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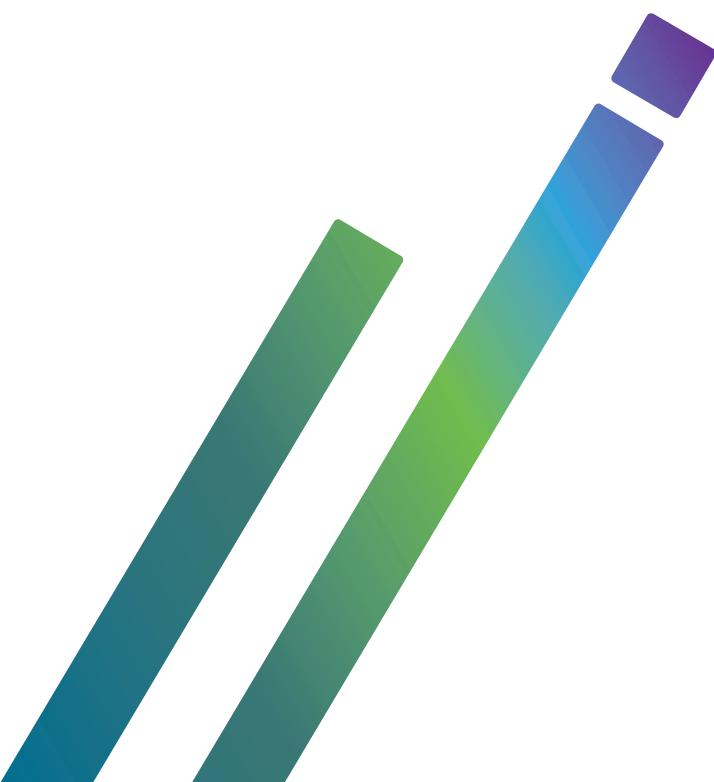
# Maternal deaths in Australia 2015–2017

AIHW



# Maternal deaths in Australia

## 2015–2017



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# Summary

Maternal deaths are rare in Australia. But healthy women do still die during pregnancy and following birth. This report aims to identify trends in maternal mortality and develop an evidence base for maternal deaths to inform maternity services policy and practice.

In the triennium 2015–2017:

- 915,610 women gave birth in Australia
- 59 deaths were classified as directly or indirectly related to pregnancy
- the maternal mortality ratio (MMR) was 6.4 deaths per 100,000 women giving birth, which is the second lowest MMR reported in any triennium in Australia
- 12 deaths were classified as coincidental to pregnancy
- 1 death was still awaiting classification at time of publication.

The most common causes of Australian maternal deaths during 2015–2017 were suicide, cardiovascular disease, and sepsis.

The MMR continues to be higher among women who:

- identified as being Aboriginal or Torres Strait Islander
- were aged 35 and over
- had a body mass index (BMI) of 30 or more
- had given birth 4 or more times
- smoked in the first 20 weeks of pregnancy.

Caution should be used when interpreting these data, due to the small number of maternal deaths in Australia, and even smaller numbers when these deaths are broken down by characteristics.

State and territory maternal mortality committees reviewed the maternal deaths for 2015–2017, and, in 26 cases, identified factors that might have contributed to the outcome. The most frequent contributory factors related to the woman, or her family, or her social situation, and to professional care issues.

The *Maternal deaths in Australia* series now documents 53 years of continuous maternal mortality audit in Australia.

# 1 Introduction

This report is focused on the deaths of 59 women who died in the triennium 2015–2017 from either:

- causes related to or exacerbated by pregnancy
- the health care and support provided to pregnant women.

In Australia, 915,610 women gave birth in that period.

## Background

Reporting of maternal deaths in Australia started in the 1964–1966 triennium (NHMRC 1966) and now documents 53 years of continuous maternal mortality audit in Australia.

Maternal death data have been reported using the same definitions as those used in this report since the 1973–1975 triennium (NHMRC 1979). This is the 18th published report on maternal deaths in Australia, and the sixth in the AIHW maternal deaths series.

Though maternal deaths are rare in Australia, healthy women do still die during pregnancy and following birth. This report aims to identify trends in maternal mortality and develop an evidence base regarding maternal deaths to inform maternity services policy and practice.

All maternal deaths require structured professional scrutiny to identify possible substandard care and ineffective provision of health care and community support. Analysis of contributory factors to maternal deaths suggests that up to one-third might be avoidable (CCOPMM 2019; Farquhar et al. 2011).

Confidential enquiries are conducted into maternal deaths in all Australian states and territories.

## Purpose of this report

This report aims to:

- provide an overview of maternal mortality from collated information on maternal deaths in Australia that occurred between 1 January 2015 and 31 December 2017
- provide an evidence base to inform policy development
- provide information on maternal deaths to health practitioners and community service providers that might be used to prevent avoidable deaths
- provide information to women who might be at higher-than-normal risk of death or severe morbidity and are considering pregnancy
- inform national processes for classification of maternal deaths, providing a basis for consensus in the review of maternal deaths by State and Territory Maternal Mortality Committees (STMMCs).

Appendices describe the underlying data sources and method (Appendix A), and data governance (Appendix B). Supplementary data tables can be found online at [www.aihw.gov.au/reports/mothers-babies/maternal-deaths-in-australia-2015-2017/data](http://www.aihw.gov.au/reports/mothers-babies/maternal-deaths-in-australia-2015-2017/data).

# What is a maternal death?

## Box 1.1: Maternal death definition

Maternal death is the death of a woman while pregnant or within 42 days of the end of pregnancy, irrespective of the duration and outcome of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes. Maternal deaths are divided into 2 categories, **direct** and **indirect**.

### Classification of maternal deaths

<b>Direct maternal deaths</b>	Those resulting from complications of the pregnant state (pregnancy, labour and puerperium) from interventions, omissions, incorrect treatment or from a chain of events resulting from any of the above. These deaths are included in the maternal deaths total.
<b>Indirect maternal deaths</b>	Those resulting from previous existing diseases or diseases that developed during pregnancy, and which were not due to a direct obstetric cause, but were aggravated by the physiologic effects of pregnancy. These deaths are included in the maternal deaths total.
<b>Coincidental deaths</b>	Deaths from unrelated causes (such as accidental and incidental causes) that happen to occur in pregnancy or the puerperium. Unlike direct and indirect maternal deaths, coincidental deaths are excluded from analysis and MMR calculations. These deaths were previously classified as 'incidental deaths'.

#### Notes

1. Definitions of direct and indirect maternal deaths are from the International Statistical Classification of Diseases and Related Health Problems, 10th revision, volume 2, section 5.8.1.
2. Maternal deaths are reviewed and classified by STMMCs.

All *Maternal deaths in Australia* reports since that published in 1973–1975 (NHMRC 1979) have used the same definitions as are used in this report.

This report does not include *late* maternal deaths (those deaths occurring from 43–365 days after the end of a pregnancy). Though some states and territories are submitting late maternal deaths to the National Maternal Mortality Data Collection, these data are not currently consistent enough across jurisdictions to be used for national reporting.

# Measuring maternal mortality

The incidence of maternal death is expressed as the maternal mortality ratio (MMR), which is calculated using direct and indirect maternal deaths combined. All coincidental and unclassified deaths are excluded from the calculation of the MMR.

## Calculation of MMR

$$\text{MMR} = \frac{\text{Number of maternal deaths (direct + indirect + maternal deaths not further classified)}^{(a)}}{\text{Number of women who gave birth}^{(a)}} \times 100,000$$

(a) For a defined place and time.

The World Health Organization (WHO) specifies that the number of live births or the total number of births (live births plus fetal deaths) can be used as the denominator, and where both denominators are available, both calculations are made (WHO 2011).

Although the most appropriate denominator for estimating maternal mortality would be the number of women at risk (the number of pregnant or recently pregnant women), this number is not available in Australia, because the number of pregnancies ending before 20 weeks' gestation is unknown.

In Australia, accurate population data are available in the AIHW's National Perinatal Data Collection for the number of women who gave birth to at least 1 baby (either a live birth or a stillbirth) of at least 20 weeks' completed gestation or at least 400 grams birthweight. This is the denominator used when calculating the MMR in this report.

## 2 Overview of maternal deaths

In 2015–2017, of the 915,610 women who gave birth in Australia, 72 died during or within 42 days of the end of pregnancy (Table 2.1). The STMMCs reviewed these deaths, and found that 59 had occurred as a direct or indirect result of the pregnancy. These were classified as maternal deaths. Of the remaining 13 deaths, 12 were classified as coincidental, and 1 was yet to be classified at time of publication.

**Table 2.1: Maternal deaths in Australia, by type of death, 2015–2017**

Year	Women who gave birth	Direct maternal deaths		Indirect maternal deaths		Total maternal deaths		Coincidental deaths	Deaths not yet classified
		Number	MMR	Number	MMR	Number	MMR	Number	Number
2015	304,268	6	2.0	11	3.6	17	5.6	3	0
2016	310,247	13	4.2	12	3.9	25	8.1	2	1
2017	301,095	4	1.3	13	4.3	17	5.6	7	0
<b>Total</b>	<b>915,610</b>	<b>23</b>	<b>2.5</b>	<b>36</b>	<b>3.9</b>	<b>59</b>	<b>6.4</b>	<b>12</b>	<b>1</b>

*Notes*

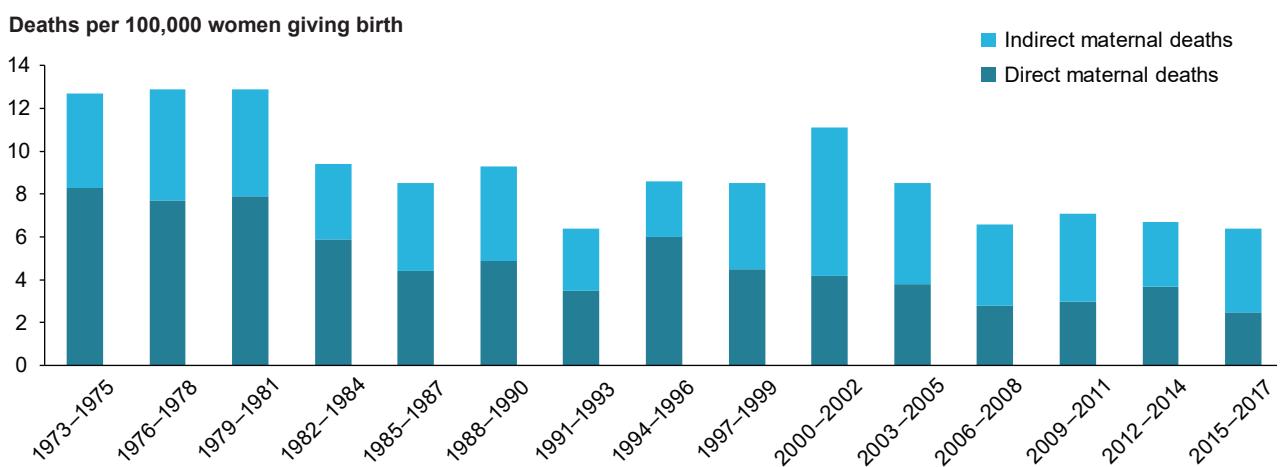
1. The MMR is the number of deaths per 100,000 women who gave birth.
2. Variations in MMR between years should be interpreted with caution, due to the small numbers of deaths.
3. Deaths not yet classified may be classified in future as a direct or indirect maternal death or as a coincidental death, so are excluded from MMR calculations until they are classified.

Of the 59 maternal deaths, 23 (39%) were classified as a direct maternal death (resulting from complications of the pregnancy), and 36 (61%) were classified as indirect maternal deaths (due to conditions that were not pregnancy-related, but were aggravated by the pregnancy or its management).

The MMR for 2015–2017 was 6.4 per 100,000 women giving birth, the second lowest MMR reported in any triennium in Australia (Figure 2.1).

The direct MMR has declined from 8.3 per 100,000 women who gave birth in 1973–1975 to 2.5 per 100,000 women who gave birth in 2015–2017 (Supplementary Table 1). But the MMR for indirect maternal deaths has remained steady.

**Figure 2.1: Maternal mortality ratio, by type of death and triennium, 1973–2017**



*Notes*

1. Data for this figure are available in Supplementary Table 1.
2. Maternal death rates—age-standardised to the Australian female population aged 15–44 at 30 June 2001, and expressed per 100,000 female population—are available in supplementary tables 2 and 3.

## State or territory of maternal death

Maternal deaths varied by state and territory (Table 2.2). Maternal deaths are reviewed by the STMMC in the jurisdiction in which the birth occurred or the pregnancy ended. Due to the small numbers of maternal deaths, variations between states and territories should be interpreted with caution.

**Table 2.2: Maternal deaths, by state or territory of death, 2015–2017**

State or territory	Maternal deaths	Women who gave birth
New South Wales and Australian Capital Territory <sup>(a)</sup>	15	305,700
Victoria	20	236,428
Queensland	14	182,174
Western Australia	3	103,896
South Australia	4	58,771
Tasmania	1	16,924
Nothern Territory	2	11,717
<b>Total</b>	<b>59</b>	<b>915,610</b>

(a) In the Australian Capital Territory, almost 14% of births for 2015–2017 were to women whose usual residence is in New South Wales.

*Notes*

1. Includes maternal deaths classified as direct or indirect. Does not include coincidental deaths, deaths awaiting classification, and late maternal deaths (deaths occurring from 43–365 days postpartum).
2. State or territory refers to the jurisdiction in which the birth occurred or, in the event that a birth did not occur, where the pregnancy ended.
3. Variations in the number of maternal deaths between states and territories should be interpreted with caution, due to the small numbers of deaths.

## **Box 2.1: An international perspective**

The World Health Organization (WHO) estimates that, worldwide, 300,000 women die each year from complications of pregnancy and childbirth (WHO 2015).

Australia was a signatory to the Millennium Development Goals. One of these goals is to 'reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio' (UN 2010).

The global MMR dropped by almost 44% between 1990 and 2015, from 385 to 216 deaths per 100,000 live births (WHO 2015) (Supplementary Table 4).

In 2015, the MMR estimate for developed regions was estimated as 12 (80% uncertainty interval (UI) 11–14) per 100,000 women giving birth. In individual countries, the MMR was:

- 6 (UI 5–7) in Australia
- 11 (UI 9–14) in New Zealand
- 9 (UI 8–11) in the United Kingdom
- 14 (UI 12–16) in the United States of America
- 215 (UI 98–457) in Papua New Guinea
- 215 (UI 150–300) in Timor Leste
- 114 (UI 75–175) in the Solomon Islands
- 546 (UI 511–652) in sub-Saharan Africa, more than 45 times as high as that found in developed regions.

### 3 Demographic characteristics

Understanding the demographic characteristics, such as age, parity, and place of residence of the women who die might help explain the incidence of maternal death in Australia. This demographic information might be used for appropriate planning of services.

**Table 3.1: Maternal deaths, by selected maternal demographics and type of death, 2015–2017**

	Direct maternal deaths		Indirect maternal deaths		Total maternal deaths	
	Number	MMR	Number	MMR	Number	MMR
<b>Total</b>	<b>23</b>	<b>2.5</b>	<b>36</b>	<b>3.9</b>	<b>59</b>	<b>6.4</b>
<b>Age at death</b>						
Under 20	0	0.0	4	18.0	4	18.0
20–24	1	0.9	1	0.9	2	1.8
25–29	1	0.4	13	5.3	14	5.7
30–34	11	3.4	6	1.8	17	5.2
35–39	7	4.1	10	5.8	17	9.9
40 and over	3	7.7	2	5.1	5	12.8
Not stated	0	..	0	..	0	
<b>Indigenous status</b>						
Indigenous	4	11.5	3	8.6	7	20.1
Non-Indigenous	16	2.1	27	3.5	43	5.6
Not stated	1	..	5	..	6	
<b>Remoteness of usual residence</b>						
Major cities	11	1.9	23	3.9	34	5.8
Inner regional	6	4.3	6	4.3	12	8.7
Outer regional	3	4.4	1	1.5	4	5.9
Remote and very remote	0	0.0	3	19.4	3	19.4
Not stated/unable to be assigned	3	..	3	..	6	
<b>Socioeconomic area</b>						
1 Lowest	7	4.0	8	4.6	15	8.6
2	4	2.5	9	5.7	13	8.2
3	5	3.1	6	3.7	11	6.7
4	2	1.2	6	3.7	8	4.9
5 Highest	2	1.4	4	2.8	6	4.2
Not stated/unable to be assigned	3	..	3	..	6	
<b>Country of birth</b>						
Australia (includes external territories)	15	2.5	28	4.7	43	7.2
Born overseas	6	1.9	6	1.9	12	3.8
Not stated	2	..	2	..	4	

#### Notes

1. The MMR is the number of maternal deaths per 100,000 women who gave birth.
2. Data for Indigenous status, remoteness of usual residence, and socioeconomic area were not available from Western Australia for all years. The number of Western Australian women who gave birth was also excluded to enable accurate calculation of the MMR.
3. Remoteness area was derived by applying the Australian Bureau of Statistics (ABS) Australian Statistical Geography Standard (ASGS) to the area of a mother's usual residence (ABS 2011a, 2016a).
4. Socioeconomic area was derived by applying the Australian Bureau of Statistics (ABS) Index of Relative Socio-Economic Disadvantage (IRSD) fifths to the area of a mother's usual residence (ABS 2011b, 2016b).
5. More information on the calculation of remoteness area and socioeconomic area can be found in Appendix A.
6. Further breakdowns of country of birth can be found in Table 3.2.

## Age at death



In 2015–2017, the incidence of maternal death was higher for younger and older mothers, with the lowest incidence of maternal death occurring among women aged 20–34 (MMR 4.8 per 100,000 women who gave birth) (Table 3.1).

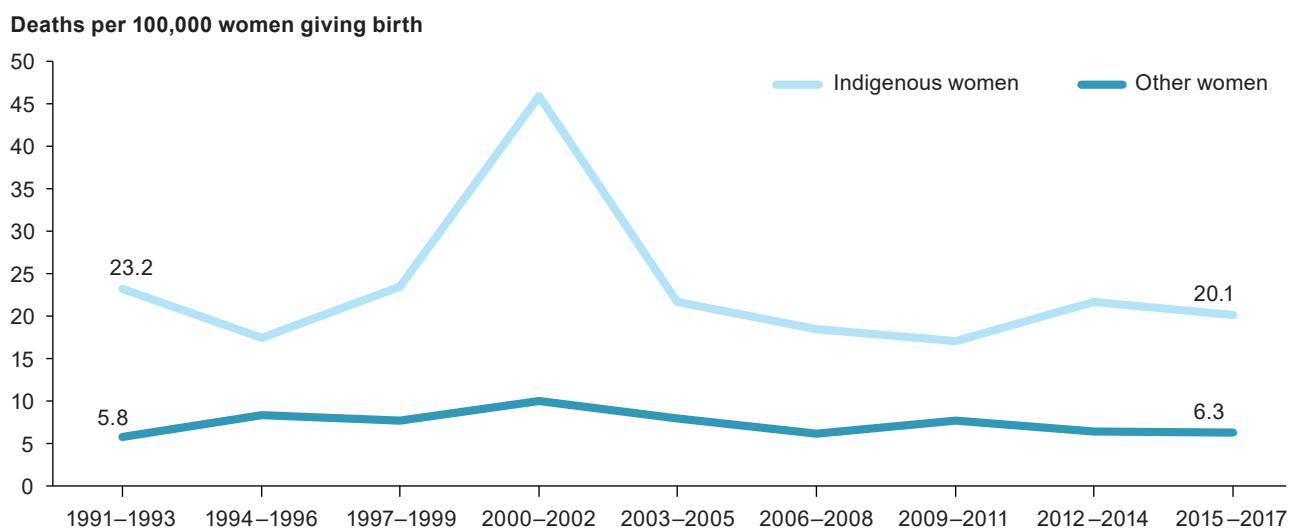
More than 1 in 3 maternal deaths (about 37%) occurred in women who were aged 35 or over (MMR 10.5 per 100,000 women who gave birth). As in previous years, the incidence of maternal death in women aged under 20 was high (MMR 18.0 per 100,000 women who gave birth). Interpretation of these numbers should be treated with caution, due to the small number of women aged less than 20 who gave birth (Supplementary Table 5).

## Aboriginal and Torres Strait Islander women



In 2015–2017, the rate of maternal death for Indigenous women was 20.1 per 100,000. This was a rise from 17.0 in 2009–2011, but a fall from 21.7 in 2012–2014 (Figure 3.1). The corresponding figures for other women (which includes non-Indigenous women and women whose Indigenous status was not stated) were 6.3 per 100,000 in 2015–2017, 6.4 in 2012–2014, and 7.7 in 2009–2011. Caution should be taken when interpreting the MMR for Indigenous women, due to the relatively small number of Indigenous women giving birth annually and variation in data quality across triennia.

**Figure 3.1: Maternal mortality rates, by Indigenous status, 1991–2017**



### Notes

1. Data and detailed methodological notes for this figure are available in Supplementary Table 9.
2. For consistency with groupings reported for previous trienniums, 'Other women' includes non-Indigenous women and women whose Indigenous status was not stated.
3. Indigenous status data were not available from Western Australia, and have been excluded from calculations from 2006 onwards.

## Remoteness of usual residence



Of the women who died whose usual residence was identified, almost two-thirds (64%) lived in *Major cities*, and this group had the lowest MMR (5.8 per 100,000 women giving birth). Women who lived in regional areas (*Inner* and *outer regional* areas combined) had an MMR of 7.8, and those in *Remote* and *very remote* areas had an MMR of 19.4 (Table 3.1).

The incidence of maternal death in *Remote* and *very remote* areas of Australia should be treated with caution, due to the small numbers of women giving birth there (Supplementary Table 10).

## Socioeconomic area



The MMR for women who lived in the 2 lowest socioeconomic areas was 8.4 per 100,000 women giving birth. This was almost twice that of women living in the 2 highest socioeconomic areas (4.6 per 100,000 women giving birth) (Table 3.1; Supplementary Table 11).

## Country of birth



Almost three-quarters (71%) of the women who died were born in Australia. Where country of birth was stated, the MMR for women born in Australia was 7.2 per 100,000 women giving birth, compared with 3.8 per 100,000 for those born in another country (Supplementary Table 12).

**Table 3.2: Maternal deaths, by woman's country of birth, 2015–2017**

Country of birth	Maternal deaths	
	Number	%
Australia	42	71.2
New Zealand and Oceania	3	5.1
South-East Asia	3	5.1
Central and Southern Americas	2	3.4
Southern and Central Asia	2	3.4
Africa and Middle East	1	1.7
Northern Americas	1	1.7
Europe	0	0.0
North-East Asia	0	0.0
Not stated	5	8.5
<b>Total</b>	<b>59</b>	<b>100.0</b>

## Other maternal characteristics

**Table 3.3: Maternal deaths, by selected maternal characteristics and type of death, 2015–2017**

	Direct maternal deaths		Indirect maternal deaths		Total maternal deaths	
	Number	MMR	Number	MMR	Number	MMR
<b>Total</b>	<b>23</b>	<b>2.5</b>	<b>36</b>	<b>3.9</b>	<b>59</b>	<b>6.4</b>
<b>Parity</b>						
0	7	1.8	12	3.1	19	4.9
1	5	1.6	11	3.4	16	5.0
2	1	0.8	8	6.3	9	7.1
3	3	6.8	2	4.5	5	11.3
4 or more	6	19.5	0	0.0	6	19.5
Not stated	1	..	3	..	4	
<b>Body mass index</b>						
Less than 18.5	0	0.0	1	4.2	1	4.2
18.5–24.9	2	0.7	10	3.4	12	4.0
25–29.9	3	2.0	6	4.0	9	6.0
30–39.9	7	7.0	6	6.0	13	13.0
40 or more	1	5.4	3	16.1	4	21.4
Not stated	3	..	3	..	6	
<b>Smoking status</b>						
Smoked during first 20 week of pregnancy	4	5.7	8	11.4	12	17.0
Did not smoke during first 20 weeks of pregnancy	9	1.4	13	2.0	22	3.5
Not stated	5	..	9	..	14	

### Notes

1. The MMR is the number of maternal deaths per 100,000 women who gave birth.
2. Body mass index (BMI) data were not reported by Western Australia and the Northern Territory for all years, or by New South Wales for 2015 and 2016. The number of women who gave birth in those jurisdictions have been excluded for those years to enable accurate calculation of the MMR.
3. Smoking status data were not reported by the Northern Territory for all years, or by New South Wales for 2015 and 2016. The number of women who gave birth in those jurisdictions have been excluded for those years to enable accurate calculation of the MMR.
4. BMI was not available for 34% of maternal deaths, and smoking status was not available for 42% of maternal deaths. As a result, caution should be used when interpreting these data.

## Parity



Parity refers to a woman's number of previous pregnancies carried to a viable gestational age (usually 20 weeks), resulting in live births or stillbirths and excluding the current pregnancy.

The incidence of maternal death was lowest in women with a parity of 0 or 1 (MMR 4.9 and 5.0 per 100,000 women giving birth, respectively), followed by those with a parity of 2 or 3 (MMR 7.1 and 11.3, respectively). Women with a parity of 4 or more had the highest incidence of maternal death (MMR 19.5); but this number should be interpreted with caution, due to the relatively small number of women giving birth in this group (Supplementary Table 6).

## Body mass index

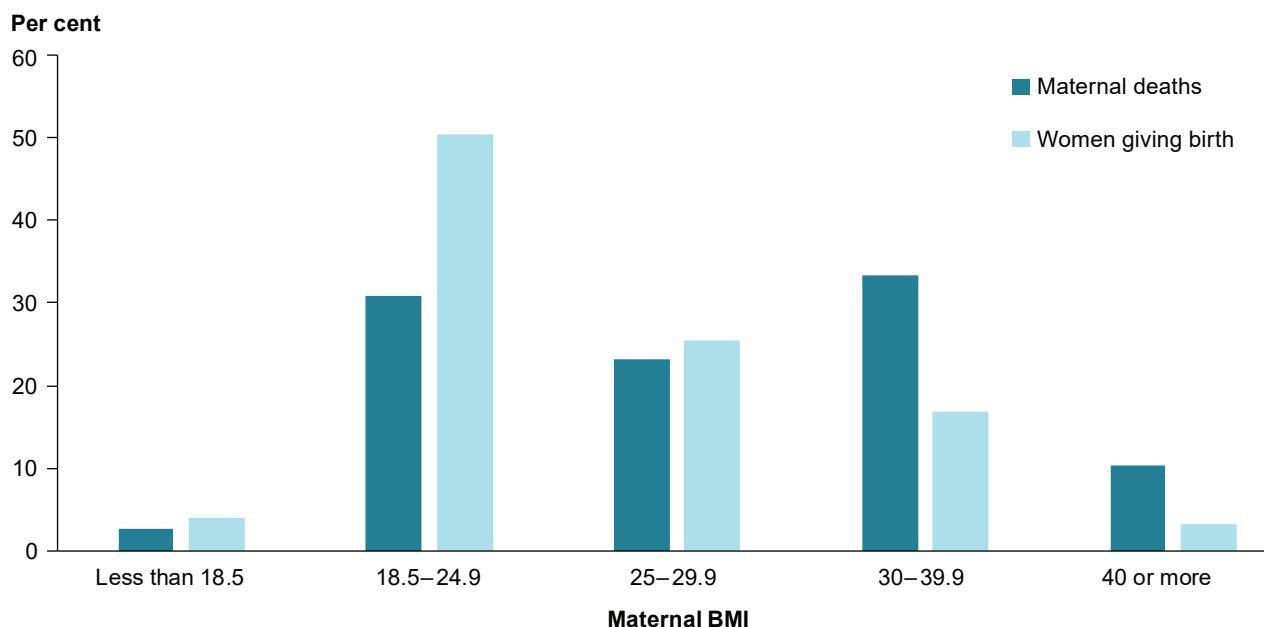


Of the 39 women who died whose BMI was reported, 9 (23%) were overweight, with a BMI of 25–29.9, and 17 (44%) were obese or morbidly obese, with a BMI of 30.0 or more (Figure 3.2).

When compared with the overall distribution of BMI among child-bearing women, maternal deaths were relatively more common in women with a BMI of 30.0 or more than in women with a lower BMI.

In maternal deaths where the woman's BMI was identified, 44% had a BMI of 30.0 or more, compared with 20% of all women who gave birth.

**Figure 3.2: Maternal deaths, by maternal BMI, 2015–2017**



### Notes

1. Data for this figure are available in Supplementary Table 7.
2. Figure does not include those women for whom BMI data were not reported.
3. BMI data for maternal deaths were not reported by Western Australia and the Northern Territory for all years, or by New South Wales for 2015 and 2016. The number of women who gave birth excludes these jurisdictions for those years.

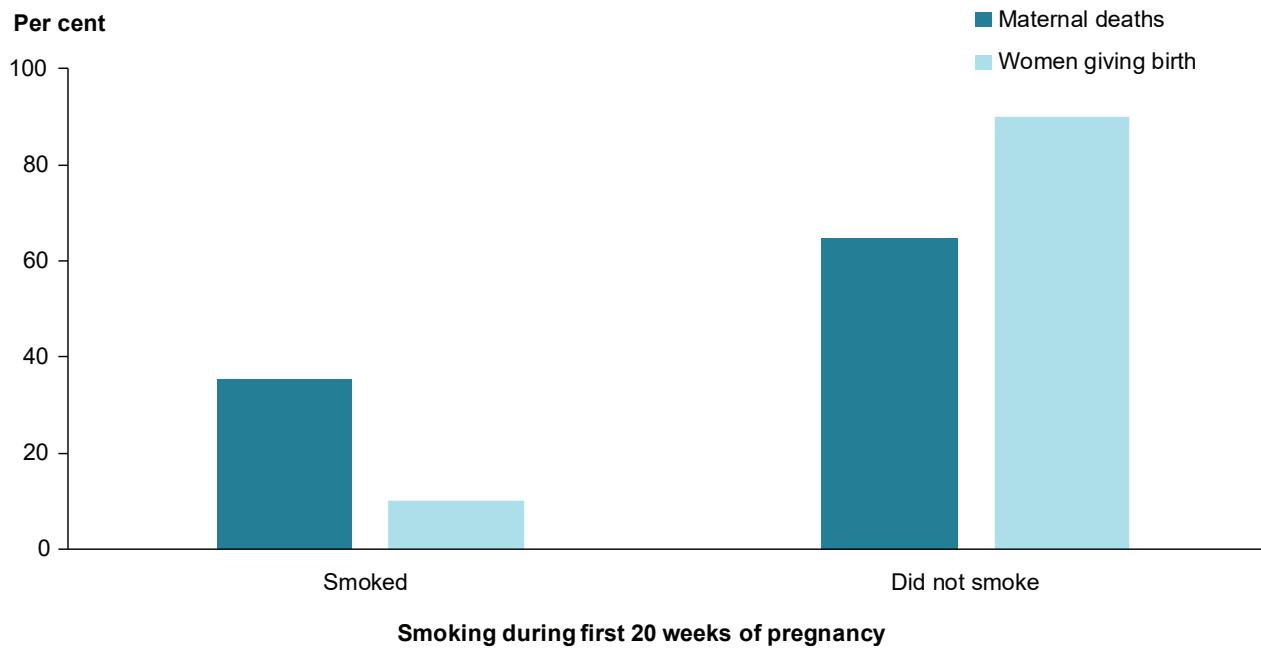
## Smoking during pregnancy



The smoking status of the women who died was available for 34 (almost 58%) of the 59 maternal deaths in 2015–2017. Of these, 12 (35%) smoked during the first 20 weeks of pregnancy, while only 10% of all women giving birth smoked during the first 20 weeks of pregnancy (Figure 3.3).

Caution should be used when interpreting these data, due to the small number of maternal deaths with a recorded smoking status.

**Figure 3.3: Maternal deaths, by maternal smoking status during the first 20 weeks of pregnancy, 2015–2017**



### Notes

1. Data for this figure are available in Supplementary Table 8.
2. Smoking status data for maternal deaths were not reported by the Northern Territory for all years, or by New South Wales for 2015 and 2016. The number of women who gave birth in those jurisdictions have been excluded for those years.

## 4 Clinical characteristics

### Antenatal care

In 2015–2017, 44 (75%) of the maternal deaths were among women whose pregnancy extended beyond 20 weeks' gestation (Table 4.1). Of these, 7 attended 0–4 antenatal visits during their pregnancy, and 23 women attended 5 or more.

Data regarding the number of antenatal visits attended by the 15 women who died before 20 weeks of pregnancy were either not available, or not applicable as they died in early pregnancy before receiving antenatal care.

**Table 4.1: Maternal deaths, by antenatal care and type of death, 2015–2017**

	Direct maternal deaths	Indirect maternal deaths	Total maternal deaths
Antenatal care			
0–4 antenatal visits	3	4	7
5 or more antenatal visits	8	15	23
Not stated	7	7	14
Death before 20 weeks' gestation	5	10	15
<b>Total</b>	<b>23</b>	<b>36</b>	<b>59</b>

## Complicating conditions during pregnancy

Of the 59 women who died, 44 (75%) had 1 or more pre-existing health conditions, and 45 (76%) had new health conditions or significant exacerbations of existing conditions (Table 4.2).

**Table 4.2: Maternal deaths, by conditions complicating pregnancy, 2015–2017**

New and pre-existing conditions complicating this pregnancy	Maternal deaths
<b>Pre-existing health conditions (more than 1 can be identified per pregnancy)</b>	
Mental health condition	19
Cardiovascular disease	8
Respiratory disease	6
Epilepsy	3
Hypertension	2
Thromboembolic disease	2
Diabetes mellitus	1
Renal disease	1
No specified pre-existing health condition recorded	12
<b>Complicating conditions arising during pregnancy (more than 1 can be identified per pregnancy)</b>	
Mental health condition	17
Postpartum haemorrhage	8
Gestational diabetes	8
Amniotic fluid embolism	5
New cardiovascular disease or exacerbation of pre-existing disease	5
Placenta praevia	4
Antepartum haemorrhage (unspecified)	4
Gestational hypertension	3
Pre-eclampsia/eclampsia	2
Thromboembolism	2
Preterm labour	1
Intra-uterine fetal death with associated sepsis	1
Uterine rupture	1
No specified new health condition recorded	6

### Notes

1. More than 1 condition or complication may be recorded for a pregnancy.
2. Pre-existing health conditions and complicating conditions arising during pregnancy were 'not stated' for 10 maternal deaths. These are not included in this table.

## Onset of labour

Where birth occurred and onset of labour was stated (33 deaths), 45% of the women who died laboured spontaneously, 15% had labour induced, and 39% had a caesarean section without labour (Table 4.3).

**Table 4.3: Maternal deaths, by onset of labour and type of death, 2015–2017**

Onset of labour	Direct maternal deaths	Indirect maternal deaths	Total maternal deaths
Pregnancies where birth occurred	17	16	33
<i>Spontaneous labour</i>	7	8	15
<i>Induced labour</i>	4	1	5
<i>Caesarean section without labour</i>	6	7	13
Not applicable—no birth	4	17	21
Not stated	2	3	5
<b>Total</b>	<b>23</b>	<b>36</b>	<b>59</b>

*Note:* No birth consists of those deaths where the pregnancy ended before 20 weeks' gestation, or where the baby remained in utero at maternal death.

## Birth method

Of the 59 women who died, 35 (59%) gave birth (Table 4.4). Of those births, 14 (40%) were vaginal births, and 21 (60%) were by caesarean section. Of the caesarean sections, 3 were perimortem caesarean sections for women who were close to death to try to resuscitate the mother and/or save the life of the baby.

A total of 21 (36%) women had not given birth when they died, and the mode of birth was not stated for 3 women.

**Table 4.4: Maternal deaths, by mode of birth and type of death, 2015–2017**

Mode of birth	Direct maternal deaths	Indirect maternal deaths	Total maternal deaths
Unassisted vaginal birth	6	5	11
Assisted vaginal birth	1	2	3
Caesarean section birth	10	8	18
Perimortem caesarean section birth	2	1	3
No birth—baby remained in-utero at maternal death	0	6	6
No birth—pregnancy ended before 20 weeks' gestation	4	11	15
Not stated	0	3	3
<b>Total</b>	<b>23</b>	<b>36</b>	<b>59</b>

*Note:* Assisted vaginal birth includes forceps or vacuum extraction-assisted vaginal births.

Information about the urgency with which the caesarean section was performed was only available for 7 of the 18 non-perimortem caesarean section births. As such, drawing conclusions on operative urgency is inappropriate for this group.

## Timing of maternal death

Between 2006 and 2017, the timing of maternal death is known for 196 of the 228 maternal deaths (Table 4.5). Of those:

- one-third (67; 34%) occurred during pregnancy
- one-fifth (40; 20%) occurred during the birth process or within 24 hours of a birth
- almost half (89; 45%) occurred after the day of birth.

For women who died during pregnancy:

- 27 (40%) occurred in the first trimester
- 22 (33%) occurred in the second trimester
- 18 (27%) occurred in the third trimester.

Due to the relatively small numbers, maternal deaths data for 2006–2017 are shown.

**Table 4.5: Timing of maternal deaths, by type of death, 2006–2017**

Timing of maternal death	Direct maternal deaths	Indirect maternal deaths	Unclassified maternal deaths	Total maternal deaths
During pregnancy	17	47	3	67
Trimester 1 (0–13 weeks)	11	15	1	27
Trimester 2 (14–28 weeks)	3	19	0	22
Trimester 3 (29+ weeks)	3	13	2	18
During or within 24 hours of birth	32	8	0	40
After birth	42	46	1	89
1–6 days	13	16	0	29
7–13 days	13	11	0	24
14–20 days	7	7	0	14
21–27 days	5	5	0	10
28–34 days	2	4	1	7
35–42 days	2	3	0	5
<b>Total</b>	<b>91</b>	<b>101</b>	<b>4</b>	<b>196</b>

### Notes

1. Data were not available from Western Australia for all years and for the Northern Territory for 2006–2014.
2. Excludes maternal deaths where timing was unknown.
3. Excludes maternal deaths where pregnancy status at time of death was 'Termination of pregnancy' or 'Miscarried'.
4. There was insufficient information for 4 maternal deaths for them to be classified as direct, indirect, or coincidental. These deaths are categorised as unclassified deaths of women during pregnancy and the puerperium.

## Location of death

Of the 59 women who died, 34 (58%) were hospital inpatients at the time of their death, and 19 died at home (Table 4.6).

Where the site of hospital death is known (19 deaths):

- 11 (58%) of the women died in an intensive care unit
- 4 (21%) died in an operating theatre
- 2 (11%) died in an emergency department
- 2 (11%) died in a maternity setting.

**Table 4.6: Maternal deaths, by location and type of death, 2015–2017**

Location of death	Direct maternal deaths	Indirect maternal deaths	Total maternal deaths
Hospital	18	16	34
<i>Intensive care unit</i>	3	8	11
<i>Operating theatre</i>	4	0	4
<i>Emergency department</i>	2	0	2
<i>Maternity setting</i>	0	2	2
<i>Location in hospital not stated</i>	9	6	15
Home	4	15	19
Birth centre	0	0	0
Other	1	3	4
Not stated	0	2	2
<b>Total</b>	<b>23</b>	<b>36</b>	<b>59</b>

*Note:* Location of death indicates where a death occurred. It does not imply that birth occurred in that setting (for example, a birth might occur in hospital, and death might subsequently occur at home).

The majority of maternal deaths that occurred in hospital were in high-level care settings in public hospitals. Maternal deaths by hospital sector and level of care are presented in Supplementary Table 13.

## Baby outcomes in maternal deaths

Babies were born to 35 (59%) of the 59 women who died. Of these, 33 were live born, and 2 were stillborn (Table 4.7). There was no birth in 21 pregnancies, and information was unavailable on the baby outcome in 3 pregnancies.

**Table 4.7: Maternal deaths, by baby outcome at birth and type of death, 2015–2017**

Baby outcome	Direct maternal deaths	Indirect maternal deaths	Total maternal deaths
Live birth	17	16	33
Stillbirth	2	0	2
No birth	4	17	21
Not stated	0	3	3
<b>Total</b>	<b>23</b>	<b>36</b>	<b>59</b>

*Note:* No birth consists of those deaths where the pregnancy ended before 20 weeks' gestation, or where the baby remained in utero at the time of maternal death.

## Incidence of autopsy

Diagnosis of cause of death was confirmed through autopsy in the majority (42; 71%) of maternal deaths (Table 4.8). Autopsy was not performed after 13 deaths.

**Table 4.8: Maternal deaths, by performance of autopsy and type of death, 2015–2017**

Autopsy	Direct maternal deaths	Indirect maternal deaths	Total maternal deaths
Autopsy performed	16	26	42
Autopsy not performed	6	7	13
Not stated	1	3	4
<b>Total</b>	<b>23</b>	<b>36</b>	<b>59</b>

## Contributing factors in maternal deaths

State and Territory Maternal Mortality Committees (STMMCs) assess the circumstances surrounding a maternal death to establish whether systemic factors might have contributed to the death.

Contributing factors identified might not have directly caused the death or had an influence on the outcome. The review of a maternal death may reveal more than 1 contributing factor.

Contributing factors are grouped into the 3 main categories of:

- **professional care** (such as inadequate numbers and/or seniority of staff, failure or delay in emergency response, failure to offer and/or follow recommended best practice)
- **delayed, or lack of, access to care** (such as geographical isolation from appropriate services, socioeconomic situation affecting access to appropriate care)
- **social and family situation** (such as substance use, family violence, language barriers).

A maternal mortality committee finding that there were contributing factors does not imply negligence. The review seeks to identify lessons that can be learned, to improve future outcomes through potential upgrades to health-care processes.

STMMCs identified 35 contributing factors relating to 26 deaths—in 7 cases 2 or more factors were identified (Table 4.9). The majority of the contributing care factors related to:

- the woman and/or her family and/or social situation (16; 46%)
- the professional care of the women (13; 37%).

**Table 4.9: Contributing factors to maternal deaths, 2015–2017**

Deaths reviewed for contributing factor(s)	Total
Number of deaths reviewed	37
<i>Contributing care factor(s) identified likely to have contributed to outcome (significant)</i>	10
<i>Contributing care factor(s) identified might have contributed to outcome (possible)</i>	11
<i>Contributing care factor(s) identified, but unlikely to have contributed to outcome (insignificant)</i>	0
<i>Contributing factor(s) identified, but significance of contributing care factor(s) not stated</i>	5
<i>No contributing care factor(s) identified</i>	11
Contributing factor assessment not undertaken	8
Not stated	14
<b>Total</b>	<b>59</b>
Contributory factors identified (more than 1 can be identified per case)	Total
Contributing care factor(s) related to the woman/her family/social situation	16
Contributing care factor(s) related to professional care	13
Contributing care factor(s) related to access to care	3
Other contributing factors identified	3
<b>Total</b>	<b>35</b>

Note: Contributing factors were found in 26 cases. In 7 of these cases 2 or more factors were identified.

## 5 Causes of maternal deaths

In this report, deaths have been categorised according to their primary cause, as assessed by the STMMC, after consideration of all available information. Autopsy, coronial, and other information is often only available after the health-care facility admission and discharge coding process is completed. As a result, the cause of death allocated by the STMMC might not be the same as the initial ICD-10 coding used by the ABS.

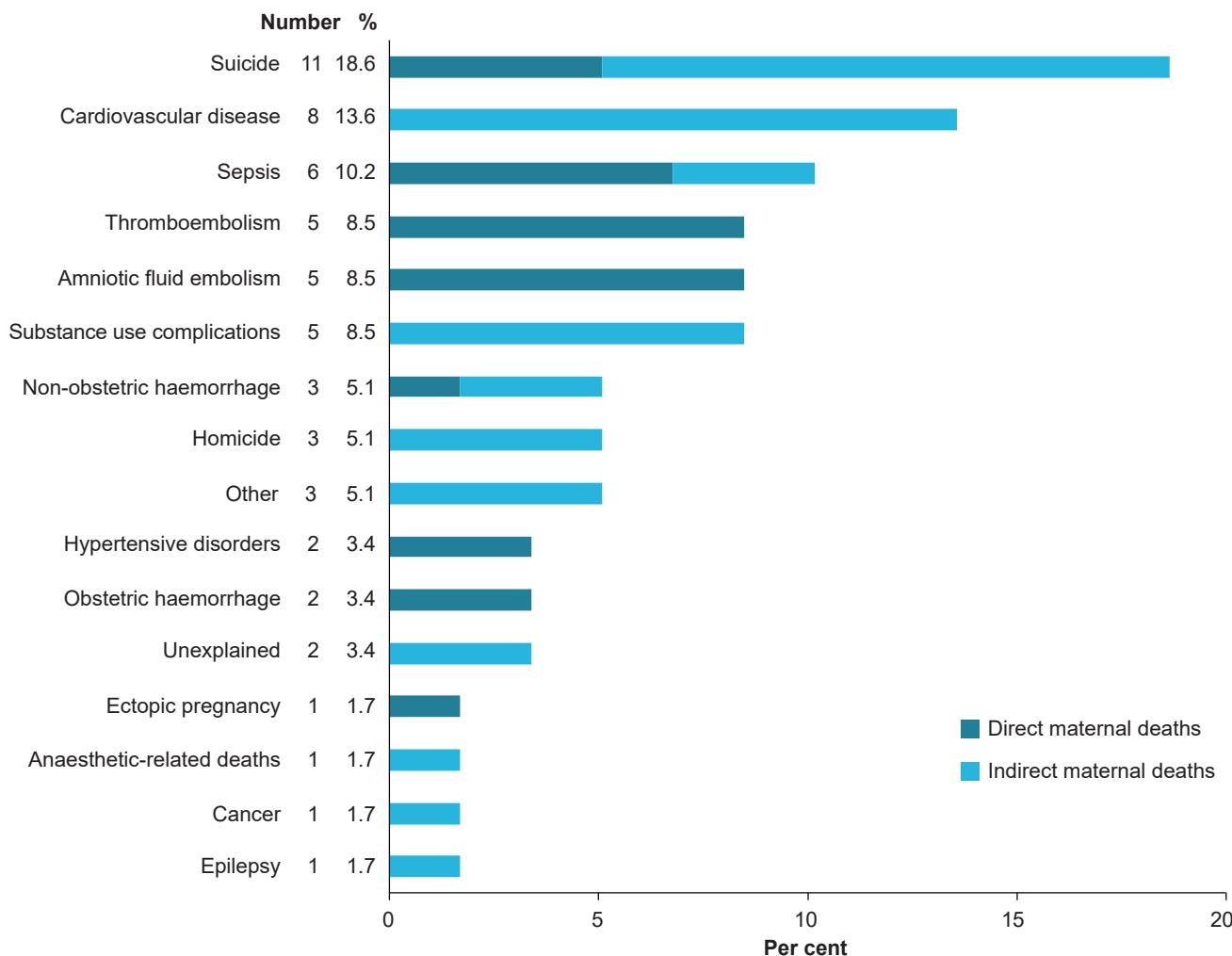
### Box 5.1: Primary causes of maternal deaths definitions

- **Amniotic fluid embolism:** deaths related to the effects of significant amounts of amniotic fluid and fetal cells entering the maternal circulation.
- **Anaesthetic-related:** deaths where the cause was related to anaesthesia and/or a surgical procedure.
- **Cancer:** deaths from a disease in which abnormal cells divide uncontrollably and destroy body tissue.
- **Cardiovascular:** deaths due to a disease process (usually pre-existing) affecting the heart and/or major blood vessels.
- **Ectopic pregnancy:** deaths due to the development of a fertilised egg at a site other than within the uterus, most commonly in the fallopian tube.
- **Epilepsy:** deaths due to a disturbance of brain function marked by recurrent fits and loss of consciousness.
- **Homicide:** deaths resulting from the killing of a person by another.
- **Hypertensive disorders:** deaths related to the effects of pre-eclampsia and eclampsia and other disorders of high blood pressure in pregnancy.
- **Non-obstetric haemorrhage:** deaths due to haemorrhage from blood vessels other than those in the genital tract, most commonly haemorrhage from a ruptured blood vessel in the brain or in the abdomen (the splenic artery).
- **Obstetric haemorrhage:** deaths related to haemorrhage from the genital tract, usually being from the placenta.
- **Sepsis:** deaths originating from an infection.
- **Substance use complications:** deaths resulting from the consumption of alcohol and/or other drugs.
- **Suicide:** deaths caused by the mother deliberately ending her own life.
- **Thromboembolism:** deaths due to obstruction of a blood vessel (most frequently the pulmonary blood vessels) by a blood clot that has become dislodged from another site in the circulation.
- **Other:** deaths that do not fall into any of the these categories.
- **Unclassified:** deaths that the STMMC has been unable to classify due to insufficient information being available about the cause.

## Causes of maternal deaths

The most common causes of maternal death in 2015–2017 were suicide, cardiovascular disease, and sepsis (Figure 5.1).

**Figure 5.1: Causes of maternal deaths, by type of death, 2015–2017**



Note: Data for this figure are in Supplementary Table 14.

## Causes of direct maternal deaths

The most common causes of direct maternal deaths were:

- pulmonary thromboembolism (5)
- amniotic fluid embolism (5)
- sepsis (4).

## Causes of indirect maternal deaths

The most common causes of indirect maternal deaths were:

- cardiovascular disease (8)
- suicide (8)
- substance use complications (5).

## Causes of death, by maternal age

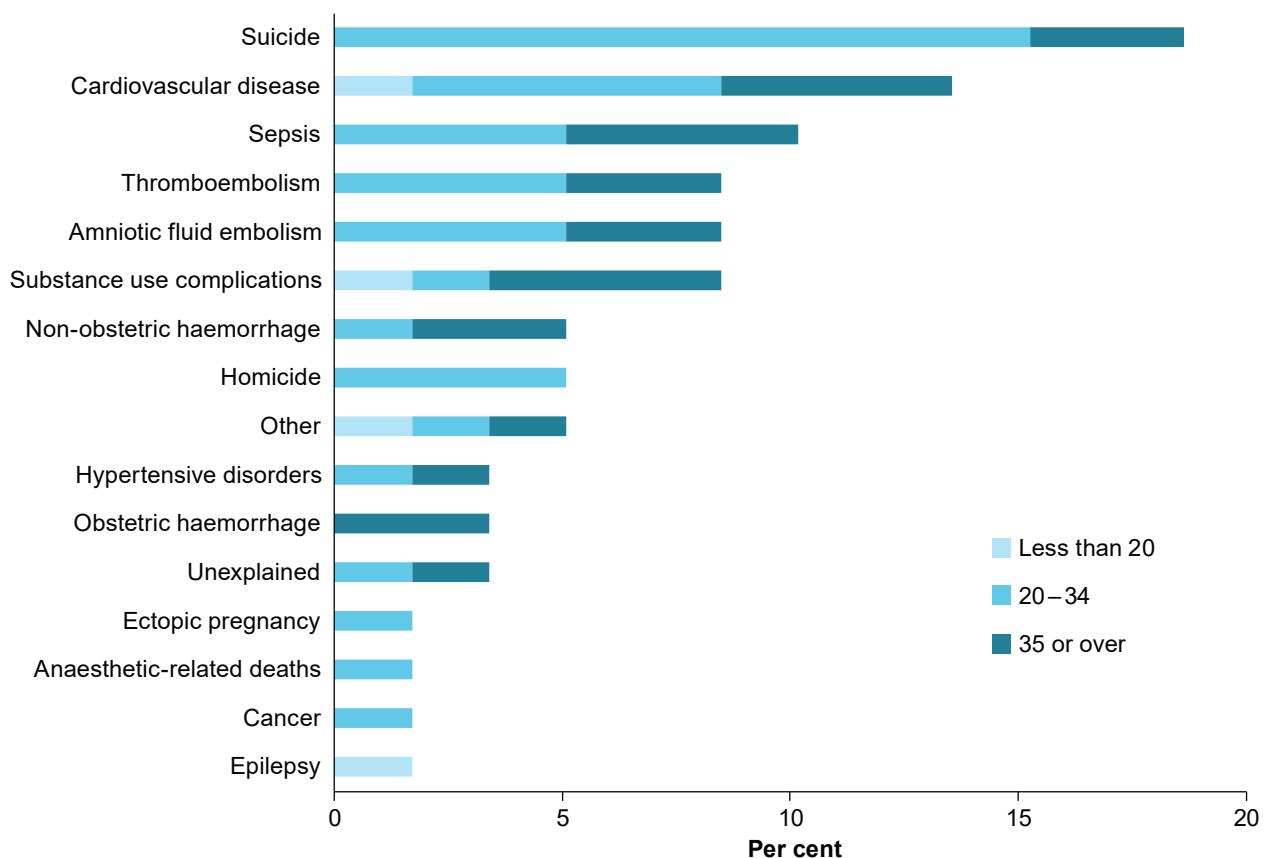
More than half (33; 56%) of the women who died were aged 20–34, 22 (37%) were aged 35 or over, and 4 (7%) were aged less than 20 (Figure 5.2).

The most common cause of death for women aged 20–34 was suicide (9 deaths), followed by cardiovascular disease (4 deaths).

By contrast, the most common causes of death for women aged 35 or over were cardiovascular disease (3), substance use complications (3), and sepsis (3).

It is not possible to identify the most common cause of death for women aged less than 20, due to the small number of women of this age giving birth.

**Figure 5.2: Causes of maternal deaths, by maternal age, 2015–2017**



Note: Data for this figure are in Supplementary Table 17.

## Causes of death, by parity

Parity was stated for 55 of the women who died. Of those:

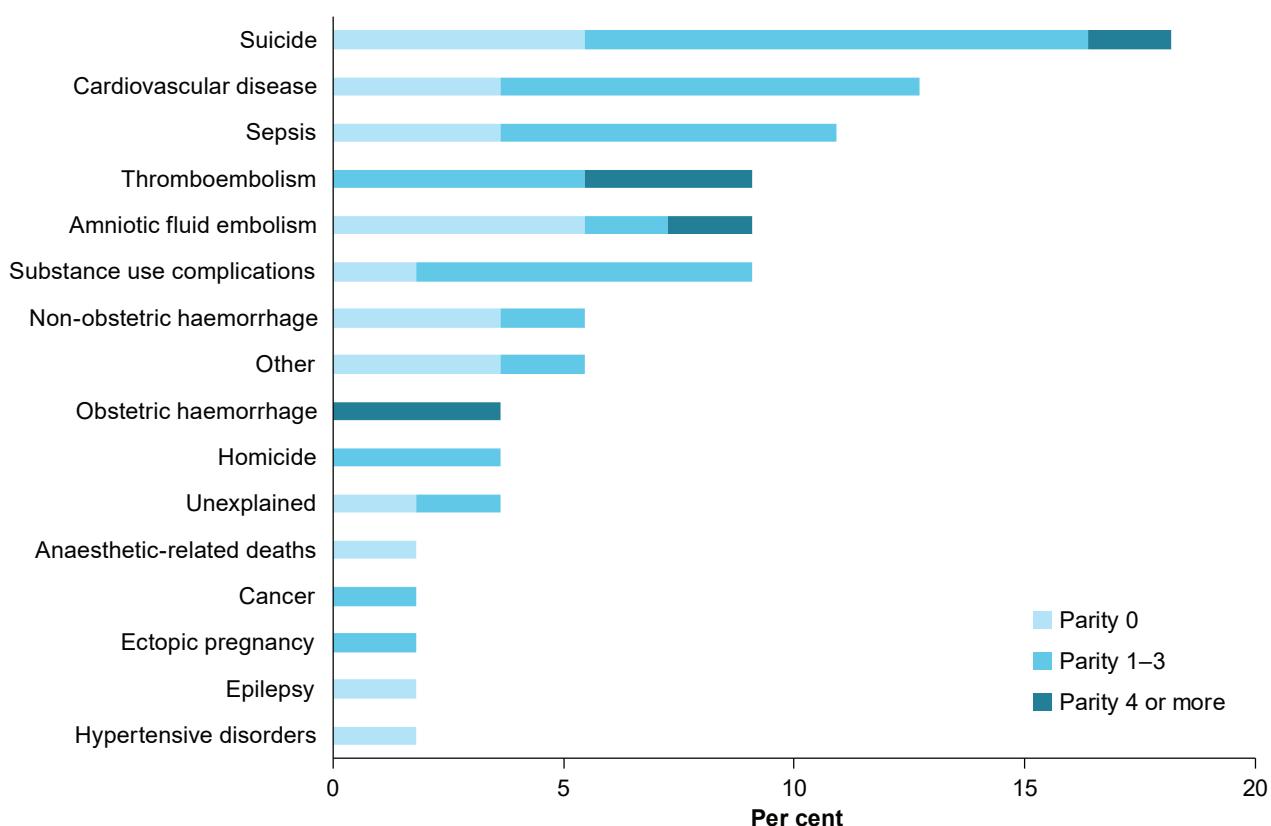
- 19 (35%) occurred in women with a parity of 0
- 30 (55%) occurred in women with a parity of 1–3
- 6 (11%) occurred in women with a parity of 4 or more (Figure 5.3).

The most common causes of death by parity were:

- suicide and amniotic fluid embolism in women with a parity of 0
- suicide and cardiovascular disease in women with a parity of 1–3
- obstetric haemorrhage and thromboembolism in women with a parity of 4 or more.

In 2015–2017, all deaths among women with a parity of 4 or more were directly related to the pregnancy.

**Figure 5.3: Causes of maternal deaths, by parity, 2015–2017**



### Notes

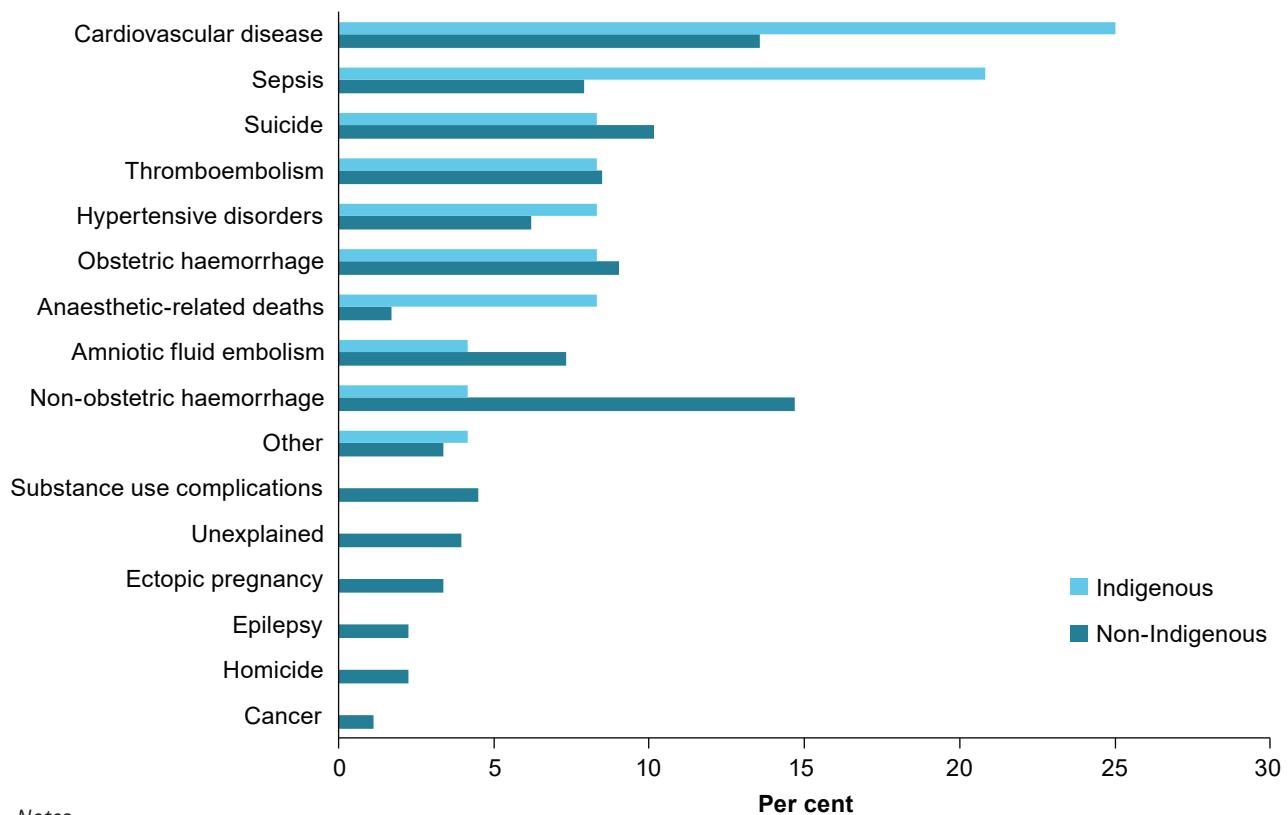
1. Data for this figure are in Supplementary Table 17.
2. Excludes 4 maternal deaths where parity was not stated.

## Causes of death, by Indigenous status

In 2006–2017, there were 24 maternal deaths of Indigenous women. The most common causes of death for Indigenous women were cardiovascular disease (25%) and sepsis (21%).

Due to the relatively small number of Indigenous women in the NMMDC, data for 2006–2017 are shown.

**Figure 5.4: Causes of maternal death, by Indigenous status, 2006–2017**



### Notes

1. Data for this figure are available in Supplementary Table 18.
2. Excludes 27 maternal deaths where Indigenous status was not stated.
3. Anaesthetic-related deaths were not classified separately before 2012.
4. Data were not available for Western Australia for all years.

## Trends in causes of maternal deaths

The major causes of maternal death in 1973–1975 were sepsis, cardiovascular disease, hypertensive disorders, obstetric haemorrhage, and thromboembolism.

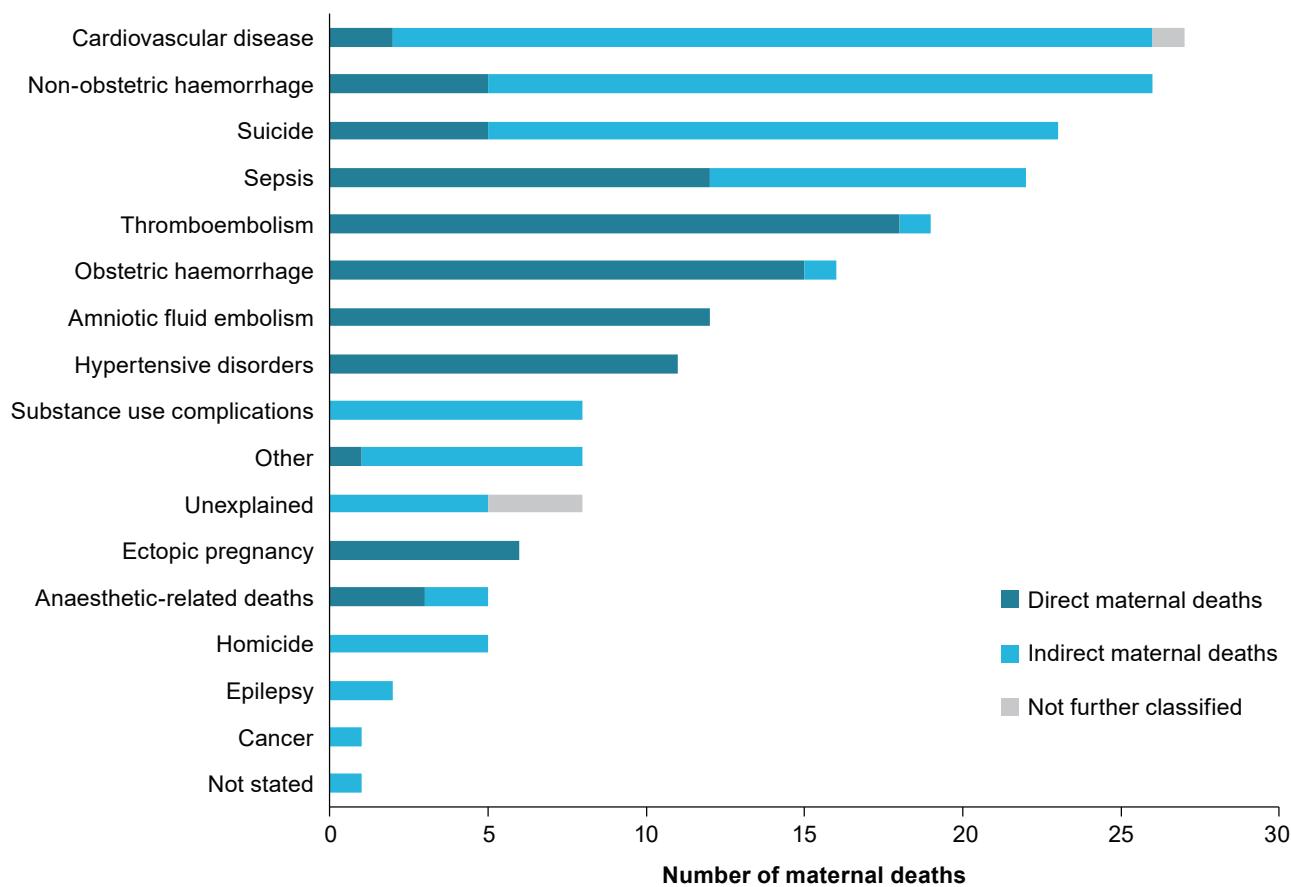
The MMR for most of these conditions (sepsis, cardiovascular disease, hypertensive disorders, and obstetric haemorrhage) has been falling over time. This is consistent with the overall decrease in MMR in Australia. In contrast to the other major groups, deaths due to suicide have not decreased. (Supplementary Table 19).

In the decade from 2008–2017, there were 200 maternal deaths. The most common cause of maternal death in this period was cardiovascular disease, followed by non-obstetric haemorrhage and suicide (Figure 5.5).

The most common cause of direct maternal death over the decade was thromboembolism, followed by obstetric haemorrhage, amniotic fluid embolism and sepsis.

The most common cause of indirect maternal death over the decade was cardiovascular disease, followed by non-obstetric haemorrhage and suicide.

**Figure 5.5: Causes of maternal death, by type of death, 2008–2017**



Note: Data for this figure are available in Supplementary Table 20.

## Suicide

Deaths categorised as suicide are those where the available evidence suggested that the woman died as a result of intentional self-harm.

Maternal deaths due to suicide are classified as direct maternal deaths where maternal mental health issues that first presented during pregnancy were identified before the suicide.

Maternal deaths due to suicide are classified as indirect maternal deaths where a mental health condition was identified before the pregnancy.

This approach to classification, developed by the National Maternal Mortality Advisory Committee in 2017, differs from that of the WHO, which recommends that all deaths due to suicide be classified as direct deaths (Pattinson et al. 2009).

In 2015–2017, 11 maternal deaths were due to suicide (supplementary tables 14, 15, and 16). The MMR for deaths due to suicide in that period was 1.2 per 100,000 women who gave birth. Maternal deaths due to suicide were most common in women aged 25–34, and those with a parity of 1–3.

In the decade 2008–2017, 23 maternal deaths due to suicide were recorded, with an MMR of 0.8 per 100,000 women who gave birth for that period.

In 2015–2017, suicide was the leading cause of death in Australian women aged 15–44, with 1,107 deaths (ABS 2018). The incidence of suicide among Australian women varied from 6.8 per 100,000 women aged 15–24 to 8.1 per 100,000 women aged 35–44.

## Cardiovascular disease

Deaths caused by cardiovascular disease have their primary origin in either new or existing disease processes in the heart or major blood vessels. New disease processes include cardiomyopathy of pregnancy (inflammation of the heart muscle). Existing disease processes include congenital heart malformations and rheumatic heart valve lesions.

Cardiovascular disease is one of the most common causes of death during pregnancy in industrialised countries. Pregnancy might reveal or exacerbate previously undiagnosed cardiovascular disease, due to the physiological changes that occur. Older mothers are at increased risk of heart disease, especially when obesity, smoking, diabetes, and hyperlipidaemia (high blood lipid levels) coexist with advanced maternal age.

In 2015–2017, there were 8 maternal deaths from cardiovascular causes. Cardiovascular disease was the most common cause of indirect maternal death for this period (supplementary tables 14, 15, and 16). The MMR for cardiovascular deaths in that period was 0.9 per 100,000 women who gave birth.

A total of:

- 3 deaths were related to cardiomyopathy
- 2 to apparent arrhythmic events
- 1 to a thrombosed prosthetic heart valve
- 1 to complications of ischaemic heart disease
- 1 to the rare condition of pulmonary capillary haemangiomatosis.

In the decade 2008–2017, 27 women died from cardiovascular disease, with an MMR of 0.9 per 100,000 women who gave birth for that period.

## Sepsis

Deaths caused by sepsis have their primary origin in infection. Infection might arise from complications of the pregnancy, such as retained products of conception after an early pregnancy loss, chorioamnionitis in late pregnancy, or infection elsewhere in the mother's body, such as H1N1 influenza.

In 2015–2017, there were 6 maternal deaths due to sepsis (supplementary tables 14, 15, and 16). The MMR for deaths due to sepsis in that period was 0.7 per 100,000 women who gave birth. Of those sepsis deaths, 4 were not related to caesarean section; the causes were *E. coli* septicaemia secondary to chorioamnionitis, group A streptococcal sepsis related to an ascending genital tract infection, bacterial meningitis, and meningococcal sepsis. Additional information about the remaining 2 deaths due to sepsis was not provided to the NMMDC.

In the decade 2008–2017, there were 22 maternal deaths from sepsis, with an MMR of 0.7 per 100,000 women who gave birth for that period.

## Amniotic fluid embolism

Deaths caused by amniotic fluid embolism start with the effects of amniotic fluid and the fetal cells that it contains entering the maternal circulation, leading to severe shock, obstructed pulmonary blood flow, poor oxygen exchange, and severe clotting failure. Diagnosis is usually possible only by microscopic demonstration at autopsy of fetal cells and other debris within the mother's major blood vessels.

In 2015–2017, 5 maternal deaths were caused by amniotic fluid embolism (supplementary tables 14, 15, and 16). The MMR for death due to amniotic fluid embolism in that period was 0.5 per 100,000 women who gave birth. The women who died from amniotic fluid embolism were all aged 30 or over.

In the decade 2008–2017, there were 12 maternal deaths from amniotic fluid embolism, with an MMR of 0.4 per 100,000 women who gave birth for that period.

## Thromboembolism

Deaths caused by thromboembolism start with the effects of blood clots travelling from a point of origin in the circulation to obstruct major blood vessels. The most common example is pulmonary thromboembolism with obstruction of the major pulmonary arteries.

In 2015–2017, 5 maternal deaths were due to thromboembolism (supplementary tables 14, 15, and 16). The MMR for deaths due to thromboembolism in that period was 0.5 per 100,000 women who gave birth. All of these deaths were classified as direct. The women who died from pulmonary thromboembolism were aged 25–39. In most cases, information was not available about the use of preventive measures, such as thromboprophylaxis and/or thrombolysis.

In the decade 2008–2017, there were 19 maternal deaths from thromboembolism, with an MMR of 0.6 per 100,000 women who gave birth for that period.

## Substance use complications

Deaths caused by complications arising from substance use are those that can be attributed to the effects of alcohol or other drug use, as determined by toxicology or pathology reports.

Some deaths due to substance use complications may be classified as coincidental to pregnancy, so are not counted as maternal deaths. But if the available information suggests that pregnancy might have been influential in the death, it may be classified as an indirect maternal death.

In 2015–2017, there were 5 maternal deaths due to substance use complications (supplementary tables 14, 15, and 16). The MMR for deaths due to substance use complications in that period was 0.5 per 100,000 women who gave birth.

In the decade 2008–2017, there were 8 maternal deaths from substance use complications, with an MMR of 0.3 per 100,000 women who gave birth for that period.

## Non-obstetric haemorrhage

Deaths caused by non-obstetric haemorrhage start with bleeding arising from maternal blood vessels that are not within the genital tract. Most maternal deaths that fall into this category are related to intracerebral haemorrhage or rupture of an aneurysm of the splenic artery.

Intracerebral haemorrhage occurs when a blood vessel within the brain bursts, allowing blood to leak into the substance of the brain. This increases pressure in the brain and damages the brain cells surrounding the blood vessel, potentially leading to unconsciousness or death.

The cause of splenic artery aneurysm, and the strong association of aneurysmal rupture with pregnancy, is unclear (Sadat et al. 2008). Hormonal influences in pregnancy and the increased cardiac output in pregnancy have been suggested as being responsible for increasing the likelihood of aneurysm formation and/or rupture during pregnancy, by respectively weakening the arterial wall and increasing the blood pressure. Rupture of a splenic artery aneurysm in pregnant women is unusual, and typically presents as sudden, unexpected severe abdominal pain, followed by death.

In 2015–2017, 3 maternal deaths were due to non-obstetric haemorrhage between (supplementary tables 14, 15, and 16). The MMR for deaths due to non-obstetric haemorrhage in that period was 0.3 per 100,000 women who gave birth. These 3 deaths were all caused by intracerebral haemorrhage. The women were all aged 25 or over, and had a parity of 0–3.

In the decade 2008–2017, 26 maternal deaths were caused by non-obstetric haemorrhage, with an MMR of 0.9 per 100,000 women who gave birth for that period.

## Homicide

Deaths included in this category are those where the available evidence suggested that the woman was killed by another person.

In 2015–2017, 3 maternal deaths were due to homicide (supplementary tables 14, 15, and 16), with an MMR of 0.3 per 100,000 women who gave birth in that period.

In the decade 2008–2017, there were 5 maternal deaths caused by homicide, with an MMR of 0.2 per 100,000 women who gave birth for that period. All of these deaths were classified as indirectly related to pregnancy. Of those 5 deaths, 4 were reported as being related to family violence. The remaining death did not provide enough information to determine whether it was related to family violence.

Deaths due to homicide are often classified as coincidental to pregnancy, so are not classified as maternal deaths. But if the available information suggests that pregnancy might have been influential in the death, it may be classified as an indirect maternal death.

## Hypertensive disorders

Deaths caused by hypertensive disorders start with the effects of raised blood pressure. The most common deaths in this category relate to pre-eclampsia and its complications, such as HELLP syndrome and intracerebral haemorrhage. The Society of Obstetric Medicine of Australia and New Zealand defines hypertension in pregnancy as systolic blood pressure greater than or equal to 140 mmHg, and/or diastolic blood pressure greater than or equal to 90 mmHg (Lowe et al. 2015). Severe hypertension requiring urgent treatment is defined as a systolic blood pressure greater than or equal to 170 mmHg with or without diastolic blood pressure greater than or equal to 110 mmHg.

In 2015–2017, there were 2 maternal deaths due to hypertensive disorders (supplementary tables 14, 15, and 16). The MMR for deaths due to hypertensive disorders in that period was 0.2 per 100,000 women who gave birth. These women were aged 30 or over. One woman had a parity of 0, and the parity was not stated for the second woman.

In the decade 2008–2017, 11 maternal deaths were caused by hypertensive disorders, with an MMR of 0.4 per 100,000 women who gave birth for that period.

## Obstetric haemorrhage

Deaths caused by obstetric haemorrhage start with bleeding from the genital tract or uterus, either during pregnancy or following birth.

Deaths due to obstetric haemorrhage have been declining fairly steadily in Australia over the past 30 years (Supplementary Table 18).

In 1973–1975, the MMR for deaths due to obstetric haemorrhage was 1.7, falling to 0.2 in 2015–2017. The advent of oxytocic drugs has contributed to the reduction in this pregnancy complication (Begley et al. 2019).

In 2015–2017, there were 2 maternal deaths due to obstetric haemorrhage (supplementary tables 14, 15, and 16). Both deaths were due to postpartum haemorrhage, and both women were aged 35 or over, and had a parity of 4 or more.

In the decade 2008–2017, 16 maternal deaths were caused by obstetric haemorrhage, with an MMR of 0.5 per 100,000 women who gave birth for that period.

## Ectopic pregnancy

An ectopic pregnancy is where a fertilised egg implants at a site other than in the uterus, most commonly in the fallopian tube. If not treated, ectopic pregnancies can rupture, causing internal bleeding, infection, and potentially death.

In 2015–2017, there was 1 maternal death due to an ectopic pregnancy (supplementary tables 14, 15, and 16). The MMR for deaths in early pregnancy in that period was 0.1 per 100,000 women who gave birth.

In the decade 2008–2017, 6 maternal deaths were caused by ectopic pregnancies, with an MMR of 0.2 per 100,000 women who gave birth for that period.

The denominator for the calculation of MMR is the number of women who gave birth, rather than the number of women who had a pregnancy. This is because the number of non-progressing early pregnancies, miscarriages, pregnancy terminations, and ectopic pregnancies is unknown.

## Anaesthetic-related deaths

Anaesthetic-related deaths are those where the cause was related to anaesthesia (usually in association with a surgical procedure).

In 2015–2017, 1 maternal death was anaesthesia-related (supplementary tables 14, 15, and 16). This death related to difficulty reversing general anaesthesia, which was required due to a failed regional anaesthetic.

These deaths were not classified separately before 2012. Since the category was established in 2012, there have been 5 maternal deaths due to anaesthetic complications, with an MMR of 0.2 per 100,000 women who gave birth for that period.

## Cancer

Deaths caused by cancer start with the uncontrolled division of cells of a malignant growth or tumour. Typically, deaths caused by cancer during pregnancy or within 6 weeks of the end of pregnancy are classified as coincidental to the pregnancy.

However it is possible for the physiological effects of pregnancy to affect the trajectory or outcome of the disease, and there are rare cancers that arise from a fertilised egg. In such cases, the STMMC may deem the death to be directly or indirectly related to pregnancy.

In 2015–2017, there was 1 indirect maternal death due to cancer (supplementary tables 14, 15, and 16), with an MMR of 0.1 per 100,000 women who gave birth in that period.

This was the only maternal death due to cancer in the decade 2008–2017, with an MMR of 0.0 per 100,000 women who gave birth for that period.

## Epilepsy

Epilepsy is a neurological disorder characterised by recurrent seizures caused by sudden abnormal electrical activity in the brain. This results in convulsions, sensory disturbance, or loss of consciousness. A seizure might lead to a disruption in the supply of oxygen to the brain, which can cause injury, brain damage and death.

In 2015–2017, there was 1 maternal death as a result of epilepsy, with an MMR of 0.1 per 100,000 women who gave birth for that period.

Over the 12 years 2006–2017, there have been 5 maternal deaths due to epilepsy, with 4 of these being due to drowning in the bath as a result of epileptic seizures.

Death of pregnant women with epilepsy has been previously commented on (AIHW 2014), with the recommendation that women with epilepsy be provided with advice about the risks of using baths.

## Other causes of maternal deaths

Supplementary tables 14, 15, and 16 provide information about the causes of death, with 3 maternal deaths being from *Other* causes in 2015–2017.

Another 2 maternal deaths in 2015–2017 were classified as ‘unexplained’, meaning insufficient information was available to determine a cause of death. Both of these deaths were classified as indirect maternal deaths.

## Causes of coincidental deaths

Coincidental maternal deaths are those that occur in pregnancy or within 42 days of the end of a pregnancy from causes unrelated to the pregnancy.

Internationally, cases of coincidental (incidental) deaths are included in maternal mortality reporting, although only direct, indirect, and unclassified deaths are included in MMR calculations.

In addition to the 59 maternal deaths reported 2015–2017, there were 12 coincidental maternal deaths (Supplementary Table 21).

In 2015–2017, the causes of coincidental maternal deaths were:

- cancer (7)
- motor vehicle accident trauma (4)
- intracerebral haemorrhage (1).

# Appendix A: Data sources and method

## Data used in this report

This report is compiled from data held in the National Maternal Mortality Data Collection (NMMDC). The NMMDC contains information on the deaths of women reported to have died while pregnant or within 42 days of the end of pregnancy between 2006 and 2017.

The NMMDC has been established in the Australian Institute of Health and Welfare (AIHW), and collates data from state and territory sources to be used for national maternal death reports.

The AIHW only receives these jurisdictional data, and does not source, validate or review maternal deaths independently. The state and territory health authorities and other relevant jurisdictional bodies receive clinical data on the women who died from patient administrative and clinical records. The data also go to the STMMCs where death reviews are undertaken.

A confidential enquiry into each of the maternal deaths that occurred in 2015–2017 was done by 7 separate STMMCs. The Northern Territory did not convene a committee during this period.

The committees operate under legal privilege, and are provided with clinical information and the results of autopsy investigations, where available. The confidential enquiry process seeks to identify and understand the individual circumstances surrounding each death. Subsequently, the STMMC agrees on the causes of each death, and assigns the death to a maternal death category. The organisational and governance arrangements for STMMCs vary between jurisdictions.

There is no standardised method of identifying and collecting data on maternal deaths, and no nationally agreed process of reporting or investigation. The organisational structure—including relevant legislation, policy, and process for maternal death data collection—varies by state and territory. The NMMDC reflects these variations. In all cases, the best available information was used to form the NMMDC.

Data for this publication on the number of women giving birth were sourced from the AIHW's National Perinatal Data Collection. The collection includes the number of women in Australia who gave birth to at least 1 baby (either a live birth or a stillbirth) of 20 weeks' completed gestation or more, or of birthweight of 400 grams or more.

For more information on these collections, see:

- the NMMDC Data Quality Statement at <https://meteor.aihw.gov.au/content/index.phtml/itemId/723402>
- the National Perinatal Data Collection Data Quality Statement at <https://meteor.aihw.gov.au/content/index.phtml/itemId/716326>

## Reporting maternal deaths

Maternal mortality in Australia has been reported nationally since 1964. Reports were triennial until the 2003–2005 period, followed by overlapping quinquennial reports for the periods 2006–2010 and 2008–2012 (AIHW 2014, 2015). Triennial reports recommenced with the period 2012–2014 (AIHW 2017).

Some maternal deaths data are also reported annually on the AIHW website at [www.aihw.gov.au/reports/mothers-babies/maternal-deaths-in-australia/contents/maternal-deaths-in-australia](http://www.aihw.gov.au/reports/mothers-babies/maternal-deaths-in-australia/contents/maternal-deaths-in-australia).

Past *Maternal deaths in Australia* reports were the source of data in this report for years before 2012. Data elements, such as maternal place of residence (and hence remoteness of residence and socioeconomic area), could not be presented with the necessary degree of accuracy for this report due to differing legislative frameworks governing the ability of STMMCs and health departments to share information about maternal deaths and their jurisdictional review.

In several previous *Maternal deaths in Australia* reports, illustrative vignettes were developed from deidentified case information designed to protect anonymity. But jurisdictional health privacy legislation, and its interpretation, has progressively changed over time, and sufficient clinical detail is no longer available to enable case vignettes to be published.

Unit record data on maternal deaths in Western Australia were not supplied to the NMMDC. Due to health privacy legislation in Western Australia, only limited aggregate maternal deaths data are provided to the AIHW for inclusion in the report.

## The Australian maternity context

Maternity services in Australia are provided by 8 state and territory health departments and private providers. Each state and territory has differing care provision systems and care available to pregnant women and their babies.

A national review of maternity services was carried out in Australia in 2008. This resulted in a report that aimed to identify key gaps in maternity care (DoH 2009), and inform development of the first National Maternity Services Plan (AHMC 2011). The plan aimed to maintain Australia's high standard of maternity and perinatal care, while seeking to improve women's access to services and choice in care.

Under the auspices of the Council of Australian Government (COAG) Health Council, a new national strategic approach to maternity services was released in 2019 (COAG Health Council 2019). This document indicates that 3 areas inform shared decision-making between the woman and maternity service providers. These are:

- a woman's preference
- evidence as it applies to the woman
- the context of care provision.

A requirement for women to be provided with access to evidence about their care is clear throughout that document, and one of the key outcomes quoted is reducing the incidence of maternal mortality. The AIHW is specifically referenced as one of the agencies that can help provide such evidence for women and their families.

## The international context

The WHO estimates that worldwide 300,000 women die each year from complications of pregnancy and childbirth (WHO 2015).

Australia was a signatory to the United Nations Millennium Development Goals, which formed an international blueprint aimed at reducing poverty, hunger, and disease by 2015. The fifth goal was 'improve maternal health', and was stated as 'reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio' (UN 2010).

The global MMR dropped by almost 44% between 1990 and 2015, from 385 to 216 deaths per 100,000 live births (WHO 2015). But many low to middle resource countries did not meet the target.

United Nations Sustainable Development Goal 3, adopted by world leaders in September 2015, is to reduce the global MMR to fewer than 70 per 100,000 births by 2030, with no country having a rate more than twice the global average.

## Identifying Aboriginal and Torres Strait Islander women

An Aboriginal and Torres Strait Islander woman is defined, for Australian health data collections, as a woman of Aboriginal and/or Torres Strait Islander descent, who identifies herself as such. Information on the Indigenous status of the women who died is collected as part of the NMMDC, and has been analysed in this report.

The quality of data collected on Indigenous status (as measured by the proportion of individuals where Indigenous status was not stated) has improved in most data collections since the AIHW's 2007 data quality report (AIHW 2012).

Since the 2007 report, various activities have been, or are being, undertaken to better identify Indigenous Australians in community services' data collections. These include:

- modifying client forms and client information management systems
- providing staff training, including cultural awareness training
- providing training on how to collect Indigenous status data.

## Deaths by suicide

In 2011 and 2012, the WHO recommended classifying all maternal suicidal deaths as direct maternal deaths (Pattinson et al. 2009).

However in 2012, the National Maternal Mortality Advisory Committee, with advice from the Royal Australian and New Zealand College of Psychiatrists, concluded that puerperal psychosis, which may be related to 'a dramatic change in hormone levels after the end of pregnancy' is extremely rare.

The committee further concluded that:

- deaths in situations with clear evidence of a preexisting mental health disorder were to be classified as indirect deaths
- suicidal deaths of women with previously undiagnosed severe mental health illness and no pre-existing condition were to be classified as direct deaths.

## Remoteness area

Remoteness area is a classification used to divide Australia into 5 classes of remoteness (*Major cities*, and *Inner regional*, *Outer regional*, *Remote*, and *Very remote* areas), reflecting the relative access to services in those areas.

In this report, the remoteness area of usual residence has been derived by applying the ABS's Australian Statistical Geography Standard (ASGS) remoteness structure to the area of the mother's usual residence, indicated by postcode.

This was only calculated where the postcode of usual residence was provided. The ASGS is updated every 5 years. For this report:

- 2011 ASGS classifications were used for 2015 and 2016
- 2016 ASGS classifications were used for 2017.

In calculating the remoteness of area of usual residence for maternal deaths covered by this report, where a postcode included areas in more than one remoteness area category, the category making up the largest proportion of that postcode was chosen. For example, if 75% of a woman's postcode was in the *Inner regional* category and 25% was in the *Outer regional* category, the postcode would be assigned to the *Inner regional* category.

In calculating the remoteness of usual residence for women giving birth in 2015–2017, where a postcode was located entirely within one remoteness area category, that category was assigned a value of 1.

Where a postcode included areas in more than one remoteness area category, that category was assigned a decimal value to reflect the proportion of the postcode in that remoteness category.

For example, if 75% of a postcode was in the *Inner regional* category and 25% was in the *Outer regional* category, those categories would be assigned a value of 0.75 and 0.25, respectively. The number of women giving birth in each remoteness category is the sum of these values, rounded to the nearest 1.

## Socioeconomic area

Socio-Economic Indexes for Areas is a set of indices, produced by the ABS, that aim to represent the social and economic characteristics of Australian communities, and identify areas of relative advantage and disadvantage.

The index value reflects the overall or average level of disadvantage of the population of an area; it does not show how individuals living in the same area differ from each other.

Each index focuses on a different aspect of socioeconomic advantage and disadvantage. This report uses the Index of Relative Socio-Economic Disadvantage (IRSD), which focuses on variables that show relative disadvantage, and ranks areas from most to least disadvantaged in 5 categories (fifths).

In this report, the level of socioeconomic disadvantage of the area of usual residence has been derived by applying the relevant IRSD fifth to the area of mother's usual residence, indicated by postcode data. This was only calculated where the state and postcode of usual residence was provided.

Socio-Economic Indexes for Areas is based on information from the Census, and updated every 5 years. For this report:

- 2011 IRSD fifths were used for 2015 and 2016
- 2016 IRSD fifths were used for 2017.

# Appendix B: National Maternal Mortality Data Collection project governance

## The National Maternity Services Plan

In 2008, a national review of maternity services was undertaken in Australia, led by the Australian Government Chief Nurse and Midwifery Officer. The findings were presented in 2009 in *Improving maternity services in Australia: the report of the Maternity Services Review* (DoH 2009). The report aimed to identify key gaps in maternity care, and inform development of the first National Maternity Services Plan (AHMC 2011).

The National Maternity Services Plan was launched in February 2011, and set out a 5-year vision for maternity care. It provided a strategic national framework to guide policy and program development across Australia (AHMC 2011). Though the plan's 5-year period has ended, its guiding principles continue to be observed.

The plan aimed to maintain Australia's high standard of maternity and newborn care, while seeking to improve access to services and choice in care. This includes increasing and supporting the maternity workforce, strengthening infrastructure, and building the evidence base of what works well in Australia.

In particular, the plan's priority areas were to:

- meet the needs of women and their families living in rural and remote areas
- improve birth outcomes for Aboriginal and Torres Strait Islander people
- meet the requirements of women and babies who are vulnerable due to medical or other risk factors.

The plan targeted primary maternity services during the antenatal, intrapartum, and 6-week postnatal period for both women and babies (AHMC 2011).

In 2011, the Australian Government provided funding for the NMDDP.

At the Australian Health Minister's Advisory Council meeting in September 2017, it was agreed to start a new process to develop a National Strategic Approach to Maternity Services.

Members agreed that the work would be led by the Australian Government, and include all jurisdictions in a time limited Project Reference Group.

As a result, a new national strategy—*Woman-centred care: strategic directions for Australian maternity services*—was released on 5 November 2019 (COAG Health Council 2019).

## National Maternity Data Development Project

The NMDDP was set up in response to Recommendation 1 of the the Natinal Maternity Services Plan. The primary aims of the NMDDP are to develop a nationally consistent and comprehensive maternal and perinatal mortality and morbidity data collection in Australia.

High-quality and nationally consistent data are required to assess the safety and outcomes of current and emerging models of maternity care in Australia. These will enable disparities in health outcomes for population subgroups to be monitored and compared with the general population. The project is managed by the NMDDP Advisory Group. Reports on stages of the NMDDP process have been published at [www.aihw.gov.au/reports/mothers-babies/enhancing-maternity-data-collection-and-reporting](http://www.aihw.gov.au/reports/mothers-babies/enhancing-maternity-data-collection-and-reporting).

# National Maternal and Perinatal Mortality Clinical Expert Group

The National Maternal and Perinatal Mortality Advisory Group was convened in 2015 to provide guidance and national relevance to the development of the national *Maternal deaths in Australia* and *Perinatal Deaths in Australia* reports.

It is a subcommittee of the NMDDP Advisory Group. The group provided expert advice on the development of *Maternal deaths in Australia 2012–2014*.

In 2019, the group was divided into:

- a group providing AIHW with expert clinical advice—the National Maternal and Perinatal Mortality Clinical Expert Group
- a group providing expert data management advice—the National Perinatal Data Development Committee.

These committees will continue to provide guidance on current and future *Maternal deaths in Australia* and *Perinatal deaths in Australia* reports.

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The support of the State and Territory Maternal Mortality Committees, which undertake confidential review of maternal deaths, and the state and territory data managers and staff, who compile the cases, has been invaluable.

The authors would like to acknowledge the families and loved ones whose losses are documented in this report, and express their sincere condolences to them. Every maternal death is a tragedy, and the aim of investigating and reporting maternal deaths is to help find answers for those who experience such loss personally and for the health-care professionals involved.

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# Abbreviations

ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
ASGS	Australian Statistical Geography Standard
BMI	body mass index
ICD-10	International Statistical Classification of Diseases and Related Health Problems, 10th revision
IRSD	Index of Relative Socio-Economic Disadvantage
mmHg	millimetre of mercury
MMR	maternal mortality ratio
NMDDP	National Maternity Data Development Project
NMMDC	National Maternal Mortality Data Collection
STMMCs	State and Territory Maternal Mortality Committees
UI	uncertainty interval
WHO	World Health Organization

# Symbols

..	not applicable
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# Glossary

This glossary provides further information and definitions for some terms and clinical classifications used in this report. General terms about pregnancy and birth are further defined at [www.aihw.gov.au/reports-data/population-groups/mothers-babies/glossary](http://www.aihw.gov.au/reports-data/population-groups/mothers-babies/glossary).

**Aboriginal and Torres Strait Islander:** A person of Aboriginal and/or Torres Strait Islander descent, who identifies as an Aboriginal and/or Torres Strait Islander. See also **Indigenous**.

**amniotic fluid embolism:** A rare obstetric emergency in which amniotic fluid, fetal cells, hair, or other debris enter the maternal circulation, causing cardiorespiratory collapse.

**anaesthetic-related death:** Deaths where the cause was related to anaesthesia (usually in association with a surgical procedure).

**aneurysm:** A localised swelling of the wall of an artery.

**arrhythmia:** A disturbed rhythm of the heartbeat—too fast, too slow, or irregular.

**assisted vaginal birth:** A method of birth in which instruments (forceps or vacuum extraction) are used to assist the woman to give birth to her baby via the vagina.

**autopsy:** A **postmortem** examination to discover the cause of death or the extent of disease.

**cancer:** A generic term relating to diseases in which abnormal cells divide uncontrollably and destroy body tissue (also known as malignancy).

**cardiomyopathy:** Inflammation of the heart muscle.

**cardiovascular:** Relating to the heart and/or major blood vessels.

**coincidental maternal death:** Deaths that happen to occur in pregnancy or the **puerperium**, but that are not related to the pregnancy or its management.

**direct maternal death:** Death resulting from complications of the pregnant state (pregnancy, labour, and **puerperium**) from interventions, omissions, incorrect treatment, or a chain of events resulting from any of those.

**early pregnancy:** The first 13 weeks of pregnancy; the first trimester of pregnancy.

**eclampsia:** The occurrence of 1 or more convulsions not caused by other conditions, such as epilepsy or cerebral haemorrhage, in a woman with pre-eclampsia. The onset of convulsions may be preceded by a sudden rise in blood pressure and/or a sudden increase in oedema and development of oliguria.

**ectopic pregnancy:** The development of a fertilised egg at a site other than in the uterus. This might happen if the fertilised egg cell remains in the ovary or in the tube leading from near the ovary to the uterus (the fallopian tube), or if it lodges in the free abdominal cavity.

**embolism:** The condition in which an embolus becomes lodged in an artery, and obstructs its blood flow. The most common form of embolism is **pulmonary embolism**, in which a blood clot is carried in the circulation to lodge in the pulmonary artery.

**epilepsy:** A disturbance of brain function marked by recurrent fits and loss of consciousness.

**HELLP syndrome:** A severe complication of pre-eclampsia characterised by **Haemolysis**, **Elevated Liver enzymes** and **Low Platelet count**; the syndrome name is an abbreviation of the 3 main features of the syndrome.

**hypertension in pregnancy:** Systolic blood pressure of 140 mmHg or more, and/or diastolic blood pressure of 90 mmHg or more. **Severe hypertension** is defined as a systolic blood pressure of 170 mmHg or more with or without diastolic blood pressure of 110 mmHg or more.

**hypertensive disorders:** A group of disorders related to high blood pressure in pregnancy, including pre-eclampsia, eclampsia, gestational hypertension, and chronic hypertension.

**Indigenous:** A person of Aboriginal and/or Torres Strait Islander descent, who identifies as an Aboriginal and/or Torres Strait Islander. See also **Aboriginal and Torres Strait Islander**.

**indirect maternal death:** Death resulting from existing diseases or diseases that developed during pregnancy, and which were not due to a direct obstetric cause, but were aggravated by the physiologic effects of pregnancy.

**intracerebral:** Within the brain tissue.

**intrapartum:** Occurring during childbirth or during the birth process.

**in-utero:** In a woman's uterus, before birth.

**ischaemic heart disease:** Disease characterised by narrowed coronary arteries, causing reduced blood supply to the heart, which can in turn cause heart attack and angina. Also known as coronary heart disease.

**live birth:** The birth of a baby who is greater than or equal to 20 weeks' gestation or 400 grams birthweight at birth who show signs of life such as voluntary muscle movement, pulsating of the umbilical cord or presence of a heartbeat at birth, regardless of whether the placenta is still attached or the umbilical cord has been cut.

**maternal death:** The death of a woman while pregnant or within 42 days of the end of pregnancy, irrespective of the duration and the site of the pregnancy. Death can be from any cause related to or aggravated by the pregnancy or its management, but not from accidental or coincidental causes.

**maternal mortality ratio (MMR):** The number of direct and indirect maternal deaths per 100,000 women giving birth.

**morbidity:** Ill health in an individual; levels of ill health in a population or group.

**National Maternal and Perinatal Mortality Advisory Group:** The expert advisory group providing advice to the AIHW about maternal and perinatal deaths in Australia.

**National Maternal Mortality Data Collection (NMMDC):** Data provided by states and territories to AIHW for collation on Australian maternal deaths.

**non-Indigenous:** People who have indicated they are not of Aboriginal or Torres Strait Islander descent.

**non-obstetric haemorrhage:** Haemorrhage in pregnancy from blood vessels other than those in the genital tract; most commonly, haemorrhage from a ruptured blood vessel in the brain or in the abdomen (the splenic artery).

**obstetric haemorrhage:** Haemorrhage from the female genital tract, encompassing both antepartum (during pregnancy and before birth) and **postpartum** bleeding.

**parity:** A woman's number of previous pregnancies carried to a viable gestational age (usually 20 weeks), resulting in live births or stillbirths and excluding the current pregnancy.

**perimortem:** At or near the time of death.

**postmortem:** Occurring after death.

**postnatal:** Occurring after birth, with reference to the newborn.

**postpartum:** Occurring after childbirth, with reference to the mother.

**puerperium:** The period of time up to 6 weeks after childbirth, during which the uterus returns to its normal size.

**pulmonary:** Relating to the lungs.

**sepsis:** A bacterial or viral infection in the bloodstream or body tissues.

**State and Territory Maternal Mortality Committees (STMMCs):** Committees in each state and territory of Australia that review maternal deaths in that jurisdiction.

**stillbirth (fetal death):** Death before the complete expulsion or extraction from its mother of a baby of 20 or more completed weeks of gestation, or of 400 grams or more birthweight. The death is indicated by the fact that after such separation, the fetus does not breathe or show any other evidence of life, such as beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles.

**suicide:** Deliberately ending one's own life.

**termination of pregnancy (abortion):** A surgical or medical process of ending a pregnancy so that it does not result in the birth of a baby.

**thromboembolism:** The obstruction of a blood vessel (most often the pulmonary blood vessels) by a blood clot that has become dislodged from another site in the circulation.

**triennium:** A specified period of 3 years.

**trimester:** Three-month divisions of the duration of pregnancy.

**unassisted vaginal birth:** Birth without intervention in which the baby's head is the presenting part.

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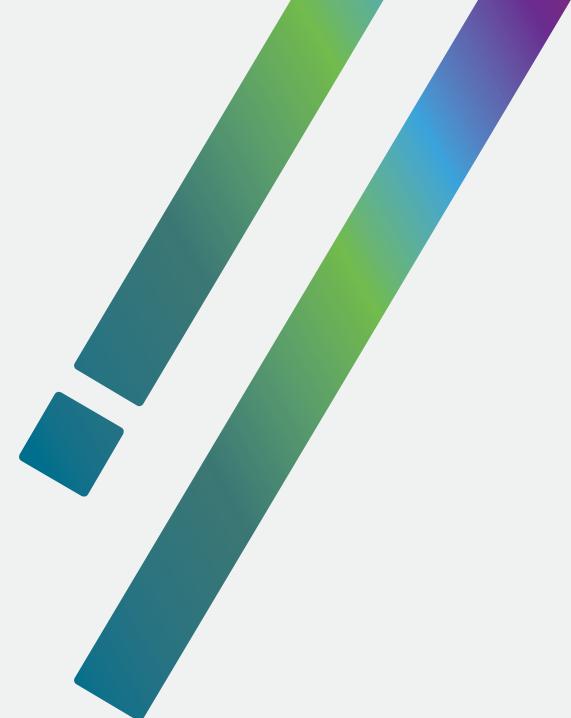
# Related publications

This report, *Maternal deaths in Australia 2015–2017*, is part of a series. The earlier editions and any published subsequently can be downloaded from [www.aihw.gov.au/publications](http://www.aihw.gov.au/publications). The websites also include information on ordering printed copies.

The *Australia's mothers and babies* series can also be downloaded.

The following publications might also be of interest:

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In 2015–2017, the maternal death rate in Australia was 6.4 deaths per 100,000 women giving birth, which is among the lowest rates in the world. The most common causes of maternal death were suicide and cardiovascular disease. The incidence of maternal death in Aboriginal and Torres Strait Islander women was more than 3 times as high as that for non-Indigenous women. More than 1 in 3 maternal deaths occurred in women who were aged 35 or over.

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