for type 2 diabetes, but other chronic conditions such as hypertension, cardiovascular disease, dyslipidaemia, some cancers and arthritis. The most serious form of obesity is the central (abdominal) rather than the peripheral form, as it is associated with higher risks for diabetes and cardiovascular disease [1, 2].

This chapter presents: (i) the changes in weight and waist circumference over 12 years, (ii) the incidence (% per year) and trends in percentage of the population with obesity, (iii) the relationship of depression, cognitive impairment, and disability with obesity, and (iv) healthcare utilization in obesity.

DEFINITION

Overweight and obesity were defined using the World Health Organization classification[3] for Europids based on BMI (weight (kg)/height (m)^2). Low risk and high risk waist circumference (cm) were defined based on the International Diabetes Federation (IDF) classification[4].

While BMI (kg/m^2) is used as a measure of overall adiposity (Table 3.1), waist circumference is a more accurate measure of central adiposity (Table 3.2).

Table 3.1: Body mass index classification

BODY MASS INDEX (KG/M^2)	
Normal	<25.0
Overweight	25.0–29.9
Obese	≥30.0

Table 3.2: Classification of abdominal obesity by waist circumference

WAIST CIRCUMFERENCE (CM)				
	Men		Women	
	Europid	Non-Europid*	Europid	Non-Europid*
Low risk	<94.0	<90.0	<80.0	<80.0
High risk	≥94.0	≥90.0	≥80.0	≥80.0

**Non-Europid defined as people of Aboriginal/Torres Strait, Asian or South European origin.*

INCIDENT OBESITY

New (incident) cases of obesity were defined as: (i) people who were not obese (BMI <30 kg/m^2) at baseline, but were obese (BMI ≥30 kg/m^2) at follow-up in 2011-12; or (ii) people who were not obese at baseline but were obese at follow-up in 2004-05 and did not attend follow-up in 2011-12.

RESULTS

CHANGE IN WEIGHT AND WAIST CIRCUMFERENCE

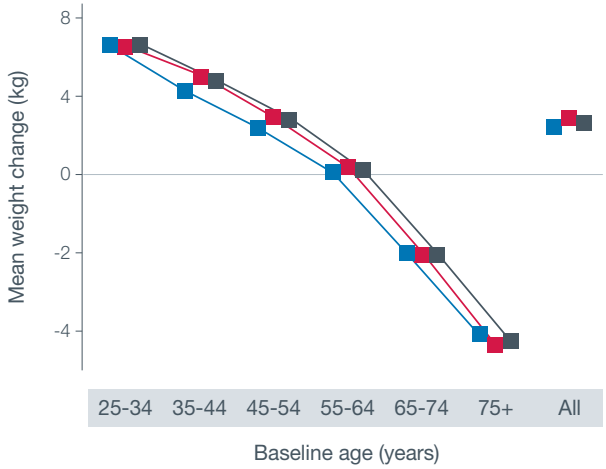
Over the follow-up period, there was an increase in average weight and waist circumference in men and women (Figures 3.1 and 3.2).

For people aged 25-64 years at baseline, weight and waist circumference increased over the 12 years of follow-up. These increases became less with increasing age. In those aged 65 years and older at baseline, weight decreased while waist circumference increased. Those aged 25-34 years at baseline showed the greatest increase in weight and waist circumference, compared to any other age group (Figures 3.1 and 3.2).

On average, those aged less than 65 years at baseline showed a weight increase of 3.2 kg, while those aged 65 years and older at baseline showed a loss in weight of 2.4 kg. The weight loss observed in the older age group may represent a loss of muscle mass, as similar losses were not observed for waist circumference over the same period (Figure 3.2).

Although the pattern of weight change was similar in men and women, women aged 35 years and older at baseline had slightly greater average weight changes than men. Thus, in people aged 64 years and younger at baseline, women gained slightly more weight than men, whereas in people aged 75 years and older at baseline, women lost slightly more weight than men (Figure 3.1).

Figure 3.1: Mean weight change over 12 years according to baseline age: the AusDiab study

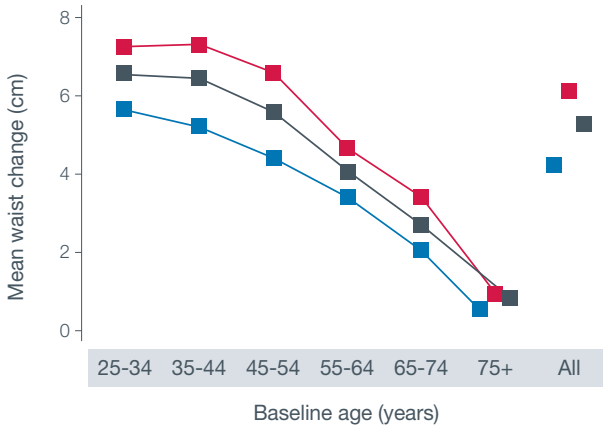


Men
Women
All

	Men	Women	All
25-34	6.7	6.6	6.7
35-44	4.3	5.0	4.7
45-54	2.4	2.9	2.7
55-64	0.3	0.5	0.4
65-74	-2.1	-2.1	-2.1
75+	-4.2	-4.7	-4.5
All	2.3	2.9	2.6

Greater waist circumference changes were observed in younger individuals compared with those who were older. On average, the waist circumference increase was approximately 50% greater in women than it was in men (Figure 3.2).

Figure 3.2: Mean waist circumference change over 12 years according to baseline age: the AusDiab study

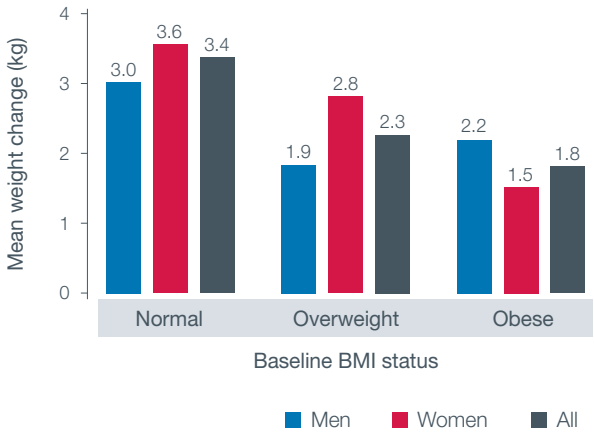


Men
Women
All

	Men	Women	All
25-34	5.7	7.3	6.6
35-44	5.3	7.4	6.5
45-54	4.5	6.6	5.6
55-64	3.4	4.7	4.1
65-74	2.1	3.4	2.7
75+	0.6	1.0	0.8
All	4.3	6.2	5.3

All BMI groups showed an increase in weight over the follow-up period, with women generally gaining more weight than men. The greatest mean weight increases were observed in those who had a normal BMI at baseline, with lesser weight gains observed in those who were initially overweight or obese (Figure 3.3).

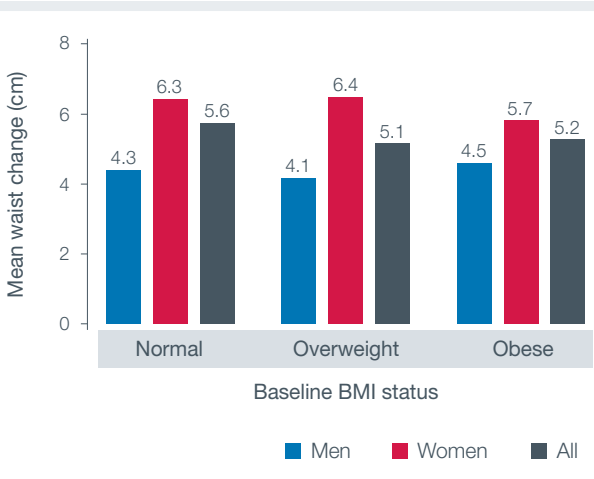
Figure 3.3: Mean weight change over 12 years according to baseline body mass index status: the AusDiab study



The heights of bars on all graphs are accurate to two decimal places, but data labels are rounded to one decimal place.

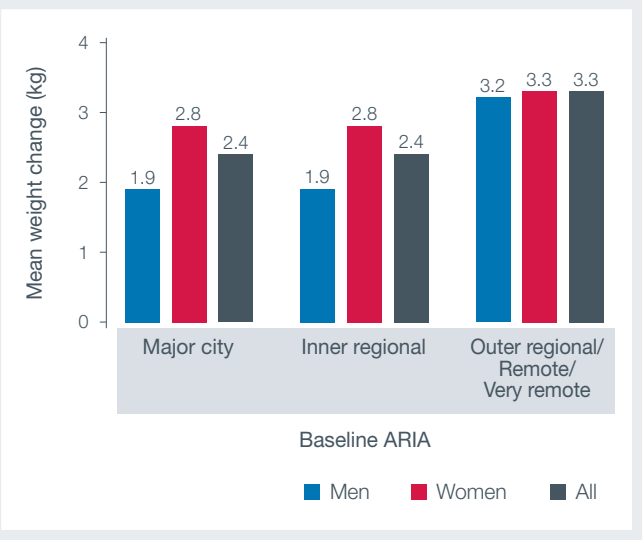
Over the period of follow-up, an increase in waist circumference was observed in all BMI groups. In men, the increase in waist circumference was greatest in those who were obese at baseline and smallest in those who were overweight at baseline. However in women, the increase in waist circumference was greatest in those who were overweight at baseline, and smallest in those who were obese at baseline (Figure 3.4).

Figure 3.4: Mean waist circumference change over 12 years according to baseline body mass index status: the AusDiab study



Change in weight over 12 years was greatest in those living in outer regional/remote/very remote areas, compared to those living in major cities and inner regional areas (Figure 3.5).

Figure 3.5: Mean weight change over 12 years according to index of remoteness*: the AusDiab study

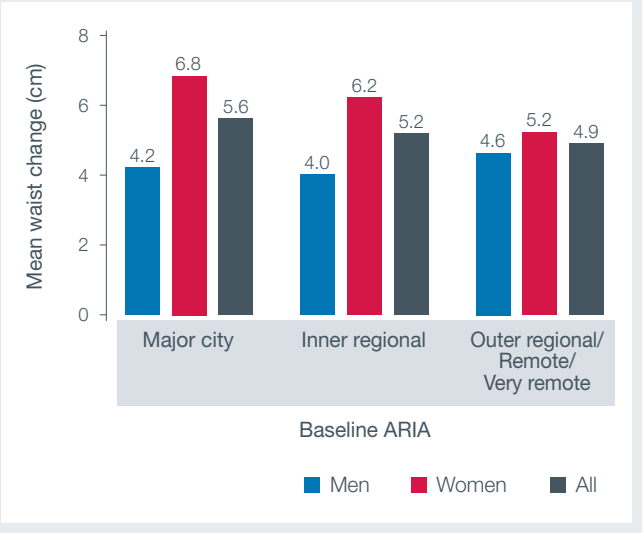


ARIA= Accessibility/Remoteness Index of Australia.

**measured based on postcode of residence.*

In men, change in waist circumference over 12 years was greater in those living in outer regional/remote/very remote areas, compared to those living in major cities and inner regional areas. However, in women, change in waist circumference over 12 years was greater in those living in major cities compared to inner regional and outer regional/remote/very remote areas (Figure 3.6).

Figure 3.6: Mean waist circumference change over 12 years according to index of remoteness: the AusDiab study



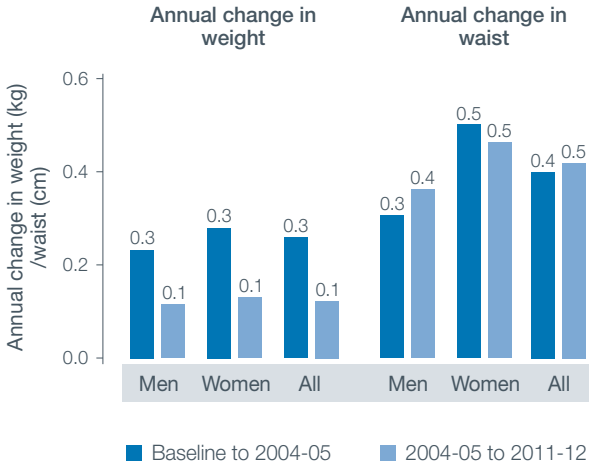
ARIA= Accessibility/Remoteness Index of Australia.

**measured based on postcode of residence.*

The annual change in weight between baseline and follow-up in 2004-05 was greater than the annual change between follow-up in 2004-05 and in 2011-12 (Figure 3.7).

The annual change in waist circumference was lower between baseline and follow-up in 2004-05 compared to the change in waist circumference between follow-up in 2004-05 and in 2011-12, particularly in men. In women, there was no difference in annual change in waist circumference between baseline and follow-up in 2004-05 and between follow-up in 2004-05 and in 2011-12 (Figure 3.7).

Figure 3.7: Difference in change in weight and change in waist circumference between baseline and 2004-05, and between 2004-05 and 2011-12: the AusDiab study

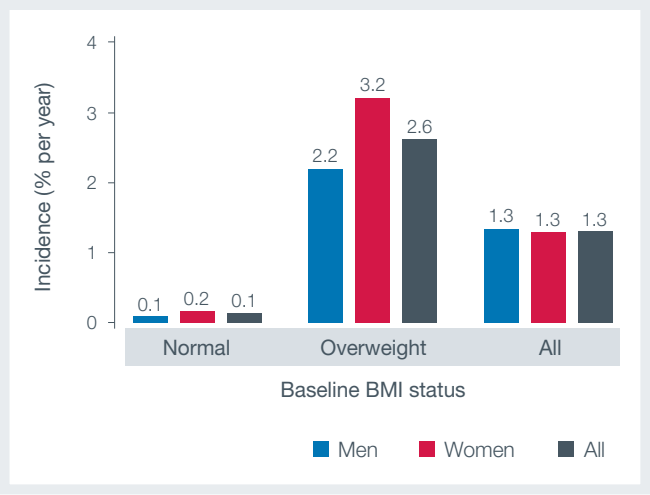


INCIDENCE OF OBESITY

The annual incidence of obesity is shown in Figure 3.8. Compared to those with a normal BMI at baseline, those classified as overweight had an approximate 26 times increased risk of developing obesity. Of note, this is not because weight gain did not occur in those whose BMI at baseline was normal (Figure 3.3). For example, if a person had a BMI of 23 kg/m^2, and a weight of 68 kg, they would need to gain 21 kg weight in order to reach the obesity cut-point of 30 kg/m^2. Hence with an average weight gain of 3.4 kg over 12 years, the chances of becoming obese from normal would have been low.

The annual incidence of obesity in those who were overweight at baseline was higher in women than in men (Figure 3.8).

Figure 3.8: Annual incidence of obesity according to baseline body mass index status: the AusDiab study



For those who were normal or overweight at baseline, 28.4% (1,044 out of 3,670) had progressed to a higher BMI category during follow-up. For those who were obese at baseline, only 12.8% (114 out of 895) had moved to a lower BMI category after 12 years (Table 3.3).

Table 3.3: Proportion of individuals classified by body mass index in 2011-12 according to baseline body mass index status: the AusDiab study

BMI STATUS AT BASELINE	BMI STATUS IN 2011-12			
	n	Normal	Overweight	Obese
Normal	1,849	1,245 (67.3)	575 (31.1)	29 (1.6)
Overweight	1,821	182 (10.0)	1,199 (65.8)	440 (24.2)
Obese	895	7 (0.8)	107 (12.0)	781 (87.3)
Total	**4,565**	**1,434**	**1,881**	**1,250**

Data are n (%). Body mass index (BMI: weight (kg)/height (m)^2) was categorized into three groups: (i) normal: <25 kg/m^2; (ii) overweight: 25-29.9 kg/m^2; and (iii) obese: ≥30 kg/m^2

For those who had a low risk waist circumference at baseline, 46.6% (900 out of 1,933) had progressed to a high risk waist circumference at follow-up. However, for those who had a high risk waist circumference baseline, only 6.7% (177 out of 2,624) had moved to a low risk waist circumference after 12 years (Table 3.4).

Table 3.4: Proportion of individuals classified by waist circumference categories in 2011-12 according to baseline waist circumference categories: the AusDiab study

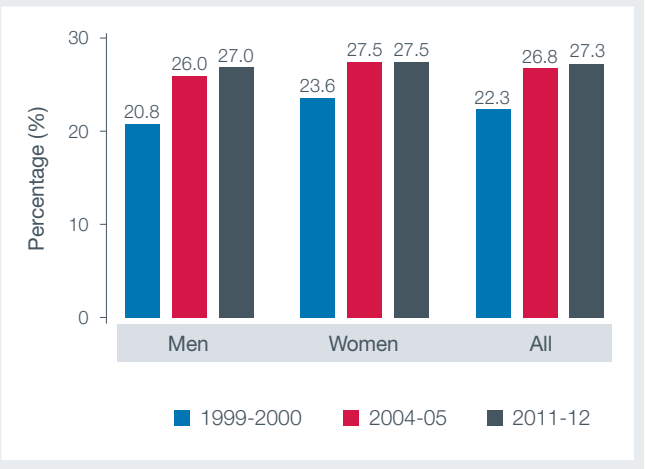
WAIST CIRCUMFERENCE CATEGORIES AT BASELINE	WAIST CIRCUMFERENCE CATEGORIES IN 2011-12		
	n	Low risk	High risk
Low risk	1,933	1,033 (53.4)	900 (46.6)
High risk	2,624	177 (6.7)	2,447 (93.3)
Total	**4,557**	**1,210**	**3,347**

Data are n (%). Waist circumference: (i) low risk: <94 cm for Europid men, <90 cm for Aboriginal/Torres Strait Islander, Asian and South European men, <80 cm for women; (ii) high risk: ≥94 cm for Europid men, ≥90 cm for Aboriginal/Torres Strait Islander, Asian and South European men, ≥80 cm for women.

PERCENTAGE OF THE POPULATION WITH OBESITY

The percentage of the population who were obese at the three time points is shown in Figure 3.9. As the population aged over the 12 years, this percentage rose from 22.3% to 27.3%. At each time point, the percentage with obesity was higher in women than in men.

Figure 3.9: Trends in the percentage of the population with obesity in 1999-2000, 2004-05 and 2011-12 according to sex: the AusDiab study

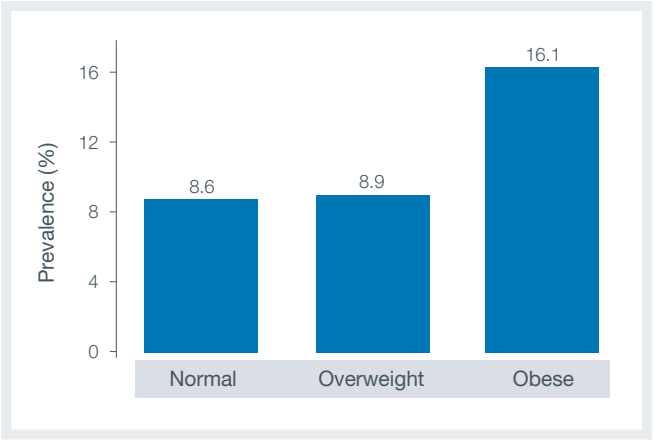


Data have not been standardised for age.

DEPRESSION AND OBESITY

The prevalence of depression was similar in people with a normal BMI and those who were overweight. However, compared to people with a normal BMI and people who were overweight, the prevalence of depression in those who were obese was approximately 80% higher (Figure 3.10).

Figure 3.10: Prevalence of depression in 2011-12 according to BMI status in 2011-12: the AusDiab study

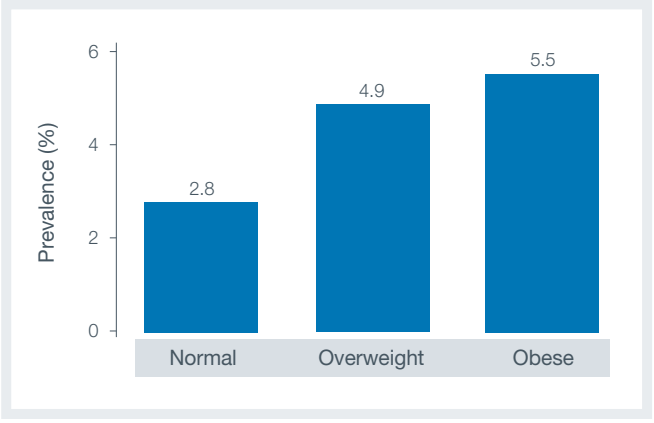


Data have not been standardised for age.

COGNITIVE IMPAIRMENT AND OBESITY

The prevalence of cognitive impairment in people aged 60 years and over was almost double among people who were obese compared to people with a normal BMI (Figure 3.11).

Figure 3.11: Prevalence of cognitive impairment in 2011-12 according to BMI status in 2011-12 among people aged 60 and over: the AusDiab Study

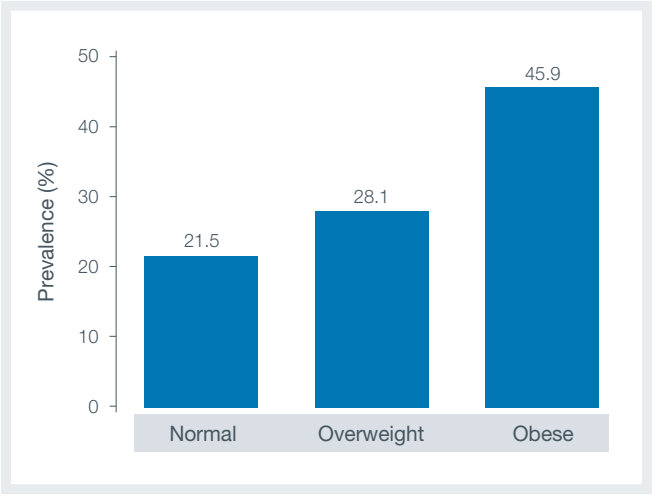


Data have not been standardised for age.

DISABILITY AND OBESITY

The prevalence of disability in people aged 60 years and over increased according to BMI status. Compared to those with a normal BMI, the prevalence of disability in those who were obese was more than twice as high (Figure 3.12).

Figure 3.12: Prevalence of disability in 2011-12 according to BMI status in 2011-12 among people aged 60 years and over: the AusDiab Study

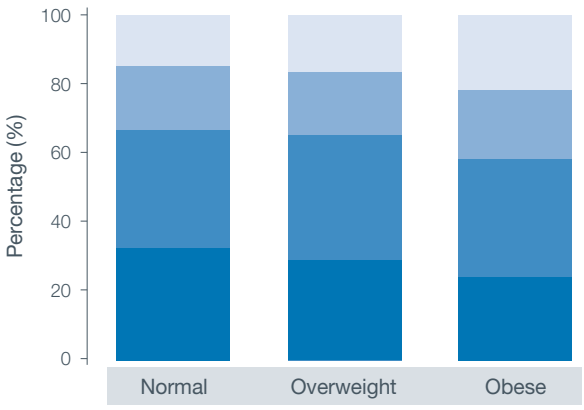


Data have not been standardised for age.

THE USE OF HEALTHCARE SERVICES

The number of visits to a general practitioner (GP) in the previous 3 months was higher in those who were obese compared to those with a normal BMI and those who were overweight. Among those who were obese, approximately 22% had visited a GP 3 times or more in the previous 3 months compared to around 16% of those with a normal BMI and those who were overweight (Figure 3.13).

Figure 3.13: Number of visits to a general practitioner in the previous 3 months according to obesity status in 2011-12: the AusDiab study

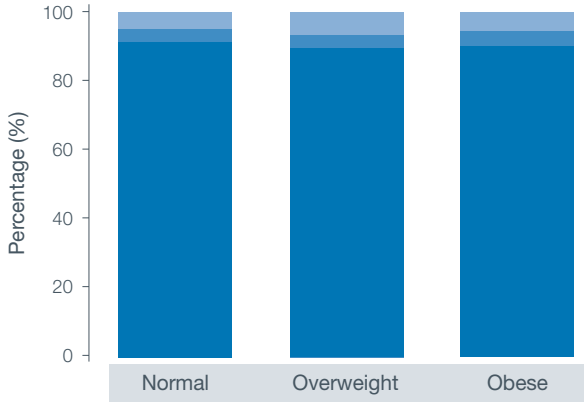


	≥3 visits	2 visits	1 visit	None
Normal	15.5	17.6	34.7	32.2
Overweight	16.2	19.0	36.5	28.4
Obese	21.7	19.9	34.4	23.9

Data have not been standardised for age.

The number of nights spent in a public or private hospital in the previous 12 months did not differ by obesity status. Across all BMI groups, around 90% of people had not spent a night in hospital in the past 12 months, and approximately 6–7% had spent 2 nights or more in hospital (Figure 3.14).

Figure 3.14: Number of nights spent in a hospital in the previous 12 months according to obesity status in 2011-12: the AusDiab study



	≥2 nights	1 night	None
Normal	6.0	3.9	90.1
Overweight	7.5	3.7	88.8
Obese	6.8	3.8	89.4

Data have not been standardised for age.

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AUSDIAB
AUSTRALIAN DIABETES, OBESITY & LIFESTYLE STUDY

4: BLOOD PRESSURE

4: BLOOD PRESSURE

High blood pressure (hypertension) represents an important risk factor for cardiovascular and kidney disease in the general population. In people with diabetes, it is a risk factor for microvascular complications as well as for cardiovascular disease. Thus, high blood pressure is of major significance to the whole population [1, 2].

In the baseline AusDiab survey conducted in 1999-2000, one in three Australians aged 25 years and over were classified as being hypertensive (either as having a blood pressure ≥140/90 mmHg or taking blood pressure-lowering medication). The 5-year and 12-year follow-up surveys provided an opportunity to measure the development of hypertension among Australians.

At follow-up in 2011-12, a random sample of people were asked to participate in an additional sub-study for ambulatory blood pressure monitoring (ABPM). The ABPM device monitors blood pressure over a period of 24 hours while the person goes about their normal daily activities, including sleep and rest. This allows independent assessment of daytime and nighttime blood pressure, in addition to overall 24-hour blood pressure.

This chapter presents: (i) the incidence (% per year) of hypertension, (ii) the impact of various risk factors on the development of hypertension, (iii) trends in the percentage of the population with hypertension and the use of antihypertensives, (iv) the relationship of depression, cognitive impairment, and disability with hypertension, (v) blood pressure measured in the ABPM sub-study, and (vi) healthcare utilisation in hypertension.

DEFINITIONS

HYPERTENSION

Hypertension was defined as having a blood pressure ≥140/90 mmHg and/or taking blood pressure-lowering medication in accordance with the World Health Organization guidelines [3]. Classification of blood pressure is outlined in Table 4.1.

Table 4.1: Classification of blood pressure

	Systolic blood pressure (mmHg)		Diastolic blood pressure (mmHg)		Blood pressure-lowering medication
Normal	<140	and	<90	and	No
Hypertension	≥140	or	≥90	or	Yes

INCIDENT HYPERTENSION

New (incident) cases of hypertension were defined as: (i) people who were classified with normal blood pressure at baseline, but had developed hypertension at follow-up in 2011-12; or (ii) people who were classified with normal blood pressure at baseline, but had developed hypertension at follow-up in 2004-05 and did not attend follow-up in 2011-12.

RESULTS

INCIDENCE OF HYPERTENSION

The incidence of hypertension was 2.9% per year (3.3% per year in men and 2.6% per year in women) (Figure 4.1). There was a mean 3.3 mmHg increase in systolic blood pressure between baseline and 2011-12.

For those classified with normal blood pressure (<140/90 mmHg and not taking blood pressure medication) at baseline, 27.9% had developed hypertension at follow-up in 2011-12. For those classified with hypertension at baseline, 13.7% were classified as having normal blood pressure at follow-up in 2011-12 (Table 4.2).

Table 4.2: Proportions of individuals classified with hypertension in 2011-12 according to baseline hypertension status: the AusDiab study

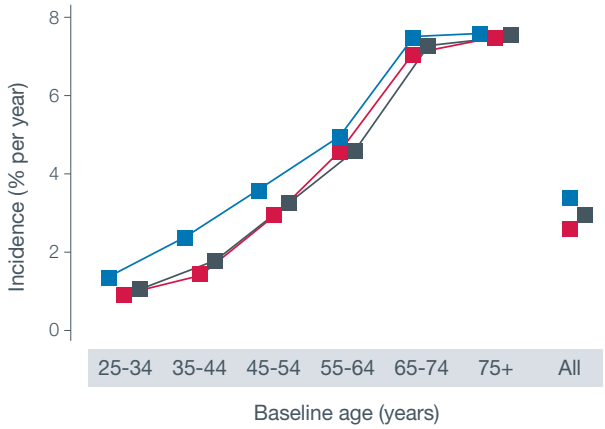
HYPERTENSION STATUS AT BASELINE		HYPERTENSION STATUS IN 2011-12	
	n	Normal blood pressure	Hypertension
Normal blood pressure	3,447	2,486 (72.1)	961 (27.9)
Hypertension	1,139	156 (13.7)	983 (86.3)
Total	**4,586**	**2,642**	**1,944**

Data are n (%). Hypertension is defined as having a blood pressure ≥140/90 mmHg and/or taking blood pressure-lowering medication.

The incidence of hypertension increased according to age, ranging from 1.0% per year for people aged 25-34 years at baseline to 7.5% per year for people aged over 75 years at baseline (Figure 4.1).

In each age group, men had a higher incidence of hypertension compared to women, and these differences were particularly evident for those aged 25-54 years at baseline. There was little difference between men and women for the annual incidence of hypertension in those aged 55 years and older at baseline (Figure 4.1).

Figure 4.1: Annual incidence of hypertension according to baseline age: the AusDiab study



Men
Women
All

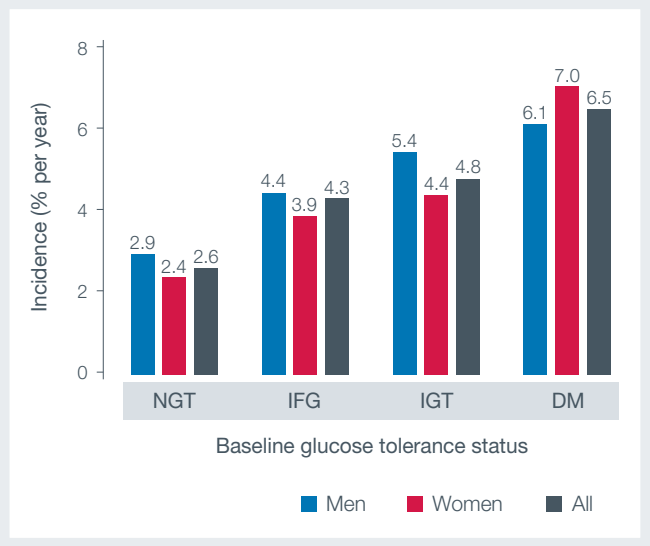
	Men	Women	All
25-34	1.3	0.9	1.0
35-44	2.3	1.5	1.8
45-54	3.6	2.9	3.2
55-64	4.8	4.6	4.7
65-74	7.5	7.1	7.3
75+	7.6	7.5	7.5
All	3.3	2.6	2.9

Compared to people with normal glucose tolerance (NGT) at baseline, the annual incidence of hypertension was greater for people with impaired fasting glucose (IFG), impaired glucose tolerance (IGT) and diabetes; with the annual incidence of hypertension being 2.5 times greater among people with diabetes at baseline than among people with NGT at baseline (Figure 4.2).

Among those with NGT, IFG or IGT at baseline, the incidence of hypertension was higher in men than in women. However, among those with diabetes at baseline, the incidence of hypertension was higher in women than in men (Figure 4.2).

The impact of diabetes on the incidence of hypertension was greater for women than for men. For women, the annual incidence of hypertension was nearly 3 times higher among those with diabetes compared to those with NGT at baseline. However, for men, the annual incidence of hypertension among those with diabetes at baseline was approximately twice as high as the incidence of those who had NGT at baseline (Figure 4.2).

Figure 4.2: Annual incidence of hypertension according to baseline glucose tolerance status: the AusDiab study



NGT – normal glucose tolerance; IFG – impaired fasting glucose; IGT – impaired glucose tolerance; DM – diabetes mellitus.

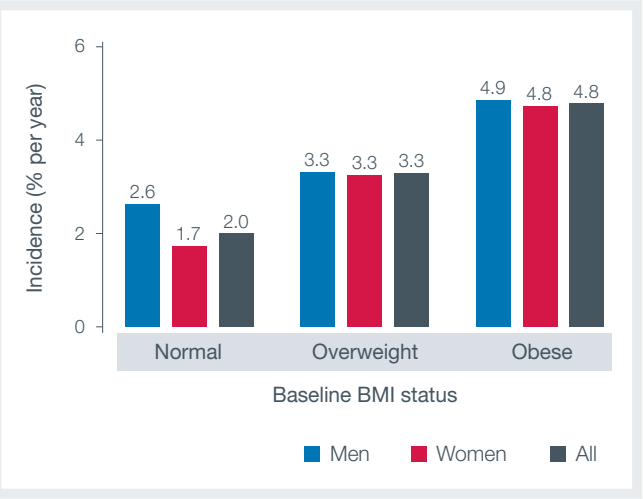
The heights of bars on all graphs are accurate to two decimal places, but data labels are rounded to one decimal place.

The incidence of hypertension was higher in people who were overweight or obese at baseline, compared to those who had a normal body mass index (BMI) at baseline (Figure 4.3).

Among those with a normal BMI at baseline, the incidence of hypertension in men was 50% higher than in women. Among those who were overweight and obese, there was only a small difference in incidence of hypertension between men and women (Figure 4.3).

The impact of obesity on the incidence of hypertension was greater for women than for men. For women, the annual incidence of hypertension was almost 3 times greater among those who were obese at baseline compared to those who had a normal BMI at baseline. However for men, the annual incidence of hypertension among those who were obese at baseline was only a little under twice the incidence of those who had a normal BMI at baseline (Figure 4.3).

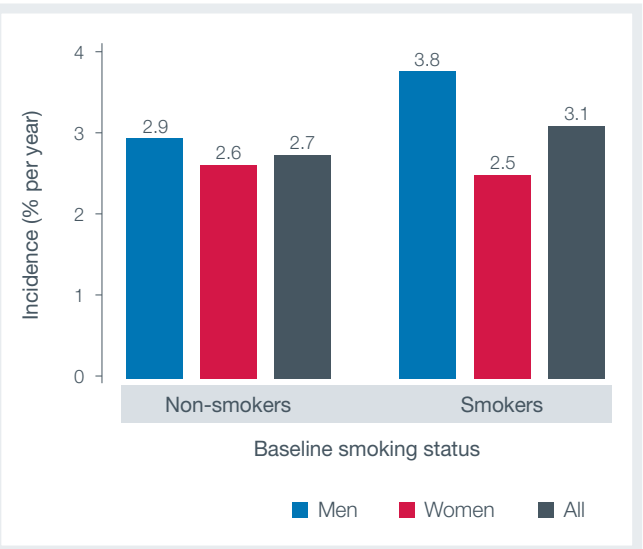
Figure 4.3: Annual incidence of hypertension according to baseline body mass index status: the AusDiab study



BMI – body mass index; where (i) normal was a BMI of <25 kg/m², (ii) overweight was a BMI of 25-29.9 kg/m² and (iii) obese was a BMI of ≥30 kg/m².

In general, the incidence of hypertension was higher in smokers than in non-smokers. Among men, the incidence of hypertension in smokers was 30% higher than in non-smokers (Figure 4.4).

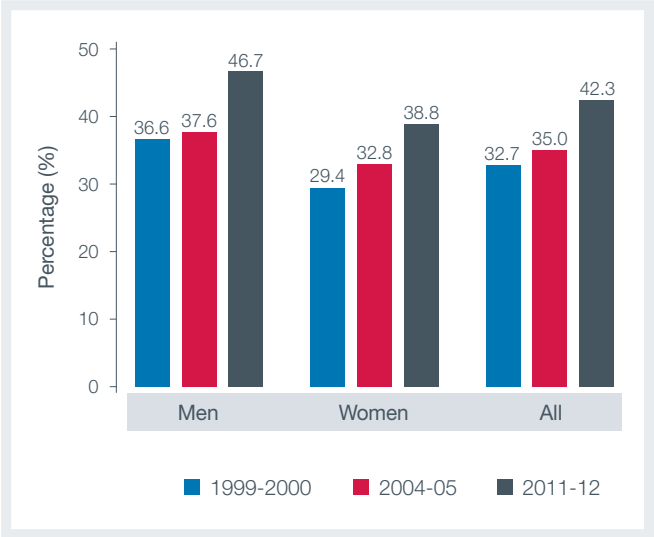
Figure 4.4: Annual incidence of hypertension according to baseline smoking status: the AusDiab study



PERCENTAGE OF THE POPULATION WITH HYPERTENSION

The percentage of the population with hypertension at the three time points is shown in Figure 4.5. As the population aged over the 12 years, this percentage rose from 32.7% to 42.3%. At each time point, the percentage with hypertension was higher in men than in women.

Figure 4.5: Trends in the percentage of the population with hypertension in 1999-2000, 2004-05 and 2011-12 according to sex: the AusDiab study

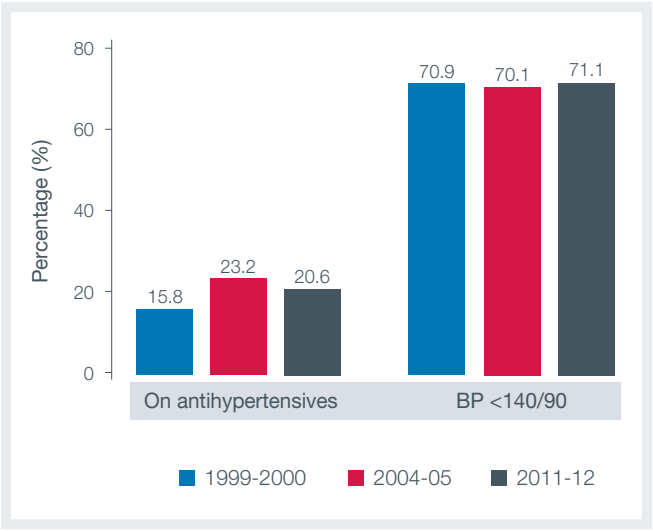


Data have not been standardised for age.

USE OF ANTIHYPERTENSIVE MEDICATION

The percentage of the population who were on antihypertensive medication and the percentage who were meeting the blood pressure target of <140/90 mmHg at the three time points is shown in Figure 4.6. As the population aged over the 12 years, the percentage who were on antihypertensive medication rose from 15.8% to 20.6%, and the percentage who were meeting the blood pressure target remained constant at approximately 71%.

Figure 4.6: Use of antihypertensive medication and the percentage of people meeting blood pressure target of <140/90 mmHg in 1999-2000, 2004-05 and 2011-12: the AusDiab study

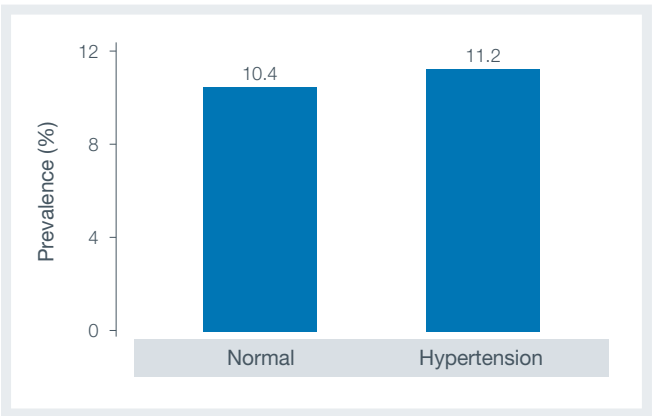


Data have not been standardised for age.

DEPRESSION AND HYPERTENSION

The prevalence of depression was approximately 8% higher in people with hypertension compared to people with normal blood pressure (Figure 4.7).

Figure 4.7: Prevalence of depression in 2011-12 according to hypertension status in 2011-12: the AusDiab study

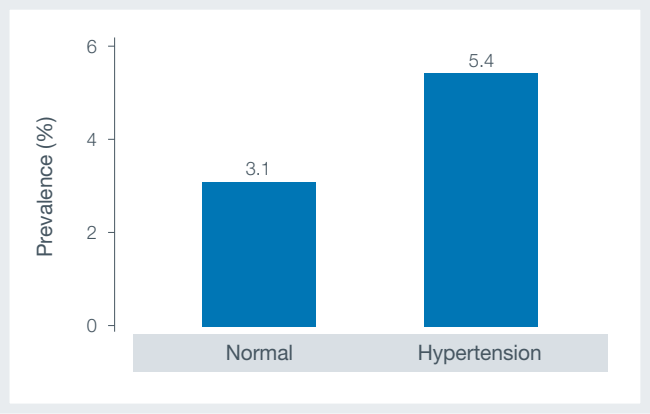


Data have not been standardised for age.

COGNITIVE IMPAIRMENT AND HYPERTENSION

Among people aged 60 years and over, the prevalence of cognitive impairment was 74% higher in people with hypertension compared to people with normal blood pressure (Figure 4.8).

Figure 4.8: Prevalence of cognitive impairment in 2011-12 according to hypertension status in 2011-12 among people aged 60 and over: the AusDiab Study

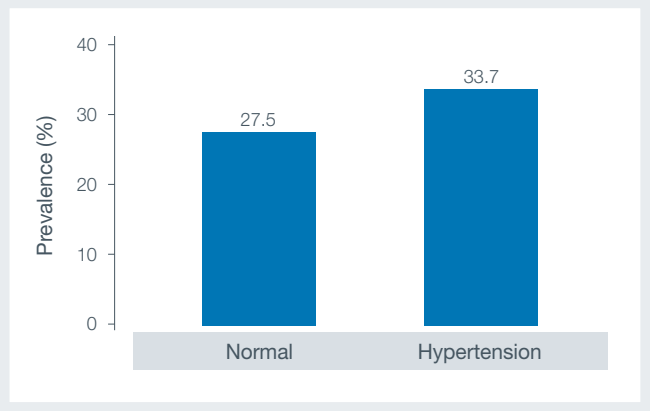


Data have not been standardised for age.

DISABILITY AND HYPERTENSION

Among people aged 60 years and over, the prevalence of disability was approximately 22% higher in those with hypertension compared to those with normal blood pressure (Figure 4.9).

Figure 4.9: Prevalence of disability in 2011-12 according to hypertension status in 2011-12 among people aged 60 years and over: the AusDiab Study



Data have not been standardised for age.

AMBULATORY BLOOD PRESSURE MONITORING

Figures 4.10 and 4.11 show the results of ambulatory blood pressure monitoring (ABPM), and illustrate how blood pressure varies across a 24-hour period. In men and women, both systolic and diastolic blood pressure were lower during the night than during the day. Among men, mean night time systolic blood pressure was 12.2 mmHg lower than during the day, and among women, the mean fall overnight was 11.1 mmHg.

Overall, systolic and diastolic blood pressures measured by ABPM were higher in men than in women.

In men, the mean systolic blood pressure measured on-site was higher than mean daytime values measured by ABPM, while in women, the mean systolic blood pressure measured on-site was similar to the mean daytime values measured by ABPM. In both men and women, the mean diastolic blood pressure measured on-site were lower than the mean daytime values measured by ABPM.

Figure 4.10: Mean blood pressure measured by ambulatory blood pressure monitoring over a 24-hour period in 2011-12 in men: the AusDiab study

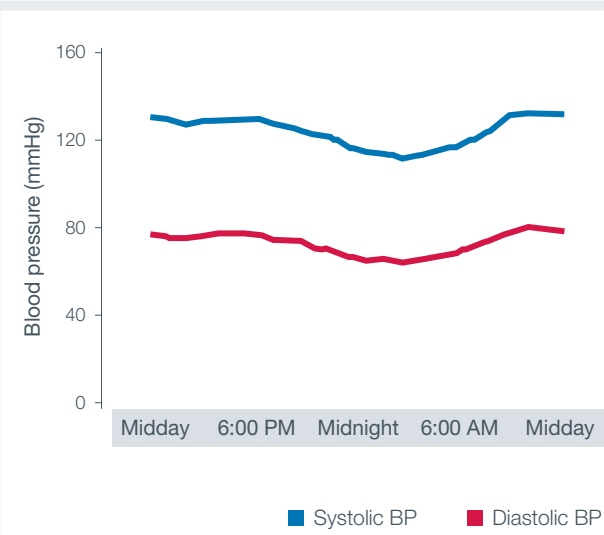
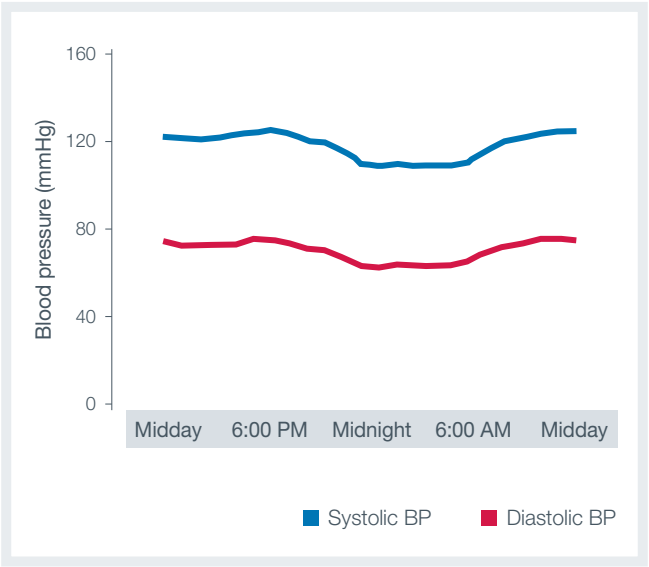


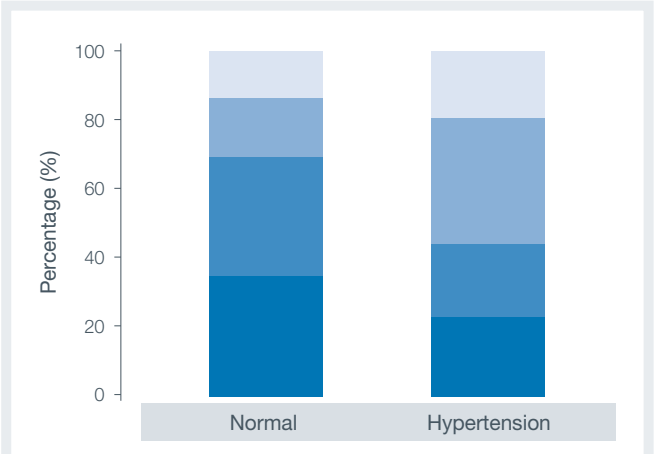
Figure 4.11: Mean blood pressure measured by ambulatory blood pressure monitoring over a 24-hour period in 2011-12 in women: the AusDiab study



USE OF HEALTHCARE SERVICES

The number of visits to a general practitioner (GP) in the previous 3 months was higher in those with hypertension compared to those with normal blood pressure. Among those with hypertension, around 23% had visited a GP 3 times or more in the previous 3 months, compared to 14% of people with normal blood pressure (Figure 4.12).

Figure 4.12: Number of visits to a general practitioner in the previous 3 months according to hypertension status in 2011-12: the AusDiab study

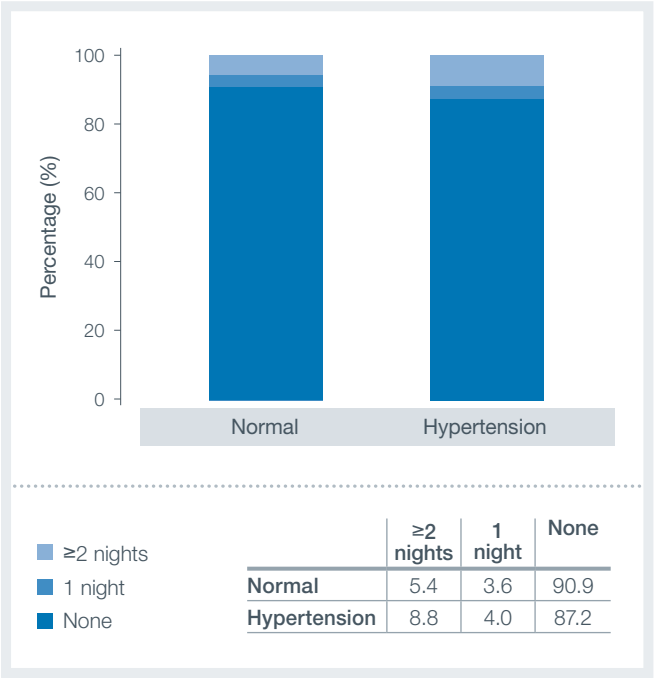


	≥3 visits	2 visits	1 visit	None
Normal	13.7	17.3	34.3	34.8
Hypertension	22.8	21.1	36.6	19.5

Data have not been standardised for age.

Of those with hypertension, almost 9% spent 2 nights or more in hospital in the previous 12 months compared to 5% of those with normal blood pressure (Figure 4.13).

Figure 4.13: Number of nights spent in a hospital in the previous 12 months according to hypertension status in 2011-12: the AusDiab study



	≥2 nights	1 night	None
Normal	5.4	3.6	90.9
Hypertension	8.8	4.0	87.2

Data have not been standardised for age.

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2 Efficacy of atenolol and captopril in reducing risk of macrovascular and microvascular complications in type 2 diabetes: UKPDS 39. UK Prospective Diabetes Study Group. *BMJ.* Sep 12 1998;317(7160):713-720.

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AUSDIAB
AUSTRALIAN DIABETES, OBESITY & LIFESTYLE STUDY

5: METABOLIC SYNDROME

5: METABOLIC SYNDROME

The metabolic syndrome is characterized by central or abdominal (visceral and retroperitoneal) obesity and clustering of other cardiovascular risk factors including abnormal glucose tolerance (diabetes, impaired glucose tolerance (IGT) or impaired fasting glucose (IFG)), raised triglycerides, decreased high-density lipoprotein cholesterol (HDL-C), elevated blood pressure, and hyperinsulinaemia with underlying insulin resistance. The clustering of these risk factors together confers a higher risk of diabetes and cardiovascular disease.

This chapter presents: (i) the incidence (% per year) and the percentage of the population with the metabolic syndrome, (ii) the impact of various risk factors on the development of the metabolic syndrome, (iii) the relationship of depression, cognitive impairment, and disability with the metabolic syndrome, and (iv) healthcare utilisation in the metabolic syndrome.

DEFINITION

METABOLIC SYNDROME

The metabolic syndrome was defined according to the Joint Interim Statement on the metabolic syndrome [1]. Classification of the metabolic syndrome is outlined in Table 5.1.

Table 5.1: Classification of the metabolic syndrome

COMPONENT	THRESHOLD
Waist circumference	**Europids:** ≥94 cm for men, ≥80 cm for women **South and South-East Asians:** ≥90 cm for men, ≥80 cm for women
Plus two or more of the following:	
Raised triglycerides	≥1.7 mmol/l or specific treatment of this lipid abnormality
Reduced HDL-cholesterol	<1.0 mmol/l in men; <1.3 mmol/l in women or specific treatment of this lipid abnormality
Raised blood pressure	Systolic ≥130 mmHg or diastolic ≥85 mmHg or treatment of previously diagnosed hypertension
Raised plasma glucose	Fasting plasma glucose ≥5.6 mmol/l or previously diagnosed type 2 diabetes

INCIDENT METABOLIC SYNDROME

New (incident) cases of the metabolic syndrome were defined as people who did not meet the criteria for the metabolic syndrome at baseline, but satisfied the criteria at follow-up in 2004-05 and 2011-12.

There were 160 people who did not meet the criteria for the metabolic syndrome at baseline and satisfied the criteria at follow-up in 2004-05, but did not satisfy the criteria at follow-up in 2011-12. These people were not included as incident metabolic syndrome cases.

RESULTS

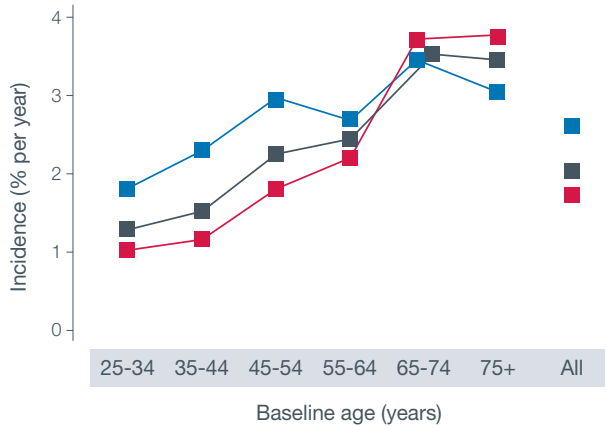
INCIDENCE OF THE METABOLIC SYNDROME

The prevalence of the metabolic syndrome at baseline was 31.0%. The annual incidence of the metabolic syndrome in those who did not meet the criteria for the metabolic syndrome at baseline was 50% higher in men than in women (Figure 5.1).

In men, the annual incidence of the metabolic syndrome increased between the ages of 25 and 54 years, decreasing slightly between the ages of 55 and 64 years, then peaking between the ages of 65 and 74 years, before declining after the age of 75 years. In women, the incidence of the metabolic syndrome was less variable and increased with age until plateaueing after the age of 65 years (Figure 5.1).

The incidence of the metabolic syndrome between the ages of 25 and 64 was higher in men than in women. However, after the age of 65 years, the incidence of the metabolic syndrome was higher in women than in men (Figure 5.1).

Figure 5.1: Annual incidence of the metabolic syndrome according to baseline age: the AusDiab study



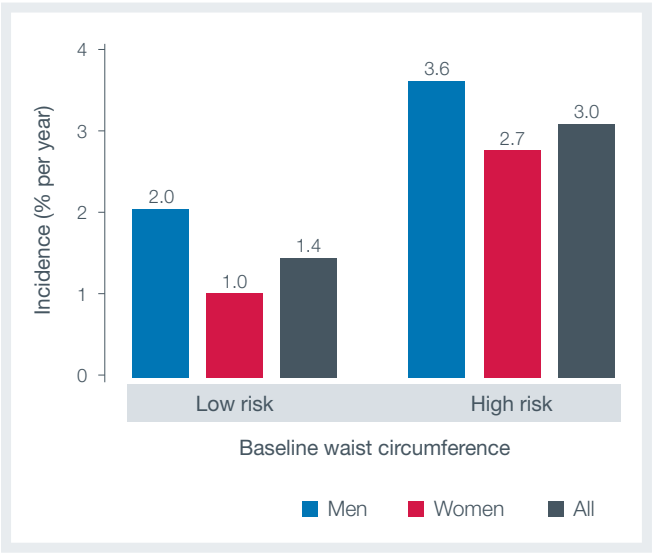
Men
Women
All

	Men	Women	All
25-34	1.8	1.0	1.3
35-44	2.3	1.2	1.6
45-54	2.9	1.8	2.3
55-64	2.7	2.2	2.4
65-74	3.5	3.7	3.6
75+	3.1	3.7	3.4
All	2.6	1.7	2.1

The annual incidence of the metabolic syndrome increased as waist circumference at baseline increased. Compared to those with a low risk waist circumference at baseline, those with a high risk waist circumference were approximately twice as likely to develop the metabolic syndrome (Figure 5.2).

Within both of the waist circumference risk categories, men had a greater annual incidence of the metabolic syndrome than did women (Figure 5.2).

Figure 5.2: Annual incidence of the metabolic syndrome according to baseline waist circumference: the AusDiab study



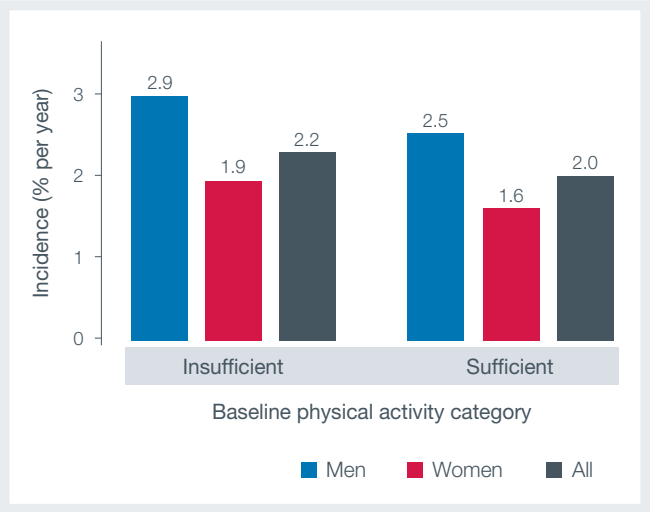
Waist circumference: (i) low risk: <94 cm for Europid men, <90 cm for Aboriginal/Torres Strait Islander, Asian and South European men, <80 cm for women; (ii) high risk: ≥94 cm for Europid men, ≥90 cm for Aboriginal/Torres Strait Islander, Asian and South European men, ≥80 cm for women.

The heights of bars on all graphs are accurate to two decimal places, but data labels are rounded to one decimal place.

When the incidence of the metabolic syndrome was examined according to baseline body mass index (BMI), the incidence in those who were categorized as normal (BMI<25 kg/m^2), overweight (BMI 25-29.9 kg/m^2) and obese (BMI ≥30 kg/m^2) at baseline was 1.3%, 2.8% and 3.9% per year respectively.

The incidence of the metabolic syndrome was slightly higher among those who reported insufficient physical activity at baseline compared to those who reported sufficient physical activity at baseline (Figure 5.3).

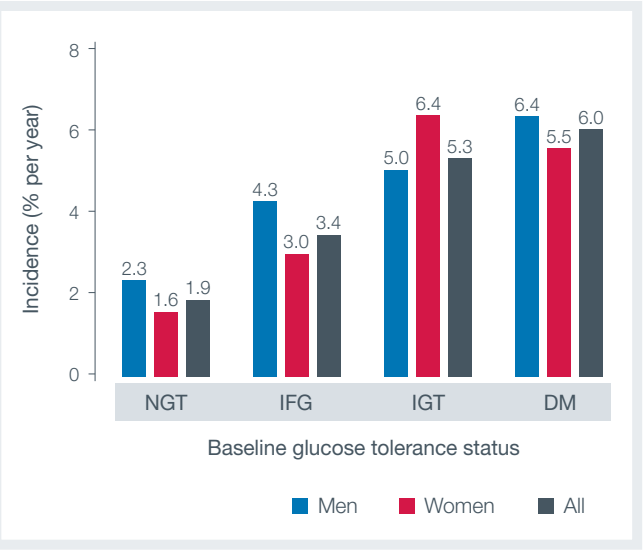
Figure 5.3: Annual incidence of the metabolic syndrome according to baseline physical activity: the AusDiab study



'Physical activity time' for the previous week was calculated as the sum of the time spent performing moderate activity (e.g. walking) plus double the time spent in vigorous activity (to reflect its greater intensity). Insufficient: 1-149 minutes of physical activity in the previous week; sufficient: ≥150 minutes of physical activity in the previous week.

The annual incidence of the metabolic syndrome was greater in those with diabetes at baseline compared to those with normal glucose tolerance at baseline. In men, the incidence of the metabolic syndrome in those with pre-diabetes was between the incidence in those with normal glucose tolerance and those with diabetes at baseline. However, in women, the incidence of the metabolic syndrome was highest in those with impaired glucose tolerance at baseline (Figure 5.4).

Figure 5.4: Annual incidence of the metabolic syndrome according to baseline glucose tolerance status: the AusDiab study

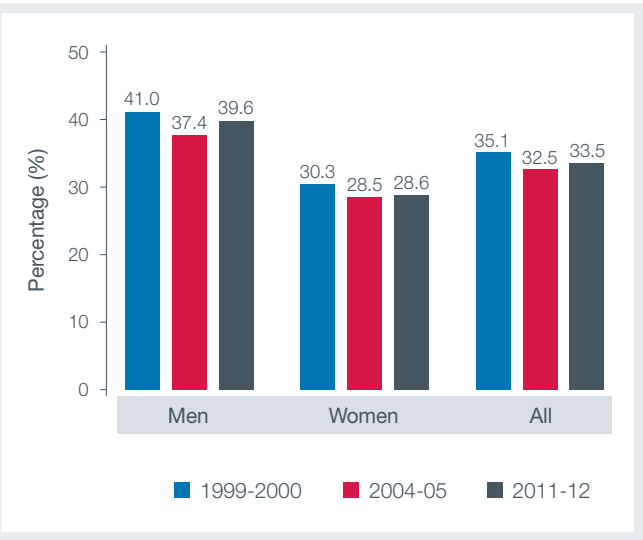


NGT: normal glucose tolerance; IFG: impaired fasting glucose; IGT: impaired glucose tolerance; DM: diabetes mellitus.

PERCENTAGE OF THE POPULATION WITH THE METABOLIC SYNDROME

The percentage of the population with the metabolic syndrome at the three time points is shown in Figure 5.5. As the population aged over the 12 years, this percentage decreased from 35.1% to 33.5%. At each time point, the percentage with the metabolic syndrome was higher in men than women.

Figure 5.5: Trends in the percentage of the population with the metabolic syndrome in 1999-2000, 2004-05 and 2011-12 according to sex: the AusDiab study

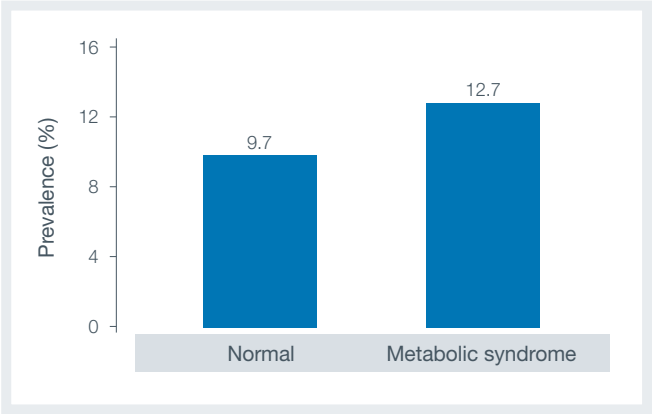


Data have not been standardised for age.

DEPRESSION AND THE METABOLIC SYNDROME

The prevalence of depression was 31% higher in those who met the criteria for the metabolic syndrome at follow-up in 2011-12 compared to those who did not meet the criteria (Figure 5.6).

Figure 5.6: Prevalence of depression in 2011-12 according to metabolic syndrome status in 2011-12: the AusDiab study

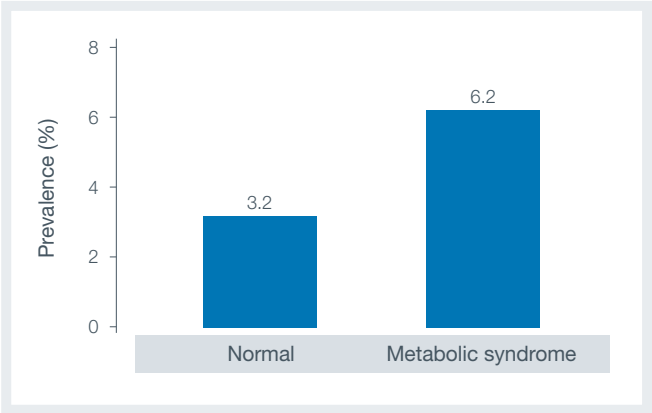


Data have not been standardised for age.

COGNITIVE IMPAIRMENT AND THE METABOLIC SYNDROME

Among people aged 60 years and over, the prevalence of cognitive impairment was almost double in those who met the criteria for the metabolic syndrome at follow-up in 2011-12 compared to those who did not meet the criteria (Figure 5.7).

Figure 5.7: Prevalence of cognitive impairment in 2011-12 according to metabolic syndrome status in 2011-12 among people aged 60 and over: the AusDiab Study

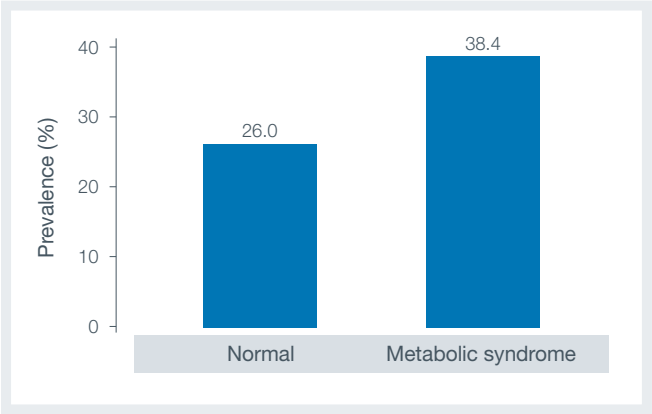


Data have not been standardised for age.

DISABILITY AND THE METABOLIC SYNDROME

Among those aged 60 years and over, the prevalence of disability was almost 50% higher in those who met the criteria for the metabolic syndrome at follow-up in 2011-12 compared to those who did not meet the criteria (Figure 5.8).

Figure 5.8: Prevalence of disability in 2011-12 according to metabolic syndrome status in 2011-12 among people aged 60 years and over: the AusDiab Study



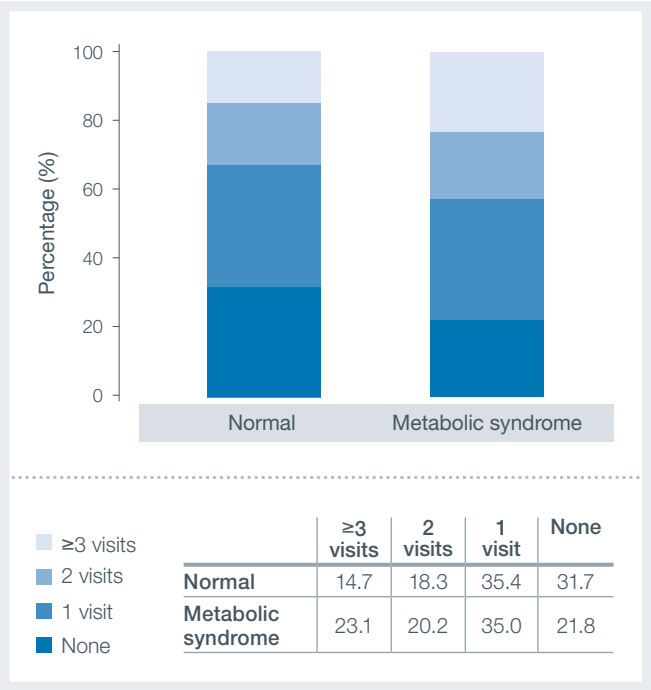
Data have not been standardised for age.

USE OF HEALTHCARE SERVICES

The number of visits to a general practitioner (GP) in the previous 3 months was higher in those who met the criteria for the metabolic syndrome at follow-up in 2011-12 compared to those who did not meet the criteria.

Among those who met the criteria for the metabolic syndrome, approximately 23% of people had visited a GP 3 times or more, compared to only 15% of people who did not meet the criteria for the metabolic syndrome (Figure 5.9).

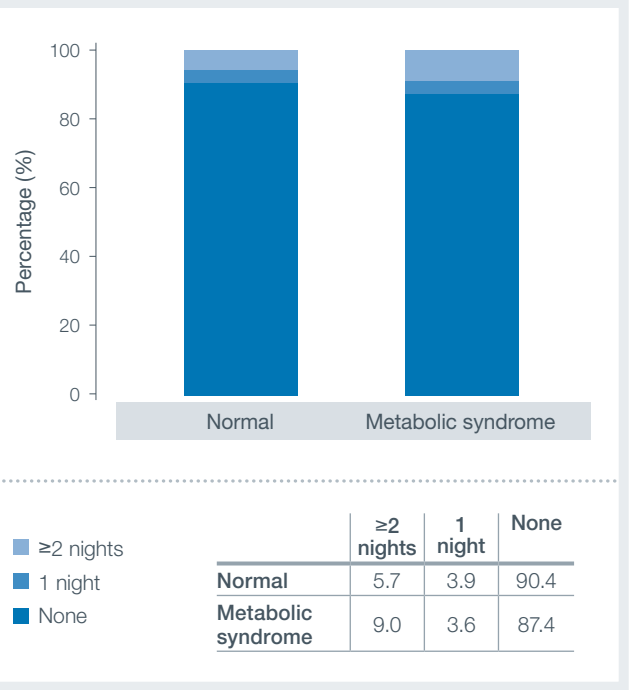
Figure 5.9: Number of visits to a general practitioner in the previous 3 months according to metabolic syndrome status in 2011-12: the AusDiab study



	≥3 visits	2 visits	1 visit	None
Normal	14.7	18.3	35.4	31.7
Metabolic syndrome	23.1	20.2	35.0	21.8

Data have not been standardised for age.

Figure 5.10: Number of nights spent in a hospital in the previous 12 months according to metabolic syndrome status in 2011-12: the AusDiab study



	≥2 nights	1 night	None
Normal	5.7	3.9	90.4
Metabolic syndrome	9.0	3.6	87.4

Data have not been standardised for age.

The number of nights spent in a hospital in the past 12 months was greater in those who met the criteria for the metabolic syndrome at follow-up in 2011-12 compared to those who did not meet the criteria.

Among those who met the criteria for the metabolic syndrome, 9% had stayed in a hospital for 2 nights or more, compared to almost 6% of people who did not meet the criteria for the metabolic syndrome (Figure 5.10).

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AUSDIAB
AUSTRALIAN DIABETES, OBESITY & LIFESTYLE STUDY

6: CHRONIC KIDNEY DISEASE

6: CHRONIC KIDNEY DISEASE

Chronic kidney disease is common in the general community and is associated with significant physical and mental disability [1, 2]. Individuals with chronic kidney disease are at increased risk of progressing to complete kidney failure (so called "end-stage kidney failure") requiring dialysis or transplantation. They are also predisposed to the development of premature cardiovascular disease with an increased risk of mortality due to heart attack or stroke [3, 4].

The number of new (incident) cases of treated end-stage kidney disease in Australia is approximately 101 per million population per year, with diabetes being the leading cause [5]. Currently 35% of all new end-stage kidney disease is due to diabetes [5], compared with 17% in 1994 [6]. The other common causes of end-stage kidney disease include glomerulonephritis (23%) and vascular kidney disease related to hypertension and/or atherosclerosis (15%) [5].

This chapter presents: (i) the incidence (% per year) and the percentage of the population with impaired estimated glomerular filtration rate (eGFR) and with albuminuria, (ii) the impact of various risk factors on the development of impaired eGFR and albuminuria, (iii) the relationship of depression, cognitive impairment, and disability with impaired eGFR and albuminuria, and (iv) healthcare utilization in impaired eGFR and albuminuria.

DEFINITIONS

IMPAIRED ESTIMATED GLOMERULAR FILTRATION RATE

Chronic kidney disease is defined as present when there is impaired kidney function. The ideal measure of kidney function is the glomerular filtration rate (GFR). GFR can be estimated from the results of a blood test (so called 'estimated' GFR or eGFR) and an impaired eGFR is defined as eGFR <60 ml/min/1.73m ^{2} [7]. In the AusDiab study, the eGFR has been calculated using the abbreviated MDRD formula [8].

INCIDENT IMPAIRED ESTIMATED GLOMERULAR FILTRATION RATE

New (incident) cases of impaired eGFR were defined as individuals who had a normal eGFR (≥60 ml/min/1.73m ^{2}) at baseline, but had an eGFR of <60 ml/min/1.73m ^{2} at follow-up in 2004-05 and 2011-12. There were 42 people with normal eGFR at baseline and impaired eGFR at follow-up in 2004-05, but normal eGFR at follow-up in 2011-12. These people were not included as incident cases.

ALBUMINURIA

Kidney disease can manifest as the leakage of protein into the urine, with or without impairment of kidney function. The earliest manifestation of an excessive leakage of protein into the urine can be detected by measuring urinary albumin excretion and is called albuminuria.

Albuminuria was considered to be present if the spot urine albumin:creatinine ratio was ≥2.5 mg/mmol for men and ≥3.5 mg/mmol for women. Albuminuria is a recognized risk factor for the progression of chronic kidney disease and additionally is an important risk factor for cardiovascular disease and mortality [9-11].

INCIDENT ALBUMINURIA

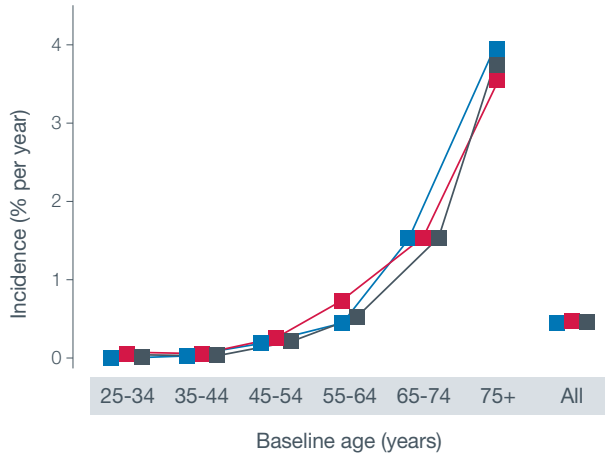
Incident cases of albuminuria were defined as people who had normal albumin:creatinine levels in the urine at baseline, but had abnormal albumin:creatinine levels in urine (≥2.5 mg/mmol for men and ≥3.5 mg/mmol for women) at follow-up in 2004-05 and 2011-12. There were 59 people who had normal albumin:creatinine levels in urine at baseline and abnormal albumin:creatinine levels at follow-up in 2004-05, but normal albumin:creatinine levels at follow-up in 2011-12. These people were not included as incident cases.

RESULTS

INCIDENCE OF IMPAIRED ESTIMATED GLOMERULAR FILTRATION RATE

The incidence of impaired eGFR was 0.4% per year as presented in Figure 6.1. The annual incidence of impaired eGFR increased with age, with an incidence close to zero among those aged between 25 and 54 years at baseline rising to 3.8% in those aged 75 years and over at baseline. In general, there was little difference in the incidence of impaired eGFR between men and women.

Figure 6.1: Annual incidence of impaired estimated glomerular filtration rate according to baseline age: the AusDiab study



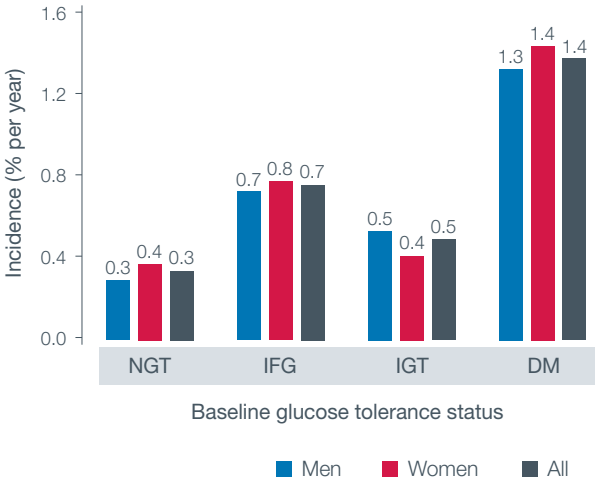
Men
Women
All

	Men	Women	All
25-34	0.0	0.1	0.0
35-44	0.1	0.1	0.1
45-54	0.2	0.3	0.2
55-64	0.4	0.7	0.6
65-74	1.7	1.7	1.7
75+	3.9	3.6	3.8
All	0.4	0.5	0.4

The annual incidence of impaired eGFR according to baseline glucose tolerance status is presented in Figure 6.2. The incidence of impaired eGFR was highest in those with diabetes and lowest in those with NGT. The incidence of impaired eGFR in those with IFG was approximately 40% higher than that seen in those with IGT.

The incidence of impaired eGFR was higher for women than for men in those with NGT, IFG and diabetes at baseline. However, the incidence of impaired eGFR was higher in men than in women in those with IGT (Figure 6.2).

Figure 6.2: Annual incidence of impaired estimated glomerular filtration rate according to baseline glucose tolerance status: the AusDiab study

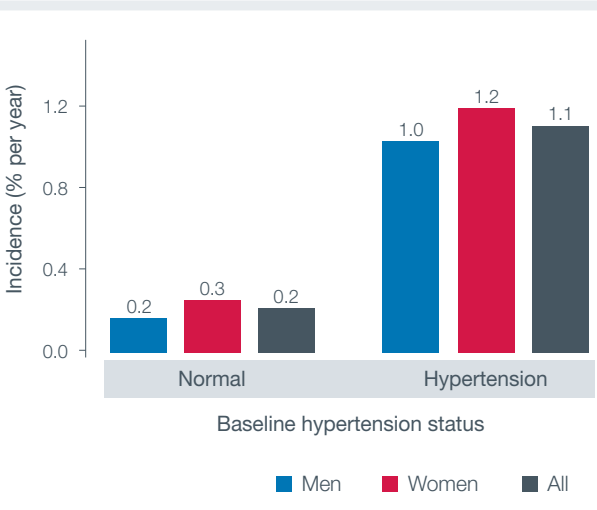


NGT – normal glucose tolerance; IFG – impaired fasting glucose; IGT – impaired glucose tolerance; DM – diabetes mellitus.

The heights of bars on all graphs are accurate to two decimal places, but data labels are rounded to one decimal place.

The annual incidence of impaired eGFR was approximately 5 times higher in those with hypertension compared to those with normal blood pressure. In those with hypertension, the incidence of impaired eGFR was higher in women compared to men (Figure 6.3).

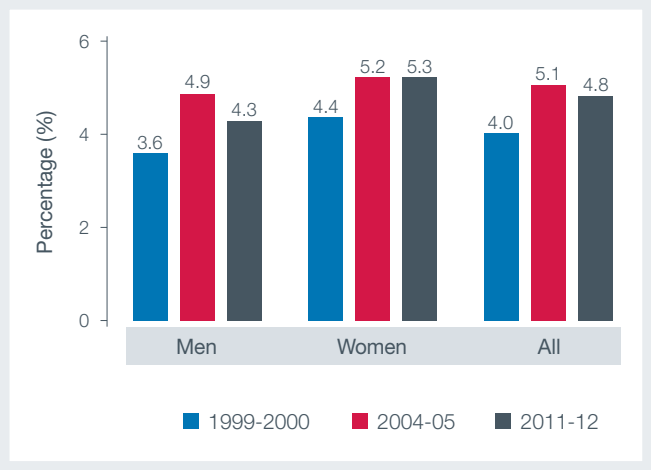
Figure 6.3: Annual incidence of impaired estimated glomerular filtration rate according to baseline hypertension status: the AusDiab study



PERCENTAGE OF THE POPULATION WITH IMPAIRED ESTIMATED GLOMERULAR FILTRATION RATE

The percentage of the population with impaired eGFR at the three time points is shown in Figure 6.4. As the population aged over the 12 year study period, this percentage rose from 4.0% to 4.8%. At all time points, the percentage with impaired eGFR was higher in women than in men.

Figure 6.4: Trends in the percentage of the population with impaired estimated glomerular filtration rate in 1999-2000, 2004-05 and 2011-12 according to sex: the AusDiab study

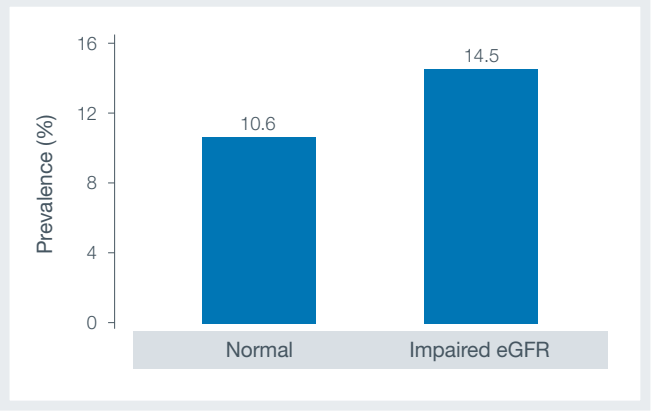


Data have not been standardised for age.

DEPRESSION AND GLOMERULAR FILTRATION RATE

The prevalence of depression was higher in those with impaired eGFR compared to those with normal eGFR (Figure 6.5).

Figure 6.5: Prevalence of depression in 2011-12 according to estimated glomerular filtration rate status in 2011-12: the AusDiab study

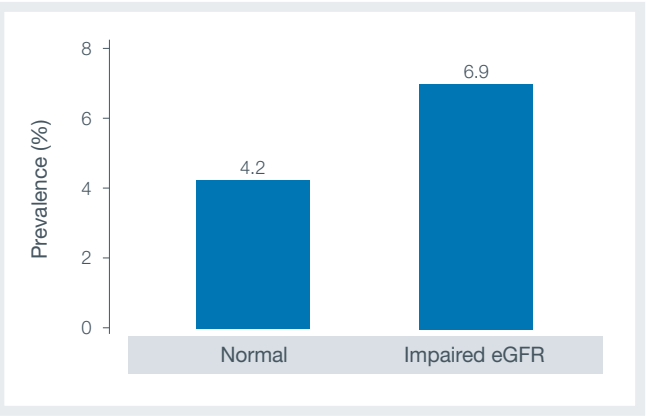


Data have not been standardised for age.

COGNITIVE IMPAIRMENT AND GLOMERULAR FILTRATION RATE

In those aged over 60 years, the prevalence of cognitive impairment was almost 65% higher in those with impaired eGFR compared to those with normal eGFR (Figure 6.6).

Figure 6.6: Prevalence of cognitive impairment in 2011-12 according to estimated glomerular filtration rate status in 2011-12 among people aged 60 and over: the AusDiab Study

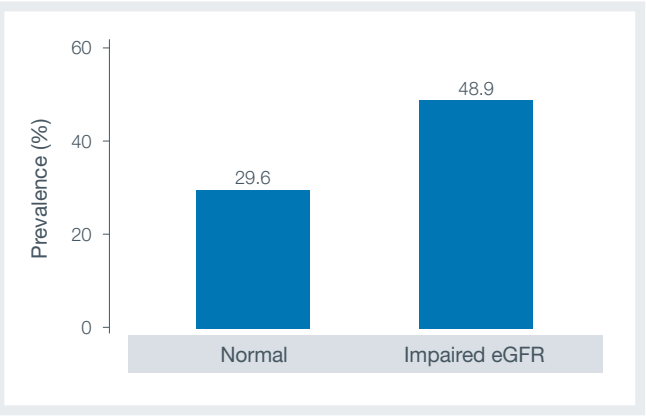


Data have not been standardised for age.

DISABILITY AND GLOMERULAR FILTRATION RATE

The prevalence of disability in those aged over 60 years with impaired eGFR was 65% higher than in those aged over 60 years with normal eGFR (Figure 6.7).

Figure 6.7: Prevalence of disability in 2011-12 according to estimated glomerular filtration rate status in 2011-12 among people aged 60 and over: the AusDiab Study

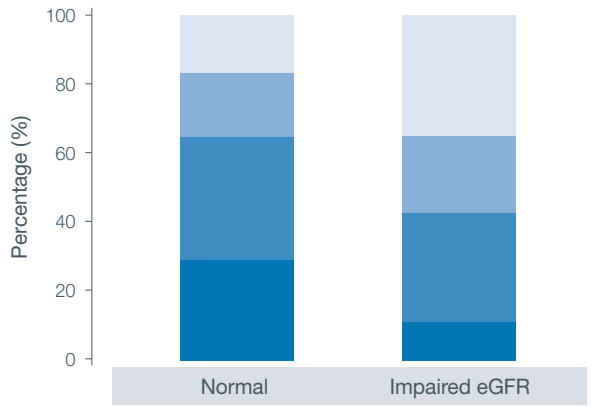


Data have not been standardised for age.

USE OF HEALTHCARE SERVICES BY GLOMERULAR FILTRATION RATE STATUS

The number of visits to a general practitioner in the previous 3 months according to eGFR status is presented in Figure 6.8. In those with normal eGFR, 29.2% had not visited a GP in the previous 3 months, compared to only 11.0% of those with impaired eGFR. In contrast, 34.9% of people with impaired eGFR had visited a GP 3 times or more in the previous 3 months, compared to 16.7% of people with normal eGFR.

Figure 6.8: Number of visits to a general practitioner in the previous 3 months according to estimated glomerular filtration rate status in 2011-12: the AusDiab study



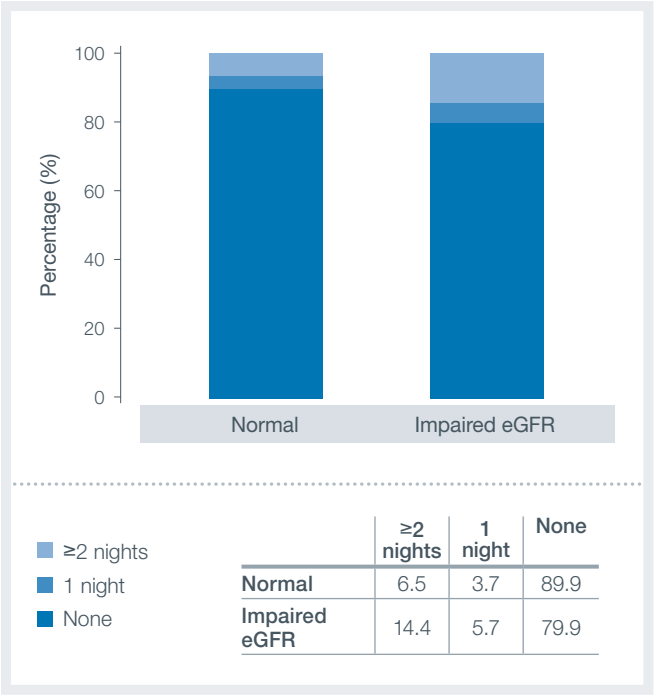
≥3 visits
2 visits
1 visit
None

	≥3 visits	2 visits	1 visit	None
Normal	16.7	18.7	35.4	29.2
Impaired eGFR	34.9	22.5	31.6	11.0

Data have not been standardised for age.

The number of nights spent in a hospital in the previous 12 months was higher in those with impaired eGFR. In those with impaired eGFR, 14.4% had spent at least two nights in hospital compared to only 6.5% of those with normal eGFR (Figure 6.9).

Figure 6.9: Number of nights spent in a hospital in the previous 12 months according to estimated glomerular filtration rate status in 2011-12: the AusDiab study



≥2 nights
1 night
None

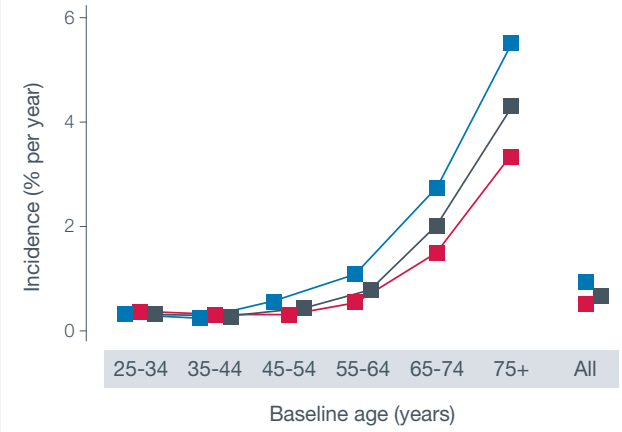
	≥2 nights	1 night	None
Normal	6.5	3.7	89.9
Impaired eGFR	14.4	5.7	79.9

Data have not been standardised for age.

INCIDENCE OF ALBUMINURIA

The incidence of albuminuria was 0.7% per year, with the incidence in men almost double that in women. In both men and women, the annual incidence of albuminuria increased with increasing age beyond 45 years (Figure 6.10).

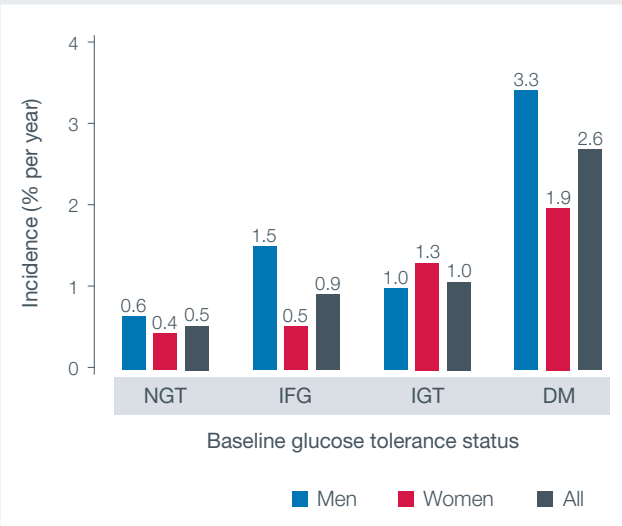
Figure 6.10: Annual incidence of albuminuria according to baseline age: the AusDiab study



	Men	Women	All
25-34	0.3	0.4	0.3
35-44	0.2	0.3	0.3
45-54	0.6	0.3	0.4
55-64	1.1	0.6	0.8
65-74	2.7	1.5	2.1
75+	5.5	3.3	4.3
All	0.9	0.5	0.7

The annual incidence of albuminuria was highest in those with diabetes at baseline, and lowest in those with NGT at baseline. In men, the incidence of albuminuria was lower in those with IGT compared to those with IFG. However, in women, the incidence of albuminuria was higher in those with IGT compared to those with IFG. The incidence of albuminuria was higher in men than in women in those with NGT, IFG and diabetes, but lower in those with IGT (Figure 6.11).

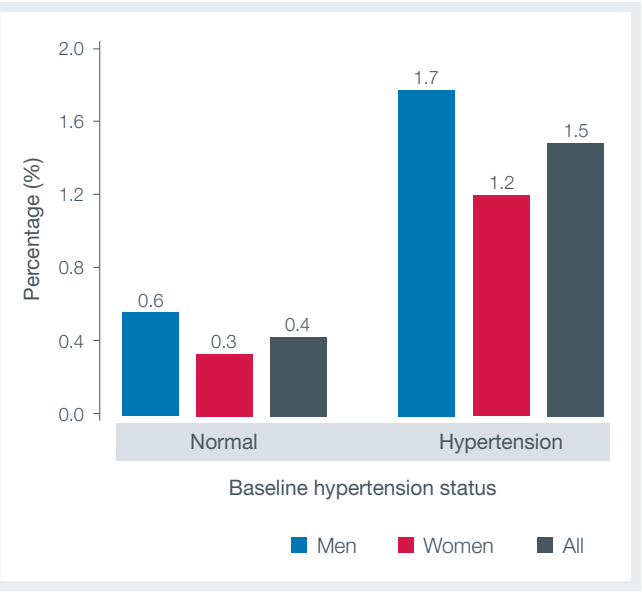
Figure 6.11: Annual incidence of albuminuria according to baseline glucose tolerance status: the AusDiab study



NGT – normal glucose tolerance; IFG – impaired fasting glucose; IGT – impaired glucose tolerance; DM – diabetes mellitus.

The annual incidence of albuminuria was around 3–4 times higher in those with hypertension than those with normal blood pressure (Figure 6.12).

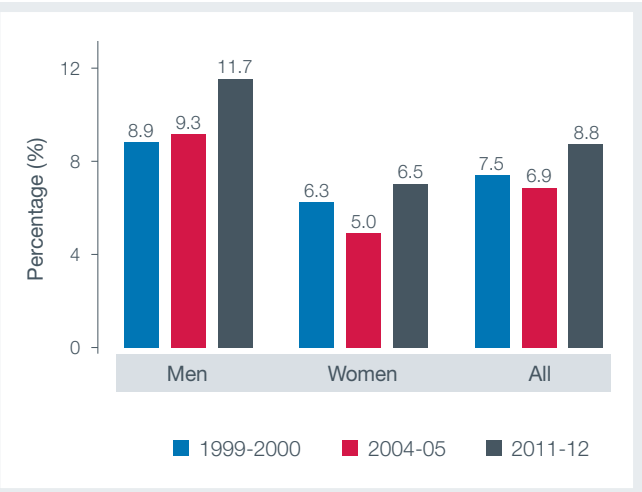
Figure 6.12: Annual incidence of albuminuria according to baseline hypertension status: the AusDiab study



PERCENTAGE OF THE POPULATION WITH ALBUMINURIA

The percentage of the AusDiab cohort with albuminuria at the three time points is shown in Figure 6.13. As the cohort aged over the 12 years of the AusDiab study, this percentage rose from 7.5% to 8.8%. At each time point, the percentage with albuminuria was higher in men than women.

Figure 6.13: Trends in the percentage of the population with albuminuria in 1999-2000, 2004-05 and 2011-12 according to sex: the AusDiab study

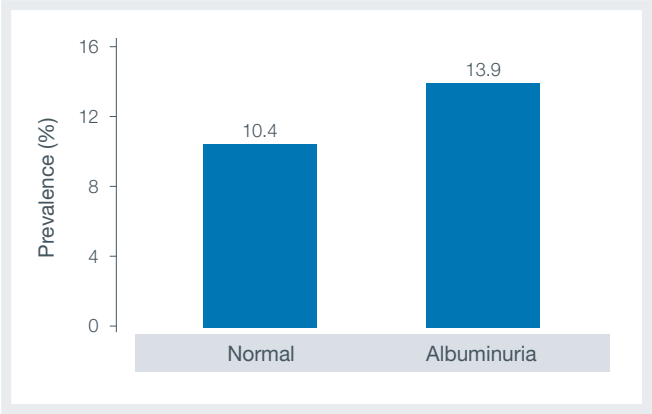


Data have not been standardised for age.

DEPRESSION AND ALBUMINURIA

The prevalence of depression was 34% higher in those with albuminuria compared to those without albuminuria (Figure 6.14).

Figure 6.14: Prevalence of depression in 2011-12 according to albuminuria status in 2011-12: the AusDiab study

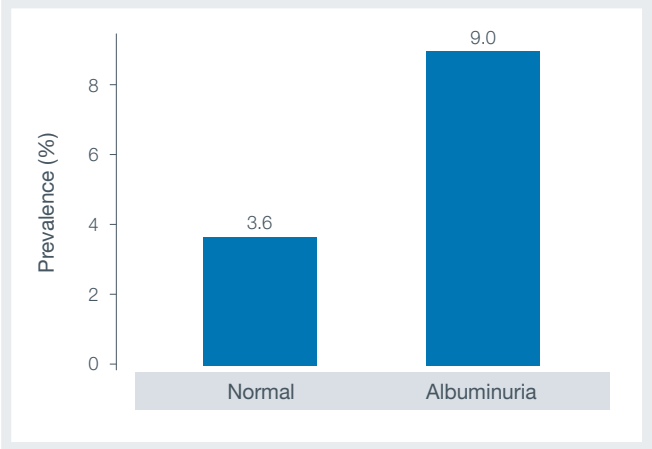


Data have not been standardised for age.

COGNITIVE IMPAIRMENT AND ALBUMINURIA

In those aged 60 years and over, the prevalence of cognitive impairment was more than twice as high in those with albuminuria compared to those without albuminuria (Figure 6.15).

Figure 6.15: Prevalence of cognitive impairment in 2011-12 according to albuminuria status in 2011-12 among people aged 60 and over: the AusDiab Study

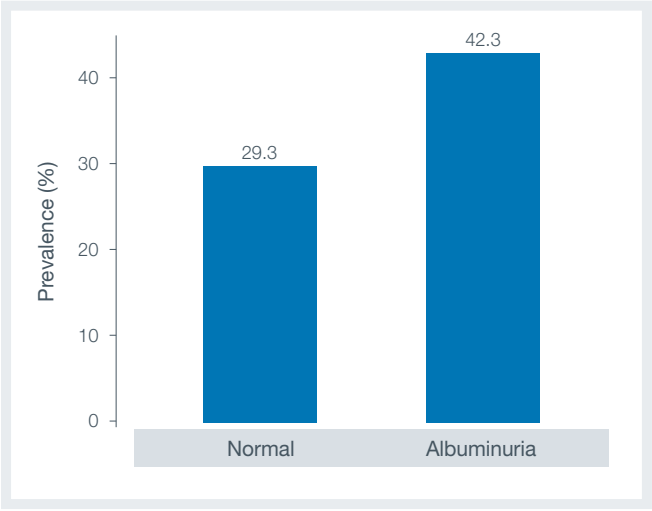


Data have not been standardised for age.

DISABILITY AND ALBUMINURIA

In those aged 60 years and over, the prevalence of disability was approximately 44% higher in those with albuminuria compared to those without albuminuria (Figure 6.16).

Figure 6.16: Prevalence of disability in 2011-12 according to albuminuria status in 2011-12 among people aged 60 and over: the AusDiab Study

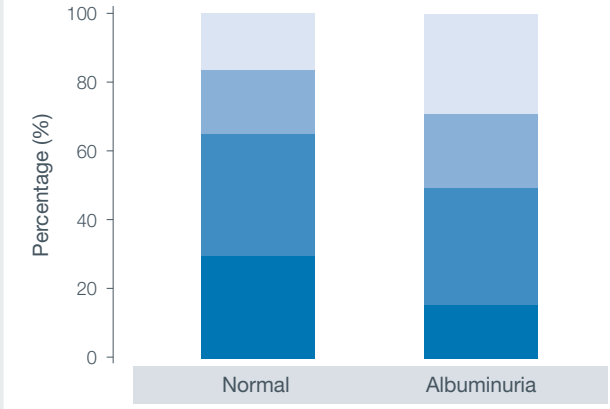


Data have not been standardised for age.

USE OF HEALTHCARE SERVICES BY ALBUMINURIA STATUS

The number of visits to a GP in the previous 3 months according to albuminuria status is presented in Figure 6.17. In those without albuminuria, 29.7% had not visited a GP in the previous 3 months, compared to only 15.4% of those with albuminuria. However, 28.9% of people with albuminuria had seen a GP 3 times or more in the previous 3 months, compared to only 16.3% of people without albuminuria.

Figure 6.17: Number of visits to a general practitioner in the previous 3 months according to albuminuria status in 2011-12: the AusDiab study

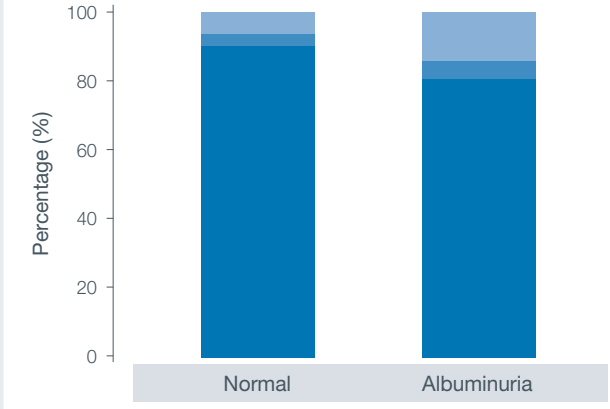


	≥3 visits	2 visits	1 visit	None
Normal	16.3	18.6	35.4	29.7
Albuminuria	28.9	22.0	33.8	15.4

Data have not been standardised for age.

In those with albuminuria, 14.0% had spent at least 2 nights in hospital in the previous 12 months, compared to 6.0% of those without albuminuria (Figure 6.18).

Figure 6.18: Number of nights spent in a hospital in the previous 12 months according to albuminuria status in 2011-12: the AusDiab study



	≥2 nights	1 night	None
Normal	6.0	3.6	90.4
Albuminuria	14.0	5.4	80.6

Data have not been standardised for age.

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AUSDIAB
AUSTRALIAN DIABETES, OBESITY & LIFESTYLE STUDY

7: PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOUR

7: PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOUR

The health benefits of regular participation in moderate- to vigorous-intensity physical activity are well established. Physical activity reduces the risk of all-cause mortality, cardiovascular disease, type 2 diabetes, some cancers, osteoporosis and depression [1]. The *National Physical Activity Guidelines for Adults* recommend the 'accumulation of 30 minutes of moderate-intensity physical activity on most days of the week' as the minimum required to obtain health benefits [2].

Sedentary behaviours involve low energy expenditure (≤ 1.5 metabolic equivalents [METs], or multiples of the basal metabolic rate), characterized by prolonged sitting or reclining and the absence of whole-body movement [3]. Within the general adult population, sedentary behaviour (put simply, 'sitting time') is associated with an elevated risk for all-cause and cardiovascular mortality, cardiovascular disease, type 2 diabetes and some cancers [4].

Regular participation in physical activity and high levels of sedentary behaviour can coexist: even if adults meet the public health guidelines for moderate- to vigorous-intensity physical activity, there are deleterious metabolic consequences of the ten or more hours of sitting that can be accumulated each day. High volumes of sedentary behaviour and lack of physical activity participation thus can contribute independently and distinctly to adverse health outcomes [4].

This chapter presents: (i) self-reported average time per day spent doing physical activity and sedentary behaviour, and (ii) objectively-assessed average time per day spent doing physical activity and sedentary behaviour.

DEFINITIONS

Based on self-report information, participants were classified into one of three categories of physical activity: 'sufficiently active' – at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity physical activity in the previous week; 'insufficiently active' – some activity reported in the previous week, but not meeting the volume specified by the definition of 'sufficient' activity; and, 'inactive' – no participation in physical activity in the previous week.

Participants were asked to estimate the total time spent watching television or videos on weekdays and weekend days during the previous week. Total sitting time was determined by asking participants to report how much time they spent sitting down while doing things like 'visiting friends, driving, reading, watching TV, or working at a desk or a computer.'

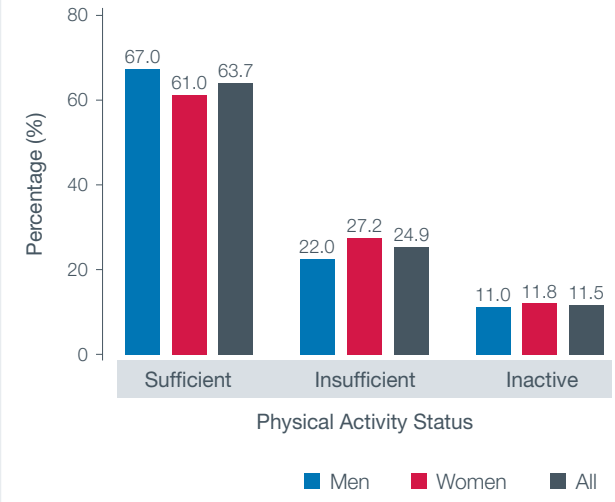
Objective activity monitoring, using accelerometers and inclinometers, provides detailed information on how most adults spend their day. An *Actigraph® GT3X+* accelerometer and an *activPAL3®* inclinometer were provided to selected participants. These devices were worn for seven consecutive days. All accelerometer and inclinometer data were adjusted for wear time, to address the daily wear time variation between participants.

RESULTS

SELF-REPORTED PHYSICAL ACTIVITY

Sixty-four percent of the study sample was classed as 'sufficiently active', based on self-reported estimates of weekly physical activity. Participation at this level was more common among men than women, but there was no gender difference in the percentage of participants who reported no physical activity at all (Figure 7.1).

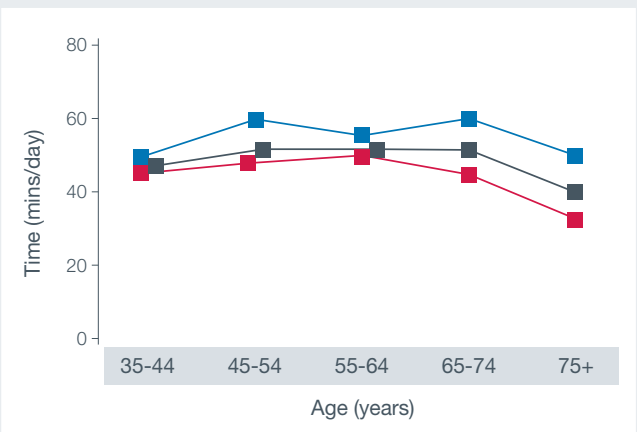
Figure 7.1: Percent of participants classed as sufficiently active, insufficiently active or inactive in 2011-12: the AusDiab study



'Physical activity time' for the previous week was calculated as the sum of the time spent performing moderate activity (e.g. walking) plus double the time spent in vigorous activity (to reflect its greater intensity). Sufficient: ≥150 minutes of physical activity in the previous week; insufficient: <150 minutes of physical activity in the previous week; inactive: no physical activity in the previous week.

On average, participants reported 50 minutes of moderate- to vigorous-intensity physical activity per day (56 minutes per day for men; 45 minutes per day for women). Moderate- to vigorous-intensity physical activity was somewhat higher amongst men than women (Figure 7.2).

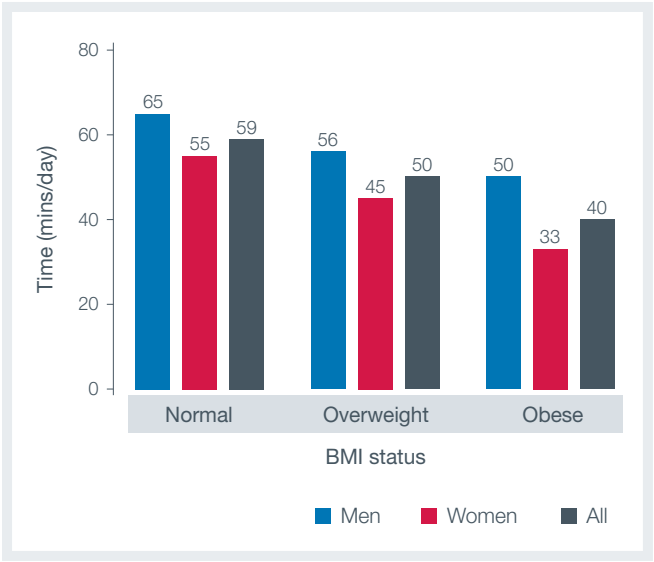
Figure 7.2: Average time spent doing moderate- to vigorous-intensity physical activity per day according to age in 2011-12: the AusDiab study



	Men	Women	All
35-44	49	45	47
45-54	59	48	52
55-64	56	49	52
65-74	60	44	52
75+	49	32	40

In both men and women, there was a progressive reduction in self-reported time undertaking moderate- to vigorous-intensity physical activity across the normal, overweight and obese categories (Figure 7.3).

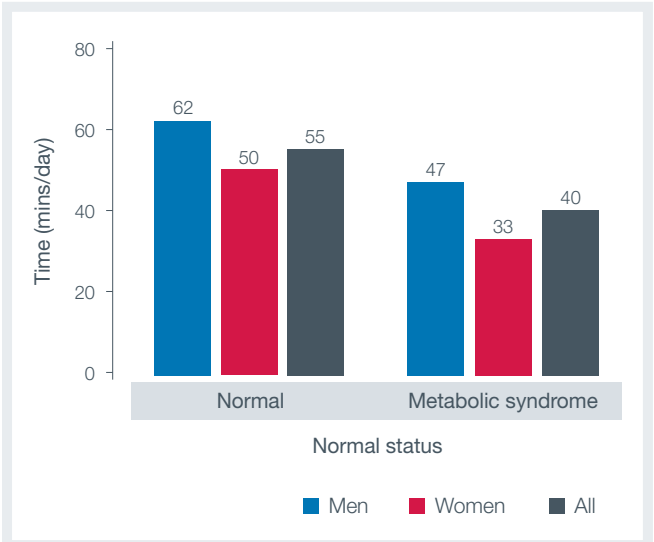
Figure 7.3: Average time spent doing moderate- to vigorous-intensity physical activity per day according to BMI in 2011-12: the AusDiab study



BMI: (i) normal: <25 kg/m^2; (ii) overweight: 25-29.9 kg/m^2; and (iii) obese: ≥30 kg/m^2.

Physical activity levels were considerably lower amongst participants with the metabolic syndrome, compared to participants who did not meet the criteria for metabolic syndrome (Figure 7.4).

Figure 7.4: Average time spent doing moderate- to vigorous-intensity physical activity per day according to metabolic syndrome status in 2011-12: the AusDiab study

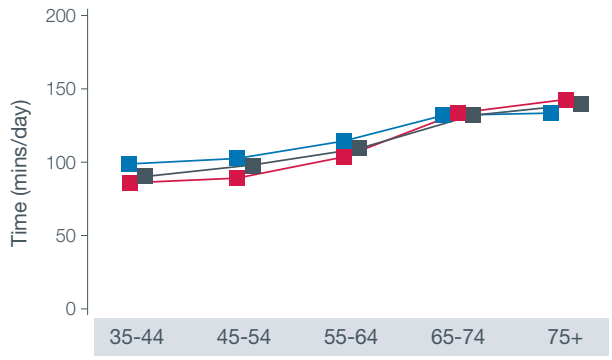


Metabolic syndrome was defined according to the Joint Interim Statement on the metabolic syndrome [5].

SELF-REPORTED SEDENTARY BEHAVIOUR

On average, participants reported 115 minutes of television viewing time per day (119 minutes per day for men; 111 minutes per day for women). Television time was higher among men than women in the younger age categories, whereas women aged 65 years and over watched more television than men of the same age. Older participants reported higher volumes of television time than younger participants (Figure 7.5).

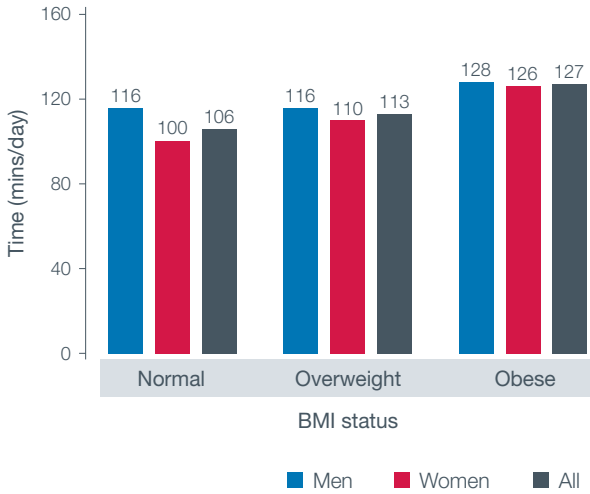
Figure 7.5: Average television viewing time per day according to age in 2011-12: the AusDiab study



	Men	Women	All
35-44	98	83	89
45-54	105	87	95
55-64	115	106	110
65-74	135	136	135
75+	136	144	140

Television viewing time increased across BMI categories, with obese participants watching 21 minutes a day more than participants in the normal BMI range (Figure 7.6).

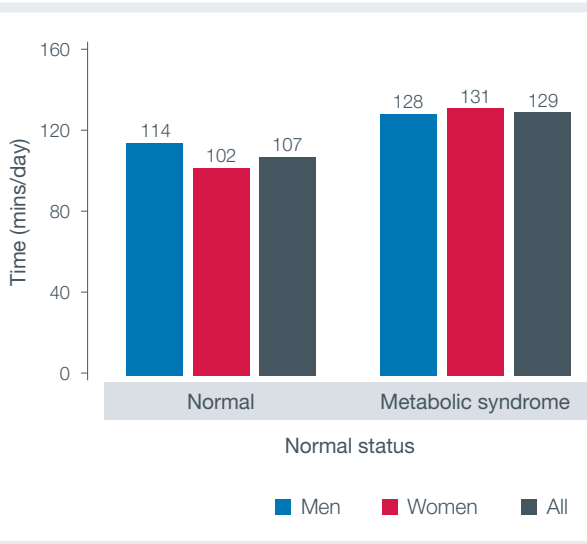
Figure 7.6: Average television viewing time per day according to BMI status in 2011-12: the AusDiab study



BMI: (i) normal: <25 kg/m²; (ii) overweight: 25-29.9 kg/m²; and (iii) obese: ≥30 kg/m².

Participants with metabolic syndrome watched, on average, 22 minutes more television per day than did participants who did not meet the criteria for metabolic syndrome (Figure 7.7).

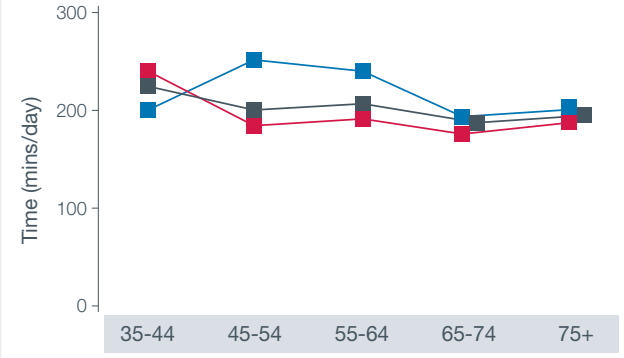
Figure 7.7: Average television viewing time per day according to metabolic syndrome status in 2011-12: the AusDiab study



Metabolic syndrome was defined according to the Joint Interim Statement on the metabolic syndrome [5].

Participants reported an average of 202 minutes per day (3 hours and 22 minutes) of sitting time (222 minutes per day for men; 190 minutes per day for women). No clear pattern could be discerned for how overall sitting varied across age categories. Highest levels were reported amongst participants aged 35 – 44 years, and lowest levels were reported amongst participants aged 65 to 74 years (Figure 7.8).

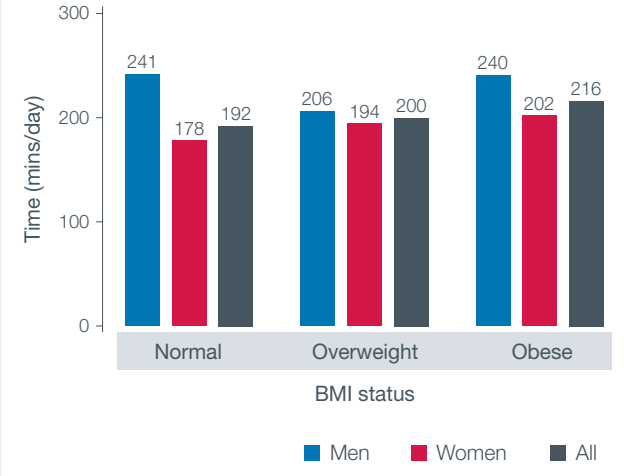
Figure 7.8: Average sitting time per day according to age in 2011-12: the AusDiab study



	Men	Women	All
35-44	201	234	221
45-54	250	185	203
55-64	236	190	207
65-74	193	178	184
75+	204	186	194

In general, there was a small increase in total sitting time across BMI categories. This trend was evident among women, but not among men (Figure 7.9)

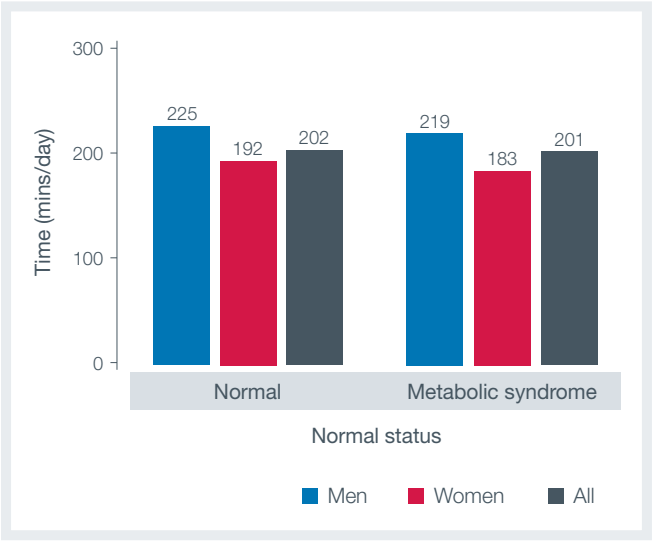
Figure 7.9: Average sitting time per day according to BMI status in 2011-12: the AusDiab study



BMI: (i) normal: <25 kg/m^2; (ii) overweight: 25-29.9 kg/m^2; and (iii) obese: ≥30 kg/m^2.

There was no difference between the overall sitting times of participants with and without metabolic syndrome (Figure 7.10).

Figure 7.10: Average sitting time per day according to metabolic syndrome status in 2011-12: the AusDiab study

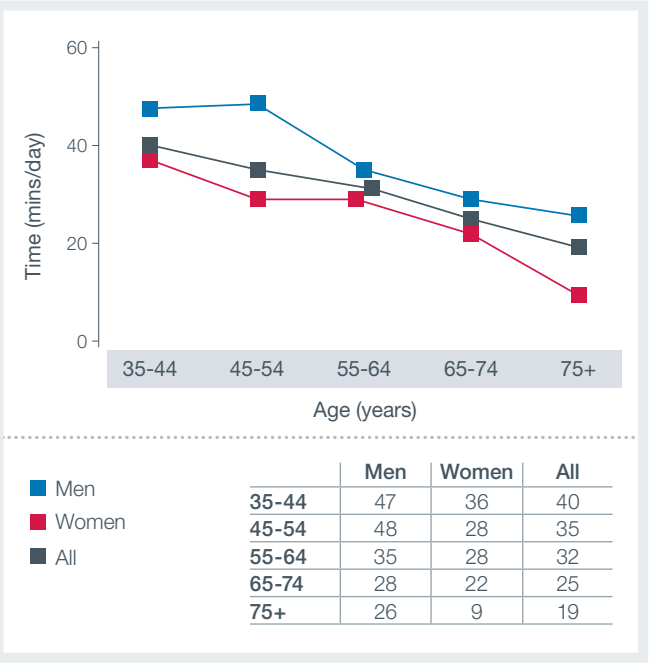


Metabolic syndrome was defined according to the Joint Interim Statement on the metabolic syndrome [5].

OBJECTIVELY-ASSESSED PHYSICAL ACTIVITY

On average, participants engaged in 32 minutes of accelerometer-assessed moderate- to vigorous-intensity physical activity per day (37 minutes per day for men; 27 minutes per day for women). Mean moderate- to vigorous-intensity physical activity was higher amongst men than women within each age category. Moderate- to vigorous-intensity physical activity decreased with increasing age (Figure 7.11).

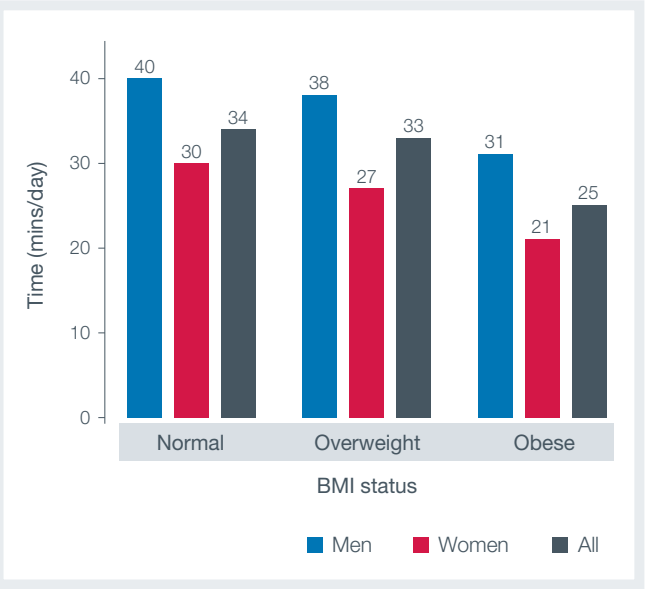
Figure 7.11: Accelerometer-assessed moderate - to vigorous-intensity physical activity according to age in 2011-12: the AusDiab study



	Men	Women	All
35-44	47	36	40
45-54	48	28	35
55-64	35	28	32
65-74	28	22	25
75+	26	9	19

A small decrease in daily moderate- to vigorous-intensity physical activity was seen with increasing BMI, for both men and women (Figure 7.12).

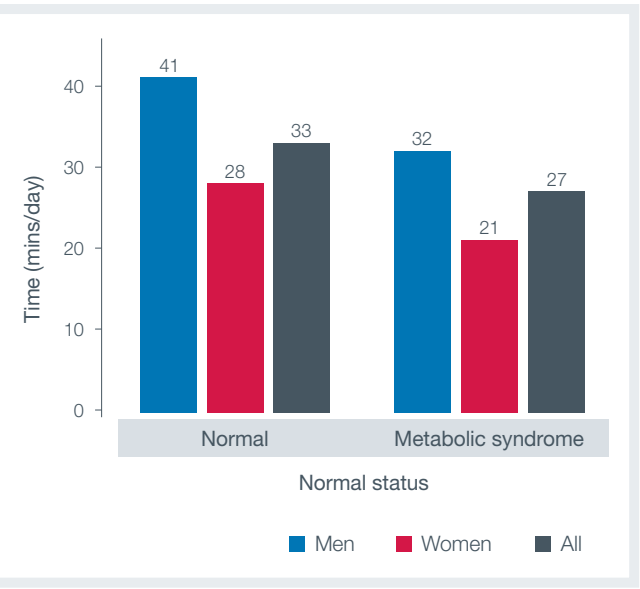
Figure 7.12: Accelerometer-assessed moderate- to vigorous-intensity physical activity according to BMI status in 2011-12: the AusDiab study



BMI: (i) normal: <25 kg/m²; (ii) overweight: 25-29.9 kg/m²; and (iii) obese: ≥30 kg/m².

Objectively-assessed moderate- to vigorous-intensity physical activity was also lower among men and women with the metabolic syndrome, compared to men and women who did not meet the criteria for the metabolic syndrome (Figure 7.13).

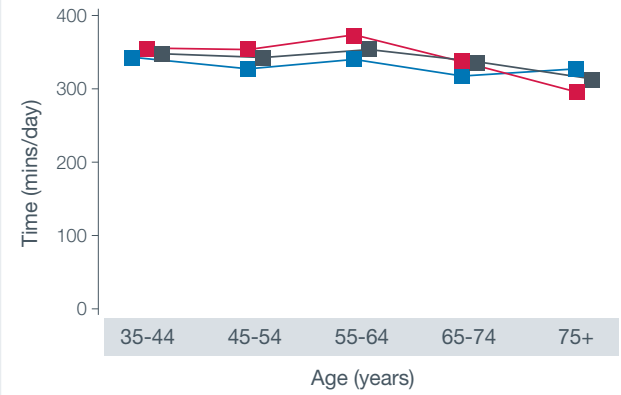
Figure 7.13: Accelerometer-assessed moderate- to vigorous-intensity physical activity according to metabolic syndrome status in 2011-12: the AusDiab study



Metabolic syndrome was defined according to the Joint Interim Statement on the metabolic syndrome [5].

Overall, participants engaged in 342 minutes (5 hours and 42 minutes) of accelerometer-assessed light-intensity physical activity per day (330 minutes per day for men; 353 minutes per day for women). Light-intensity physical activity was higher amongst women than amongst men aged less than 75 years. Men aged 75 years and over engaged in more light-intensity physical activity than women in the same age group (Figure 7.14).

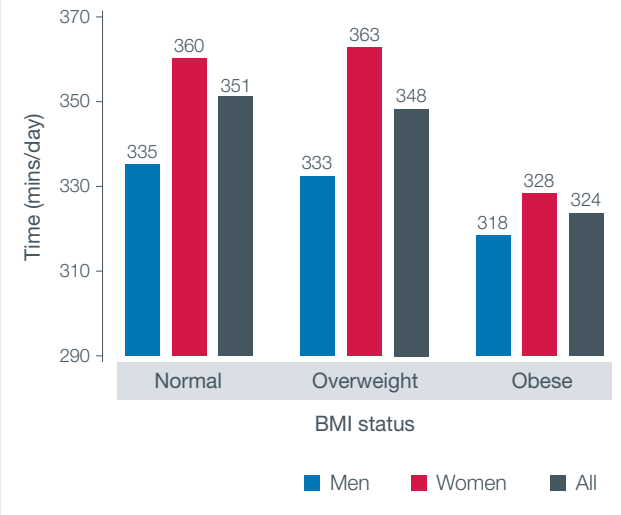
Figure 7.14: Accelerometer-assessed light-intensity physical activity according to age in 2011-12: the AusDiab study



	Men	Women	All
35-44	338	355	349
45-54	327	355	344
55-64	337	371	355
65-74	316	340	329
75+	327	294	312

There was little difference in the amount of light-intensity physical activity between the normal and overweight BMI categories. Levels of light-intensity physical activity were substantially lower within the obese category, for both men and women (Figure 7.15).

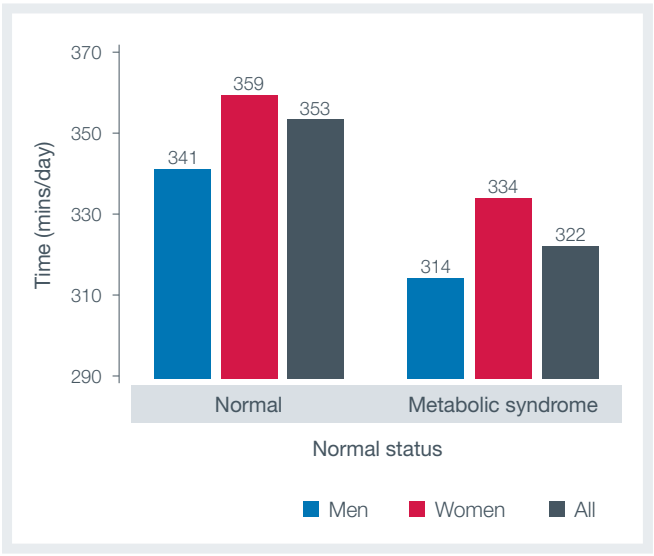
Figure 7.15: Accelerometer-assessed light-intensity physical activity according to BMI status in 2011-12: the AusDiab study



BMI: (i) normal: <25 kg/m²; (ii) overweight: 25-29.9 kg/m²; and (iii) obese: ≥30 kg/m².

Light-intensity physical activity was lower amongst men and women with the metabolic syndrome, compared to men and women who did not meet the criteria for the metabolic syndrome (Figure 7.16).

Figure 7.16: Accelerometer-assessed light-intensity physical activity according to metabolic syndrome status in 2011-12: the AusDiab study

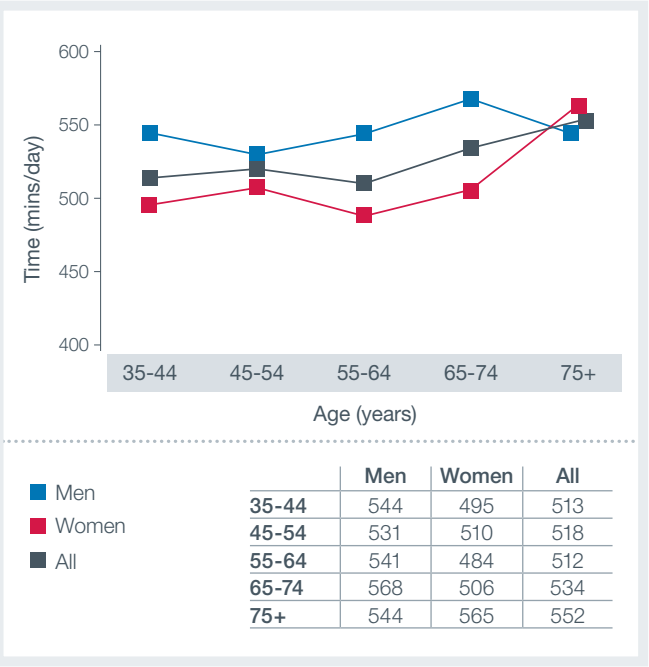


Metabolic syndrome was defined according to the Joint Interim Statement on the metabolic syndrome [5].

OBJECTIVELY-ASSESSED SITTING TIME

On average, participants engaged in 523 minutes (8 hours and 43 minutes) of inclinometer-assessed sitting time per day (540 minutes per day for men; 506 minutes per day for women). Mean sitting time was higher among men than women in those aged less than 75 years. The highest volumes of sitting time were accumulated by men aged 65 – 74 years and women aged 75+ years (Figure 7.17).

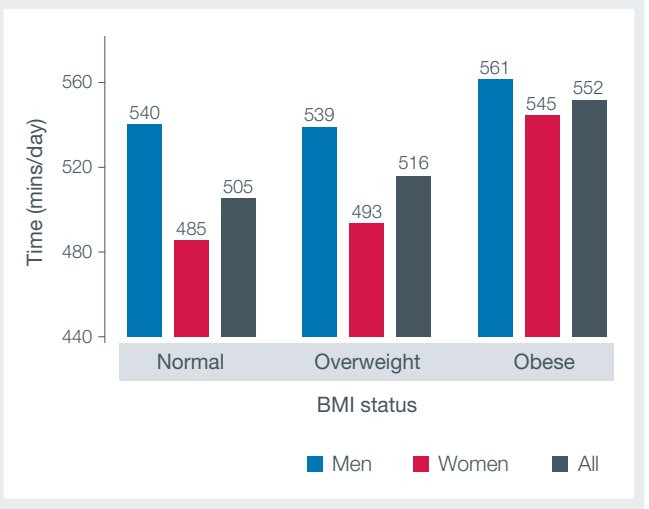
Figure 7.17: Inclinometer-assessed sitting time according to age in 2011-12: the AusDiab study



	Men	Women	All
35-44	544	495	513
45-54	531	510	518
55-64	541	484	512
65-74	568	506	534
75+	544	565	552

Inclinometer-assessed sitting time increased by BMI. This trend appeared stronger among women compared to men. On average, obese participants engaged in three quarters of an hour (47 minutes) of additional sitting time each day, compared with participants in the normal weight range group (Figure 7.18).

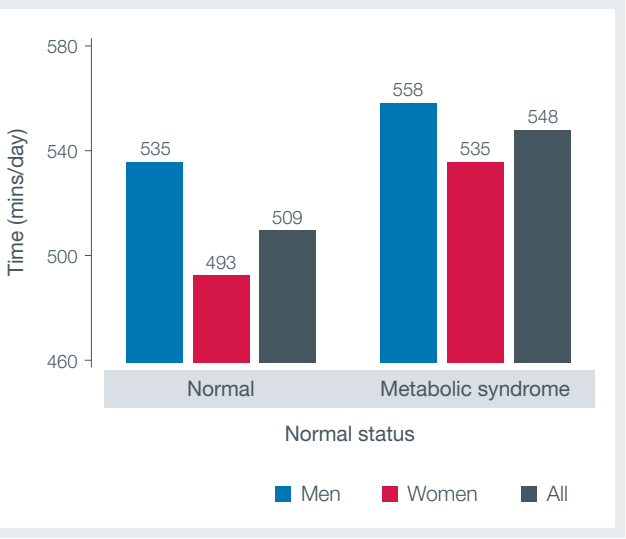
Figure 7.18: Inclinometer-assessed sitting time according to BMI status in 2011-12: the AusDiab study



BMI: (i) normal: <25 kg/m²; (ii) overweight: 25-29.9 kg/m²; and (iii) obese: 30 kg/m².

Sitting time was higher amongst men and women with the metabolic syndrome, compared to men and women who did not meet the criteria for the metabolic syndrome (Figure 7.19).

Figure 7.19: Inclinometer-assessed sitting time according to metabolic syndrome status in 2011-12: the AusDiab study



Metabolic syndrome was defined according to the Joint Interim Statement on the metabolic syndrome [5].

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AUSDIAB
AUSTRALIAN DIABETES, OBESITY & LIFESTYLE STUDY

8: MORTALITY

8: MORTALITY

Death rates are significantly affected by diabetes, cardiovascular disease, smoking, and kidney disease. To better understand the natural history of chronic diseases in Australia, it is important to investigate the mortality associated with each of these conditions. This will in turn assist in the development of preventive strategies that can be implemented to help improve health outcomes for people with these risk factors.

This chapter presents the 12-year mortality rates for men and women with different levels of glucose tolerance. Also presented is the relative mortality risk associated with diabetes and pre-diabetes (impaired fasting glucose (IFG) and impaired glucose tolerance (IGT)), chronic kidney disease, cardiovascular disease, hypertension and smoking, after adjusting for other risk factors. Unlike the information in the rest of this report which is drawn from the 7,145 participants who attended baseline and contributed to at least one follow-up survey either in 2004-05 or 2011-12, the mortality data relates to all of the 11,247 participants who attended the baseline survey.

DEFINITIONS

All-cause mortality refers to death from any cause. The National Death Index, which registers all deaths in Australia, was used to determine which of the AusDiab study participants had died and what the cause of death was.

RESULTS

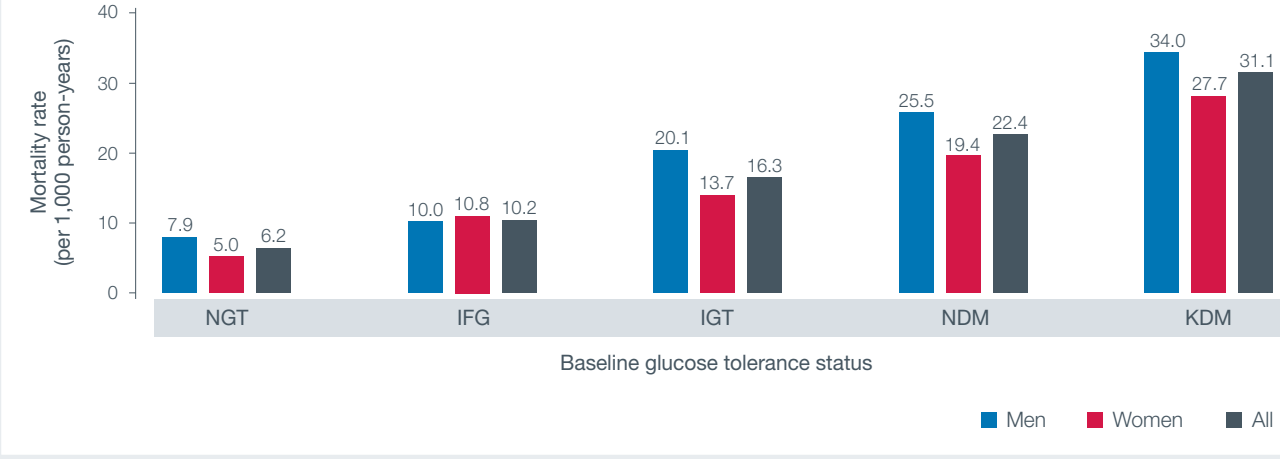
Over a median follow-up of 12.6 years, there were 1,265 deaths (686 men and 579 women), which represents a mortality rate of 9.3 per 1,000 person-years.

Of those who had diabetes at baseline (either previously known or newly diagnosed), 29% had died within 12 years of follow-up. By comparison, 18.9% who had IGT, 12.5% who had IFG and 7.7% who had normal glucose tolerance (NGT) at baseline had died after 12 years.

Figure 8.1 shows the mortality rates (per 1,000 person-years) for men and women in each glucose tolerance category. Men generally had a higher mortality rate than women, except for those with IFG where women had a higher mortality rate. The impact of diabetes on mortality was greater for women than men.

In women, those with previously known diabetes had a mortality rate that was 5.5 times greater than women with NGT (27.7 vs 5.0 deaths per 1,000 person-years). By comparison, in men, the mortality rate in those with previously known diabetes was 4.3 times higher than those with NGT (34.0 vs 7.9 deaths per 1,000 person-years).

Figure 8.1: Total mortality according to baseline glucose tolerance status: the AusDiab study



NGT – normal glucose tolerance; IFG – impaired fasting glucose; IGT –impaired glucose tolerance; NDM – newly diagnosed diabetes; KDM – previously diagnosed diabetes.

The heights of bars on all graphs are accurate to two decimal places, but data labels are rounded to one decimal place.

After accounting for the influence of age, sex, blood pressure, smoking, previous cardiovascular disease, cholesterol and triglyceride levels, lipid-lowering medication use, and waist:hip ratio on mortality risk, those individuals who were classified as having previously known diabetes at baseline were 1.5 times more likely to die within the 12 years of follow-up compared to people who had NGT at baseline.

The risk of mortality is slightly lower for those with newly diagnosed diabetes and pre-diabetes. Compared to people with NGT, those with newly diagnosed diabetes were 1.3 times more likely to die within 12 years (Figure 8.2).

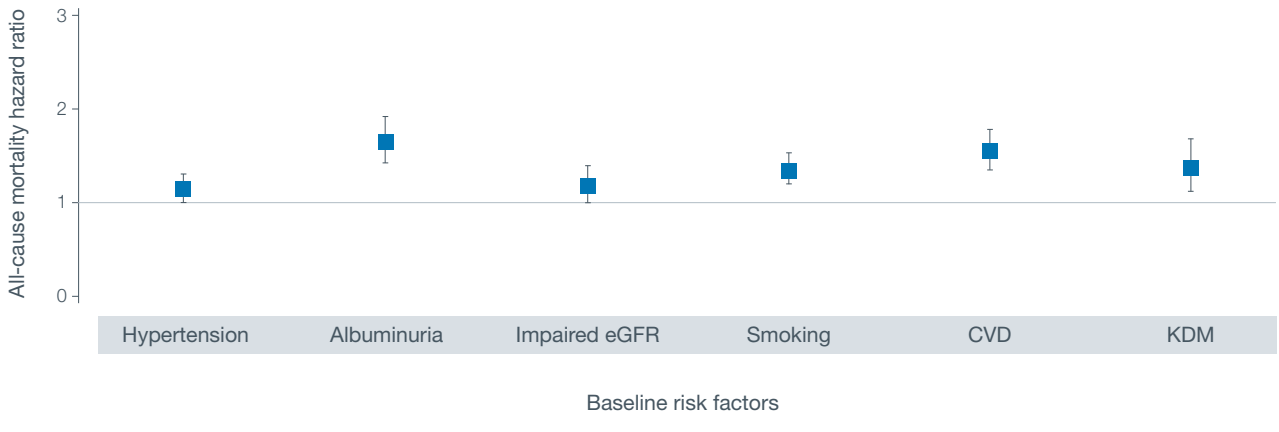
Figure 8.2: The relative risk of mortality for people with pre-diabetes and diabetes compared to people with normal glucose tolerance, after accounting for other risk factors: the AusDiab study

	NGT	IFG	IGT	NDM	KDM
Hazard Ratio	1.0	1.2	1.2	1.3	1.5

NGT – normal glucose tolerance; IFG – impaired fasting glucose; IGT – impaired glucose tolerance; NDM – newly diagnosed diabetes; KDM – previously diagnosed diabetes.

Cox proportional hazards model adjusting for age, sex, previous cardiovascular disease, hypertension, total cholesterol, triglycerides, taking lipid-lowering medication, waist:hip ratio, and smoking. Bars represent 95% confidence intervals.

Figure 8.3: The relative risk of mortality associated with hypertension, impaired kidney function, smoking, previous cardiovascular disease and diabetes, after accounting for other risk factors: the AusDiab study



	Hypertension	Albuminuria	Impaired eGFR	Smoking	CVD	KDM
Hazard Ratio	1.2	1.6	1.2	1.4	1.6	1.4

Hypertension is defined as blood pressure ≥140/90 mmHg or taking blood pressure medication. Albuminuria is defined as albumin: creatinine ratio ≥2.5 mg/mmol for men and ≥3.5 mg/mmol for women. GFR (glomerular filtration rate) provides a measure of kidney function. People with an eGFR <60 ml/min/1.73m^2 have impaired kidney function.

CVD – cardiovascular disease; KDM – previously diagnosed diabetes.

All risk factors were included in the one Cox proportional hazards model. The model was adjusted for age, sex, total cholesterol, triglycerides, taking cholesterol-lowering medication and waist: hip ratio. Bars represent 95% confidence intervals. The hazard rate for each risk factor was compared to people without that risk factor.

In addition to an association with previously diagnosed diabetes, an increased risk of mortality was also associated with hypertension, albuminuria, previous CVD and smoking (Figure 8.3).

AUSDIAB
AUSTRALIAN DIABETES, OBESITY & LIFESTYLE STUDY

9: SURVEY METHODS

9: SURVEY METHODS

The 12-year follow-up AusDiab study involved inviting all eligible participants from the baseline study to another survey and physical examination during 2011-12. The survey closely replicated the baseline AusDiab survey that was conducted in 1999-2000 and the 2004-05 follow-up survey. However, it involved two teams travelling around Australia to test participants for diabetes, heart disease and kidney disease, in contrast to only one team in previous surveys. Team 1 conducted the survey and physical examination in Victoria, Western Australia, Queensland and Tasmania. Team 2 conducted the survey and physical examination in New South Wales, Australian Capital Territory, South Australia and Northern Territory.

SAMPLE SELECTION AND ELIGIBILITY

The baseline AusDiab study (1999-2000) was a population-based national survey of the general Australian population aged 25 years and over residing in 42 randomly selected urban and rural areas (census collector districts) in six states and the Northern Territory (Appendix A).

Full details of the sampling frame, methods and response rates for the baseline AusDiab study have been published previously [1]. All eligible participants were subsequently invited to participate in a follow-up study during 2004-05 with the aim of examining the natural history of diabetes and its complications, including heart disease and kidney disease.

Since the completion of the baseline study, some participants had moved from their original testing site. These individuals were assigned to the testing site which was most closely located to their new home. In 2004-05, an additional survey site in Canberra was added to the original 42 sites used in 1999-2000. In 2011-12, further sites were added in Busselton in Western Australia, Townsville and Bundaberg in Queensland, and Byron Bay in New South Wales.

Individuals considered ineligible for invitation to the follow-up study included: (i) participants who had refused further contact, (ii) participants who were known to be deceased, (iii) participants who had moved overseas, or (iv) participants who were excluded as they had moved into a nursing facility classified for high care or were ineligible due to severe or terminal illness. The number of individuals eligible for invitation to the 2011-12 follow-up study is summarised in Figure 9.1.

SURVEY PROTOCOL AND PROCEDURES

Participants were tested at each of the 46 sites. Of those who could not attend a survey, 150 attended a local pathology laboratory and 1,422 provided self-report data using standard survey forms. On-site testing commenced on 24th August 2011 and finished on 6th June 2012.

Where possible, testing took place in the same order as originally conducted for the baseline study, which ensured that most participants had the same follow-up period between 1999-2000, 2004-05 and 2011-12. Appendix A outlines the dates of testing for each of the 46 sites in 2011-12.

Figure 9.1: Sampling frame for the AusDiab follow-up in 2011-12

**Please note that a proportion of participants who were eligible for invitation to AusDiab in 2011-12 were not able to be invited as no valid contact details were available (n = 866) and were therefore considered lost to follow-up.*

INVITATION AND RECRUITMENT

To ensure maximum participation in the 2011-12 survey, annual contact has been maintained with the AusDiab participants via letters and telephone calls. Thus, contact details of survey participants have been updated by using a range of resources including next-of-kin, online telephone directories and the Telstra White Pages directory.

Invitation to the 12-year follow-up involved:

- letters of invitation sent six and four weeks prior to testing for each site;
- follow-up telephone calls for those who did not reply to the initial letters;
- follow-up telephone calls for all individuals who declined the invitation in order to obtain a reason for non-attendance and/or to re-schedule another appointment time if possible;
- reminder telephone calls two to three days prior to appointments for all individuals who had confirmed an appointment;
- telephone calls to all participants who did not attend their appointment, with the aim of re-scheduling another appointment.

PREPARATION OF SURVEY METHODS AND TRAINING

The preparation of the survey methods, including both the physical examination equipment and questionnaires, was undertaken in accordance with the study aims and objectives, with a specific emphasis on having a direct comparability with the methods utilised in the baseline study.

Two teams of survey staff were recruited to administer the survey. All staff attended a two-day training workshop, which was conducted by the project manager and study coordinators prior to collecting data. Staff members were briefed on the survey's background, objectives and methodology to ensure accurate and consistent data collection.

PHYSICAL EXAMINATION

The AusDiab physical examination procedures closely follow the study protocol as recommended by the World Health Organisation for the study of diabetes and other non-communicable diseases [2]. The physical examination was conducted on both weekdays and weekends over a four to seven day period at each survey site. Local survey sites included community halls, scout halls, sporting halls, and church halls. Survey activities at the testing site commenced at 7am and typically finished at midday. On average approximately 24 participants attended daily.

All participants gave written informed consent to participate in the survey. Personal information was verified on-site and entered into a computer database, and each individual was given a barcode based on their original AusDiab unique identification number. Participants were moved through the examination procedures in a circuit-like manner that took approximately 2-2.5 hours to complete. Participants were asked to remain on-site until all tests were performed. Central to the physical examination was the standard two-hour oral glucose tolerance test (OGTT), during which time all other procedures were performed.

BLOOD SAMPLING, ORAL GLUCOSE TOLERANCE TEST AND LABORATORY PROCEDURES

Blood was collected by venepuncture after an overnight fast (eight hours or more). In each of the previous studies (1999-2000 and 2004-05) as well as in 2011-12 specimens were collected into separate tubes in the following order: a plain tube for measurement of total cholesterol, high-density lipoprotein cholesterol (HDL-C) and triglycerides, and a fluoride/oxalate tube for plasma glucose. All blood specimens collected in the fluoride/oxalate tubes and the plain tubes were centrifuged on-site to separate out the plasma and serum, which was placed in separate tubes.

In 1999-2000 all samples were transported daily to a central laboratory. In 2004-05 and 2011-12 samples were transported daily to a central laboratory where possible, however, when daily transportation was not possible, all samples were immediately stored on-site in a freezer at -20°C and then transferred to a -80°C storage facility within one to two weeks following collection. All analyses were conducted at a central laboratory (HITECH Pathology, Clayton, Victoria in 1999-2000, Gribbles Pathology, Clayton, Victoria in 2004-05 and Healthscope Pathology (previously Gribbles Pathology), Clayton, Victoria in 2011-12).

Serum triglycerides, total cholesterol (TC), and high density lipoprotein cholesterol (HDL) were measured by enzymatic methods. In 1999–2000 an Olympus AU600 analyser (Olympus Optical Co. Ltd, Tokyo, Japan) was utilised, in 2004-05 the Roche Modular (Roche Diagnostics, Indianapolis, USA) was utilised, and in 2011-12 the Siemens Advia 2400 (Siemens AG, Munich, Germany) was utilised. Low-density lipoprotein cholesterol (LDL) was derived by calculation using the Friedewald formula [3].

A 75g OGTT was performed on all participants, except those on insulin or oral hypoglycaemic drugs and those who were pregnant. In 1999 fasting and two-hour post-load plasma glucose levels were determined by a glucose oxidase method using an Olympus AU600 automated analyser (Olympus Optical Co. Ltd, Tokyo, Japan), in 2004-05 a spectrophotometric-hexokinase method utilising a Roche Modular (Roche Diagnostics, Indianapolis, USA) was used, and in 2011-12 a hexokinase method utilising Siemens Advia 2400 (Siemens AG, Munich, Germany).

URINE COLLECTION AND LABORATORY PROCEDURES

A morning spot urine sample was taken. In 1999-2000, urine creatinine was measured by the modified kinetic Jaffe reaction using the Olympus AU600 auto-analyser (Olympus Optical Co. Ltd). Urine albumin was measured by rate nephelometry with the Beckman Array (Beckman Coulter, Inc., California, USA).

In 2004-05, urine creatinine was measured using spectrophotometric – jaffe alkaline picrate method on a Roche Modular (Roche Diagnostics). Urine albumin was measured using nephelometry on a Beckman Immage (Beckman Coulterm Inc.).

In 2011-12, urine creatinine was measured using jaffe alkaline picrate method. Urine albumin was measured using a PEG enhanced immunoturbidometric assay on Siemens Advia 2400 (Siemens AG, Munich, Germany).

ANTHROPOMETRY

Height was measured to the nearest 0.5 cm without shoes using a stadiometer. Weight was measured without shoes and excess clothing to the nearest 0.1 kg using a mechanical beam balance in 1999-2000 and digital weighing scales in 2004-05 and 2011-12. Body mass index (BMI; kg/m^2) was calculated.

BLOOD PRESSURE

Blood pressure measurements in 2004-05 and 2011-12 were performed in a seated position after rest for ≥5 minutes using an automated blood pressure monitor which was regularly calibrated (Dinamap® Pro-series Monitor Model DP 101–NIBP, Pulse and recorder, GE Medical Systems Information Technologies, Milwaukee, USA). A cuff of suitable size was applied on the participant's exposed upper arm (the arm not used for blood collection), which was supported on a table at heart level. Three sequential measurements were taken, with a 30 second interval between them.

All measurements were documented on the participant's form. The mean of the first two measurements were taken; however if the difference between the first and second measurement was greater than 10 mmHg, the third measurement was used, and the mean of the two closest readings was used.

At baseline, blood pressure was measured similarly with an automatic Dinamap machine in all states except for Victoria where a manual sphygmomanometer was used. The two methods at baseline were tested for comparability, and as a result the manual diastolic measurements were adjusted to account for small discrepancies between the manual and automatic methods.

QUESTIONNAIRES

In 1999-2000, 2004-05 and 2011-12, a series of interviewer-administered questionnaires was used to ascertain a range of health and social information including previous diagnosis of diabetes and cardiovascular disease, exercise, and smoking. These questionnaires included:

- the Household Questionnaire – questions relating to country of birth, language spoken at home, indigenous status and marital status
- the General Questionnaire – questions relating to education, self-reported high blood pressure and high cholesterol, self-reported use of antihypertensive and lipid lowering medication, smoking status, and physical activity
- the Existing Health Conditions Questionnaire - questions relating to diabetes, kidney disease and cardiovascular disease

In 2011-12, additional questionnaires to examine cognitive function (the Mini Mental State Examination (MMSE)), depression (Centre for Epidemiology Studies Short Depression Scale (CESD)) and disability (Katz Activities of Daily Living (ADL)) were added. Impaired cognitive function was defined using the conventional cut-off of MMSE score <24. Depression was defined as CESD score ≥10 [4]. Disability was defined as a response of "a little difficulty", "some difficulty" or "a lot of difficulty" for 1 or more of the Katz ADL questions.

PHYSICAL ACTIVITY

Self-reported physical activity and sedentary behavior were assessed by questionnaire. Physical activity was determined using questions relating to time spent walking and time spent doing vigorous and moderate physical activity in the previous week. Sedentary behavior was determined using questions relating to television viewing time and how much time participants spend sitting while doing things like 'visiting friends, driving, reading, watching TV, or working at a desk or a computer.'

Objective activity monitoring was performed using accelerometers and inclinometers. An *Actigraph® GT3X+* accelerometer and an *activPAL3®* inclinometer were provided to selected participants at the time of the biomedical examination. These devices were worn for seven consecutive days, and then returned to researchers via an Express Post satchel.

FEEDBACK TO PARTICIPANTS

All participants who attended either the survey site or a pathology laboratory received a letter outlining some of their survey results. Participants were given the opportunity to request that their results also be sent to their general practitioner. Participants were sent letters approximately six to eight weeks following the completion of testing, and they were encouraged to seek advice and follow-up where required from their doctor.

MORTALITY

Vital status was determined by linking the AusDiab cohort to the National Death Index (NDI) maintained by the Australian Institute of Health and Welfare. A study by Magliano et al found that the NDI was very accurate in identifying vital status in the Australian population [5]. Linkage to the NDI was first performed in May 2004 and annually since until 2012.

This provides all-cause mortality data for a median follow-up period of 12.6 years. Various parameters including names, date of birth, sex, date of last contact or date of death, and geographic code were used to match AusDiab participants to the NDI. Only high level matches between the NDI database and the AusDiab participants were accepted as confirmed deaths. Verification of vital status was greatly assisted by the maintenance of up-to-date contact details of the participants.

STATISTICAL ANALYSIS

All anthropometric analyses in this report are based upon the 7,046 participants who attended the 1999-2000 survey and at least one follow-up in 2004-05 and 2011-12 surveys. Given that a further 208 participants were able to give blood at an external pathology laboratory, analyses based on pathology data included 7,254 individuals. Some analyses are based on smaller sample sizes which reflect variables with missing data. Missing data occurred in a random fashion and was not influenced by the study's protocols.

Annual incidence rates were estimated from a Cox proportional hazards model. Incidence rates, prevalence, percentages with depression, cognitive impairment and disability, healthcare utilization, treatment use, odds ratios and mean differences (± SD or ± SEM) relating to each chapter are summarized in Appendix B. Differences in the baseline characteristics between non-attendees, on-site attendees, and external pathology laboratory attendees of the 12-year follow-up survey were explored with analysis of variance (ANOVA), Kruskall-Wallis tests or Pearson's chi-square test as appropriate. The mean change between baseline and follow-up in 2011-12 for weight (kg) and waist circumference (cm) was calculated.

Total mortality rates were calculated on person-years of follow-up. The period of follow-up was determined by subtracting the date of testing at baseline from either the date of death or the censoring date of 30 November 2012. Cox proportional hazards models were used to determine the independent effects of a number of different baseline risk factors on risk of mortality.

Analyses were conducted with Stata statistical software version 11.2 (StataCorp, College Station, Texas, USA).

ABBREVIATIONS

Abbreviations used in this report are listed in Appendix C.

REFERENCES

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AUSDIAB
AUSTRALIAN DIABETES, OBESITY & LIFESTYLE STUDY

10: RESPONSE RATES

10: RESPONSE RATES

All surviving participants of the baseline survey in 1999-2000 survey were eligible to participate in the 2011-12 follow-up (n=10,337). However, there were a number of individuals who were eligible to participate in the 2011-12 follow-up, but were not invited as they had: (i) had refused further contact, (ii) had moved overseas, or (iii) had been excluded as they had moved into a nursing facility classified for high care or had withdrawn because of severe or terminal illness. These individuals were considered lost to follow-up. Thus, the number of participants eligible to participate in the 2011-12 follow-up (Figure 10.1) is higher than the number of participants eligible for invitation to the 2011-12 follow-up (Figure 9.1).

Of the 10,337 participants eligible to participate in 2011-12, 4,614 (44.6%) attended testing sites. A further 150 (1.5%) people attended an external pathology laboratory for blood and urine tests (analysed at the same central laboratory as all other samples) and another 1,422 (13.8%) completed a telephone questionnaire only, which gathered information on a range of health conditions including diabetes. Therefore, 59.8% (6,186/10,337) of the original AusDiab participants took part in some way in the 12-year follow-up survey (Figure 10.1).

Figure 10.1: Sampling frame for AusDiab follow-up in 2011-12

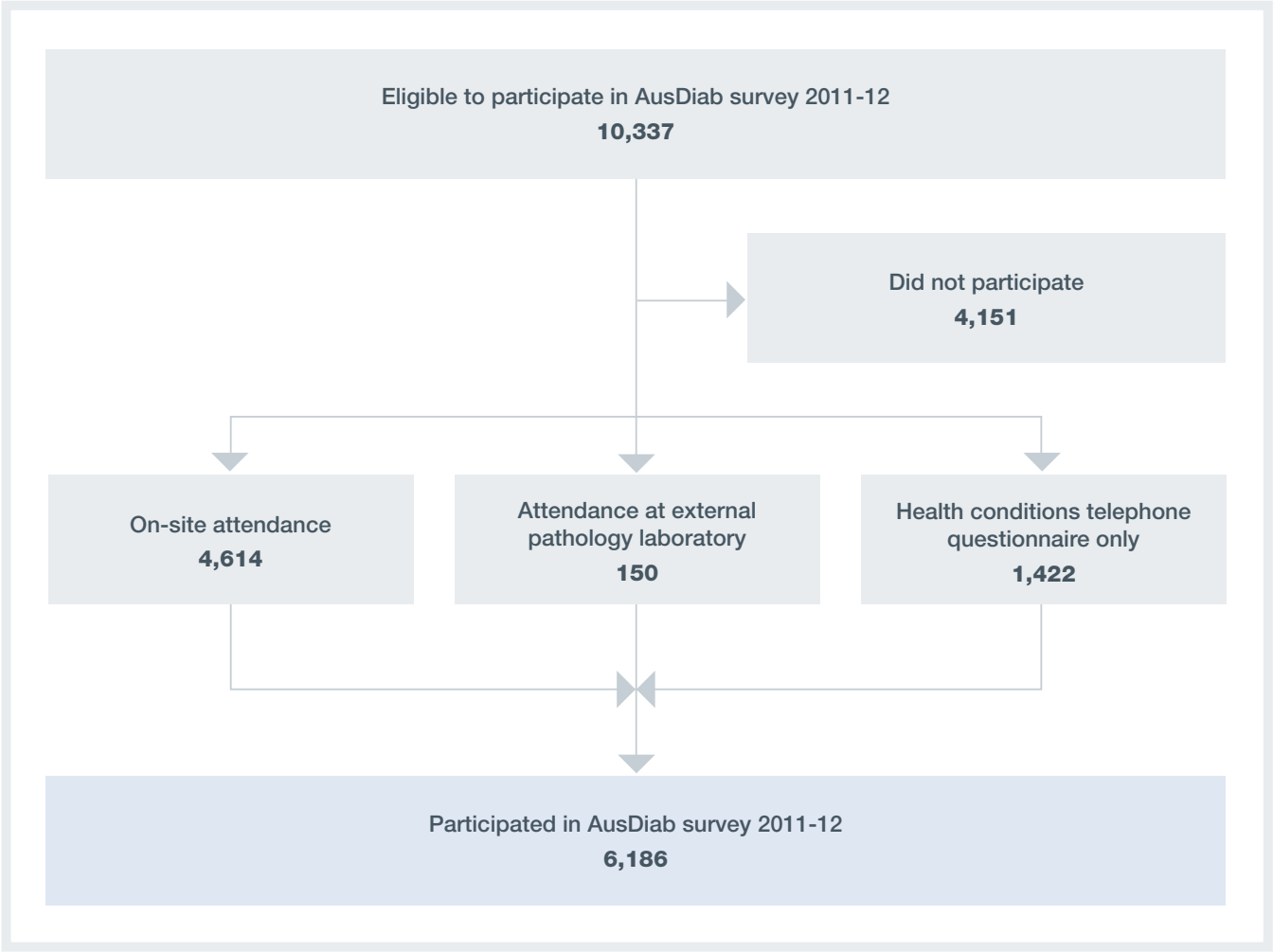

Table 10.1: Response rates for those eligible for testing in 2011-12 according to state or territory: the AusDiab Study

STATE	NUMBER ELIGIBLE	ONSITE-TESTING	PATHOLOGY LABORATORY ATTENDANCE	SELF-REPORTED MEDICAL CONDITIONS ONLY	OVERALL RESPONDERS
Victoria	1,425	653 (45.8)	48 (3.4)	242 (17.0)	943 (66.2)
Western Australia	1,482	722 (48.7)	35 (2.4)	189 (12.8)	946 (63.8)
New South Wales	1,479	658 (44.5)	27 (1.8)	213 (14.4)	898 (60.7)
Tasmania	1,569	693 (44.2)	0 (0)	174 (11.1)	867 (55.3)
South Australia	1,620	683 (42.2)	19 (1.2)	297 (18.3)	999 (61.7)
Northern Territory	989	465 (47.0)	4 (0.4)	70 (7.1)	539 (54.5)
Queensland	1,744	724 (41.5)	17 (1.0)	236 (13.5)	977 (56.0)
Australian Capital Territory	29	16 (55.2)	0 (0)	1 (3.5)	17 (58.6)
Total	10,337	4,614 (44.6)	150 (1.5)	1,422 (13.8)	6,186 (59.8)

Data are n (%).

CHARACTERISTICS OF ATTENDEES AND NON-ATTENDEES

The baseline physiological and socio-demographic characteristics of participants were compared among those who attended site (n=4,614), those who attended an external Healthscope Pathology centre (n=150), those who only completed a telephone questionnaire on self-reported medical conditions (n=1,422) and those who did not attend (n=4,151).

When comparing those who attended on-site testing in 2011-12 and those who did not, there was a significant difference in baseline systolic blood pressure, BMI, fasting and two-hour plasma glucose, total and HDL cholesterol, triglycerides, glucose tolerance status, country of birth, language spoken at home, Aboriginal/Torres Strait Islander status, marital status, education, smoking, and physical activity levels, independent of age and sex.

The annual incidence of self-reported diabetes was 0.3% (95% CI 0.1–0.4) for those who attended site or external pathology and 0.3% (95% CI 0.0–0.6) for those who completed a telephone questionnaire. There was no statistically significant difference in the incidence of self-reported diabetes between the two groups when adjusted for age and sex.

Table 10.2: Baseline physiological characteristics according to attendance status in 2011-12: the AusDiab study

	ONSITE-TESTING	PATHOLOGY LABORATORY ATTENDANCE	SELF-REPORTED MEDICAL CONDITIONS ONLY	NON-ATTENDEES	P-VALUE
n	4,614	150	1,422	4,151	
Age (years)	48.9 (± 11.3)	50.0 (± 10.0)	47.7 (± 12.9)	51.7 (± 15.6)	<0.001
Men (%)	2,063 (44.7)	67 (44.7)	590 (41.5)	1,826 (44.0)	0.20
Systolic blood pressure (mmHg)	126.5 (± 16.9)	128.0 (± 15.5)	127.5 (± 17.3)	130.1 (± 19.5)	<0.001
Diastolic blood pressure (mmHg)	69.9 (± 11.4)	72.2 (± 12.1)	69.7 (± 11.6)	69.9 (± 11.9)	0.10
BMI (kg/m^2)	26.6 (± 4.7)	27.0 (± 4.7)	27.5 (± 5.5)	27.3 (± 5.2)	<0.001
Fasting plasma glucose (mmol/l) †	5.3 (5.0, 5.7)	5.4 (5.1, 5.7)	5.4 (5.0, 5.8)	5.4 (5.1, 5.8)	<0.001
Two-hour plasma glucose (mmol/l) *†	5.7 (4.8, 6.7)	5.9 (5.1, 7.2)	5.9 (4.9, 7.1)	6.0 (5.0, 7.4)	<0.001
Total cholesterol (mmol/l)	5.5 (4.9, 6.2)	5.6 (5.0, 6.1)	5.6 (4.9, 6.2)	5.6 (5.0, 6.4)	<0.001
LDL-C (mmol/l)	3.4 (2.9, 4.1)	3.5 (2.9, 4.1)	3.4 (2.9, 4.1)	3.5 (2.9, 4.2)	0.003
HDL-C (mmol/l)	1.4 (1.2, 1.7)	1.4 (1.2, 1.7)	1.4 (1.1, 1.7)	1.4 (1.1, 1.6)	<0.001
Triglycerides (mmol/l)	1.2 (0.8, 1.8)	1.3 (0.8, 1.8)	1.3 (0.9, 1.9)	1.3 (0.9, 2.0)	<0.001
Glucose tolerance status (%)					<0.001
› NGT	3,640 (79.7)	112 (75.7)	1,051 (75.0)	2,873 (70.6)	
› IFG	255 (5.6)	9 (6.1)	88 (6.3)	239 (5.9)	
› IGT	436 (9.6)	19 (12.8)	160 (11.4)	576 (14.2)	
› NDM	125 (2.7)	5 (3.4)	54 (3.9)	194 (4.8)	
› KDM	111 (2.4)	3 (2.0)	48 (3.4)	185 (4.6)	

Percentages may not add up to 100% due to missing data.

BMI – body mass index; LDL-C – low-density lipoprotein cholesterol; HDL-C – high-density lipoprotein cholesterol; NGT – normal glucose tolerance; IFG – impaired fasting glucose; IGT – impaired glucose tolerance; NDM – newly diagnosed diabetes mellitus at baseline; KDM – previously diagnosed diabetes mellitus at baseline.

Data are mean (± SD), median (25th, 75th percentile) or n (%).

**Excluded people who were pregnant at baseline.*

† Excluded people who fasted for less than nine hours.

Table 10.3: Baseline socio-demographic characteristics according to attendance status in 2011-12: the AusDiab study

	ONSITE-TESTING	PATHOLOGY LABORATORY ATTENDANCE	SELF-REPORTED MEDICAL CONDITIONS ONLY	NON-ATTENDEES	P-VALUE
n	4,614	150	1,422	4,151	
Country of birth (%)					<0.001
› Australia/New Zealand	3,616 (78.4)	113 (75.3)	1,125 (79.2)	3,006 (72.5)	
› United Kingdom/Ireland	497 (10.8)	26 (17.3)	166 (11.7)	452 (10.9)	
› Other countries	499 (10.8)	11 (7.3)	130 (9.2)	691 (16.7)	
Language spoken at home (%)					<0.001
› English	4,496 (97.5)	147 (98.0)	1,384 (97.4)	3,875 (93.4)	
› Italian	19 (0.4)	0 (0)	3 (0.2)	50 (1.2)	
› Greek	14 (0.3)	0 (0)	6 (0.4)	46 (1.1)	
› Cantonese	6 (0.1)	1 (0.7)	6 (0.4)	33 (0.8)	
› Mandarin	12 (0.3)	0 (0)	3 (0.2)	7 (0.2)	
› Other	65 (1.4)	2 (1.3)	19 (1.3)	138 (3.3)	
Aboriginal/Torres Strait Islander (%)	24 (0.5)	0 (0)	11 (0.8)	54 (1.3)	0.001
Marital status (%)					<0.001
› Married	3,588 (77.8)	122 (81.3)	1,074 (75.6)	2,732 (65.9)	
› De Facto	193 (4.2)	6 (4.0)	82 (5.8)	234 (5.6)	
› Separated	94 (2.0)	2 (1.3)	36 (2.5)	137 (3.3)	
› Divorced	255 (5.5)	5 (3.3)	74 (5.2)	276 (6.7)	
› Widowed	127 (2.8)	6 (4.0)	67 (4.7)	354 (8.5)	
› Never married	355 (7.7)	9 (6.0)	88 (6.2)	416 (10.0)	
Highest level of education (%)					<0.001
› Secondary school qualification (includes attending primary school only)	1,522 (33.2)	58 (39.2)	599 (42.4)	1,877 (45.8)	
› Trade, technician's certificate	1,357 (29.6)	51 (34.5)	428 (30.3)	1,253 (30.6)	
› Associate, undergraduate diploma, nursing or teaching qualification	660 (14.4)	17 (11.5)	175 (12.4)	424 (10.4)	
› Bachelor degree, post-graduate diploma	1,047 (22.8)	22 (14.9)	211 (14.9)	543 (13.3)	
Smokers (%)	1,792 (39.4)	68 (46.6)	688 (49.2)	1,935 (47.6)	<0.001
Exercise (%)					0.01
› Sufficient (≥150 minutes/day)	2,484 (54.1)	91 (61.9)	732 (51.8)	2,117 (51.5)	
› Insufficient (1–149 minutes/day)	1,406 (30.6)	39 (26.5)	436 (30.9)	1,263 (30.7)	
› Inactive	700 (15.3)	17 (11.6)	244 (17.3)	734 (17.8)	

Percentages may not be exact due to missing data.

APPENDIX A
TESTING SITES AND DATES

	AUSDIAB SITE	PLACE OF TESTING	PERIOD OF TESTING
Victoria	Parkdale	Mordialoc Bowls Club, 38 McDonald Street, Mordialloc	24/08/2011 – 29/08/2011
	Burwood	The Hive Creative Centre, 710 Station Street, Box Hill	02/09/2011 – 06/09/2011
	Blackburn	The Hive Creative Centre, 710 Station Street, Box Hill	09/09/2011 – 13/09/2011
	Wattle Glen	Hurstbridge Hall, 974 Kinglake-Hurstbridge Road, Hurstbridge	16/09/2011 – 20/09/2011
	Bendigo	MacGillivray Hall, 136 McCrae Street, Bendigo	23/09/2011 – 28/09/2011
	Mildura	Sacred Heart Hall, Wattle Parade, Mildura	01/10/2011 – 05/10/2011
Western Australia	Scarsborough and Trigg	Osbone Park Bowling Club, 31 Park Street, Tuart Hill	29/10/2011 – 08/11/2011
	Kardinya	North Lake Senior Campus, 188 Winterfold Road, Kardinya	11/11/2011 – 15/11/2011
	Oakford	Wandi Hall, 302 De-Haer Road, Wandi	18/11/2011 – 22/11/2011
	Mount Helena	Mt Helena Scout & Guide Hall, Chidlow Street, Mt Helena	25/11/2011 – 29/11/2011
	High Wycombe	Cyril Road Hall, 58 Cyril Road, High Wycombe	02/12/2011 – 06/12/2011
	Busselton	Railway Hall, Causeway Road, Busselton	09/12/2011 – 10/12/2011
New South Wales	Grays Point	Grays Point Community Hall, 116–120 Grays Point Road, Grays Point	19/10/2011 – 24/10/2011
	Hurstville	Club Central, 2 Crofts Avenue, Hurstville	28/10/2011 – 01/11/2011
	Orange	2nd Orange Scout Hall, Kite Street, Orange	10/11/2011 – 14/11/2011
	Berkeley Vale	Berkeley Vale Sports Complex, Lot 3 Berkeley Road, Glenning Valley	17/11/2011 – 21/11/2011
	West Pennant Hills	Castle Hill Girls Guides Hall, 5 Bounty Avenue, Castle Hill	25/11/2011 – 29/11/2011
	Auburn	Lidcombe Scout Hall, Olympic Drive, Lidcombe	02/12/2011 – 05/12/2011
ACT	Canberra	ANU Clinical School, Canberra Hospital, Hospital Road, Garran	04/11/2011 – 05/11/2011

Continued on page 73.

	AUSDIAB SITE	PLACE OF TESTING	PERIOD OF TESTING
Queensland	Cairns	Cairns and District Darts Association, 36–38 MacNamara Street, Manoora	02/02/2012 – 06/02/2012
	Townsville	Townsville City Council, 86 Thuringowa Drive, Townsville	10/02/2012 – 11/02/2012
	Nambour	Nambour Bowls Club, Cnr Coronation Avenue and School Street, Nambour	16/02/2012 – 20/02/2012
	Bundaberg	CQ University Australia, University Drive, Bundaberg	24/02/2012 – 26/02/2012
	Toowoomba	QRI Toowoomba Hall, Bellevue Street, Toowoomba	02/03/2012 – 05/03/2012
	Currumbin	Merv Craig Sporting Complex, Galleon Way, Elanora	09/03/2012 – 13/03/2012
	Byron Bay	Byron Ball Girl Guides Hall, Carlyle St, Byron Bay	16/03/2012 – 17/03/2012
	Chapel Hill	Kenmore Scout Hall, 301 Beilby Road, Kenmore Hills	21/03/2012 – 23/03/2012
	Stafford Heights	Michelton Seventh-day Adventist Church, Cnr Blackwood Street and Ruby Road, Michelton	29/03/2012 – 02/04/2012
South Australia	Unley	Goodwood 3rd Scout and Guide Hall, 51 Frederick Street, Clarence Park	10/02/2012 – 14/02/2012
	Netley	Goodwood 3rd Scout and Guide Hall, 51 Frederick Street, Clarence Park	17/02/2012 – 21/02/2012
	Millicent	Millicent Civic and Arts Centre Function Room, Ridge Terrace, Millicent	24/02/2012 – 28/02/2012
	Glenelg	Holdfast Bay Bowling Club, 583 Anzac Highway, Glenelg North	02/03/2012 – 06/03/2012
	Parafield Gardens	Para Hills Bowling Club, Lot 92 Bridge Road, Para Hills	09/03/2012 – 13/03/2012
	Port Lincoln	Port Lincoln RSL Memorial Hall, 14 Hallet Place, Port Lincoln	16/03/2012 – 20/03/2012
Tasmania	Alanvale	Rocherlea Community Hall, Archer Street, Rocherlea	27/04/2012 – 01/05/2012
	Ravenswood	Ravenswood Memorial Hall, Old Vermont Road, Ravenswood	04/05/2012 – 07/05/2012
	Ulverstone	Ulverstone Bowls Club, 41 Water Street, Ulverstone	11/05/2012 – 15/05/2012
	George Town	Graham Fairless Centre, Macquarie Street, George Town	18/05/2012 – 22/05/2012
	Blackmans Bay	Blackmans Bay Scout Hall, 120 Tiderbox Road, Blackmans Bay	26/05/2012 – 30/05/2012
	Taroona	Taroona Community Hall, Batchelor Way, Taroona	02/06/2012 – 06/06/2012
Northern Territory	Marrara	Alawa Community Hall, Lakeside Drive, Alawa	03/05/2012 – 05/05/2012
	Wagaman	Alawa Community Hall, Lakeside Drive, Alawa	06/05/2012 – 10/05/2012
	Nightcliff	Alawa Community Hall, Lakeside Drive, Alawa	11/05/2012 – 19/05/2012
	Parap	Top Indoor Sports Centre, 7 Bishop Street, Woolner	20/05/2012 – 25/05/2012
	Larrakeyah	Top Indoor Sports Centre, 7 Bishop Street, Woolner	26/05/2012 – 28/05/2012
	Driver	Charley Darwin University, University Avenue, Palmerston	01/06/2012 – 04/06/2012

APPENDIX B
SUMMARY TABLES

ANNUAL INCIDENCE OF DIABETES AND PRE-DIABETES: THE AUSDIAB STUDY

	INCIDENCE (% PER YEAR) (95% CONFIDENCE INTERVAL)	ODDS RATIO* (95% CONFIDENCE INTERVAL)
Diabetes and pre-diabetes		
Overall incidence		
Diabetes	0.7 (0.6 – 0.7)	–
IGT	0.9 (0.8 – 1.0)	–
IFG	0.4 (0.4 – 0.5)	–
Incidence of diabetes according to baseline risk factors		
Age (years)		
25-34	0.3 (0.2 – 0.5)	1.0
35-44	0.3 (0.2 – 0.4)	0.9 (0.6 – 1.6)
45-54	0.7 (0.6 – 0.8)	2.3 (1.4 – 3.7)
55-64	0.9 (0.8 – 1.1)	3.0 (1.8 – 4.8)
65-74	1.3 (1.0 – 1.6)	4.0 (2.4 – 6.7)
75+	0.9 (0.5 – 1.6)	2.9 (1.4 – 5.9)
Glucose tolerance status		
NGT	0.3 (0.2 – 0.3)	1.0
IFG	2.2 (1.7 – 2.7)	7.4 (5.5 – 9.9)
IGT	3.0 (2.6 – 3.4)	10.0 (7.9 – 12.6)
AUSDRISK		
Low risk	0.1 (0.1 – 0.2)	1.0
Intermediate risk	0.4 (0.3 – 0.4)	3.6 (2.0 – 6.5)
High risk	1.6 (1.4 – 1.8)	15.2 (8.5 – 27.5)
BMI† status		
Normal	0.3 (0.2 – 0.4)	1.0
Overweight	0.6 (0.5 – 0.7)	1.9 (1.4 – 2.5)
Obese	1.5 (1.3 – 1.7)	4.7 (3.6 – 6.3)
Waist circumference‡ categories		
Low risk	0.3 (0.2 – 0.3)	1.0
High risk	0.9 (0.8 – 1.1)	3.1 (2.4 – 4.0)

Continued on page 75.

	INCIDENCE (% PER YEAR) (95% CONFIDENCE INTERVAL)	ODDS RATIO* (95% CONFIDENCE INTERVAL)
Physical activity§		
Inactive	1.0 (0.8 – 1.3)	1.0
Insufficient	0.7 (0.6 – 0.8)	0.7 (0.5 – 0.9)
Sufficient	0.5 (0.4 – 0.6)	0.5 (0.4 – 0.6)
Hypertension#		
Normal	0.4 (0.4 – 0.5)	1.0
Hypertension	1.3 (1.1 – 1.5)	2.2 (1.8 – 2.8)
Remoteness		
Major cities	0.7 (0.6 – 0.8)	1.0
Inner regional	0.6 (0.5 – 0.7)	0.8 (0.7 – 1.1)
Outer regional/Remote/Very remote	0.7 (0.6 – 0.8)	1.1 (0.9 – 1.4)
Socio-economic disadvantage		
1st quintile (most disadvantaged)	1.0 (0.8 – 1.2)	1.0
2nd quintile	0.7 (0.6 – 0.9)	0.8 (0.6 – 1.0)
3rd quintile	0.7 (0.5 – 0.9)	0.7 (0.5 – 0.9)
4th quintile	0.6 (0.5 – 0.7)	0.6 (0.4 – 0.8)
5th quintile (least disadvantaged)	0.5 (0.4 – 0.6)	0.5 (0.4 – 0.7)

NGT – normal glucose tolerance; IFG – impaired fasting glucose; IGT – impaired glucose tolerance.

** Odds ratio by age category was adjusted for sex. All other odds ratios were adjusted for age and sex.*

† BMI – body mass index (weight/height^2) was categorised into three groups: (i) normal: BMI <25 kg/m^2; (ii) overweight: BMI 25–29.9 kg/m^2; and (iii) obese: BMI ≥30 kg/m2.

‡ Waist circumference: (i) low risk: <94 cm for Europid men, <90 cm for Aboriginal/Torres Strait Islander, Asian and South European men, <80 cm for women; (ii) high risk: ≥94 cm for Europid men, ≥90 cm for Aboriginal/Torres Strait Islander, Asian and South European men, ≥80 cm for women.

§ 'Physical activity time' was calculated as the sum of the time spent performing moderate activity (e.g. walking) plus double the time spent in vigorous activity (to reflect its greater intensity): inactive – no participation in physical activity in the previous week; insufficient – 1 to 149 minutes of physical activity in the previous week; sufficient – at least 150 minutes of physical activity in the previous week.

 # Hypertension (high blood pressure) was defined as having a blood pressure ≥140/90 mmHg and/or taking blood pressure-lowering medication.

PREVALENCE OF DIABETES: THE AUSDIAB STUDY

	PREVALENCE (%) (95% CONFIDENCE INTERVAL)	ODDS RATIO* (95% CONFIDENCE INTERVAL)
Percentage of the population with diabetes by survey year		
1999-2000	8.5 (8.0 – 9.0)	–
2004-2005	9.3 (8.5 – 10.0)	–
2011-2012	12.0 (11.1 – 13.0)	–
Percentage with depression, cognitive impairment and disability		
Depression		
No diabetes	9.8 (8.7 – 10.8)	1.0
Pre-diabetes	11.8 (9.4 – 14.2)	1.4 (1.1 – 1.8)
Diabetes	16.2 (12.7 – 19.7)	2.1 (1.6 – 2.8)
Cognitive impairment		
No diabetes	3.4 (2.3 – 4.4)	1.0
Pre-diabetes	5.5 (3.1 – 7.8)	1.3 (0.7 – 2.4)
Diabetes	8.2 (4.8 – 11.6)	2.0 (1.1 – 3.4)
Disability		
No diabetes	27.7 (25.5 – 29.9)	1.0
Pre-diabetes	33.3 (28.9 – 37.7)	1.2 (1.0 – 1.5)
Diabetes	43.6 (38.3 – 49.0)	1.9 (1.5 – 2.4)
Meeting metabolic targets for diabetes control		
Low-density lipoprotein <2.59 mmol/L		
1999-2000	21.4 (17.6 – 25.2)	–
2004-2005	48.5 (43.4 – 53.6)	–
2011-2012	73.3 (68.5 – 78.1)	–
Blood pressure <130/80 mmHg		
1999-2000	23.4 (19.5 – 27.2)	–
2004-2005	35.5 (30.7 – 40.4)	–
2011-2012	27.4 (22.4 – 32.3)	–
HbA1c <7%		
1999-2000	54.0 (49.5 – 58.5)	–
2004-2005	61.0 (56.1 – 65.9)	–
2011-2012	55.6 (50.2 – 60.9)	–

Continued on page 77.

	PREVALENCE (%) (95% CONFIDENCE INTERVAL)	ODDS RATIO* (95% CONFIDENCE INTERVAL)
Treatment and medication use in people with diabetes		
Antihypertensive		
1999-2000	46.5 (42.0 – 51.0)	–
2004-2005	59.2 (54.2 – 64.2)	–
2011-2012	63.9 (59.2 – 68.5)	–
Cholesterol lowering agents		
1999-2000	34.2 (29.9 – 38.5)	–
2004-2005	53.1 (48.0 – 58.1)	–
2011-2012	60.2 (55.5 – 65.0)	–
Diabetes management		
Diet only		
1999-2000	26.8 (22.8 – 30.8)	–
2004-2005	20.2 (16.2 – 24.2)	–
2011-2012	9.8 (7.0 – 12.6)	–
Tablets		
1999-2000	54.6 (50.1 – 59.1)	–
2004-2005	60.6 (55.7 – 65.5)	–
2011-2012	65.4 (60.8 – 69.9)	–
Insulin +/- tablets		
1999-2000	17.9 (14.5 – 21.4)	–
2004-2005	17.9 (14.0 – 21.7)	–
2011-2012	23.5 (19.5 – 27.5)	–
Use of healthcare services		
One or more visits to a general practitioner in the previous 3 months		
No diabetes	68.5 (66.9 – 70.1)	1.0
Pre-diabetes	75.4 (72.2 – 78.6)	1.2 (1.0 – 1.5)
Diabetes	90.1 (87.3 – 92.9)	3.3 (2.3 – 4.5)
One or more nights spent in a hospital in the previous 12 months		
No diabetes	9.8 (8.8 – 10.8)	1.0
Pre-diabetes	10.1 (7.8 – 12.4)	0.9 (0.7 – 1.1)
Diabetes	17.0 (13.5 – 20.6)	1.5 (1.1 – 2.0)

**Odds ratios were adjusted for age and sex*

ANNUAL INCIDENCE OF OBESITY AND HYPERTENSION: THE AUSDIAB STUDY

	INCIDENCE (% PER YEAR) (95% CONFIDENCE INTERVAL)	ODDS RATIO* (95% CONFIDENCE INTERVAL)
Obesity		
Overall incidence	1.3 (1.2 – 1.4)	–
Incidence of obesity according to baseline BMI† status		
Normal	0.1 (0.1 – 0.2)	1.0
Overweight	2.6 (2.4 – 2.8)	26.4 (18.4 – 38.0)
Hypertension‡		
Overall Incidence	2.9 (2.7 – 3.0)	–
Incidence of hypertension according to baseline risk factors		
Age (years)		
25-34	1.0 (0.8 – 1.3)	1.0
35-44	1.8 (1.6 – 2.0)	1.7 (1.3 – 2.3)
45-54	3.2 (2.9 – 3.5)	3.1 (2.4 – 4.0)
55-64	4.7 (4.2 – 5.3)	4.6 (3.5 – 6.0)
65-74	7.3 (6.2 – 8.6)	7.4 (5.5 – 10.0)
75+	7.5 (5.1 – 11.2)	8.8 (5.5 – 14.1)
Glucose tolerance status		
NGT	2.6 (2.4 – 2.7)	1.0
IFG	4.3 (3.5 – 5.3)	1.4 (1.1 – 1.8)
IGT	4.8 (4.0 – 5.6)	1.6 (1.3 – 1.9)
DM	6.5 (5.0 – 8.3)	1.8 (1.4 – 2.3)
BMI† status		
Normal	2.0 (1.8 – 2.2)	1.0
Overweight	3.3 (3.0 – 3.6)	1.5 (1.3 – 1.7)
Obese	4.8 (4.3 – 5.4)	2.3 (2.0 – 2.7)
Smoking status		
Never smoker	2.7 (2.5 – 2.9)	1.0
Smoker§	3.1 (2.8 – 3.4)	1.1 (1.0 – 1.2)

NGT – normal glucose tolerance; IFG – impaired fasting glucose; IGT – impaired glucose tolerance; DM – diabetes mellitus.

** Odds ratio by age category was adjusted for sex. All other odds ratios were adjusted for age and sex.*

† BMI – body mass index (weight/height^2) was categorised into three groups: (i) normal: BMI <25 kg/m^2; (ii) overweight: BMI 25–29.9 kg/m^2; and (iii) obese: BMI ≥30 kg/m^2.

‡ Hypertension (high blood pressure) was defined as having a blood pressure ≥140/90 mmHg and/or taking blood pressure-lowering medication.

§Smokers included people who were either current smokers or ex-smokers at baseline.

PREVALENCE OF OBESITY: THE AUSDIAB STUDY

	PREVALENCE (%) (95% CONFIDENCE INTERVAL)	ODDS RATIO* (95% CONFIDENCE INTERVAL)
Percentage of the population with obesity by survey year		
1999-2000	22.3 (21.6 – 23.1)	–
2004-2005	26.8 (25.7 – 27.9)	–
2011-2012	27.3 (26.0 – 28.6)	–
Percentage with depression, cognitive impairment and disability		
Depression		
Normal	8.6 (7.2 – 10.1)	1.0
Overweight	8.9 (7.6 – 10.2)	1.1 (0.8 – 1.4)
Obese	16.1 (14.1 – 18.2)	2.1 (1.6 – 2.6)
Cognitive impairment		
Normal	2.8 (1.4 – 4.1)	1.0
Overweight	4.9 (3.3 – 6.4)	1.8 (1.0 – 3.4)
Obese	5.5 (3.5 – 7.5)	2.6 (1.4 – 5.1)
Disability		
Normal	21.5 (18.5 – 24.6)	1.0
Overweight	28.1 (25.3 – 30.9)	1.5 (1.2 – 1.9)
Obese	45.9 (42.1 – 49.7)	3.7 (2.9 – 4.7)
Use of healthcare services		
One or more visits to a general practitioner in the previous 3 months		
Normal	67.8 (65.4 – 70.3)	1.0
Overweight	71.7 (69.6 – 73.7)	1.2 (1.0 – 1.4)
Obese	76.1 (73.7 – 78.5)	1.6 (1.3 – 1.9)
One or more nights spent in a hospital in the previous 12 months		
Normal	9.9 (8.4 – 11.5)	1.0
Overweight	11.2 (9.7 – 12.6)	1.1 (0.9 – 1.4)
Obese	10.6 (8.9 – 12.3)	1.1 (0.8 – 1.4)

** Odds ratios were adjusted for age and sex.*

BMI – body mass index (weight/height^2) was categorised into three groups: (i) normal weight: BMI <25 kg/m^2; (ii) overweight: BMI 25–29.9 kg/m^2; and (iii) obese: BMI ≥30 kg/m^2.

PREVALENCE OF HYPERTENSION: THE AUSDIAB STUDY

	PREVALENCE (%) (95% CONFIDENCE INTERVAL)	ODDS RATIO* (95% CONFIDENCE INTERVAL)
Percentage of the population with hypertension by survey year		
1999-2000	32.7 (31.8 – 33.5)	–
2004-2005	35.0 (33.8 – 36.2)	–
2011-2012	42.3 (40.9 – 43.7)	–
Use of hypertensive medication		
1999-2000	15.8 (15.1 – 16.5)	–
2004-2005	23.2 (22.2 – 24.3)	–
2011-2012	20.6 (19.6 – 21.6)	–
The number of people meeting blood pressure target of <140/90 mmHg		
1999-2000	70.9 (69.6 – 72.3)	–
2004-2005	70.1 (68.6 – 71.5)	–
2011-2012	71.1 (69.8 – 72.4)	–
Percentage with depression, cognitive impairment and disability		
Depression		
No hypertension	10.4 (9.3 – 11.6)	1.0
Hypertension	11.2 (9.8 – 12.6)	1.3 (1.0 – 1.6)
Cognitive impairment		
No hypertension	3.1 (1.8 – 4.2)	1.0
Hypertension	5.4 (4.0 – 6.8)	1.4 (0.8 – 2.3)
Disability		
No hypertension	27.5 (24.7 – 30.3)	1.0
Hypertension	33.7 (31.2 – 36.2)	1.2 (1.0 – 1.4)
Use of healthcare services		
One or more visits to a general practitioner in the previous 3 months		
No hypertension	65.2 (63.4 – 67.0)	1.0
Hypertension	80.5 (78.7 – 82.3)	1.6 (1.4 – 1.9)
One or more nights spent in a hospital in the previous 12 months		
No hypertension	9.1 (7.9 – 10.2)	1.0
Hypertension	12.9 (11.3 – 14.4)	1.1 (0.9 – 1.4)

** Odds ratios were adjusted for age and sex.*

Hypertension (high blood pressure) was defined as having a blood pressure ≥140/90 mmHg and/or taking blood pressure-lowering medication.

ANNUAL INCIDENCE OF THE METABOLIC SYNDROME: THE AUSDIAB STUDY

	INCIDENCE (% PER YEAR) (95% CONFIDENCE INTERVAL)	ODDS RATIO* (95% CONFIDENCE INTERVAL)
Metabolic syndrome†		
Overall Incidence	2.1 (1.9 – 2.2)	–
Incidence of metabolic syndrome according to baseline risk factors		
Age (years)		
25-34	1.3 (1.1 – 1.7)	1.0
35-44	1.6 (1.4 – 1.8)	1.2 (0.9 – 1.5)
45-54	2.3 (2.0 – 2.5)	1.7 (1.3 – 2.1)
55-64	2.4 (2.1 – 2.8)	1.8 (1.4 – 2.4)
65-74	3.6 (3.0 – 4.3)	2.6 (1.9 – 3.5)
75+	3.4 (2.4 – 4.9)	2.7 (1.7 – 4.1)
Waist circumference‡ categories		
Low risk	1.4 (1.3 – 1.6)	1.0
High risk	3.0 (2.8 – 3.3)	2.1 (1.8 – 2.4)
Physical activity§		
Insufficient	2.2 (2.0 – 2.5)	1.0
Sufficient	2.0 (1.8 – 2.1)	0.8 (0.7 – 1.0)
Glucose tolerance status		
NGT	1.9 (1.7 – 2.0)	1.0
IFG	3.4 (2.8 – 4.2)	2.5 (1.8 – 3.3)
IGT	5.3 (3.9 – 7.1)	1.7 (1.4 – 2.1)
DM	6.0 (4.3 – 8.5)	2.5 (1.7 – 3.5)

NGT – normal glucose tolerance; IFG – impaired fasting glucose; IGT – impaired glucose tolerance; DM – diabetes mellitus.

** Odds ratio by age category was adjusted for sex. All other odds ratios were adjusted for age and sex.*

† Metabolic syndrome was defined according to the definition of the Joint Interim Statement.

‡ Waist circumference: (i) low risk: <94 cm for Europid men, <90 cm for Aboriginal/Torres Strait Islander, Asian and South European men, <80 cm for women; (ii) high risk: ≥94 cm for Europid men, ≥90 cm for Aboriginal/Torres Strait Islander, Asian and South European men, ≥80 cm for women.

§ 'Physical activity time' was calculated as the sum of the time spent performing moderate activity (e.g. walking) plus double the time spent in vigorous activity (to reflect its greater intensity): insufficient – <150 minutes of physical activity in the previous week; sufficient – at least 150 minutes of physical activity in the previous week.

PREVALENCE OF THE METABOLIC SYNDROME: THE AUSDIAB STUDY

	PREVALENCE (%) (95% CONFIDENCE INTERVAL)	ODDS RATIO* (95% CONFIDENCE INTERVAL)
Percentage of the population with the metabolic syndrome by survey year		
1999-2000	35.1 (34.2 – 36.0)	–
2004-2005	32.5 (31.4 – 33.7)	–
2011-2012	33.5 (32.2 – 34.9)	–
Percentage with depression, cognitive impairment and disability		
Depression		
No metabolic syndrome	9.7 (8.7 – 10.8)	1.0
Metabolic syndrome	12.7 (11.0 - 14.4)	1.5 (1.2 – 1.8)
Cognitive impairment		
No metabolic syndrome	3.2 (2.1 – 4.3)	1.0
Metabolic syndrome	6.2 (4.5 – 7.9)	1.8 (1.1 – 2.9)
Disability		
No metabolic syndrome	26.0 (23.6 – 28.3)	1.0
Metabolic syndrome	38.4 (35.4 – 41.5)	1.7 (1.4 – 2.1)
Use of healthcare services		
One or more visits to a general practitioner in the previous 3 months		
No metabolic syndrome	68.3 (66.6 – 70.0)	1.0
Metabolic syndrome	78.2 (76.1 – 80.3)	1.4 (1.2 – 1.7)
One or more nights spent in a hospital in the previous 12 months		
No metabolic syndrome	9.6 (8.5 – 10.6)	1.0
Metabolic syndrome	12.6 (10.9 – 14.3)	1.2 (1.0 – 1.4)

** Odds ratios were adjusted for age and sex.*

Metabolic syndrome was defined according to the definition of the Joint Interim Statement.

ANNUAL INCIDENCE OF IMPAIRED ESTIMATED GLOMERULAR FILTRATION RATE AND ALBUMINURIA: THE AUSDIAB STUDY

	INCIDENCE (% PER YEAR) (95% CONFIDENCE INTERVAL)	ODDS RATIO* (95% CONFIDENCE INTERVAL)
Impaired estimated glomerular filtration rate†		
Overall incidence	0.4 (0.4 – 0.5)	–
Incidence of impaired eGFR according to baseline risk factors		
Age (years)		
25-34	0.0 (0.0 – 0.1)	1.0
35-44	0.1 (0.0 – 0.1)	1.6 (0.5 – 5.7)
45-54	0.2 (0.2 – 0.3)	4.9 (1.5 – 15.9)
55-64	0.6 (0.5 – 0.7)	13.0 (4.1 – 41.3)
65-74	1.7 (1.4 – 2.0)	39.1 (12.4 – 123.5)
75+	3.8 (2.8 – 5.0)	93.6 (29.1 – 301.3)
Glucose tolerance status		
NGT	0.3 (0.3 – 0.4)	1.0
IFG	0.7 (0.6 – 1.0)	1.2 (0.7 – 2.0)
IGT	0.5 (0.3 – 0.8)	1.2 (0.9 – 1.7)
DM	1.4 (1.0 – 1.8)	1.8 (1.3 – 2.6)
Hypertension‡		
Normal	0.2 (0.2 – 0.3)	1.0
Hypertension	1.1 (0.9 – 1.3)	2.1 (1.6 – 2.7)
Albuminuria§		
Overall Incidence	0.7 (0.6 – 0.8)	–
Incidence of albuminuria according to baseline risk factors		
Age (years)		
25-34	0.3 (0.2 – 0.5)	1.0
35-44	0.3 (0.2 – 0.4)	0.8 (0.5 – 1.3)
45-54	0.4 (0.3 – 0.5)	1.2 (0.7 – 1.9)
55-64	0.8 (0.7 – 1.0)	2.3 (1.5 – 3.7)
65-74	2.1 (1.7 – 2.5)	6.3 (4.0 – 10.0)
75+	4.3 (3.3 – 5.6)	16.0 (9.7 – 26.3)

Continued on page 84.

	INCIDENCE (% PER YEAR) (95% CONFIDENCE INTERVAL)	ODDS RATIO* (95% CONFIDENCE INTERVAL)
Glucose tolerance status		
NGT	0.5 (0.5 – 0.6)	1.0
IFG	0.9 (0.7 – 1.2)	1.5 (1.1 – 2.1)
IGT	1.0 (0.8 – 1.4)	1.2 (0.9 – 1.6)
DM	2.6 (2.1 – 3.3)	3.0 (2.3 – 3.9)
Hypertension		
Normal	0.4 (0.4 – 0.5)	1.0
Hypertension	1.5 (1.3 – 1.7)	1.8 (1.4 – 2.2)

NGT – normal glucose tolerance; IFG – impaired fasting glucose; IGT – impaired glucose tolerance; DM – diabetes mellitus.

** Odds ratio by age category was adjusted for sex. All other odds ratios were adjusted for age and sex.*

† Impaired estimated glomerular filtration rate (eGFR) defined as having an eGFR of <60ml/min/1.73m^2.

‡ Hypertension (high blood pressure) was defined as having a blood pressure ≥140/90 mmHg and/or taking blood pressure-lowering medication.

§ Abnormal albumin:creatinine ratio (albuminuria) was defined as ≥2.5 mg/mmol for men and ≥3.5 mg/mmol for women.

PREVALENCE OF IMPAIRED GLOMERULAR FILTRATION RATE AND ALBUMINURIA: THE AUSDIAB STUDY

	PREVALENCE (%) (95% CONFIDENCE INTERVAL)	ODDS RATIO* (95% CONFIDENCE INTERVAL)
Impaired glomerular filtration rate†		
Percentage of the population with impaired estimated GFR by survey year		
1999-2000	4.0 (3.7 – 4.4)	–
2004-2005	5.1 (4.5 – 5.6)	–
2011-2012	4.8 (4.2 – 5.4)	–
Percentage with depression, cognitive impairment and disability		
Depression		
Normal estimated GFR	10.6 (9.7 – 11.5)	1.0
Impaired estimated GFR	14.5 (9.7 – 19.3)	1.7 (1.1 – 2.6)
Cognitive impairment		
Normal estimated GFR	4.2 (3.2 – 5.2)	1.0
Impaired estimated GFR	6.9 (2.7 – 11.1)	0.8 (0.4 – 1.6)
Disability		
Normal estimated GFR	29.6 (27.7 – 31.6)	1.0
Impaired estimated GFR	48.9 (41.7 – 56.2)	1.6 (1.2 – 2.2)

Continued on page 85.

	PREVALENCE (%) (95% CONFIDENCE INTERVAL)	ODDS RATIO* (95% CONFIDENCE INTERVAL)
Use of healthcare services		
One or more visits to a general practitioner in the previous 3 months		
Normal estimated GFR	70.8 (69.4 – 72.2)	1.0
Impaired estimated GFR	89.0 (84.7 – 93.3)	1.8 (1.1 – 2.8)
One or more nights spent in a hospital in the previous 12 months		
Normal estimated GFR	10.1 (9.2 – 11.1)	1.0
Impaired estimated GFR	20.1 (14.6 – 25.6)	1.5 (1.1 – 2.2)
Albuminuria§		
Percentage of the population with albuminuria by survey year		
1999-2000	7.5 (7.0 – 7.9)	–
2004-2005	6.9 (6.3 – 7.5)	–
2011-2012	8.8 (8.0 – 9.6)	–
Percentage with depression, cognitive impairment and disability		
Depression		
No albuminuria	10.4 (9.4 – 11.3)	1.0
Albuminuria	13.9 (10.4 – 17.3)	1.6 (1.2 – 2.2)
Cognitive impairment		
No albuminuria	3.6 (2.7 – 4.6)	1.0
Albuminuria	9.0 (5.3 – 12.7)	1.5 (0.8 – 2.6)
Disability		
No albuminuria	29.3 (27.3 – 31.2)	1.0
Albuminuria	42.3 (36.7 – 48.0)	1.4 (1.1 – 1.9)
Use of healthcare services		
One or more visits to a general practitioner in the previous 3 months		
No albuminuria	70.3 (68.9 – 71.7)	1.0
Albuminuria	84.7 (81.1 – 88.2)	1.7 (1.3 – 2.3)
One or more nights spent in a hospital in the previous 12 months		
No albuminuria	9.6 (8.7 – 10.5)	1.0
Albuminuria	19.4 (15.5 – 23.3)	1.7 (1.3 – 2.3)

** Odds ratios were adjusted for age and sex.*

† Impaired glomerular filtration rate(GFR) defined as having an estimated GFR of <60ml/min/1.73m2.

‡ Abnormal albumin:creatinine ratio (albuminuria) was defined as ≥2.5 mg/mmol for men and ≥3.5 mg/mmol for women.

ANNUAL MORTALITY RATE (PER 1,000 PERSON-YEARS) ACCORDING TO BASELINE GLUCOSE STATUS: THE AUSDIAB STUDY

	INCIDENCE (% PER YEAR) (95% CONFIDENCE INTERVAL)	ODDS RATIO* (95% CONFIDENCE INTERVAL)
Mortality		
Glucose tolerance status		
NGT	6.2 (5.8 – 6.7)	1.0
IFG	10.2 (8.2 – 12.7)	1.2 (0.9 – 1.5)
IGT	16.3 (14.4 – 18.4)	1.2 (1.1 – 1.4)
NDM	22.4 (18.7 – 26.9)	1.4 (1.1 – 1.7)
KDM	31.1 (26.6 – 36.4)	1.7 (1.5 – 2.1)

NGT – normal glucose tolerance; IFG – impaired fasting glucose; IGT – impaired glucose tolerance; NDM – newly diagnosed diabetes mellitus; KDM – previously diagnosed diabetes mellitus.

** Odds ratio was adjusted for age and sex.*

SUMMARY OF MEAN CHANGE ±SD IN WEIGHT AND WAIST CIRCUMFERENCE OVER 12 YEARS ACCORDING TO BASELINE AGE AND SEX: THE AUSDIAB STUDY

AGE (YEARS)	MEN	WOMEN	ALL
Mean weight (kg) change			
25-34	6.7 ± 8.1	6.6 ± 8.7	6.7 ± 8.5
35-44	4.3 ± 7.0	5.0 ± 7.4	4.7 ± 7.2
45-54	2.4 ± 6.1	2.9 ± 6.9	2.7 ± 6.6
55-64	0.2 ± 6.3	0.5 ± 6.1	0.4 ± 6.2
65-74	-2.1 ± 5.8	-2.1 ± 7.2	-2.1 ± 6.5
75+	-4.2 ± 4.7	-4.7 ± 7.0	-4.5 ± 6.0
Total	2.3 ± 7.0	2.9 ± 7.6	2.6 ± 7.3
Mean waist circumference (cm) change			
25-34	5.7 ± 7.6	7.3 ± 9.2	6.6 ± 8.6
35-44	5.2 ± 6.9	7.4 ± 8.3	6.5 ± 7.8
45-54	4.5 ± 6.6	6.6 ± 7.9	5.6 ± 7.4
55-64	3.4 ± 6.6	4.7 ± 8.0	4.1 ± 7.4
65-74	2.1 ± 6.5	3.4 ± 8.2	2.7 ± 7.4
75+	0.6 ± 6.3	0.9 ± 9.2	0.8 ± 7.9
Total	4.3 ± 6.9	6.2 ± 8.3	5.3 ± 7.7

SD – standard deviation.

SUMMARY OF MEAN CHANGE ±SD IN WEIGHT AND WAIST CIRCUMFERENCE OVER 12 YEARS ACCORDING TO BASELINE BODY MASS INDEX STATUS: THE AUSDIAB STUDY

	MEN	WOMEN	ALL
Mean weight (kg) change according to baseline BMI			
Normal	3.0 ± 5.8	3.6 ± 6.0	3.4 ± 5.9
Overweight	1.9 ± 6.7	2.8 ± 7.4	2.3 ± 7.0
Obese	2.2 ± 9.1	1.5 ± 10.5	1.8 ± 9.9
Mean waist circumference (cm) change according to baseline BMI			
Normal	4.3 ± 6.5	6.3 ± 7.4	5.6 ± 7.1
Overweight	4.1 ± 6.7	6.4 ± 8.7	5.1 ± 7.7
Obese	4.5 ± 7.6	5.7 ± 9.8	5.2 ± 8.9

SD – standard deviation. BMI – body mass index (weight (kg)/height (m)^2) was categorized into three groups: (i) normal: BMI <25 kg/m^2; (ii) overweight: BMI 25–29.9 kg/m^2; and (iii) obese: BMI ≥30 kg/m^2.

SUMMARY OF MEAN ±SEM OF OBJECTIVELY ASSESSED MODERATE - TO VIGOROUS-INTENSITY AND SEDENTARY PHYSICAL ACTIVITY TIME ACCORDING TO AGE IN 2011-12: THE AUSDIAB STUDY

AGE (YEARS)	MEN	WOMEN	ALL
Total moderate to vigorous intensity activity time (mins/day)			
35-44	47 ± 4	36 ± 3	40 ± 3
45-54	48 ± 2	28 ± 2	35 ± 2
55-64	35 ± 2	28 ± 2	32 ± 1
65-74	28 ± 3	22 ± 2	25 ± 2
75+	26 ± 4	9 ± 4	19 ± 3
Total light activity time (mins/day)			
35-44	338 ± 16	355 ± 12	349 ± 10
45-54	327 ± 9	355 ± 7	344 ± 6
55-64	337 ± 7	371 ± 7	355 ± 5
65-74	316 ± 10	340 ± 9	329 ± 7
75+	327 ± 14	294 ± 16	312 ± 11
Total sitting activity time (mins/day)			
35-44	544 ± 20	495 ± 16	513 ± 13
45-54	531 ± 12	510 ± 10	518 ± 8
55-64	541 ± 9	484 ± 10	512 ± 7
65-74	568 ± 12	506 ± 13	534 ± 9
75+	544 ± 18	565 ± 22	552 ± 14

SEM – standard error of mean.

SUMMARY OF MEAN ±SEM OF OBJECTIVELY ASSESSED MODERATE - TO VIGOROUS-INTENSITY AND SEDENTARY PHYSICAL ACTIVITY TIME ACCORDING TO BODY MASS INDEX STATUS: THE AUSDIAB STUDY

	MEN	WOMEN	ALL
Total moderate to vigorous intensity activity time (mins/day)			
Normal	40 ± 2	30 ± 2	34 ± 1
Overweight	38 ± 2	27 ± 2	33 ± 1
Obese	31 ± 2	21 ± 2	25 ± 2
Total light activity time (mins/day)			
Normal	335 ± 9	360 ± 6	351 ± 5
Overweight	333 ± 6	363 ± 6	348 ± 5
Obese	318 ± 9	328 ± 8	324 ± 6
Total sitting activity time (mins/day)			
Normal	540 ± 11	485± 9	505 ± 7
Overweight	539 ± 8	493 ± 9	516 ± 6
Obese	561 ± 11	545 ± 11	552 ± 8

SEM – standard error of mean. BMI – body mass index (weight (kg)/height (m)^2) was categorized into three groups: (i) normal: BMI <25 kg/m^2; (ii) overweight: BMI 25–29.9 kg/m^2; and (iii) obese: BMI ≥30 kg/m^2.

SUMMARY OF MEAN ±SEM OF OBJECTIVELY ASSESSED MODERATE - TO VIGOROUS-INTENSITY AND SEDENTARY PHYSICAL ACTIVITY TIME ACCORDING TO METABOLIC SYNDROME STATUS: THE AUSDIAB STUDY

	MEN	WOMEN	ALL
Total moderate to vigorous activity time (mins/day)			
No metabolic syndrome	41 ± 2	28 ± 1	33 ± 1
Metabolic syndrome	32 ± 2	21 ± 2	27 ± 2
Total light activity time (mins/day)			
No metabolic syndrome	341 ± 6	359 ± 4	353 ± 4
Metabolic syndrome	314 ± 7	334 ± 8	322 ± 5
Total sitting activity time (mins/day)			
No metabolic syndrome	535 ± 7	493 ± 6	509 ± 5
Metabolic syndrome	558 ± 9	535 ± 12	548 ± 7

SEM – standard error of mean. Metabolic syndrome was defined according to the definition of the Joint Interim Statement.

SUMMARY OF MEAN ±SD OF SELF REPORTED TOTAL ACTIVITY, TV VIEWING AND SEDENTARY PHYSICAL ACTIVITY TIME ACCORDING TO AGE IN 2011-12: THE AUSDIAB STUDY

AGE (YEARS)	MEN	WOMEN	ALL
Total activity time (mins/day)			
35-44	49 ± 44	45 ± 47	47 ± 46
45-54	59 ± 60	48 ± 50	52 ± 54
55-64	56 ± 57	49 ± 50	52 ± 54
65-74	60 ± 56	44 ± 46	52 ± 51
75+	49 ± 55	32 ± 38	40 ± 48
Total TV viewing time (mins/day			
35-44	98 ± 64	83 ± 72	89 ± 69
45-54	105 ± 73	87 ± 64	95 ± 68
55-64	115 ± 75	106 ± 77	110 ± 76
65-74	135 ± 79	136 ± 86	135 ± 83
75+	136 ± 82	144 ± 92	140 ± 87
Total sitting activity time (mins/day)			
35-44	201 ± 162	234 ± 171	221 ± 167
45-54	250 ± 196	185 ± 141	203 ± 160
55-64	236 ± 163	190 ± 142	207 ± 152
65-74	193 ± 177	178 ± 125	184 ± 150
75+	204 ± 135	186 ± 124	194 ± 128

SD – standard deviation.

SUMMARY OF MEAN ±SD OF SELF REPORTED TOTAL ACTIVITY, TV VIEWING AND SEDENTARY PHYSICAL ACTIVITY TIME ACCORDING TO BODY MASS INDEX STATUS: THE AUSDIAB STUDY

	MEN	WOMEN	ALL
Total time (mins/day)			
Normal	65 ± 61	55 ± 55	59 ± 57
Overweight	56 ± 55	45 ± 46	50 ± 51
Obese	50 ± 53	33 ± 37	40 ± 46
Total TV viewing time (mins/day)			
Normal	116 ± 79	100 ± 74	106 ± 76
Overweight	116 ± 74	110 ± 77	113 ± 76
Obese	128 ± 80	126 ± 91	127 ± 86
Total sitting activity time (mins/day)			
Normal	241 ± 171	178 ± 120	192 ± 136
Overweight	206 ± 171	194 ± 158	200 ± 164
Obese	240 ± 176	202 ± 140	216 ± 155

SD – standard deviation. BMI – body mass index (weight (kg)/height (m)^2) was categorized into three groups: (i) normal: BMI <25 kg/m^2; (ii) overweight: BMI 25–29.9 kg/m^2; and (iii) obese: BMI ≥30 kg/m^2.

SUMMARY OF MEAN ±SD OF SELF REPORTED TOTAL ACTIVITY, TV VIEWING AND SEDENTARY PHYSICAL ACTIVITY TIME ACCORDING TO METABOLIC SYNDROME STATUS: THE AUSDIAB STUDY

	MEN	WOMEN	ALL
Total activity time (mins/day)			
No metabolic syndrome	62 ± 58	50 ± 51	55 ± 54
Metabolic syndrome	47 ± 52	33 ± 38	40 ± 46
Total TV viewing time (mins/day)			
No metabolic syndrome	114 ± 74	102 ± 74	107 ± 74
Metabolic syndrome	128 ± 81	131 ± 91	129 ± 86
Total sitting activity time (mins/day)			
No metabolic syndrome	225 ± 178	192 ± 146	202 ± 157
Metabolic syndrome	219 ± 167	183 ± 123	201 ± 148

SD – standard deviation. Metabolic syndrome was defined according to the definition of the Joint Interim Statement.

APPENDIX C
ABBREVIATIONS

AUSDIAB	AUSTRALIAN DIABETES OBESITY AND LIFESTYLE STUDY
ABPM	Ambulatory blood pressure monitoring
ADL	Activities of daily living
BMI	Body mass index
CESD	Centre for Epidemiology Studies Short Depression Scale
CVD	Cardiovascular disease
DM	Diabetes mellitus
GFR	Glomerular filtration rate
eGFR	Estimated glomerular filtration rate
HDL-C	High-density lipoprotein cholesterol
IFG	Impaired fasting glucose
IGT	Impaired glucose tolerance
KDM	Known diabetes mellitus
LDL-C	Low-density lipoprotein cholesterol
METs	Metabolic equivalents
MMSE	Mini Mental State Examination
NDI	National death index
NDM	Newly diagnosed diabetes mellitus
NGT	Normal glucose tolerance
OGTT	Oral glucose tolerance test
SD	Standard deviation
SEM	Standard error of the mean

APPENDIX D
CONTRIBUTORS

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AUSDIAB

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