



Australian Government

**Australian Institute of
Health and Welfare**



Perinatal deaths in Australia 2013–2014



AIHW



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2013–2014

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The authors of this report would like to acknowledge the families and loved ones whose losses are documented in this report and to express their sincere condolences to them. The loss of a baby causes immeasurable sadness and grief in millions of women, their partners and families around the world. Perinatal deaths are tragic events and the aim of investigating and reporting these deaths is to seek answers for those who experience such loss personally and to assist health-care professionals involved in the care of mothers and their babies in seeking information regarding means by which such devastating events may be less likely in the future.

Abbreviations

ABS	Australian Bureau of Statistics
AHMAC	Australian Health Ministers' Advisory Council
AHMC	Australian Health Ministers' Conference
AIHW	Australian Institute of Health and Welfare
ANC	Antenatal Care
ARIA+	Accessibility/Remoteness Index of Australia
BMI	Body mass index
ICD-10	International Statistical Classification of Diseases and Related Health Problems, Tenth Revision
ICD-PM	The WHO application of ICD-10 to deaths during the perinatal period
DoH	Department of Health, Australian Government
FaHCSIA	Department of Families, Housing, Community Services and Indigenous Affairs
FGR	Fetal growth restriction
IUFD	Intra-uterine fetal death
IUGR	Intra-uterine growth restriction
LGA	Large for gestational age
MDG	United Nations Millennium Development Goal
METeOR	Metadata Online Registry
n	number
NHDD	National Health Data Dictionary
NMDDP	National Maternity Data Development Project
NMDDPAG	National Maternity Data Development Project Advisory Group
NMPMAG	National Maternal and Perinatal Mortality Advisory Group
NMR	Neonatal mortality rate
NPDC	National Perinatal Data Collection
NPESU	National Perinatal Epidemiology and Statistics Unit
NPMDC	National Perinatal Mortality Data Collection

NPMRAC	National Perinatal Mortality Report Advisory Committee
PLR	Plain Language Report
PMMRC	Perinatal and Maternal Mortality Review Committee, New Zealand
PNMDS	Perinatal National Minimum Data Set
PNMR	Perinatal mortality rate
PSANZ	Perinatal Society of Australia and New Zealand
PSANZ-NDC	Perinatal Society of Australia and New Zealand Neonatal Death Classification
PSANZ-PDC	Perinatal Society of Australia and New Zealand Perinatal Death Classification
RCOG	Royal College of Obstetricians and Gynaecologists
SBR	Stillbirth rate
SDG	Sustainable Development Goal
SEIFA	Socio-Economic Indexes for Areas Index of Advantage/Disadvantage
SGA	Small for gestational age
SIDS	Sudden Infant Death Syndrome
TOP	Termination of pregnancy
UN	United Nations
UNICEF	United Nations Children's Fund
WHO	World Health Organization

Symbols

—	nil or rounded to zero
..	not applicable
n.a.	not available
n.p.	not publishable because of small numbers, confidentiality or other concerns about the quality of the data
>	greater than
<	less than
≥	greater than or equal to

Summary

Global estimates from the World Health Organization indicate that in 2010 there were 2.6 million stillbirths, with at least half of all stillbirths occurring during labour and birth, and a further 2.8 million newborn deaths occurring in the first week of life. The majority of these deaths occurred in low to middle income countries.

In the years 2013 and 2014, 622,037 babies were born in Australia and 6,037 of those babies died in the perinatal period (4,419 stillbirths and 1,618 neonatal deaths). The perinatal mortality rate was 9.7 per 1,000 births; the stillbirth (fetal mortality) rate was 7.1 per 1,000 births, and the neonatal mortality rate 2.6 per 1,000 live births. Between 1995 and 2014 there has been some reduction in the neonatal mortality rate, but the stillbirth rate has remained relatively unchanged.

The incidence of perinatal death in Australia was higher for a number of demographic factors, including low birthweight, prematurity, low birthweight for gestational age, babies of women who are of Aboriginal and/or Torres Strait Islander status, have multiple pregnancy, are older or younger, use tobacco in pregnancy, have poor attendance or access to antenatal care, live in more remote areas and are at socio-economic disadvantage. It is beyond the scope of this report to understand the interaction of these various risk factors, but the marked excess of perinatal deaths in babies of women who had little or no antenatal care should be noted in future maternity care policy reviews.

The most common causes of perinatal death were congenital anomaly, unexplained antepartum death and spontaneous preterm birth. Stillbirths were most frequently classified as being related to congenital anomaly, unexplained antepartum death and various maternal conditions that affect the fetus within the intra-uterine environment. Extreme prematurity, congenital anomaly and various neurological conditions were the most frequent causes of neonatal deaths. Extremely pre-term birth was a more prominent cause of perinatal death in Aboriginal and/or Torres Strait Islander babies, while congenital anomaly was less prominent.

This report highlights, in particular, perinatal deaths of singleton mature (37 or more weeks of pregnancy) babies without a congenital anomaly causing death. The most frequent cause of perinatal death in these babies, across all birthweight groups, was unexplained antepartum death. However, it must be noted that the level of investigations performed to be able to determine cause of death is likely to be insufficient. There is no placental assessment in a significant proportion of all perinatal deaths, and no post mortem in more than 50% of such deaths.

This report is limited by incomplete information regarding babies who died in the perinatal period. Of the 397 babies whose birthweight was not recorded in 2013–2014, 139 (35%) were perinatal deaths. Equally, recording of Indigenous status, gestational age, and age at neonatal death was noticeably incomplete.

When considering plans aimed at ending preventable perinatal deaths in Australia, focussed high quality review of stillbirths is a priority. Review of instances where the baby died during labour (intrapartum deaths), and perinatal deaths in singleton births where the baby did not have a lethal congenital anomaly and birth occurred at a mature gestation, are particularly important (RCOG 2017). It is likely that appropriate investigations and careful institutional review of these perinatal deaths may lead to the most effective reviews of policy and practice in maternity and neonatal care (Flenady et al. 2016; RCOG 2017).

1 Introduction

1.1 Background

Stillbirth and death in the first month of life (perinatal death) is not uncommon in Australia, with the perinatal mortality rate in 2013–2014 being 9.7 per 1,000 births. The review of perinatal deaths is an important measure of the care of mothers and their babies.

This is the second report published regarding perinatal deaths in Australia; the first, published in 2016, reported on perinatal deaths in Australia 1993–2012. The purpose of the report is to identify trends in perinatal mortality to inform maternity and newborn services policy and practice.

The Australian context

In 1993, 260,331 babies were born and notified to perinatal data collections in the 8 states and territories of Australia (AIHW 2016), increasing to 312,548 babies born in 2014. Between 1993 and 2014, 61,344 perinatal deaths were recorded in Australia, from 6,069,670 births.

Maternity services in Australia are provided by 8 state and territory health departments and by a number of private providers. Each state or territory has a different system to provide care to pregnant women and their babies.

In 2008, a national review of maternity services was carried out in Australia. 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 to inform development of the first National Maternity Services Plan (AHMC 2011).

The National Maternity Services Plan (the Plan) was launched in February 2011 and set out a 5-year vision for maternity care that provided a strategic national framework to guide policy and program development across Australia (AHMC 2011). The years 2013–2014 were included in this 5-year period.

The purpose of the Plan was to maintain Australia's high standard of maternity and perinatal care while seeking to improve women's access to services and choice in care, which includes increasing and supporting the maternity workforce, strengthening infrastructure and building an evidence base of what works well in Australia.

At the Australian Health Ministers' Advisory Council meeting in September 2017 it was agreed to start a new process to develop a National Strategic Approach to Maternity Services (NSAMS). Members agreed that the work would be led by the Commonwealth and include all jurisdictions in a time-limited Project Reference Group (DoH 2017). This work is currently under way and is expected to be completed late in 2019.

The international context

The World Health Organization (WHO) has estimated that there were 5.4 million perinatal deaths worldwide in 2010, including 2.6 million stillbirths and 2.8 million neonatal deaths (WHO 2010). The majority of these perinatal deaths (approximately 98%) occurred in developing countries.

Australia was a signatory to the United Nations Millennium Development Goals (MDGs), which formed an agreed international blueprint aimed at reducing poverty, hunger and disease by 2015. The fourth MDG was 'Reduce child mortality', and was stated as

'Reduce by two thirds, between 1990 and 2015, the under-five mortality rate' with specific mention of the infant (under 1 year) mortality rate (UN 2015).

In 2014, the WHO released an action plan to end preventable deaths (WHO 2014), which aims to reduce the stillbirth rate to 10 or fewer per 1,000 births and the neonatal mortality rate to 10 or fewer per 1,000 live births by 2035 in every country, and for countries already meeting this target to reduce equity gaps and strive to continue to improve risks of death and disability. While Australia already meets the stillbirth and newborn death rate targets, the issues of equity gaps and continuing improvement need to remain very visible in the minds of all involved in the provision of care to babies and their mothers.

Following on from the Millennium Development Goals, the United Nations released 17 aspirational Sustainable Development Goals (SDGs) in 2016 (UN 2016). An element of SDG goal 3 is 'By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births'. Stillbirth is not mentioned in the SDGs. However, the stillbirth rate has been added to the 2015 WHO list of core health indicators (WHO 2015).

This work has been supported by the various governance committees described in Appendix B.

Purpose of this report

The National Maternity Services Plan Priority Action 2.1 recommended that national maternal and perinatal mortality and morbidity reports be produced, and indicate an expectation that such national systems and processes will drive improved performance in the private and public health-care sectors (AHMC 2011).

This report reviews 2 years of perinatal deaths, in 2013 and 2014, and builds on the inaugural *Perinatal deaths in Australia 1993–2012* report (AIHW 2016).

Detailed examination and reporting of perinatal deaths improves performance in all sectors of the care of mothers and their babies by advancing maternity and newborn care practices and informing policy. Internationally, measuring perinatal mortality enables comparisons of perinatal health outcomes across countries, and may be seen as an indicator of each society's health-care services. Along similar lines to the Sustainable Development Goal 3 mentioned above ('...end preventable deaths...'), particular emphasis is placed on reporting and considering the causation of perinatal deaths of near-term (mature) normally-formed babies.

Where possible, comparisons are made with data contained in the most recent perinatal mortality reports from New Zealand (PMMRC 2016) and United Kingdom (Mankeltow et al. 2015, Draper et al. 2015).

The specific aims of the report were to:

- provide an overview of perinatal mortality from collated information on perinatal deaths in Australia occurring between 1 January 2013 and 31 December 2014
- identify trends in perinatal mortality to inform practice and policy aimed at reducing these deaths
- provide information about known risk factors to assist families who are considering pregnancy
- provide information for women who may be at higher than normal risk of perinatal death or severe morbidity

- identify areas requiring improvement in data quality
- inform national processes for classification of perinatal deaths, providing a basis for consensus in the review of perinatal deaths by perinatal mortality committees at local, regional, state and territory and national levels
- encourage examination of factors contributing to stillbirths and perinatal deaths throughout Australia.

1.2 Definitions and classifications

The definitions of perinatal death, stillbirth and neonatal death differ across jurisdictions and reporting agencies in Australia, and differ even more internationally. The National Health Data Dictionary (NHDD) uses a definition of perinatal deaths that includes all fetal and neonatal deaths of at least 20 weeks' gestation or 400 grams birthweight.

A fetal death is the death of a baby prior to the complete expulsion or extraction from its mother of a product of conception 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. Neonatal death is defined as the death of a live birth that occurs during the first 28 days of life. This may be subdivided into early neonatal deaths, occurring during the first 7 days of life, and late neonatal deaths, occurring after the seventh day but before 28 completed days of life.

This report uses the definitions shown in Table 1.1. The term 'fetal death' is synonymous with stillbirth. Hence the terminology used in this report includes live birth, perinatal death, stillbirth and neonatal death.

Table 1.1: Perinatal death definitions used in this report

Type of death	Definition ^(a)
Stillbirth (fetal death)	A fetal death prior to the complete expulsion or extraction from its mother of a product of conception 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.
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.
Neonatal death	The death of a live-born baby within 28 days of birth. This can be further categorised as early neonatal deaths, which occur 0–6 days after birth, and late neonatal deaths that occur 7–28 days after birth.
Perinatal death	Stillbirth or neonatal death of a baby of 20 or more completed weeks of gestation or of 400 grams or more birthweight.

(a) Definitions from NHDD (AIHW 2015).

Note: Stillbirth does not include terminations of pregnancy performed at gestational ages of less than 20 weeks' gestation; terminations of pregnancy performed at gestational ages of 20 or more weeks are included in perinatal collections and recorded either as stillbirths or, in the unlikely event of showing evidence of life, as live births.

The exact wording of definitions of perinatal death and neonatal death are confusing, as they approach the first 28 days of life from different perspectives. For data collection purposes, the NHDD perinatal data rules state that age at death during the first day of life is called day zero. Hence age at death in the perinatal period under NHDD definitions relates to zero to 27 completed days of life. The Australian Bureau of Statistics (ABS) defines perinatal death as the death of a live-born baby or a fetal death, where the gestation at birth is at least 20

weeks or birthweight is at least 400 grams (ABS 2009) and neonatal death as the death of a live-born baby within 28 completed days of life (ABS 2012).

There are some subtle differences in the rules applied by agencies and different jurisdictions when information about gestational age or birthweight is missing (Li et al. 2013). In South Australia, induced termination of pregnancy is specifically excluded from the definition of stillbirth (South Australia 2011).

Definitions vary internationally such that caution is needed when comparing perinatal mortality rates across jurisdictions. In New Zealand, the definition of stillbirth includes all fetal deaths from 20 weeks' gestational age or 400 grams birthweight if the gestation is unknown: the term 'stillbirth' does not include terminations of pregnancy whilst the term 'fetal death' includes stillbirth and termination of pregnancy (PMMRC 2014). In the United Kingdom neonatal death is defined as the death of a live-born baby (born at 20 weeks' gestation of pregnancy or later or 400 grams where an accurate estimate of gestation is not available and occurring before 28 completed days after birth; however, stillbirth is defined as the birth of a baby from 24+0 weeks' gestation showing no signs of life (Mankeltow et al. 2015). European reports use the definition of deaths at or after 22 completed weeks of gestation or a birthweight of 500 grams or more when gestational age is missing (Euro-Peristat 2010).

The WHO defines the perinatal period as commencing at 22 completed weeks (154 days) of gestation and ending 7 completed days after birth. Stillbirths are defined as weighing 500 grams, or born at or after 22 completed weeks' gestational age, or 25 centimetres crown-heel length if neither birthweight nor gestational age is known (WHO 2011). When data from Australia are compared with those from other countries, these WHO international standards for reporting are applied.

1.3 Measuring perinatal mortality

Perinatal mortality, stillbirth and neonatal mortality rates

Perinatal mortality rates are calculated for all stillbirths and neonatal deaths, including the death of any fetus or a baby greater than or equal to 20 weeks' gestation or 400 grams birthweight up to 27 completed days where the first day of life is termed day zero. The rates of perinatal mortality and stillbirth have different denominators from neonatal mortality.

For stillbirths, the rate is reported as the number of stillbirths in the reference group per 1,000 total births in the reference group. For neonatal mortality, the rate is reported as the number of neonatal deaths in the reference group per 1,000 total *live* births. When reporting overall perinatal mortality, the rate is reported as the total number of stillbirths plus neonatal deaths in the reference group per 1,000 total births.

Calculation of stillbirth rate (SBR)

The stillbirth rate is calculated as the proportion of births in a specified population (defined in time and place) which are stillbirths. This is calculated by dividing the number of stillbirths (numerator) by the number of total births (denominator). This proportion is expressed in relation to all births.

$$\text{Stillbirth rate} = \frac{\text{Number of stillbirths}}{\text{Total number of births}} \times 1,000 \text{ (per 1,000 births)}$$

Calculation of neonatal mortality rate (NMR)

The neonatal mortality rate is calculated as the proportion of births in a specified population (defined in time and place) which are live born and subsequently die (neonatal deaths). This is calculated by dividing the number of neonatal deaths (numerator) by the number of live births (denominator). This proportion is expressed in relation to all live births.

$$\text{Neonatal mortality rate} = \frac{\text{Number of neonatal deaths}}{\text{Number of live births}} \times 1,000 \text{ (per 1,000 live births)}$$

Calculation of perinatal mortality rate (PNMR)

The perinatal mortality rate is calculated as the proportion of births in a specified population (defined in time and place) which are stillbirths or neonatal deaths (perinatal deaths). This is calculated by dividing the number of perinatal deaths (numerator) by the number of total births (denominator). This proportion is expressed in relation to all births.

$$\text{Perinatal mortality rate} = \frac{\text{Number of perinatal deaths}}{\text{Total number of births}} \times 1,000 \text{ (per 1,000 births)}$$

To allow for international comparisons this report includes reference to the WHO recommendation regarding reporting perinatal mortality (WHO 2006) which recommends publication of rates of fetal death, neonatal death and perinatal mortality of babies weighing 1,000 grams or more, or born at 28 weeks or more if birthweight is unknown, per 1,000 total births of babies weighing 1,000 grams or more, or born at 28 weeks or more if birthweight is unknown. Babies without birthweight or gestation are to be included if they have been registered.

Perinatal mortality risk

The gestational age-specific risk of perinatal mortality is the chance of a perinatal death occurring within a specified gestation interval. This is calculated by dividing the number of perinatal deaths occurring within the gestational interval (numerator) by the total number of unborn babies at the start of the interval (denominator). The perinatal mortality risk is expressed as the proportion per 1,000 fetuses remaining in utero.

Calculation of perinatal mortality risk

$$\text{Risk of perinatal death} = \frac{\text{Number of perinatal deaths within a specified gestational age}}{\text{Number of total unborn babies at the start of the period}} \times 1,000$$

While closely related to the perinatal mortality rate as a measure of risk, the perinatal mortality risk examines the chance of a perinatal death occurring at the specified gestational interval, rather than the total number of perinatal deaths per 1,000 births (the rate) that have occurred.

1.4 Investigation of perinatal deaths

When a baby is stillborn or dies in the neonatal period in Australia, clinicians at the hospital where the birth and/or death occurred should undertake an investigation and review of the death. In some instances of neonatal deaths, the coroner will undertake a review. The Perinatal Society of Australia and New Zealand (PSANZ) Clinical Practice Guideline for Perinatal Mortality Audit (PSANZ 2009) was the most frequently used audit methodology throughout Australia in the process of clinical investigation and audit of perinatal death.

Investigation of the death (including clinical tests, examination and autopsy) assists with determining the cause of death, and the recommended methodology is found in Appendix D. The number and type of tests may differ between stillbirths and neonatal deaths and with clinical circumstances.

Following review of a perinatal death, the PSANZ Perinatal Death Classification (PSANZ-PDC) (and in the case of neonatal deaths, the PSANZ Neonatal Death Classification, PSANZ-NDC) classification is used by a multi-disciplinary perinatal mortality review committee, which may be local or regional, to assign the main cause of death and associated maternal, fetal or neonatal conditions. A multi-disciplinary review of the clinical and pathological details of each perinatal death, termed perinatal mortality audit, should be undertaken following any perinatal death. Perinatal mortality audit includes review of potential contributing factors, the quality of the care provided around the time of death, and review of potentially avoidable factors that may lead to the development of recommendations for improving care.

1.5 Classification of cause of perinatal death

Though 81 systems for classifying the causes of perinatal deaths have been found, by systematic review, to be in use internationally (Reinebrant et al. 2018, Leisher et al. 2016, Flenady et al. 2009), 2 systems are in common use in Australia.

The PSANZ system is the most commonly used in Australia. It includes the PSANZ Perinatal Death Classification (PSANZ-PDC) and PSANZ Neonatal Death Classification (PSANZ-NDC). The PSANZ-PDC system classifies all perinatal deaths by the single most important factor seen as the antecedent cause of death. Neonatal deaths are also classified by conditions in the neonatal period leading to the death, using the PSANZ-NDC system. The relevant perinatal mortality review committee applies the classifications at the end of a multi-disciplinary review of the perinatal death following completion of investigations. The National Maternal and Perinatal Mortality Advisory Group (NMPMAG) has concluded that the PSANZ-PDC and PSANZ-NDC classifications are the most appropriate for a national review, such as this report.

The International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10) classification is based on the registered cause/s of death on the medical certificate of cause of perinatal death, assigned by the treating medical practitioner shortly after death without access to any subsequent investigations, and is thought to have less clinical application. The ICD classification of cause of death has not been included in this report. This coding is undertaken on discharge or death, and not after expert perinatal mortality review of the death and all available investigations. As such, the NMPMAG considers the PSANZ-PDC classification system is more appropriate for this reporting purpose than the ICD-10 system. The ABS uses the ICD-10 system.

The NMPMAG is watching with interest international progress with the development of the ICD-Perinatal Mortality (ICD-PM) system (WHO 2016a, Allanson et al. 2016a, Allanson et al.

2016b). The WHO has also issued guidance to assist the commencement of audits in low-income settings using the ICD-PM (WHO 2016b). While not finalised, this system may be suitable for future international comparisons.

1.6 Structure of this report

Chapter 1 provides the background and aims of the report, as well as definitions and information on the classification of perinatal deaths and the methods and data used in the report.

Chapter 2 provides an overview of perinatal deaths in Australia and in an international context.

Chapter 3 provides information on baby and clinical characteristics.

Chapter 4 provides information on maternal characteristics.

Chapter 5 provides information on the causes of perinatal deaths.

Chapter 6 provides information on perinatal deaths in term singleton births not known to have a congenital anomaly causing death.

Chapter 7 provides information on contributing factors in perinatal deaths.

Further information on methodology, project governance and data quality can be found in Appendixes A, B and C, respectively.

Detailed supplementary tables are available online from the AIHW website at <<https://www.aihw.gov.au/reports/mothers-babies/perinatal-deaths-in-australia-2013-2014/data>>.

2 Overview of perinatal deaths

2.1 Perinatal mortality rate

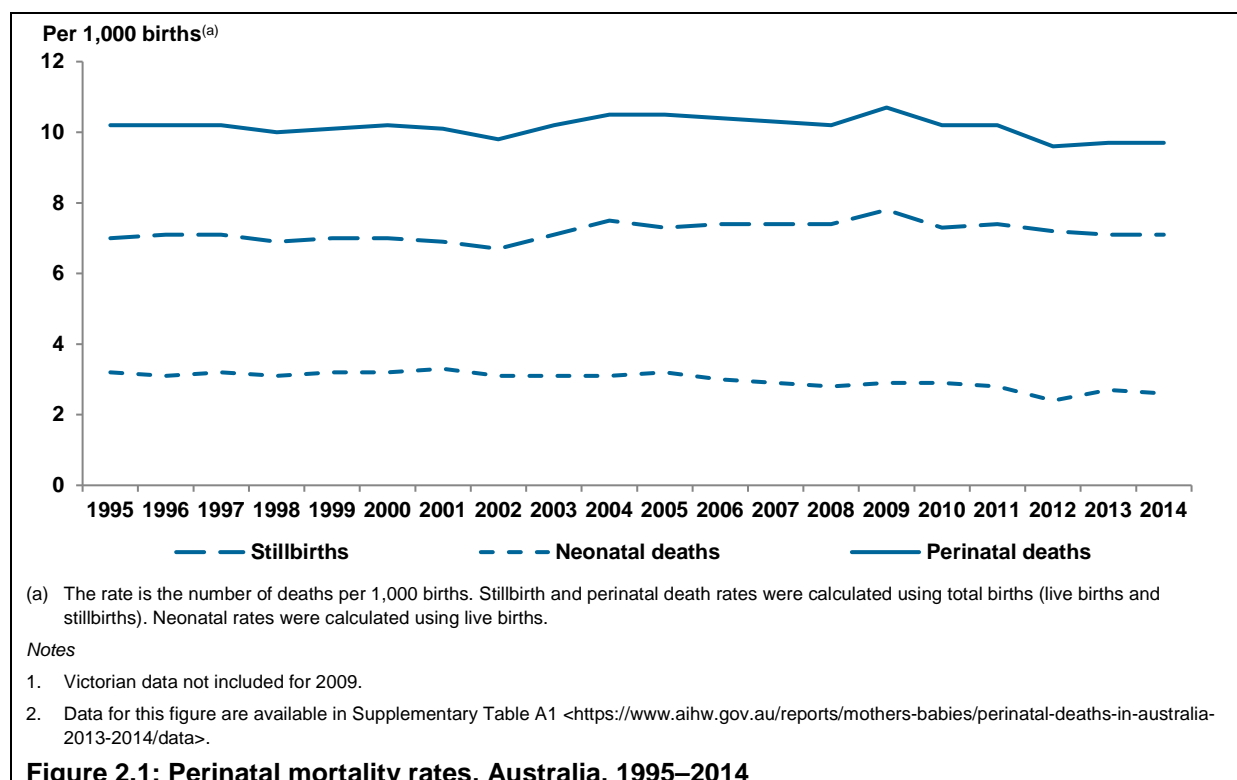
In the years 2013 and 2014, 622,037 babies were born in Australia to 612,621 women. The perinatal mortality rate in those years was 9.7 per 1,000 births, with the component stillbirth rate being 7.1 per 1,000 births and the neonatal mortality rate being 2.6 per 1,000 live births (Table 2.1).

Table 2.1: Perinatal mortality rates, Australia, 2013–2014

Year	Total		Stillbirths		Neonatal deaths		Perinatal deaths	
	births	Live births	n	Rate ^(a)	n	Rate ^(a)	n	Rate ^(a)
2013	309,489	307,280	2,194	7.1	822	2.7	3,016	9.7
2014	312,548	310,320	2,225	7.1	796	2.6	3,021	9.7
Total	622,037	617,600	4,419	7.1	1,618	2.6	6,037	9.7

(a) The rate is the number of deaths per 1,000 births. Stillbirth and perinatal death rates were calculated using total births (live births and stillbirths). Neonatal rates were calculated using live births.

Between 1995 and 2014, the perinatal mortality rate decreased from 10.2 per 1,000 births to 9.7 per 1,000 births. The neonatal mortality rate over this period decreased from 3.2 per 1,000 live births to 2.6 per 1,000 live births, but the stillbirth rate remained relatively unchanged, varying between 6.7 per 1,000 births and 7.5 per 1,000 births (Figure 2.1 and Supplementary Table A1).



2.2 International comparisons

The WHO recommends that all countries report perinatal mortality data (WHO 2006) using the WHO international definitions of fetal death, neonatal death and perinatal death.

World Health Organization international definitions

Stillbirth rate (per 1,000 total births): Number of stillbirths per 1,000 births (live and stillbirths). Stillbirths can occur antepartum or intrapartum. For purposes of international comparison, stillbirths are defined as third trimester fetal deaths ($\geq 1,000$ grams or ≥ 28 weeks). Neonatal mortality rate (per 1,000 live births): Probability that a child born in a specific year or period will die during the first 28 completed days of life if subject to age-specific mortality rates of that period, expressed per 1,000 live births. Neonatal deaths (deaths among live births during the first 28 completed days of life) may be subdivided into early neonatal deaths, occurring during the first 7 days of life, and late neonatal deaths, occurring after the 7th day but before the 28th completed day of life.

Source: WHO 2015.

Table 2.2 describes mortality of babies born in Australia weighing 1,000 grams or more, or born at 28 weeks or more if birthweight is unknown, per 1,000 total births (weighing 1,000 grams or more, or born at 28 weeks or more if birthweight is unknown). Babies without birthweight or gestation are included if they have been registered.

Comparison of these data with data using Australian definitions (Table 2.1 and Supplementary Table A1) reveals that almost two-thirds of perinatal deaths by the Australian definitions are of babies weighing between 400 grams and 999 grams, or of gestations between 20 and 28 weeks.

Table 2.2: Perinatal mortality rates (WHO definition), Australia, 2005–2014

Year	Total births ^(a)	Live births ^(a)	Stillbirths		Neonatal deaths		Perinatal deaths	
			n	Rate ^(b)	n	Rate ^(c)	n	Rate ^(b)
2005	269,924	269,154	770	2.9	326	1.2	1,096	4.1
2006	279,554	278,763	791	2.8	301	1.1	1,092	3.9
2007	291,496	290,728	767	2.6	336	1.2	1,103	3.8
2008	294,235	293,414	821	2.8	286	1.0	1,107	3.8
2009 ^(d)	223,816	223,177	639	2.9	241	1.1	880	3.9
2010	297,438	296,602	836	2.8	341	1.1	1,177	4.0
2011	299,158	298,375	781	2.6	293	1.0	1,074	3.6
2012	309,515	308,562	831	2.7	263	0.9	1,094	3.5
2013	306,683	305,921	727	2.4	282	0.9	1,009	3.3
2014	309,701	308,912	774	2.5	264	0.9	1,038	3.4

(a) Births of babies weighing 1,000 grams or more (or 28+ weeks if birthweight not known).

(b) Stillbirth and perinatal mortality rates = per 1,000 births of babies weighing 1,000 grams or more (or 28+ weeks if birthweight not known).

(c) Neonatal mortality rates = per 1,000 live births of babies weighing 1,000 grams or more (or 28+ weeks if birthweight not known).

(d) Victorian data not included for 2009.

An international consensus conference held in 2015 reviewed fetal death/stillbirth definitions and registration (Joseph et al. 2017). The conference recommended that criteria for registration of spontaneous fetal deaths should be revised such that registration of spontaneous fetal deaths should be required for all fetal deaths occurring at 20 or more completed weeks of gestation, and if gestational age at fetal death and gestational age at stillbirth were both unknown, a birthweight criterion of 400 grams or more should be used to determine if the fetal death required registration. These recommendations have not been adopted by the WHO at the time of writing this report.

The same conference also recommended that documentation of fetal death registration should be revised such that the gestational age at fetal death should be recorded based on the health-care provider's best estimate of when fetal death occurred (in addition to the gestational age at stillbirth; that is, the gestational age at birth) and that the process for the registration and reporting of therapeutic abortions should be separate from that for spontaneous fetal deaths.

The most recent comprehensive report detailing international global estimates of neonatal mortality rates was published relating to births in 2015 (UNICEF 2015), whereas the most recent comprehensive reporting of global estimates of international stillbirth rates relates to births in 2009 (WHO 2013) (Table 2.3). For the purposes of such reports countries are grouped by region and by income status; the income status groupings are found in Supplementary Table A2.

Table 2.3: International stillbirth and neonatal mortality rates, 2009 and 2015

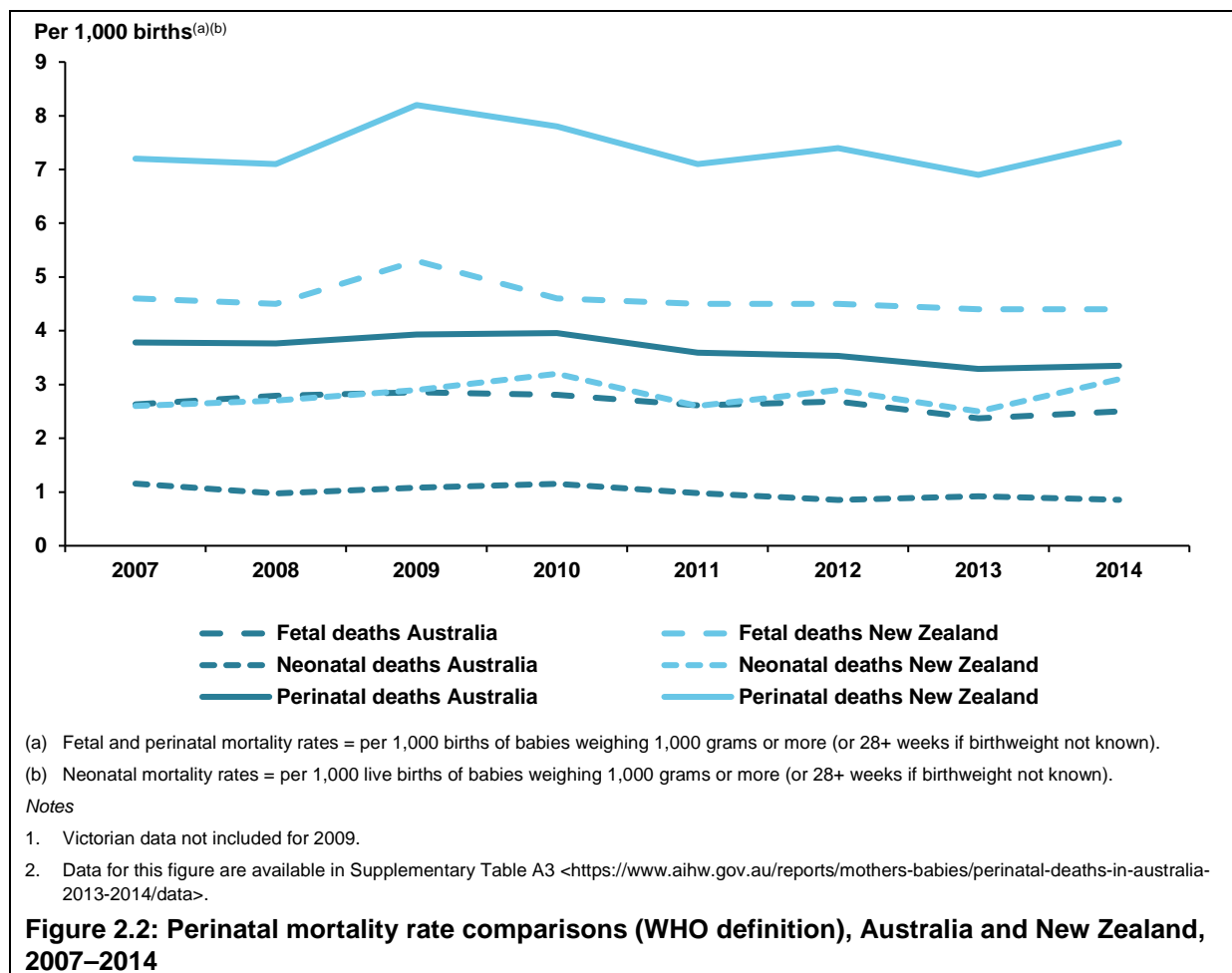
	Estimated stillbirth rate (per 1,000 births) ^(a) in 2009	Estimated neonatal mortality rate (per 1,000 live births) in 2015
Global	19	19
African region	28	28
Region of the Americas	7	8
South-East Asia region	22	24
European region	6	6
Eastern Mediterranean region	27	27
Western Pacific region	10	7
Low income countries	26	27
Lower-middle income countries	21	26
Upper-middle income countries	9	9
High income countries	3	4

(a) Stillbirth definition greater than or equal to 1,000 grams, or greater than or equal to 28 weeks.

Note: Country groups are available in Supplementary Table A2 <<https://www.aihw.gov.au/reports/mothers-babies/perinatal-deaths-in-australia-2013-2014/data>>.

Sources: Stillbirth data WHO 2013, Neonatal mortality data UNICEF 2015.

Since 2007, the Perinatal and Maternal Mortality Review Committee of New Zealand (PMMRC) has published New Zealand perinatal mortality data using the WHO international definitions (PMMRC 2016). Figure 2.2 shows comparative perinatal mortality rates for Australia and New Zealand using the same definitions. The PMMRC definitions use the term 'fetal death before birth' rather than stillbirth, so that term is used in Figure 2.2. Trend data with similar definitions is not readily available from other countries.



2.3 State and territory perinatal mortality rates

The rates of stillbirth and neonatal deaths varied by the state or territory in which babies were born and are shown in Table 2.4. The stillbirth rates ranged between 5.8 deaths per 1,000 births and 9.8 deaths per 1,000 births. The neonatal death rates ranged from 1.6 per 1,000 live births to 5.7 per 1,000 live births. The overall rate of perinatal mortality ranged from 8.1 deaths per 1,000 births to 15.4 deaths per 1,000 births.

Most babies were born in the same state or territory as their mother’s usual residence (Table 2.5). However, a number of babies born in the Australian Capital Territory were born to mothers who usually resided in New South Wales. One possibility for this interstate movement was that these mothers had high-risk pregnancies and were transferred from smaller maternity units in rural or regional New South Wales to larger maternity units in the Australian Capital Territory. Therefore, the rate of perinatal death for babies born in the Australian Capital Territory may be inflated relative to the state or territory of the mother’s usual residence.

Care should be taken with interpreting the variation in stillbirth rates as the majority of late terminations of pregnancy performed in Australia are undertaken in Victoria, and many women travel from interstate (and overseas) to Victoria to undertake late termination of pregnancy.

Table 2.4: Perinatal mortality by jurisdiction of birth, Australia, 2013–2014

State or Territory	Total Births	Total Live Births	Stillbirths ^(a)		Neonatal Deaths ^(a)		Perinatal Deaths ^(a)	
			n	Rate	n	Rate	n	Rate
NSW	194,287	193,156	1,126	5.8	451	2.3	1,577	8.1
Vic ^(b)	157,496	156,054	1,436	9.1	473	3.0	1,909	12.1
Qld	126,968	126,125	843	6.6	380	3.0	1,223	9.6
WA ^(c)	69,609	69,150	459	6.6	109	1.6	568	8.2
SA	41,012	40,729	283	6.9	84	2.1	367	8.9
Tas	11,913	11,822	91	7.6	40	3.4	131	11.0
ACT ^(d)	12,716	12,614	102	8.0	36	2.9	138	10.9
NT	8,036	7,957	79	9.8	45	5.7	124	15.4
Australia	622,037	617,600	4,419	7.1	1,618	2.6	6,037	9.7

(a) The rate is the number of deaths per 1,000 births. Stillbirth and perinatal death rates were calculated using total births (live births and stillbirths). Neonatal rates were calculated using live births.

(b) Perinatal deaths in Victoria include terminations of pregnancy and fetus papyraceous. The majority of late terminations for psychosocial indications performed in Australia are undertaken in Victoria, and many women travel from interstate (and overseas) to Victoria to have the termination undertaken.

(c) For Western Australia, stillbirths and neonatal deaths include late termination of pregnancy.

(d) In 2013–2014, 14.4% of women who gave birth in the ACT were non-ACT residents. Care must be taken when interpreting rates. Rates by jurisdiction of mother's usual residence are shown in Table 2.5.

Table 2.5: Perinatal mortality by jurisdiction of mother's usual residence, Australia, 2013–2014

State or Territory	Total Births	Total Live Births	Stillbirths ^(a)		Neonatal Deaths ^(a)		Perinatal Deaths ^(a)	
			n	Rate	n	Rate	n	Rate
NSW	197,140	195,897	962	4.9	411	2.1	1,373	7.0
Vic	154,696	153,462	1,228	7.9	461	3.0	1,689	10.9
Qld	127,200	126,311	883	6.9	374	3.0	1,257	9.9
WA	69,660	69,171	489	7.0	111	1.6	600	8.6
SA	40,859	40,578	281	6.9	82	2.0	363	8.9
Tas	11,946	11,846	101	8.5	42	3.5	143	12.0
ACT	11,130	11,049	80	7.2	27	2.4	107	9.6
NT	8,022	7,932	90	11.2	44	5.5	134	16.7
Other ^(b)	1,384	1,354	305	220.4	66	48.7	371	268.1
Australia	622,037	617,600	4,419	7.1	1,618	2.6	6,037	9.7

(a) The rate is the number of deaths per 1,000 births. Stillbirth and perinatal death rates were calculated using total births (live births and stillbirths). Neonatal rates were calculated using live births.

(b) Includes 'Other Australian territories', 'Non-Australian residents' and 'Not stated'.

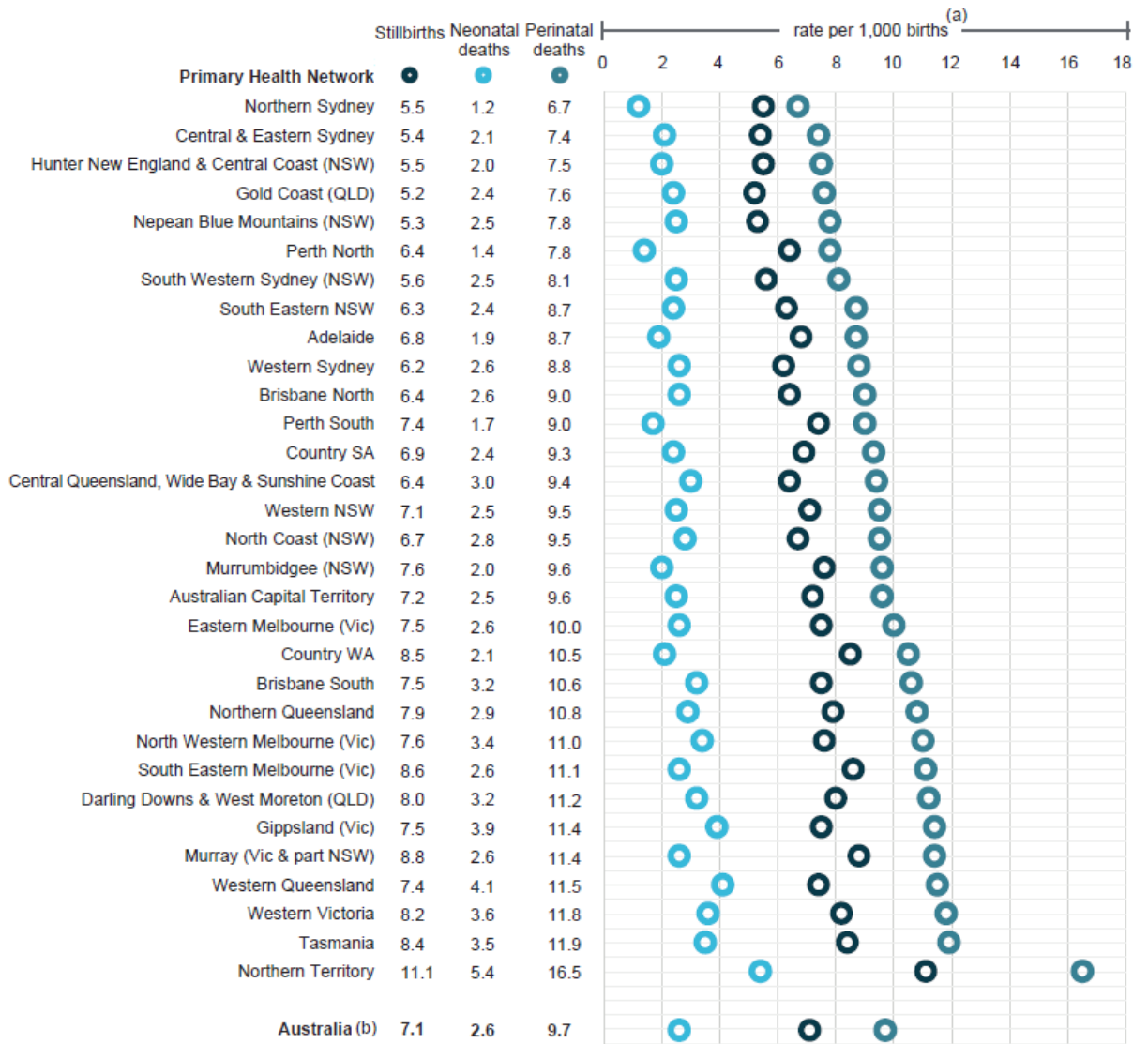
2.4 Perinatal mortality rates by Primary Health Network area

The rates of perinatal mortality varied by Primary Health Network area (Supplementary Table A4). These rates are derived from mother's place of usual residence.

The highest perinatal mortality rates were reported in the Northern Territory (16.5 per 1,000 births), Tasmania (11.9 per 1,000 births) and Western Victoria (11.8 per 1,000 births). The lowest rates were recorded in Northern Sydney (6.7 per 1,000 births), Central and Eastern Sydney (7.4 per 1,000 births) and Hunter New England and Central Coast (NSW) (7.5 per 1,000 births).

The highest rates of stillbirth were reported in the Northern Territory (11.1 per 1,000 births), Murray (8.8 per 1,000 births) and South Eastern Melbourne (8.6 per 1,000 births). The lowest rates were recorded in the Gold Coast (5.2 per 1,000 births), Nepean Blue Mountains (NSW) (5.3 per 1,000 births) and Central and Eastern Sydney (5.4 per 1,000 births).

Neonatal mortality rates were reported highest in the Northern Territory (5.4 per 1,000 live births) and Gippsland (Vic) (3.9 per 1,000 live births). Northern Sydney (1.2 per 1,000 live births), Perth North and Perth South (1.4 and 1.7 per 1,000 live births) recorded the lowest rates.



(a) The rate is number of deaths per 1,000 births. Stillbirth and perinatal death rates were calculated using total births (live births and stillbirths). Neonatal rates were calculated using live births.

(b) Includes 'Other Australian territories', 'Non-Australian residents' and 'Not stated'.

Note: Data for this figure are available in Supplementary Table A4 <<https://www.aihw.gov.au/reports/mothers-babies/perinatal-deaths-in-australia-2013-2014/data>>.

Figure 2.3: Perinatal mortality rates by Primary Health Network of mother's usual residence, Australia, 2013–2014

3 Baby and clinical characteristics

3.1 Birthweight for gestation

Birthweight and gestational age are interrelated. Some babies who are smaller than average for their gestational age are pathologically growth-restricted whilst others are constitutionally small (Dobbins et al. 2012). Similarly, babies larger than their cohort colleagues may be constitutionally large or may have been subjected to pathological processes causing them to be large. Therefore, the most useful review of perinatal mortality with birthweight and gestational age is to examine birthweight for gestation.

Birthweight for gestation is expressed in terms of population percentiles. Babies who weigh less than the 10th percentile birthweight for gestational age are termed small for gestational age (SGA), whilst those with a birthweight greater than the 90th percentile for their gestational age are termed large for gestational age (LGA).

The term fetal growth restriction (FGR), previously known as intra-uterine growth restriction (IUGR), is a functional definition that refers to a condition in which a fetus is unable to achieve its genetically determined potential size, and is thought to identify a population of fetuses at risk for modifiable but otherwise poor outcomes. Opinion is divided as to whether the term IUGR should be applied to babies less than the third percentile or less than the 10th percentile birthweight for gestational age.

Perinatal death was most common in babies who were small for gestational age, especially those weighing less than the third percentile, birthweight for gestational age (Figure 3.1, Supplementary Table A5). Babies born less than the third percentile, birthweight for gestational age, had a perinatal mortality rate of 48.3 per 1,000 births (compared with 9.7 per 1,000 births for all births). Babies born at more than 36 weeks' gestation and weighing less than the third percentile, birthweight for gestational age, had a perinatal mortality rate of 9.6 per 1,000 births (compared with 1.9 per 1,000 births for all births over 36 weeks' gestation).

Large for gestational age babies were more likely to die in the perinatal period, though the difference was not as large as that seen in small for gestational age babies. All babies born weighing more than the 97th percentile, birthweight for gestational age, had a perinatal mortality rate of 12.6 per 1,000 births (compared with 9.7 per 1,000 births for all births). Babies born at more than 36 weeks' gestation and weighing more than the 97th percentile, birthweight for gestational age, had a perinatal mortality rate of 2.0 per 1,000 births (compared with 1.9 per 1,000 births for all births over 36 weeks' gestation).

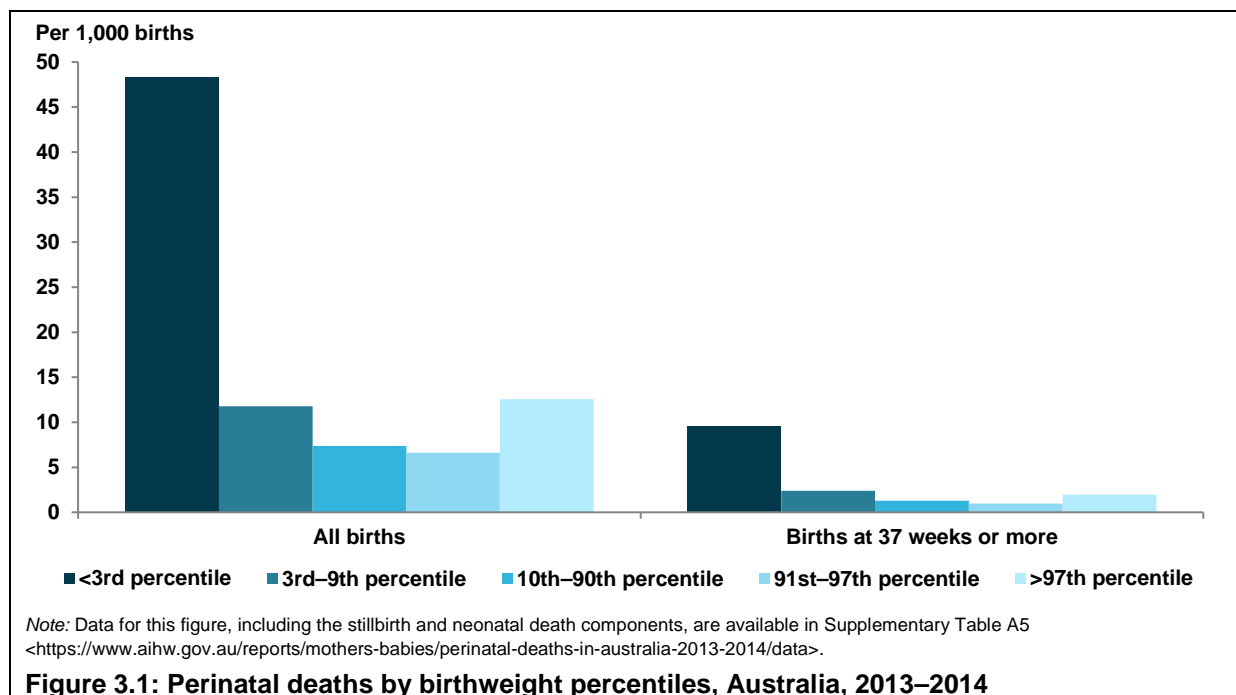


Figure 3.1: Perinatal deaths by birthweight percentiles, Australia, 2013–2014

Good practice guidance

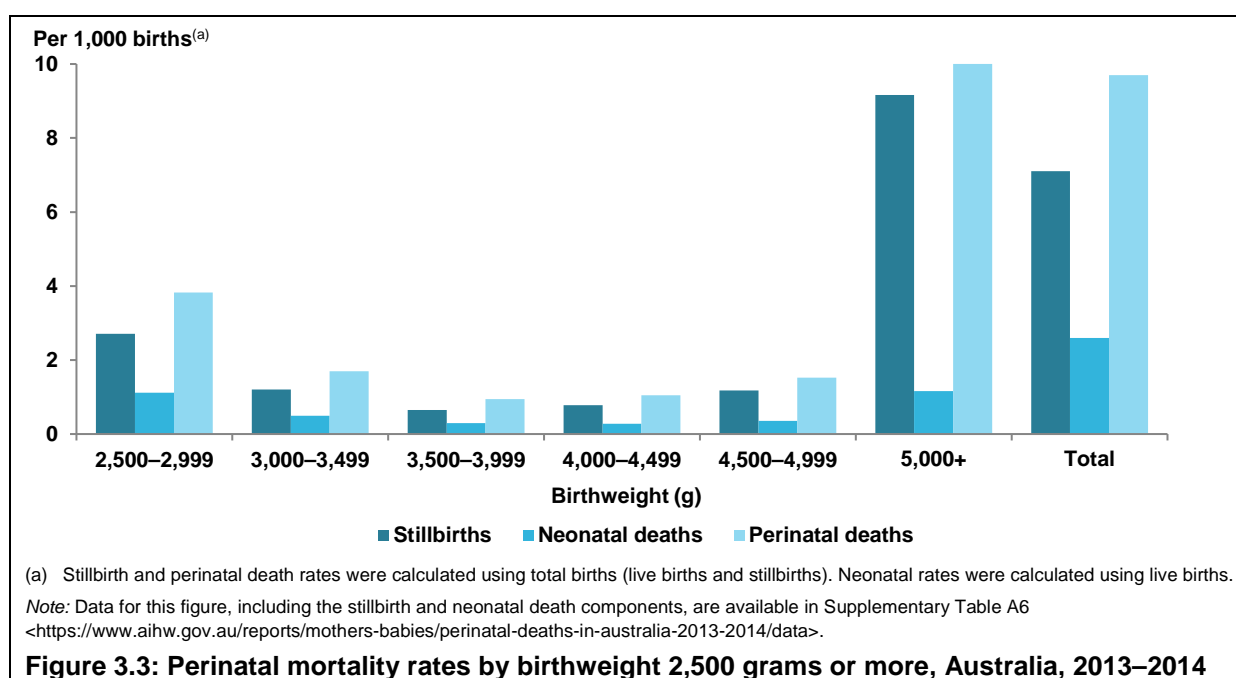
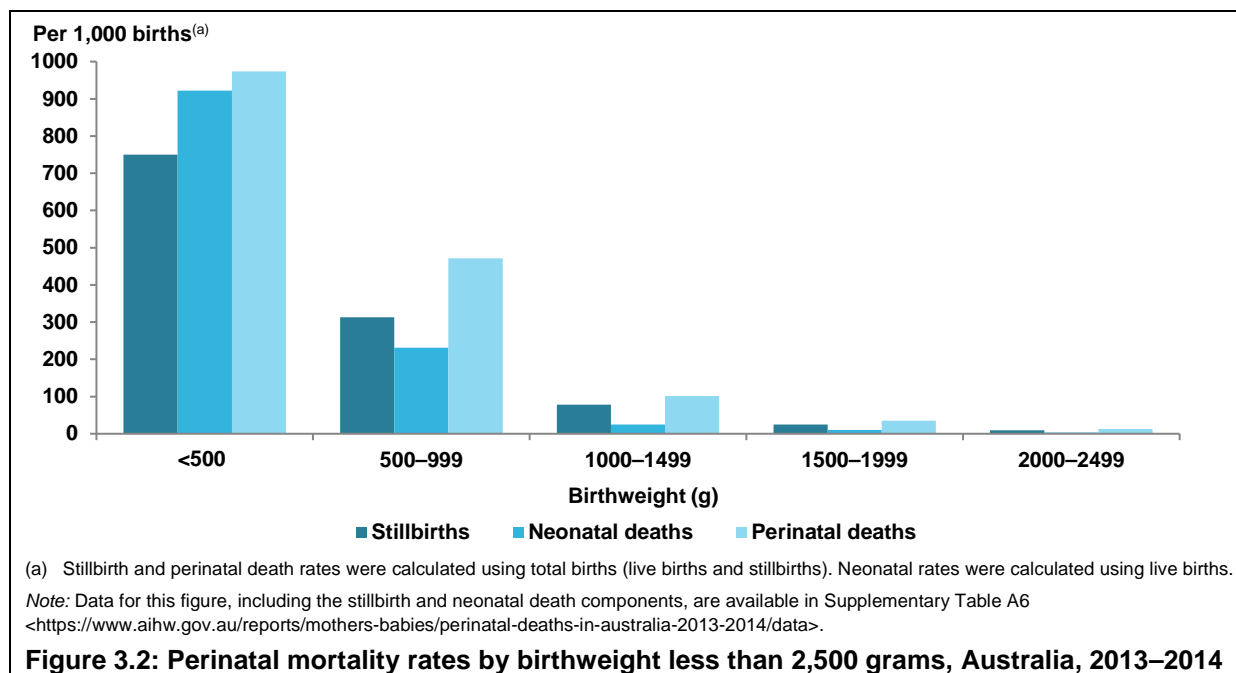
Women identified as being at risk of having a small-for-gestational-age baby should be provided with advice about modifiable risk factors. Fetal growth assessment based solely on abdominal palpation is insufficient; at each antenatal visit from 24 weeks the fundal height in cm should be measured.

Source: DoH 2018.

3.2 Birthweight

Stillbirth rates and neonatal mortality rates both declined dramatically with increasing birthweight (figures 3.2 and 3.3 and Supplementary Table A6). Figure 3.2 shows births of babies born with birthweights less than 2,500 grams, and Figure 3.3 shows births of babies born with birthweights of 2,500 grams or more.

The perinatal mortality rate for babies with a birthweight of less than 500 grams was very high (973.8 per 1,000 births). Babies with a birthweight of 500–999 grams had a perinatal mortality rate of 471.2 per 1,000 births. Babies with a birthweight between 2,000 grams and 2,500 grams had a very low perinatal mortality rate (1.8 per 1,000 births) but this increased significantly to 10.3 per 1,000 births with a birthweight of 5,000 grams or more.

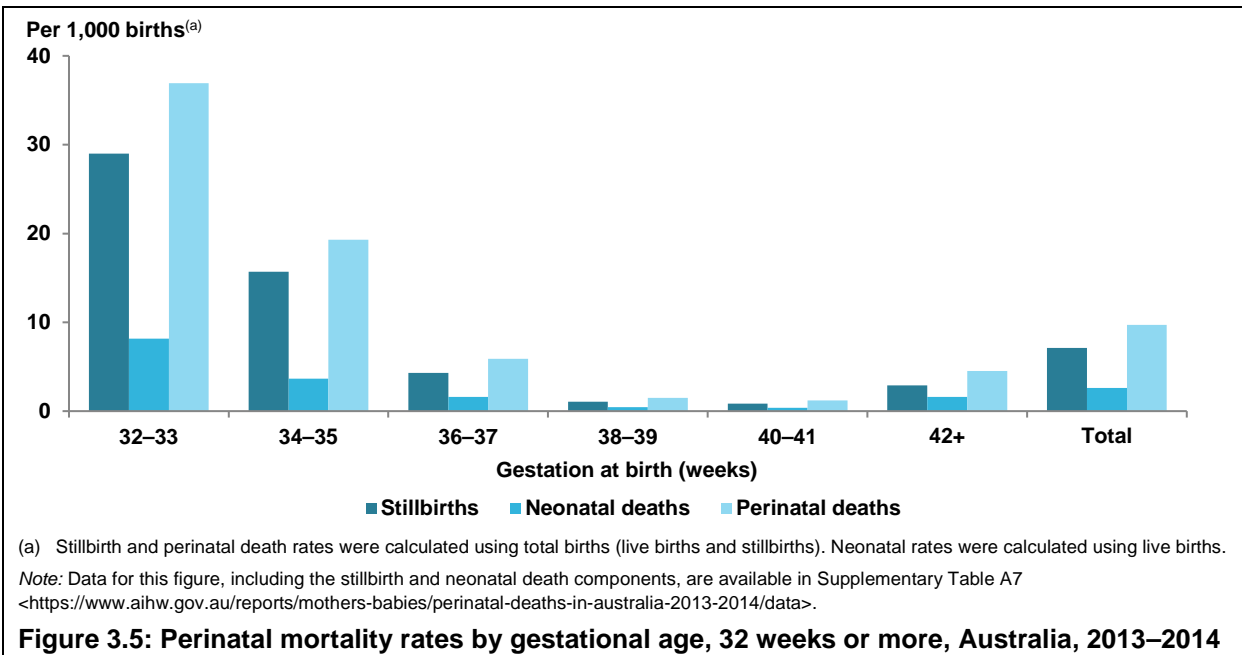
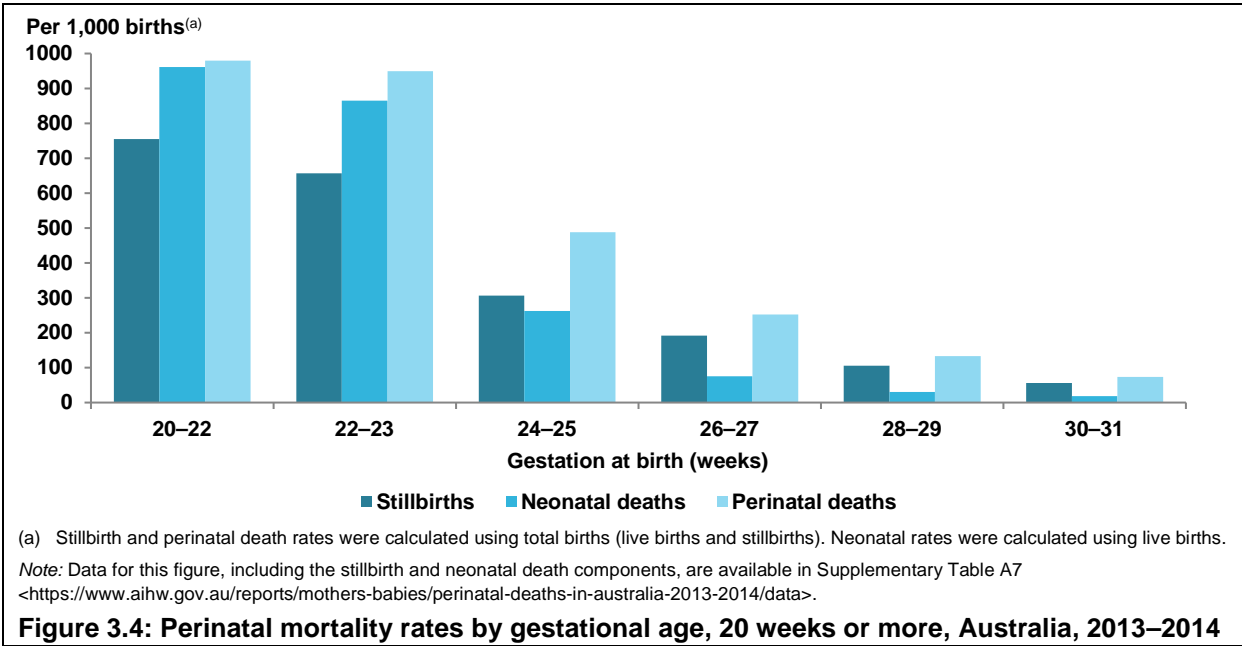


3.3 Gestational age

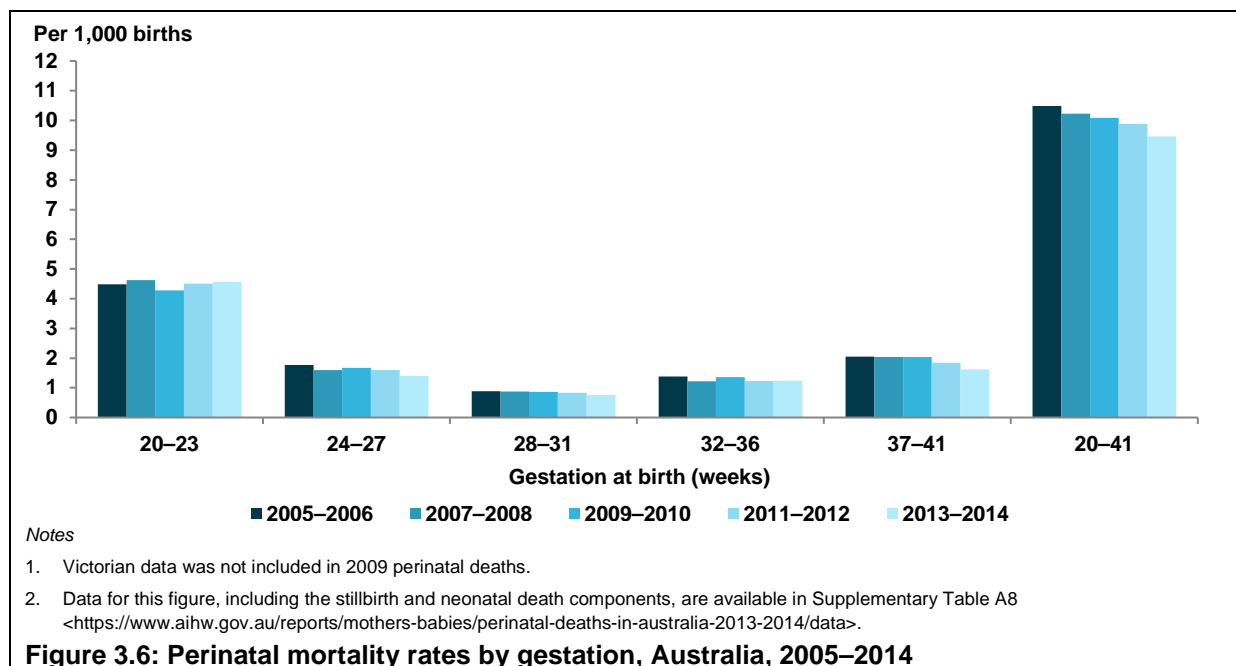
Stillbirth and neonatal mortality rates declined with increasing gestational age to 38 weeks' gestation, with the lowest rates between 38 and 41 weeks' gestation. The stillbirth and neonatal mortality rates increased again after 42 weeks (figures 3.4 and 3.5 and Supplementary Table A7). Figure 3.4 shows births of all babies born at a gestation of 20 weeks or more, and Figure 3.5 shows births of babies born at 32 weeks or more.

Babies born at less than 28 weeks' gestation had perinatal mortality rates of 695.3 per 1,000 births. Babies born at 28–33 weeks had perinatal mortality rates of 62.2 per 1,000 births, those born at 34–35 weeks had perinatal mortality rates of 19.3 per 1,000 births, and those

born at 36–37 weeks had perinatal mortality rates of 5.9 per 1,000 births. Babies born at 38–41 weeks had perinatal mortality rates of 1.4 per 1,000 births, whilst those born at 42 weeks or more had perinatal mortality rates of 4.5 per 1,000 births.



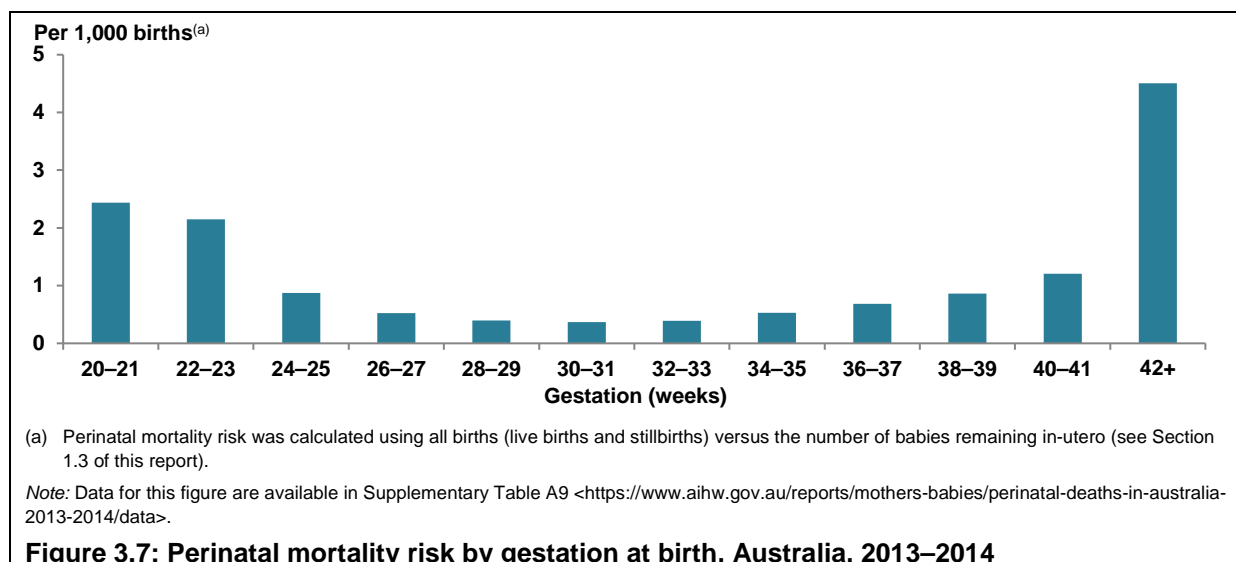
There has been a steady decrease in the perinatal mortality rate over the period 2005–2014 (Figure 3.6 and Supplementary Table A8). The neonatal mortality contribution to the perinatal mortality rate has shown a greater decrease than the stillbirth contribution.



3.3.1 Perinatal mortality risk

The gestational age-specific risk of perinatal mortality is the prospective likelihood of a perinatal death occurring within a specified gestation interval and is a measure of the likelihood of a perinatal death occurring at the specified gestational interval (see Section 1.3).

The risk of a baby dying in the perinatal period was greatest after 41 weeks' gestation and before 24 weeks' gestation (Figure 3.7 and Supplementary Table A9). Some caution is required with interpretation of these figures as the number of babies remaining in-utero after 41 weeks was small.



3.4 Sex of the babies

Male babies were born more frequently than female babies (male to female ratio 1.06) with approximately 4 babies per 10,000 born of indeterminate sex. The perinatal mortality rate for

male babies was higher than that for female babies, with the principal difference relating to a higher male stillbirth rate (Table 3.1).

The perinatal mortality rate among babies of indeterminate sex was approximately 100 times that of babies whose sex was determined at birth (912.9 versus 9.1 deaths per 1,000 births) and the majority of these babies were stillborn.

Table 3.1: Perinatal deaths by sex of the babies, Australia, 2013–2014

Sex of baby	Total births	Live births	Stillbirths ^(a)		Neonatal deaths ^(a)		Perinatal deaths ^(a)	
			n	Rate	n	Rate	n	Rate
Male	319,510	317,279	2,182	6.8	801	2.5	2,983	9.3
Female	302,190	300,215	1,933	6.4	770	2.6	2,703	8.9
Indeterminate	241	27	212	879.7	8	296.3	220	912.9
Not stated	96	79	13	135.4	1	12.7	14	145.8
Total	622,037	617,600	4,419^(b)	7.1	1,618^(b)	2.6	6,037^(b)	9.7

(a) The rate is the number of deaths per 1,000 births. Stillbirth and perinatal death rates were calculated using total births (live births and stillbirths). Neonatal rates were calculated using live births.

(b) Total includes 117 perinatal deaths (comprising 79 stillbirths, 38 neonatal deaths) from NSW where birthweight cannot be determined.

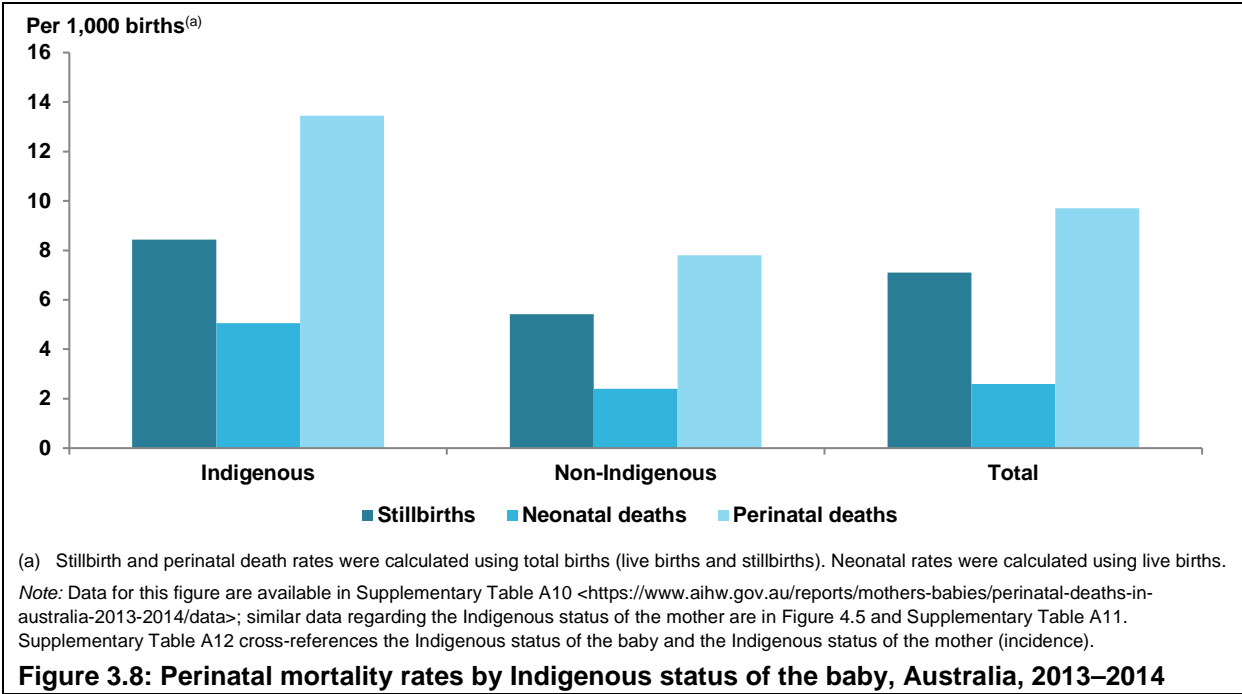
3.5 Indigenous status of the babies

Aboriginal and/or Torres Strait Islander babies had perinatal mortality rates more than 70% higher than non-Indigenous babies (Figure 3.8 and Supplementary Table A10). Both the stillbirth and neonatal death rates were similarly higher among Aboriginal and/or Torres Strait Islander babies.

The perinatal mortality rates for Aboriginal babies and/or Torres Strait Islander babies were similar (13.4 per 1,000 births and 12.2 per 1,000 births, respectively). However, there is an apparent difference in distribution between babies born to Aboriginal women and those born to Torres Strait Islander women in regard to the incidence of stillbirth and neonatal death. Babies of Aboriginal women had stillbirth rates almost 60% higher than those for babies of non-Indigenous women, and neonatal mortality rates more than twice those of babies of non-Indigenous women. Babies of Torres Strait Islander women, on the other hand, had stillbirth rates 40% higher than those for babies of non-Indigenous women, and neonatal mortality rates more than 3 times those for babies of non-Indigenous women.

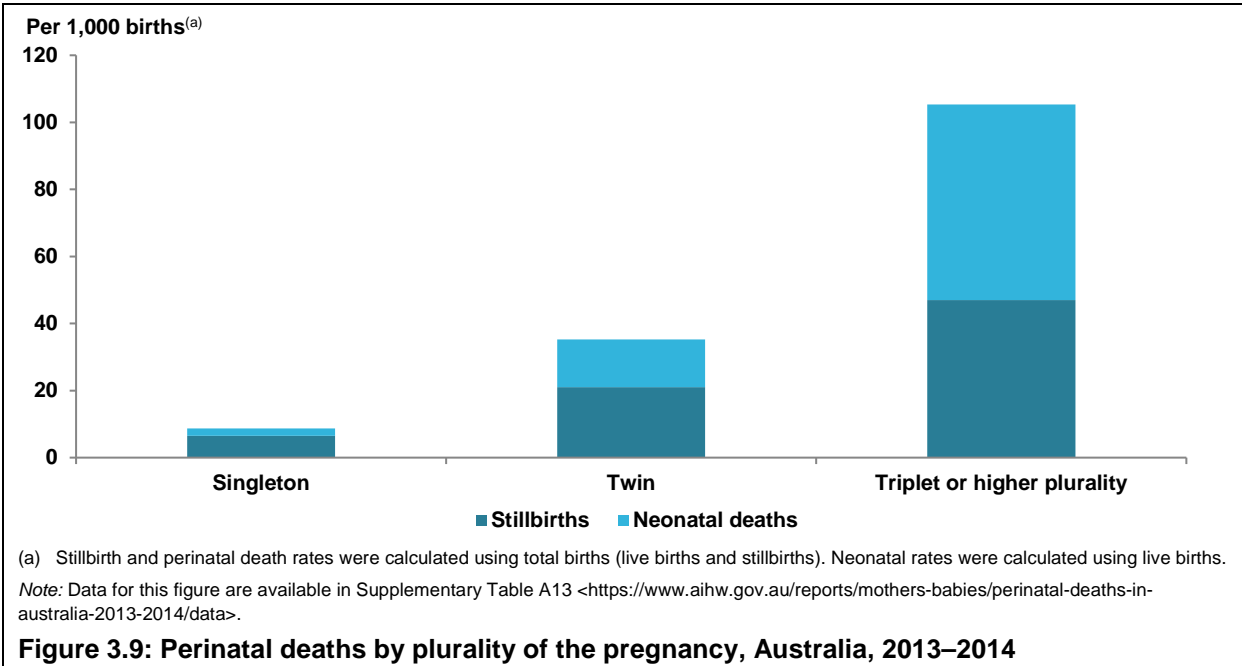
Some caution is advised in consideration of the apparent differences in perinatal mortality rates in babies of mothers of differing Aboriginal and/or Torres Strait Islander status as the number of Aboriginal and/or Torres Strait Islander babies is relatively small, and this analysis has not been controlled for risk factors such as socioeconomic status, remoteness of residence, maternal age, BMI and smoking.

Aboriginal and/or Torres Strait Islander status was not recorded for 901 of the 6,037 babies (15%) that died in the perinatal period and the mother’s Aboriginal and/or Torres Strait Islander status was not recorded for 69 of the babies (Supplementary Table A10) who died in the perinatal period.

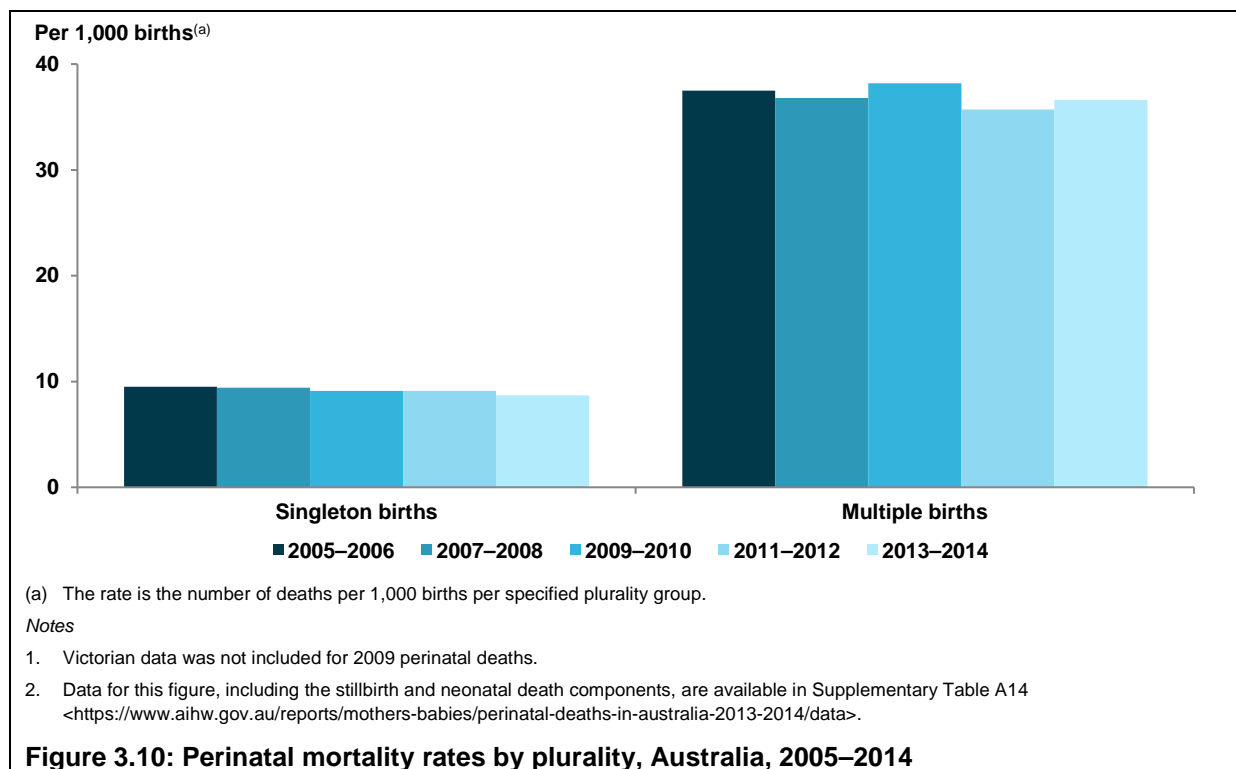


3.6 Birth plurality

Multiple pregnancy and birth carries a significant risk for the baby. The perinatal mortality rate for singleton births was 8.7 per 1,000 births, with three-quarters of those deaths being stillbirths (Figure 3.9 and Supplementary Table A13). Just over 3% of babies born (18,208) were twins and less than 0.1% of babies born (468) were triplets or higher multiples. The perinatal mortality rate for twins was 4 times that for singletons, and for higher multiples was approximately 12 times that for singletons. As plurality increased, neonatal deaths became more prominent relative to stillbirths.



From 2005–2006 to 2013–2014 the perinatal mortality rate decreased for both singleton births (9.5 to 8.7 per 1,000 births) and multiple births (37.5 to 36.6 per 1,000 births); proportionately, the decrease has been greater for singleton births than for multiple births (Figure 3.10 and Supplementary Table A14).



3.7 Timing of perinatal death

Stillbirths

Three-quarters of stillborn babies died in-utero prior to the onset of labour (Figure 3.11 and Supplementary Table A15), and 55% died extremely pre-term (less than 26 weeks' gestation) (Figure 3.12 and Supplementary Table A15).

Fetal deaths occurring during labour in relatively mature pregnancies are a particular focus of concern to parents, health-care professionals and the public (De Bernis et al. 2016). In total, 84 babies died during labour and before birth at gestations of 34 weeks or more; 947 babies at similar gestations were known to have died prior to labour and 41 were known to have died before birth but the timing of that fetal death was uncertain. The subject of stillbirths occurring during labour and before birth at mature gestations is addressed in more detail in Chapter 6 of this report.

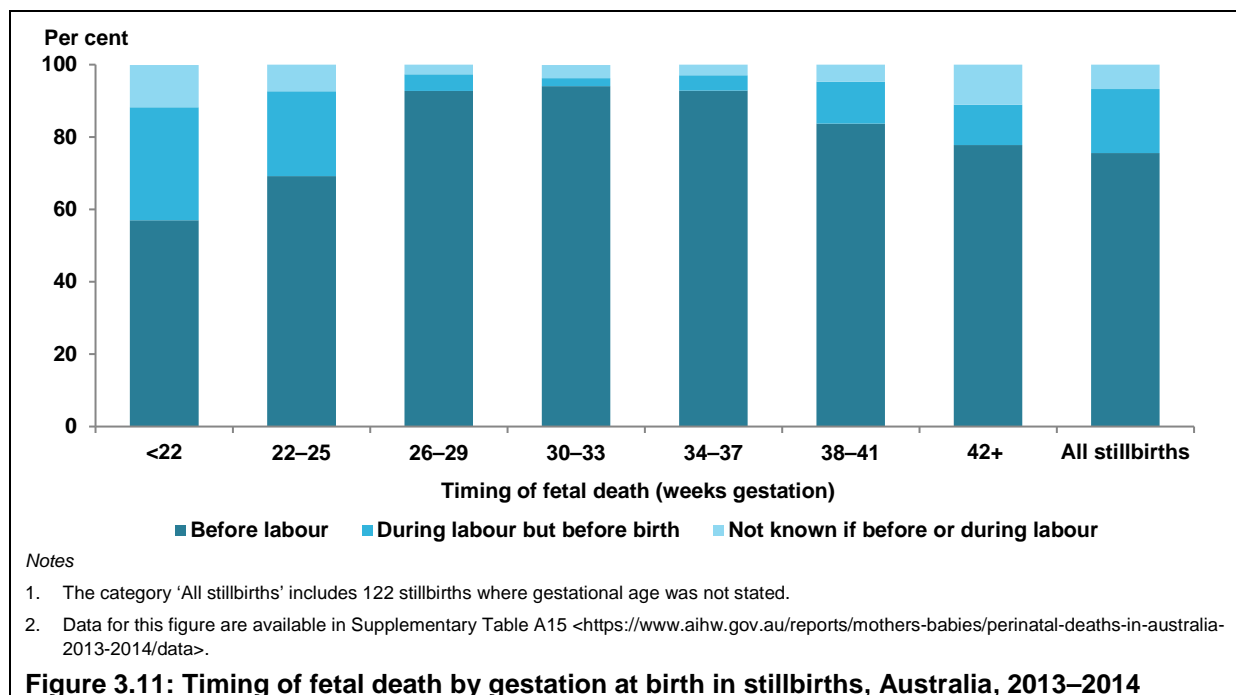


Figure 3.11: Timing of fetal death by gestation at birth in stillbirths, Australia, 2013–2014

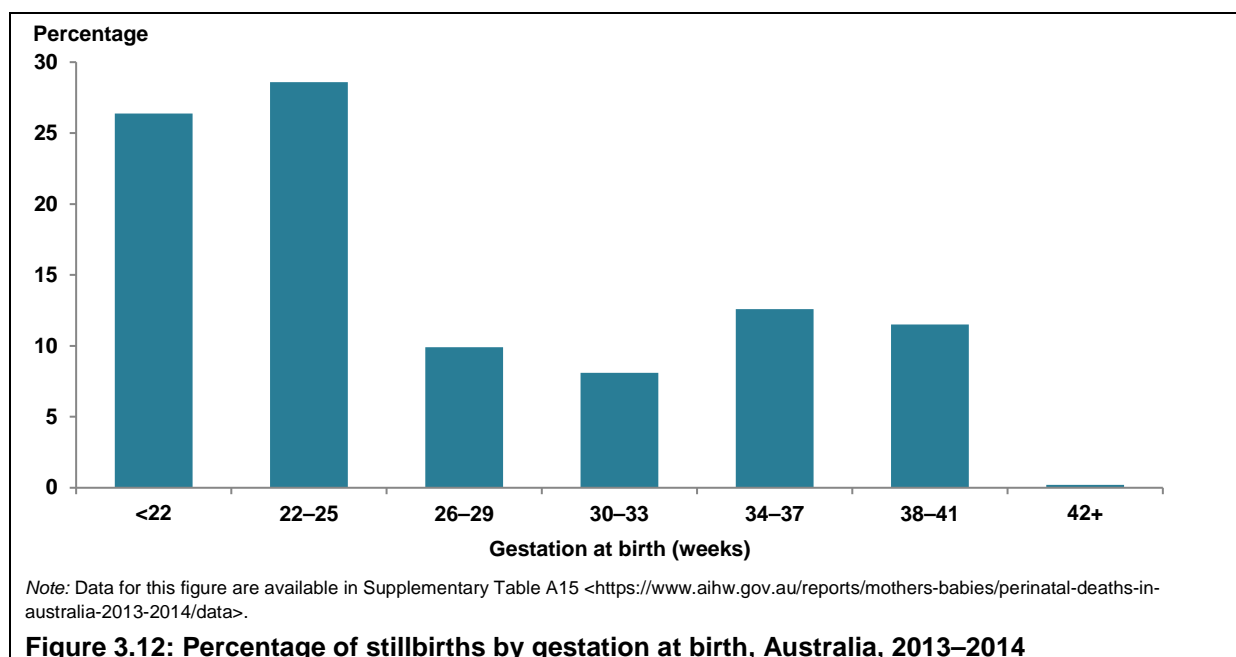
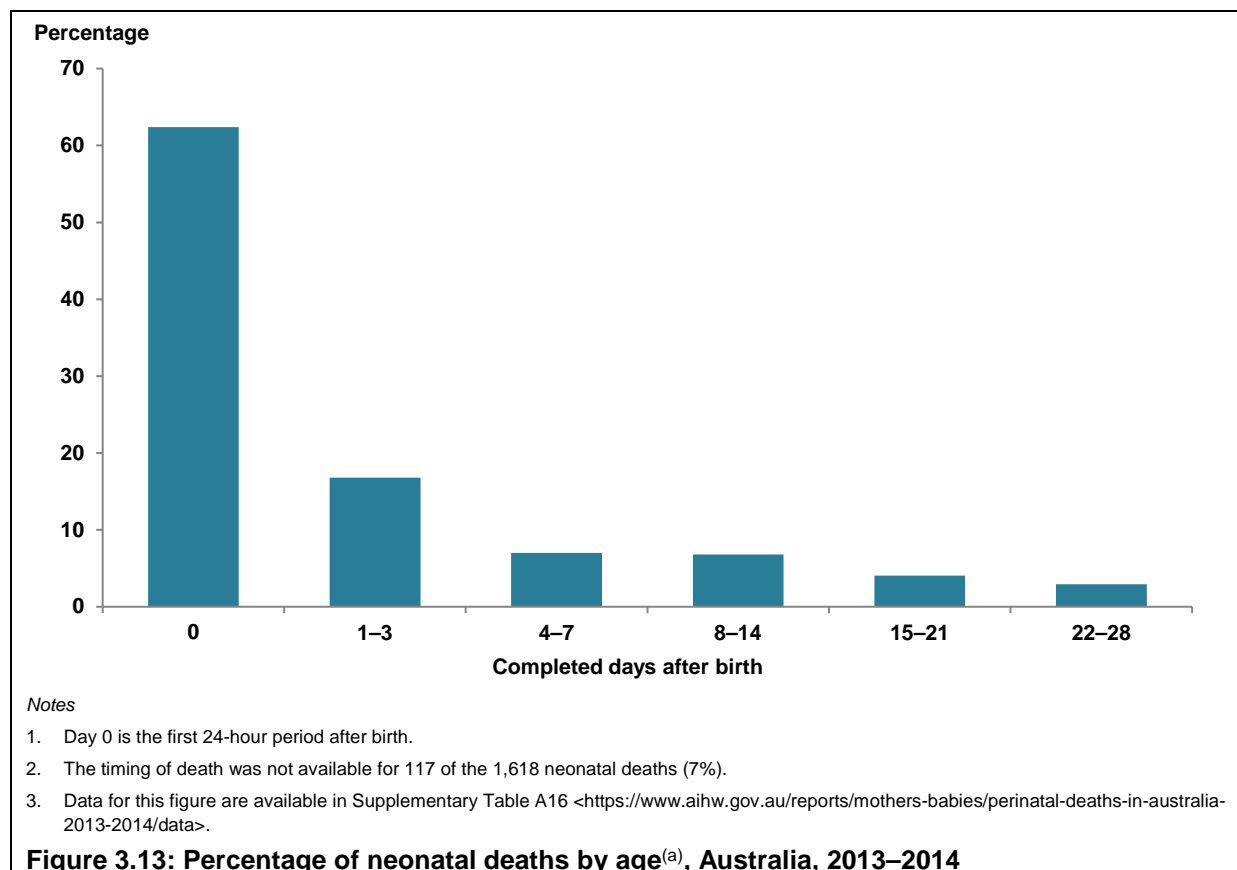


Figure 3.12: Percentage of stillbirths by gestation at birth, Australia, 2013–2014

Neonatal deaths

Most neonatal deaths (62%) occurred within the first day of life (day 0); a further 17% died within the first 3 days of life and a total of 86% had died within the first week (Figure 3.13 and Supplementary Table A16). From day 6 onwards, the frequency of neonatal deaths gradually declined.



3.8 Incidence of autopsy

Full autopsy was performed in only 19% of cases of perinatal death; 16% were examined by limited or undefined autopsy, 2% had an external examination only performed and 58% had no recorded post-mortem examination (Table 3.2). Stillborn babies had some form of autopsy performed in 40.4% of cases. Neonatal deaths had some form of autopsy performed in 27.8% of cases. More accurate collection of this data and increased rates of autopsy would improve the classification of perinatal deaths, in particular reducing the number of unexplained deaths.

Table 3.2: Incidence of perinatal death post-mortem examination, Australia, 2013–2014

Autopsy type	Stillbirths		Neonatal deaths		Perinatal deaths	
	n	%	n	%	n	%
Full autopsy performed	934	21.1	210	13.0	1,144	18.9
Limited autopsy performed	33	0.7	23	1.4	56	0.9
External examination only	96	2.2	36	2.2	132	2.2
Autopsy performed but type unknown	726	16.4	181	11.2	907	15.0
No autopsy performed	2,402	54.4	1,069	66.1	3,471	57.5
Not stated	228	5.2	99	6.1	327	5.4
Total	4,419	100.0	1,618	100.0	6,037	100.0

Good practice guidance

While accepting that there are a number of reasons that autopsy may be declined by the parents and caregivers, the National Maternal and Perinatal Mortality Advisory Group strongly supports the Perinatal Society of Australia and New Zealand (PSANZ) guidelines relating to autopsy examination of perinatal deaths:

- *A post-mortem examination, including examination of the placenta, by a perinatal/paediatric pathologist should be offered to all parents following stillbirth.*
- *Clinicians should discuss the value of an autopsy with the parents in all cases of a neonatal death and offer the option of the procedure.*

It is too late to consider autopsy months after a perinatal death when the parents ask for advice regarding the likelihood of a similar event in a subsequent pregnancy.

Every effort should be made to ensure that information recorded at institutional and jurisdictional level regarding perinatal deaths is as complete as possible.

Source: PSANZ 2018 (section 4), RCOG 2017.

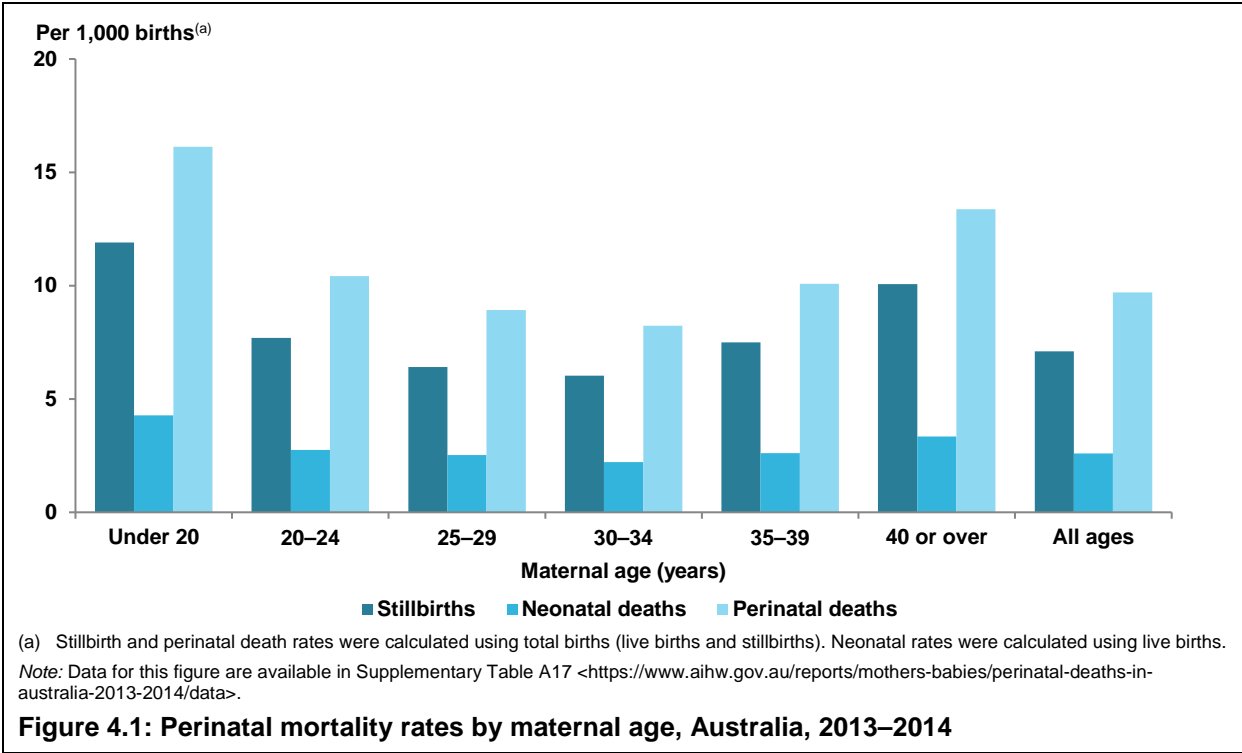
4 Maternal characteristics

4.1 Maternal age

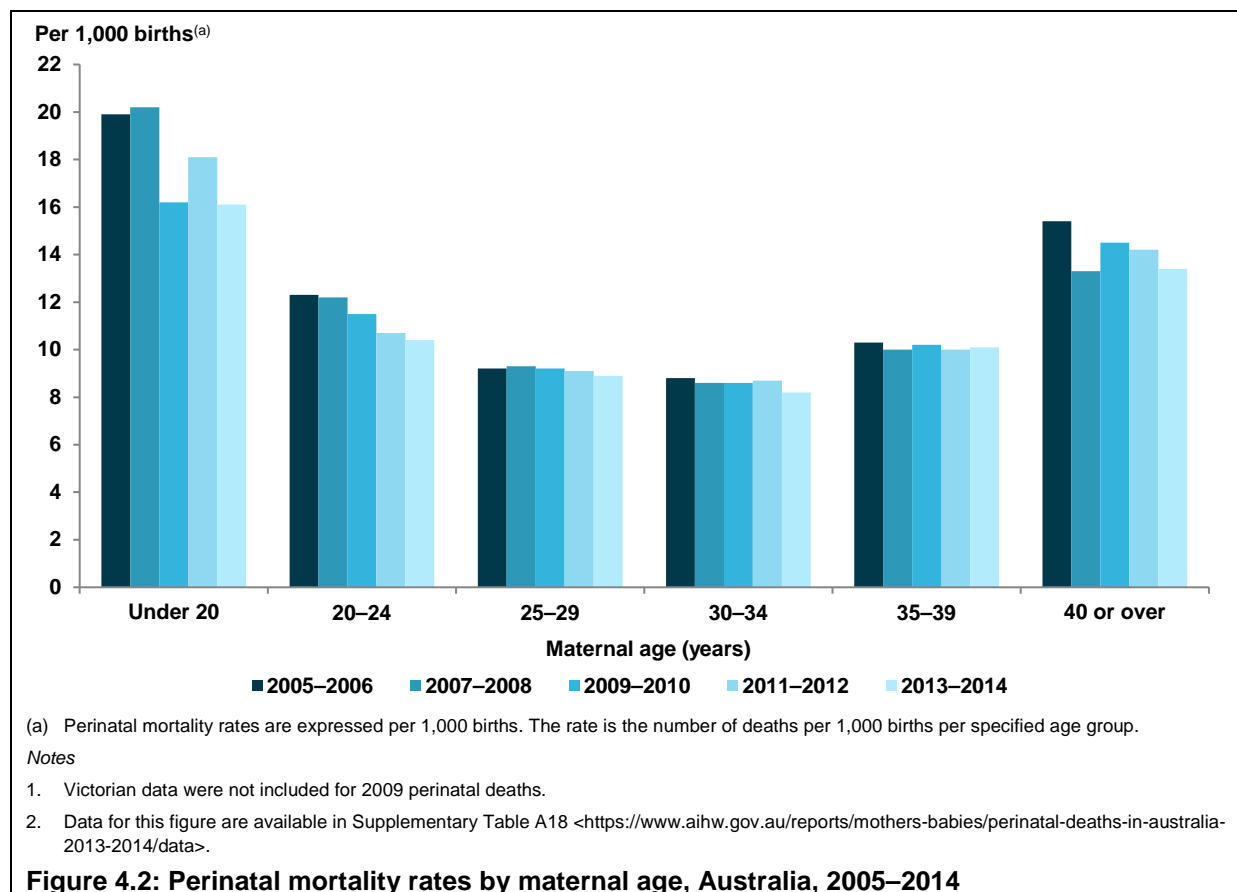
The perinatal mortality rate was lowest for babies born to women aged 25–34 (Figure 4.1 and Supplementary Table A17). A similar pattern was seen for stillbirth and neonatal mortality rates.

Perinatal mortality rates increased among babies of both the youngest and oldest mothers. Whilst the mothers aged under 20 and those aged 40 or over accounted for only a small proportion of the births in Australia (3% and 4%, respectively), the perinatal deaths in babies of these mothers accounted for 11% of all perinatal deaths (5% and 6%, respectively). The perinatal mortality rate for babies of mothers under 20 was 16.1 per 1,000 births and the rate for mothers aged 40 or over was 13.4 per 1,000 births, while babies of mothers aged 25–34 had a perinatal mortality rate of 8.5 per 1,000 births.

Perinatal mortality rates were higher for babies born to Aboriginal and/or Torres Strait Islander mothers than for those born to non-Indigenous mothers across all maternal age groups. Differences in perinatal mortality rates between these groups were most pronounced in mothers aged 40 or over (22.4 per 1,000 births and 9.8 per 1,000 births, respectively).



From 2005 to 2014, the pattern of perinatal mortality rates being lowest for women aged 25–34 continued (Figure 4.2 and Supplementary Table A18). The greatest reduction has been in the under 20 and the 20–24 age groups. This improvement includes babies born to both Aboriginal and/or Torres Strait Islander and non-Indigenous women. Perinatal mortality rates for babies born to Aboriginal and/or Torres Strait Islander mothers aged 40 or over decreased from 31.4 per 1,000 births to 17.3 per 1,000 births over the period 2005 to 2014.



An Australian study of women aged 35 or over found that the presence of medical conditions conferred a greater risk for perinatal mortality than age itself (Morris et al. 2017). The contribution of maternal age to adverse outcomes in pregnancies without significant medical and obstetric history was found to be modest, and the presence of medical and obstetric issues more likely in older women were responsible for raising the risk.

The Lancet Ending Preventable Stillbirths Series Study Group working with The Lancet Stillbirth Epidemiology Investigator Group noted increased age-related risks of stillbirth for adolescent mothers and mothers over the age of 35 (Lawn et al. 2016). The groups reported that between 6.3% and 7.3% of stillbirths, worldwide, were attributable to women aged 35 or over, but were unable to quantify the stillbirth risk to adolescent women due to a lack of robust data for this age group of mothers.

A WHO multi-country study (Ganchimeg et al. 2014) confirmed increased risks of early neonatal death to mothers aged 10–19 when compared with those aged 20–24, but found that the risk became insignificant when confounding factors such as gestational age, birthweight, mode of delivery and congenital malformation were taken into account.

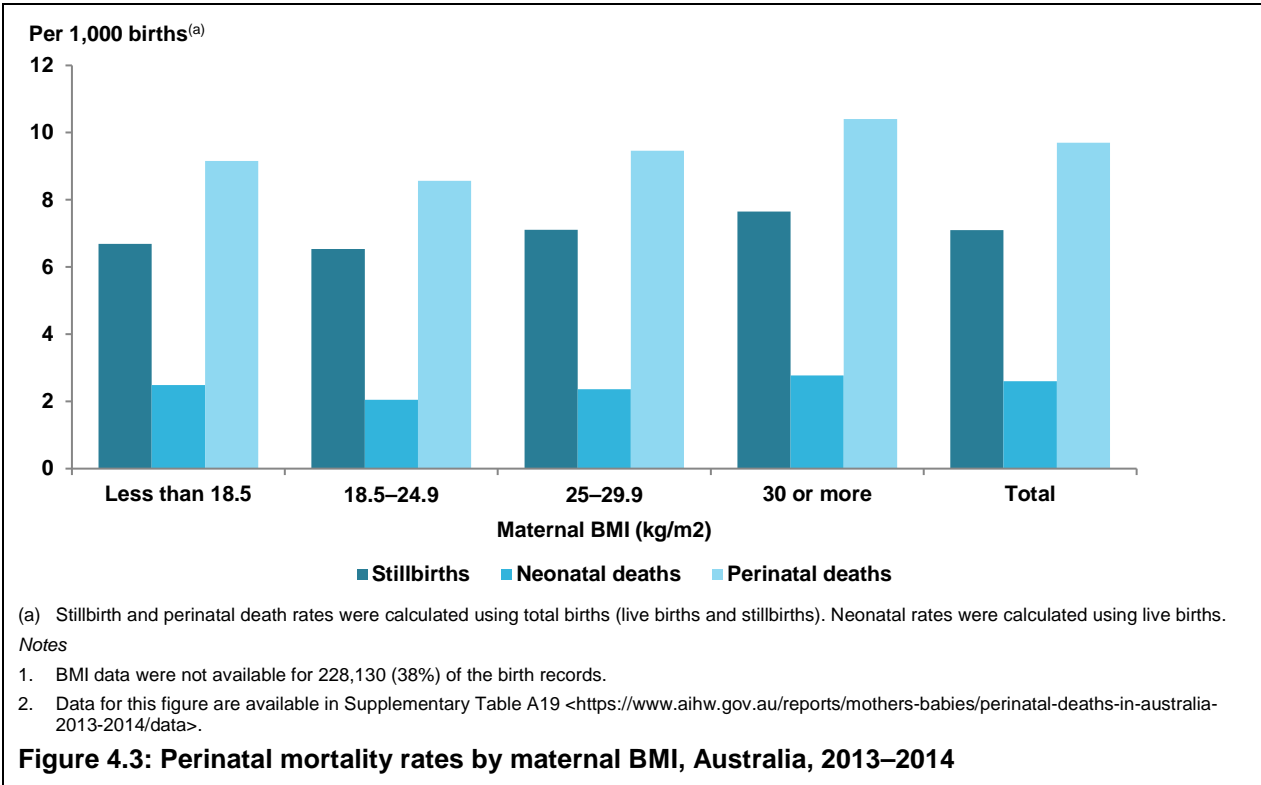
4.2 Maternal BMI

Body Mass Index (BMI) is a ratio of weight and height that can be used to classify adults as either underweight, overweight or obese. A pre-pregnancy BMI of less than 18.5 kg/m² (where kg is a persons weight in kilograms and m² is their height in metres squared) is considered 'underweight', 18.5–24.9 kg/m² 'normal', 25.0–29.9 kg/m² 'overweight', and greater than or equal to 30.0 kg/m² 'obese' (AIHW 2017).

Where BMI data were available, 20% of babies were born to mothers who were obese during pregnancy (Supplementary Table A19). The perinatal mortality in babies of obese mothers was greater than that for women with a BMI below 30 (10.4 per 1,000 births and 8.6 per 1,000 births, respectively) (Figure 4.3).

The biggest difference, when comparing perinatal mortality rates between babies born to Aboriginal and/or Torres Strait Islander mothers and non-Indigenous mothers, was seen for women classified as underweight (19.9 per 1,000 births versus 8.3 per 1,000 births) and less significantly for women classified as obese (15.9 per 1,000 births versus 10.1 per 1,000 births).

Some caution is needed in drawing conclusions in regard to the relationship between BMI and perinatal mortality, as BMI was unavailable in 37% of the birth records and 40% of death records.



A data-linkage study of records from regional perinatal registers in northern United Kingdom showed an increased risk of both fetal death and infant death for babies of women with a BMI greater than or equal to 30.0 kg/m² (Tennant et al. 2011). In that study population, fetal deaths were defined as comprising miscarriages and stillbirths, and infant deaths comprised neonatal deaths and post-neonatal deaths.

4.3 Maternal smoking during pregnancy

Perinatal mortality rates were higher among babies born to women who smoked during pregnancy when compared to those who did not smoke (9.7 per 1,000 births and 8.5 per 1,000 births respectively) (Table 4.1). Babies born to Aboriginal and/or Torres Strait Islander mothers who smoked during pregnancy had higher rates of perinatal mortality than those born to corresponding non-Indigenous mothers (17.4 per 1,000 births versus 11.6 per 1,000 births).

Table 4.1: Perinatal deaths by maternal smoking during pregnancy and maternal Indigenous status, Australia, 2013–2014

Maternal smoking status	Total births	Live births	Stillbirths ^(a)		Neonatal Deaths ^(a)		Perinatal Deaths ^(a)	
			n	Rate	n	Rate	n	Rate
Total^(c)	622,037	617,600	4,419^(b)	7.1	1,618^(b)	2.6	6,037^(b)	9.7
Smoking recorded at any time throughout pregnancy	69,213	68,610	590	8.5	283	4.1	873	12.6
Smoking recorded in only the first 20 weeks of pregnancy	14,944	14,866	76	5.1	43	2.9	119	8
No smoking recorded	542,270	538,861	3,327	6.1	1,258	2.3	4,585	8.5
Not stated	10,554	10,129	423	..	39	..	462	..
Indigenous	25,519	25,262	251	9.8	151	6.0	402	15.8
Smoking recorded at any time throughout pregnancy	11,809	11,677	129	10.9	77	6.6	206	17.4
Smoking recorded in only the first 20 weeks of pregnancy	1,420	1,407	13	9.2	5	3.6	18	12.7
No smoking recorded	13,346	13,241	102	7.6	62	4.7	164	12.3
Not stated	364	344	20	..	12	..	32	..
Non-Indigenous	595,290	591,181	4,025	6.8	1,424	2.4	5,449	9.2
Smoking recorded at any time throughout pregnancy	57,278	56,809	459	8.0	205	3.6	664	11.6
Smoking recorded in only the first 20 weeks of pregnancy	13,503	13,438	63	4.7	38	2.8	101	7.5
No smoking recorded	527,956	524,670	3,214	6.1	1,194	2.3	4,408	8.3
Not stated	10,056	9,702	352	..	25	..	377	..

(a) The rate is the number of deaths per 1,000 births. Stillbirth and perinatal death rates were calculated using total births (live births and stillbirths). Neonatal rates were calculated using live births.

(b) Total includes 117 perinatal deaths (comprising 79 stillbirths, 38 neonatal deaths) from NSW where birthweight is not able to be determined.

(c) Includes women where Indigenous status was not stated.

Note: Maternal smoking status during pregnancy is self-reported and differences in definitions and methods used for data collection can vary across jurisdictions.

The importance of smoking cessation programs for pregnant women is supported by these data that show that women who smoked tobacco in early pregnancy, but ceased by 20 weeks' gestation, had a similar perinatal mortality rate to women who did not smoke.

A systematic review of the international literature and meta-analysis of the risk of stillbirth in association with maternal smoking (Marufu et al. 2015) provides contemporary estimates of the association between maternal smoking in pregnancy and the risk of stillbirth. Their meta-analysis showed that smoking during pregnancy was significantly associated with a 47% increase in the odds of stillbirth, which is a similar increase to that seen for the Australian women reported here who are recorded as having smoked throughout pregnancy.

There is little in the contemporary literature regarding the relationship between maternal smoking and neonatal mortality. There has been controversy in the literature in the past regarding such a relationship, best summarised by Goldstein in 2014, who noted that it is likely that the neonatal mortality effects of maternal smoking are secondary to the harmful effects of tobacco products on intra-uterine fetal growth (Goldstein 2014). The Australian

data reported here show that the neonatal mortality rate for all babies whose mothers smoked was 70% higher than for babies whose mothers did not smoke.

Good practice guidance

At the first antenatal visit, pregnant women's smoking status and exposure to passive smoking should be assessed. Pregnant women who smoke, or who are exposed to passive smoking (for example, if they have a partner who smokes), should be given information about the risks to the unborn baby associated with maternal and passive smoking. The benefits of quitting smoking as early as possible in the pregnancy should be emphasised and referral made for smoking cessation interventions. Smoking status should be monitored and smoking cessation advice, encouragement and support offered throughout pregnancy.

Source: DoH 2018.

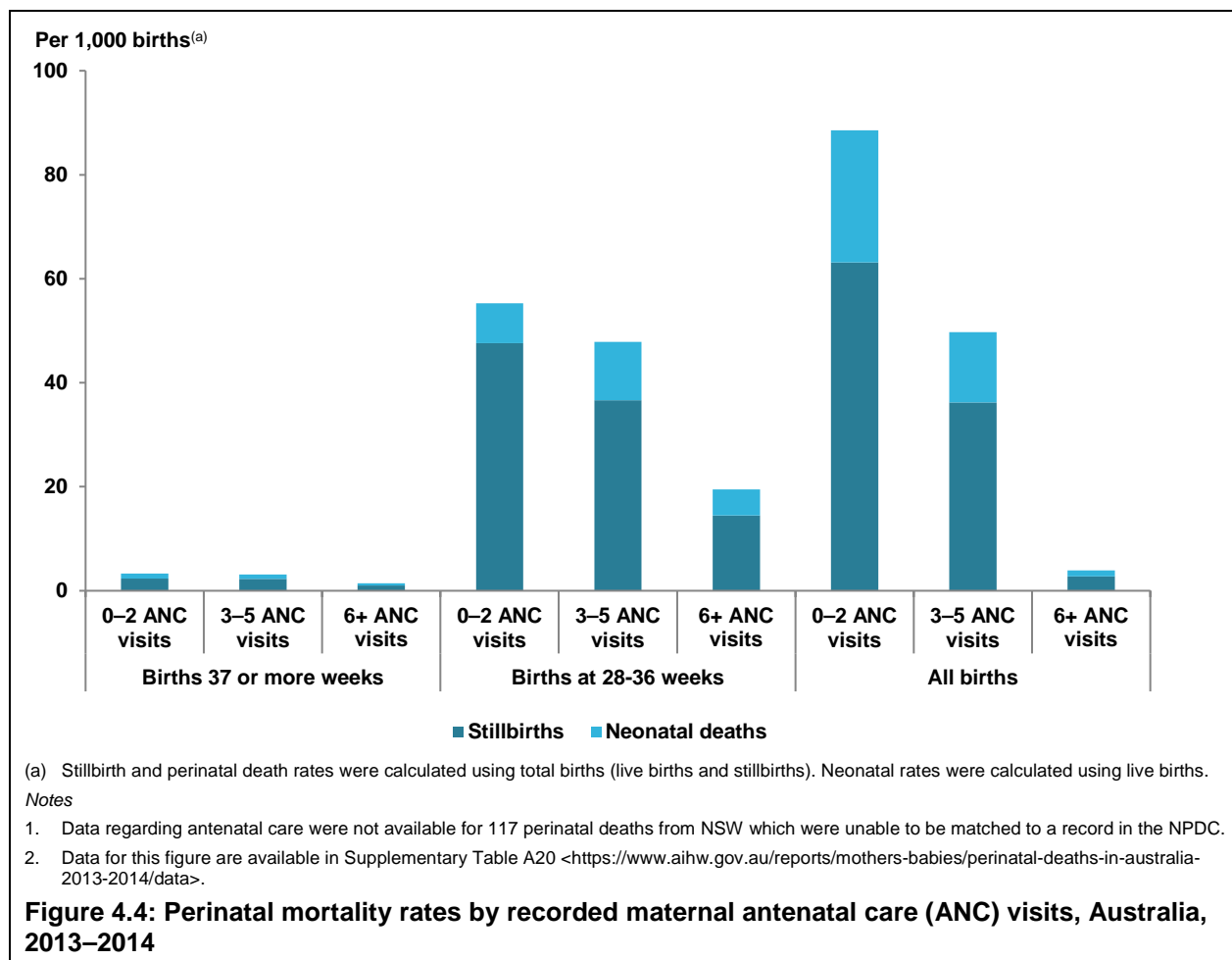
4.4 Maternal antenatal care

Antenatal care in community and/or hospital-based settings, delivered by a range of health-care professionals, is a routine part of pregnancy for most women who give birth in Australia. Australian national clinical practice guidelines for antenatal care recommend that a schedule of antenatal visits be developed based on each woman's needs (DoH 2018). They recommend that 10 visits should be adequate for a woman's first pregnancy without complications and that 7 visits should be adequate for subsequent uncomplicated pregnancies.

In 2013 and 2014, babies born to women who accessed 6 or more antenatal visits had a lower perinatal mortality rate than babies born to women who accessed fewer antenatal visits or had not accessed antenatal care at all (Figure 4.4 and Supplementary Table A20).

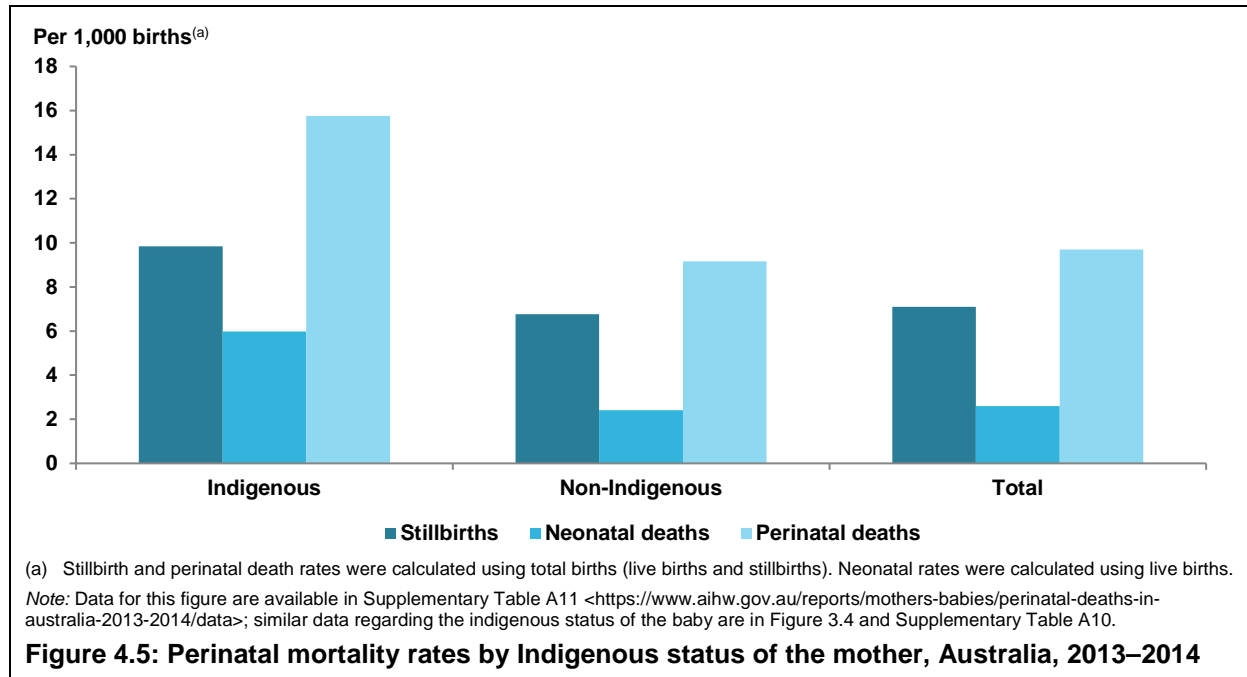
Most women accessed 6 or more antenatal visits (92.1%) and those women gave birth to 42.6% of the babies who died in the perinatal period, with a perinatal mortality rate of 3.9 per 1,000 births. The 1.9% of women who accessed 0–2 antenatal visits gave birth to 20% of the babies who died in the perinatal period, with a perinatal mortality rate of 86.9 per 1,000 births. The 6.4% of women who accessed 3–5 antenatal visits gave birth to 38% of babies who died in the perinatal period, with a perinatal mortality rate of 49.2 per 1,000 births.

Caution is advised in consideration of the relationship between number of antenatal visits and perinatal mortality rates in babies born very pre-term (before 28 weeks) as those women did not have the same opportunities to access antenatal visits as women who gave birth later in pregnancy.

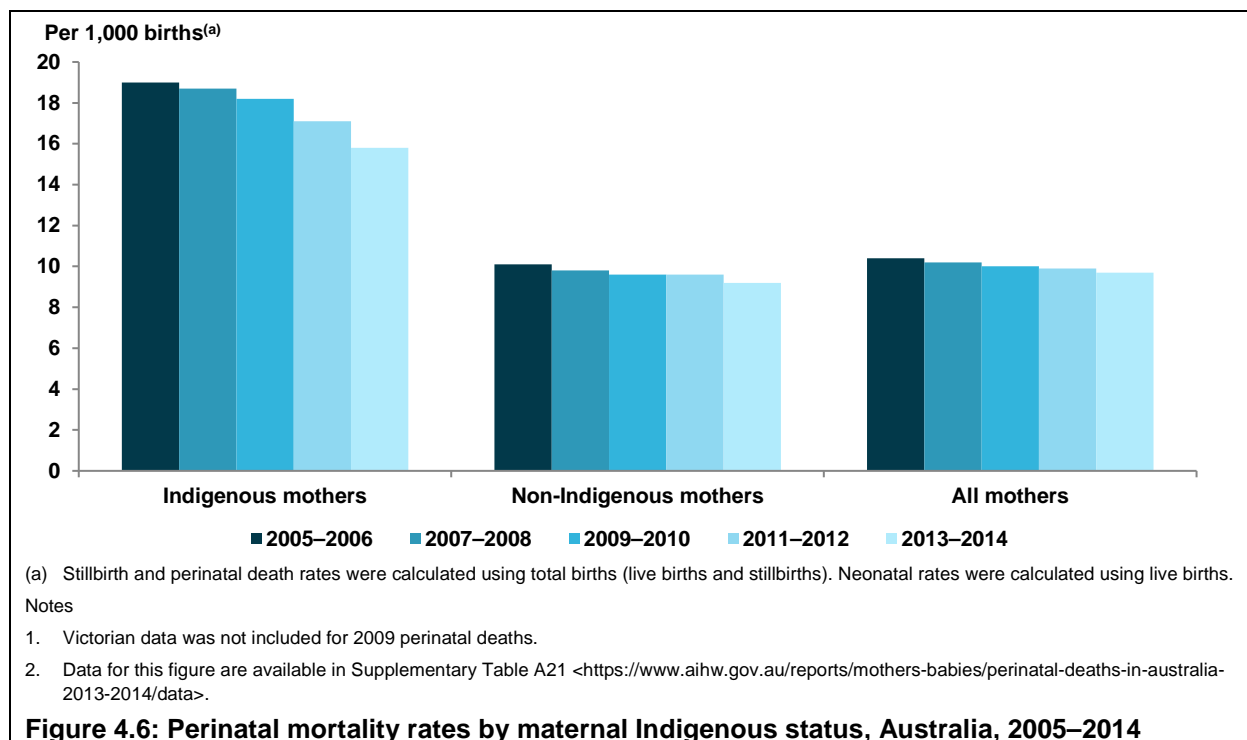


4.5 Maternal Indigenous status

In 2013–2014, Aboriginal and/or Torres Strait Islander mothers were 70% more likely to have a perinatal death than non-Indigenous mothers (Figure 4.5 and Supplementary Table A11). Both stillbirth and neonatal death were more common.



In 2005–2006, Aboriginal and/or Torres Strait Islander mothers were 90% more likely to have a perinatal death than non-Indigenous mothers (Figure 4.6 and Supplementary Table A21). Though there has been a progressive decrease in the difference between Aboriginal and/or Torres Strait Islander and non-Indigenous perinatal mortality rates, the incidence of perinatal death for babies of Aboriginal and/or Torres Strait Islander mothers is still significantly higher than that for babies of non-Indigenous mothers.



4.6 Maternal country of birth

Two-thirds of the babies who died were born to women born in Australia and their perinatal mortality rate was 9.4 per 1,000 births (Table 4.2). Fifteen per cent of the babies who died were born to women born in Asia and their perinatal mortality rate was also 9.4 per 1,000 births. Babies born to women born in Africa or the Middle East had a perinatal mortality rate of 11.9 per 1,000 birth.

Table 4.2: Perinatal deaths by maternal country of birth, Australia, 2013–2014

Maternal country of birth	Total births	Live births	Stillbirths ^(a)		Neonatal deaths ^(a)		Perinatal deaths ^(a)	
			n	Rate	n	Rate	n	Rate
Oceania and Antarctica								
Australia ^(b)	421,093	418,148	2,888	6.9	1,077	2.6	3,965	9.4
New Zealand	18,742	18,607	131	7.0	59	3.2	190	10.1
Other Oceania	5,795	5,739	54	9.3	16	2.8	70	12.1
North-East, Southern and Central Asia								
India	23,629	23,414	214	9.1	63	2.7	277	11.7
Philippines	7,878	7,812	63	8.0	24	3.1	87	11.0
Vietnam	8,366	8,315	51	6.1	22	2.6	73	8.7
China and Hong Kong	20,854	20,747	105	5.0	35	1.7	140	6.7
Other Asia	38,859	38,590	263	6.8	96	2.5	359	9.2
North Africa and the Middle East								
Africa (excluding North Africa)	12,510	12,394	113	9.0	35	2.8	148	11.8
Lebanon	3,746	3,725	20	5.3	13	3.5	33	8.8
Other Middle East and North Africa	14,064	13,929	127	9.0	54	3.9	181	12.9
Europe								
United Kingdom	16,040	15,946	94	5.9	26	1.6	120	7.5
Other Europe	17,524	17,413	107	6.1	37	2.1	144	8.2
Americas								
South and Central America and the Caribbean	4,723	4,690	31	6.6	8	1.7	39	8.3
North America	4,805	4,772	31	6.5	8	1.7	39	8.1
Not stated	3,409	3,359	48	14.1	7	2.1	55	16.1
Total	622,037	617,600	4,419^(b)	7.1	1,618^(b)	2.6	6,037^(b)	9.7

(a) The rate is the number of deaths per 1,000 births. Stillbirth and perinatal death rates were calculated using total births (live births and stillbirths). Neonatal rates were calculated using live births.

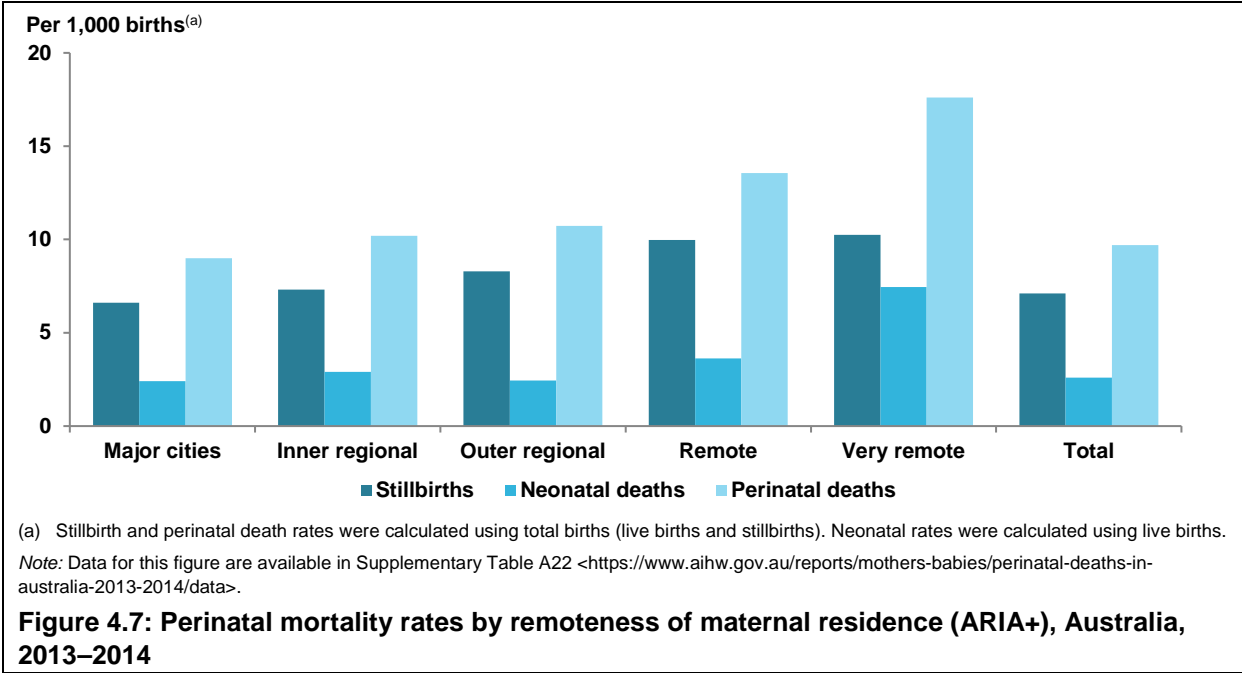
(b) Total includes 117 perinatal deaths (comprising 79 stillbirths, 38 neonatal deaths) from NSW where birthweight is not able to be determined.

4.7 Maternal remoteness of residence

The ARIA+ scoring system (Accessibility/Remoteness Index of Australia) is used to identify the degree of remoteness of the mother's usual residence (ABS 2011a). ARIA+ is a geographic measure of remoteness derived from measures of road distances between populated localities and service centres, and is the standard ABS endorsed measure of remoteness. ARIA+ is a continuous varying index with values ranging from high accessibility (*Major cities*) to high remoteness (*Very remote*). Not all capital cities are classified as *Major cities*; for example, although Sydney is classed as *Major cities*, Hobart is classed as *Inner regional* and Darwin *Outer regional*. The ARIA+ score has been derived from the mother's postcode of usual residence.

The majority of the mothers of babies born in 2013–2014 lived in major cities (72%) and inner regional areas (17%), while less than 3% of mothers lived in remote and very remote areas. Babies born to women who lived in remote and very remote Australia were 65% more likely to die in the perinatal period (perinatal mortality rate 15.2 per 1,000 births) than those born to women who lived in major cities and inner regional areas (perinatal mortality rate 9.2 per 1,000 births) (Figure 4.7 and Supplementary Table A22).

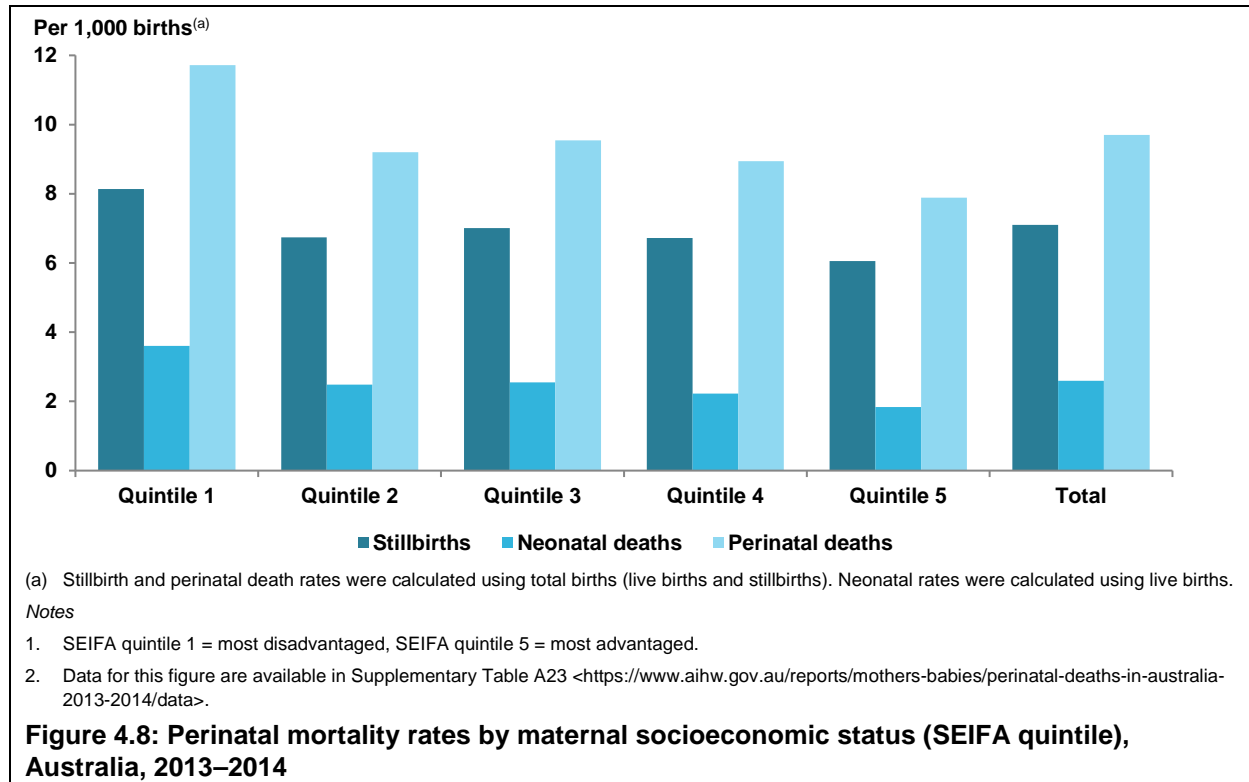
The incidence of perinatal death in remote and very remote areas should be treated with caution due to the relatively small numbers of women living in these areas.



4.8 Maternal socioeconomic status

The Socio-Economic Indexes for Areas Index of Advantage/Disadvantage (SEIFA) applied here is a composite index developed by the ABS where lower scores indicate more disadvantaged areas and higher scores indicate more advantaged areas (ABS 2011b). This index is constructed using a number of variables that indicate both advantage (for example, high income, having a degree qualification) and disadvantage (for example, unemployment status, low income, not enough bedrooms) and is applied to the mother’s area of residence. The distribution of SEIFA quintiles varies across jurisdictions.

Women with a SEIFA index in quintiles 1 and 2 (most disadvantaged) were 25% more likely to have a perinatal death than women with a SEIFA index in quintiles 4 and 5 (most advantaged) (perinatal mortality rate 10.5 per 1,000 births versus 8.4 per 1,000 births respectively) (Figure 4.8 and Supplementary Table A23). The difference was most marked in relation to neonatal death.



5 Causes of perinatal deaths

5.1 Cause of perinatal deaths

Perinatal deaths are classified according to the PSANZ Perinatal Mortality Classification System as part of each state and territory's perinatal mortality review process. The PSANZ Perinatal Mortality Classification System incorporates a Perinatal Death Classification (PSANZ-PDC) and a Neonatal Death Classification (PSANZ-NDC).

The PSANZ-PDC system classifies all perinatal deaths by the single most important factor seen as the antecedent cause of the death (Table 5.1). The PSANZ-NDC classification system is applied only to neonatal deaths and classifies them by condition present in the baby in the neonatal period leading to the death (Table 5.2).

The perinatal deaths reported in this section were classified by the PSANZ-PDC and PSANZ-NDC systems in place in 2013–2014. The PSANZ Perinatal Mortality Classification System has since been revised and the revision was released in March 2018 (PSANZ 2018).

Table 5.1: PSANZ-PDC perinatal death classification primary groups

PSANZ-PDC antecedent cause of death	
1	Congenital anomaly: This category includes deaths in which a congenital abnormality, whether structural, functional or chromosomal, is considered to have made a major contribution, even though the abnormality may not always be lethal. This category includes terminations of pregnancy ≥ 20 weeks undertaken because of congenital abnormalities, even if they are not considered to be lethal abnormalities.
2	Perinatal infection: This category includes primary infections occurring in term and preterm neonatal and fetal deaths and secondary infections in term infants.
3	Hypertension: This category includes deaths where the hypertensive disorder is considered the factor initiating the chain of events leading to the death.
4	Antepartum haemorrhage: This category includes all perinatal deaths where the primary factor leading to the death was an antepartum haemorrhage.
5	Maternal conditions: This category includes deaths attributed to any medical or surgical disorder in the mother, or to its complications or treatment, excluding hypertensive disorders. Terminations of pregnancy undertaken for any other indication than congenital abnormality are included in this category.
6	Specific perinatal conditions: This category includes deaths of normally formed, appropriately grown babies in which a specific perinatal condition made a major contribution.
7	Hypoxic peripartum deaths: This category includes deaths from acute or chronic hypoxia of normally formed babies, typically of >24 weeks' gestation or >600 grams birthweight. The presence of fetal growth restriction overrides this classification and, if present, the death should be classified under fetal growth restriction (Category 8).
8	Fetal growth restriction: This category includes deaths of babies with birthweight <10 th percentile for gestational age for live births or non-macerated stillbirths, or for all perinatal deaths where repeated antenatal ultrasound measurements have already shown growth restriction or growth arrest before death. This category excludes perinatal deaths with fetal growth restriction as a result of an identified maternal or fetal condition where the death is classified according to the condition.
9	Spontaneous preterm: This category includes deaths of normally formed, appropriately grown preterm babies following spontaneous onset of preterm labour or spontaneous rupture of membranes, irrespective of induction of labour or mode of delivery.
10	Unexplained antepartum death: This category includes deaths of normally formed fetuses prior to the onset of labour where no predisposing factors are considered likely to have caused the death.
11	No obstetric antecedent: This category includes Sudden Infant Death Syndrome (SIDS), postnatally acquired infection, accidental asphyxiation and other accidents, poisoning or violence.

Source: PSANZ 2009.

Table 5.2: PSANZ-NDC neonatal death classification main groups

PSANZ-NDC neonatal condition causing death	
1	Congenital anomaly: This category includes neonatal deaths in which a congenital abnormality, whether structural, functional or chromosomal, is considered to have made a major contribution, even though the abnormality may not always be lethal.
2	Extreme prematurity: This group includes infants deemed too immature for resuscitation (positive pressure ventilation) or continued life support beyond the delivery room, typically infants of gestational age ≤ 24 weeks or birthweight ≤ 600 grams.
3	Cardio-respiratory disorders: This category includes neonatal deaths in which a cardio-respiratory condition is considered to have been the major contributor.
4	Infection: This category includes neonatal deaths in which infection is considered to have been the major contributor.
5	Neurological: This category includes neonatal deaths in which hypoxic ischaemic encephalopathy, perinatal asphyxia or intracranial haemorrhage was considered to have been the major contributor.
6	Gastrointestinal: This category primarily includes neonatal deaths related to necrotizing enterocolitis.
7	Other: This category includes Sudden Infant Death Syndrome (SIDS), multisystem failure, trauma and treatment complications.

Source: PSANZ 2009.

Details of the PSANZ-PDC and PSANZ-NDC classification of the babies who died in the perinatal period are found in Supplementary tables A24 and A25, respectively.

The most common causes for all perinatal deaths were congenital anomaly (28%), unexplained antepartum death (15%) and spontaneous preterm birth (13%) (Figure 5.1 and Supplementary Table A24). Congenital anomaly (27%), unexplained antepartum death (20%) and maternal conditions (11%) were the main causes of stillbirth, while congenital anomaly (32%) and spontaneous preterm birth (31%) were the main causes of neonatal death.

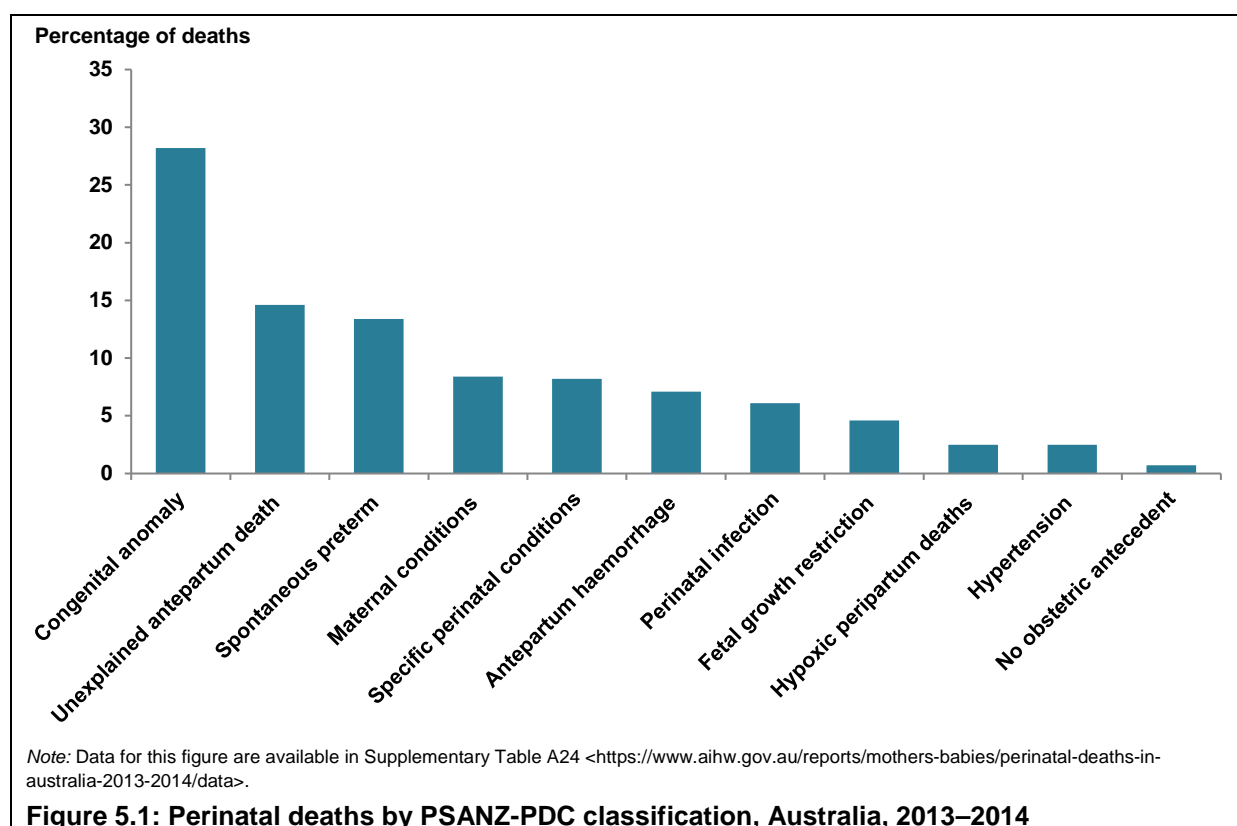


Figure 5.1: Perinatal deaths by PSANZ-PDC classification, Australia, 2013–2014

Interpretation of the incidence of congenital abnormality as the leading cause of stillbirths is complicated by the fact that a proportion of these stillbirths were due to terminations of

pregnancy (TOP), including some in relation to non-lethal abnormalities, but the number of pregnancy terminations cannot be determined because they are not consistently reported in the National Perinatal Data Collection (NPDC) or in supplementary data due to variations in jurisdictional legislation and reporting practices.

The type of anomaly was specified in 1,143 of the 1,704 perinatal deaths classified as due to a congenital anomaly; 23% of these perinatal deaths related to anomalies of the central nervous system, 22% were related to chromosomal anomalies and 15% were related to anomalies of the cardiovascular system. The distribution of anomaly types was similar for both stillbirths and neonatal deaths.

Unexplained antepartum deaths were marked by the absence of information regarding appropriate pathological examination of the placenta in 30% of cases.

Spontaneous preterm birth was classified by PSANZ-PDC as a major obstetric antecedent factor of neonatal death. Where the cause of the spontaneous preterm birth was specified, 64% had pathological evidence in the placenta or clinical evidence of underlying infection of the placenta and/or membranes (chorioamnionitis). It could be hypothesised that many of the perinatal deaths due to spontaneous preterm birth that were not subjected to pathological examination of the placenta were of a similar cause.

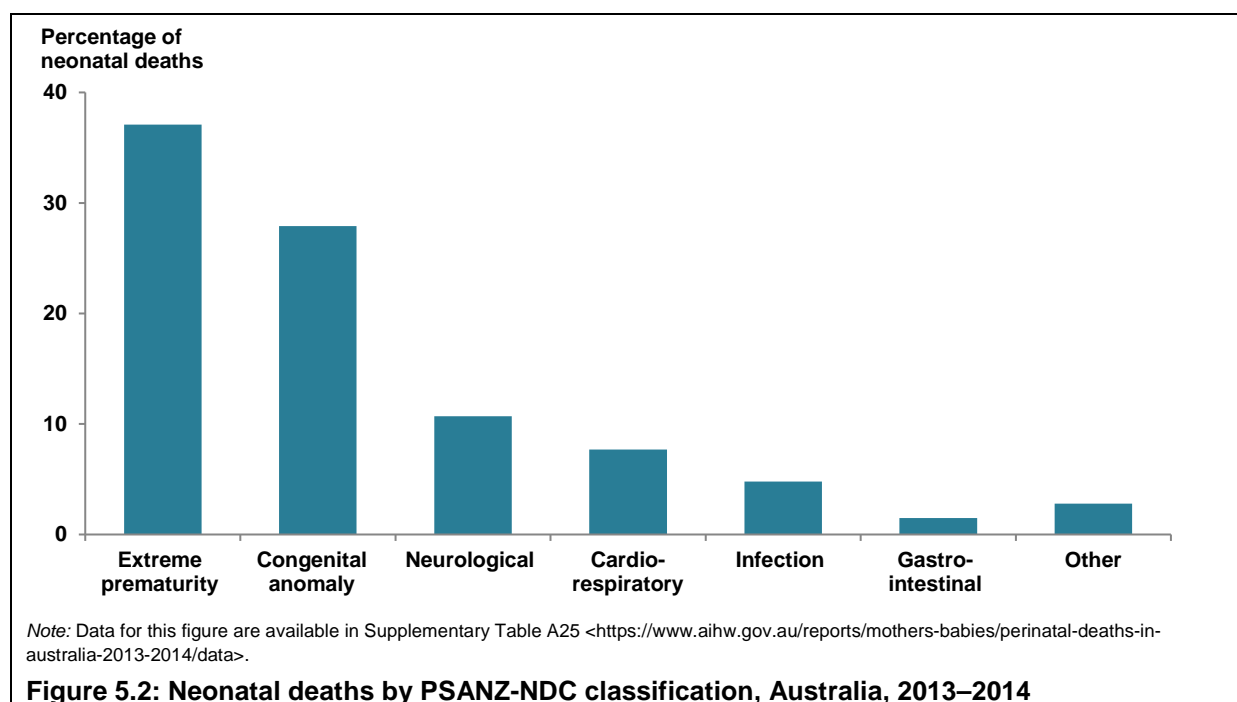
The remaining perinatal deaths were classified as due to maternal conditions (8%), specific perinatal conditions (8%), antepartum haemorrhage (7%), perinatal infection (6%), fetal growth restriction (5%), hypoxic peripartum death (3%), maternal hypertension (3%) and no obstetric antecedent (1%) (Supplementary Table A24).

Good practice guidance

Following a stillbirth or birth of a high risk infant, the placenta, membranes and cord should be sent for examination by a perinatal/paediatric pathologist regardless of whether consent for an autopsy has been granted.

Source: PSANZ recommendations regarding investigation of a perinatal death (PSANZ 2009).

Extreme prematurity (37%), congenital anomaly (28%) and neurological conditions (11%) were the most frequent PSANZ-NDC causes of neonatal deaths (Figure 5.2 and Supplementary Table A25).



Of the 600 neonatal deaths classified as due to extreme prematurity, resuscitation was not attempted in 62% and resuscitation attempts were not recorded in a further 34%.

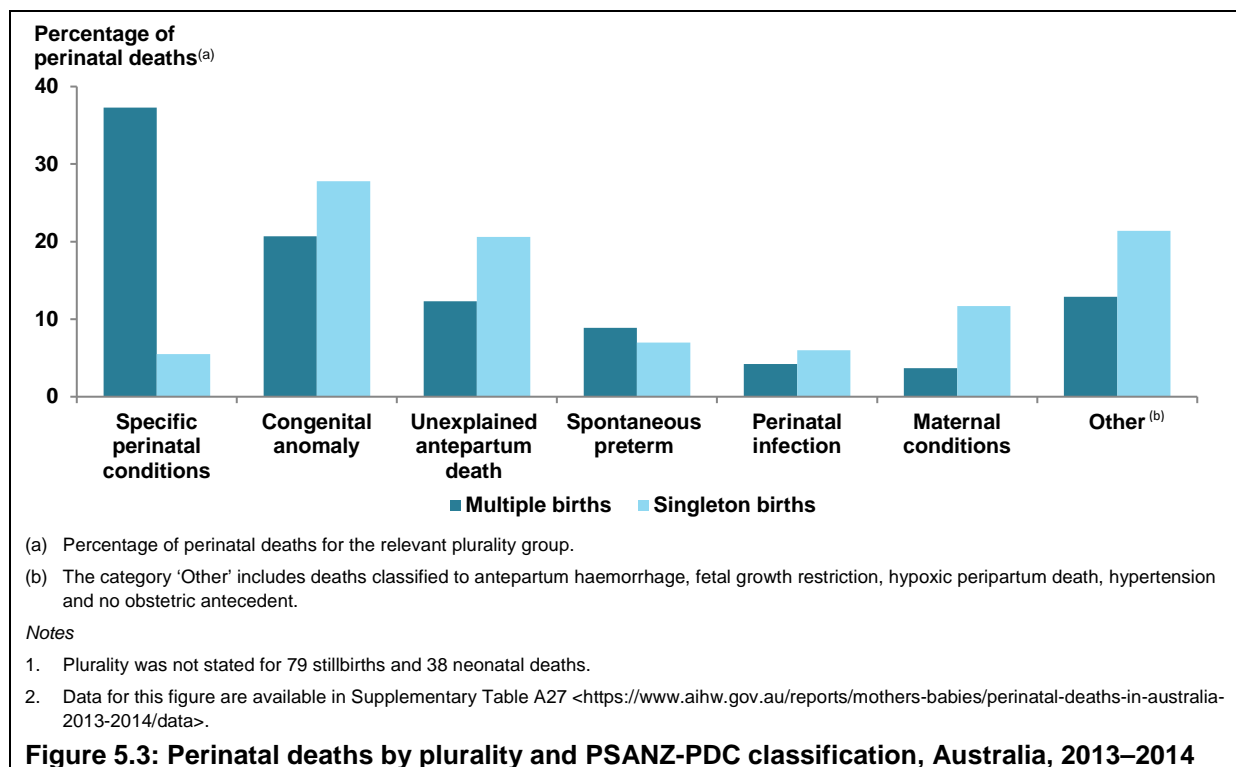
There was a broad spread of congenital anomalies leading to neonatal death, including 11% related to the central nervous system, 10% chromosomal anomalies and 9% each due to cardiovascular anomalies and to non-chromosomal syndromes with multiple anomalies.

Supplementary Table A26 provides a correlation between PSANZ-PDC and PSANZ-NDC causes of neonatal deaths.

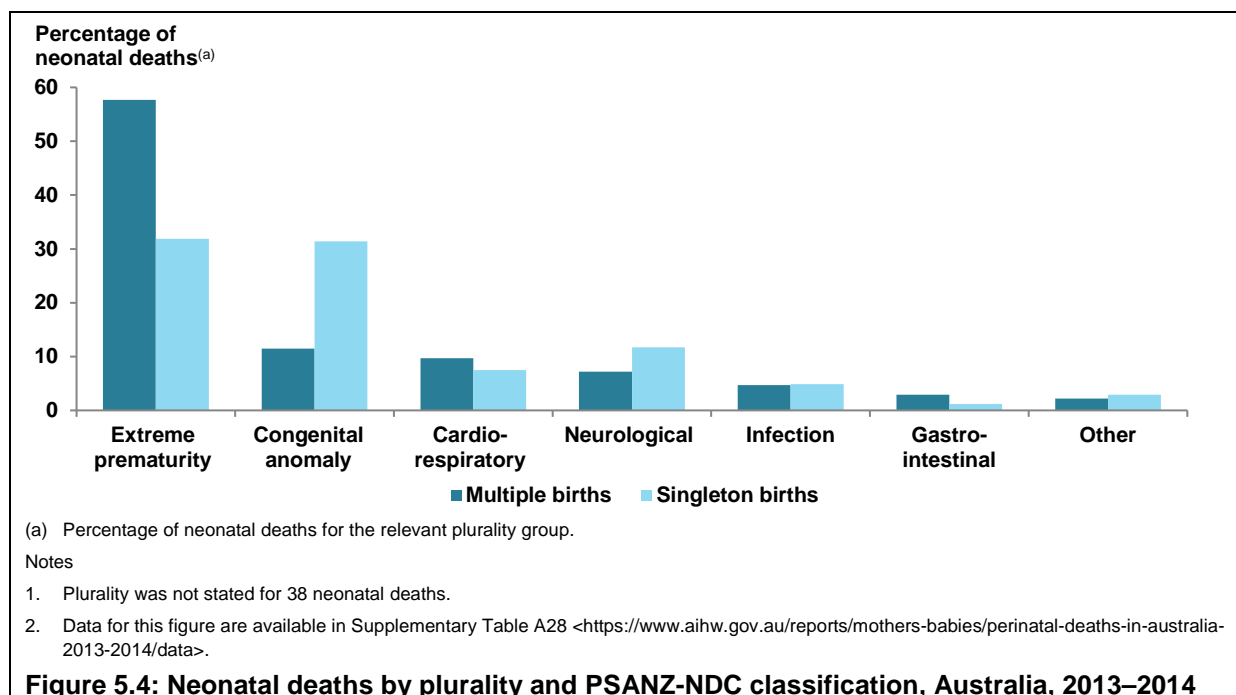
5.2 Plurality

Babies born from multiple pregnancies had a different pattern of causes of perinatal death from those born from singleton pregnancies.

Perinatal death in multiple births, as classified by PSANZ-PDC, was most frequently due to specific perinatal conditions such as twin-twin transfusion syndrome (37%), congenital anomaly (21%), unexplained antepartum death (12%) and spontaneous preterm birth (9%) (Figure 5.3 and Supplementary Table A27). A similar pattern was seen for both stillbirths and neonatal deaths (except for unexplained antepartum death).

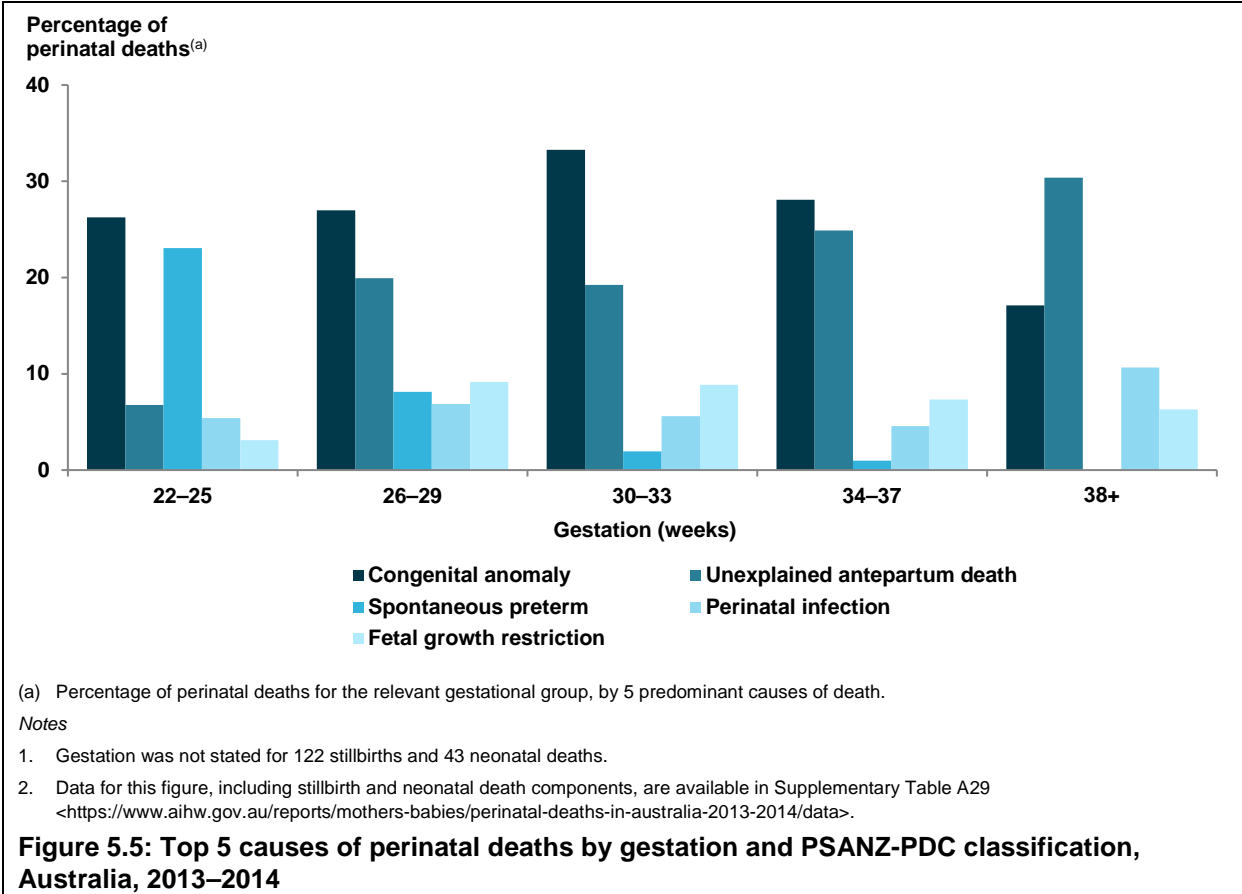


The majority of neonatal deaths from multiple births, as classified by PSANZ-NDC, were due to extreme prematurity (58%), congenital anomaly (12%), cardio-respiratory conditions (10%) and neurological conditions (7%) (Figure 5.4 and Supplementary Table A28).

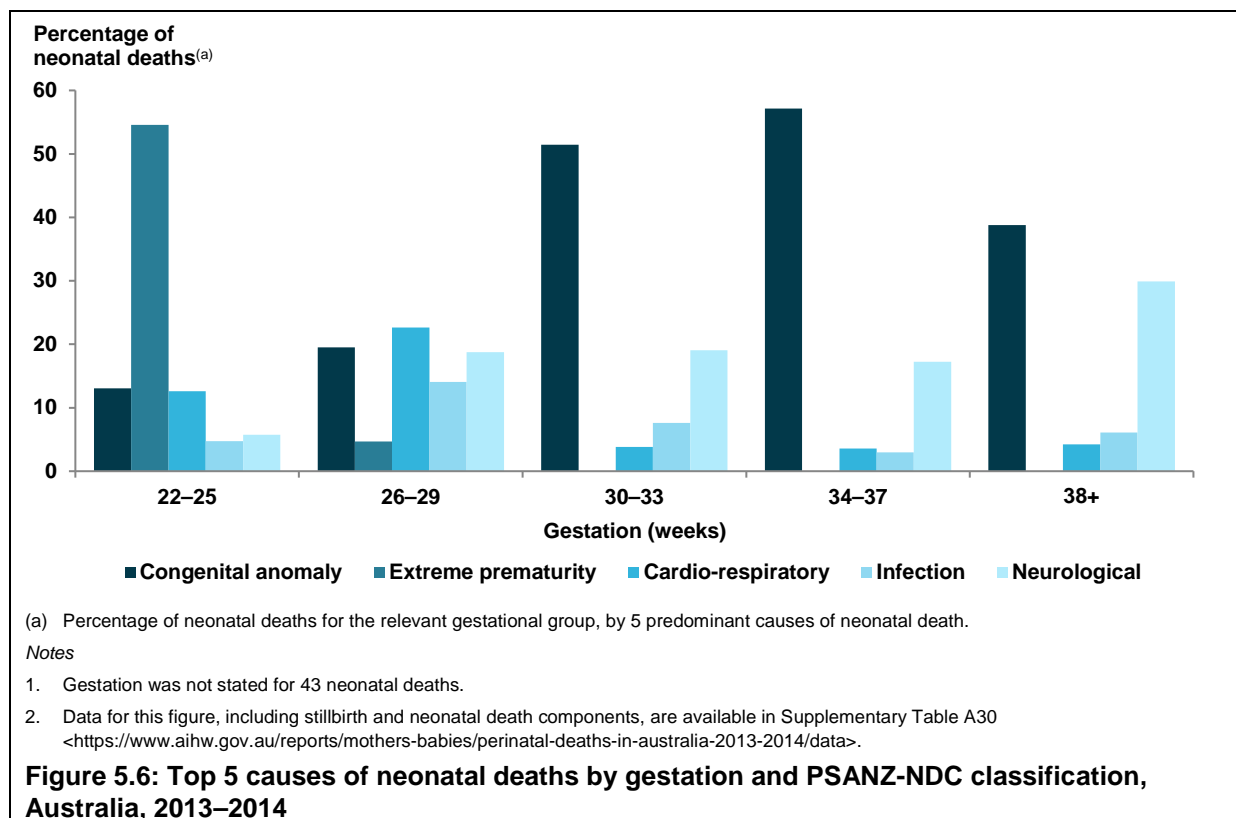


5.3 Gestation

The gestational pattern of perinatal deaths varied with PSANZ-PDC cause of death (Figure 5.5 and Supplementary Table A29). Congenital anomaly was the most common category of perinatal death, and it became relatively less frequent as gestation increased. Spontaneous preterm birth was the most frequent category before 30 weeks' gestation. Unexplained antepartum death, perinatal infection and hypoxic peripartum death were more frequent with near term (38 weeks or more) gestation.

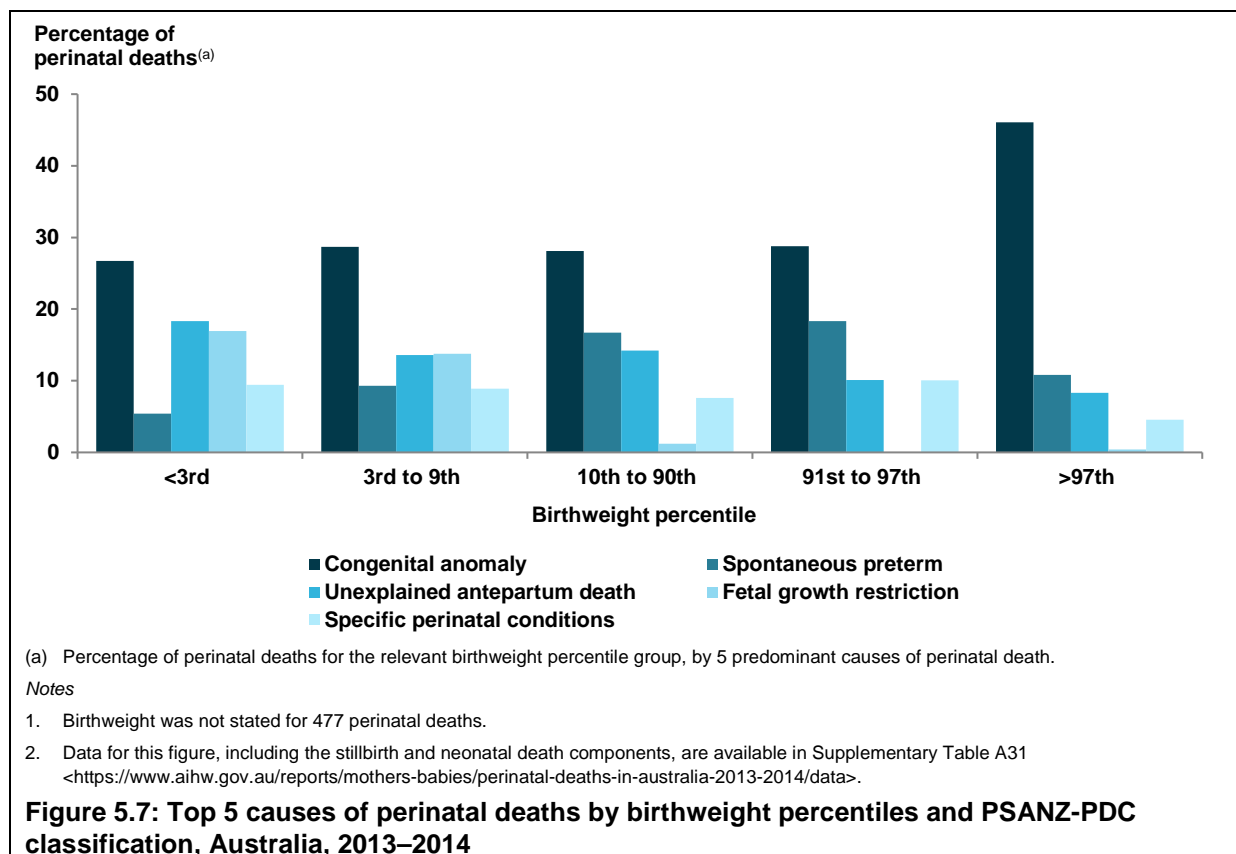


Congenital anomaly and neurological conditions became more frequent as causes of neonatal deaths as gestation advanced, while extreme prematurity and cardio-respiratory conditions were more prominent at earlier gestations (Figure 5.6 and Supplementary Table A30).

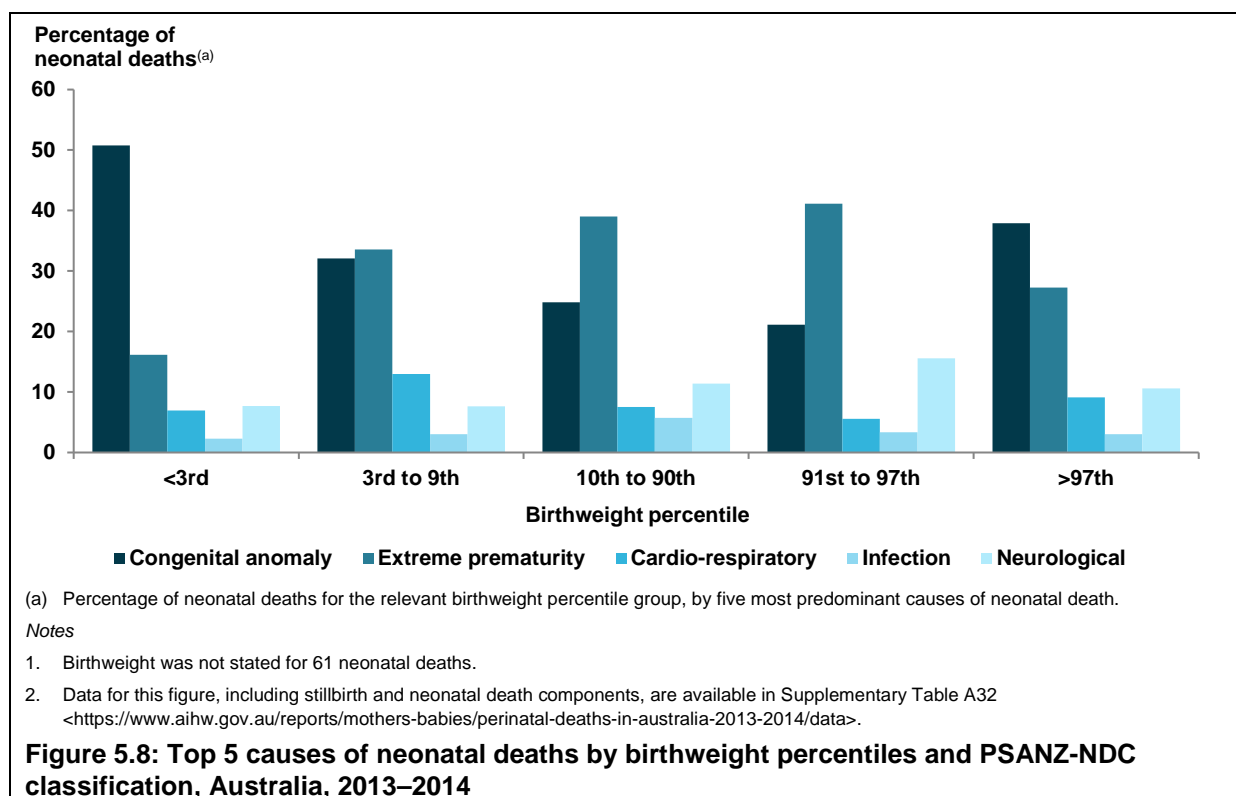


5.4 Birthweight

Perinatal deaths due to congenital anomaly predominated at all birthweights, whereas deaths due to unexplained antepartum death and fetal growth restriction were most frequent at lower birthweights and those due to spontaneous preterm birth were most frequent between the 10th and 97th percentiles of weight (Figure 5.7 and Supplementary Table A31). Stillbirths showed a similar pattern to all perinatal deaths. Neonatal deaths due to congenital anomalies were prominent across all birthweights while spontaneous preterm birth, antepartum haemorrhage and specific perinatal conditions predominated as causes of neonatal death in the 10th to 90th percentile birthweight groups.



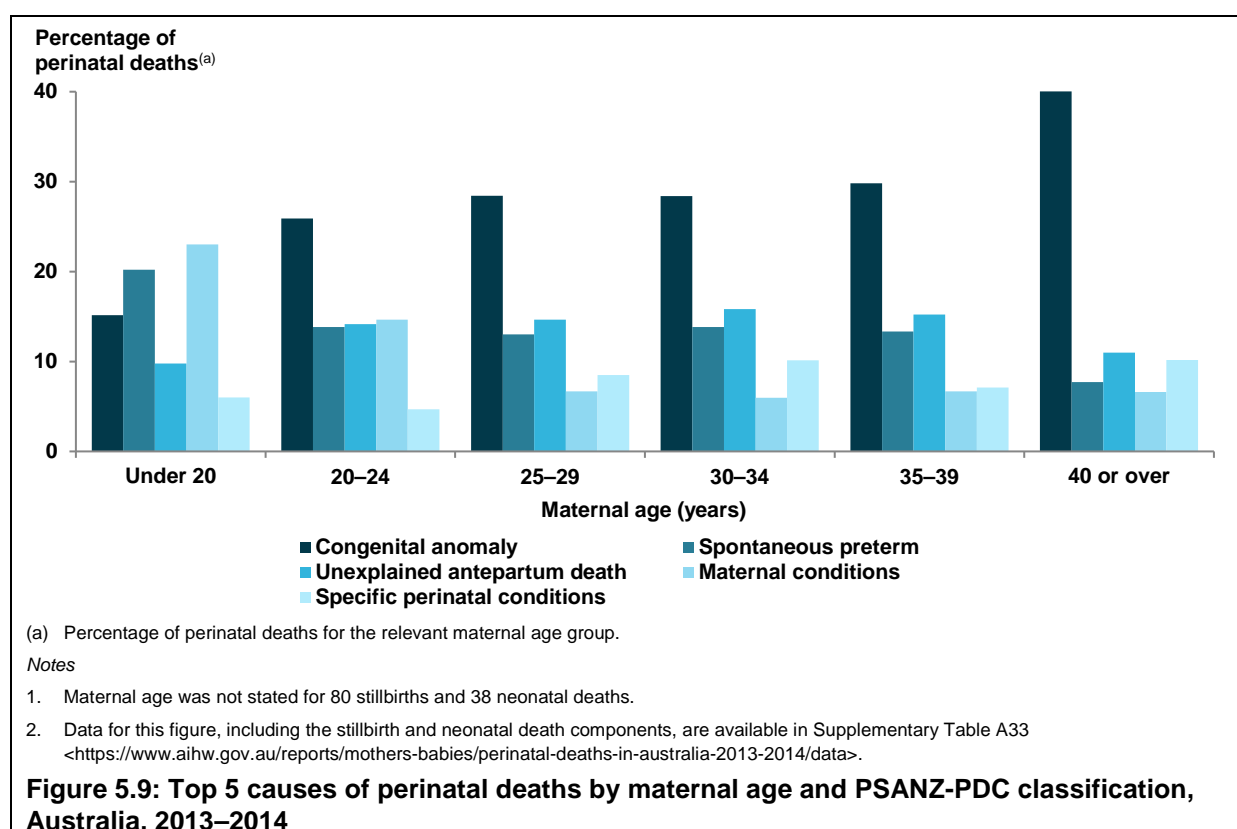
Congenital anomaly and extreme prematurity were the main PSANZ-NDC causes of neonatal deaths in all birthweight groups (Figure 5.8 and Supplementary Table A32).



5.5 Maternal age

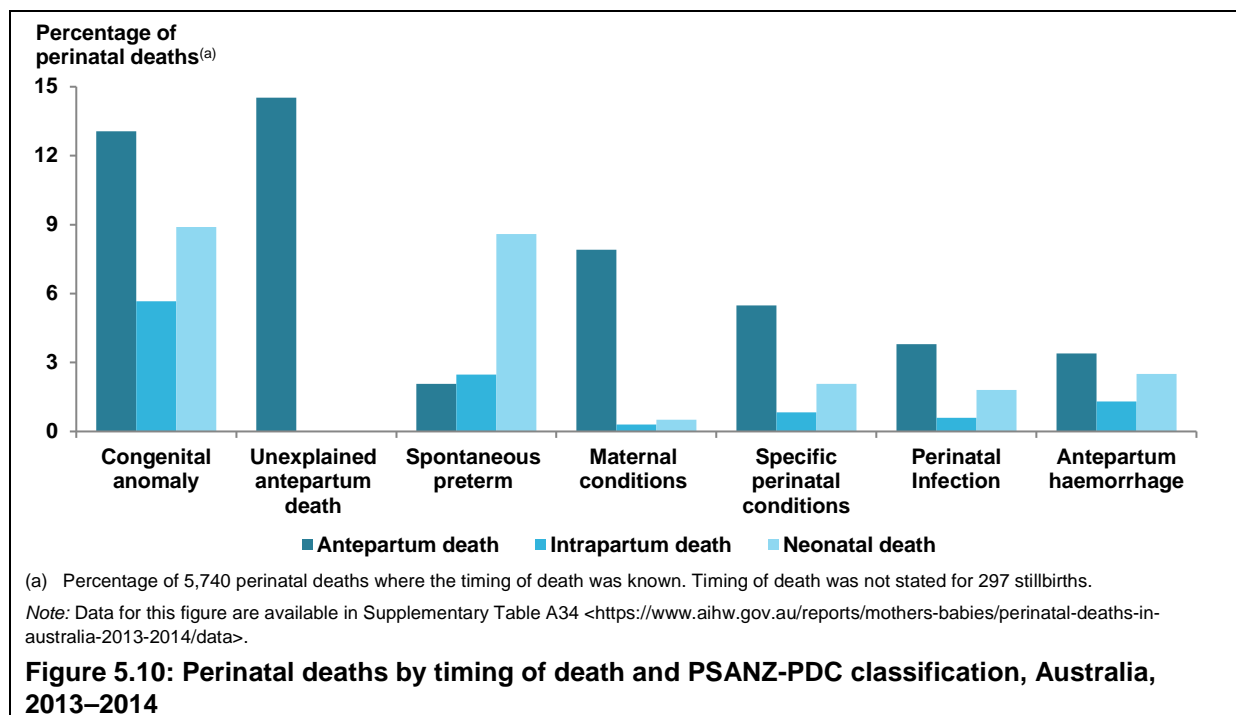
The causes of perinatal death varied with the age of the mother (Figure 5.9 and Supplementary Table A33). Overall, the most common causal group was congenital anomaly, and this cause became more dominant as maternal age increased, being responsible for 40% of perinatal deaths in babies born to women aged 40 or over. Spontaneous preterm birth and maternal conditions were responsible for a greater percentage of perinatal deaths in babies of women aged under 20, while unexplained antepartum death was more prominent in babies of women aged 20 to 39.

The causation of stillbirths had a similar distribution to the causation of all perinatal deaths in relation to maternal age; antepartum haemorrhage was more prominent in the babies of older mothers with regard to neonatal death.



5.6 Timing of perinatal death

The overall timing of perinatal death (antepartum, intrapartum or neonatal) was reported for 4,122 of the 4,419 stillbirths (93%) and all 1,618 neonatal deaths. Where the timing of intrauterine fetal death was known for stillbirths, 3,341 (81%) died prior to the onset of labour (antepartum) and 781 (19%) died during labour (intrapartum) (Figure 5.10 and Supplementary Table A34). Congenital anomaly was very prominent as a causal group in all periods. Unexplained antepartum death and maternal conditions were the predominant causal groups in the period prior to the onset of labour. Spontaneous preterm was prominent in both intrapartum deaths and neonatal deaths.

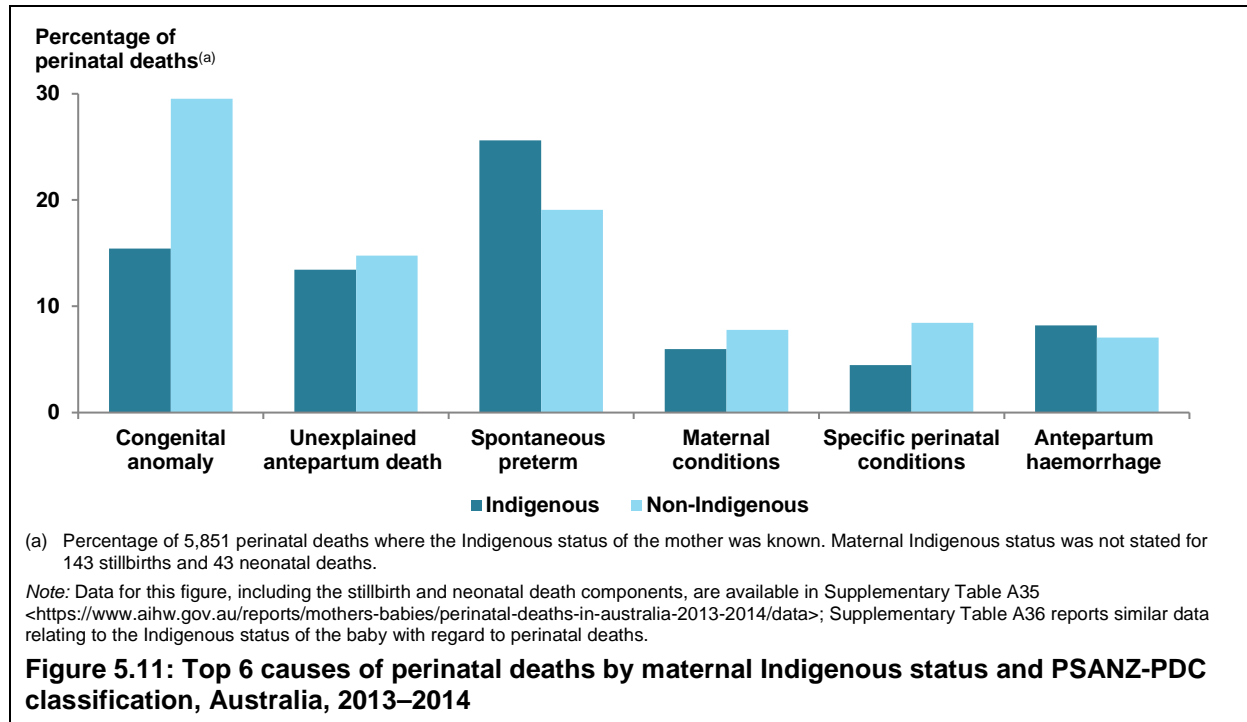


5.7 Maternal Indigenous status

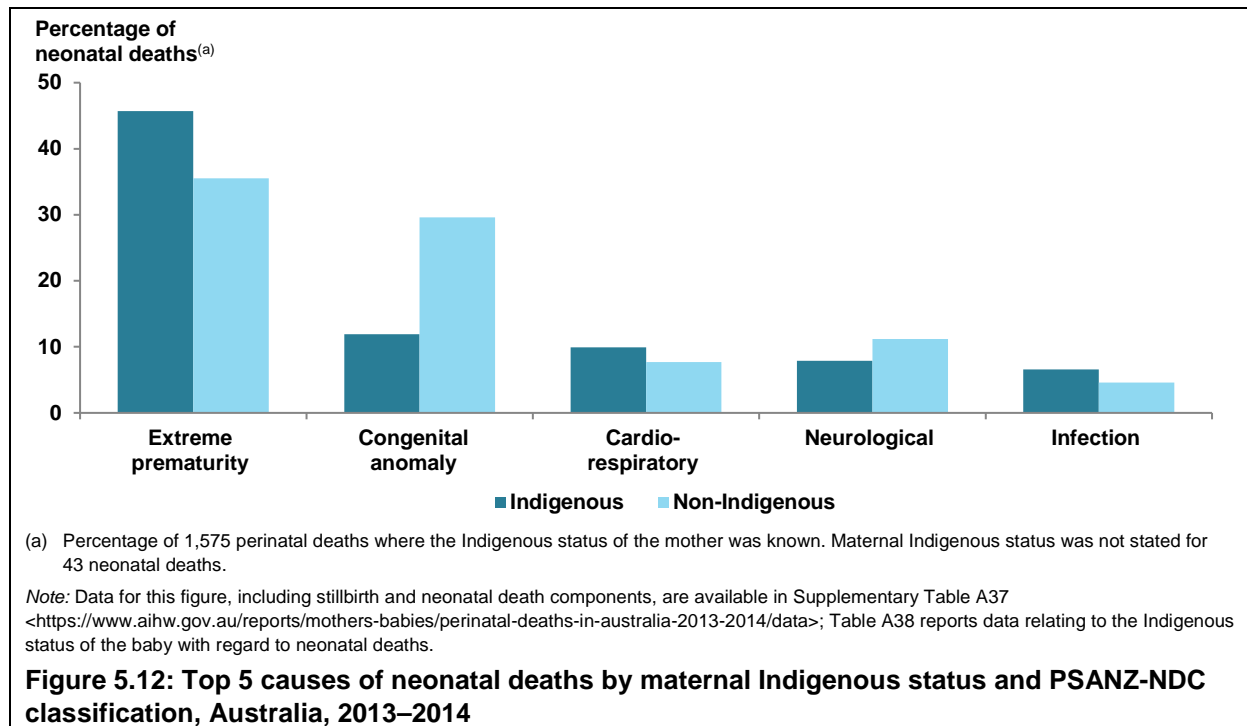
Spontaneous preterm birth was the most commonly identified cause of perinatal death in the babies of Aboriginal and/or Torres Strait Islander mothers (26% compared with 19% for non-Indigenous mothers) (Figure 5.11 and Supplementary Table A35). Congenital anomaly was much more common for the babies of non-Indigenous mothers (30% compared with 15% for Aboriginal and/or Torres Strait Islander babies). Similar percentages of perinatal deaths were classified as due to unexplained antepartum death (15% Aboriginal and/or Torres Strait Islander babies compared with 13% for non-Indigenous babies).

The main identified causes for Aboriginal and/or Torres Strait Islander stillbirths were unexplained antepartum death (22%), congenital anomaly (14%), spontaneous preterm birth (12%), antepartum haemorrhage (10%) and maternal conditions (9%). Non-Indigenous stillbirths were classified as due to congenital anomaly (28%), spontaneous preterm birth (24%), unexplained antepartum death (20%), maternal conditions (10%), specific perinatal conditions (9%) and antepartum haemorrhage (6%).

Spontaneous preterm birth was the leading cause of neonatal death for 48% of babies of Aboriginal and/or Torres Strait Islander mothers compared with 4% for babies of non-Indigenous mothers. Congenital anomaly was the leading cause of neonatal death for 33% of babies of non-Indigenous mothers compared with 18% of babies of Aboriginal and/or Torres Strait Islander mothers.



Neonatal deaths showed a similar pattern of causation. Extreme prematurity was more prominent for babies of Aboriginal and/or Torres Strait Islander mothers (46%) compared with babies of non-Indigenous mothers (36%), while congenital anomaly was more prominent for babies of non-Indigenous mothers (30%) compared with babies of Aboriginal and/or Torres Strait Islander mothers (12%) (Figure 5.12 and Supplementary Table A37).



6 Perinatal death in term singleton babies with no known congenital anomaly causing death

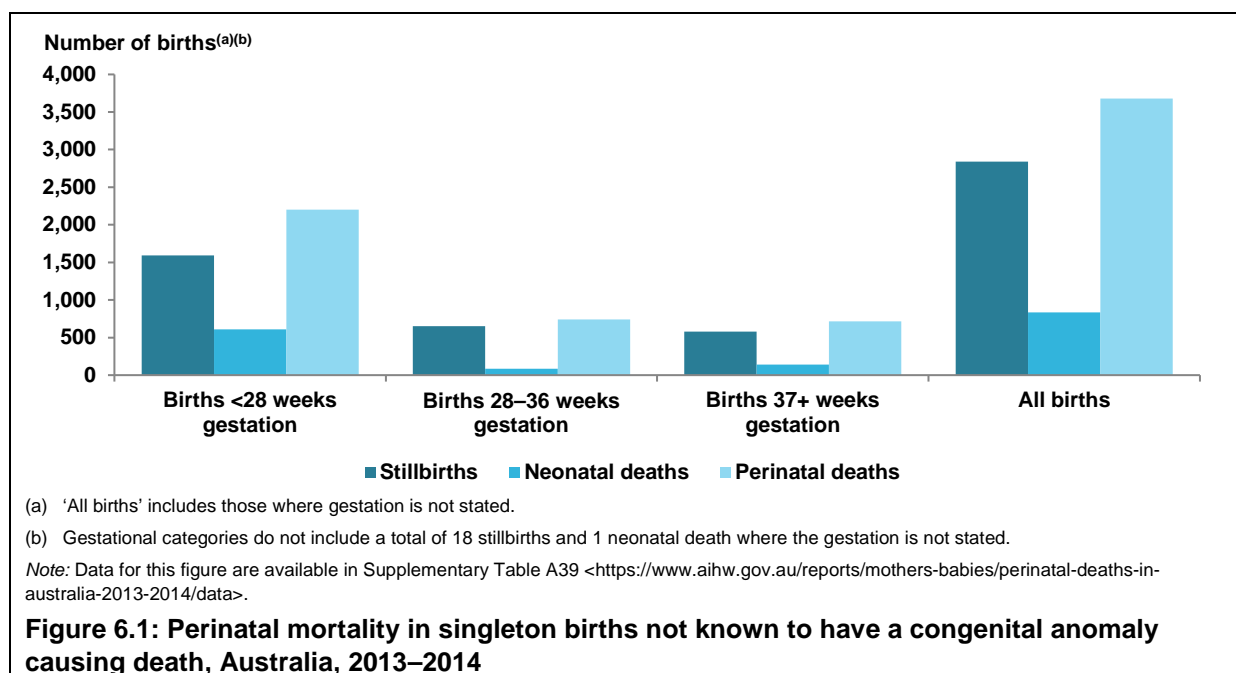
When considering potential avoidability in relation to perinatal death, the incidence of perinatal death in singleton births where the baby does not have a congenital anomaly causing death, and especially in pregnancies of mature gestation, is likely to be most effective in reviewing policy and practice in maternity and neonatal care (Draper et al. 2015; Draper et al. 2017; RCOG 2017).

This section examines perinatal deaths that occurred in singleton pregnancies where the baby did not have a congenital anomaly causing death and where the pregnancy ended at or after 37 weeks' gestation. Calculations for this section have been restricted to 2013–2014 as relevant data were not available from all states and territories before 2013.

6.1 Mortality rates of singleton births not known to have a congenital anomaly causing death

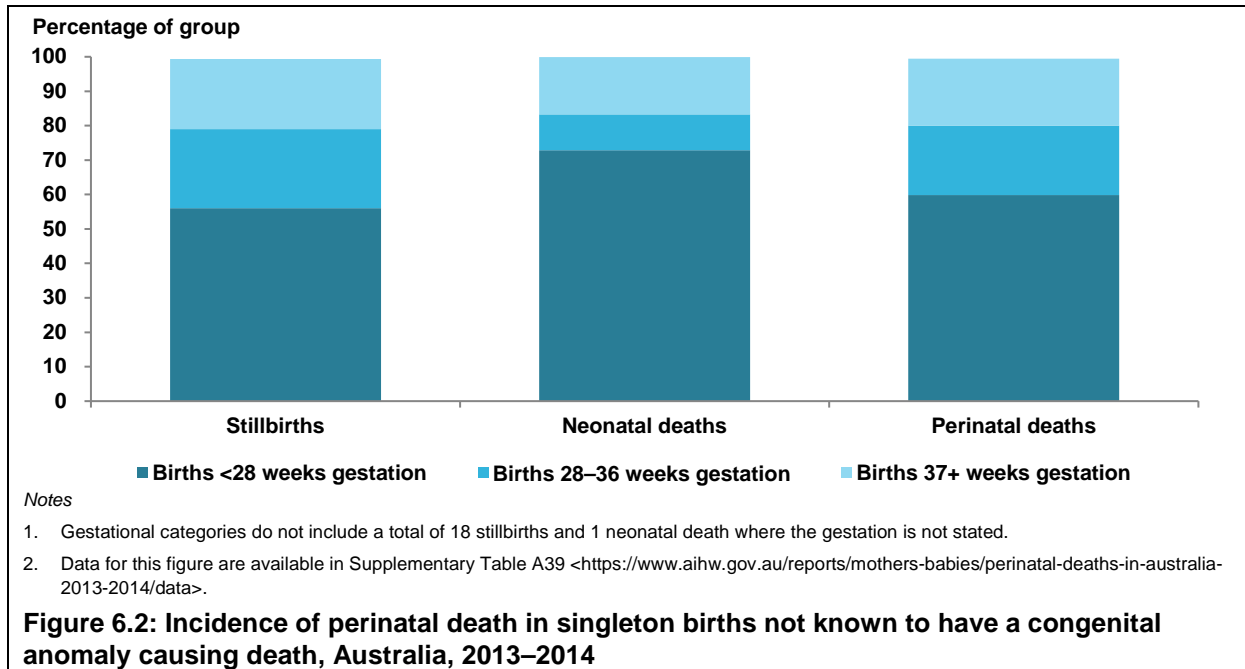
Perinatal death occurred in 3,677 singleton babies without a congenital anomaly causing death (Figure 6.1 and Supplementary Table A39); 2,842 of these babies were stillborn and 835 died in the neonatal period.

The largest proportion of these perinatal deaths occurred before 28 weeks' gestation (60%); 20% were born between 28 and 36 weeks' gestation and 20% at 37 weeks or more. Gestational information was not available for 19 of these perinatal deaths (18 stillbirths and 1 neonatal death).



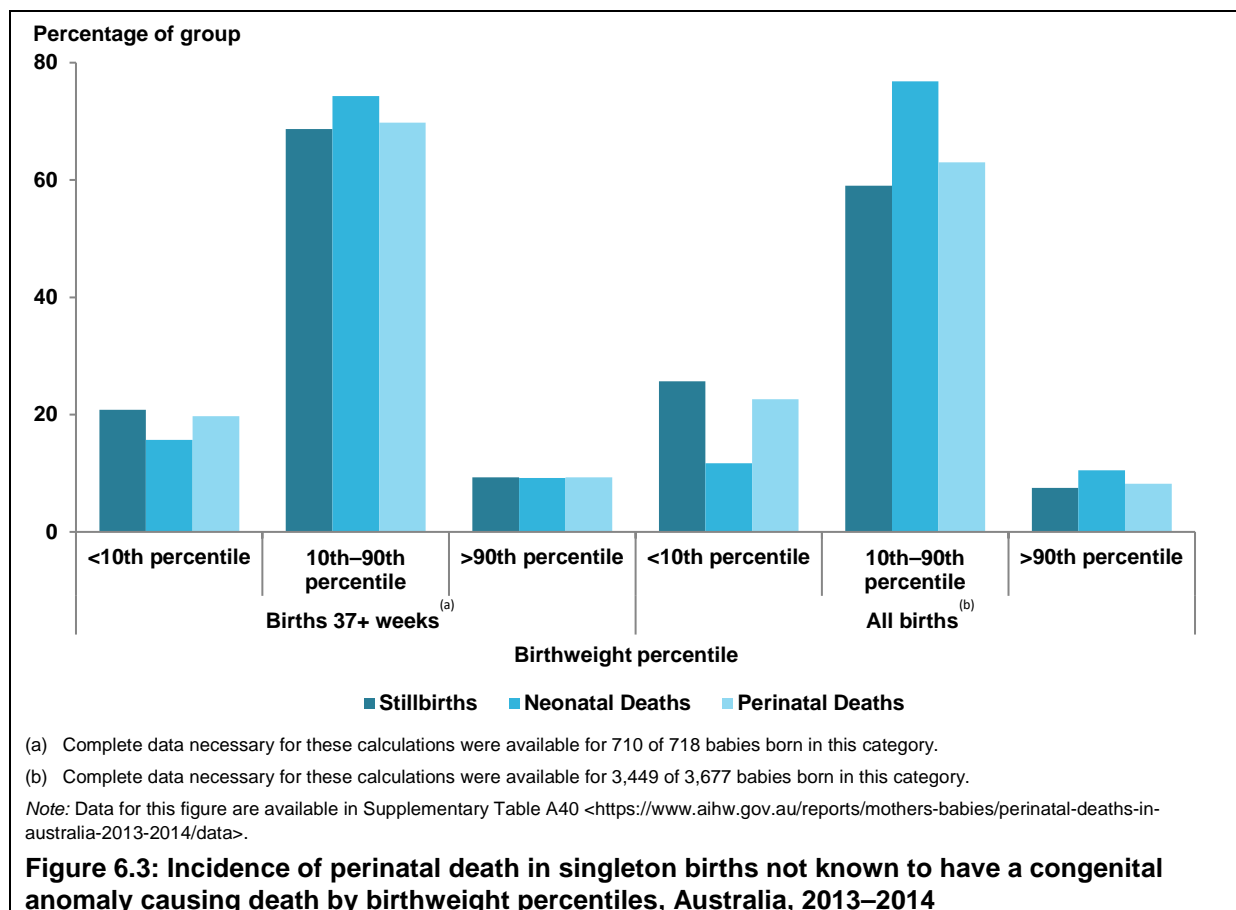
The distribution of stillbirths and neonatal deaths in singleton babies born without a congenital anomaly causing death differed (Figure 6.2 and Supplementary Table A39).

Over half (56%) of stillbirths occurred before 28 weeks' gestation, 23% between 28 and 36 weeks' gestation and 20% at 37 weeks or more. Almost three-quarters (73%) of neonatal deaths occurred before 28 weeks' gestation, 10% between 28 and 36 weeks' gestation and 17% at 37 weeks or more.



Most perinatal deaths in singleton babies without a congenital anomaly causing death (63%) occurred in babies with birthweights between the 10th and 90th percentiles (Figure 6.3 and Supplementary Table A40). Almost one-quarter (23%) of perinatal deaths of singleton babies without a congenital anomaly causing death occurred in babies with birthweights below the 10th percentile and 8% occurred in singleton babies without a congenital anomaly causing death and birthweights above the 90th percentile.

For singleton babies without a congenital anomaly causing death born at 37 weeks or more, most perinatal deaths (70%) occurred in babies with birthweights between the 10th and 90th percentiles, 20% occurred in babies with birthweights below the 10th percentile, and 9% occurred in those with birthweights above the 90th percentile.



6.2 Perinatal death in term singleton babies not known to have a congenital anomaly causing death

There were 717 singleton babies who did not have a congenital anomaly causing death born at or after 37 weeks' gestation in Australia in 2013–2014 (Figure 6.4 and Supplementary Table A40). Birthweight was stated for 709 of these babies allowing calculation of birthweight percentiles.

The majority of these babies (71%) had birthweights between the 10th and the 90th percentiles, and the major PSANZ-PDC causes of death in this group were unexplained antepartum death (43%), hypoxic peripartum death (15%), perinatal infection (12%) and specific perinatal conditions (11%). Babies with birthweights less than the 10th percentile principally died as a result of fetal growth restriction (31%), unexplained antepartum death (27%) and perinatal infection (10%), while babies with birthweights greater than the 90th percentile principally died as a result of unexplained antepartum death (27%), perinatal infection (19%) and hypoxic peripartum death (16%).

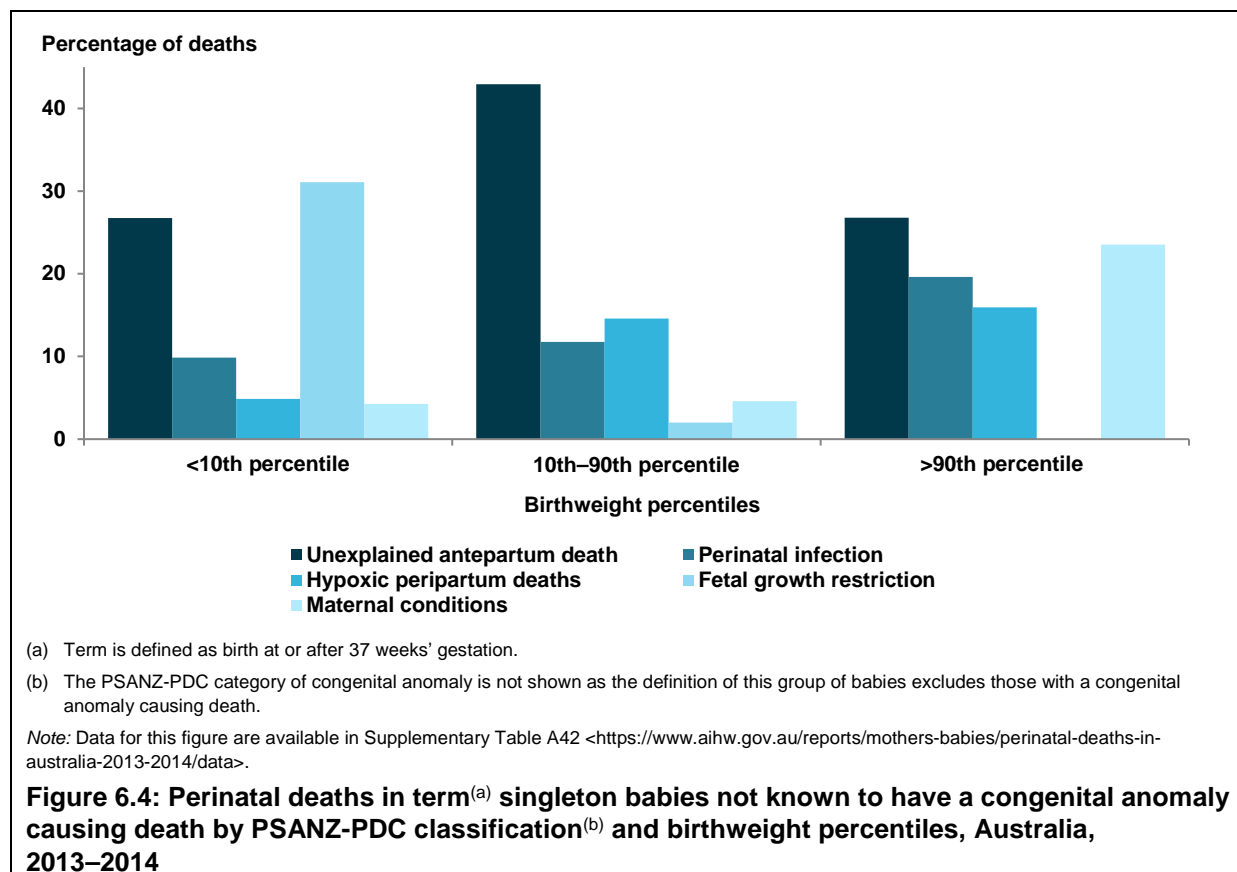
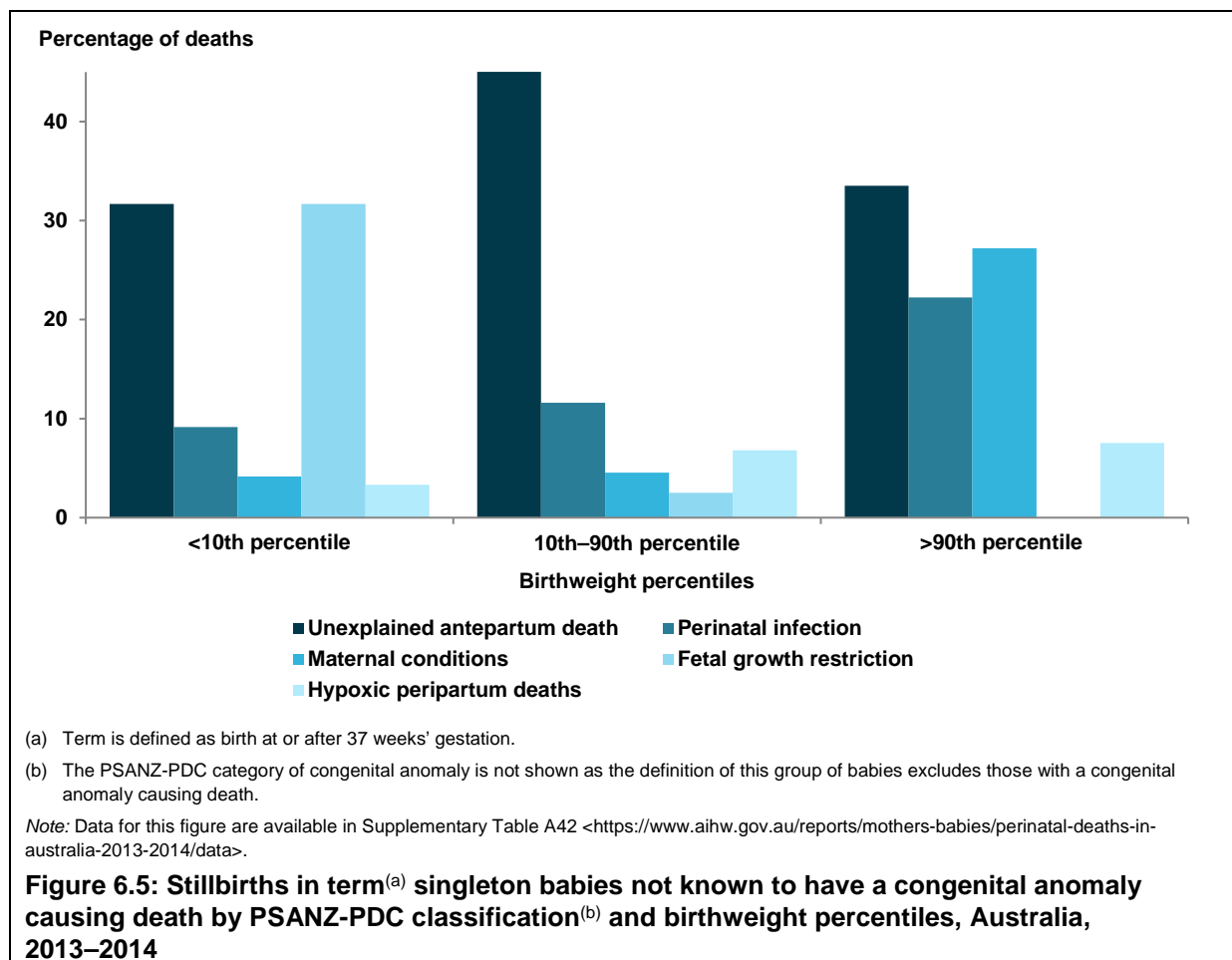


Figure 6.5 and Supplementary tables A41 and A42 detail similar information regarding stillbirths in singleton babies who did not have a congenital anomaly causing death and who were born at or after 37 weeks' gestation in Australia in 2013-2014. Unexplained antepartum death (54%), perinatal infection (12%) and hypoxic peripartum death (7%) were the most common causal classifications allocated to babies with birthweight in the 10th to 90th percentile range. Unexplained antepartum death (32%), fetal growth restriction (32%) and perinatal infection (9%) were the most common causal classifications allocated to babies with birthweight less than the 10th percentile, while unexplained antepartum death (33%), maternal conditions (28%) and perinatal infection (22%) were the most common causal classifications allocated to babies with birthweights above the 90th percentile.



The pattern of cause of death was quite different for neonatal deaths in singleton babies who did not have a congenital anomaly causing death and who were born at or after 37 weeks' gestation in the corresponding period (Figure 6.6 and Supplementary tables A41 and A42). Hypoxic peripartum deaths (44%), deaths with no obstetric antecedent (23%) and deaths due to perinatal infection (13%) were the most common in babies with a birthweight between the 10th and 90th percentiles. Babies with birthweights below the 10th percentile died mainly as a result of fetal growth restriction (27%), no obstetric antecedent (27%), hypoxic peripartum death (13%) and perinatal infection (13%); babies with birthweights above the 90th percentile died mostly as a result of hypoxic peripartum death (58%), no obstetric antecedent (20%) and perinatal infection (17%).

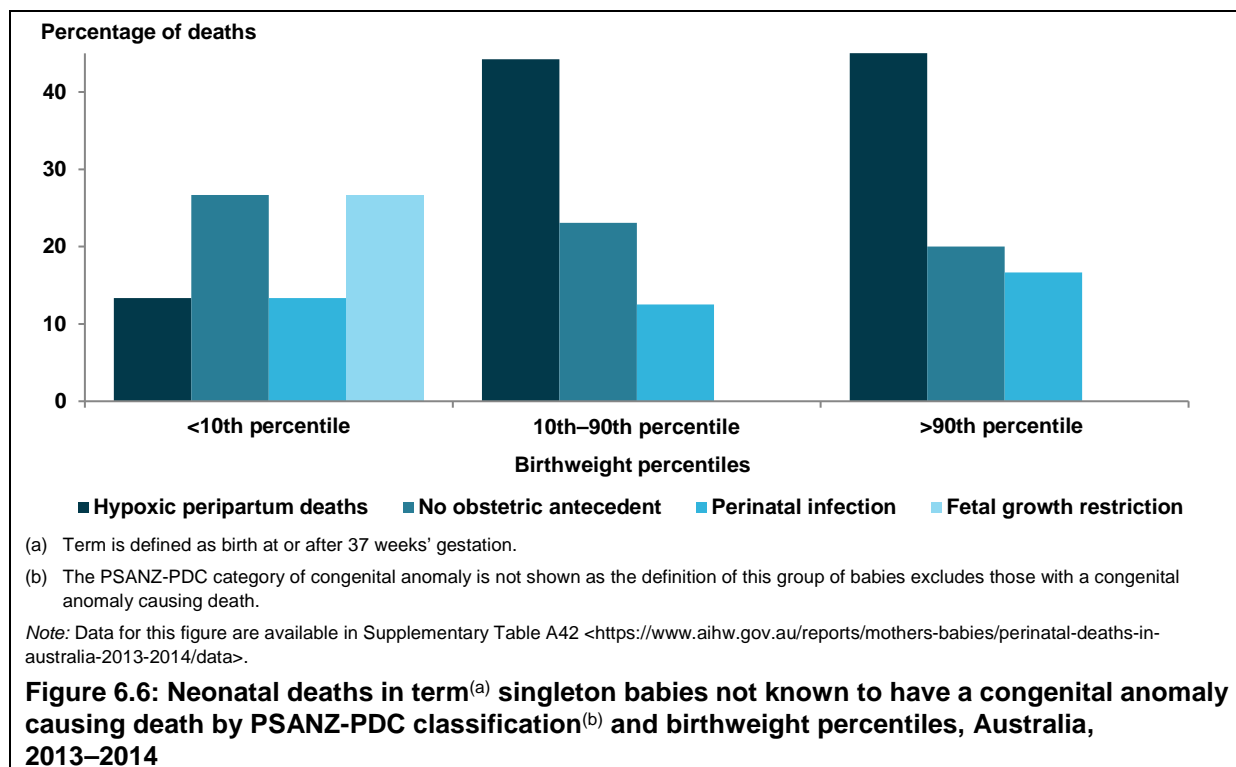
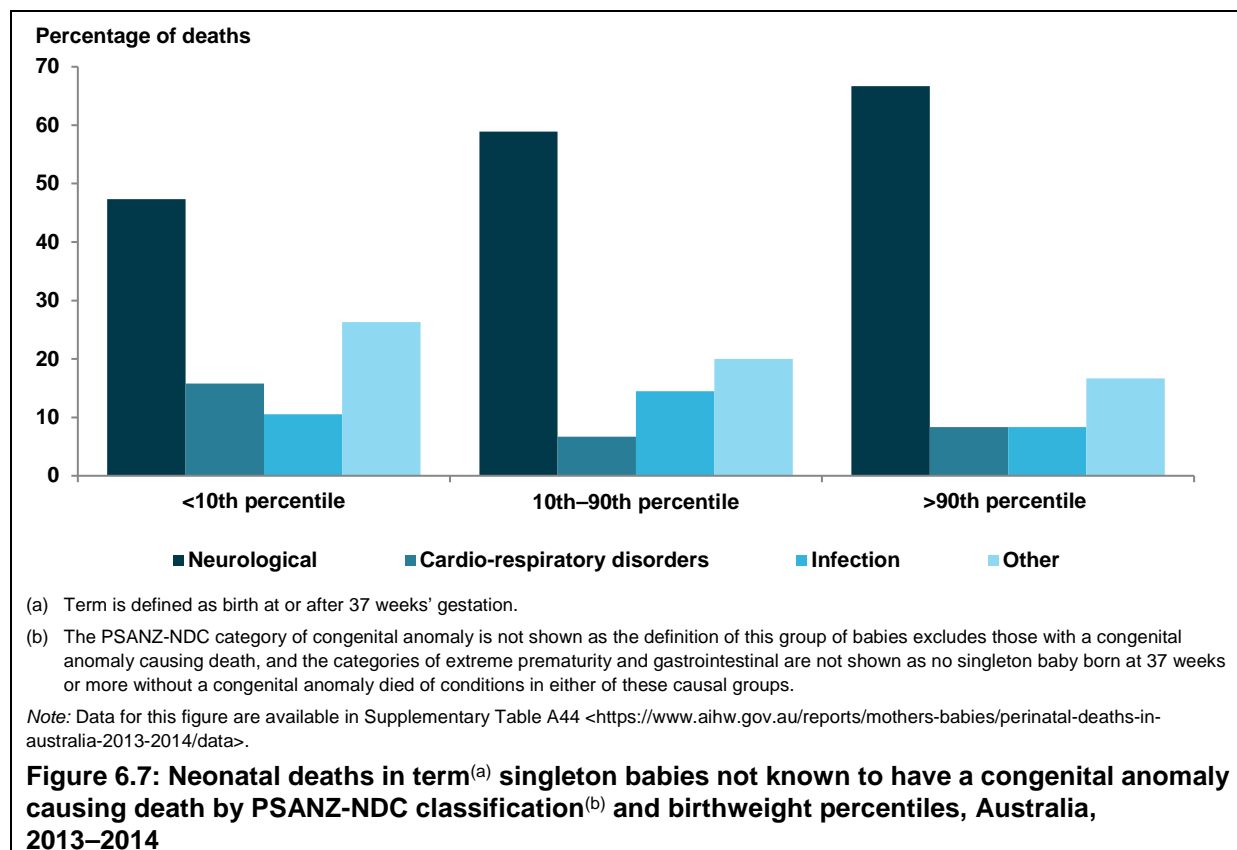


Figure 6.7 details the PSANZ-NDC causes of death for the 118 neonatal deaths that occurred in singleton babies who did not have a congenital anomaly causing death and who were born at or after 37 weeks' gestation in Australia in 2013–2014 and when the classification was stated (Supplementary Table A43).

The principal cause of these neonatal deaths was neurological conditions (59%), and these became more prominent as the birthweight increased. Infection was the cause of death in 14% of neonates and the incidence was relatively stable across the birthweight range. Cardio-respiratory conditions caused 9% of neonatal deaths and became less prominent as birthweight increased. Other conditions were recorded as the cause of death for 21% of neonates. Gastrointestinal conditions were not recorded as a cause of neonatal death in any of this group of babies.



6.3 Autopsy in perinatal deaths of term singleton babies not known to have a congenital anomaly causing death

Autopsy, whether full autopsy, limited autopsy or external examination only, was reported as being performed on 28% of the singleton babies who did not have a congenital anomaly causing death and who were born at or after 37 weeks' gestation in Australia in 2013–2014 (Supplementary Table A45). A further 25% were noted as having been subjected to autopsy, though the type of autopsy was not reported. Autopsy was not performed (or was not stated as having been performed) in relation to almost half (47%) of singleton near-term normally formed perinatal deaths.

Autopsy was not performed (or was not stated as having been performed) in relation to 50% of these babies categorised as unexplained antepartum deaths.

Good practice guidance

In line with the WHO Action Plan aimed at ending preventable deaths and United Nations Sustainable Development Goal 3, health-care providers to mothers and babies at all levels should review their processes regarding counselling of parents about perinatal autopsy in the event of near-term perinatal death.

Sources: WHO 2014, UN 2016, PSANZ recommendations regarding investigation of a perinatal death (PSANZ 2009).

7 Contributing factors in perinatal deaths

Some jurisdictional perinatal mortality committees have begun to examine circumstances associated with perinatal deaths to identify possible contributing factors, so that systemic factors affecting the perinatal mortality rate may be identified. Review of a perinatal death may identify more than one contributing factor.

Contributing factor review regarding perinatal deaths that occurred in 2013–2014 was reported in 235 cases. Contributing factors were identified in relation to 99 perinatal deaths (42%), with those factors likely to have significantly contributed to the outcome in 38 (Table 7.1).

Table 7.1: Assessment of possible contributing factors in perinatal deaths, Australia, 2013–2014

Contributing factor assessment	Total
Contributing care factor(s) identified but unlikely to have contributed to outcome (insignificant)	7
Contributing care factor(s) identified that might have contributed to outcome (possible)	54
Contributing care factor(s) identified likely to have contributed to outcome (significant)	38
No contributing care factors identified	136
Contributing factor assessment not undertaken	5,802
Total	6,037

In the 99 perinatal deaths that were reviewed by a state or territory perinatal mortality committee a total of 108 contributing factors were identified (Table 7.2). Most frequent were those related to professional care (58%) and to the woman, her family and the social situation (39%).

Table 7.2: Type of contributing care factor identified in perinatal deaths, Australia, 2013–2014

Contributing care factor(s) identified by state or territory perinatal mortality committee ^(a)	Total
Contributing care factor(s) related to professional care	63
Contributing care factor(s) related to access to care	2
Contributing care factor(s) related to the woman/her family/social situation	42
Other contributing factors identified	1
Total	108

(a) More than one contributing care factor can be identified in relation to a perinatal death.

Good practice guidance

NMPMAG encourages a systematic approach to audit of all perinatal deaths in Australia according to the PSANZ Perinatal Mortality Guidelines, with particular reference to perinatal deaths of term singleton normally formed babies.

Appendix A: Methodology

Data used in this report

This report is compiled from data held in the National Perinatal Mortality Data Collection (NPMDC) and the National Perinatal Data Collection (NPDC).

National Perinatal Mortality Data Collection

The NPMDC has been established within the Australian Institute of Health and Welfare (AIHW) and collates data from state and territory sources to be used in the preparation of national perinatal death reports.

The state and territory health departments undertake primary data collection and review regarding perinatal deaths in Australia, with initial notification including significant input from the relevant registrars of Births, Deaths and Marriages, and coroners. Data from these jurisdictions are subsequently provided to AIHW for collation into the NPMDC.

These data are then collated centrally in each state and territory into a single data collection that undergoes significant validation prior to submission to the AIHW to form the NPMDC, which sits as a continuing adjunct to the NPDC.

National Perinatal Data Collection

The NPDC is a national population-based cross-sectional collection of data on pregnancy and childbirth. The data are based on births reported to the perinatal data collection in each state and territory. Midwives and other birth attendants, using information obtained from mothers and from hospital or other records, complete notification forms for each birth. A standard de-identified extract is provided to the AIHW on an annual basis to form the NPDC.

Information is included in the NPDC for both live births and stillbirths, where gestational age is at least 20 weeks or birthweight is at least 400 grams, except in Victoria and Western Australia, where births are included if gestational age is at least 20 weeks or, if gestation is unknown, birthweight is at least 400 grams.

The NPDC consists of the Perinatal National Minimum Data Set and some additional data items.

Combining data collections

In addition to perinatal deaths data held in the NPMDC, relevant and useful data regarding babies who die and their mothers (such as gestational age, birthweight and maternal characteristics) are sourced from the NPDC. Both data sets hold unique identifiers that the jurisdictions supply, allowing matching of perinatal death records to records in the NPDC. Information relating to neonatal deaths may be incomplete in the NPDC for babies transferred to another hospital, re-admitted to hospital after discharge or who died at home.

Identification of Aboriginal and Torres Strait Islander mothers and their babies

Australian health facilities providing maternity and newborn care ask women to self-identify their Indigenous status. The following definitions are used:

- **Aboriginal:** A person of Aboriginal descent who identifies as an Aboriginal and is accepted as such by the community in which he or she lives.
- **Torres Strait Islander:** A person of Torres Strait Island descent who identifies as a Torres Strait Islander and is accepted as such by the community in which he or she lives.

The Indigenous status of babies is mostly recorded based on the Indigenous status of the mother; the Indigenous status of the father is not widely recorded.

Remoteness

This report uses the Australian Statistical Geography Standard Remoteness Structure which groups geographic areas into 6 classes of Remoteness Area based on their relative access to services using the Accessibility/Remoteness Index of Australia.

The 6 classes are: *Major Cities, Inner Regional, Outer Regional, Remote, Very Remote* and *Migratory*: See Australian Statistical Geography Standard (ASGS): Volume 5—Remoteness Structure, July 2011 (ABS 2013).

Frequency and timeliness of reporting perinatal deaths

The *Perinatal Deaths in Australia* series began with the report *Perinatal Deaths in Australia 1993–2012*. AIHW plans future reporting to be biennial with annual updates as data allow.

Unanticipated delays occurred in the receipt of data to populate the NPMDC, leading to a delay in the publication of this report. The AIHW is working with state and territory data custodians to find ways to improve the timeliness of data receipt in the future. AIHW intends to publish future reports in the *Perinatal Deaths in Australia* series approximately 18 months after the end of the data collection period.

Supplementary information

Supplementary tables, a data quality statement and information regarding the governance of the national perinatal mortality data project are available online from the AIHW website.

A data visualisation summary of this information is also available at

<<https://www.aihw.gov.au/reports/mothers-babies/perinatal-deaths-in-australia-2013-2014>>.

This report and accompanying products are part of a comprehensive program of AIHW work in relation to maternal and perinatal care and outcomes.

Appendix B: National Perinatal Mortality Data Collection project governance

The National Maternity Services Plan

In 2008, a national review of maternity services was carried out, led by the Commonwealth 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 to inform development of the first National Maternity Services Plan (AHMC 2011).

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

The purpose of the Plan was to maintain Australia's high standard of maternity and newborn care while improving access to services and choice in care, which 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, and to 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 National Maternity Data Development Project (NMDDP).

National Maternity Data Development Project

The NMDDP was set up in response to Recommendation 1 of the 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 and will enable the monitoring of disparities in health outcomes for population subgroups compared with the general population. The project is managed by the NMDDP Advisory Group (NMDDPAG). Reports on stages of the NMDDP process have been published, available at <www.aihw.gov.au/reports/mothers-babies/enhancing-maternity-data-collection-reporting-nmdd/contents/table-of-contents>.

Members of the NMDDPAG at 18 April 2018 were:

Dr Fadwa Al-Yaman	Australian Institute of Health and Welfare
Ms Sue Cornes	Health Statistics Centre, Performance and Accountability Division, Queensland Health
Ms Leah Hardiman	Maternity Choices Australia
Professor Ross Haslam	Australian and New Zealand Neonatal Network
Professor Caroline Homer	Clinical expert—Midwifery
Professor Michael Humphrey	Australian Institute of Health and Welfare—Perinatal adviser
Ms Ann Kinnear	Australian College of Midwives

Professor Yee Khong	Department of Anatomical Pathology, Women's and Children's Hospital
Mr Peter Mansfield	Department of Health and Human Services Tasmania
Ms Lisa Murphy	Australian Commission on Safety and Quality in Health Care
Professor Michael Nicholl	New South Wales Health
Professor Jeremy Oats (chair)	Victorian Consultative Council on Obstetric and Paediatric Mortality and Morbidity, Department of Health and Human Services
Professor Michael Permezel	University of Melbourne, Mercy Hospital for Women
Ms Alecia Staines	Maternity Consumer Network
Dr Barb Vernon	Women's and Children's Healthcare Australasia
Mr Louis Young	Department of Health

National Maternal and Perinatal Mortality Advisory Group

The National Maternal and Perinatal Mortality Advisory Group (NMPMAG) 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, and is a subcommittee of the NMDDP Advisory Group. The NMPMAG provides expert advice on the development of *Perinatal deaths in Australia* reports, including strategic advice, facilitation of data supply and provision of clinical commentary, and good practice guidance.

NMPMAG has replaced the previous National Maternal Mortality Advisory Committee that advised AIHW and the National Perinatal Epidemiology and Statistics Unit of the University of New South Wales in its collaboration with AIHW regarding the production of the report *Perinatal deaths in Australia 1993–2012* (AIHW 2016).

Members of the NMPMAG at 18 April 2018 are:

Dr Fadwa Al-Yaman	Australian Institute of Health and Welfare
Dr Teresa Ballestas	Department of Health, Western Australia
Ms Sue Cornes	Health Statistics Centre, Performance and Accountability Division, Queensland Health
Professor Jodie Dodd	Chair, South Australian Maternal and Neonatal Clinical Network
Dr Katina D'Onise	SA Department of Health
Professor David Ellwood	Chair, Queensland Maternal and Perinatal Council
Associate Professor Vicki Flenady	Perinatal Society of Australia and New Zealand
Ms Leah Hardiman	Maternity Choices Australia
A/Professor Ross Haslam	Chair, Australian and New Zealand Neonatal Network
Professor Caroline Homer	President, Australian College of Midwives

Professor Michael Humphrey (chair)	Australian Institute of Health and Welfare— Perinatal adviser
Professor Alison Kent	Chair, Australian Capital Territory Maternal and Perinatal Mortality Committee
Professor Yee Khong	Royal College of Pathologists Australia
Dr Shu Qin Li	Northern Territory Department of Health
Dr Beth Mah	Royal Australian and New Zealand College of Psychiatrists
Mr Peter Mansfield	Department of Health and Human Services Tasmania
Professor Jonathan Morris	NSW Perinatal and Maternal Mortality Committee
Professor John Newnham	Chair, WA Maternal Mortality Committee
Professor Michael Nicholl	Women’s Healthcare Australasia
Professor Jeremy Oats	Chair, Victorian Consultative Council on Obstetric and Paediatric Mortality and Morbidity, Department of Health and Human Services
Professor Michael Permezel	Royal Australian and New Zealand College of Obstetricians and Gynaecologists
Dr Lynn Sinclair	Australian College of Neonatal Nurses
Professor John Smoleniec	NSW Perinatal and Maternal Mortality Committee
Ms Gail Wilkinson	Australian College of Midwives
Dr Michelle Williams	Chair, Tasmanian Council of Obstetric and Paediatric Mortality and Morbidity
Vacant	New Zealand Perinatal and Maternal Mortality Review Committee

Appendix C: Data quality statement regarding National Perinatal Mortality Data Collection

Summary of key issues

- The National Perinatal Mortality Data Collection (NPMDC) provides national information for use in preparing a national report on the death of babies during pregnancy, birth or within 28 days of birth, between 1993 and 2014. The NPMDC builds on mortality data collected at the time of birth and held in the National Perinatal Data Collection (NPDC).
- Institutional or regional perinatal mortality committees review perinatal deaths for causation and, in some circumstances, the presence of possible contributory factors; state or territory perinatal mortality committees or subcommittees also review some perinatal deaths.
- Data collection for earlier years in the collection in some jurisdictions was retrospective and not from existing collections. Retrospective data collection limited the quality and completeness of data supplied. Data describing perinatal deaths are incomplete for some years for some jurisdictions prior to 2013.
- Perinatal death data reported by the Australian Bureau of Statistics (ABS) are not directly comparable with the NPMDC and NPDC data contained in this report. ABS data are sourced from state and territory registrars of Births, Deaths and Marriages; NPMDC and NPDC data contained in this report are sourced from midwives, and other staff, who collect information from mothers and perinatal administrative and clinical record systems (AIHW 2014).
- Data reported to the NPMDC may differ from those of the NPDC as delayed data submission to the NPMDC allows for data updates and corrections to have occurred prior to submission. In this report, data for total births and live births are sourced from the NPDC while the data for perinatal deaths (comprising stillbirths and neonatal deaths) are sourced from the NPMDC. Therefore, the sum of the number of stillbirths plus the number of live births may not always be equal to the total number of births.

Description

The NPMDC is a data collection established within the Australian Institute of Health and Welfare (AIHW) and collates data from state and territory sources to be used in the preparation of national perinatal death reports. The data set contains information on the deaths of babies in hospitals and in the community within the scope of the collection, which includes all live births and stillbirths of at least 20 weeks' gestation or at least 400 grams birthweight.

The NPMDC builds on the NPDC managed by the AIHW and collates a broad data set from state and territory sources regarding all babies born in hospitals and in the community within the scope of that collection. Common identifier fields in the NPDC and NPMDC allow demographic information regarding perinatal death records in the NPMDC to be retrieved from the NPDC.

State and territory health authorities supplied data to the AIHW under individual data agreements between AIHW and each state or territory health authority. The NPMDC and NPDC data are obtained from the birth hospitals and may not include information about

deaths that occur among babies who died after transfer to a different hospital or after discharge home.

Institutional environment

The AIHW is a major national agency set up by the Australian Government under the *Australian Institute of Health and Welfare Act 1987* to provide reliable, regular and relevant information and statistics on Australia's health and welfare. It is an independent statutory authority established in 1987, governed by a management board, and accountable to the Australian Parliament through the Health and Ageing portfolio.

The AIHW aims to improve the health and wellbeing of Australians through better health and welfare information and statistics. It collects and reports information on a wide range of topics and issues, from health and welfare expenditure, hospitals, disease and injury, and mental health to ageing, homelessness, disability and child protection.

The Institute also plays a role in developing and maintaining national metadata standards. This work contributes to improving the quality and consistency of national health and welfare statistics. The Institute works closely with governments and non-government organisations to achieve greater adherence to these standards in administrative data collections to promote national consistency and comparability of data and reporting.

One of the main functions of the AIHW is to work with the states and territories to improve the quality of administrative data and, where possible, to compile national data sets based on data from each jurisdiction, to analyse these data sets and disseminate information and statistics.

The *Australian Institute of Health and Welfare Act 1987*, in conjunction with compliance to the *Privacy Act 1988* (Commonwealth), ensures that the data collections managed by AIHW are kept securely and under the strictest conditions with respect to privacy and confidentiality. For further information, see the AIHW website <www.aihw.gov.au>.

A National Maternal and Perinatal Mortality Advisory Group (NMPMAG) was convened in 2015 to advise AIHW regarding the process of data collection and reporting maternal and perinatal deaths.

Timeliness

National data are to be published in the *Perinatal deaths in Australia* series less than 1 year after collection of the data by the AIHW, and within 3 years of the time frame for including perinatal deaths up to 31 December 2014. An annual web summary of NPMDC data will also be published shortly after finalisation of the data collection.

Interpretability

Since its inception the NPDC has included some data regarding perinatal deaths. The Perinatal National Minimum Data Set (P–NMDS) was implemented in July 1998 to standardise data reported to the NPDC by states and territories and has undergone regular review and refinement since then. Data specifications and supporting metadata for the PNMDs are documented in the AIHW's online metadata repository (METeOR) available at: <<http://meteor.aihw.gov.au/content/index.phtml/itemId/517456>>.

Specific extra data elements regarding the events related to and the classified cause of perinatal deaths are requested from states and territories to populate the NPMDC. The NPDC and NPMDC contain common identifier information regarding the baby, to allow cross-referencing.

Relevance

Whilst the death of a baby during pregnancy, birth or within 28 days of birth is a rare event in Australian society such deaths are key indicators of the quality of maternity care.

Perinatal mortality data have been obtained, where available, for all babies born in Australia. Most perinatal deaths occur before or soon after birth and are captured within jurisdictional perinatal data collections, though deaths occurring after discharge of the mother's care from the birth episode may not be captured.

The *Perinatal Society of Australia and New Zealand* (PSANZ) Perinatal Mortality Classification System, incorporating the Perinatal Death Classification (PSANZ-PDC) and Neonatal Death Classification (PSANZ-NDC), is applied as part of each state and territory's perinatal mortality review process. Details of the PSANZ-PDC and NDC classification system are found in Section 5.1 and Supplementary tables A23 and A24. The PSANZ-PDC system classifies all perinatal deaths by the single most important factor seen as the antecedent cause of the perinatal death and is applied to both stillbirths (fetal deaths) and neonatal deaths (that is, to all perinatal deaths). The PSANZ-NDC classification system is applied only to neonatal deaths and classifies them by condition present in the baby in the neonatal period leading to the death.

Common identifier information was missing from 117 records submitted from New South Wales, meaning that these deaths are excluded from consideration in some areas of this report as demographic information regarding these deaths could not be retrieved from the NPDC.

Accuracy

Inaccurate responses may occur in all data provided to the AIHW. The AIHW does not have direct access to perinatal mortality committee records to determine the accuracy of the data provided. However, the AIHW undertakes validation on receipt of data. Data received from states and territories are checked for completeness, validity and logical errors. Potential errors are queried with jurisdictions, and corrections and resubmissions are made in response to these edit queries.

Errors may occur during the processing of data by the states and territories or at the AIHW. Processing errors prior to data supply may be found through the validation checks applied by the AIHW. The data are corrected when verification of an error is supplied. The AIHW does not adjust the data to correct for missing values.

Some data items are supplied voluntarily to the NPMDC, resulting in a relatively high number of 'Not stated' values. Data items that are particularly affected by this issue include Remoteness of usual residence, Socioeconomic status, Number of antenatal visits, Gestation at first antenatal visit and Smoking status (especially after 20 weeks of pregnancy). Maternal alcohol use was not reported for 95% of pregnancies.

Prior to publication, data are referred back to jurisdictions for checking and review. Note that because of data editing and subsequent updates of state/territory information, numbers reported may differ from those in reports published by the states and territories.

Data gaps

A number of data items supplied to AIHW by states and territories for the NPMDC, regarding babies that died in the perinatal period in 2013–2014, were noticeably incomplete. Amongst the most crucial items of missing data were birthweight (missing or not stated in 256 perinatal deaths), maternal Indigenous status (missing or not stated in 186 perinatal deaths),

gestational age (missing or not stated in 165 perinatal deaths), and age at neonatal death (missing in 117 neonatal deaths).

Coherence

The NPMDC is an ongoing data set collected specifically, in the first instance, for use in the *Perinatal deaths in Australia 1993–2012* report; it will be a continuing collection and will be available as it expands for future reports in that series.

State and territory health authorities compile statistics and publish reports on maternal deaths. Methodology, definitions, classifications and reference periods for these collections differ significantly across states and territories, and comparisons between states and territories should be made with caution.

Appendix D: Perinatal Society of Australia and New Zealand recommendations regarding investigation of a perinatal death

This appendix contains a summary of the revised recommendations from the Perinatal Society of Australia and New Zealand guidelines relating to the investigation of a perinatal death, published in March 2018 (PSANZ 2018).

Recommendations regarding autopsy

- 1 Clinicians should discuss the value of an autopsy with parents in all cases of perinatal death and offer them the option of the procedure.
- 2 To increase the rates of perinatal autopsy:

Clinicians should collaborate with pathologists and parent-based organisations to raise public awareness of the value of perinatal autopsy and to advocate high standards in perinatal autopsy at local and government level.

Clinical leaders should promote formal and informal educational opportunities for clinicians on: post-mortem examination procedures; the potential benefits of an autopsy; compassionate counselling and obtaining parental consent; and address specific local barriers to the conduct of perinatal autopsy.

All clinicians providing maternity and newborn care should attend the IMproving Perinatal mortality Review and Outcomes Via Education (IMPROVE) Workshops educational program <www.sanda.psanz.com.au/clinical-practice/improve>.
- 3 Seek advice from the coroner or an experienced coronial officer if any doubt exists as to whether a death should be referred to the coroner.
- 4 Clinicians need to be aware of costs associated with transferring an infant from non-metropolitan areas to tertiary centres for autopsies within their region and inform parents of any personal cost implications relevant to their decision-making.
- 5 The Guidelines on Autopsy Practice produced by the Royal College of Pathologists should be used for guidance on minimum standards until guidelines for Australia and New Zealand are developed.
- 6 Specific protocols developed for post-mortem examination in the event of Sudden Unexpected Death in Infancy and death with suspected genetic metabolic disorders should be followed.
- 7 A perinatal/paediatric pathologist should perform or supervise all perinatal post-mortems. Clinicians should request autopsies from the service providing the highest quality.
- 8 Transport to a centre with appropriate expertise should be arranged to ensure that all perinatal post-mortem examinations are of sufficient quality. Transport should be arranged with a registered undertaker.

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- 9 A comprehensive maternal history should accompany the baby for a post-mortem examination including:
 - clinical/obstetric history including relevant previous obstetric history
 - copies of all ultrasound reports
 - copy of the death certificate if available
 - copy of amniocentesis report if available.
 - 10 Guidelines for post-mortem reports produced by the Royal College of Pathologists should be used as a guide for reporting of perinatal post-mortem examinations.
 - 11 Ideally, a preliminary post-mortem report should be forwarded to the referring clinician within 3 working days of the post-mortem. The final report should be forwarded to the referring clinician ideally within 8 weeks of the autopsy.
 - 12 The post-mortem report should be made available to the parents at a time when the primary care clinician is present to discuss the findings.
 - 13 A Plain Language Report (PLR) should be available to parents on request.
 - 14 A request for the general practitioner to receive a copy of the report (including the PLR, if available) should be explicit on the request form, as they are the main care provider on discharge.
 - 15 Where possible, a senior clinician who has established a rapport and understanding with the parents should discuss the value of an autopsy and offer the option of the procedure. Such clinicians should have high-level communication skills and knowledge of all post-mortem examinations, and preferably have witnessed several perinatal autopsies.
 - 16 Any clinician approaching parents for autopsy consent should discuss:
 - options for full, less invasive autopsies, minimally invasive autopsies, non-invasive autopsies or stepwise post-mortem examinations
 - issues related to retained tissues, organs and DNA for genetic and other tests
 - the value of autopsy
 - possibility that cause of death may not be determined
 - possibility that some potential causes of death could be excluded
 - information gained may not directly benefit the family but may benefit others
 - possible implications for future pregnancies
 - the care and respect that will be given to the baby.
 - 17 Discussion with parents should be supplemented by written information explaining autopsies to help in their decision on autopsy for their baby.
 - 18 When consent is obtained for specific organ/s to be retained for further examination, parents should be offered the option of either delaying the funeral until the organs can be returned to the body or specifying their preferred method of organ disposal.
 - 19 Consent for the autopsy which clearly outlines the extent of the investigation should be recorded on an approved consent form, relevant to the jurisdiction.
 - 20 Where possible the pathologist should be available to discuss the autopsy with the parents before and/or after the procedure and, where feasible, the requesting clinician should attend the autopsy and provide the parents with a preliminary report immediately after the examination.

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- 21 Placentas should be sent for examination by the perinatal/paediatric pathologist regardless of whether consent for an autopsy has been gained following stillbirths, neonatal deaths in the delivery room or birth of high-risk infants.
 - 22 Consent should be sought from parents for less invasive testing if permission for an autopsy is not obtained, including: external examinations by skilled clinician; an MRI scan; babygram; ultrasound scan; post-mortem needle biopsy; laparoscopic autopsy and small incision access.
 - 23 When an MRI scan is undertaken it should be undertaken as soon as possible after a stillbirth.
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Recommendations for investigation of stillbirths

- 1 A non-selective approach according to the recommended core investigations should be adopted for all stillbirths (unless the cause of death has been unequivocally determined antenatally). These investigations are:
 - comprehensive maternal (medical, social, family) and pregnancy history
 - Kleihauer-Betke test/flow cytometry for fetal to maternal haemorrhage
 - external examination of the baby performed by the attending clinician
 - clinical photographs of the baby
 - autopsy
 - detailed macroscopic examination of the placenta and cord
 - placental histopathology
 - cytogenetics (chromosomal microarray (CMA) or karyotype if CMA is not available).
- 2 Further sequential and/or selective investigations should be undertaken according to the particular clinical scenario based on a comprehensive history, and information gained from core investigations.
- 3 An external examination of the baby should be performed at birth by the attending clinician using the recommended checklist and clearly documented in the medical record. Where the family has consented to autopsy, all information gained from the initial external examination (along with comprehensive maternal (medical, social, family) and pregnancy history) should be forwarded to the pathology service to guide this procedure.
- 4 Following a stillbirth, the placenta, membranes and cord should be kept refrigerated and, where feasible, sent fresh and unfixed for macroscopic and histological examination by a perinatal pathologist. The pathology service should be informed if the parents have requested return of the placenta following examination.
- 5 Clinicians should discuss the value of a full autopsy with parents in all cases of perinatal death where the cause of death is not already known. If the parents decline a full autopsy, a limited/partial autopsy should be offered.

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- 6 Selective investigations based on findings of core investigations:
- serology for congenital infections (Cytomegalovirus, Toxoplasmosis, Rubella, Syphilis)
 - blood group and antibody screen
 - thrombophilia testing
 - haemoglobin A1C
 - thyroid function tests
 - liver function tests and bile acids
 - drug screen.
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Recommendations for investigation of neonatal deaths

- 1 Obstetric and neonatal care teams should collaborate closely to ensure that all relevant maternal (pregnancy and birth) and neonatal factors are considered in the investigation of the neonate. Comprehensive maternal medical, social and antenatal history including results of all investigations documented in the medical record by obstetric staff. A comprehensive neonatal history including death scene analysis is always required.
 - 2 A detailed external examination of the baby must be performed by a perinatal pathologist, neonatologist or paediatrician where possible.
 - 3 Accurate anthropometric parameters of birth weight, length and head circumference plotted on appropriate gender specific birth growth charts.
 - 4 A newborn screening blood sample should be taken for all neonatal deaths.
 - 5 Clinicians should discuss the value of an autopsy with parents in all cases of a neonatal death and offer the option of the procedure.
 - 6 Following consent from the parents, clinical photographs should be taken for later review, particularly in the circumstance of birth in non-tertiary hospital settings. These photos are additional to the bereavement photographs, and should be clearly labelled and filed in the medical record (not given to the parents) and be available for members of expert perinatal mortality committee to view. The use of digital imaging for this purpose is optimal, however issues regarding storage and patient confidentiality must be considered.
 - 7 For neonates at high risk of death at the time of birth, or in birth suite, targeted investigations based on the presenting scenario should be undertaken:
 - detailed external examination of the baby by a neonatologist or paediatrician (where possible) with clear documentation of findings in the medical record
 - where possible, cord blood gas analysis that includes both arterial and venous samples
 - newborn screening blood sample
 - detailed macroscopic examination of the placenta and cord with findings documented in the medical record by obstetric staff
 - histopathological examination of fresh and unfixed placenta, cord and membranes
 - autopsy.
 - 8 Clinicians should initiate investigations specific to the circumstances of the birth.
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- 9 Clinicians should investigate possible thrombophilic disorders in mothers with pre-eclampsia or with a personal/family history of thrombosis, or following the birth of an infant with severe growth restriction.
 - 10 Selective screening in addition to placental examination for thrombophilic disorders should be undertaken following the birth of high-risk neonate or a neonatal death:
 - anticardiolipin, lupus anticoagulant, anti-B2 glycoprotein-1 antibodies
 - microarray/karyotype
 - autopsy.
 - 11 Investigation for maternal diabetes, if not previously undertaken, should include:
 - maternal HbA1c level (as soon as possible after delivery)
 - if the HbA1c level is raised, a fasting blood glucose should be undertaken and, if abnormal, a glucose tolerance test performed 6–8 weeks postnatally.
 - 12 Other causes of macrosomia, such as Beckwith Wiedemann syndrome, should be investigated if there is no maternal or paternal diabetic history.
 - 13 In the case of a suspected genetic metabolic disorder, clinicians should discuss individual cases with their state laboratory to identify the optimum tests to request and consult a clinical metabolic specialist if more expert guidance required.
 - 14 All tissue samples should be stored and transported to a specialist metabolic laboratory for investigation.
 - 15 When a lethal genetic metabolic disorder is suspected prior to birth, clinicians should:
 - seek consent from the parents for a metabolic autopsy
 - consult a metabolic physician or a histopathologist before collecting the following samples:
 - blood sample (0.8 ml) in lithium heparin tube (refrigerate)
 - urine sample (5–10 ml)
 - knee cartilage and/or skin biopsy (3 x 2 mm punch biopsies) (sent to cytogenetics with request for fibroblast culture and store)
 - liver and muscle biopsies (for electron microscopy, histopathology and enzymology).
 - 16 Investigation of any sudden unexpected neonatal death should include:
 - coroner notification
 - thorough maternal and infant medical histories
 - full autopsy examination by a forensic pathologist skilled in perinatal autopsy or a forensic pathologist in conjunction with a perinatal pathologist
 - investigation of the various scenes where incidents leading to the death might have occurred including the infant's sleeping environment.
 - 17 Investigations for genetic metabolic disorders should be undertaken for all sudden unexpected neonatal deaths.
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Glossary

Aboriginal: A person of Aboriginal descent who identifies as an Aboriginal and is accepted as such by the community in which he or she lives.

antenatal: The period covering conception up to the time of birth. Synonymous with prenatal.

antepartum: Prior to labour.

autopsy: A post-mortem examination to discover the cause of death or extent of disease.

benchmark: A standard or point of reference for measuring quality or performance.

body mass index: The most commonly used method of assessing whether a person is of normal weight, underweight, overweight or obese (see **obesity**). It is calculated by dividing the person's weight (in kilograms) by their height (in metres) squared; that is, $\text{kg} \div \text{m}^2$. For both men and women, underweight is a BMI below 18.5, acceptable weight is from 18.5 to less than 25, overweight is from 25 to less than 30, and obese is 30 and over. Sometimes overweight and obese are combined, and defined as a BMI of 25 or over.

chorionicity: Whether or not babies of a multiple pregnancy share the same placenta.

fetal death: The death of a baby prior to birth (alternatively, stillbirth).

fetal growth restriction: (Also known as intra-uterine growth restriction.) A baby not reaching its genetic growth potential due to adverse intra-uterine conditions.

gestational age: The duration of pregnancy in completed weeks calculated from the date of the first day of a woman's last menstrual period and her baby's date of birth, or via ultrasound, or derived from clinical assessment during pregnancy or from examination of the baby after birth.

hypoxic: A condition in which the body or a region of the body is deprived of adequate oxygen supply at the tissue level.

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**.

intrapartum: Occurring during childbirth or during the birth process.

live birth: The complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of pregnancy, which, after such separation, breathes or shows any other evidence of life, such as beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles, whether or not the umbilical cord has been cut or the placenta is attached; each product of such a birth is considered live born (WHO definition).

mortality: Death.

neonatal death: Death of a live-born baby within 28 days of birth.

neonatal mortality rate: Number of neonatal deaths per 1,000 live births.

non-Indigenous: People who have declared they are not of Aboriginal and/or Torres Strait Islander descent.

obesity: Marked degree of overweight, defined for population studies as a **body mass index** of 30 or over.

percentile: Each of the 100 equal groups into which a population can be divided according to the distribution of values of a particular variable.

perinatal: Pertaining to, or occurring in, the period shortly before or after birth (usually up to 28 days after).

perinatal death: A fetal or neonatal death of at least 20 weeks' gestation or at least 400 grams birthweight.

pre-term birth: Birth before 37 completed weeks of gestation.

plurality: Number of births resulting from a pregnancy.

quintile: Any of 5 equal groups into which a population can be divided according to the distribution of values of a particular variable.

socioeconomic status: An indication of how 'well-off' a person or group is. In this report socioeconomic status is mostly reported using the **Socio-Economic Indexes for Areas**, typically for 5 groups, from the most disadvantaged (worst-off) to the least disadvantaged (best-off).

Socio-Economic Indexes for Areas: A set of indexes, created from Census data, that aim to represent the socioeconomic status of Australian communities and identify areas of 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 in their socioeconomic status. This report uses the **Index of Relative Socio-Economic Advantage and Disadvantage**.

stillbirth (fetal death): Death before the complete expulsion or extraction from its mother of a product of conception 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.

term birth: Birth after 37 and before 42 completed weeks of gestation.

Torres Strait Islander: A person of Torres Strait Island descent who identifies as a Torres Strait Islander and is accepted as such by the community in which he or she lives.

zygosity: Whether the babies of a multiple pregnancy are identical or non-identical.

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Related publications

This report, *Perinatal deaths in Australia 2013–2014*, is part of a series that began with *Perinatal deaths in Australia 1993–2012*. Future publication, biennially, of similar reports is planned. The preceding report and any published subsequently can be downloaded free from the AIHW website <www.aihw.gov.au>. The website also includes information on ordering printed copies.

The following AIHW publications relating to mothers and babies might also be of interest:

- AIHW 2017. Maternal deaths in Australia 2012–2014. Cat. no. PER 92. Canberra: AIHW.
- AIHW 2017. Australia's mothers and babies 2015—in brief. Perinatal statistics series no. 33. Cat. no. PER 91. Canberra: AIHW.
- AIHW: Hilder L, Li Z, Zeki R & Sullivan EA 2014. Stillbirths in Australia, 1991–2009. Perinatal statistics series no. 29. Cat. no. PER 63. Canberra: AIHW National Perinatal Epidemiology and Statistics Unit.



The perinatal mortality rate in Australia in 2013–2014 was low (9.7 deaths per 1,000 births). Perinatal mortality rates increased with low birthweight for gestational age, Aboriginal and/or Torres Strait Islander ethnicity and a number of other demographic factors. Perinatal death was most commonly caused by congenital anomaly and spontaneous preterm birth.

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