Gestational diabetes mellitus in Australia, 2005–06

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Gestational diabetes mellitus in Australia, 2005–06

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Abbreviations

ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
DoHA	Department of Health and Ageing
GDM	Gestational diabetes mellitus
NCMD	National Centre for Monitoring Diabetes
NDSS	National Diabetes Services Scheme
NDR	National Diabetes Register
NHMD	National Hospital Morbidity Database
SACC	Standard Australian Classification of Countries

Summary

Gestational diabetes mellitus in Australia, 2005–06 is the first national report on the incidence of gestational diabetes mellitus (GDM) among Australian women. The report contains the most recent national data on the incidence of GDM among Australian women of child-bearing age who give birth in hospital, described in this report as confinements. Additional analyses are presented for women from high-risk groups—those aged over 30 years, women who identify as Aboriginal or Torres Strait Islander and women born overseas.

Some of the main findings about the incidence of GDM among Australian women are given below.

The incidence of gestational diabetes is increasing.

- In 2005–06, GDM was diagnosed in 4.6% of confinements among women aged 15–49 years.
- The incidence of confinements with GDM among women aged 15–49 years increased by over 20% between 2000–01 and 2005–06.

The risk of GDM increases with age.

- In 2005–06, the risk of GDM increased with age: from 1% among 15–19 year old women to 13% among women aged 44–49 years.
- Women aged 30–34 years accounted for more than one-third of GDM cases in 2005–06.

Aboriginal and Torres Strait Islander women are at high risk.

- In 2005–06, the age-adjusted incidence rate of GDM among Indigenous Australian women was 1.5 times that of Other Australian women.
- The risk of GDM was higher among Indigenous compared to Other Australian women across all age groups.
- Indigenous Australian women aged 15–29 years accounted for 51% of GDM cases in 2005–06, compared to 30% among Other Australian women in this age group.

Women born overseas are at greater risk.

- In 2005–06, women born overseas had twice the incidence rate of GDM compared with women born in Australia.
- The incidence of GDM was greatest among women born in Southern Asia, at 3.4 times the rate of women born in Australia.

1 Introduction

1.1 Purpose and structure of this report

This report aims to determine for the first time the number of Australian women with gestational diabetes, the peak age for developing the condition, the changing incidence of GDM over time, the population groups at highest risk, and the proportion of GDM cases treated with insulin.

This introductory chapter provides an overview of GDM, including screening and diagnosis, outcomes, management and control, and the implications for monitoring.

Chapter 2 presents national estimates of GDM incidence in Australian women overall.

Chapter 3 focuses on GDM incidence among Aboriginal and Torres Strait Islander women and among women born overseas.

Both Chapter 2 and Chapter 3 include an overview of the literature, the current incidence estimates by age, whether insulin is used, and an analysis of trends over time.

Chapter 4 draws together the results and discusses issues around the comparability of and information available from the two data sources used in this report. This chapter also includes a discussion of future work needed in this area.

A detailed description of the methods used is given in the Appendix. Supplementary tables to chapters 2, 3 and 4 are available electronically on the AIHW website.

Confinements

Throughout this report we use the term 'confinement' to refer to a unique pregnancy resulting in the live birth or stillbirth of one or more babies in hospital. Although some consider it old-fashioned, the term 'confinement' gives an accurate technical description of the data we report here.

1.2 What is gestational diabetes mellitus?

Gestational diabetes mellitus is defined as glucose intolerance that has its onset or is first diagnosed during pregnancy. The diagnostic criteria for GDM are discussed later in this chapter.

While most women diagnosed with GDM have their blood glucose levels return to the normal range after giving birth, there is an increased likelihood that they will develop abnormal glucose tolerance, including diabetes, in the future.

Every cell in the body depends on glucose for energy and the hormone insulin helps glucose enter the cells from the bloodstream. During the second trimester of pregnancy, due to the effects of the pregnancy hormones, there is a decrease in the ability of cells to respond to insulin. This effect is known as 'increased insulin resistance'. Those women who develop GDM are unable to produce enough extra insulin to overcome this resistance and as a result, the level of glucose in the bloodstream becomes higher than normal. Women who have chronically high levels of glucose in the blood, are unable to take glucose into their cells

within a short time after eating, or both, are considered to be 'glucose intolerant'. This condition increases the risk of serious complications in both the mother and the child.

Any complications usually arise late in pregnancy and during delivery. Babies born to mothers with GDM are likely to be large for their gestational age (called 'macrosomic'), and this can cause problems with vaginal birth. These babies also have a higher risk of low blood glucose levels (hypoglycaemia) and of needing neonatal intensive care for hypoglycaemia and breathing difficulties. There is also a greater risk of stillbirth (Gonzalez-Quintero et al. 2007). Women with GDM are at higher risk of high blood pressure and pre-eclampsia, pre-term labour and caesarean delivery.

A number of factors place pregnant women at higher risk of developing GDM, including older maternal age, Indigenous status, ethnic background, family history and overweight or obesity. Most of these risk factors are not modifiable; however, maintaining a healthy weight range before and during pregnancy plays an important role in reducing the risk of developing GDM.

Pregnancies may also be complicated by pre-existing Type 1, Type 2 or less common forms of diabetes. In some cases women with pre-existing diabetes are not diagnosed until pregnancy, and are classified as having GDM. It is possible that some women diagnosed with GDM who continue to have high blood glucose levels after their pregnancy fall into this group as, unlike GDM, pre-existing diabetes complicating pregnancy is a long-term condition that persists after women have given birth.

Compared to women with GDM, pregnant women with pre-existing Type 1, Type 2 or other forms of diabetes are at much higher risk of complications throughout their pregnancy (miscarriage, hypertension, stillbirth), and their offspring are at higher risk of adverse outcomes (congenital anomalies, growth restriction or macrosomia). While there is some evidence to suggest that babies born to women with GDM have an increased risk of congenital anomalies compared to other babies, it is possible that these women may have had Type 2 diabetes misdiagnosed as GDM (Farrell et al. 2002; Correa et al. 2008).

Available estimates suggest that between 3% and 9% of Australian women develop GDM during pregnancy (Simmons et al. 2002; Hoffman et al. 1998). The Australasian Diabetes in Pregnancy Society suggests 5% of pregnancies are complicated by GDM (Hoffman et al. 1998). International estimates have the figure at around 8% of all pregnancies worldwide. However, differences in the criteria used to diagnose GDM make it difficult to compare data between countries.

Hospitalisation data show that in 2004–05 GDM was diagnosed in 4.2% of women giving birth in hospital in Australia. This equates to about 10,900 women giving birth in hospital, with more than 11,000 babies at risk of birth complications and longer-term health conditions (AIHW 2008).

International studies show that the incidence of GDM is increasing over time, aligning with an increase in the prevalence of overweight and obesity and an increase in maternal age (Ferrara 2007).

Screening and diagnosis

Public health programs to promote awareness of risk factors and the use of screening programs can affect the incidence of GDM. Screening of pregnant women for GDM may result in more women being diagnosed with the condition, while public awareness of the

risk factors and the steps that can be taken to modify these can reduce the number of women developing GDM.

GDM is a condition considered suitable for screening because:

- the population at risk (pregnant women) is quantifiable and can be screened during routine prenatal care
- many of the risk factors for GDM are known and therefore the subpopulation at high risk of GDM is identifiable
- the severity of potential complications in both mother and infant, as well as the risk of maternal conversion to Type 2 diabetes, can be reduced with treatment compliance.

The 1998 Australasian Diabetes in Pregnancy Society (ADIPS) guidelines recommend that all pregnant women be screened to identify those who need to undergo a diagnostic test for GDM. However, if resources do not allow for universal screening, then targeting women at high risk is an alternative (Hoffman et al. 1998).

Pregnant women with the following characteristics are at increased risk of GDM:

- detectable levels of glucose in their urine (glycosuria)
- age over 30 years
- being overweight (BMI > 25) or obese (BMI > 30) at the time of conception
- poor pregnancy outcome in the past
- family history of Type 2 diabetes mellitus, personal or family history of GDM or glucose intolerance
- being from an Australian Aboriginal or Torres Strait Islander background
- belonging to a high-risk ethnic group—Polynesian, Southern Asian (Indian), Middle Eastern or other Asian origin (Hoffman et al. 1998).

The recommended screening and diagnostic tests for GDM in Australia are outlined in Box 1.1. A positive screening test indicates that a woman is at risk for GDM, and a diagnostic test then needs to be performed. Women may proceed directly to the diagnostic test, especially if they display any of the 'high-risk ' characteristics listed above.

Box 1.1: Screening and diagnosis for gestational diabetes mellitus

Screening for GDM

Screening for GDM should be performed between 26–28 weeks' gestation. A positive screening test result is either:

- *50g glucose load (morning, non-fasting) with a 1 hour venous plasma glucose level 7.8 mmol/L or over, or*
- *75g glucose load (morning, non-fasting) with a 1 hour venous plasma glucose level 8.0 mmol/L or over.*

Diagnosis of GDM

Diagnostic testing for GDM can be performed between 26–30 weeks' gestation, following a positive screening test, or at any stage of pregnancy if a woman is thought to be at high risk of GDM.
A positive diagnosis of GDM is made based on a 75g oral glucose tolerance test with either:

- *fasting (0 hour) venous plasma glucose level 5.5 mmol/L or over, and/or*
- *2 hour venous plasma glucose level 8.0 mmol/L or over.*

Source: *Hoffman et al. 1998.*

Although universal screening for GDM is recommended in Australia, there are currently no national data sources available for assessing the proportion of pregnant women who are being screened.

Long-term outcomes of GDM

Around 17% of Australian women with GDM develop Type 2 diabetes within 10 years, and up to 50% within 30 years (Lee et al. 2007). It is likely, however, that due to the increasing prevalence of Type 2 diabetes and associated risk factors in the Australian population, the proportion of women with GDM converting or progressing to Type 2 diabetes is also increasing. Testing for conversion to Type 2 diabetes or continuing glucose intolerance should be carried out 6–8 weeks after a woman with GDM gives birth (see Box 1.2).

Babies who are exposed to maternal gestational diabetes in the uterus are more likely to be overweight or obese in childhood and youth, and carry a higher risk of progressing to Type 2 diabetes (Fetita et al. 2007).

Box 1.2: Follow-up testing for women with a history of gestational diabetes mellitus

Women with GDM are at increased risk of developing Type 2 diabetes. A follow-up oral glucose tolerance test (diagnostic test) should be performed about 6–8 weeks after giving birth to test whether the woman's blood glucose level is within the normal range. A positive diagnosis of diabetes is made by a 75g oral glucose tolerance test with either:

- *fasting (0 hour) venous plasma glucose level of greater than or equal to 7.0 mmol/L, and/or*
- *2 hour venous plasma glucose level of greater than or equal to 11.1 mmol/L.*

The test should be performed every three years after that to determine whether there has been a conversion or progression to Type 2 diabetes. More frequent testing may be recommended for women intending to have more children (Simmons et al. 2002). Studies indicate that conversion to Type 2 diabetes occurs in 20–50% of women within 28 years of being diagnosed with GDM (O'Sullivan 1989; Lee et al. 2007).

Source: *Hoffman et al. 1998.*

Management and control

Management of GDM, or other forms of diabetes complicating pregnancy, with good blood glucose control throughout pregnancy decreases the risk of adverse health outcomes, whereas poor glucose control increases the risk of adverse health outcomes for mother and child (Gonzalez-Quintero et al. 2007; Crowther et al. 2005). Identification of women at risk of GDM, early diagnosis and effective treatment of the condition if it arises and taking steps to maintain a healthy weight before and during pregnancy, can benefit the outcomes for both mother and child.

GDM can be managed by modifying dietary habits and increasing physical activity levels. However, due to the importance of maintaining tight control of blood glucose levels for the health of both mother and baby, insulin therapy is commonly introduced to achieve this control. Although oral glucose-lowering medications may be used in conjunction with diet and exercise to manage GDM, this is not widely practised in Australia (Simmons et al. 2002).

1.3 Data sources

Two main sources of data are used in this report: the National Hospital Morbidity Database (NHMD) and the National Diabetes Services Scheme (NDSS) database. The NHMD and NDSS were selected because they contain national data on pregnancies or individual women with diagnosed GDM. The National Perinatal Data Collection is another source of data on women with GDM. In this collection, the method of collecting data on GDM differs between each state and territory, and care should be taken when interpreting national estimates derived from this data. As a result this data source has not been included in this report. The NHMD data allow the calculation of a national estimate of GDM incidence. The NDSS provides additional information on the age and insulin treatment status of registrants diagnosed with GDM. More details of the NHMD and NDSS data, as well as the limitations of each data set, are given below.

National Hospital Morbidity Database

The NHMD is an administrative data set maintained by the AIHW. The NHMD collects information about care provided to patients admitted to Australian hospitals. Diagnostic information relevant only to the current episode of care, including conditions or disorders that affect the treatment received by the patient during the episode, are included.

The NHMD contains demographic, diagnostic, procedural and duration-of-stay information on episodes of care for patients admitted to hospital. The collection comprises comparable state and territory hospitalisation data. These data are episode-based and in most instances it is not possible to count individual patients.

It is estimated that approximately 0.2% of all births in Australia are homebirths and some may occur in private birthing centres outside the hospital system (Laws et al. 2007). As a result, these are not captured by the NHMD.

National Diabetes Services Scheme database

The NDSS is a subsidy scheme operated by Diabetes Australia Ltd for the Australian Government since 1987. The scheme subsidises the supply of insulin syringes, insulin infusion pump consumables and diagnostic reagents (blood and urine testing strips) to people with diabetes. To receive these benefits people with diabetes must register with the scheme. At registration, information regarding date of diagnosis and diabetes type (certified by a health professional) is recorded on the database. The NDSS database is therefore an administrative data collection of people with diagnosed diabetes.

It is important to note, however, that not all people with diabetes register with this voluntary scheme—particularly, but not limited to, those who manage their diabetes by exercise and diet modification alone.

Registration on the NDSS requires certification of diabetes diagnosis from a doctor or diabetes educator, detailing the type of diabetes and the requirement for insulin treatment. Despite this, it is still possible for the type of diabetes to be misclassified, especially since over time various changes have been made to the definitions of different diabetes types.

In addition, due to the administrative nature of the NDSS database, only one record is kept for each registrant and changes are made to this record over time. This affects estimates of incident cases of GDM because the practice has been to overwrite records where a diagnosis of GDM is made in subsequent pregnancies, or where a conversion to Type 2 diabetes, or re-classification to Type 1 diabetes, occurs. Therefore, care must be taken when using this data source to estimate the incidence of GDM.

It is important to note that this is the first time that this database has been used to analyse incident cases of GDM in detail. Improvements to the database over time and subsequent revisions of the methods used to access and analyse the data may impact on the comparability of future estimates of GDM derived from the NDSS.

1.4 Selection of data for this study

In our analyses, the incidence of GDM among Australian women, with analyses by age, insulin treatment status and trends over time, is based on the NHMD. Additional data on the

number of female registrants with GDM, by age and insulin treatment status come from the NDSS.

The practice of overwriting a previous diagnosis of GDM with a more recent diagnosis in a subsequent pregnancy among women registered on the NDSS means that trend analysis of the NDSS data would be unreliable and therefore it has not been included in this report.

Due to the uncertain quality of country of birth and Indigenous status information provided on the NDSS registration form, our analyses by population groups (Indigenous Australian and overseas-born) are based only on the NHMD. Before 2005, NDSS registration forms used 'non-Indigenous' as the default category when Indigenous status was not supplied. Only 1% of registrations where GDM was diagnosed from 2000 until 2005 identified as Indigenous and the remaining 99% were classified as 'non-Indigenous'. In 2005, a 'not stated' category was added to the form and represented 10% of GDM records with a diagnosis year of 2000 or later. This 'not stated' category is now the default if Indigenous status is not recorded on the NDSS registration form. Country of birth data were missing for approximately 32% of all records where GDM was diagnosed from 2000 onwards.

In the NHMD we are able to identify unique birth events, and correlate these to unique pregnancies resulting in the birth of one or more babies. Although it is possible that an individual woman gives birth more than once in a year, GDM arises in individual pregnancies and each case contributes to the overall incidence estimate. In our analyses, all birth events resulting in the delivery of one or more babies are counted in the denominator population. Birth events with a diagnosis of gestational diabetes or diabetes arising in pregnancy are counted in the numerator. The term 'confinement' is used to describe a unique pregnancy resulting in the birth of one or more babies in hospital.

The criteria for assigning a diagnosis of GDM in the NHMD are detailed in Box 1.3. Note that these criteria differ slightly from the broader definition of GDM given earlier in this chapter. In the NHMD, GDM is assigned only when glucose intolerance is diagnosed at or after 24 weeks' gestation.

Box 1.3: ***Criteria for assigning a GDM diagnosis in hospitalisations data***

The ICD-10-AM defines GDM as follows:

'Diabetes mellitus arising at or after 24 weeks gestation'(ICD-10-AM code, O24.4) is appropriate where diabetes is first detected by glucose tolerance testing according to WHO criteria during or later than the 24th week of pregnancy. Where doubt exists regarding the time of onset which may reflect undiagnosed pre-existing diabetes, such cases should be assigned code O24.9- Diabetes mellitus in pregnancy, unspecified onset.'

Source: *extract from National Centre for Classification in Health eBook, July 2006.*

Single year data in this report include confinements that occurred between 1 July 2005 and 30 June 2006. Trend data include confinements that occurred between 1 July 2000 and 30 June 2006. These data therefore include cases where GDM was diagnosed in the previous financial year, and exclude those cases diagnosed toward the end of the financial year of interest but where the confinement occurred in the following year. Date of diagnosis data are not recorded in the NHMD.

In cases where age at diagnosis is missing from NDSS data, age at registration is used as a proxy, providing age at registration is greater than or equal to 18 years (AIHW: Catanzariti et al. 2007). In 2005–06, there were three records with a diagnosis of GDM where age at

diagnosis was missing and age at registration was less than 18 years. These records were excluded from the analysis of NDSS data.

Women of child-bearing age (15–49 years) have been selected from the two data sources. While there are cases of GDM in the hospital data outside this age range, these account for less than 0.1% of births and have been excluded from the analysis.

The child-bearing age range for Aboriginal and Torres Strait Islander women used in this report is 15–44 years and for women born overseas it is 20–44 years. The excluded age groups have been suppressed for privacy reasons as the small numbers of cases in each group makes them potentially identifiable.

2 How many women in Australia develop GDM?

In 2005–06, GDM affected a total of 12,403 women aged 15–49 years giving birth in Australian hospitals. This equates to 4.6% of all hospital confinements in 2005–06 (Table 2.1). More than 12,700 babies were born to women diagnosed with GDM in this year.

In 2005–06, 9,528 female registrants on the NDSS had a new diagnosis of GDM. This equates to 77% of the incident cases of GDM recorded on the NHMD.

Table 2.1: Incidence of confinements with gestational diabetes mellitus (GDM) among women aged 15–49, 2005–06

	Confinements
Confinements with GDM	12,403
Total confinements	269,113
Per cent confinements with GDM	4.6

Note: Numerator and denominator populations defined using ICD-10-AM diagnosis codes. For method, see Chapter 1; Appendix 1: Methods

Source: AIHW National Hospital Morbidity Database.

2.1 Age distribution

The likelihood of developing GDM increases with age. Insulin resistance increases both with age and in response to pregnancy hormones. Although the reason for age-related insulin resistance is unclear, it is possible that pregnancy-induced insulin resistance could be compounded by advanced maternal age (Buchanan et al. 2005).

In 2005–06 the proportion of confinements with GDM increased with age from 1.3% in the 15–19 year age group to 13.2% among women aged 45–49 years (Table 2.2).

Women aged 30–34 years had the highest number of GDM cases in 2005–06, with 36% of all GDM confinements. This was also the peak age for giving birth, accounting for 34%of all hospital births during 2005–06.

Table 2.2: Incidence of confinements with gestational diabetes mellitus (GDM), by age group, 2005–06

Age group (years)	Number of confinements with GDM	Total number of confinements	GDM as proportion of total confinements (%)	Proportion of confinements with GDM by age (%)
15–19	156	11,626	1.3	1.3
20–24	887	39,357	2.3	7.2
25–29	2,693	71,690	3.8	21.7
30–34	4,488	90,390	5.0	36.2
35–39	3,306	46,944	7.0	26.7
40–44	824	8,734	9.4	6.6
45–49	49	372	13.2	0.4
Total	**12,403**	**269,113**	**4.6**	**100.0**

Note: Numerator and denominator populations defined using ICD-10-AM diagnosis codes. For method, see Chapter 1; Appendix 1: Methods.

Source: AIHW National Hospital Morbidity Database.

More than 9,500 females aged 15–49 years registered with the NDSS had a new diagnosis of GDM in 2005–06 (Table 2.3). Nearly two-thirds (63%) of GDM registrants were aged 30–39 years.

Very high proportions of all female registrants aged 25–34 years had GDM—nearly 9 out of 10 female registrants in this age group were diagnosed with GDM in 2005–06. In contrast, less than half of female NDSS registrants aged 15–19 years (41%), barely 32% of those aged 40–44 years and only 2% of those aged 45–49 years were diagnosed with GDM in 2005–06.

GDM was the most common type of diabetes among female NDSS registrants aged 15–39 years, whereas Type 2 diabetes was more common among women aged 40 years and over.

Table 2.3: Proportion of gestational diabetes mellitus (GDM) cases among women registered with the National Diabetes Services Scheme (NDSS), by age group, 2005–06

Age group (years)	Registrants with GDM	Total female registrants	GDM as a proportion of total registrants (%)	Proportion of GDM registrants by age (%)
15–19	121	292	41.4	1.3
20–24	715	934	76.6	7.5
25–29	2,101	2,443	86.0	22.1
30–34	3,520	4,054	86.8	36.9
35–39	2,442	3,325	73.4	25.6
40–44	592	1,873	31.6	6.2
45–49	37	1,948	1.9	0.4
Total	**9,528**	**14,869**	**64.1**	**100.0**

Note: For method, see Appendix 1: Methods.

Source: National Diabetes Services Scheme de-identified data (Data at June 2007).

2.2 Management of GDM

Australian hospitalisation data do not indicate how many GDM confinements were managed with diet and exercise, and/or oral medications, but data are available for those that were insulin-treated. It is not possible to determine from those data how women who did not use insulin managed their GDM.

Overall, more women with GDM aged 15–49 years had their diabetes managed using non-insulin treatments (58%) than those whose diabetes was managed with insulin therapy (32%). Ten per cent of women with GDM did not have their insulin treatment status recorded in the NHMD in 2005–06. In 2005–06, the proportion of confinements with GDM that were treated with insulin increased with age (Table 2.4). Older women with GDM were more likely to be treated with insulin than younger women: 45% of women aged 45–49 years were insulin-treated, compared with 26% of women aged 15–19 years.

Table 2.4: Number and proportion of confinements with gestational diabetes mellitus (GDM), by insulin use status, 2005–06

	Number				Per cent	
Age group (years)	Insulin-treated	Non insulin-treated	Unspecified	Total GDM	Insulin-treated	Non insulin-treated
15–19	41	98	17	156	26.3	62.8
20–24	229	561	97	887	25.8	63.2
25–29	795	1,617	281	2,693	29.5	60.0
30–34	1,415	2,622	451	4,488	31.5	58.4
35–39	1,108	1,849	349	3,306	33.5	55.9
40–44	320	439	65	824	38.8	53.3
45–49	22	22	5	49	44.9	44.9
Total	**3,930**	**7,208**	**1,265**	**12,403**	**31.7**	**58.1**

Note: Insulin treatment status defined using ICD-10-AM diagnosis codes. For method, see Appendix 1: Methods.

Source: AIHW National Hospital Morbidity Database.

As found in the 2005–06 hospitalisation data, the proportion of female NDSS registrants with GDM who were treated with insulin increased with age. Overall, 30% of female registrants aged 15–49 years diagnosed with GDM in 2005–06 were treated with insulin, compared with 70% who were not. The proportion of female NDSS registrants using insulin to manage their GDM ranged from 17% among those aged 15–19 years, to 38% among the 45–49 year age group (Table 2.5).

Table 2.5: Number and proportion of gestational diabetes mellitus (GDM) cases among women registered on the National Diabetes Services Scheme (NDSS), by insulin use status, 2005–06

	Number			Per cent	
Age group (years)	Insulin-treated	Non insulin-treated	Total GDM	Insulin-treated	Non insulin-treated
15–19	21	100	121	17.4	82.6
20–24	195	520	715	27.3	72.7
25–29	569	1,532	2,101	27.1	72.9
30–34	1,051	2,469	3,520	29.9	70.1
35–39	764	1,678	2,442	31.3	68.7
40–44	207	385	592	35.0	65.0
45–49	14	23	37	37.8	62.2
Total	**2,821**	**6,707**	**9,528**	**29.6**	**70.4**

Note: For method, see Appendix 1: Methods.

Source: National Diabetes Services Scheme de-identified data (Data at June 2007).

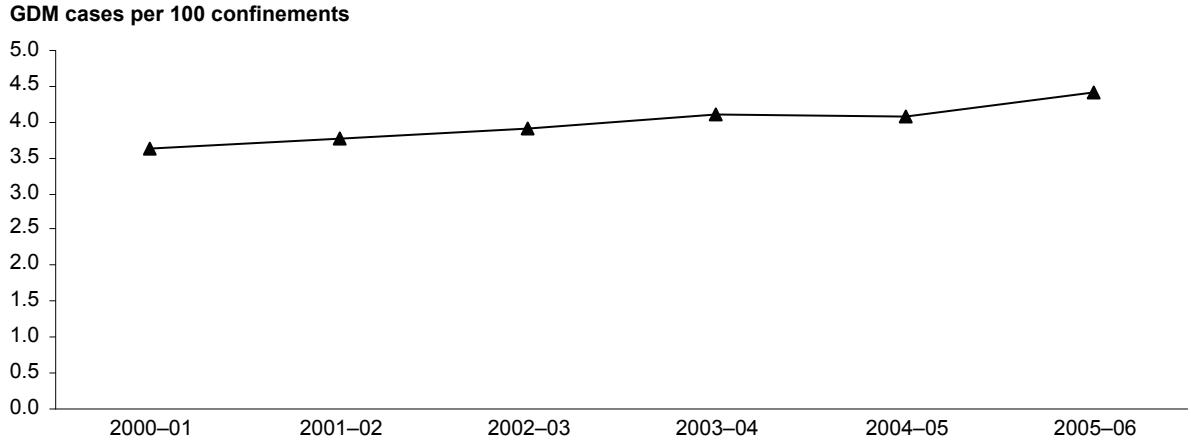
Among more than 2,800 registrants with insulin-treated GDM, 98% used insulin injections to manage their condition. The remaining 2% of GDM registrants did not have the type of insulin administration route recorded.

A comparison of insulin status between the two data sources shows that there is greater agreement in the number of cases of non insulin-treated GDM (93% agreement) than for insulin-treated GDM cases (73% agreement).

2.3 Trend

An important aspect of disease monitoring is to determine whether the incidence of the disease is increasing, decreasing or remaining stable over time. This information is useful for risk factor intervention and modification programs, for screening programs and for the provision of treatment services.

The age-standardised incidence rate of confinements with GDM among women aged 15–49 years increased by 22% over 6 years: from 3.6 per 100 confinements in 2000–01 to 4.4 per 100 confinements in 2005–06 (Figure 2.1, Table A2.1).



Note: Directly age-standardised to the 2000–01 confinement population aged 15–49 years. For method, see Appendix 1: Methods.

Source: AIHW National Hospital Morbidity Database.

Figure 2.1: Incidence rate of confinements with gestational diabetes mellitus (GDM) among women aged 15–49 years, 2000–01 to 2005–06

Over the period 2000–01 to 2005–06, the GDM confinement rate increased from 2.4% to 3.1% among women aged 15–29 years, and from 4.9% to 5.8% among women aged 30–49 years (Table A2.2).

3 GDM among population groups

Women from an Aboriginal and/or Torres Strait Islander background or born overseas—in particular Polynesia, Southern Asia, the Middle East and other Asian countries—are at increased risk of developing GDM during pregnancy. This chapter presents the incidence of GDM among women from these population groups, based on hospitalisation data.

3.1 Aboriginal and Torres Strait Islander women

Aboriginal and Torres Strait Islander women are at particular risk of developing GDM (Hoffman et al. 1998). Further, there is evidence to suggest that Aboriginal and Torres Strait Islander people have difficulty accessing and utilising health care services, compared to other Australians. Lack of local services, travel distance, lack of transport, cost of health care and language or cultural differences may all contribute to Indigenous Australian women not accessing appropriate health care for the treatment of diabetes when needed (ABS and AIHW 2008).

These factors, combined with higher rates of overweight and obesity, more births per mother and a propensity towards developing diabetes, place Aboriginal and Torres Strait Islander women at higher risk of GDM and their babies at greater risk of associated complications.

While it is known that there are different levels of risk for developing GDM for women who identify as Aboriginal compared with Torres Strait Islander or both Aboriginal and Torres Strait Islander, small numbers have forced us to present these data by the broader groupings of Indigenous Australians and Other Australians (non-Indigenous Australians and those with Indigenous status not stated). Almost 9 out of 10 confinements among Indigenous Australian women were for women who identified as being Aboriginal (88%), only 8% identified as Torres Strait Islander and 4% as both Aboriginal and Torres Strait Islander origin.

Due to the younger average age of Indigenous mothers, the age range used for the analysis in this chapter is 15–44 years. While some Indigenous women with GDM who gave birth in hospital in the period of interest were aged 45–49 years, their numbers were very small and they have been excluded from the analysis. This has not affected the overall rates.

Due to limitations in the collection of Indigenous status information, only hospitalisations in New South Wales, Victoria, Queensland, Western Australia, South Australia and from public hospitals in the Northern Territory have been included in the single year analysis for 2005–06.

In 2005–06, 440 Aboriginal and/or Torres Strait Islander women from these jurisdictions aged 15–44 years who gave birth in hospital were diagnosed with GDM. This equated to 4.8% of Indigenous Australian women who gave birth in hospitals in the six jurisdictions in 2005–06 (Table 3.1). The Australian Indigenous population is much younger than the non-Indigenous population and, when the different age structures of the two populations are taken into consideration, the incidence of GDM among Indigenous Australian women was 1.5 times that among Other Australian women in 2005–06.

Table 3.1: Incidence of confinements with gestational diabetes mellitus (GDM) among women aged 15–44 years, by Indigenous status, 2005–06[a]

	Number	Per cent	Standardised incidence ratio[b]
Indigenous Australian women[c]	440	4.8	1.5
Other Australian women[d]	11,502	4.6	1.0

(a) Data are for hospitalisations in New South Wales, Victoria, Queensland, Western Australia, South Australia and public hospitals in the Northern Territory only. These data are not necessarily representative of the other jurisdictions, or Australia as a whole.

(b) Indirectly age-standardised to the Other Australian confinement population aged 15–44 years. The standardised incidence ratio (SIR) of actual GDM cases compared to the expected number of GDM cases among Indigenous Australian population groups is based on the age-specific rate of Other Australian women. For methods, see Appendix 1: Methods.

(c) Includes women who identify as Aboriginal, Torres Strait Islander, and both Aboriginal and Torres Strait Islander.

(d) Includes both non-Indigenous Australian women and records with a missing/not stated Indigenous status.

Source: AIHW National Hospital Morbidity Database.

Age distribution

Women aged over 30 years are at increased risk of developing GDM. This is also the case for Indigenous Australian women. One major difference between Indigenous Australian and Other Australian women is the age distribution of confinements. The median age of child-bearing among Indigenous Australian women in 2001–2004 was 25 years—five years younger than among Other Australian women (30 years) (AIHW: Leeds et al. 2007).

In 2005–06, the incidence of confinements with GDM increased with age for both the Indigenous Australian and Other Australian populations. The proportion of confinements with GDM among Indigenous Australian women increased from just over 1% among 15–19 year olds to nearly 13% among women aged 40–44 years. Similarly, 1% of Other Australian women aged 15–19 years had a diagnosis of GDM, increasing to almost 10% among women aged 40–44 years (Table 3.2).

Table 3.2: Proportion of confinements with gestational diabetes mellitus (GDM), by age group and Indigenous status, 2005–06[a]

	Age group (years)					
	15–19	20–24	25–29	30–34	35–39	40–44
	Per cent					
Indigenous Australian women[b]	1.4	3.2	4.8	8.7	12.3	12.8
Other Australian women[c]	1.4	2.2	3.8	5.0	7.0	9.5

(a) Data are for hospitalisations in New South Wales, Victoria, Queensland, Western Australia, South Australia and public hospitals in the Northern Territory only. These data are not necessarily representative of the other jurisdictions, or Australia as a whole.

(b) Includes Aboriginal, Torres Strait Islander, and both Aboriginal and Torres Strait Islander women.

(c) Includes both non-Indigenous Australian women and records with a missing/not stated Indigenous status.

Source: AIHW National Hospital Morbidity Database.

While the incidence of GDM increased with age in both the Indigenous Australian and Other Australian populations, the distribution of GDM confinements was quite different, reflecting the younger maternal age of Indigenous women. Indigenous women aged 25–29 years had similar risk to Other Australian women aged 30–34 years (4.8% and 5.0%, respectively) and

Indigenous women aged 30–34 years had a higher risk of GDM than Other Australian women aged 35–39 years (8.7% and 7.0%, respectively).

Fifty-one per cent of GDM confinements and 77% of all confinements among Indigenous Australian women in 2005–06 occurred among women aged 15–29 years. The corresponding proportions among Other Australian women were 30% and 44%(Table A2.3).

Management of GDM

In 2005–06, the proportion of women with GDM who were treated with insulin was similar for Indigenous Australian and Other Australian women (30%) (Table 3.3). There was no difference in rates between the two populations when the younger age structure of the Indigenous Australian population was taken into consideration.

Table 3.3: Incidence of confinements with gestational diabetes mellitus (GDM), by insulin use and Indigenous status, 2005–06[(a)]

	Insulin-treated	Non insulin-treated	Unspecified	Total
		Number		
Indigenous Australian women[(b)]	128	272	40	**440**
Other Australian women[(c)]	3,626	6,702	1,174	**11,502**
		Per cent		
Indigenous Australian women[(b)]	29.1	61.8	9.1	**100.0**
Other Australian women[(c)]	31.5	58.3	10.2	**100.0**

(a) Data are for hospitalisations in New South Wales, Victoria, Queensland, Western Australia, South Australia and public hospitals in the Northern Territory only. These data are not necessarily representative of the other jurisdictions, or Australia as a whole.

(b) Includes Aboriginal, Torres Strait Islander, and both Aboriginal and Torres Strait Islander women.

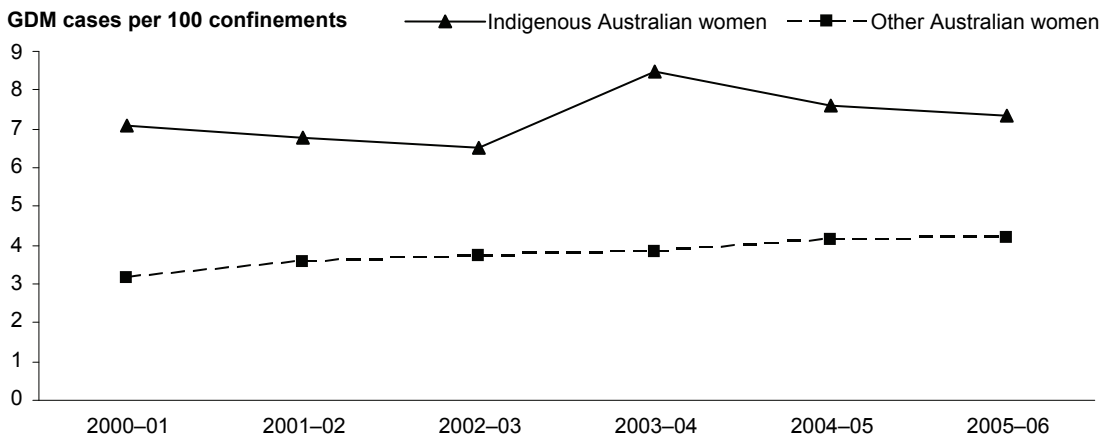
(c) Includes both non-Indigenous Australian women and records with a missing/not stated Indigenous status.

Source: AIHW National Hospital Morbidity Database.

Trend

While single-year data for 2005–06 presented earlier in this chapter combine data from six jurisdictions, data from only four jurisdictions—Queensland, Western Australia, South Australia and the Northern Territory—can be used in the time series analysis between 2000–01 and 2005–06. This is because Indigenous status data from New South Wales and Victoria before 2004–05 are not considered reliable.

Data from the NHMD show no consistent trend in the incident rate of confinements with GDM among Indigenous Australian women aged 15–44 years over the six-year period. In contrast, the incident rate of confinements with GDM among Other Australian women aged 15–44 years in the four jurisdictions steadily increased over the six-year period, from 3.2% to 4.2% between 2000–01 and 2005–06 (Figure 3.1, Table A2.4). As a result of this, the disparity in the incidence of GDM between Indigenous Australian and Other Australian women appears to be decreasing slightly.



Notes

1. Data are for hospitalisations in Queensland, Western Australia, South Australia and public hospitals in the Northern Territory only. These data are not necessarily representative of the other jurisdictions, or Australia as a whole.

2.Directly age-standardised to the 2000–01 Other Australian confinement population aged 15–44 years. For method, see Appendix 1: Methods.

3. Indigenous Australian includes Aboriginal, Torres Strait Islander, and both Aboriginal and Torres Strait Islander women.

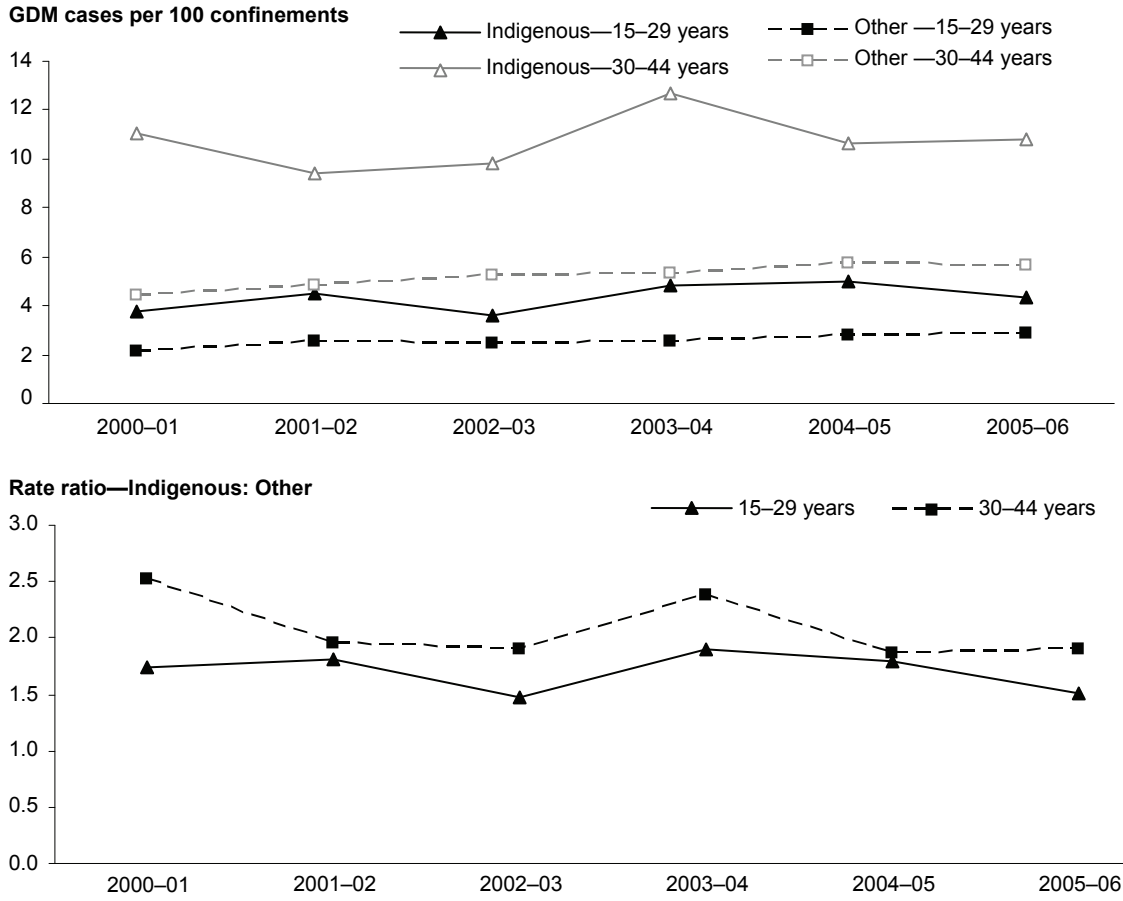
4. Other Australian women includes both non-Indigenous Australian women and records with a missing/not stated Indigenous status.

Source: AIHW National Hospital Morbidity Database.

Figure 3.1: Standardised incidence rate of confinements with gestational diabetes mellitus (GDM) among women aged 15–44 years, by Indigenous status, 2000–01 to 2005–06

The incidence of GDM confinements among Indigenous women aged 15–29 years ranged from 1.5 to 1.9 times that among Other Australian women over the 6 years from 2000–01 to 2005–06. However, the disparity in the incidence of GDM between the two populations is most apparent among women aged 30–44 years where the rate of GDM confinements among Indigenous women was between 1.9 and 2.5 times that among Other Australian women (Figure 3.2, Table A2.5).

There was no discernible trend in the incidence of confinements with GDM among Indigenous Australian women aged 30–44 years, ranging from 11.0% in 2000–01 and 10.8% in 2005–06 with peaks and troughs in between. Among Other Australian women there was a definite increasing trend—from 4.4% in 2000–01 to 5.7% in 2005–06 (Figure 3.2).



Notes

1. Data are for hospitalisations in Queensland, Western Australia, South Australia and public hospitals in the Northern Territory only. These data are not necessarily representative of the other jurisdictions, or Australia as a whole.

2. Directly age-standardised to the Other Australian confinement population aged 15–29 years or 30–44 years. The rate ratio compares the rate of GDM among Indigenous Australian women in each age group with the rate of GDM among Other Australian women in each age group. For methods, see Appendix 1: Methods.

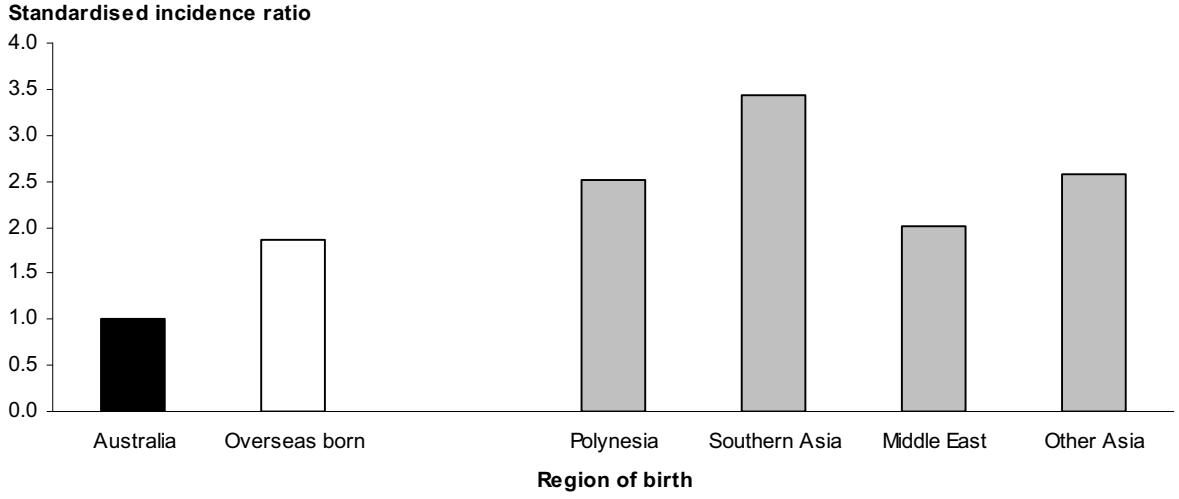
Source: AIHW National Hospital Morbidity Database.

Figure 3.2: Incidence of confinements with gestational diabetes mellitus (GDM), by Indigenous status and broad age group, 2000–01 to 2005–06

3.2 Women born overseas

As a group, women born overseas have a higher risk of GDM than women born in Australia. Further, it is known that women from certain ethnic backgrounds are more likely to develop GDM, including Polynesian, South Asian (Indian), Middle-Eastern or other Asian background (see Chapter 1). Although data on ethnicity are not commonly collected in Australia, country of birth (grouped into regions for this report) is used as a proxy measure for ethnicity.

In 2005–06, there were about 7,400 confinements with GDM among women born in Australia and just over 4,600 among women born overseas. When the different age structures of the populations were considered, women born overseas had nearly twice the incidence rate of confinements with GDM as women born in Australia (Figure 3.3). Among women born in the four regions with the highest risk of GDM—Polynesia, Southern Asia (Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka), the Middle East and other Asian countries—the age-adjusted incidence rate was closer to three times that of women born in Australia. The bulk of this burden can be attributed to confinements among women born in Southern Asia, with more than three times the age-adjusted incidence rate of GDM compared to women born in Australia. Women born in the Middle East, Polynesia and other Asian countries had 2.0, 2.5 and 2.6 times the rate of GDM, respectively, compared to women born in Australia.



Notes

1. Indirectly age-standardised to the Australian-born confinement population aged 20–44 years. Standardised incidence ratio (SIR) of actual GDM cases compared to the number of expected GDM cases in each region of birth, based on the age-specific rate among Australian-born women. For methods, see Appendix 1: Methods.

2. Country of birth was not adequately defined in 162 records in the numerator and 5,717 records in the denominator. These have been excluded from the analysis.

3. For countries included in each region of birth, see Appendix 1: Methods.

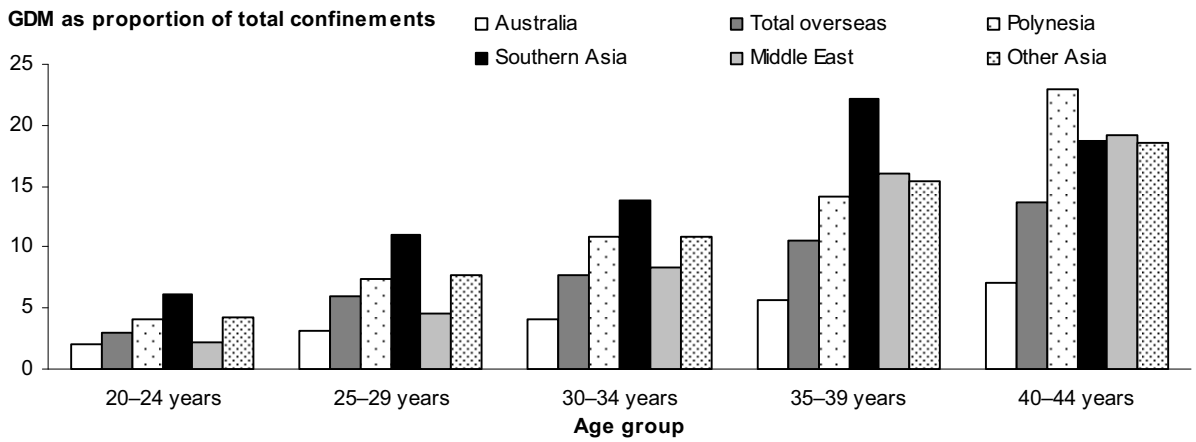
Source: AIHW National Hospital Morbidity Database.

Figure 3.3: Standardised incidence ratio of confinements with gestational diabetes mellitus (GDM) among women aged 20–44 years, by selected region of birth, 2005–06

Age distribution

In 2005–06, there was a general trend of increasing incidence of GDM with increasing age among the Australian-born and four high-risk overseas-born populations (Figure 3.4). Among women aged 20–24 years the age-specific rates of GDM ranged from 2% to 6% of confinements across the regions of birth. GDM incidence peaked at age 40–44 years with age-specific rates ranging from 7–23% for all regions of birth except Southern Asia, where the age group with the highest risk of GDM was 35–39 years (22%).

As with women born in Australia, the highest proportion of GDM confinements among women born in Polynesia, Southern Asia, the Middle East and other Asian countries occurs in women aged 30 years and over. In 2005–06, between 63% and 77% of GDM cases among women born in high-risk regions were in women aged 30–44 years.



Notes

1. Country of birth was not adequately defined in 162 records in the numerator and 5,717 records in the denominator. These have been excluded from the analysis.

2. For countries included in each region of birth, see Appendix 1: Methods.

Source: AIHW National Hospital Morbidity Database.

Figure 3.4: Proportion of confinements with gestational diabetes mellitus (GDM) among women aged 20–44 years, by selected region of birth, 2005–06

Management of GDM

In 2005–06, the majority of GDM cases were not treated with insulin, with similar rates for Australian-born (58%) and overseas-born (59%) women. Among women born in high-risk regions, only those born in 'other Asian' countries had a higher proportion of GDM that was not treated with insulin (64.5%) compared to women born in Australia (Table 3.4).

Women born in 'other Asian' countries also had the lowest proportion of GDM treated with insulin at 27%, compared to about 40% for women born in Polynesia, Southern Asia (India) and the Middle East and 31% for women born in Australia.

Table 3.4: Incidence of confinements with gestational diabetes mellitus (GDM) among women aged 20–44 years, by insulin use and region of birth, 2005–06

Region of birth	Insulin-treated	Non insulin-treated	Unspecified	Total
		Number		
Australia	2,316	4,260	818	**7,394**
Total overseas-born	1,508	2,734	400	**4,642**
Polynesia	93	124	13	**230**
Southern Asia	255	323	44	**622**
Middle East	156	195	30	**381**
Other Asia	503	1,220	168	**1,891**
		Per cent		
Australia	31.3	57.6	11.1	**100.0**
All overseas-born	32.5	58.9	8.6	**100.0**
Polynesia	40.4*	53.9	5.7	**100.0**
Southern Asia	41.0*	51.9	7.1	**100.0**
Middle East	40.9*	51.2	7.9	**100.0**
Other Asia	26.6*	64.5*	8.9	**100.0**

* significantly different compared to Australian-born women.

Notes

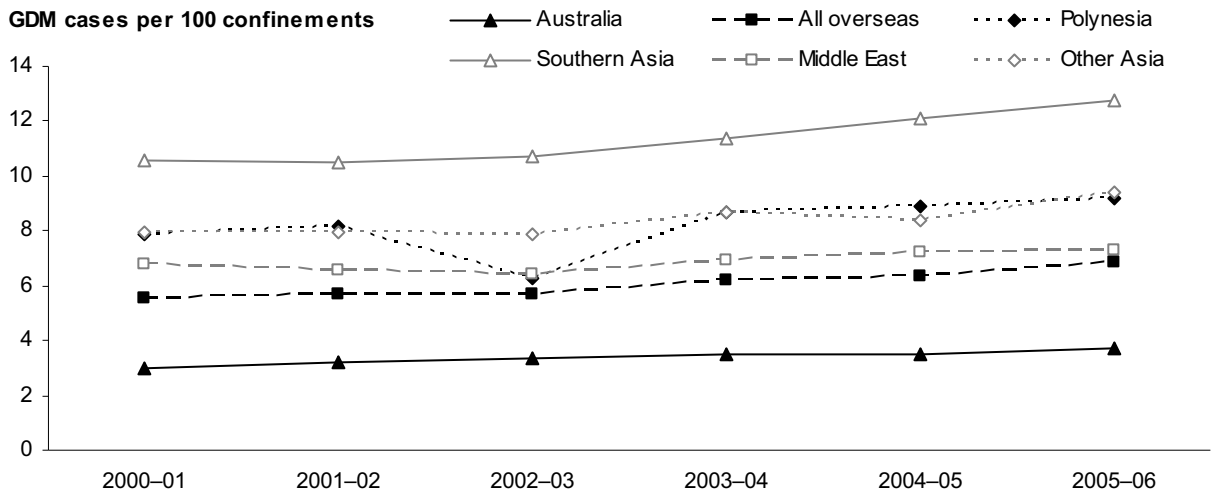
1. Country of birth was not adequately defined in 162 records in the numerator and 5,717 records in the denominator. These have been excluded from the analysis.
2. For countries included in each region of birth, see Appendix 1: Methods.

Source: AIHW National Hospital Morbidity Database.

Trend

Between 2000–01 and 2005–06, there was a steady increase in the incidence of GDM among women aged 20–44 years across all regions of birth (Figure 3.5).

Over that period there was a similar proportional increase in GDM incidence among women born in Australia (23%) and those born overseas (24%). Among the higher risk regions, the greatest proportional increase in GDM incidence occurred for women born in Southern Asia (20%), other Asia (19%) and Polynesia (16%). There was a smaller change over the 6-year period for women born in the Middle East (8%) (Figure 3.5, Table A2.6).



Notes

1. Directly age-standardised to the Australian-born confinement population aged 15–49 years. For method, see Appendix 1: Methods.
2. For excluded numerator values by year, see Appendix 2: Supplementary tables.
3. For countries included in each region of birth, see Appendix 1: Methods.

Source: AIHW National Hospital Morbidity Database.

Figure 3.5: Standardised incidence of confinements with gestational diabetes mellitus (GDM) among women aged 20–44 years, by selected region of birth, 2000–01 to 2005–06

4 Discussion and conclusions

This report presents current data and trends on the incidence of gestational diabetes mellitus among Australian women. By doing so, it aims to address gaps in the information available on this subject, particularly among established high-risk groups. The report specifically seeks to determine the number of Australian women with gestational diabetes, the peak age for developing the condition, the changing incidence of GDM over time, the population groups at highest risk, and the proportion of GDM cases treated with insulin.

4.1 All Australian women

In 2005–06, just over 12,400 (4.6%) hospital confinements among women aged 15–49 years had a diagnosis of GDM. In the same year, more than 9,500 women registered with the NDSS had a new diagnosis of GDM.

The risk of GDM increased with age to 13% of confinements among women aged 45–49 years. The number of new GDM cases was highest among women aged 30–34 years—accounting for 36% of confinements with GDM and 87% of GDM registrations on the NDSS.

Approximately one-third of confinements with GDM and women with GDM registered on the NDSS were treated with insulin. The proportion of GDM cases treated with insulin increased with age.

Between 2000–01 and 2005–06 the incidence of confinements with GDM increased by 22%. The finding of a 30% increase in GDM over time among women aged 15–29 years, compared to 18% among older women, is important given that the criteria for high risk screening includes 'age over 30 years' and that women aged less than 25 are not considered at risk (Hoffman et al 1998; ADA 2003).

4.2 Aboriginal and Torres Strait Islander women

Studies have shown that pregnant women of Aboriginal and/or Torres Strait Islander origin are at high risk of developing GDM. In 2005–06, the age-standardised incidence of GDM among Indigenous women aged 15–44 years was 1.5 times that of Other Australian women, for confinements in New South Wales, Victoria, Queensland, Western Australia, South Australia and the Northern Territory.

However, from 2000–01 to 2005–06 there was no discernible trend in the incidence rate of GDM among Indigenous Australian women in Queensland, Western Australia, South Australia and the Northern Territory, while the incidence rate of GDM is steadily increasing among Other Australian women. Despite the disparity in GDM incidence rates between the two populations appearing to decrease slightly over time, the incidence of GDM among Indigenous Australian women remains high at around twice the rate among Other Australian women, in the four jurisdictions. The disparity in the incidence of GDM between Indigenous Australian and Other Australian women over time is greater among women aged 30–44 years than among women aged 15–29 years.

While Indigenous women aged 30–44 years are at significantly greater risk of GDM compared to Other Australian women, a higher proportion of confinements with GDM in 2005–06 occurred among Indigenous women aged 15–29 years (51%) compared to Other Australian women (30%). These results reflect the younger age profile, younger maternal age and greater predisposition to glucose intolerance of the Indigenous Australian population compared to the Other Australian population. The public health implication of this finding is that GDM screening and lifestyle modification programs to maintain a healthy weight may need to target younger Indigenous Australian women, where the greater number of GDM cases arise.

4.3 Women born overseas

The literature shows that women from a Polynesian, Southern Asian, Middle Eastern or other Asian ethnic background are at higher risk of developing GDM during their pregnancies. While the data from the NHMD support this, there are some differences in which region of birth has the highest rates of GDM.

Australian literature cites women from a Polynesian and Southern Asian (Indian) background as having the highest risk of GDM (Hoffman et al. 1998). In 2005–06, women born in Southern Asia had the highest risk of GDM—3.4 times that of Australian-born women. Women born in Polynesia or in the Middle East had 2.6 times the risk of GDM of Australian-born women.

Reasons for this difference may relate to the means by which 'ethnicity' has been defined in each of the data sources. The NHMD contains information on country of birth, and this measure has been identified as an acceptable proxy for ethnicity, although it is by no means ideal nor complete. Genetic background, language, food choices, length of residence in Australia, cultural understanding of health and, in the case of GDM, access to appropriate antenatal care and GDM screening, all influence the level of risk of developing the condition. The country a person is born in may be indicative of the former aspects of culture and ethnicity, however it is not definitive and the use of this single variable may result in different findings to those referenced in the literature. Changing patterns of emigration may also influence the comparability of results between studies and over time.

Additionally, the ADIPS guidelines included findings from research conducted in New Zealand, where a higher proportion of the population identify as being of Polynesian background—3.3% compared to 0.4% in Australia (Statistics New Zealand 2008). This difference in ethnic diversity between Australia and New Zealand may account for some of the difference between the findings in this report and those reported in the ADIPS management guidelines.

4.4 Other women at risk of GDM

This analysis indicates that although age and ethnicity are clearly associated with a higher incidence of GDM, many women who do not fall into these high-risk groups also develop the condition. Of the 11,791 confinements with GDM in New South Wales, Victoria, Queensland, Western Australia, South Australia and the Northern Territory, 2,109 (18%) women did not fit into a high-risk age or ethnic group (Table A2.7). That is, these women were Australian-born, did not identify as being of Aboriginal and/or Torres Strait Islander origin and were aged less than 30 years.

Hospitalisation data does not enable analysis of GDM incidence among Australian women by all risk factors. While it is known that some women who develop GDM do not have any identifiable risk factors, it is possible that these women, who appear to be 'low-risk' based on the data available in the NHMD, may have a family history of diabetes, be overweight or obese, or have another of the known risk factors for GDM, such as polycystic ovary syndrome and excessive weight gain during pregnancy.

4.5 Data issues

Data coverage and data gaps

In this report we have identified incident cases of GDM among Australian women from two data sources: the NHMD and the NDSS.

The number of women diagnosed with GDM differs between the data sources, with just over 12,400 in the NHMD and close to 9,500 in the NDSS. The NDSS estimate equates to 77% of the NHMD estimate. There is also a difference in estimates by insulin treatment status: the NDSS has 72% of the insulin-treated GDM cases in the NHMD, and 93% of those not treated with insulin. The NHMD reported 'unspecified' insulin treatment status for 10% of the total confinements with GDM.

Each of the two data sources analysed in this report has its strengths. For example, the NHMD is associated with ICD-10-AM birth event and diagnosis codes and complete dates for each episode, while the NDSS does not have any missing insulin status data and identifies a diagnosis date. Each provides a different part of the whole picture of GDM in Australia. The fundamental differences in the collections and their coverage, however, make it difficult to compare the two, and, although the NHMD population is larger than the NDSS population, there are some issues with coverage.

It is estimated that approximately 0.2% of all births in Australia are home-births and some may occur in private birthing centres outside of the hospital system (Laws et al. 2007). This small proportion of births are not captured by the NHMD and therefore not counted among the confinement population studied in this report. However, it is unlikely that they include women diagnosed with GDM as pregnancies complicated with GDM are considered to be at high risk for labour complications, where hospital-based delivery is advisable.

Further to this, the data contained in this report are based on counts of diagnosed cases of GDM. In the absence of universal screening it is possible that some pregnant women have undiagnosed GDM. As a consequence it is possible that the incidence of GDM among Australian women presented in this report is an underestimate (Stone et al. 2002).

The method of collection and counting diagnoses of GDM differs between the two data sources. The NHMD method allows the enumeration of unique pregnancies complicated by GDM. In contrast, the NDSS contains a single record per female registrant and does not currently allow for the identification of unique GDM diagnosis events. The current practice is to overwrite the initial record created when a woman with GDM first registers with the NDSS with subsequent diagnoses of GDM. This will affect a small number of cases where a woman has two pregnancies complicated by GDM in a 12-month period and a more substantial number of cases where a woman registers with subsequent diagnoses of GDM in the years following the first diagnosis. In any given year, this will have an effect on numbers compared to the NHMD and will introduce a source of error in the calculation of time trends

from the NDSS data. For this reason time series analysis of NDSS data has not been included in this report.

Comparability of data sources

In this report, the number of hospital confinements with a diagnosis of GDM among women aged 15–49 years has been used to estimate the incident GDM population. In 2005–06 this number was 12,403.

The number of women with GDM registering with the NDSS reflects the choice of individual women to register, and provides an indication of service uptake and, in the case of insulin status data, management practices. In 2005–06, 9,528 women with GDM aged 15–49 years registered with the NDSS.

It therefore appears that 77% of women diagnosed with GDM in 2005–06 who gave birth in hospital also registered for subsidised products with the NDSS (Table A2.8). The lowest rate of registration was among the 40–44 year age group (72%) and the highest was among 20–24 year olds (81%).

There are a number of possible reasons for the difference between the number of confinements with GDM and the number of women with GDM registering with the NDSS:

- the short duration of the condition did not warrant registration
- lack of awareness of the NDSS and the benefits of registration
- overwriting of GDM records on the NDSS in the following year (2006–07)
- management of the condition through diet and exercise decreased the need for NDSS subsidised products
- frequent hospitalisation and use of hospital or privately subsidised products for management of the condition decreased the need for NDSS subsidised products
- incorrect recording of GDM as Type 2 diabetes on the NDSS registration form
- diagnosis of GDM in confinements among women with pre-existing Type 1 or Type 2 diabetes
- change in management between diagnosis (NDSS) and delivery (NHMD).

It is likely that much of the 23% difference in the number of confinements with GDM and the number of women with GDM registering with the NDSS could be attributed the voluntary nature of registration with the NDSS, the short duration of GDM and associated treatment programs and the issue of overwriting of GDM records on the NDSS.

The difference observed in the number of insulin-treated GDM cases in the NHMD and among NDSS registrants warrants further investigation. Although there were no missing values for the insulin status variable in the NDSS data set, it does not appear to represent complete coverage of insulin-treated GDM cases among Australian women. Changes in the management of GDM between registration with the NDSS and admission to hospital around the time of delivery may account for the difference in the insulin treatment status between NDSS registrants and hospital confinements.

4.6 Future work

In this report we have addressed the key GDM risk factors of age, Indigenous status and ethnic origin. The incidence of short- and longer-term complications of GDM among women and their babies has not been a focus of this report. Future planned work of the National Centre for Monitoring Diabetes will address the issue of adverse outcomes and complications among women and their babies affected by all forms of diabetes complicating pregnancy, including GDM.

4.7 Conclusions

This report has shown that 4.6% of confinements among Australian women of childbearing age had a diagnosis of gestational diabetes mellitus in 2005–06. The incidence of GDM is on the rise, increasing steadily between 2000–01 and 2005–06. The risk of developing GDM increased with age and, compared to the overall Australian female population, it was higher among women of Aboriginal and/or Torres Strait Islander origin and women born in Southern Asia, Polynesia, other Asian countries and the Middle East.

Appendix 1: Methods

Incidence

Incidence refers to the number of new cases (of a disease, condition or event) occurring in a population during a given period. Incidence rate is calculated by dividing the number of new cases in a given period by the population at risk in the same period and expressed as the number of cases per a given population base (for example, per 100 or 1000). In this report, the incidence of GDM was calculated from NHMD and NDSS data.

Calculating GDM incidence from NHMD data

The number of new cases of GDM (numerator) was calculated based on the number of hospitalisations of females with a birth event code (Z37) and coexisting diagnosis of GDM (O244) in the year of interest. A single birth event code is entered for each woman, regardless of the number of times she is hospitalised during the same pregnancy or the number of babies born. As a result, this method counts unique pregnancies complicated by GDM resulting in a hospital birth, referred to throughout this report as a 'confinement'.

The population at risk of GDM (denominator population) was based on the number of hospitalisations with a birth event code (Z37) in the year of interest. For the same reasons as detailed above, this method captures the number of confinements.

All confinements, regardless of outcome (that is, stillbirth or live birth) are counted by this method.

The numerator, hospital confinements with GDM, were divided by the denominator population, total hospital confinements, to give the proportion of confinements complicated by GDM in the year of interest.

Calculating incident cases of GDM from NDSS data

The number of new cases of GDM was calculated based on the number of female registrants on the NDSS who had been diagnosed with GDM in the year of interest. If a diagnosis date was not provided, the date of registration was used as a proxy.

Age-standardisation

Two methods of age-standardisation, direct and indirect, were used in this report to eliminate the effect of differences in age structures when comparing rates for different populations and periods of time.

Direct age-standardisation

Direct age-standardisation applies the age-specific rates to a 'standard population' in order to determine the rate that would have occurred in the standard population. This allows direct comparison of different rates applied to the same standard population. The standard populations are detailed in Table A1.1.

The method used for the calculation of directly standardised age-standardised rates consists of three steps, as described below:

Step 1: Calculate the age-specific rate for each age group.

Step 2: Calculate the expected number of cases in each age group by multiplying the age-specific proportion by the corresponding standard population.

Step 3: Add the expected number of cases in each age group, divide by the total of the standard population and multiply by the determined population base (for example, 100 or 1000).

Indirect age-standardisation

The indirect method is recommended for use when calculating rates for small populations where fluctuations in age-specific rates can affect the reliability of rates calculated using the direct method (HDSC 2006). The standard populations are detailed in Table A1.1.

Indirect standardisation was used for the single-year country of birth and Indigenous analyses, using 2005–06 data.

Comparisons between two populations which use indirect age-standardisation should be presented as standardised incidence ratios. These are calculated using the following steps:

Step 1: Calculate age-specific proportions for the standard population.

Step 2: Calculate the expected number of cases by multiplying the actual number of cases in the population of interest by the age-specific proportions in the standard population.

Step 3: Divide the total number of actual cases by the total number of expected cases.

A ratio of 1.0 indicates that there is no difference in the incidence rate between the population of interest and the standard population. A ratio of more than 1.0 indicates the population of interest has a higher incidence rate compared to the standard population and vice versa for a ratio of less than 1.0.

Table A1.1: Characteristics of the standard populations used throughout this report

	Standard population characteristics			
Analysis	**Age group**	**Year**	**Jurisdiction**	**Population group**
Single year				
Indigenous	15–44 years	2005–06	NSW, Victoria, Queensland, Western Australia, South Australia, public hospitals in the Northern Territory	Other Australian women
Overseas born	20–44 years	2005–06	National	Australian-born women
Trend				
Overall Australian	15–49 years	2000–01	National	All women
Indigenous	15–44 years	2000–01	Queensland, Western Australia, South Australia, public hospitals in the Northern Territory	Other Australian women
Overseas born	20–44 years	2000–01	National	Australian-born women

Proportional rate of change

The proportional rate of change has been calculated in this report to show the difference in incidence rates between the first and final years of a time series.

The proportional rate of change is calculated using the following method:

(Final year estimate – First year estimate) / First year estimate x 100%

This method does not take into consideration variation in the years between the two end points.

Analytical codes

The following tables present the codes used in the analysis of the NHMD. Table A1.2 provides the ICD-10-AM codes for 'birth event' and gestational diabetes mellitus. Table A1.3 presents the Standard Australian Classification of Countries (SACC) codes for countries included in each high-risk region of birth.

Table A1.2: ICD-10-AM codes used to define hospital births complicated by gestational diabetes mellitus (GDM)

Diagnosis	ICD-10-AM code
Outcome of delivery (birth event)	Z37
–single live birth	Z37.0
–single stillbirth	Z37.1
–twins, both live born	Z37.2
–twins, one live born and one stillborn	Z37.3
–twins, both stillborn	Z37.4
–other multiple births, all live born	Z37.5
–other multiple births, some live born	Z37.6
–other multiple births, all stillborn	Z37.7
–outcome of delivery, unspecified	Z37.9
Gestational diabetes mellitus (diabetes arising in pregnancy)	O244
– Non-insulin use	O244.1
– Insulin use	O244.2
– Unknown/missing insulin use	O244.9

Source: NCCH 2006.

Table A1.3: Country groupings for selected region of birth analyses (SACC)

Region of birth	SACC code (1998)	Country
Polynesia	1500 to 1508; 1511; 1512; 1599	Cook Islands, Fiji, French Polynesia, Niue, Samoa, Samoa American, Tokelau, Tonga, Tuvalu and Wallis and Futuna. *Hawaii is excluded*
Southern Asia	7100 to 7107	Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka
Middle East	4200 to 4208; 4211 to 4217	Bahrain, Gaza Strip and West Bank, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, Yemen
Other Asia	5100 to 5105; 5200 to 5206; 6100 to 6105; 6200 to 6203; 7201 to 7208; 5000; 6000; 7000; 7211	Burma (Myanmar), Cambodia, Laos, Thailand, Viet Nam, Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore, East Timor, China, Hong Kong, Macau, Mongolia, Taiwan, Japan, Korea Democratic Peoples Republic (North), Korea Republic (South), Afghanistan, Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, Uzbekistan

Source: ABS 2008.

Appendix 2: Supplementary tables

Table A2.1: Proportional rate of change, standardised incidence of confinements with gestational diabetes mellitus (GDM) among women aged 15–49 years, 2000–01 to 2005–06

	Number confinements with GDM	Number total confinements	Age standardised rate (%)
2000–01	8,858	244,764	3.6
2001–02	8,847	233,345	3.8
2002–03	9,466	236,123	3.9
2003–04	10,671	252,152	4.1
2004–05	10,856	256,209	4.1
2005–06	12,403	269,113	4.4
% change 2000–01 to 2005–06			**21.9**

Note: For calculation of % change, see Appendix 1: Methods.

Source: AIHW National Hospital Morbidity Database.

Table A2.2: Proportional rate of change, standardised incidence of confinements with gestational diabetes mellitus (GDM) among women aged 15–49 years, 2000–01 to 2005–06

	15–29 years			30–49 years		
	Number GDM	Number confinements	Age standardised rate (%)	Number GDM	Number confinements	Age standardised rate (%)
2000–01	2,973	125,851	2.4	5,885	118,913	4.9
2001–02	2,899	116,192	2.5	5,948	117,153	5.1
2002–03	2,856	112,416	2.6	6,610	123,707	5.3
2003–04	3,207	118,168	2.7	7,464	133,984	5.5
2004–05	3,261	117,775	2.8	7,595	138,434	5.4
2005–06	3,736	122,673	3.1	8,667	146,440	5.8
		% change	**29.8**		**% change**	**18.0**

Note: For calculation of % change, see Appendix 1: Methods.

Source: AIHW National Hospital Morbidity Database.

Table A2.3: Standardised incidence ratio of confinements with gestational diabetes mellitus (GDM) among women aged 15–44 years, by Indigenous status and broad age groups, 2005–06

	GDM confinements	Total confinements	% Total confinements	GDM as % of total confinements	Standardised incidence ratio
			15–29 years		
Indigenous Australian women	225	7,086	76.7	51.1	1.3
Other Australian women	3,394	109,966	44.4	29.5	1.0
			30–44 years		
Indigenous Australian women	215	2,156	23.3	48.9	1.7
Other Australian women	8,108	137,728	55.6	70.5	1.0

Source: AIHW National Hospital Morbidity Database.

Table A2.4: Proportional rate of change, standardised incidence rate and standardised incidence ratio of confinements with gestational diabetes mellitus (GDM) among women aged 15–44 years, by Indigenous status, 2000–01 to 2005–06

	2000–01	2001–02	2002–03	2003–04	2004–05	2005–06	% change
				Number GDM confinements			
Indigenous Australian women	255	269	260	330	321	324	
Other Australian women	2,769	3,145	3,270	3,520	3,890	4,178	
				Number total confinements			
Indigenous Australian women	5,557	5,849	5,861	5,764	6,083	6,327	
Other Australian women	87,113	86,877	85,933	88,747	90,724	95,825	
				Age standardised rate (%)			
Indigenous Australian women	7.1	6.8	6.5	8.5	7.6	7.3	**3.4**
Other Australian women	3.2	3.6	3.7	3.8	4.1	4.2	**31.4**
				Standardised incidence ratio			
Indigenous: Other	2.2	1.9	1.7	2.2	1.8	1.8	**–21.3**

Note: For calculation of % change, see Appendix 1: Methods.

Source: AIHW National Hospital Morbidity Database.

Table A2.5: Proportional rate of change and standardised incidence rate of confinements with gestational diabetes mellitus (GDM) among women aged 20–44 years, by Indigenous status and broad age groups, 2000–01 to 2005–06

	2000–01	2001–02	2002–03	2003–04	2004–05	2005–06	% change
				Age standardised rate (%)			
				15–29 years			
Indigenous—15–29 years	3.7	4.5	3.6	4.9	5.0	4.4	**17.0**
Other —15–29 years	2.1	2.5	2.4	2.6	2.8	2.9	**34.6**
				30–44 years			
Indigenous—30–44 years	11.0	9.4	9.9	12.7	10.6	10.8	**–1.9**
Other —30–44 years	4.4	4.8	5.2	5.3	5.7	5.7	**29.6**
				Rate ratio (Indigenous : Other)			
15–29 years	1.7	1.8	1.5	1.9	1.8	1.5	**–13.1**
30–44 years	2.5	1.9	1.9	2.4	1.9	1.9	**–24.4**

Note: For calculation of % change, see Appendix 1: Methods.

Source: AIHW National Hospital Morbidity Database.

Table A2.6: Proportional rate of change, standardised incidence of confinements with gestational diabetes mellitus (GDM) among women aged 20–44 years, by selected region of birth, 2000–01 to 2005–06

Region of birth	2000–01	2001–02	2002–03	2003–04	2004–05	2005–06	% change
				Number GDM confinements			
Australia	5,238	5,512	5,949	6,523	6,567	7,394	
Total overseas	3,323	3,089	3,221	3,868	4,002	4,642	
Polynesia	177	5,512	2,020	1,322	340	177	
Southern Asia	301	164	5,949	2,038	1,661	301	
Middle East	284	317	131	6,523	2,631	284	
Other Asia	1,501	257	337	199	6,567	1,501	
Missing	*144*	*89*	*116*	*118*	*130*	*162*	
				Age standardised rate (%)			
Australia	3.0	3.2	3.4	3.5	3.5	3.7	**23.1**
Total overseas	5.5	5.7	5.7	6.2	6.3	6.9	**23.8**
Polynesia	7.9	8.2	6.3	8.7	8.9	9.2	**16.2**
Southern Asia	10.6	10.5	10.7	11.4	12.1	12.8	**20.3**
Middle East	6.8	6.5	6.4	6.9	7.2	7.3	**7.6**
Other Asia	7.9	7.9	7.9	8.7	8.4	9.4	**18.8**

Note: For calculation of % change, see Appendix 1: Methods.

Source: AIHW National Hospital Morbidity Database.

Table A2.7: Incidence of 'low-risk' confinements with gestational diabetes mellitus (GDM), 2005–06

	Number	% of GDM confinements[(b)]	% of total confinements[(c)]
'Low-risk' GDM confinements[(a)]	2,109	**17.9**	**0.9**

(a) Australian-born women aged 20–29 years who do not identify as Indigenous Australian.

(b) Women aged 20–44 years who gave birth in a hospital in New South Wales, Victoria, Queensland, Western Australia, South Australia or public hospitals in the Northern Territory and had a diagnosis of GDM.

(c) Women aged 20–44 years who gave birth in a hospital in New South Wales, Victoria, Queensland, Western Australia, South Australia or public hospitals in the Northern Territory.

Source: AIHW National Hospital Morbidity Database.

Table A2.8: Comparison of NHMD confinements with gestational diabetes mellitus (GDM) and NDSS registrants with a diagnosis of GDM, by insulin treatment status, 2005–06

	Number		% agreement (NDSS / NHMD)
	NDSS	NHMD	
Insulin-treated	2,821	3,930	71.8
Non insulin-treated	6,707	7,208	93.0
Unspecified	—	1,265	
Total	**9,528**	**12,403**	**76.8**

Source: AIHW National Hospital Morbidity Database and National Diabetes Services Scheme database (Data at June 2007).

Glossary

Confinement: A unique pregnancy resulting in the live birth or stillbirth of one or more babies.

Diabetes mellitus: A chronic condition in which the body cannot properly use its main energy source, the sugar glucose. This is due to either the pancreas not producing enough of the hormone insulin, or the body being unable to effectively use the insulin produced. Insulin helps glucose enter the body's cells from the bloodstream and then be processed by them. Diabetes is marked by an abnormal build-up of glucose in the blood and it can have serious short-term and long-term effects on many of the body's systems, especially the blood vessels and nerves. See also *Type 1 diabetes*, *Type 2 diabetes* and *gestational diabetes mellitus (GDM).*

Gestational diabetes mellitus (GDM): A form of diabetes that is defined as glucose intolerance in pregnant women not previously diagnosed with diabetes. Women who have had GDM are at increased risk of developing Type 2 diabetes and GDM increases the risk of perinatal morbidity and mortality. See also *Type 1 diabetes* and *Type 2 diabetes*.

Glucose intolerance: Slower metabolism of glucose due to insulin deficiency or insulin resistance. See also *Insulin resistance*.

Indigenous Australians: An alternative term for a person who identifies as being of Aboriginal and/or Torres Strait Islander origin.

Insulin: A hormone produced in the pancreas that helps glucose to enter body cells for energy metabolism.

Insulin resistance: The inability of cells to respond to insulin, resulting in higher levels of glucose in the blood.

Other Australians: Used in hospital data, 'Other' Australians is the term given to people who have identified as being of non-Indigenous Australian origin or whose Indigenous status is missing or not stated.

Overseas born: A measure of ethnicity, based on self-reported country of birth in hospital records. Australian-born includes Indigenous Australians if they nominated Australia as their country of birth.

Type 1 diabetes mellitus: A form of diabetes marked by a complete lack of insulin production and needing insulin replacement for survival. This form of diabetes mostly arises in childhood or in young adults, though it can occur at any age. Adults may develop a slowly progressing form of Type 1 diabetes called Latent Autoimmune Diabetes in Adults (LADA), which may be able to be treated initially without insulin injections. See also *Type 2 diabetes* and *gestational diabetes mellitus (GDM)*.

Type 2 diabetes mellitus: The most common form of diabetes, which is marked by reduced or less effective insulin. Some cases may be managed with changes to diet along with increased exercise and weight loss. Many require medicines as well—namely oral glucose lowering medicines that work on the pancreas. Some do require insulin, either alone or in addition to other treatments. See also *Type 1 diabetes* and *gestational diabetes mellitus (GDM)*.

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