

Methods and definitions for
Perinatal and Maternal Mortality Review Committee reporting

June 2024



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Definitions

Mortality definitions

Perinatal and infant mortality

**Gestation Birth 7 days 28 days 1 year**

**20 weeks or more**

**or**

**≥400 grams birthweight**

**0–<7 days**

**7–27 days**

**28 days–<1 year**

**Late
Neonatal
deaths**

**Early
Neonatal
deaths**

**Post-neonatal
deaths**

**Fetal deaths**

**Perinatal deaths**

**Perinatal related deaths**

**Neonatal deaths**

**Infant deaths**

(Adapted from [New Zealand Health Information Service 2007](http://www.health.govt.nz/system/files/documents/publications/fetal200304.pdf) and [Ministry of Health 2010](http://www.health.govt.nz/system/files/documents/publications/fetal-and-infant-deaths-2006.pdf).)

Fetal death

Fetal death is the death of a fetus at 20 weeks’ gestation or beyond (≥20 weeks) or weighing at least 400 g if gestation is unknown. Fetal death includes stillbirth and termination of pregnancy. Note that the term ‘stillbirth’ does not include terminations in this report. Where a termination of pregnancy died after birth, the pregnancy is included as a termination of pregnancy and therefore as a fetal death rather than as a neonatal death.

Stillbirth

Stillbirth is the birth of a fetus showing no signs of life at 20 weeks’ gestation or beyond (≥20 weeks) or weighing at least 400 g if gestation is unknown.

Termination of pregnancy

Termination of pregnancy is the interruption of an ongoing pregnancy (whether the baby was stillborn or live born). This report only includes termination of pregnancy from 20 weeks’ gestation.

Fetal death rate

Fetal death rate is calculated as fetal deaths per 1,000 babies born at 20 weeks’ gestation or beyond or weighing at least 400 g if gestation is unknown.

Neonatal death

Neonatal death is the death of any baby showing signs of life at 20 weeks’ gestation or beyond (for the purposes of this Perinatal and Maternal Mortality Review Committee [PMMRC] data set), or weighing at least 400 g if gestation is unknown, that occurs up until midnight of the 27th day of life. Early neonatal death is a death that occurs up until midnight of the 6th day of life. Late neonatal death is a death that occurs between the 7th day and midnight of the 27th day of life.

Neonatal death rate

The neonatal death rate is calculated as neonatal deaths per 1,000 live born babies at 20 weeks’ gestation or beyond or weighing at least 400 g if gestation is unknown.

Perinatal mortality rate

In Aotearoa New Zealand, the perinatal mortality rate is calculated as fetal deaths and early neonatal deaths per 1,000 total babies born alive or born dead at 20 weeks’ gestation or beyond, or weighing at least 400 g if gestation is unknown. This is in line with the legal definition in Aotearoa for stillbirth.[[1]](#footnote-2)

Perinatal related mortality rate

The perinatal related mortality rate refers to fetal deaths and early and late neonatal deaths per 1,000 total babies born at 20 weeks’ gestation or beyond or weighing at least 400 g if gestation is unknown.

International perinatal mortality rates

The World Health Organization (WHO) recommends the use of international perinatal mortality rate definitions to facilitate international comparison (WHO 2021). These are rates of fetal death, neonatal death, perinatal mortality and perinatal related mortality of babies weighing ≥1,000 g, or ≥28 weeks if birthweight is unknown, per 1,000 total births of babies ≥1,000 g, or ≥28 weeks if birthweight is unknown. Babies without birthweight or gestation are to be included if they have been registered as a birth or a death in accordance with a country’s own legislation.

The number of fetal deaths of at least 28 weeks’ gestation and/or 1,000 g in weight and newborn deaths (up to and including the first 7 days after birth).

Lethal and terminated fetal anomalies

Lethal and terminated fetal anomalies are all perinatal related deaths classified by the Perinatal Society of Australia and New Zealand Perinatal Death Classification (PSANZ-PDC) system as PSANZ-PDC 1 (congenital anomaly) and neonatal deaths classified by the PSANZ Neonatal Death Classification (PSANZ-NDC) system as PSANZ-NDC 1 (congenital anomaly).

Intrapartum stillbirth rate

The intrapartum stillbirth rate calculates deaths of babies of at least 24 weeks’ gestation without congenital anomaly who entered labour alive but then died during labour, as a rate per 1,000 births ≥24 weeks.

Maternal death

Maternal death is the death of a person while pregnant or within 42 days of the end of pregnancy (miscarriage, termination or birth), irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes ([WHO nd](http://www.who.int/healthinfo/statistics/indmaternalmortality/en/)).

The cause of maternal death is sub-classified into the following categories based on *The WHO Application of ICD-10 to Deaths during Pregnancy, Childbirth and Puerperium: ICD MM* ([WHO 2012](http://apps.who.int/iris/bitstream/10665/70929/1/9789241548458_eng.pdf?ua=1)).

* **Direct maternal deaths:** those resulting from obstetric complications of the pregnant state (pregnancy, labour or puerperium[[2]](#footnote-3)), from interventions, omissions, incorrect treatment or from a chain of events resulting from the above. In 2018, the PMMRC adopted the WHO revision to include deaths by suicide with direct maternal deaths. This was then applied retrospectively to data from previous years.
* **Indirect maternal deaths:** those resulting from previous existing disease or disease that developed during pregnancy and was not due to direct obstetric causes but that was aggravated by the physiologic effects of pregnancy.
* **Unknown/undetermined (or unclassifiable) maternal death** is a death during pregnancy, childbirth and the puerperium where the underlying cause is unknown or was not determined.
* **Coincidental maternal deaths:** deaths from unrelated causes that happen to occur in pregnancy or the puerperium. Coincidental maternal deaths are not included in maternal death analyses.

Maternal mortality ratio

Maternal mortality ratio is the number of maternal deaths per 100,000 maternities as per WHO recommendations (see maternities below).

The term ‘ratio’ is used to describe ‘incidence’ of maternal mortality because cases included in the numerator may arise from pregnancies that end before 20 weeks. As the total number of pregnancies ending before 20 weeks is unknown, the denominator cannot include all those at risk and thus the estimate cannot truly be called a ‘rate’.

Maternities

Maternities are defined here as all live births and all fetal deaths at 20 weeks’ gestation or beyond or weighing 400 g or more if gestation was unknown. Pregnancies ending before 20 weeks are not included in this working definition because the absolute number of pregnancies ending before this time is unknown.

The variable definition of ‘maternities’ creates unnecessary confusion when making international comparisons. The WHO recommends 100,000 live births as the most available denominator in countries with limited collection of vital statistics. In countries where fetal deaths are also collected, the WHO recommends the denominator be 100,000 live births plus fetal deaths of ≥20 weeks’ gestation.

* The UK uses the number of pregnancies that result in a live birth at any gestation or a stillbirth at or after 24 completed weeks’ gestation (as only stillbirths at ≥24 weeks’ gestation are required to be notified by law) (National Perinatal Epidemiology Unit 2023).
* Australia reports information on both live births and stillbirths where gestational age is ≥20 weeks or birthweight is ≥400 g, except in Victoria and Western Australia, where births are included if gestational age is ≥20 weeks or, if gestation is unknown, birthweight is ≥400 g (Australian Institute of Health and Welfare 2021).

Other definitions

Customised birthweight centiles

The customised birthweight centiles (CBWCs) are calculated using the bulk calculator available from the Gestation Network ([www.gestation.net](http://www.gestation.net/)). The calculator takes as input the maternal height, maternal weight, maternal ethnicity (prioritised), parity, sex, gestation at birth and birthweight.

Variations for PMMRC numerator data

* Gestation according to birth state:
	+ If it is a live birth, gestation at birth is used.
	+ If it is a stillbirth, gestation at fetal death is used.
* Exclusions:
	+ CBWC is not calculated if gestation at fetal death was <20 weeks, was unknown or if a week or more had elapsed between fetal death and birth (because of the unknown effect on birthweight of prolonged time in utero after known fetal death) as it may be invalid.
* Gestation accuracy:
	+ PMMRC data has gestation (birth/fetal death) weeks and days recorded, and two CBWC values are recorded: one using weeks only and the other using weeks and days.
		- The weeks-only CBWC is used for comparison with the New Zealand National Maternity Collection (MAT) denominator, which only has gestation in weeks.

Variations for MAT data

* Gestation:
	+ Gestation data is supplemented with PMMRC data if a link to a PMMRC case is available and follows the PMMRC birth state rules and exclusion rules above.
	+ If no PMMRC data is available, gestation at birth is used (as MAT does not have gestation at fetal death).
* Exclusions:
	+ CBWC is not calculated for deliveries in or before 2007 as too much data is missing.
	+ CBWC is not calculated for lead maternity carer (LMC) types of ‘no LMC’, ‘DHB’ or ‘other’ as too much data is missing (height, weight, parity).
* Gestation accuracy:
	+ MAT data only has gestation in weeks.

District health board

In 2022, district health boards (DHBs) transitioned to Health New Zealand – Te Whatu Ora (Health New Zealand) when the Pae Ora (Healthy Futures) Act 2022 came into law. Health New Zealand was established to run the health system across Aotearoa, with functions delivered at local, regional and national levels. As this 16th report covers data up to 2021, the DHB system was still in place and the report is written in line with this. Future reports will reflect these system changes.

Ethnicity

Ethnicities of women and birthing people and babies for perinatal related deaths and maternal deaths were collected from two sources: from information supplied to the Births, Deaths, and Marriages (BDM) registrar (with priority given to information in the birth registration over information in the death registration) and from rapid reporting forms completed by LMCs (eg, in cases where the death had not been registered by the time of analysis), with information from BDM taking priority over data from rapid reporting forms. In both instances, ethnicity should be identified by the woman/birthing person and/or parents. Death registration forms are usually completed by either the parents or a funeral director and are therefore largely self-reported.

Ethnicities of women and birthing people and babies in the MAT denominator data set are derived from ethnic codes reported to the National Minimum Dataset (NMDS) birth and postnatal events, LMC labour and birth claims and national health index (NHI) number at time of delivery. These should also be self-reported.

Ethnicity has been reported as prioritised ethnicity. This method is frequently used in health statistics in Aotearoa. Multiple ethnicities can be identified for both woman/birthing person and baby. The PMMRC follows the guidelines in *Health Information Standards Organisation (HISO) 10001:2017 Ethnicity Data Protocols* ([Ministry of Health 2017](https://www.health.govt.nz/publication/hiso-100012017-ethnicity-data-protocols)) for prioritising ethnicity. These protocols prioritise ethnicity into the following hierarchy: Māori; Pacific; Indian; other Asian; Middle Eastern, Latin American or African (MELAA); other; other European; New Zealand European/New Zealander; and unknown. Indian has been identified as an ethnicity separate from ‘other Asian’ because Aotearoa data suggests that pregnancies of Indian women and birthing people are at higher risk than those of other Asian women and birthing people. In the PMMRC reports, most analyses use these ethnic groups, but ethnic groups are sometimes aggregated.

Where multiple ethnic groups are recorded for an individual, the process prioritises minority ethnic groups that might otherwise be swamped by New Zealand European. In doing so, it does not allow individuals to identify a group with which they most feel affinity. It is a simple system that results in relatively few groups for analysis and, when used across different data sets, ensures a standardised process is used.

Although StatsNZ does recommend total response ethnicity reporting rather than prioritisation, currently Manatū Hauora Ministry of Health and other health reports in Aotearoa largely use prioritised ethnicity, and this includes annual maternity reporting. The PMMRC continues to use the prioritised method for ease of comparison with these sources. The implications for monitoring Māori health through changes to total response reporting of ethnicity are discussed by Cormack & Robson (2010). Prioritisation may undercount some ethnic groups (particularly Pacific peoples), but it does ensure Māori are always counted.

Lead maternity carer

LMC is defined as the practitioner or caregiver who provides a birthing person and their baby with continuity of care throughout pregnancy, labour, birth and the postnatal period as described in the Primary Maternity Services Notice pursuant to Section 88 of the New Zealand Public Health and Disability Act 2000 (amended 2022).

Maternity care in Aotearoa

In Aotearoa, maternity care is funded by Manatū Hauora Ministry of Health/Health New Zealand. During the period this report covers (to 2021), maternity care was provided by 20 DHBs nationally and by LMCs, who receive funding from Manatū Hauora Ministry of Health. LMCs may be self-employed midwives, general practitioners (GPs), private obstetricians or hospital-based midwives and obstetricians. Their services are free for eligible people, except in the case of private obstetricians, who have the right to charge co-payments for their services.

LMCs are required to sign access agreements with any maternity facility where they intend to provide care. Women and birthing people have the right to choose whom they engage as their LMC. However, professional colleges and Manatū Hauora Ministry of Health provide guidelines about appropriate care for those with risk factors.

The *Guidelines for Consultation with Obstetric and Related Medical Services (Referral* Guidelines*)* provide information about referring pregnant people, transferring clinical responsibility and transferring care in emergencies ([Te](https://www.health.govt.nz/system/files/documents/publications/observation-mother-baby-immediate-postnatal-period-consensus-statements.pdf) Whatu Ora 2023).

New Zealand Index of Deprivation (NZDep)

The NZDep is an area-based measure of socioeconomic deprivation based on variables from the Census of Population and Dwellings ([Atkinson et al 2014](http://www.otago.ac.nz/wellington/otago069936.pdf); [Salmond et al 2007](http://www.otago.ac.nz/wellington/otago020337.pdf)). NZDep06, NZDep13 and NZDep18 are used in this report and are derived from the 2006, 2013 and 2018 censuses in Aotearoa, respectively.

The score is assigned according to maternal place of residence and is presented as a decile or quintile. Increasing deciles of deprivation, from least deprived at decile 1 to most deprived at decile 10, are associated with higher mortality and rates of many diseases ([Atkinson et al 2014](http://www.otago.ac.nz/wellington/otago069936.pdf); [Salmond et al 2007](http://www.otago.ac.nz/wellington/otago020337.pdf)). Census area unit-level data were used for the 11th–14th PMMRC reports (in previous reports, meshblock unit-level data was used to assign a deprivation score). For NZDep18, Statistical Area (SA) 1 was used (Atkinson et al 2019). Generally, data is presented as quintiles rather than deciles so that individual categories are large enough for analysis.

NZDep18 deciles were assigned to births and deaths from 2018 to present; NZDep2013 deciles were assigned to births and deaths from 2013 to 2017 inclusive and NZDep2006 was used for previous years.

PSANZ death classifications

**PSANZ-PDC** – the purpose of the PSANZ-PDC is to identify the single most important factor that led to the chain of events that resulted in the death.

**PSANZ-NDC** – the purpose of the PSANZ-NDC is in addition to the PSANZ-PDC to identify the single most important factor in the neonatal period that caused the death.

For this report, the 2018 PSANZ classifications were used. For babies who died from 2018 onwards, the death classification was coded in the 2018 version. Babies who died during the years 2007–2017 had been coded in the 2007 version. For these babies, the primary PDC and NDC category codes were mapped to the 2018 version. For NDC codes, the mapping was straightforward, with one-to-one category mapping. PDC codes required a mix of direct category mapping, selected sub-category mapping and custom (individual) case mapping. One result of the change in death classification schema was that idiopathic hydrops (PDC 6.7 in the 2007 version) was moved to idiopathic hydrops fetalis (PDC 1.192 in the 2018 version). This change has increased the number of babies whose death classification is congenital anomaly.

Place of birth

Place of birth is defined for the data collection as:

* home: a home environment does not have to be the woman/birthing person’s own home
* birthing unit: stand-alone birthing centre
* hospital level 1: a hospital with no neonatal or caesarean section facilities
* hospital level 2: a hospital that is unable to provide long-term ventilation for babies
* hospital level 3: a hospital with full neonatal intensive care, including facilities for long-term ventilation
* other: for example, car, ambulance
* not registered: has not registered at any facility.

Registration with an LMC

Registration with an LMC is the process by which a woman/birthing person selects their LMC. This generally occurs at the time of the first antenatal visit with the LMC. Upon registration, the LMC assumes clinical responsibility for maternity care. Clinical responsibility for care may transfer from the LMC to another service or provider; for example, if a person’s condition warrants transfer of clinical responsibility to a specialist. Registration may also be with a DHB/Health New Zealand health district providing primary maternity care.

Rural/urban residence

Rural/urban residential locality of whānau is introduced in the 16th report. Using the Geographic Classification for Health (GCH) categories developed by Whitehead et al (2022), residential area was determined to be rural or urban based on residential address at registration. The five-level GCH rurality classification delineates three levels of rural and two urban levels for health research and policy purposes in Aotearoa. In this report, we have used the condensed binary rural/urban classifications. This classification system, albeit new, has been tested and shown to be technically robust and tailored to the context of health in Aotearoa.

Parity

Parity is described in this report by the terms ‘primiparous’ and ‘multiparous’. A primiparous person is defined here as having their first baby/babies after 20 weeks’ gestation. In figures and tables, this is called ‘parity 0’. Multiparous people are those who have already had a baby after 20 weeks’ gestation, and parity is ≥1.

Neonatal encephalopathy

Neonatal encephalopathy (NE) is a clinically defined syndrome of disturbed neurological function within the first week after birth in an infant born from 35 weeks’ gestation, manifested by difficulty in initiating and maintaining respiration, depression of tone and reflexes, subnormal level of consciousness and often seizures (Nelson and Leviton 1991). The PMMRC data set of NE cases includes Sarnat stages 2 or 3 (equivalent to moderate and severe) only.

All reported cases of term infants with NE are included in this data set, whatever the cause. Therefore, the full cohort includes cases where NE is associated with hypoglycaemia, congenital anomaly of the central nervous system or infection.

From 2016, the neonatal encephalopathy working group widened the inclusion criteria for the NE cohort and included cases from 35 weeks’ gestation at birth in line with international definitions and practice of cooling from this gestation ([American College of Obstetricians and Gynecologists 2014](http://pediatrics.aappublications.org/content/133/5/e1482)). Reporting on 35- and 36-week gestations began in the 15th annual report when 5 years of data became available.

Contributing factors

Some past reports have presented contributing factors to mortality outcomes. Although identifying, describing and understanding these factors (organisational and/or management, personnel, barriers to access and/or engagement with care) is crucial, the way this information is collected, reviewed and described is being re-evaluated to ensure the process contributes to knowledge on preventing avoidable deaths but does not cause harm or distress in doing so. This work is in alignment with the four aspects of Te Pou, and it is vital that we ‘get the story right’ and preserve mana.

Numerator data

Case ascertainment and data collection

Perinatal mortality

The perinatal deaths presented in the PMMRC reports occurred between 1 January and 31 December of the stated year. The denominator contains all births that occurred between 1 January and 31 December of the stated year. There is therefore some inconsistency with denominator data, as some babies born in one year will die in the next year. For fetal deaths, the date of birth is used in place of the date of death. For neonatal deaths, the actual date of death is used.

An expanded description of data collection methods is available in the first PMMRC report ([PMMRC 2007](https://www.hqsc.govt.nz/assets/PMMRC/Publications/First-PMMRC-report-2005-07.pdf)).

Individual PMMRC local coordinators within each DHB identify perinatal deaths and oversee the collection of the required data. This data is submitted to the New Zealand Mortality Review Data Group at the University of Otago via a custom website. The coordinators are also responsible for initiating local clinical reviews of each case, including assigning PSANZ-PDCs for cause of death, determining contributory factors and potentially avoidable deaths and ensuring appropriate, timely follow-up with parents and families.

The data set of perinatal deaths is a compilation of data submitted by LMCs, local coordinators, Manatū Hauora Ministry of Health and BDM. A website commissioned by the former PMMRC and run by the University of Otago enables web-based data entry.

LMCs and/or local coordinators are required to complete rapid reporting forms within 48 hours of a perinatal death. One form contains information on the woman/birthing person (eg, their medical and obstetric history and details of the birth), and the other form contains information on the baby. The questions are reviewed and adjusted regularly to ensure the data collection remains relevant and robust.

After local review, a multidisciplinary team led by the local coordinator completes the PMMRC death classification form. The classification system that has been adopted is the PSANZ system of classification of cause of perinatal death.[[3]](#footnote-4) This system includes both perinatal and neonatal classifications. The local coordinator also submits any post-mortem and histology reports with the classification form. Figure 1 outlines the PMMRC process.

From the 11th PMMRC report (PMMRC 2017), the numerator data set of perinatal mortalities has been merged with the MAT denominator data set so that compatible data could be used for analyses where there was a potential issue of numerator–denominator bias. The development of this amended numerator data set is described below under ‘Compiling the MAT denominator and numerator data’.

Maternal mortality

Since 2006, the PMMRC has asked that all clinicians aware of a maternal death notify either their PMMRC DHB/Health New Zealand local coordinator or the PMMRC national coordinator.

Deaths are primarily brought to the attention of the former Maternal Mortality Review Working Group (MMRWG) PMMR DHB/Health New Zealand local coordinators and other clinicians within regions. Other sources include pathologists, Coronial Services and media reports. The Coroners Act 2006 requires that maternal deaths are notified to Coronial Services. Often multiple notifications are received. At the end of each year, known deaths are cross-referenced with the mortality collection at the BDM registry to ensure the collection is complete.

The MMRWG has developed a data collection tool for maternal deaths. Following notification of a maternal death, the PMMR national coordinator issues maternal death reporting forms to the appropriate local coordinator, who is then responsible for gathering the relevant clinical information from practitioners involved with the woman/birthing person’s care. This data is then entered into our PMMRC Maternal Death website by the national coordinator and undergoes validation before analysis and reporting.

All completed reporting forms, along with relevant clinical information and reports from DHBs, Coronial Services and any other relevant investigative processes, are reviewed by designated members of the MMRWG, who present a summary of each case to the working group. The MMRWG then discusses each case in detail, including assessing the presence of contributory factors and potential avoidability.

Figure 1: Flow of information in the PMMRC’s national perinatal data collection process



Neonatal encephalopathy

Cases of NE were initially identified with the assistance of the New Zealand Paediatric Surveillance Unit, and the collection of data was facilitated by paediatricians, LMCs and the national coordination service of the PMMRC, as described in detail in the 5th PMMRC report ([PMMRC 2011](https://www.hqsc.govt.nz/assets/PMMRC/Publications/Fifth-PMMRC-report-2009-Lkd.pdf)). Since 2012, cases have been notified by key clinicians in neonatal and special care units and the PMMRC local coordinators.

From the 12th PMMRC report (2018), the numerator data set of babies with NE has been merged with the MAT denominator data set so that compatible data could be used for analyses where there was a potential issue of numerator–denominator bias. The development of this amended numerator data set is described below under ‘Compiling the MAT denominator and numerator data’. These methods have been replicated for the 16th report.

Data validation

Data is regularly validated using a standard set of queries to eliminate duplicate records, complete missing woman/birthing person or baby information, clarify DHB/Health New Zealand region of residence (where this is inconsistent with the given residential address) and rectify other inconsistencies. The PMMR national coordinator reviews all perinatal death classifications and discusses complicated cases with a PMMRC member with expertise in PSANZ classifications.

At the end of each year, PMMR local coordinators and key clinicians in special care and neonatal units are contacted to ensure the NE data collection is complete.

Once a year, the mortality collection at the BDM registry is cross-referenced to ensure maternal mortality data collection is complete.

COVID-19 data

COVID-19 case data was sourced from Health New Zealand and matched to the maternity data set (described below) and the perinatal numerator set (described previously) by encrypted NHI number. COVID-19 infection during pregnancy was defined as a confirmed positive COVID-19 rapid antigen test/polymerase chain reaction test recorded during pregnancy. ‘During pregnancy’ includes the pregnancy start date and the delivery date. Pregnancy start was calculated using the delivery date minus the gestation weeks.

Denominator data

Prior to the 11th report (PMMRC 2017), PMMRC reporting of perinatal and maternal mortality and morbidity used the New Zealand birth registrations data set (administered by BDM) as the denominator data set. In the 11th report (PMMRC 2017), the birth registration data set was replaced by the New Zealand MAT (administered by Manatū Hauora Ministry of Health) for almost all analyses, and perinatal deaths were merged with the MAT data set to establish a compatible numerator for analyses. In 2018, this process was extended to a merge of NE cases with the MAT data set. This process is not possible for maternal mortalities as not all potential cases are included in the denominator data set, which only includes births from 20 weeks of gestation.

New Zealand National Maternity Collection

The MAT combines data collected by LMCs, which is required to enable claims for payment, data from some DHBs that provide primary maternity care and hospital discharge data (NMDS).

Compiling the MAT denominator and numerator data

1. **Denominator MAT data (all babies born ≥20 weeks):** The MAT is a data set based on pregnancies. For reporting, the PMMRC requires a data set based on babies. To create a MAT denominator data set with the correct number of babies, the ‘delivery outcome’ field for each MAT pregnancy was used as an indicator of the number of babies who should be in the denominator data set. For example, if the delivery outcome variable was ‘twin’, then two babies were expected. ‘Other multiple’ was assumed to be three babies. This method was modified (and overridden) in cases where a MAT woman/birthing person was linked by NHI number to a PMMR data set woman/birthing person, and the PMMR data was then used to determine the number of expected babies. An ‘entry’ or ‘baby’ was added for each expected baby. If no MAT baby was linked where one was expected, then a baby was created with no MAT baby data (but with woman/birthing person data from the delivery or woman/birthing person data set). If there were more babies in the MAT baby data set than expected, only the expected number of babies was kept in the data set (except if these were perinatal death babies, who were always kept in the data set). If there was no ‘delivery outcome’ data for a woman/birthing person, then one baby was assumed, and this baby was recorded, again without MAT baby data but including woman/birthing person data.
2. **Numerator (perinatal related deaths):** The PMMRC asked Manatū Hauora Ministry of Health to help merge the PMMR perinatal related deaths (and babies with NE) with their MAT birthing person and baby records so the consistency of data in the PMMRC data collection and in the MAT data set could be examined.

The MAT data consists of births (the main set) and the associated babies linked to those births. Stillborn babies are often not included in the MAT data set and so need to be matched to a woman/birthing person’s record. The following steps were undertaken to compile the dataset:

* 1. Mothers and birthing parents of babies who died or had NE in the perinatal period (PMMR data set) were matched to those in the MAT data set (delivery data set) by matching the woman/birthing person’s NHI and the date of birth, allowing a 28-day window either side of the recorded date of birth.
	2. Perinatal mortality and NE babies (PMMR data set) were matched to MAT babies (birth data set) by matching the baby’s NHI.
	3. Perinatal mortality and NE babies (PMMR data set) were then matched to the woman/birthing person’s MAT data set (delivery data set) using the matched PMMRC woman/birthing person; that is, babies with no MAT birth (baby) data set record were matched to their birthing person using that person’s NHI number.

This process of matching resulted in a PMMR to MAT match of 96% for the babies who died and 99% for NE babies.

1. **Denominator MAT data further cleaning**: Some field values in the MAT data were considered extreme, so they were ‘cleaned’ before being used to calculate other fields:
	1. Gestation (at birth): overridden with perinatal or NE data, if available
	2. Birthweight: if >7,000 g, set to missing; overridden with perinatal or NE data, if available
	3. Parity: overridden with perinatal or NE data, if available
	4. Plurality (singleton, twin, multiple, unknown): overridden with perinatal or NE data, if available
	5. Baby sex: overridden with perinatal or NE data, if available
	6. Age of the woman/birthing person at baby date of birth: calculated from woman/birthing person date of birth and baby date of birth (or date of delivery, if birth data not available); if the woman/birthing person’s age was <12 years or >60 years, set to missing.
2. **Denominator MAT data further exclusions**: the MAT data set was further checked to make sure all cases were compatible with the numerator, using the ‘cleaned’ gestation and birthweight.
	1. The following cases were excluded:
		1. gestation <20 weeks and birthweight <400 g
		2. gestation <20 weeks and birthweight missing
		3. gestation missing and birthweight <400 g
		4. gestation >43 weeks and birthweight <400 g.
	2. The following cases were included:
		1. gestation <20 weeks and birthweight ≥400 g (the case was included but gestation was set to missing)
		2. gestation missing and birthweight ≥400 g
		3. both gestation and birthweight missing
		4. gestation >43 weeks and birthweight ≥400 g (the case is included but gestation set to missing)
		5. gestation >43 weeks and birthweight missing (the case is included but gestation set to missing).

In the appended data up to 2021, 114 cases were excluded, and 1,026 cases had gestation set to missing. No cases with linked mortalities and morbidities (PMMR data set) were eliminated.

Specific limitations to the use of the MAT data set

1. Deaths are included in the numerator data set based on their year of death (as previously), but births are included in the MAT denominator data set according to their year of birth. Some babies are born in one year and die in the next, creating a numerator–denominator mismatch. For the purposes of these analyses, deaths will remain in the year of their death (to be comparable with previous years).
2. Health New Zealand advised that body mass index data was not available to the PMMR for this report due to significant quality issues.
3. Not all registration data is provided to the MAT (specifically, body mass index and smoking is missing for many women and birthing people who receive primary maternity care from DHBs/Health New Zealand). For this reason, in past reports, analyses involving these variables was limited to people under the care of LMCs (community-based midwives, private obstetricians and GPs). In 2021, over all of Aotearoa, 93.9% of people registered with an LMC, but there was broad regional variation. For example, in Auckland, LMCs are recorded as providing just 80% of primary care compared with 99.7% in Canterbury.[[4]](#footnote-5) Idiosyncrasies in funding systems and maternity data collection across Aotearoa mean that some DHBs/Health New Zealand regions do not provide complete primary maternity data to the MAT data set. The development and implementation of a ‘perinatal spine’ should resolve many of these issues.[[5]](#footnote-6)
4. The variable for LMC is inaccurate for any LMC before 2008. From 2008, this variable provides a reasonable estimate of LMC for the groups midwife (self-employed or community), private obstetrician and GP. However, data about primary care provided by DHBs remains inaccurate, with some who are under the care of DHB primary maternity services noted as having ‘no LMC’, some as ‘DHB’ and some as ‘LMC’.
5. As the PMMR deaths have been merged where possible with records in the MAT data set, data is now available from both the PMMR data set and the MAT data set for the babies and women and birthing parents of babies who died in the perinatal period or were diagnosed with NE. It is therefore possible to examine the consistency of some of the collected data fields. Some variables have systematically different measurements in the PMMR data set compared with the MAT data set; for example, smoking is systematically higher and more common in the PMMR data set than in the MAT data set for the birthing parents of babies who died in the perinatal period. In addition, some variables do not match directly between the two sets. For example, smoking data is collected for time of death in the PMMR data set but for time of registration with an LMC and for 2 weeks postpartum in the MAT data set.

MAT data have therefore been used for both the numerator and the denominator for smoking to avoid numerator–denominator bias. Consequently, the analysis is limited to women and birthing people and babies where there was a successful match.

For variables (eg, gestation, birthweight, plurality) where the MAT and PMMR data is variably inconsistent but not systematically different, the PMMR data is used for the numerator deaths data because we believe this has been checked for accuracy more thoroughly than the MAT data set and because it means all babies can be included in the analyses.

1. There is a systematic error in the data sent to the MAT data set by some DHBs when parity is ‘zero’ (nulliparity) such that these women and birthing people are recorded in the MAT data set as ‘missing’ parity. The extent of this problem is unknown, but parity analysis should be treated with caution.
2. There are differences in the ethnicity defined for women and birthing people and babies in the PMMR data sets compared with the MAT data set, and this is an example of potential numerator–denominator bias. Ethnicity for numerators (perinatal and maternal mortality and NE) has been defined in most instances using the ethnicity data in the PMMR data sets (primarily obtained from BDM registration) because BDM data is most similar to census data (ie, the ethnicity in the BDM data set is obtained directly from parents). Any exceptions are indicated as footnotes to tables and figures. Denominator ethnicity is that defined in the MAT data set.

Ethnicity in the MAT is ‘derived from ethnic codes reported to NMDS birth and postnatal events, LMC Labour & Birth claims and NHI at time of delivery. The three highest priority ethnic codes that reach a threshold proportion are stored in the Aggregated Pregnancy table’ (National Health Board Business Unit 2011).

Further analysis of the impact of differences in the collection and output of ethnicity data can be found in chapter 5, page 138, of the 11th PMMRC report (PMMRC 2017). Briefly, it appears that the MAT data set overestimates Māori ethnicity in comparison with BDM data, at least for live births. When BDM data is used for deaths (numerator) and BDM data is used for births (denominator), a higher perinatal related mortality rate is observed than when MAT data is used for either denominator alone or for both numerator and denominator. The 11th PMMRC report changed to using the MAT data set as the preferred denominator because the BDM denominator data set includes very few variables for analyses in maternity; in addition, it does not retain NHIs, so data is not easy to merge. Using the MAT denominator for PMMR analyses enabled linking of the PMMR data set of deaths with the birth data in the MAT data set and therefore provided a data set that could be used for more extensive analysis. In the 12th PMMRC report (PMMRC 2018), NE data was also linked to the MAT data set of births. On a number of occasions, the former PMMRC has recommended that Manatū Hauora Ministry of Health retain the ethnicity data shared with it by BDM within the MAT data set so that an ethnicity variable that more closely resembles Census data (at least in definition) could be available for more accurate analysis of ethnicity associations within maternity (PMMRC 2015, 2017).

1. In the MAT data set, only the census area unit-based deprivation score is available as a measure of residence-based deprivation. This changed to Statistical Area 2 (SA2) in the NZDep from 2018. Previously, the meshblock-based deprivation score was used in PMMRC analyses. Census area units and SA2s are larger than meshblocks. Deprivation scores based on Census area units (before 2018) and SA2 (from 2018) will be used for both numerator and denominator so rates can still be presented.

Data analysis

Percentages

Percentages have been displayed with one decimal place or without decimal places when the denominator is small. In some cases, the percentages do not add to exactly 100% because of rounding.

Confidence intervals

We have computed 95% confidence intervals (CIs) for perinatal mortality rates using the methods for vital statistics described by the Centers for Disease Control and Prevention (Heron 2011). The CI represents the degree of uncertainty around the point estimate of the rate for the particular period.

This uncertainty depends on the absolute number of deaths and the number of births from which the deaths arose. If the number of births is large, then the CI (ie, the level of uncertainty) is generally small; if the number of births is small, the CI is large. The CI represents the limits within which the ‘true’ rate is most likely to lie. This calculation is necessary when numbers are small because the point estimate of the rate calculated from the data given may by chance have taken a wide range of values. The CI describes this range.

It is possible to compare rates by looking at the CI. If the CI for one rate does not overlap the estimate of another rate, it is likely that the rates are different. This is equivalent to the rates being statistically significantly different at the p <0.05 level. If the CI does overlap the estimate, the rates may or may not be different.

Rate ratio

Rate ratio is calculated as the ratio of the incidence rate for an exposed group and an unexposed or less exposed group. For example, the ratio of the maternal mortality rate associated with women and birthing people living in deprivation quintile 5 areas (exposed group) versus those living in deprivation quintile 1 (less/unexposed group).

Odds ratio

The odds ratio (OR) is a statistical measure of the association between the outcome and the exposure. The OR is calculated as the ratio of the odds of the outcome occurring in the exposure group to the odds of it occurring in the non-exposure group. An OR of 1 indicates no association between the outcome and the exposure. This was used in the COVID-19 section where we calculated the OR of a perinatal related mortality if there was a confirmed COVID-19 infection in pregnancy.

Statistical testing

Where the text notes a statistically significant difference or association, this indicates that a statistical test has been applied and that the p-value is less than 0.05. Conversely, if a difference is said to be not statistically significant, then the p-value is equal to or greater than 0.05. If the words ‘statistically significant’ are not used to describe a difference or association, it can be assumed that a statistical test has not been applied.

Simple linear regression analysis has been used to investigate linear change across time. Autocorrelation and normality of the residuals was investigated for all models. From each model, the change across time is estimated, along with the 95% CI. A positive slope indicates an increase in rate during that time period; a negative slope indicates a decrease over time.

Where applicable, chi-squared tests were used to investigate the association between categorical variables.

Missing data

Cases with missing data are still included in the data tables. However, where missing data exceeds 30% of all possible data points, the data has generally not been presented.

At the lower extremes of gestation and birthweight, for example less than 23 weeks’ gestation or less than 500 g birthweight, denominator numbers are small and almost all babies will not survive. If the denominator data set does not include all births, for whatever reason, then it may appear that more babies died than were born.

Multiple-year data

Figures (and tables) in the reports sometimes include combined data for the most recent 10 years (or for all years) that the PMMRC has collected data. This increases the numbers and so improves the confidence around the estimates given.

National rates

Some figures presenting DHB data indicate a national rate. This is calculated as a total rate over the stated time period for all DHBs shown.

Management of late notifications

Cases notified after the data set is closed are included in overall mortality rates in the initial tables of each section but not in subsequent tables.

List of abbreviations

BDM Births, Deaths, and Marriages

CBWC Customised birthweight centile

CI Confidence interval

DHB District health board

GCH Geographical classification for health

GP General practitioner

HISO Health Information Standards Organisation

LMC Lead maternity carer

MAT New Zealand National Maternity Collection

MELAA Middle Eastern, Latin American or African

MMRWG Maternal Mortality Review Working Group

NE Neonatal encephalopathy

NHI National Health Index

NMDS National Minimum Dataset

NZDep New Zealand Index of Deprivation

PMMR Perinatal and maternal mortality review

PMMRC Perinatal and Maternal Mortality Review Committee

PSANZ Perinatal Society of Australia and New Zealand

PSANZ-NDC PSANZ Neonatal Death Classification

PSANZ-PDC PSANZ Perinatal Death Classification

WHO World Health Organization

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